Diagenesis and Provenance of Marmora and Sable members of the Upper Logan Canyon Formation, in wells near Sable Island

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A Thesis Submitted to
Saint Mary's University, Halifax, Nova Scotia
in Partial Fulfillment of the Requirements for
the Bachelor of Science, Honours Geology.

April, 2018, Halifax, Nova Scotia

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Date: April 10, 2018

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Abstract

Provenance and diagenesis are important processes to study in order to determine reservoir potential of sandstones within a sedimentary basin. The Scotian Basin is a large sedimentary basin located off the eastern part of Canada. Samples from the Upper Logan Canyon Formation of the Central Scotian Basin were studied in order to determine provenance and diagenesis. The studied wells are located near the West Sable oil and gas field and are targeted in the upward dome created by a large salt diapir.

Diagenetic minerals were studied by scanning electron microscopy (SEM) and energy dispersive spectroscopy (EDS). This allowed for identification of early seafloor diagenetic minerals, late diagenetic minerals, clay coats, and coated grains. The presence of clay coats is important because they prevent the formation of authigenic quartz, which helps to preserve porosity during prolonged burial.

To understand provenance, detrital minerals were point counted from Back-Scattered Electron (BSE) Images, lithofacies were applied, and petrographic and chemical data was analyzed. The detrital mineralogy of these sandstones is similar to other analyzed wells in the Scotian Basin, and suggests that they were sourced by the Sable River, with minor detrital minerals coming from the Meguma Terrane, and Newfoundland. Whole rock geochemistry was also performed on selected mudstone intervals. It indicates that Cree Member mudstones were sourced by the Sable River or Newfoundland, and the Sable Member mudstones were sourced from the Meguma Terrane and the Sable River.

April 10, 2018

Acknowledgements

I would like to thank Dr. Georgia Pe-Piper for giving me this opportunity to undertake an honours thesis. Thank you for guiding me through this process and taking the time to teach me the proper skills to succeed with this project.

I would like to thank the Canada Nova Scotia Offshore Petroleum Board (CNSOPB) for providing all of the samples that were used in this project.

I would like to thank Dr. Xiang Yang at Saint Mary's University for help with collecting SEM analyses as well as X-ray maps. Thank you Randy Corney, for your help with preparing the samples.

I would also like to thank Dr. David Piper for his help in reviewing this thesis, as well as taking the time to help collect samples at the CNSOPB. His assistance with lithofacies has been invaluable.

Thank you to all other facility and students at Saint Mary's University who have helped me over the course of this thesis.

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Chapter 1: Introduction

The Scotian Basin is a large sedimentary basin located offshore Eastern Canada (Fig. 1.1.1). It is a passive continental margin basin that initially formed during the rifting of the North Atlantic Ocean in Late Triassic times (Wade and MacLean, 1990). The Scotian Basin is sub-divided into three main subbasins: Shelburne Subbasin, Sable Subbasin, and Laurentian Subbasin. The Sable Subbasin is the key focus of this study.

Most of the oil and gas discoveries in the Scotian Basin have been from sandstones that are Mesozoic in age (Wade and MacLean, 1990). The quality of sandstone reservoirs in the Scotian Basin is important to understand because it reduces exploration risk related to reservoir quality. The samples studied in this project come from the West Sable oil and gas field, which has sandstone reservoirs in the Albian-Cenomanian Logan Canyon Formation (CNSOPB, 2000). The provenance and diagenesis of these samples have been studied. The results may give insight into reservoir quality of the Upper Cree, Sable, and Marmora Members of the Logan Canyon Formation.

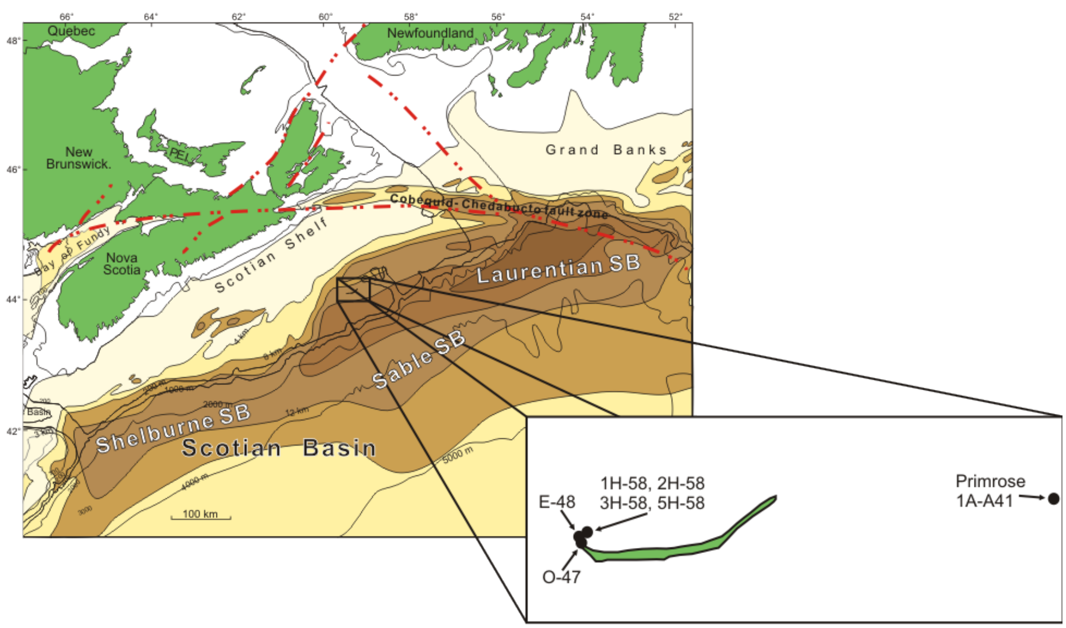

Figure 1.1.1: Map of the Scotian Basin showing the location of studied wells. Modified after Weston et al. 2012.

1.1 Geological Setting

The Sable Subbasin developed from rifting during the Late Triassic. This rifting was followed by clastic sedimentation of the Eurydice Formation, and then was overlain by an evaporitic sequence known as the Argo Formation (CNSOPB, 2000) (Fig. 1.1.2). Further sedimentation of carbonate, sandstone and shale packages occurred in the Middle Jurassic. The overlying sedimentation, Late Jurassic to Early Cretaceous, consists of fluvial and deltaic sandstones and shales, which make up the Missisauga and Logan Canyon formations (Fig. 1.1.2). Termination of the deltaic sequence occurred in Late Cretaceous times and is marked by Dawson Canyon Formation shales and a carbonate facies known as the Wyandot Formation (CNSOPB, 2000) (Fig. 1.1.2). This prolonged subsidence and accommodation of sediments is related to the expulsion of Argo salt and the creation of salt diapirs (Kendell, 2012). This sequence is then overlain by Tertiary coastal and marine clastic rocks (CNSOPB, 2000) (Fig. 1.1.2).

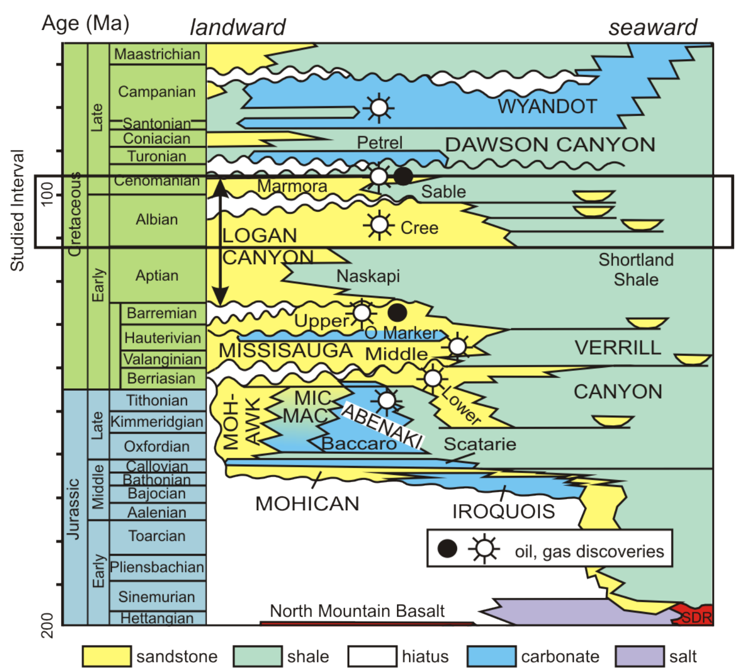

Figure 1.1.2: Stratigraphic column of the Scotian Basin. Rectangle shows the interval of the studied samples. Modified from Weston et al. (2012).

The West Sable oil and gas field is located on the western tip of Sable Island, in the Sable Subbasin. The studied samples come from the Logan Canyon Formation, which is Albian to Early Cenomanian in age. The Logan Canyon Formation consists of four members: Naskapi, Cree, Sable, and Marmora. Naskapi and Sable are shales, Cree and Marmora are fining upwards sands interbedded with shales (Wade and MacLean, 1990).

Starting in Late Jurassic times, sedimentation shifted to a mixed energy delta complex around the Sable Island area (CNSOPB, 2000). This deltaic progradation stopped during the Aptian, when a large marine transgression occurred, depositing the Naskapi Member. The Naskapi Member consists of yellow-brown to green-grey to red-brown shales with interbedded silty and sandy intervals (Wade and MacLean, 1990). It is believed that the depositional environment of the Naskapi Member is tidal flat to marginal marine (Wade and MacLean, 1990). Renewed deltaic progradation resulted in deposition of the Cree Member. The Cree Member consists of interbedded sands and shales. The base of the Cree Member contains medium-coarse grained sands that fine and thin upwards, with the top consisting of fine-medium grained sands (Wade and MacLean, 1990). This was followed by a rapid marine transgression, which resulted in the deposition of the Sable Member. The Sable Member consists of mostly shale, with some thin sandstone and siltstone beds (Wade and MacLean, 1990). This is then overlain by the Marmora Member, which is similar to the Cree Member and consists of upward fining and thinning sands.

The wells drilled in the West Sable oil and gas field, pass through a series of faults resulted from the upward doming of a large salt diapir that belongs to the Argo Formation. The targeted areas were fault blocks on the flanks and crest of the salt dome

(CNSOPB, 2000). The West Sable gas reservoirs are located in the Dawson Canyon and Logan Canyon Formations and the oil reservoirs are only located in the Marmora Member of the Logan Canyon Formation (CNSOPB, 2000).

It has been suggested that the Sable River was bringing sediments into the central part of the Scotian Basin, draining from the Labrador rift through the Gulf of St. Lawrence (Zhang et al., 2014). The same river is also thought to have brought in Upper Paleozoic as well as Meguma Terrane sediments (Zhang et al., 2014). This occurred from Late Jurassic to Early Cretaceous times.

1.2 Well History

The Sable Island wells (1H-58, 2H-58, 3H-58, 5H-58, E-48, and O-47) were drilled off of the same platform near the western tip of Sable Island, with the field being discovered in 1971 (CNSOPB, 2000). They were drilled by Mobil-Tetco and completed between 1971 and 1973. Primrose 1A-A41 was drilled by Shell and is located approximately 64 km from Sable Island. Drilling was completed in 1973.

Chapter 2: Methods

2.1 Conventional Core and Sampling

The studied samples (Table 2.1) come from conventional core. These cores are stored at the Geoscience Research Centre of the Canada Nova Scotia Offshore Petroleum Board (CNSOPB) in Dartmouth, Nova Scotia. During sampling, it was more favourable to obtain a piece of rubble if there was rubble, instead of cutting a thin slab off the back of the core. The samples were restricted to less than 30 g. The 24 samples taken were mostly targeted in sandy sections of the core, as in this way provenance could best be studied.

Table 2.1: Summary of samples and activities performed.

Well	Core	Box	Depth (m)	Lithology	PTS	WRA	SEM	Appendix No.	Notes
Primrose 1A-A41	5	8	1616.39a	Shale		✓			Washed
Primrose 1A-A41	5	8	1616.39b	Shale		✓			Unwashed
Primrose 1A-A41	6	4	1620.49	Shale		✓			
Primrose 1A-A41	6	6	1623.34	Shale		✓			
Sable Island E-48	1	2	2244.39	Sandstone	✓	✓	✓	1-1	
Sable Island E-48	1	4	2246.46	Sandstone	✓	✓	✓	1-2	
Sable Island E-48	1	7	2249.76	Shale	✓				
Sable Island 2H-58	1	3	1600.27	Sandstone	✓		✓	1-3	
Sable Island 3H-58	1	1	1613.63	Sandstone	✓		✓	1-4	
Sable Island 3H-58	1	4	1618.73	Sandstone		✓			
Sable Island 3H-58	2	2	1798.89	Sandstone	✓				
Sable Island 3H-58	2	6	1804.26	Sandstone	✓	✓	✓	1-5	
Sable Island 3H-58	3	2	1994.66a	Shale		✓			Washed
Sable Island 3H-58	3	2	1994.66b	Shale		✓			Unwashed
Sable Island 3H-58	3	3	1996.11	Shale		✓			WRA will contain cleaned + uncleaned sample
Sable Island 3H-58	3	4	1998.03	Sandstone	✓	✓			
Sable Island 3H-58	3	5	1999.72	Shale		✓			

Sable Island 3H-58	3	6	2000.72	Sandstone	✓				
Sable Island 3H-58	3	6	2001.33	Sandstone	✓	✓	✓	1-6	
Sable Island 5H-58	1	5	1469.12	Sandstone	✓	✓			Laminated beds of mud + sand. Still sent for WRA
Sable Island 5H-58	2	4	1577.78	Sandstone	✓		✓	1-7	
Sable Island 5H-58	3	1	1903.66	Sandstone	✓	✓	✓	1-8	
Sable Island 5H-58	3	2	1905.15	Shale		✓			
Sable Island 5H-58	3	2	1905.15a	Shale	✓				Sandstone + Mudstone
Sable Island 5H-58	3	2	1905.15b	Shale	✓				Shale
Sable Island 5H-58	3	3	1906.89	Sandstone	✓		✓	1-9	
Sable Island O-47	1	5	1886.68	Sandstone	✓		✓	1-10	Sandstone + Mudstone
Sable Island O-47	1	7	1890.17	Shale	✓	✓			

2.2 Lithofacies Description

Lithofacies are interpretations from the studied section of core that relates to a past depositional environment. Lithofacies were identified by describing the core in detail at the CNSOPB. The definition of lithofacies used is after Gould et al. (2011). This will be expanded on in Chapter 3 when comparing lithofacies to parasequences, as in Gould et al. (2012).

2.3 Sampling Preparation

2.3.1 Polished Thin Sections

The polished thin section (pts) preparation started at the Geology Lab in the Department of Geology at Saint Mary's University. This involved taking the slabs of rock obtained from the CNSOPB and trimming them to the appropriate size of a thin section. Some samples had to be impregnated in epoxy in order to stop them from breaking apart. The slabs were washed and dried, and they were then sent to Vancouver Petrographics Ltd, Vancouver, BC in order to produce 30 μm thick polished thin sections. Of the 18 thin sections made, 10 of them were selected for further analysis by petrographic microscope and scanning electron microscope (SEM). The selection was based on quality of the sandstone (grainsize, cement, matrix, and muddy intervals if present). The selected samples were then carbon coated using Leica EM CED030 desktop carbon coater before analysis using the scanning electron microscope (SEM).

2.3.2 Whole Rock Analysis

Whole rock analysis (WRA) preparation started again at the Geology Lab in the Department of Geology at Saint Mary's University. Rock slabs that were obtained from the CNSOPB were cut into small thin chips, and then were washed and brushed with deionized water in order to remove dirt and other contaminants. The chips were then crushed and homogenized. A subsample from each sample was sent to Activations Laboratories Limited for major and trace element analysis according to their Code 4Lithoresearch. The analyses were performed by an ICP-MS package.

2.4 Scanning Electron Microscope (SEM)

A Tescan Mira 3 LMU Variable Pressure Schottky Field Emission Scanning Electron Microscope (FE-SEM) was used in this study. The SEM has a maximum resolution of 1.2 nm at 30 kV and is equipped with an INCA X-max 80 mm^2 Silicon Drift Detector (SDD) energy dispersive spectroscopy (EDS) for chemical analyses of minerals, with a detection limit > 0.1 wt. %. The beam size was set at 6.4 nm. However, only minerals that were greater than 10 µm in size were analyzed due to the much larger X-ray generation volume. X-rays are produced due to the interaction of electrons with the mineral in sample. This causes the diameter of the X-rays generation to be larger than the beam size. A pure cobalt sample was used to calibrate the EDS detector before analysis.

Counting times for each spot analysis was approximately 60 seconds. These analyses were completed at the Regional Analytical Centre at Saint Mary's University.

Elemental X-ray mapping was also performed on some of the selected samples. This was done in order to separate mineral phases in very fine-grained occurrences. Mapping acquisition on the SEM was run at a Map Dwell of 17500 – 20000 μs (3.82 – 4.37 hours per site of interest), at a maximum resolution of 1024 x 768 pixels. This was completed using Oxford Instrument's Mapping package within the INCA program. Later, the X-ray maps were quantified using Oxford Instrument's QuantMap package within INCA. This quantified X-rays for each element present (volatile free) were normalized and then false coloured. The resulting quantification maps have a maximum resolution of 512 x 384 pixels. X-ray mapping of compound percent, weight percent, and peak area were used to best show the different mineral phases. Compound percent represents the weight percent of each element expressed as an oxide, which is most useful for mineral identification. Weight percent is the elemental percent of each element. It is expressed by the equation: Weight percent = Apparent concentration / Intensity correction. Peak area is the area under the curve of the element's X-ray peak at that given location. The value is not normalized and is useful because it gives all the data including background. It also easily shows the location of voids, cracks, and fractures.

2.5 Counting of Detrital Minerals from BSE images

Once the detrital minerals of the studied samples were identified using EDS geochemical analyses and Back-Scattered Electron (BSE) images all minerals were counted. Minerals of the same brightness (density) in BSE images are most likely the same mineral as the one identified by the EDS analysis. This is because the brightness of a mineral in BSE images depends on the average atomic number of all elements that make up that mineral. Using this principle and the mineral chemical analyses for each polished thin section, detrital minerals were then counted. Summaries of the detrital mineral counting from BSE images were plotted as pie diagrams located on the individual stratigraphic columns in Chapter 3.

2.6 Chemical Fingerprinting

The chemical analyses of some mineral for all studied samples were plotted on appropriate discrimination diagrams, in order to identify mineral varieties, which may be of provenance significance. Only pure analyses of minerals were used. The detrital minerals used for plotting were: biotite, garnet, muscovite, and spinel. The analyses were recalculated to 100 % and binary plots were made using MinPet software (section 2.8).

2.7 Mineral Identification

2.7.1 Definitions Applied to Clastic Sedimentary Rocks

<u>Coated grains:</u> Consist of concentric layers, usually fine-grained and made up of both detrital and seafloor diagenetic minerals such as clays, chlorite, siderite, phosphates, etc.

<u>Cement:</u> Any new mineral that forms in pore spaces during diagenesis.

<u>Fe-chlorite:</u> Diagenetic very fine-grained chlorite that appears bright in BSE images and usually Fe-rich.

<u>Framework Grains:</u> Either detrital (extrabasinal source) or intraclast (intrabasinal source) grains that make up the skeleton of the rock.

<u>Glauconite:</u> forms during seafloor diagenesis and is similar to an intraclast (transported), and makes up some of the framework grains.

Glaucony: Also forms during seafloor diagenesis, but is the intermediary between Fe-smectite and end-member glauconite.

Intraclast: Any previously deposited sediment that has been eroded out of a clast. It is usually fine-grained or is cemented by seafloor carbonate or phosphate.

Lithic Clasts: Are rock fragments that can be made up of more than two different minerals. Often displays the same texture as the source rock.

Matrix: Any fine-grained clastic material that is deposited between detrital minerals, or mixed in with bioturbation (from interbedded muds). Matrix is restricted to sandstones and conglomerates. Mudstones are completely made up of matrix.

Nodule: irregularly rounded knot of minerals or mineral aggregate, which may be an intraclast or may result from diagenesis.

Pellets: fecal pellet produced by an organism. Typically characterized based on its habit (i.e. is it circular or oval shaped), and is usually fine-grained. It may be glauconite in oxidizing environments. In reducing environments, it may be odinite, which then alters to berthierine, and eventually chamosite during burial.

2.7.2 Mineral and Mineral Mixtures Identification

All minerals in the studied samples were identified using both the petrographic microscope and their EDS chemical analyses. Such analyses were compared to analyses published in Deer et al. (1992). Minerals identified in this study were abbreviated after Whitney and Evans (2010), and as such are presented in the tables of Appendix 1. If there was a mixture of more than one mineral, careful examination of the BSE image and the

EDS chemical analyse was performed, which allowed for the determination of the mineral phases that made up the mixture.

In such mineral mixtures, illite was differentiated from muscovite using the grain size in BSE images. Both minerals typically have at least 3 wt. % K_2O. Anything very fine-grained (< 30 µm) in the matrix or cement that contained > 18 wt. Al_2O_3 was considered to be illite. Muscovite was anything larger than > 30 µm and contained > 25 wt. % Al_2O_3, and basal cleavage planes were usually seen in BSE images.

Chlorite was classified based on its appearance in BSE images. Well-formed grains with basal cleavage planes were considered to be detrital. Chlorite which appeared to be fine-grained, fibrous, or coating other mineral grains was considered to be diagenetic. Detrital chlorite also occurs as an alteration product of detrital mica.

Muscovite and K-feldspar were distinguished from one another using the EDS geochemical analysis for K_2O and Al_2O_3. This was useful if the analysis was a mixture that was made up of more than one mineral. If the ratio of Al_2O_3 to K_2O was approximately 1.5, then the mineral was K-feldspar. If the ratio was approximately 3 then the mineral was muscovite.

Glauconite was identified based on its habit as well as its chemistry. Glauconites in the studied samples are very fine-grained, contain silt-sized inclusions of minerals and are usually comprised of Al_2O_3 < 12 %, K_2O > 6 %, and FeO up to 25 %. However, there are grains that have more Al_2O_3, less K_2O, and more FeO. At this time, those grains are referred to as glaucony. Nevertheless, chemistry alone was not enough to distinguish glauconite from glaucony. An optical microscope was used in order to tell the different types of glauconite that were present based on Eder et al. (2007). X-ray maps were also created in order to help with determination. The glaucony – glauconite problem will be explored more thoroughly in Chapter 5.1.

2.8 Software Used

CorelDRAW was the main software used for this thesis. It allowed for the development of figures and annotated images including those in the appendices. Appendix construction was aided by the use of scripts (macros) created by Dr. Xiang Yang, Regional Analytical Centre, Saint Mary's University. MinPet was used for the creation of binary plots, and ternary diagrams. Grapher 8 was used for the creation of some binary plots for well data, as well as pie diagrams. Logplot 7 was used for the construction of stratigraphic columns for each well. These columns used similar symbols as in Gould et al. (2011).

Chapter 3: Lithofacies and Depositional Environments

3.1 Stratigraphy

Stratigraphy for the studied wells was based on data from the well history reports. Formation and member depth picks are from Wade and MacLean (1993). Figures 3.1.1 and 3.1.2 show gamma-ray plots for the studied area for the Logan Canyon Formation above the Naskapi Member, and the location of the cores. Formations and members are colour-coded in these figures. Similar patterns in the gamma-ray logs have been correlated between wells. Two of the studied cores are located in the Cree Member, one is located in the Sable Member, and the remaining six cores are located in the Marmora Member. The Primrose 1A-A41 cores are located in the Wyandot Formation.

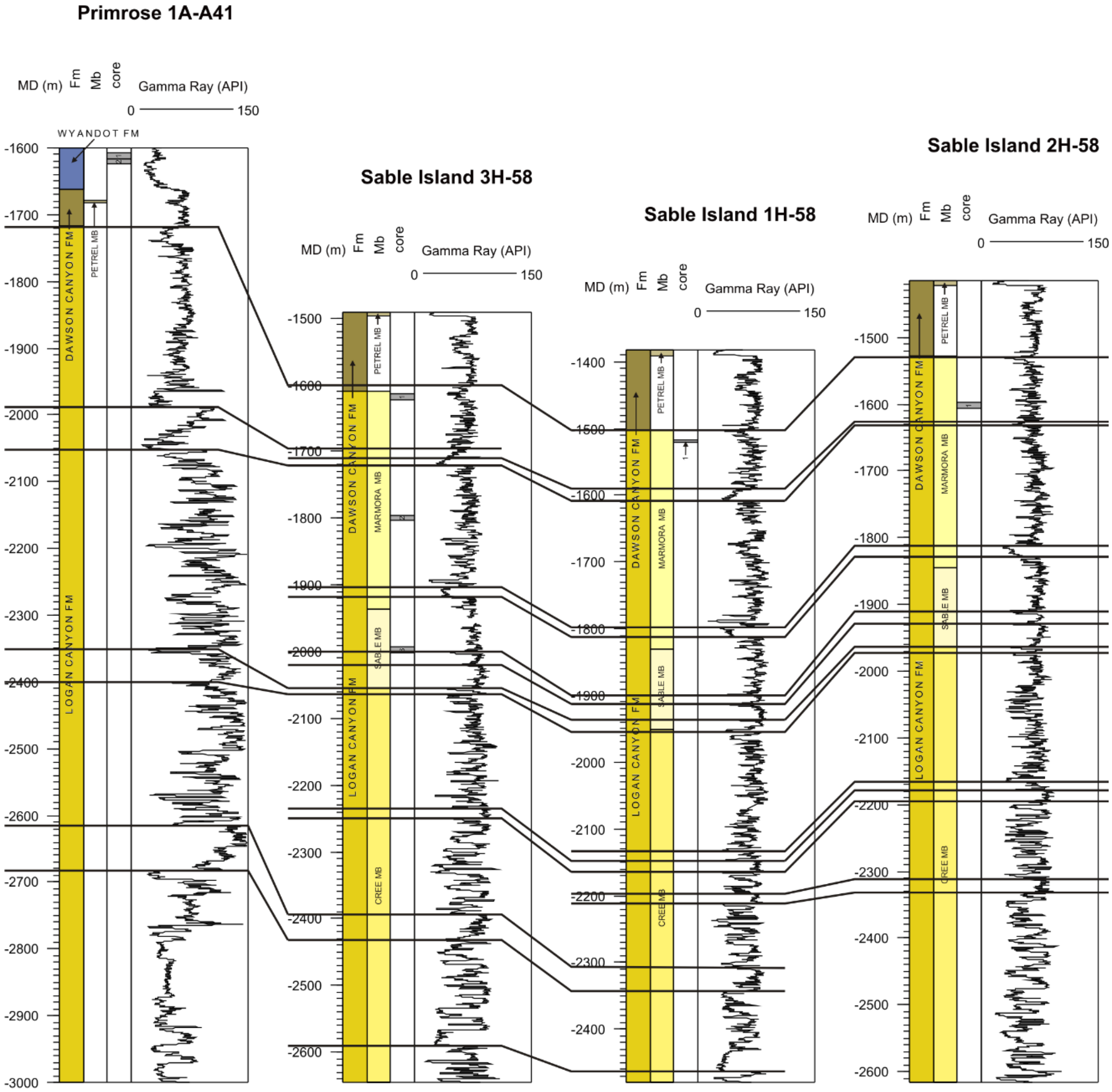

Figure 3.1.1: Correlation based on gamma-ray logs of studied wells from Primrose 1A-A41 to Sable Island 2H-58.

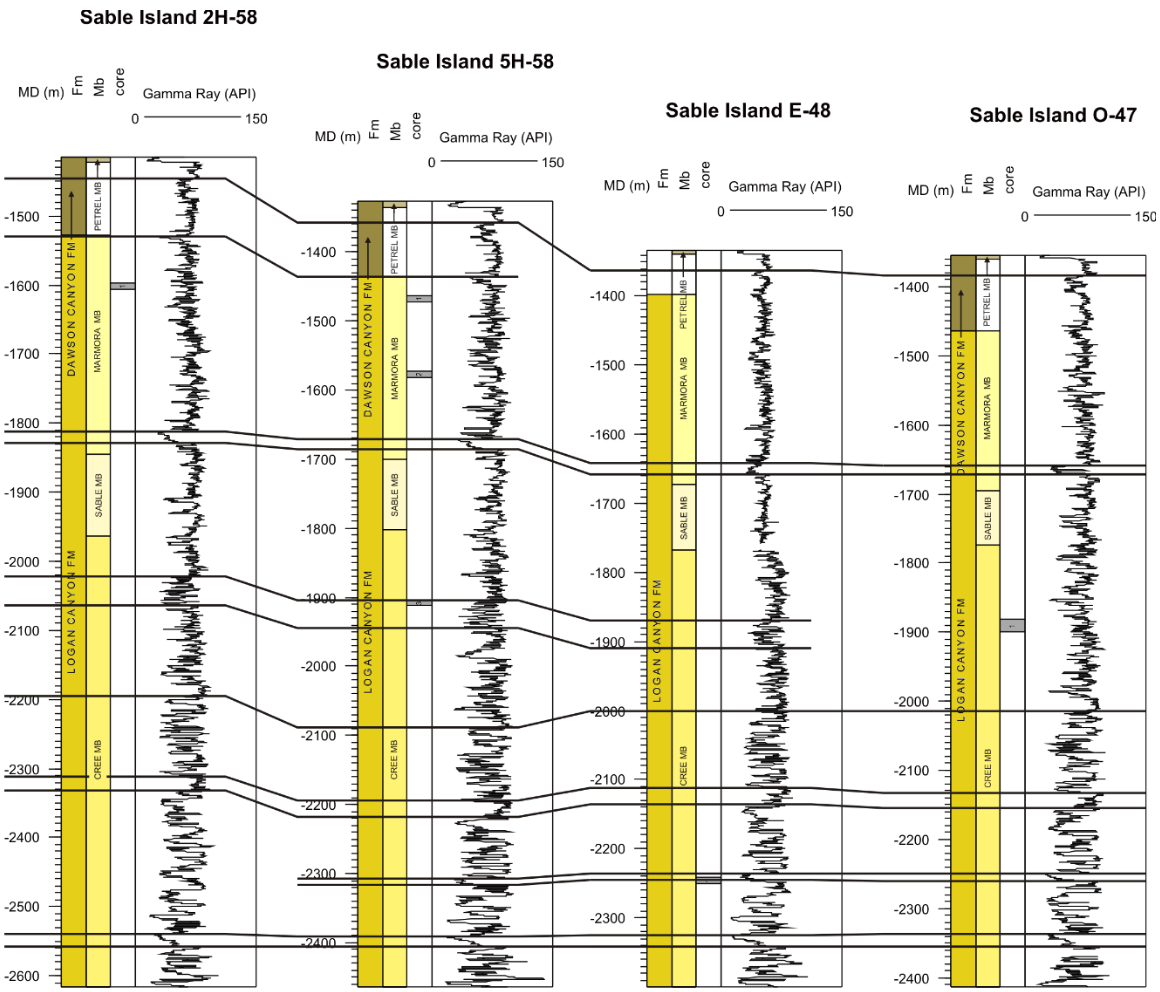

Figure 3.1.2: Correlation based on gamma-ray logs of studied wells from Sable Island 2H-58.to Sable Island O-47.

3.2 Introduction to Lithofacies

Understanding lithofacies is important in determining depositional environments. The description and type of lithofacies for this study are as in Gould et al. (2011), and include the depositional environment. The authors in that study have identified 11 different facies, based on: lithology, primary structures, and biogenic influence. Below is a summary of each major facie and their respective depositional environment.

Facies 0: Consists of thin bedded mudstone and sandstone with uncommon to absent bioturbation suggesting deposition in river mouth to shoreface, as well as prodeltaic turbidites. *Subfacies: 0g* (generally fine sandstone, absent to sparse bioturbation, lacks interbedded mudstone); *0b* (fine sandstone, siltstone, mudstone (sandstone > mudstone), sparse to uncommon bioturbation); *0m* (mudstone, siltstone, very fine sandstone (mudstone >> sandstone), uncommon bioturbation); *0a* (mudstone, with coarse and fine grained sandstone, absent to sparse bioturbation).

Facies 1: Consists of mudstone with <5% fine sandstone or siltstone, with abundant to complete bioturbation suggesting deposits in an open shelf environment. No subfacies.

Facies 2: Consists of sandstone and mudstone deposited in a shoreface environment with sparse to complete bioturbation. *Subfacies: 2b* (mudstone, with 10-60% fine sandstone, common to moderate bioturbation); *2c* (60-95% fine sandstone, with lesser mudstone, common to complete bioturbation); *2o* (fine sandstone, with sparse to moderate bioturbation, no mud drapes); *2x* (fine-rare medium sandstone, cross-bedding present, sparse bioturbation, no coal or mud drapes).

Facies 3: Consists of an open shelf transgressive setting, conglomerates, sandstones, mudstones, or limestones. *Subfacies: 3x* (sandy mudstone (10-50% sand), moderate to complete bioturbation); *3y* (muddy sandstone (50-90% sand), moderate to complete bioturbation); *3i* (intraclast conglomerate, may include shells or early siderite); *3c* (lithic conglomerate, may include shells, generally rare); 3f (firm ground – rare); *3l* (bioclastic limestone); *3o* (oolitic limestone and sandstone).

Facies 4: Consists of a tidal estuary to fluvial depositional environment of mostly sandstone. *Subfacies: 4o* (fine sandstone, with sparse to common bioturbation, mud drapes present); *4a* (medium to coarse sandstone, lesser mudstone, absent bioturbation, present coal laminations or intraclasts); *4g* (medium to coarse sandstone, possible lag at base, <5% mudstone, mud drapes present, absent to sparse bioturbation); *4x* (medium to coarse sandstone, mudstone intraclasts, may have lag at base, coal intraclasts, bioturbation and mud drapes absent); *4n* (mudstone, siltstone, very fine sandstone (sandstone > mudstone), absent or sparse bioturbation).

Facies 5: Consists of tidal flats and channels mixed sand and mud (sand > mud). The depositional environment varies between subfacies. *Subfacies: 5m* (>75% sandstone (usually fine sands), variable bioturbation and mud drapes, deposition in mixed flat-intertidal environment); *5s* (>95% sandstone (usually fine sands), possible cross-bedding, shells, sparse to moderate bioturbation, deposited in sand flats in intertidal to subtidal environments); *5b* (20-75% sandstone (usually fine sands), destroyed primary structures, abundant to complete bioturbation, may have shells and subvertical burrows, depositional environment in mixed flats-intertidal zones); *5c* (medium sandstone, absent bioturbation, deposited in tidal channel-subtidal zone).

Facies 6: Consists of tidal flat mixed mud and sand (mud > sand). Depositional environment varies between subfacies. *Subfaces: 6s* (60-75% mudstone, burrows absent to common, possible coarser sands in burrows, deposited in mixed flat-intertidal zone); *6b* (>80% mudstone, with very fine-fine sandstone, common to complete bioturbation, possible whole or fragmented oyster shells, deposited in mudflat-intertidal zone); *6m* (>95% mudstone, subvertical-vertical burrows cut discontinuous laminations, absent to common bioturbation, may have subvertical to horizontal burrows, deposited in mudflat-intertidal zone).

Facies 7: Consists of lignite, or carbon-rich mud, with rootlets beneath it suggesting deposition in a tidal marsh environment. No subfacies.

Facies 8: Consists of mudstone with rare siltstone, absent to sparse bioturbation, however, it can be locally intense, deposited in lagoon environment. No subfacies.

Facies 9: Consists of thick bedded sandstones deposited in river mouths to prodelta turbidites. *Subfacies: 9g* (very coarse to fine grained sandstones, some graded beds, absent to moderate bioturbation at the top of beds, possible plant detritus, possible reworked costal deposits); *9s* (fine sandstone with minor mudstone, moderate bioturbation at top of beds, possible plant detritus, possible reworked coastal deposits).

Facies 10: Consists of deformed sediments in which the original facies cannot be recognized. *Subfacies: 10f* (mudstone to muddy sandstone, massive texture, horizontal foliation); 10g (sandstone, liquefied beds); *10s* (sandstone, siltstone, mudstone, sheared and foliated beds, variable bioturbation).

3.2.1 Sable Island 2H-58 Well Facies

The Sable Island 2H-58 well core extends from 1596.54 m depth to 1603.76 m depth (Fig. 3.2.3). The core consists of four main lithologies:

1600.95 m to 1603.76 m: there is interbedded mudstone and sandstone that are well bioturbated. There are also some siderite concretions. There is also the presence of a vertical burrow at 1602.96, and mudstone interbedding increases near the base of the interval.

1600.12 m to 1600.95 m: there is interbedded mudstone and fine-lower red sandstone. Sandstone appears more dominant. The interval is well bioturbated. It becomes richer in mud near the base of the interval, and syn-sedimentary deformation is seen (Fig. 3.2.4).

1598.70 m to 1600.12 m: the interval is predominantly made up of fine-lower sands. There is also the occasional mud layer. It is well bioturbated.

1598.70 m to 1596.54 m: there is interbedded mudstone with some sandstone. There is also some shells and siderite concretions. It grades into more sand dominated (fine-lower) towards the base. The interval is also well bioturbated.

The lithofacies for this core have been divided into seven different facies (Fig. 3.2.3) and suggest an estuarine-tidal flat depositional environment.

Figure 3.2.4: Syn-sedimentary faulting from Sable Island 2H-58 1600.25m.

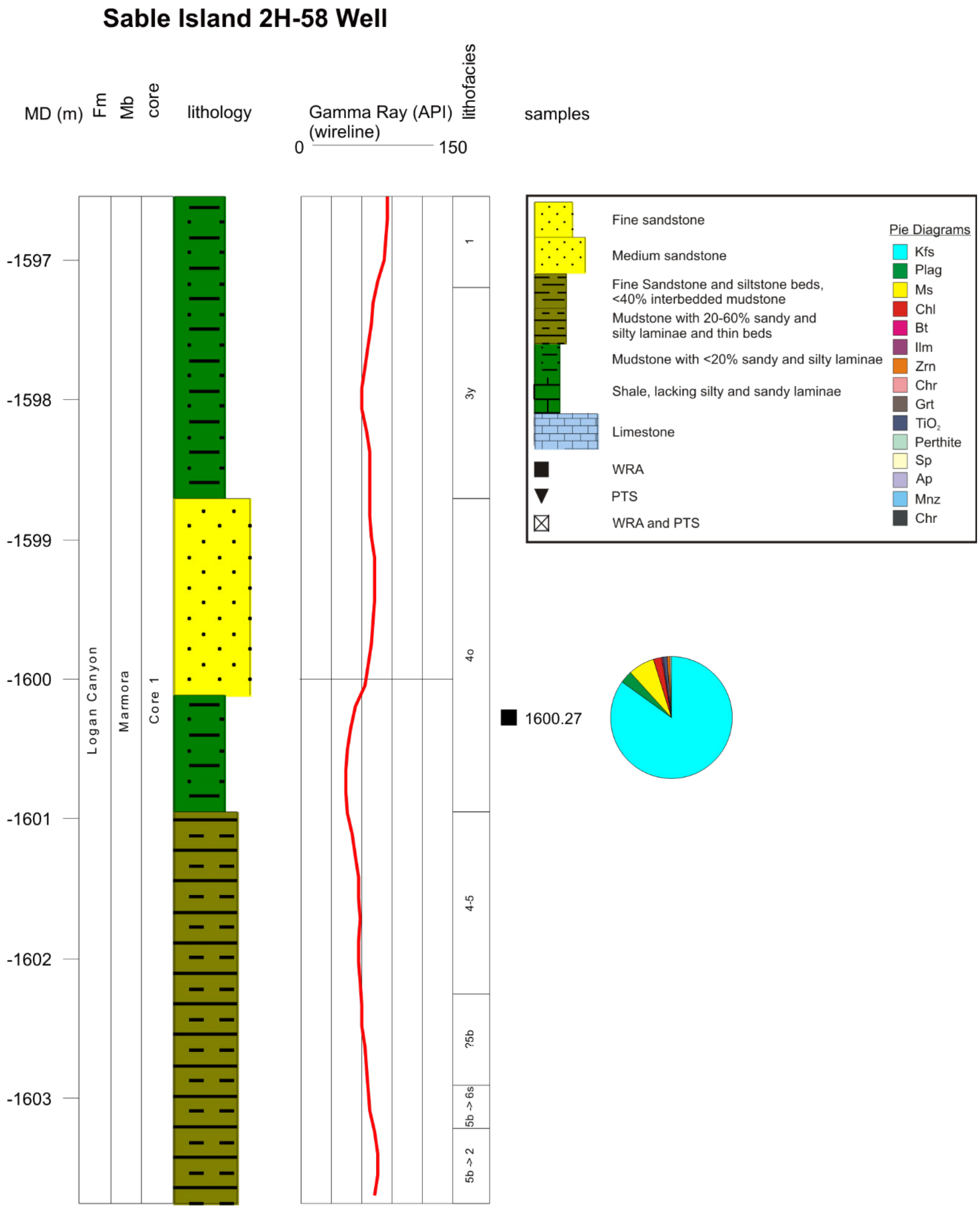

Figure 3.2.3: Stratigraphic column for core 1 from Sable Island 2H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

3.2.2 Sable Island 3H-58 Well Facies

The Sable Island 3H-58 well cores extend from 1613 m to 1621.81 m (core 1), 1796.18 m to 1803.80 m (core 2), and 1993.39 m to 2001.40 m (core 3). Core 1 has been split into six different lithologies (Fig. 3.2.5):

1619.74 m to 1621.81 m: This interval consists of fine-lower sands that appear to contain iron oxidation. It coarsens down until ~ 1620.82 m (increasing shell content) (Fig 3.2.5.1). At 1620.70 m there are reworked shell fragments. Cross-bedding becomes more dominant with depth. Further down the core there are green, red, and clean sands (fine-lower to very fine-lower). The green sands are probably glauconitic sands. There is also slight mud draping and some of the sand beds contain bioturbation and rare shells.

Figure 3.2.5.1: 3H-58 Core 1
(A) Interval of well bioturbated fine sands at 1618.41m.
(B) Vertical burrow partially filled with shells at 1616.08m.

1617.68 m to 1619.74 m: This interval consists of fine sands with slight mud draping. The interval is well bioturbated and with cross-bedding. Some of the sand patches / beds are fine-lower in size. There are some scattered shells.

1617.43 m to 1617.68 m: This interval contains abundant shells. It also consists of fine sands and some large ?siderite concretions. The sands appear to have been a green colour (suggesting the presence of glauconite), now they are oxidized. There are also a few large bivalve fossils.

1615.91 m to 1617.43 m: This interval consists of fine sandy inclined bedding. There are short intervals of fine-upper to fine-lower clean sands. The inclined beds are more green in colour (?glauconite), and range from fine-upper to fine lower.

1613.00 m to 1615.91 m: This interval consists of fine sands with scattered shells. It also contains some vertical burrows. Sands are slightly green, oxidizing to red. Generally it is a sandy mudstone.

Based on the six lithofacies (Figure 3.2.5) in core 1, the depositional environment of the sediments in this core was from an estuarine-tidal flat.

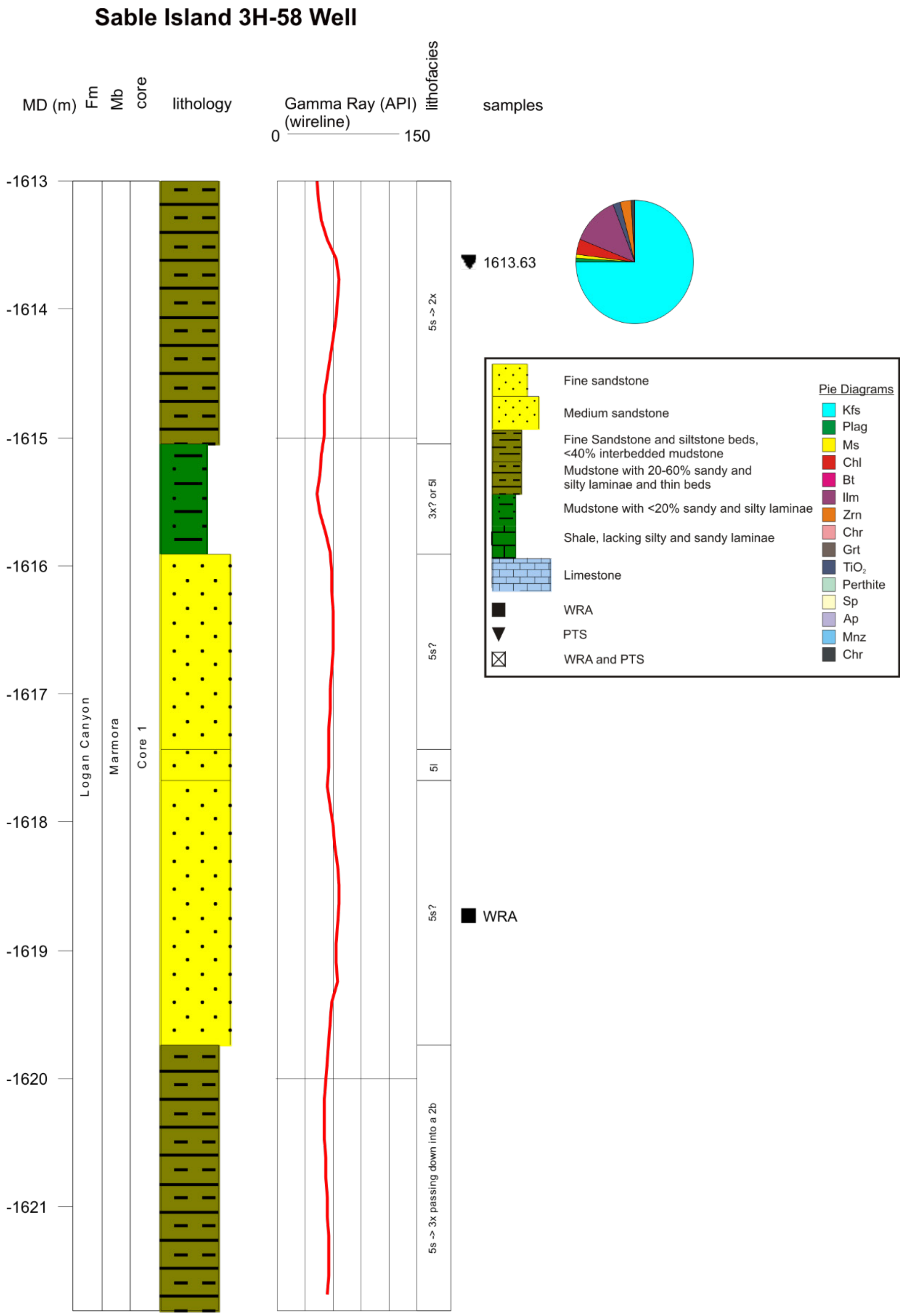

Figure 3.2.5: Stratigraphic column for core 1 from Sable Island 3H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

Core 2 consists of three different lithologies (Fig. 3.2.6):

1800.33 m to 1804.59 m: This is a mud dominate interval with slight sandstone interbedding. The sands grade into darker coloured sands (red/green), with some bioturbation. Then the core transitions into more sandstone (fine-lower), with less bioturbation and mudstone interbeds. It then grades into muds again, with lots of bioturbation, and back into very fine-lower sandstone with rare mudstone. There are also some large siderite concretions.

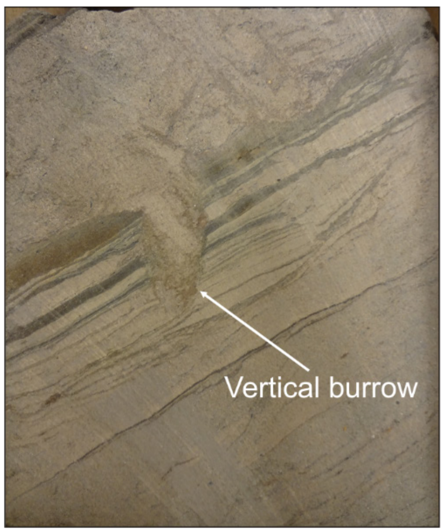

Figure 3.2.6.1: 3H-58 Core 2. Vertical burrow at 1802.10m.

1796.85 m to 1800.33 m: This interval consists of fine-lower mostly green (?glauconite) sands. There is abundant bioturbation. The interval is interbedded with mudstone. Rare vertical burrows. It then grades into more sand, and then back into more mud. It contains thick sand beds, mud drapes, and lenticular bedding.

1796.19 m to 1796.85 m: This interval consists of rubble that is made up of fine-lower sands. Bioturbation is rare.

Core 2 has also been divided into four different lithofacies (Fig. 3.2.6), which suggests that the depositional environment is a tidal flat.

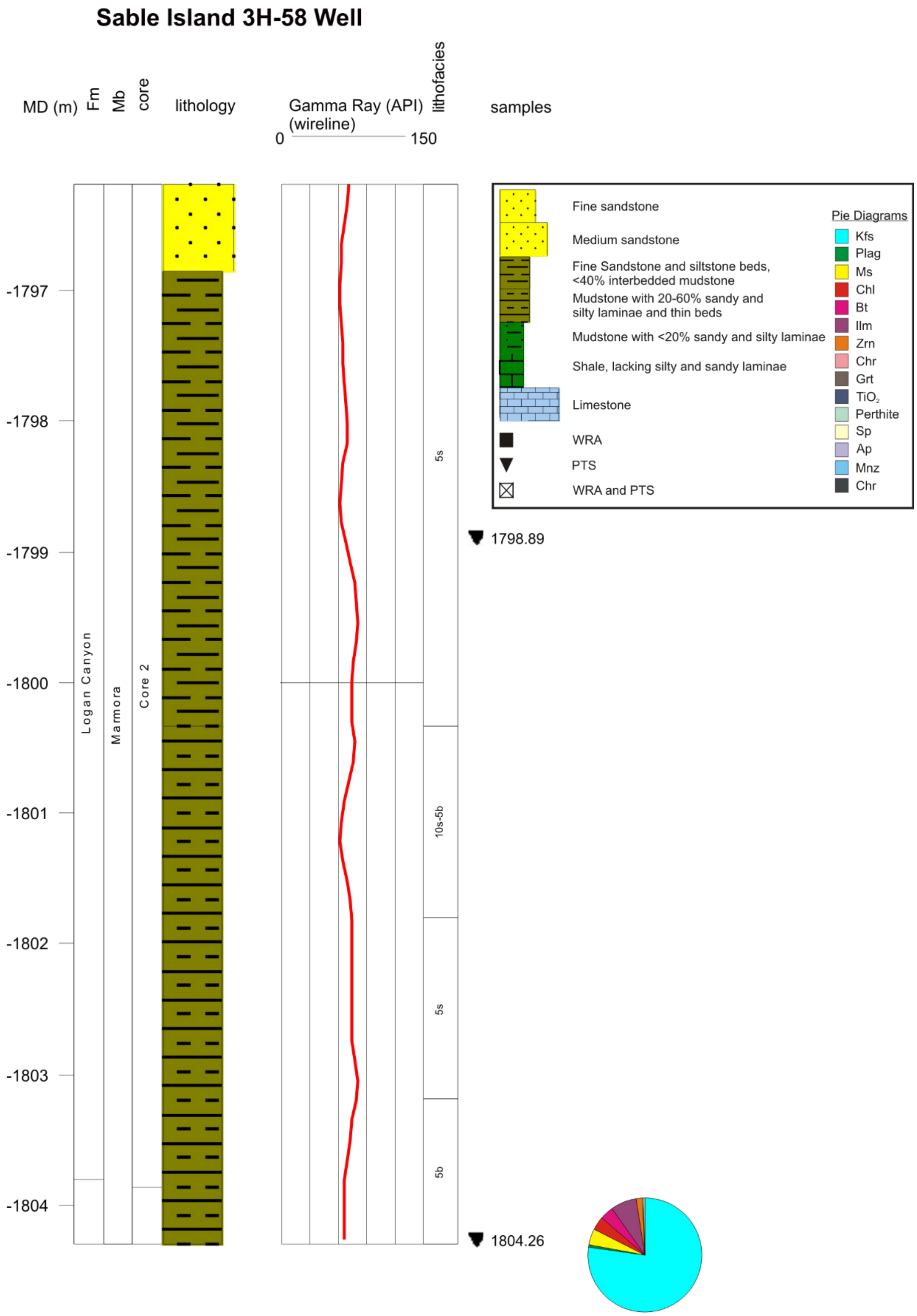

Figure 3.2.6: Stratigraphic column for core 2 from Sable Island 3H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

Core 3 consists of three different lithologies (Fig. 3.2.7):

2000.64 m to 2001.40 m: This interval consists of medium–lower sands that appear to be slightly laminated with some siderite concretions. This then grades into more concretions and bioturbations, then back into fine-lower sands.

1999.77 m to 2000.64 m: The base of this interval is a large siderite concretion, which then grades into cleaner sands that become laminated, with few mud laminations. The core then grades into slightly coarser sands (medium to fine-upper), with some green (?glauconite) laminated beds.

1993.39 m to 1999.77 m: This interval consists of interbedded sandstone and mudstone. It is more mud dominated at the top, grading into sand dominated. It also contains some siderite concretions and bioturbation. In the sandy section of the interval, it is fine-lower in grain size. In the mud dominated part at the bottom of the interval, there are abundant shells, and some bioturbation and concretions.

Based on the seven identified lithofacies in core 3 (Fig. 3.2.7), the sediments in this core appear to have been deposited in a prodeltaic setting.

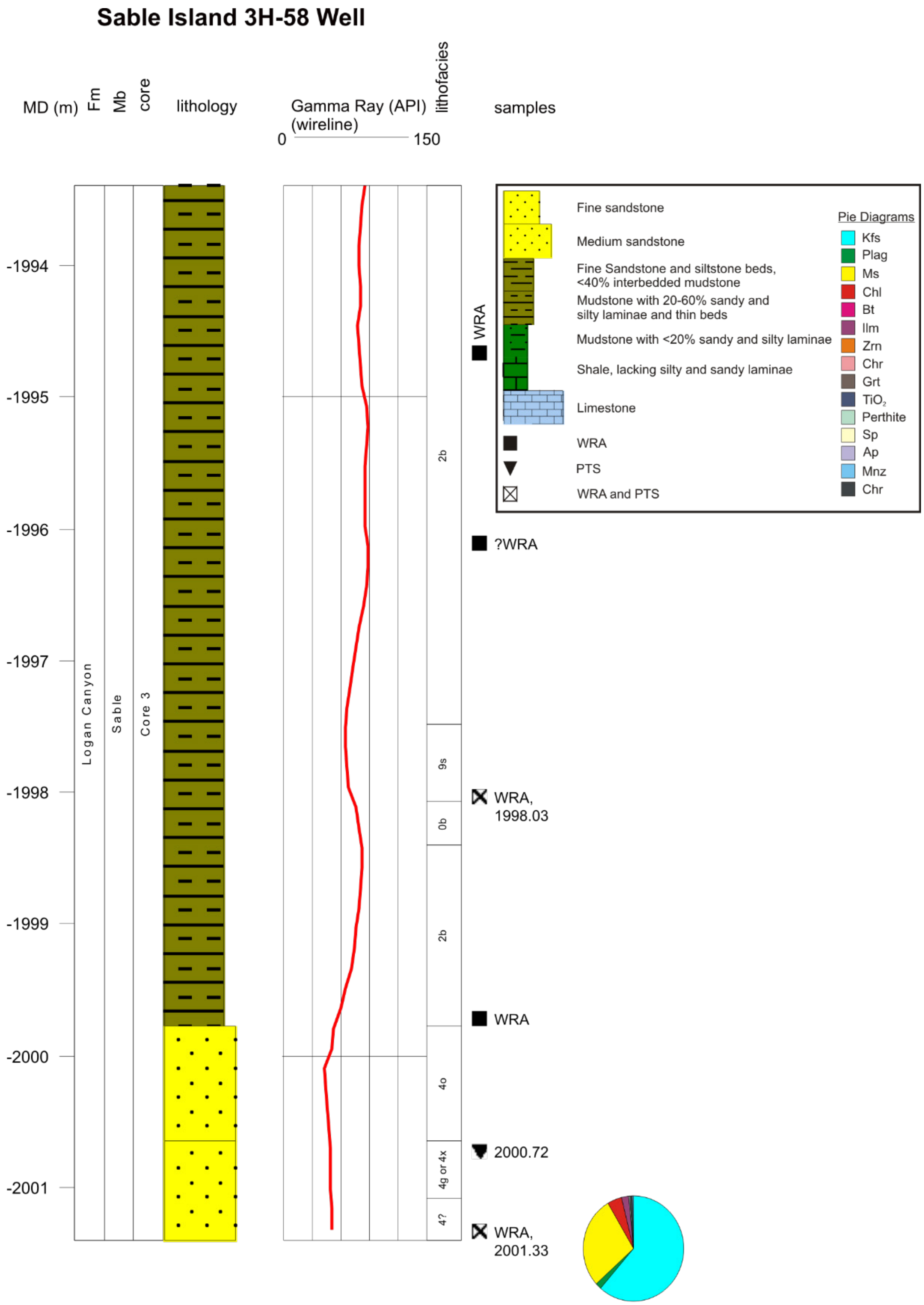

Figure 3.2.7: Stratigraphic column for core 3 from Sable Island 3H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

By comparison to Gould et al. (2012), the depositional environment of core 1 resembles that of an estuarine-tidal flat, core 2 of a tidal flat, and core 3 partially resembles a prodeltaic system. The overall interpretation to this well is that deposition started in a prodeltaic setting. Over time, sedimentation changed, allowing for tide dominated processes to occur. This led to the estuarine-tidal flat depositional setting seen in the higher stratigraphic cores.

3.2.3 Sable Island 5H-58 Well Facies

The Sable Island 5H-58 well cores extend from 1463.04 m to 1472.21 m (core 1), 1572.76 m to 1580.09 m (core 2), and 1903.48 m to 1912.39 m (core 3). Core 1 has been split into four different lithologies (Fig. 3.2.8):

1469.93 m to 1472.21 m: This interval consists of interbedded mudstone with very fine-lower sandstone. It appears to be a mud dominated interval. There is some bioturbation, and it grades into more sandstone dominated. Siderite concretions are common and there are rare reworked shells.

1468.93 m to 1469.93 m: This interval consists of interbedded mudstone and sandstone that grades downwards into more mud dominate. The interval is well bioturbated and there are rare siderite concretions.

1467.10 m to 1468.93 m: This interval consists of mostly mudstone with some fine sand beds. It is well bioturbated, there are large siderite concretions, and shells may be reworked. The interval may also contain cross-bedding.

1463.04 m to 1467.10 m: This interval consists of interbedded mudstone and sandstone that becomes more mud dominated downwards. There are rare shells, some siderite concretions, and wood fragments. It is also well bioturbated.

Figure 3.2.8.1: 5H-58 Core 1. Large siderite concretion at 1464.85m.

Based on the ten different lithofacies identified for core 1 (Fig. 3.2.8), the depositional setting for the sediments appears to resemble a tidal flat.

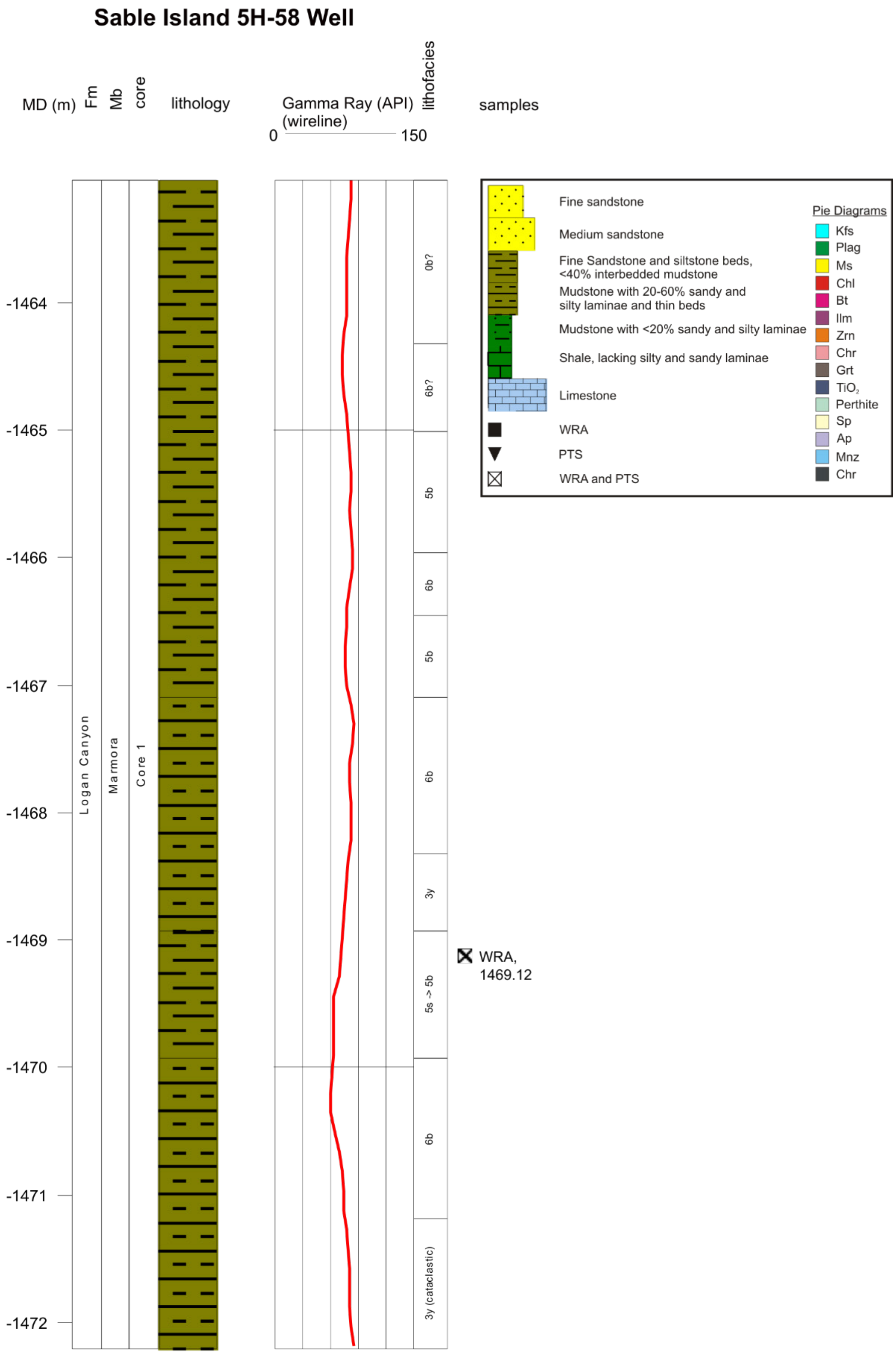

Figure 3.2.8: Stratigraphic column for core 1 from Sable Island 5H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

Core 2 consists of four different lithologies (Fig. 3.2.9):

1578.84 m to 1580.09 m: This interval consists of interbedded mudstone and sandstone that appears to be more sand dominated. There appears to be leaching near the top of the interval. Lots of bioturbation is present, some vertical burrows?, and possible intraclasts.

1575.64 m to 1578.84 m: This interval consists of interbedded mudstone and sandstone. Lots of shells are present at the top of the interval. Gluconite appears to fill burrows / scours. There are also siderite concretions, and the interval grades downwards into cleaner sands until 1577.95 m. Then it becomes more mud dominated.

1574.89 m to 1575.64 m: This interval consists of mostly mudstone. There are some shells and possibly glauconite.

1572.77 m to 1574.89 m: This interval consists of interbedded mudstone and sandstone. Abundant bioturbation and the presence of vertical burrows. The interval grades into more mud dominated, and contains siderite nodules and reworked shells.

Based on the five different lithofacies identified in core 2 (Fig. 3.2.9), the depositional environment for the sediments in this core appears to be a shoreface setting.

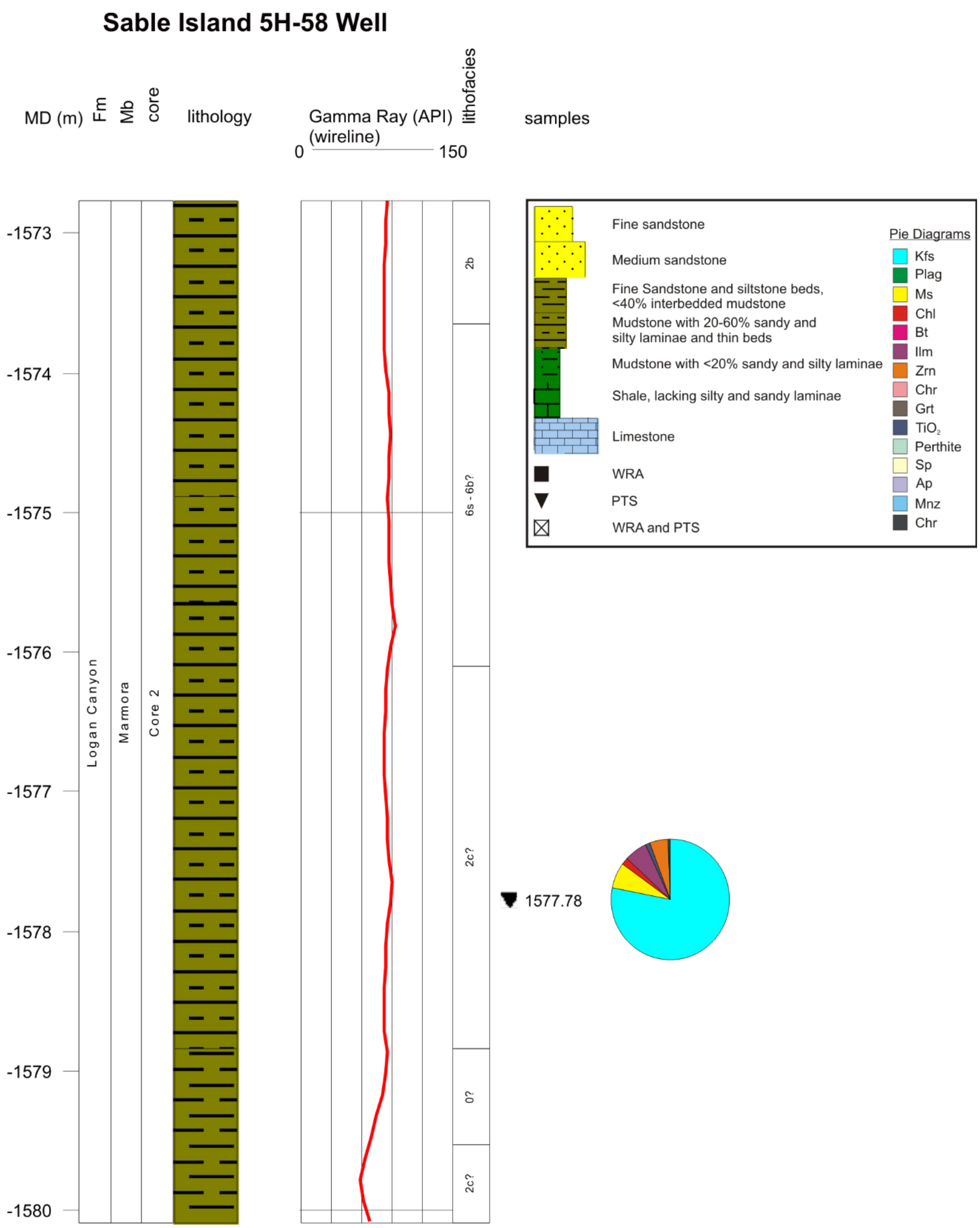

Figure 3.2.9: Stratigraphic column for core 2 from Sable Island 5H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

Core 3 consists of four different lithologies (Fig. 3.2.10):

1911.32 m to 1912.39 m: This interval contains rare shells and shaley layers. This then grades into fine-upper sands with some mud drapes. Then it grades into fine-lower to very fine-lower sands.

1909.48 m to 1911.32 m: This interval consists of interbedded mudstone and sandstone that become more sand dominated (very fine-lower to fine-lower). There are rare vertical burrows, most are horizontal. Erosional surfaces with scours are filled with medium –coarse sands. Some siderite concretions.

1904.58 m to 1909.48 m: This interval consists of interbedded mudstone and sandstone and starts off as more mud dominated, but grades into more sand dominated near the base. There are some small shells and siderite concretions. The glauconite that is present here borders facies 3, but grades into facies 2.

1903.48 m to 1904.58 m: This interval consists of fine-lower sands with some mud laminations. It appears to contain irregular tidal drapes. No shells or bioturbation has been seen.

Lithofacies for this core were classified into three different types (Fig. 3.2.10). The depositional environment of the sediments in this core was an estuarine-tidal flat.

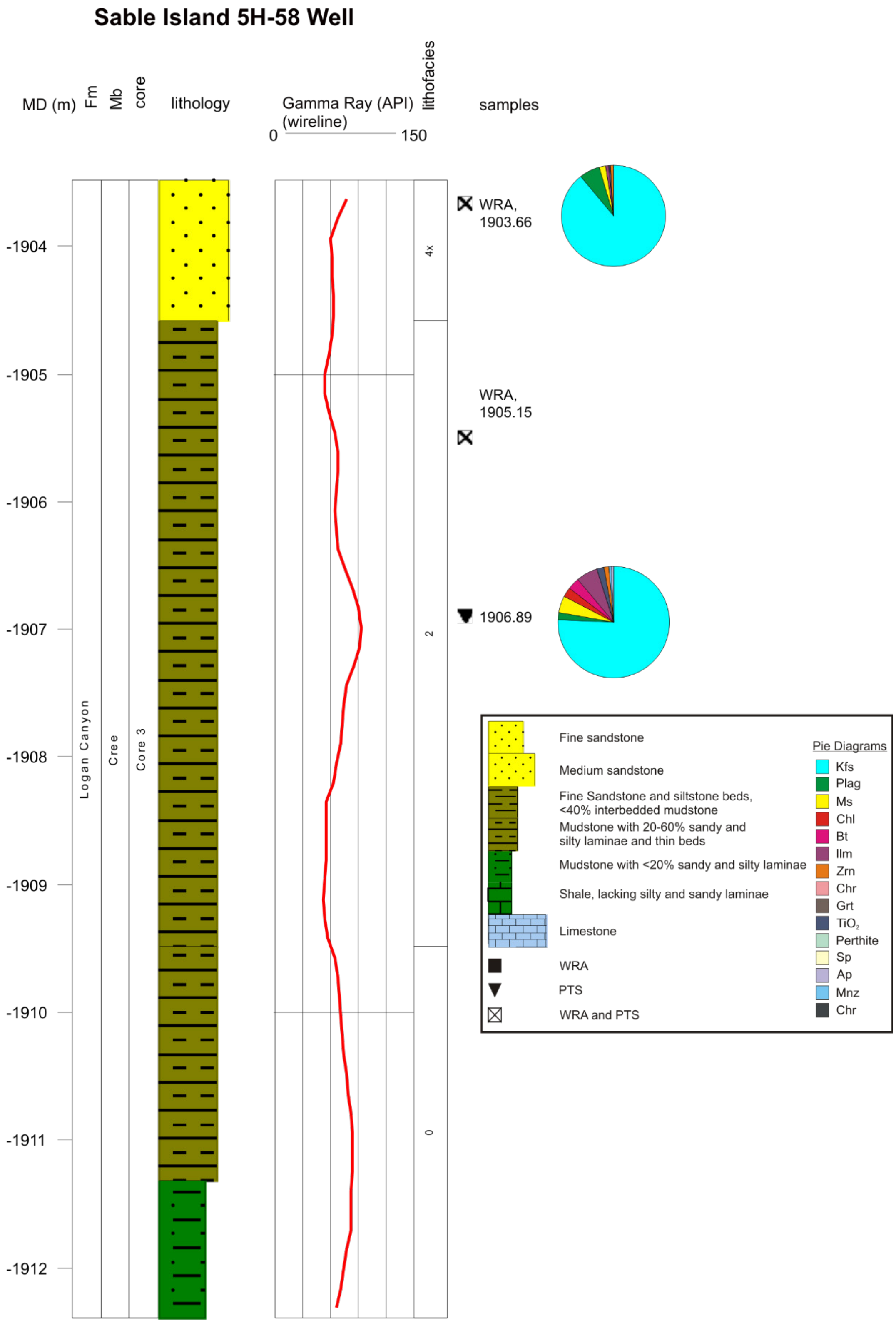

Figure 3.2.10: Stratigraphic column for core 3 from Sable Island 5H-58 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

Based on the ten lithofacies identified in core 1, the five lithofacies identified in core 2, and the three lithofacies identified in core 3, the depositional environment of this well appears to be an estuarine-tidal flat environment when compared to Gould et al. (2012). The general interpretation is that core 3 was deposited in an estuarine-tidal flat setting. Over time, sediment supply or sea level changed, which caused core 2 to be deposited in a shoreface setting. As more time passed, sediment supply changed again, and core 1 was deposited in a tidal flat setting.

3.2.4 Sable Island E-48 Well Facies

The Sable Island E-48 well core 1 extends from 2242.11 m to 2250.15 m. Core 1 has been split into eight different lithologies (Fig. 3.2.11):

2248.51 m to 2250.15 m: This interval consists of interbedded very fine to fine-lower sands and mud. There is some lenticular bedding, and rare vertical burrows. Abundant bioturbation is present, and leaching of greenish nodules.

2247.19 m to 2248.51 m: This interval consists of fine-upper sands with rare shells. There are no structures present here. Near the bottom of the interval there is a change to finer sands and thin beds of laminated sand and mud. There are also a few pieces of wood.

2246.44 m to 2247.19 m: This interval consists of fine-upper to medium sands and rare mud.

2245.88 m to 2246.44 m: This interval consists of fine-lower sands with siderite concretions.

2245.32 m to 2245.88 m: This interval consists of fine-lower sands with mud drapes, and horizontal burrows. There are erosion surfaces at 2245.63 m and 2245.72 m, and some small shells at the second erosion surface.

2245.11 m to 2245.32 m: This interval consists of fine-upper sands. This is a very rubbly interval.

2243.68 m to 2245.11 m: This interval consists of fine-lower sands with some mud draping and minor bioturbation. There are also some siderite concretions, and further down the interval there are some shells.

2242.11 m to 2243.68 m: This interval consists of fine-upper sands with siderite concretions / patches. This interval grades into finer sands near the base of the interval. *Ophiomorpha* trace fossils are present. The core appears to be tilted.

Based on the ten identified lithofacies of this core (Fig. 3.2.11), the depositional environment of the sediments was an estuarine-tidal flat.

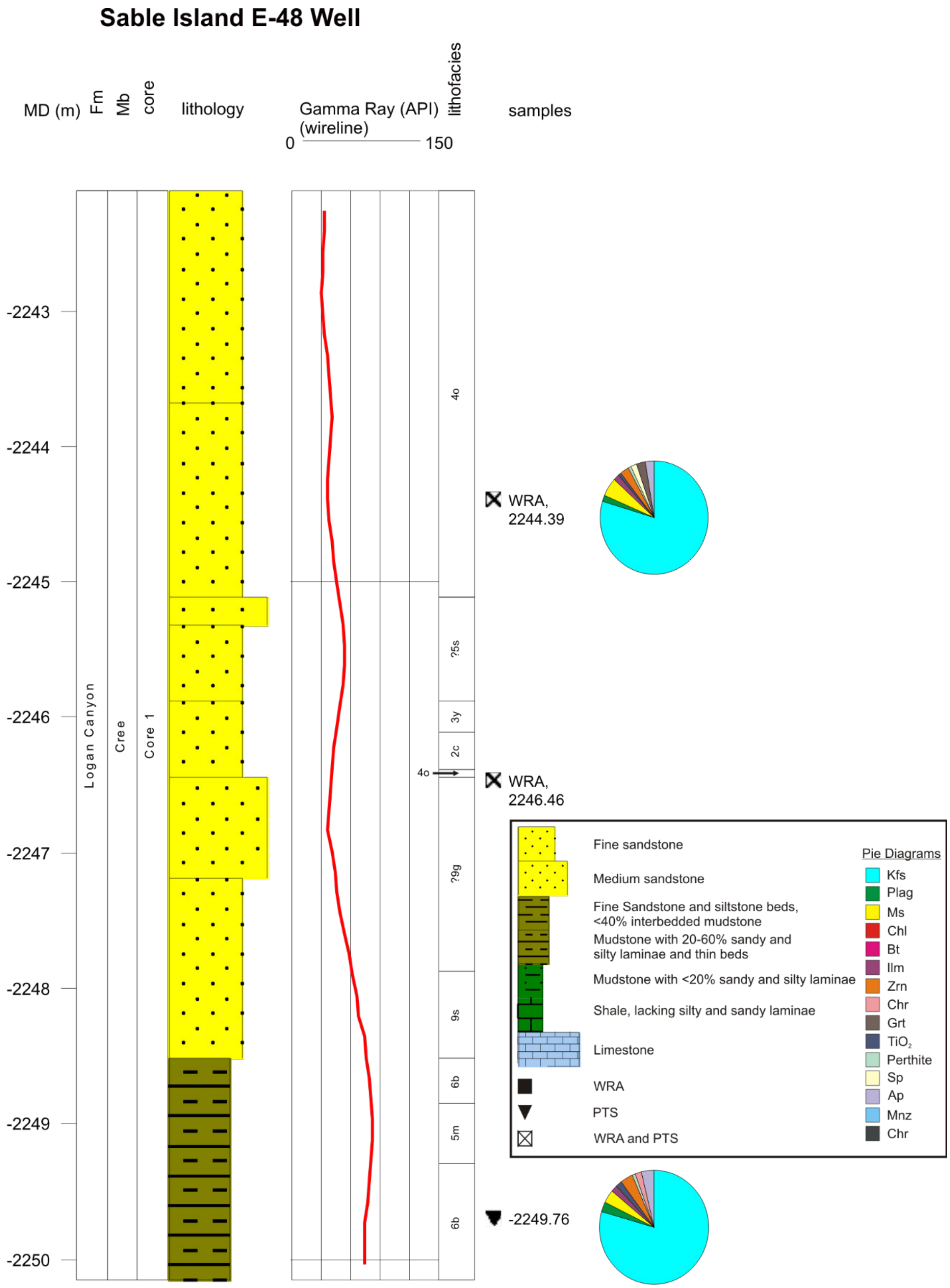

Figure 3.2.11: Stratigraphic column for core 1 from Sable Island E-48 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

3.2.5 Sable Island O-47 Well Facies

The Sable Island O-47 well core 1 extends from 1882.14 m to 1898.90 m, with 8.05 m not recovered. Core 1 has been split into five different lithologies (Fig. 3.2.12):

1888.60 m to 1890.85 m: This interval consists of interbedded mudstone and sandstone (very fine-lower) that is more mud dominated. There does not appear to be any bioturbation, and there are very small thin shells, and almost parallel laminations.

1887.85 m to 1888.60 m: This interval consists of interbedded sandstone and mudstone. There is lenticular bedding and rare shells. The sands are very fine to fine-lower. The interval becomes more mud dominated towards the bottom.

1887.57 m to 1887.85 m: This interval is more mud dominant with some sands and abundant bioturbation.

1886.42 m to 1887.57 m: This interval consists of interbedded very fine to fine-lower sands and mudstone. Lenticular bedding is present. There are also some vertical burrows and rare shells.

1882.14 m to 1886.42 m: This interval consists of very fine lower to fine-lower sands with lots of bioturbation. There are oyster-like shells, siderite concretions, a lenticular bed at 1883.54 m, and a vertical burrow at 1884.34 m. Possible reworked shells occur at 1884.80 m.

Based on the five identified lithofacies (Fig. 3.2.12), the sediments of this core were deposited in a shoreface-type environment. However, it is difficult to tell when compared with Gould et al. (2012).

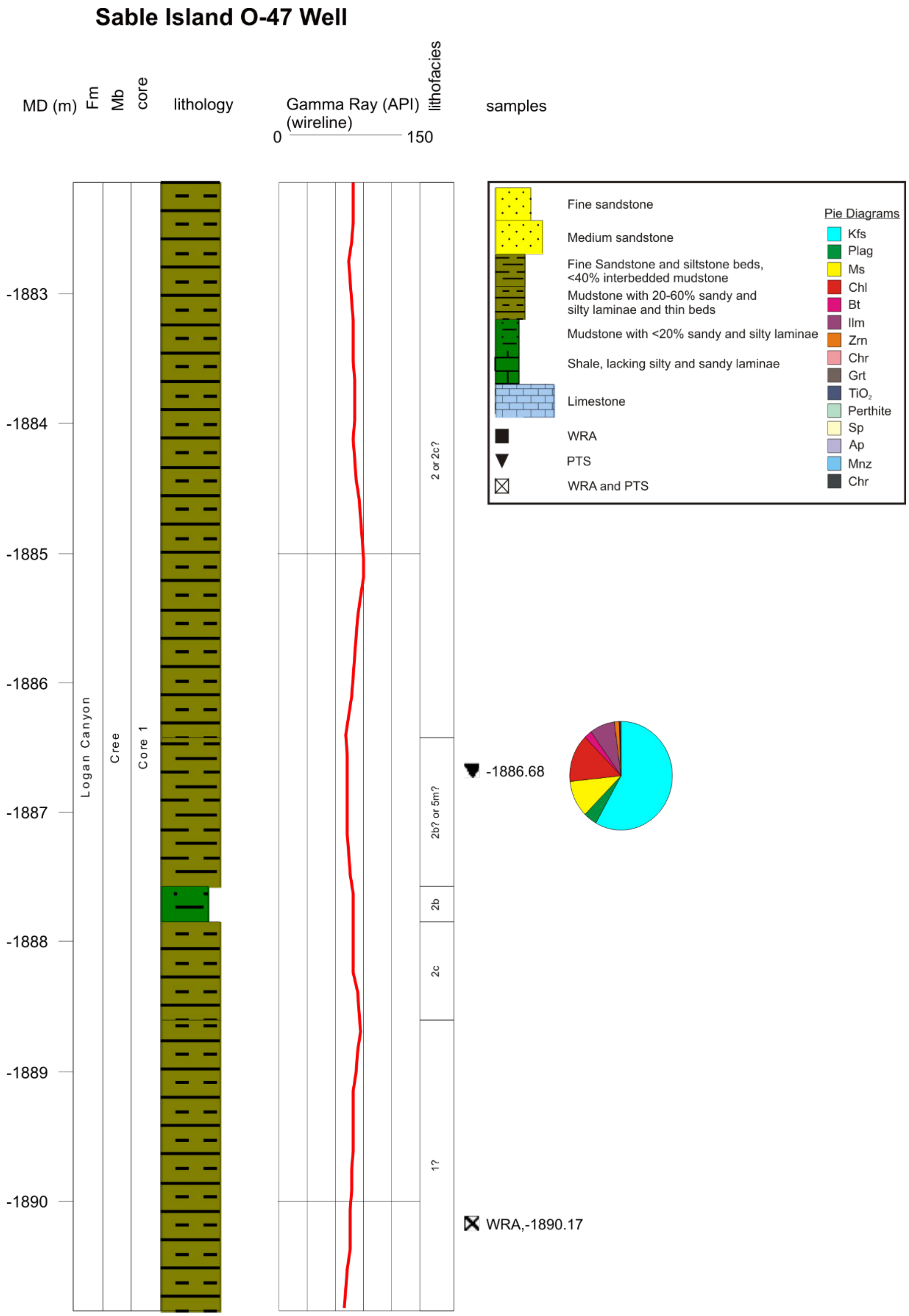

Figure 3.2.12: Stratigraphic column for core 1 from Sable Island O-47 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

3.2.6 Primrose 1A-A41 Well Facies

The Primrose 1A-A41 well cores extend from 1607.82 m to 1616.96 m (core 1), and from 1616.96 m to 1624.58 m (core 2). The lithology for this well has not been described for this project. However, the lithofacies from Gould et al. (2011) have been used, noting that the facies model does not completely fit with this well (Figs. 3.2.13, 3.2.14). The lithofacies for the cores 1 and 2 appear to be facies 1 (shelf deposition), but they could also be classified as facies 3 (condensed unit on the shelf).

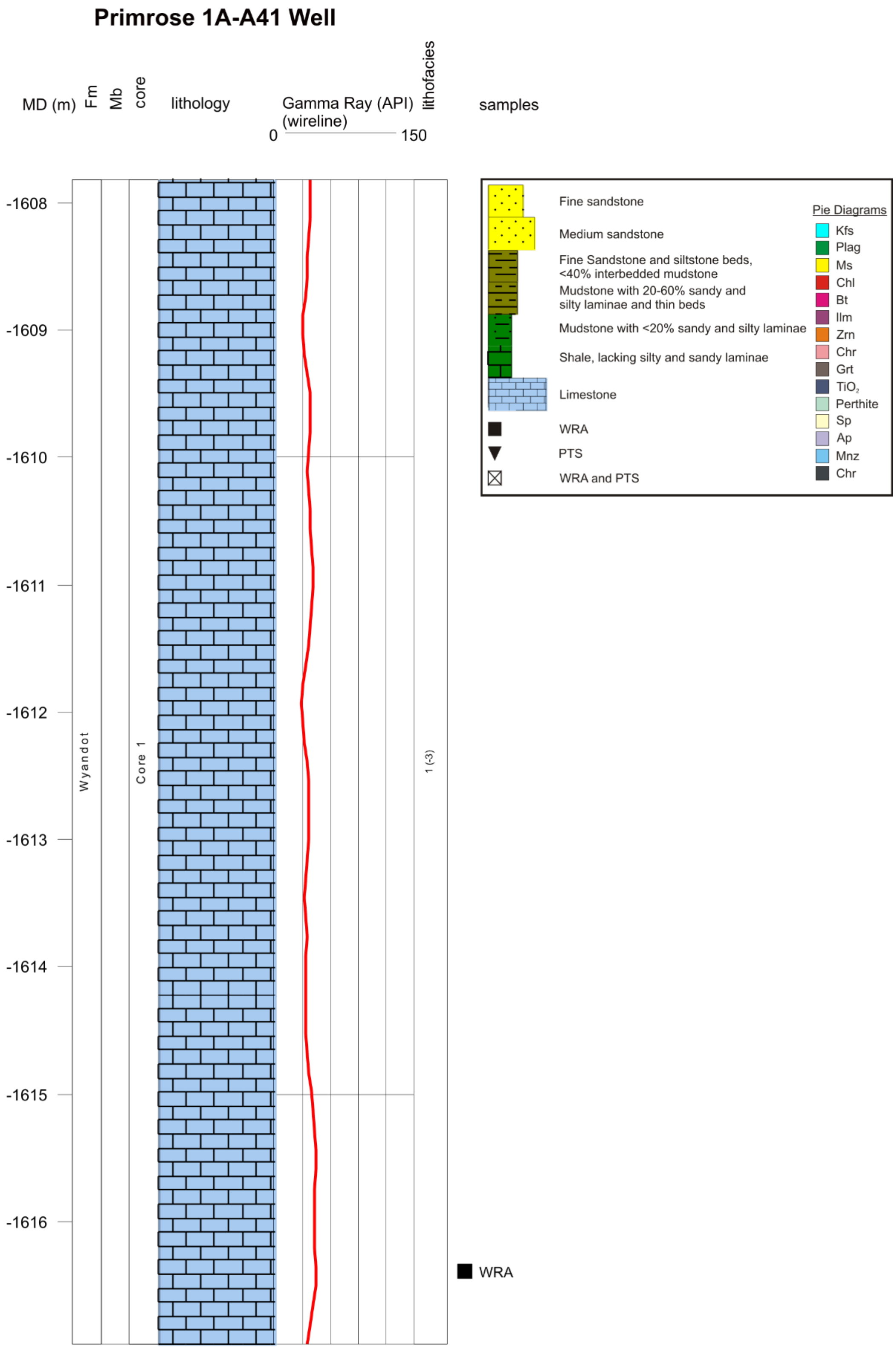

Figure 3.2.13: Stratigraphic column for core 1 from Primrose 1A-A41 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

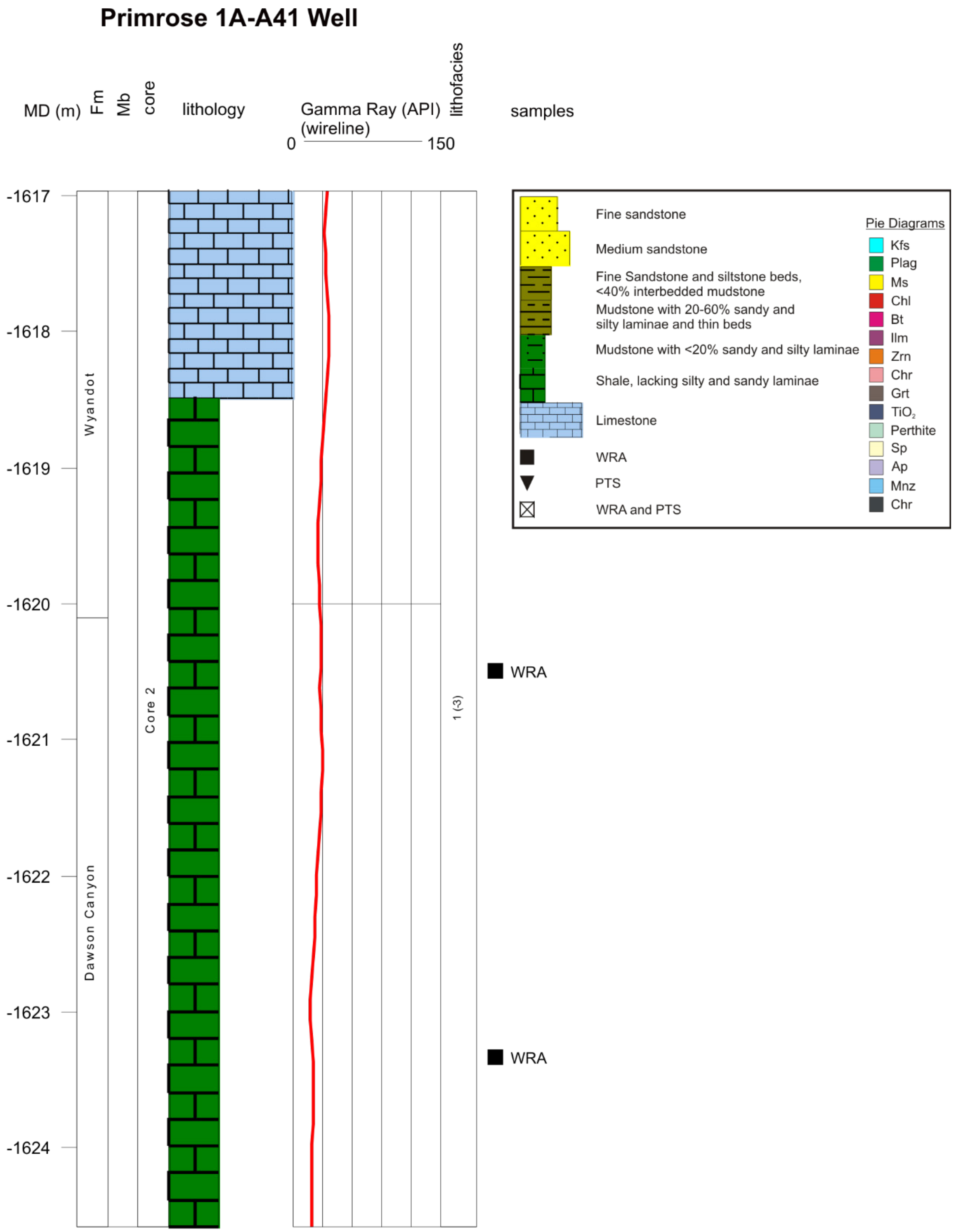

Figure 3.2.14: Stratigraphic column for core 2 from Primrose 1A-A41 well. Formation and member picks are from Wade and MacLean (1993). Pie diagram shows modal distribution of detrital minerals present, excluding quartz. Gamma ray plot is not depth corrected.

3.2.7 Summary

All Sable Island wells appear to have a very similar depositional environment, which is expected since they are all within a few kilometres of each other. Their depositional environment appears to be an estuarine-tidal flat, with minor variations ranging to shoreface and prodeltaic in some of the cores.

Chapter 4: Mineralogy and Petrography

4.1 Introduction to Collected Data

Ten polished thin sections were chosen for sandstone petrography utilizing BSE images and EDS analyses. This involved looking at the detrital minerals, cement, coated grains, and lithic clasts in order to determine provenance and diagenesis. Seven mudstone samples were chosen for WRA in order to determine provenance.

4.2 Description of Studied Samples

4.2.1 Sample 2H-58 1600.27

The detailed core description from the well history report (Dawson, 1973b) suggests that the sample is from an interval that consists of a very fine-grained, well sorted sandstone, with some shaley laminations. There is also some carbonaceous material, as well as slightly dirtier sandstone with silty, argillaceous material. SEM-EDS analysis (Fig. 4.2.1) indicates that the detrital minerals are: albite, chlorite, ilmenite, K-feldspar, muscovite, oligoclase, quartz, titania, and zircon. The diagenetic minerals in this sample are: chlorite, kaolinite, pyrite, siderite, and titania. Suturing is common between quartz and K-feldspar grains. Overgrowths are rare, and occur in quartz. Primary porosity within the sample appears to have been preserved (Figs. 4.2.1A,B). Some of the micas appear to have expanded along cleavage planes, allowing for diagenetic siderite to precipitate (Fig. 4.2.1C). Lithic clasts identified are argillites, metasiltstones, and granitoid rocks. The tentative paragenetic sequence is: kaolinite → chlorite → siderite, pyrite, titania. Drilling mud appears to have infiltrated the sample, contaminating it with barite (Fig. 4.2.1D).

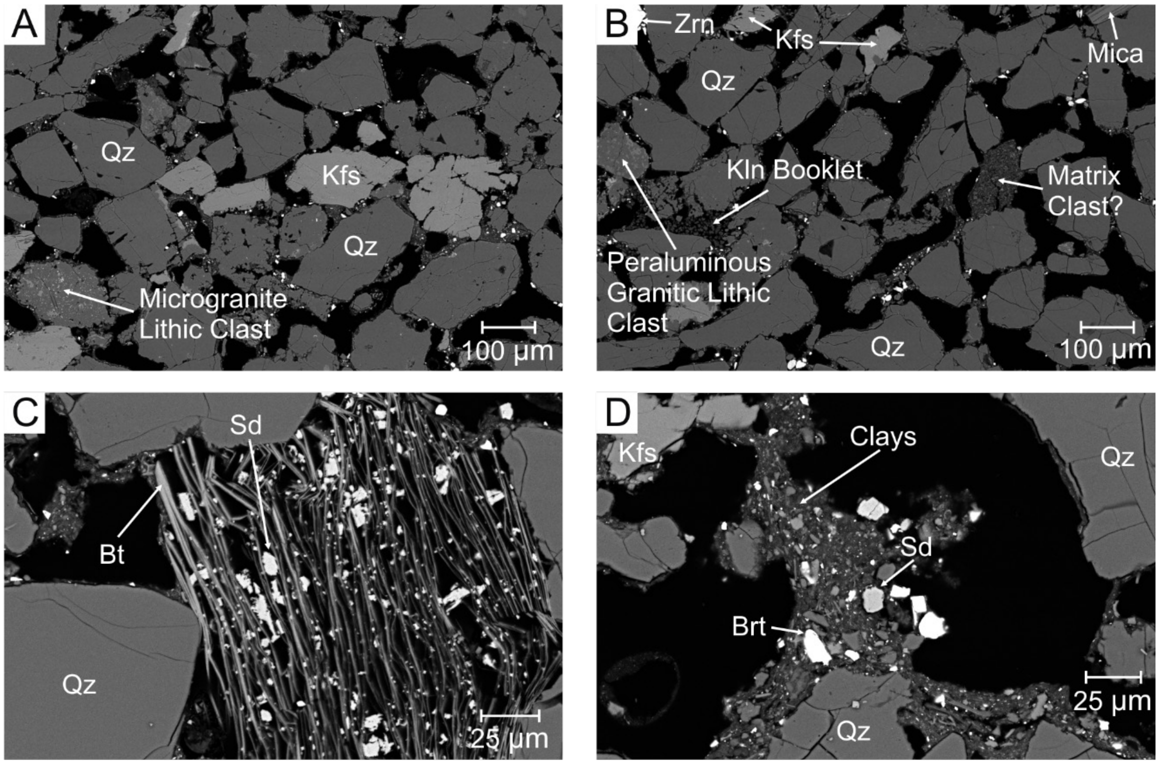

Figure 4.2.1: Representative BSE images of sample 2H-58 1600.27.
A: Framework grains consist of quartz and K-fledspar. The grains appear to be partially coated by clays. There is also a microgranite lithic clast.
B: Framework grains consist of quartz and K-feldspar. The grains are partially coated by clays. There is a matrix clast as well as a detrital zircon grain. Kaolinite is diagenetic and is patially filling primary porosity.
C: A partially dissolved biotite grain is altered, and has expanded along cleavage planes allowing late diagenetic siderite to precipitate.
D: This site consists of a silty clay coat around framework grains. The barite is probably from drilling mud.

4.2.2 Sample 3H-58 1613.63

The detailed core description from the well history report (Dawson, 1973c) suggests that the sample is from an interval that consists of light green siltstone that is slightly sandy and argillaceous. SEM-EDS analysis (Fig. 4.2.2) indicates that the detrital minerals are: albite, Fe-chlorite, illite + chlorite, ilmenite, K-feldspar, monazite, muscovite, quartz, titania, and zircon. The diagenetic minerals in this sample are: glauconite, glaucony, pyrite, siderite, and titania. By examining the BSE images, the sample appears to be a fine-medium grained sandstone with glauconitic cement (Fig.

4.2.2A). The glaucony grains appear to have been affected by volume reduction. Common substrates for glaucony appear to be pellets, detrital grains, and matrix or possibly intraclasts. There is a coated grain made up of multiple generations of siderite (Fig. 4.2.2D). Siderite is usually late diagenetic mineral, seen partially filling voids, and rims grains. The matrix appears to be made up usually of a fine-grained illite + chlorite mixture (Fig. 4.2.2C). The tentative paragenetic sequence is: glaucony → glauconite → pyrite, siderite, titania.

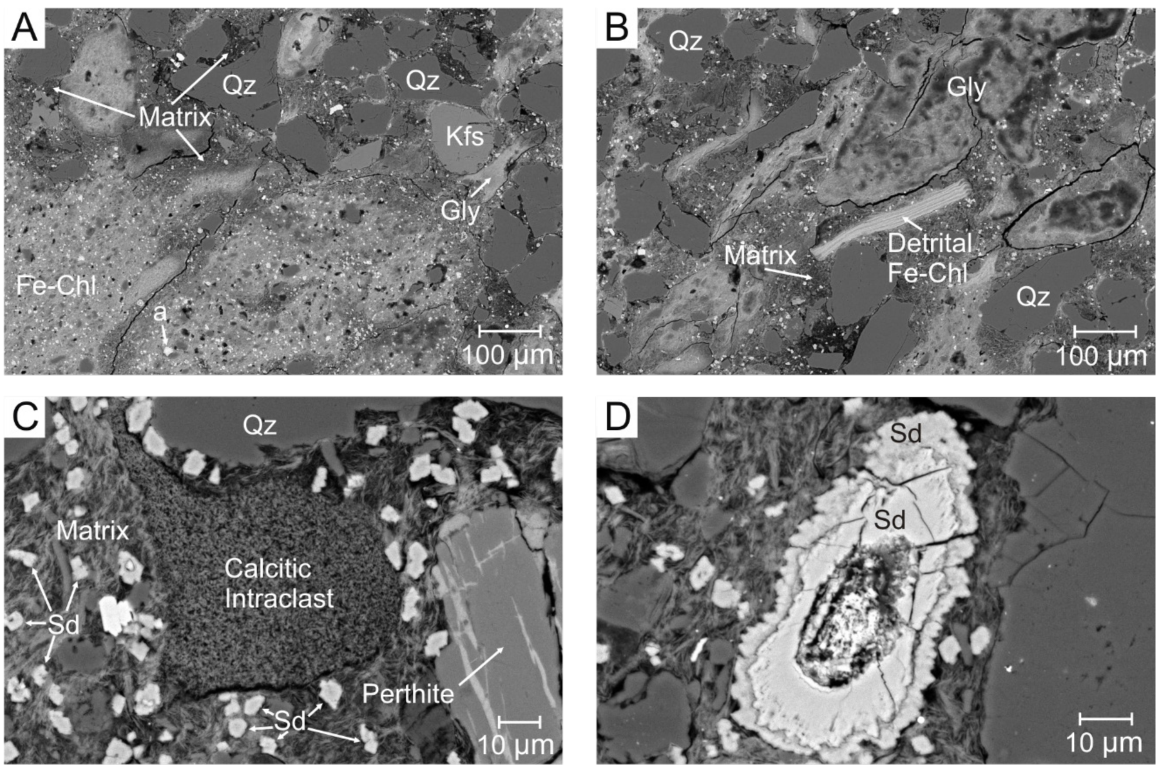

Figure 4.2.2: Representative BSE images of sample 3H-58 1613.63.
A: Framework grains consist of quartz and K-feldspar. The matrix consists of illite + chlorite, and diagenetic Fe-chl. Glaucony is early diagenetic, and siderite (position a) is probably late diagenetic.
B: Framework grains consist of quartz and Fe-chlorite. The matrix contains illite + chlorite, and diagenetic Fe-chl. Glaucony is early diagenetic.
C: This site consists of a calcitic intraclast. The matrix is made up of illite + chlorite. There is also a perthite grain made up of K-feldspar that had its albite altered to Fe-chlorite. Siderite is late diagenetic and partially fills voids.
D: This site consists of a coated grain with multiple generations of siderite.

4.2.3 Sample 3H-58 1804.26

The detailed core description from the well history report (Dawson, 1973c) suggests that the sample is from an interval that consists of greenish grey very fine-grained sandstone with local shale laminae. SEM-EDS analysis (Fig. 4.2.3) indicates that the detrital minerals are: albite, biotite, chlorite, illite + chlorite (matrix), ilmenite, K-feldspar, muscovite, quartz, spinel, and zircon. The diagenetic minerals in this sample are: Fe-chlorite, kaolinite, pyrite, and titania. By examining the BSE images, it appears that illite + chlorite make up the matrix (Fig. 4.2.3A), and form intraclasts. Micas appear to follow bedding planes. Chlorite is often seen along cleavages of either micas (muscovite or biotite) or K-feldspar. It is difficult to say if chlorite in such grains is detrital, or formed during burial diagenesis, or both. Glaucony has been seen replacing pellets (Fig. 4.2.3C), detrital grains, matrix, and lithic clasts. The tentative paragenetic sequence is: kaolinite, chlorite → pyrite, titania. Halite appears to be a contamination from washing the core in salt water.

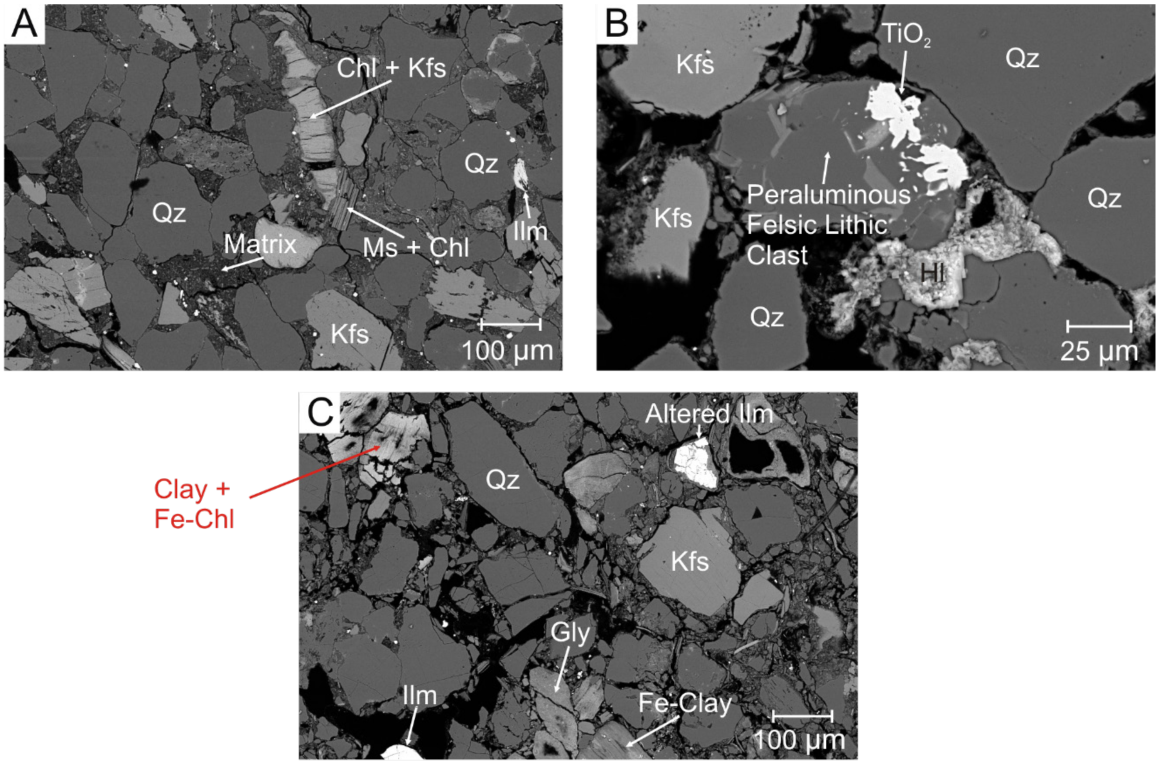

Figure 4.2.3: Representative BSE images of sample 3H-58 1804.26.
A: The framework grains are made up of quartz, K-feldspar, and ilmenite. The matrix is made up of illite + chlorite, and kaolinite.
B: This site consists of a peraluminous lithic clast, detrital quartz, and K-feldspar grains. The titania is late diagenetic, and the halite is most likely from washing the core with salt water.
C: The framework grains consist of quartz, K-feldspar, and ilmenite. The matrix is made up of illite + chlorite. Glaucony is early diagenetic.

4.2.4 Sample 3H-58 2001.33

The detailed core description from the well history report (Dawson, 1973c) suggests that the sample is from an interval that consists of white to light greenish grey, very fine-grained sandstone with calcareous cement. Contains some laminae of grey shale. SEM-EDS analysis (Fig. 4.2.4) indicates that the detrital minerals are: albite, chlorite, chromite, ilmenite, K-feldspar, monazite-(Ce), muscovite, oligoclase, and quartz. The diagenetic minerals are: calcite, chlorite, illite, glauconite, glaucony, kaolinite, pyrite, siderite, titania, and ?quartz overgrowths. By closely examining BSE images, the sample appears to be a medium-fine grained sandstone with calcitic cement

(Fig. 4.2.4A). Siderite commonly appears to partially fill secondary porosity (Figs. 4.2.4A,C). Carbonates tend to coat detrital grains. There is more than one generation of calcite. There is chloritized muscovite, which is probably detrital. There are also rare kaolinite booklets, that usually fill primary porosity. Glauconite/glaucony commonly occurs in various forms, sometimes displaying volume reduction (Fig. 4.2.4B). The tentative paragenetic sequence is: glaucony, glauconite → kaolinite ± chlorite → calcite → siderite → pyrite, titania.

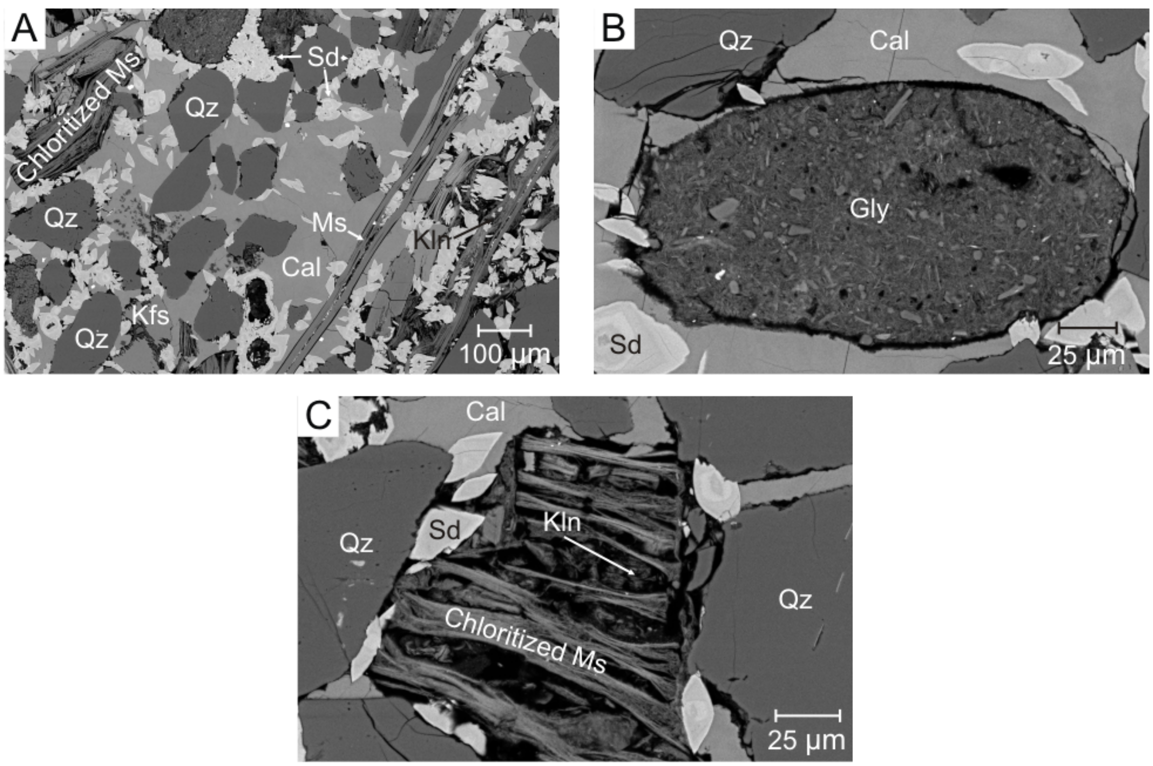

Figure 4.2.4: Representative BSE images of sample 3H-58 2001.33.
A: The framework grains are made up of quartz, K-feldspar, muscovite, and chloritized muscovite. The cement is made up of calcite, with late siderite filling secondary porosity. Muscovite commonly expands along cleavage allowing for siderite to precipitate.
B: This site consists of early diagenetic glaucony, and late diagenetic siderite partially cross-cutting the glaucony.
C: This site consists of a chloritized muscovite grain that is partially dissolved and expanded along cleavage, allowing for kaolinite to form.

4.2.5 Sample 5H-58 1577.78

The detailed core description from the well history report (Dawson, 1974) suggests that the sample is from an interval that consists of white to salt and pepper very fine to fine-grained sandstone that is interbedded with fine laminae of dark grey shale. SEM-EDS analysis (Fig. 4.2.5) indicates that the detrital minerals are: chlorite, chromite, ilmenite, K-feldspar, muscovite, quartz, titania, and zircon. From careful examination of BSE images, this sample is a mixture of sandstone and mudstone. Identification of diagenetic minerals and their paragenetic sequence is difficult, and was not performed on this sample. Quartz commonly displays overgrowths. Bioturbation is present in this sample. Suturing is ?rare between quartz and K-feldspar grains (Fig. 4.2.5A). Anhydrite seems to be the latest cement (Fig. 4.2.5B).

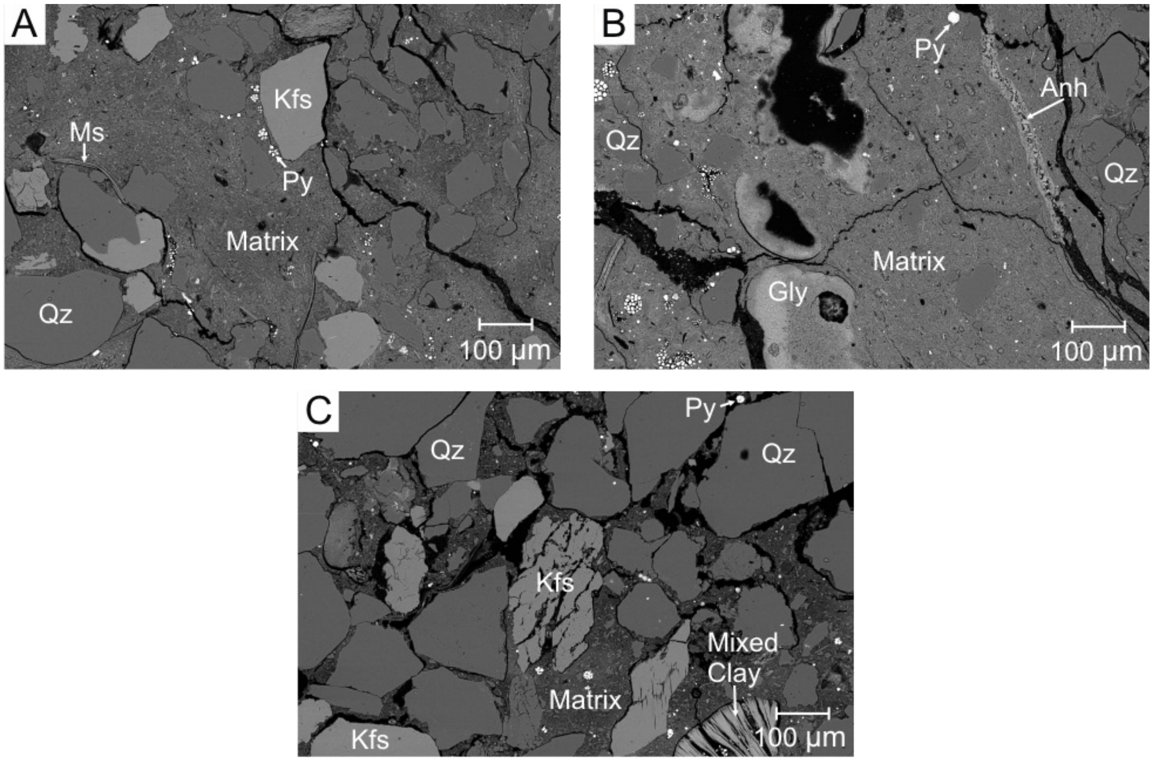

Figure 4.2.5: Representative BSE images of sample 5H-58 1577.78.
A: The framework grains consist of quartz, K-feldspar, and muscovite. The matrix is made up of illite + chlorite.
B: This is a muddier part of the sample. It consists of some silt and sand sized quartz grains. There are also large glaucony grains, and late anhydrite appears to partially fill a fracture.
C: This is a sandier part of the sample. It consists of mostly quartz and K-feldspar. The matrix is made up of mixed clay minerals.

4.2.6 Sample 5H-58 1903.66

The detailed core description from the well history report (Dawson, 1974) suggests that the sample is from an interval that consists light brown medium to fine-grained sandstone. SEM-EDS analysis (Fig. 4.2.6) indicates that the detrital minerals are: albite, ilmenite, K-feldspar, muscovite, oligoclase, quartz, titania, and zircon. The diagenetic minerals are: kaolinite, siderite, titania, quartz overgrowths, and K-feldspar overgrowths. Suturing is common between detrital minerals (K-feldspar and quartz) (Fig. 4.2.6B). The sample has a large amount of primary porosity preserved (Fig. 4.2.6C). The tentative paragenetic sequence is: kaolinite → siderite, titania. Drilling mud has partially infiltrated this sample, contaminating it with barite (Fig. 4.2.6C).

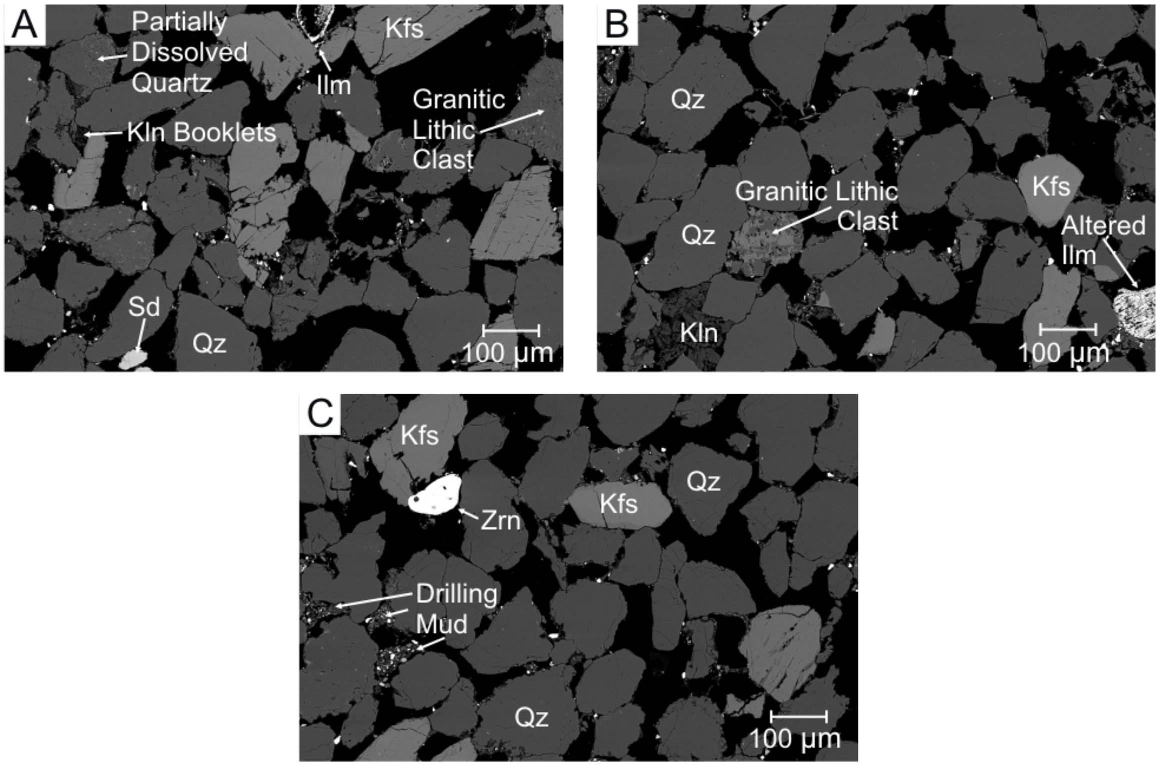

Figure 4.2.6: Representative BSE images of sample 5H-58 1903.66.
A: The framework grains consist of quartz, K-feldspar, and ilmenite. There is also a granitic lithic clast. Kaolinite appears to partially fill primary porosity, as well as late diagenetic siderite.
B: The framework grains are quartz, K-feldspar, and ilmenite. There is also a granitic lithic clast. Kaolinite partially fills primary porosity.
C: The framework grains are quartz, K-feldspar, and zircon. Drilling mud (barite) appears to be a contaminant.

4.2.7 Sample 5H-58 1906.89

The detailed core description from the well history report (Dawson, 1974) suggests that the sample is from an interval that consists of dark grey glauconitic-rich shale. SEM-EDS analysis (Fig. 4.2.7) indicates that the detrital minerals are: albite, apatite, chloritized biotite, chloritized muscovite, illite, ilmenite, K-feldspar, monazite-(Ce), muscovite, oligoclase, quartz, spinel, titania, and zircon. The diagenetic minerals are: calcite, Fe-chlorite, glauconite, glaucony, kaolinite, siderite, and titania. Closely examination of the BSE images indicates that the sample is most likely a fine-medium grained glauconitic sandstone (Fig. 4.2.7A). Detrital quartz and K-feldspar grains commonly contain dissolution voids (Fig. 4.2.7D). Large fractures appear to be filled by calcite. Siderite commonly rims large calcite patches/cement (Fig. 4.2.7A). Siderite also occurs as veinlets. The tentative paragenetic sequence is: glaucony, glauconite → kaolinite → calcite → siderite, titania. Halite (Fig. 4.2.7B) appears to be a contamination from the result of washing the core with salt water.

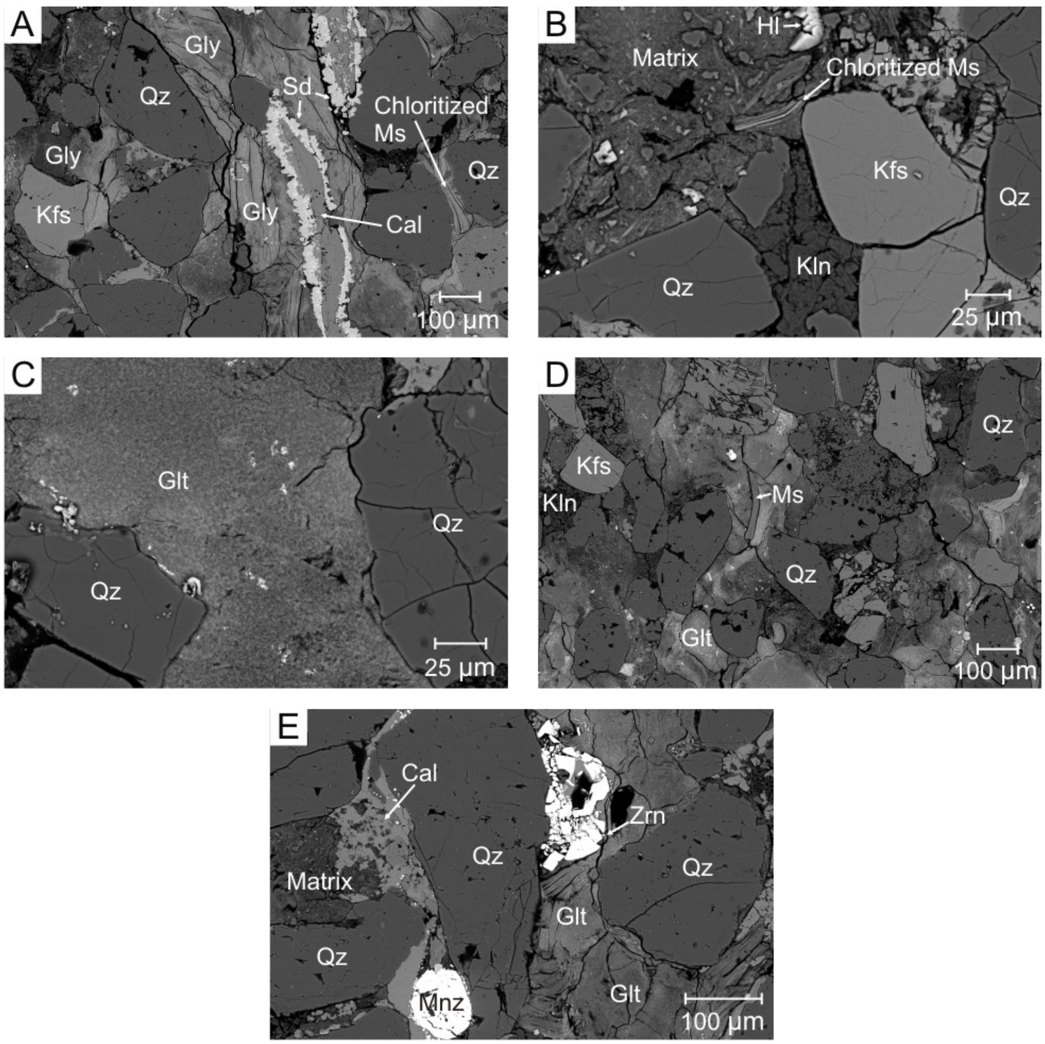

Figure 4.2.7: Representative BSE images of sample 5H-58 1906.89.
A: The framework grains are quartz and K-feldpsar. Glaucony is an early diagenetic mineral. Calcite and late siderite make up the cement.
B: The matrix is made up of illite + chlorite. The diagenetic minerals are kaolinite and later calcite. Halite is the latest mineral to form but is a contaminant from washing the core.
C: Glauconite forms between detrital quartz grains.
D: The framework minerals are quartz, K-feldspar, and muscovite. Glauconite is an early diagenetic mineral.
E: The matrix in this site is made up of illite + chlorite, which is being replaced by a calcite cement. Monazite appears to be diagenetic. Zircon appears fractured into many small detrital grains. Glauconite is the earliest diagenetic mineral to form.

4.2.8 Sample E-48 2244.39

The detailed core description from the well history report (Dawson, 1972a) suggests that the sample is from an interval that consists of light brown, fine to very fine-grained sandstone, with very thin irregular laminations of shale. SEM-EDS analysis (Fig. 4.2.8) indicates that the detrital minerals are: albite, apatite, garnet, ilmenite, K-feldspar, muscovite, quartz, spinel, titania, and zircon. The diagenetic minerals are: chlorite, kaolinite, pyrite, siderite, titania, quartz overgrowths, and K-feldspar overgrowths. Examination of the BSE images shows siderite-cemented intraclasts (Fig. 4.2.8B), a titania veinlet cross-cuts Fe-rich chlorite (Fig. 4.2.8D). There is also suturing between quartz and K-feldspar (Fig. 4.2.8A). A fine-grained Fe-chlorite appears to coat detrital grains (Fig. 4.2.8C), and form between detrital grains along with kaolinite booklets. The tentative paragenetic sequence is: kaolinite → chlorite → calcite → pyrite, titania, siderite cemented intraclasts. Halite appears with Fe-chlorite, and with a cubic habit and is considered a contaminant. This most likely happened because the core was washed with salt water.

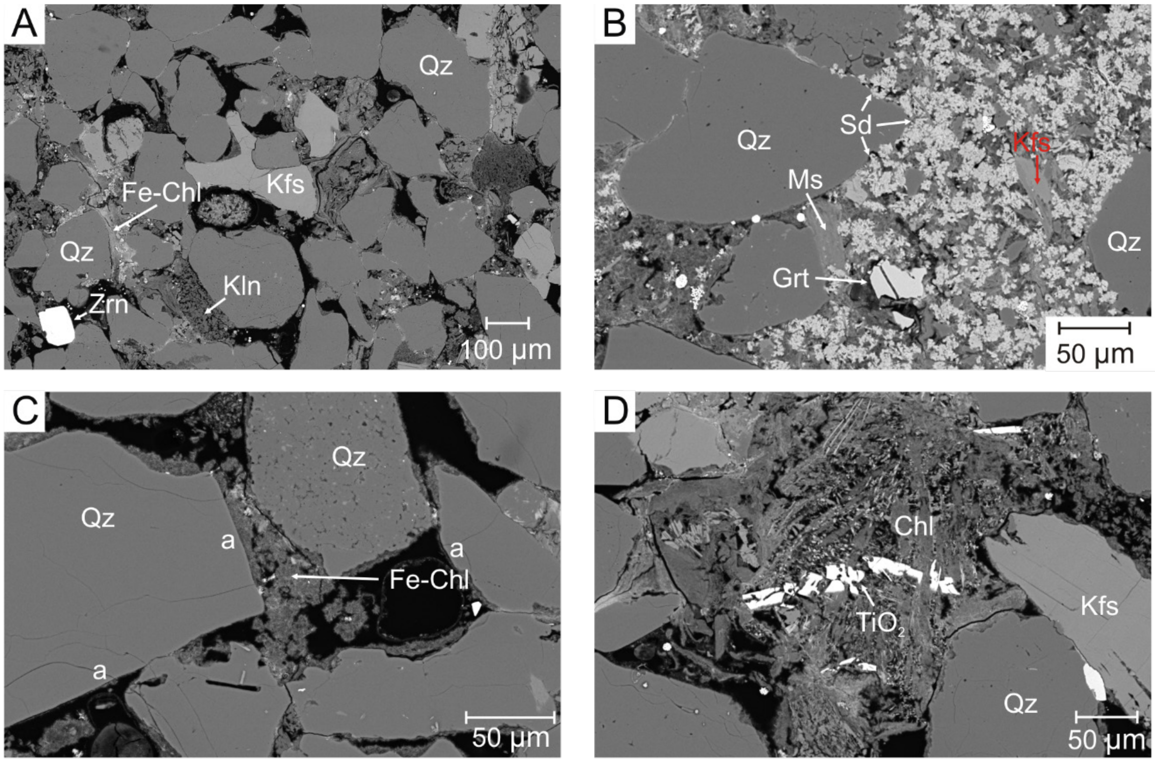

Figure 4.2.8: Representative BSE images of sample E-48 2244.39.
A: The framework grains are made up of quartz, K-feldspar, and zircon. The cement is made up of kaolinite.
B: Detrital quartz grains with a silty mudstone intraclast cemented by siderite. Siderite partially fills voids in the mudstone.
C: Detrital quartz grains are partially coated by clays and contain overgrowths (positions a).
D: Titania veinlet cross-cuts Fe-chlorite. This may be an intraclast.

4.2.9 Sample E-48-2246.46

The detailed core description from the well history report (Dawson, 1972a) suggests that the sample is from an interval that consists of a brown coloured sandstone that is medium to fine-grained. SEM-EDS analysis (Fig. 4.2.9) indicates that the detrital minerals are: albite, apatite, chromite, ilmenite, K-feldspar, muscovite, quartz, sphalerite, and zircon. The diagenetic minerals are: ?apatite, calcite, kaolinite, pyrite, and titania minerals. After examining the BSE images, the sample appears to be a very fine-grained sandstone. Quartz and K-feldspar commonly display suturing and overgrowths. Kaolinite appears to be the main clay cement (Fig. 4.2.9B), and clays sometimes partially or fully coat detrital quartz and K-feldspar. The garnet in this sample is a solid solution of almandine-pyrope. Several albitized K-feldspar grains have also been seen (Fig. 4.2.9B). The tentative paragenetic sequence is: kaolinite → calcite → pyrite, titania, siderite. Barite (Fig. 4.2.9A) appears to be a contaminant from the drilling mud because it fills voids and intergranular boundaries.

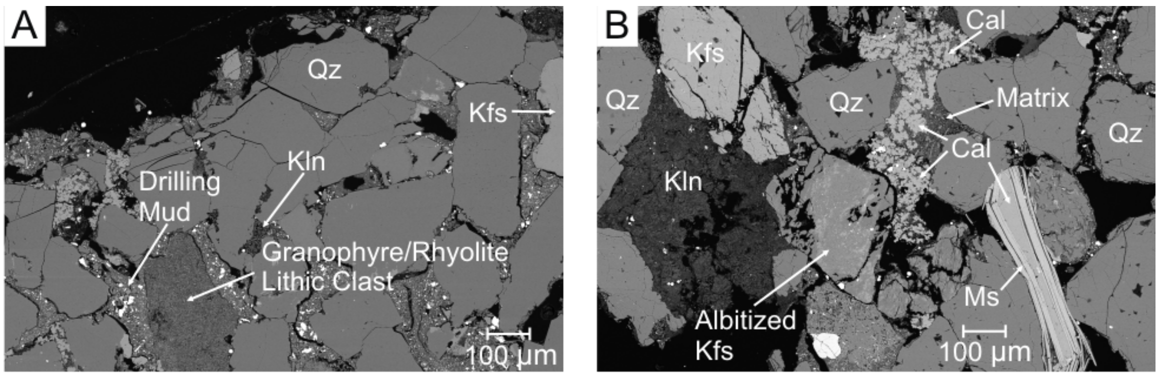

Figure 4.2.9: Representative BSE images of sample E-48 2246.46.
A: Framework grains consist of quartz and K-feldspar. There is also a granophyre/rhyolite lithic clast. Diagenetic kaolinite forms booklets. The drilling mud (barite) appears as a contaminant.
B: The framework grains are quartz and K-feldspar. Kaolinite is an early diagenetic mineral and calcite appears to be replacing the matrix. Muscovite appears slightly deformed and has expanded along cleavage allowing calcite to precipitate.

4.2.10 Sample O-47 1886.68

The detailed core description from the well history report (Dawson, 1972b) suggests that the sample is from an interval that consists of micaceous, glauconitic, shelly shale, with a few thin sandstone lenses. SEM-EDS analysis (Fig. 4.2.10) indicates that the detrital minerals are: albite, chlorite, biotite, chromite, ?Fe-clay, garnet, illite, ilmenite, K-feldspar, muscovite, oligoclase, quartz, and zircon. The diagenetic minerals are: anhydrite, chlorite, kaolinite, pyrite, siderite, and titania. After careful examination of BSE images, the sample appears to be a fine-grained sandstone with thin mudstone intervals. Quartz commonly displays suturing and overgrowths. Chlorite and muscovite are usually plastically deformed, causing them to expanded along cleavage planes (Fig.

4.2.10B), allowing for diagenetic minerals to precipitate. When looking at the photograph of the thin section, the sample appears to be layered with fine sands and muddy intervals. The paragenetic sequence is: kaolinite → chlorite → siderite, titania, pyrite, anhydrite.

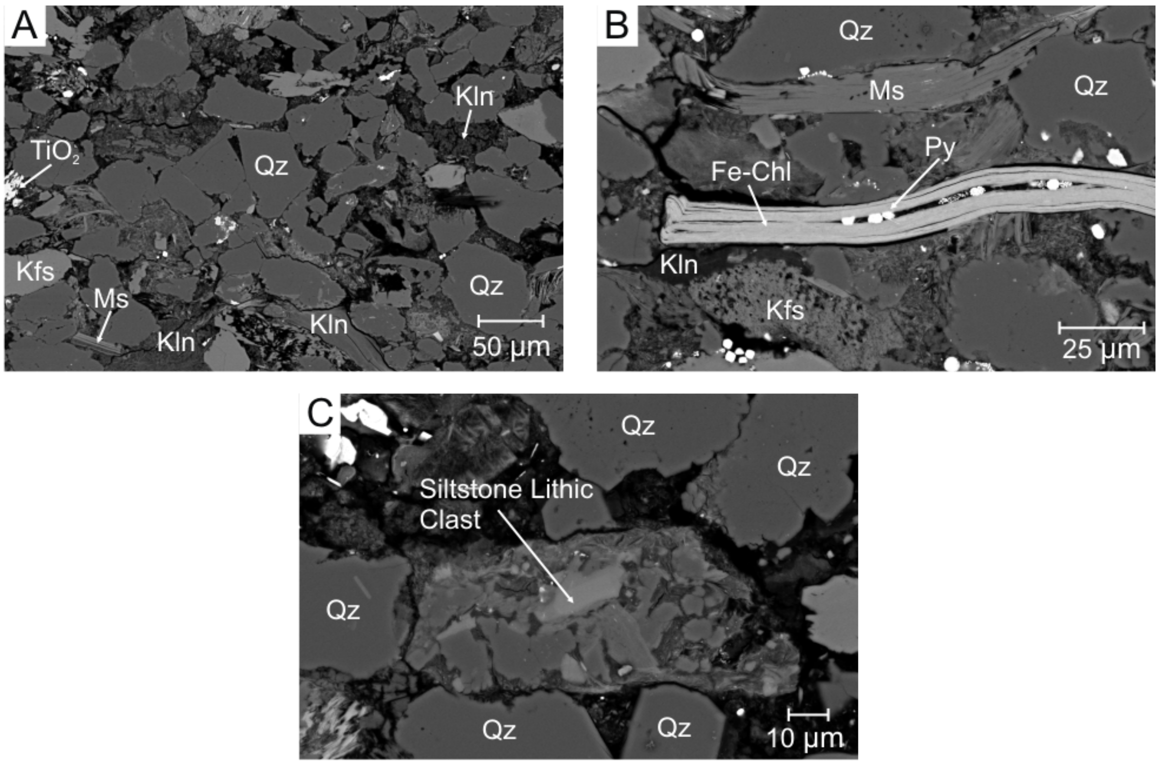

Figure 4.2.10: Representative BSE images of sample O-47 1886.68.
A: The framework grains consist of quartz, K-feldspar, and muscovite. Kaolinite appears as early diagenetic booklets as well as massive grains (possibly replacing earlier minerals). Titania is the latest diagenetic mineral to form.
B: A detrital Fe-chlorite grain appears plastically deformed and has expanded along cleavage allowing for diagenetic pyrite to precipitate. K-feldspar appears partially dissolved.
C: There is a siltstone lithic clast made up of quartz, K-feldspar, and chlorite.

4.3 Lithic Clasts

Lithic clasts are an important tool that can be used to determine provenance in sedimentary rocks. Table 4.3.1 summarizes the general types of lithic clasts that are present in the studied samples. Further classification of lithic clasts into possible source rocks is below.

Table 4.3.1: General Summary of Lithic Clasts

Well	Member	Depth	Lithic Clasts			Total
			Felsic Igneous	Sedimentary	Metamorphic	
2H-58	Marmora	1600.27	26	1	5	32
3H-58	Marmora	1613.63	4			4
3H-58	Marmora	1804.26	5			5
3H-58	Sable	2001.33	11	1	1	13
5H-58	Marmora	1577.78	2	1		3
5H-58	Cree	1903.66	14		2	16
5H-58	Cree	1906.89	1			1
E-48	Cree	2244.39	7	2		9
E-48	Cree	2246.46	18	2	4	24
O-47	Cree	1886.68	3	1		4

Lithic clasts for 2H-58 1600.27: consists of metasiltstone (slate), argillite, granitoid, peraluminous granite, microgranite, and rhyolite.

Lithic clasts for 3H-58 1613.63: consists of peraluminous granite, and rhyolite or quartzite.

Lithic clasts for 3H-58 1804.26: consists of peraluminous granite, and granite.

Lithic clasts for 3H-58 2001.26: consists of metasiltstone (schist), rhyolite, granitoid, granite, peraluminous granite, ?siltstone.

Lithic clasts for 5H-58 1577.78: consists of mudstone, and granite.

Lithic clasts for 5H-58 1903.66: consists of rhyolite, metasiltstone, granite, and microgranite.

Lithic clasts for 5H-58 1906.89: consists of granite.

Lithic clasts for E-48 2244.39: consists of granitoid, siltstone/mudstone, and rhyolite.

Lithic clasts for E-48 2246.46: consists of granophyre/rhyolite, subvolcanic rhyolite, metasiltstone (schist), granite, ?mudstone, metasandstone, metasiltstone (slate), ?peraluminous granite, and vein quartz.

Lithic clasts for O-47 1886.68: consists of granite, and siltstone.

4.4 Clay Coats

Clay coats are very important in reservoir rocks because they can affect reservoir quality. During burial, clay coats can help to inhibit quartz overgrowths, which would otherwise fill primary porosity. This is very important because it preserves porosity and permeability that otherwise will decrease with burial. Chlorite and illite clay coats continuous or discontinuous on detrital quartz grains are able to reduce the nucleation area around the grain that is available for authigenic quartz growth (Wooldridge et al. 2017a). Three different types of clay coats have been identified by Wooldridge et al. (2017a) and have been applied to the studied samples.

Type 1: Ridged clay coats. In thin section, these coats appear as partial clay coats or full clay coats along grain boundaries. They are usually occur with coarser, cleaner sediment assemblages in the outer tidal flat and nonvegetated tidal bar environments (Wooldridge et al. 2017a).

Type 2: Bridged clay coats. These types of coats act as a linkage connecting detrital grains together.

Type 3: Clumped clay coats. These coats contain abundant clay and silt, and range up to 200 μm in size in near-surface environments. They commonly form in depositional environments such as upper-estuary, intertidal, muddy sand flat, tidal bar, and saltmarsh (Wooldridge et al. 2017a).

4.4.1 Sample 2H-58 1600.27

This sample displays abundant clay coats. Most grains are typically fully or partially coated, and there is also bridging between grains (Fig. 4.4.1A). Clay clumps are not as common as the other two types of clay coats. There is also a lot of bright mineral phases present in the clay coats in this sample (probably barite). This means that the clay coats in this sample may be the result of barite drilling mud infiltration.

4.4.2 Sample 3H-58 1613.63

This sample has almost no remaining porosity. Clay coats are very difficult to distinguish from matrix and cement. In the areas that do contain porosity, it appears that a kaolinite cement has partially filled the pore space. There might be a clay coat shown in Figure 4.4.1B.

4.4.3 Sample 3H-58 1804.26

This sample is a mixture of a sandstone with local shale laminae. It consists of partial and full clay coats, clay clumps, and bridges (Fig. 4.4.1C). It is also common for matrix to locally fill porosity (in the areas that are muddier).

4.4.4 Sample 3H-58 2001.33

This sample does not appear to contain any clay coats. The sample has had its porosity filled with a carbonate cement, and to a lesser degree kaolinite cement.

4.4.5 Sample 5H-58 1577.78

This sample is a mixture of a fine-grained muddy sandstone. Porosity is very low in this sample. However, there is a large patch of bioturbation, which has been infilled with larger sand grains, creating porosity. Within this bioturbation patch, partial clay coats, bridges, and clumps are commonly seen (Fig. 4.4.1D).

4.4.6 Sample 5H-58 1903.66

This sample contains abundant porosity and clay coats. Clay coats are commonly partial or full, bridge, and less commonly clay clumps (Fig. 4.4.1E). The clay coats in this sample also contain abundant bright minerals (probably barite). This means that the clay coats in this sample may be the result of barite drilling mud infiltration.

4.4.7 Sample 5H-58 1906.89

This sample consists of a fine-grained glauconitic sandstone with calcitic cement. Porosity is very limited and seems to have been partially filled with kaolinite, calcite, and early diagenetic cement.

4.4.8 Sample E-48 2244.39

This sample contains mostly partial and full clay coats (Fig. 4.4.2A). Bridges are uncommon. Kaolinite cement appears to be partially filling porosity.

4.4.9 Sample E-48 2246.46

This sample contains abundant partial and full clay coats as well as bridges (Fig. 4.4.2B). Clay clumps are less common. The bright minerals in the clay coats is probably barite. This suggests that drilling mud has infiltrated the sample, and that the clay coats are from the drilling mud.

4.4.10 Sample O-47 1886.68

This sample consists mostly of a fine-grained sandstone with mudstone intervals. Porosity is very limited, with only possible partial clay coats. Kaolinite appears to be early diagenetic, partially filling primary porosity.

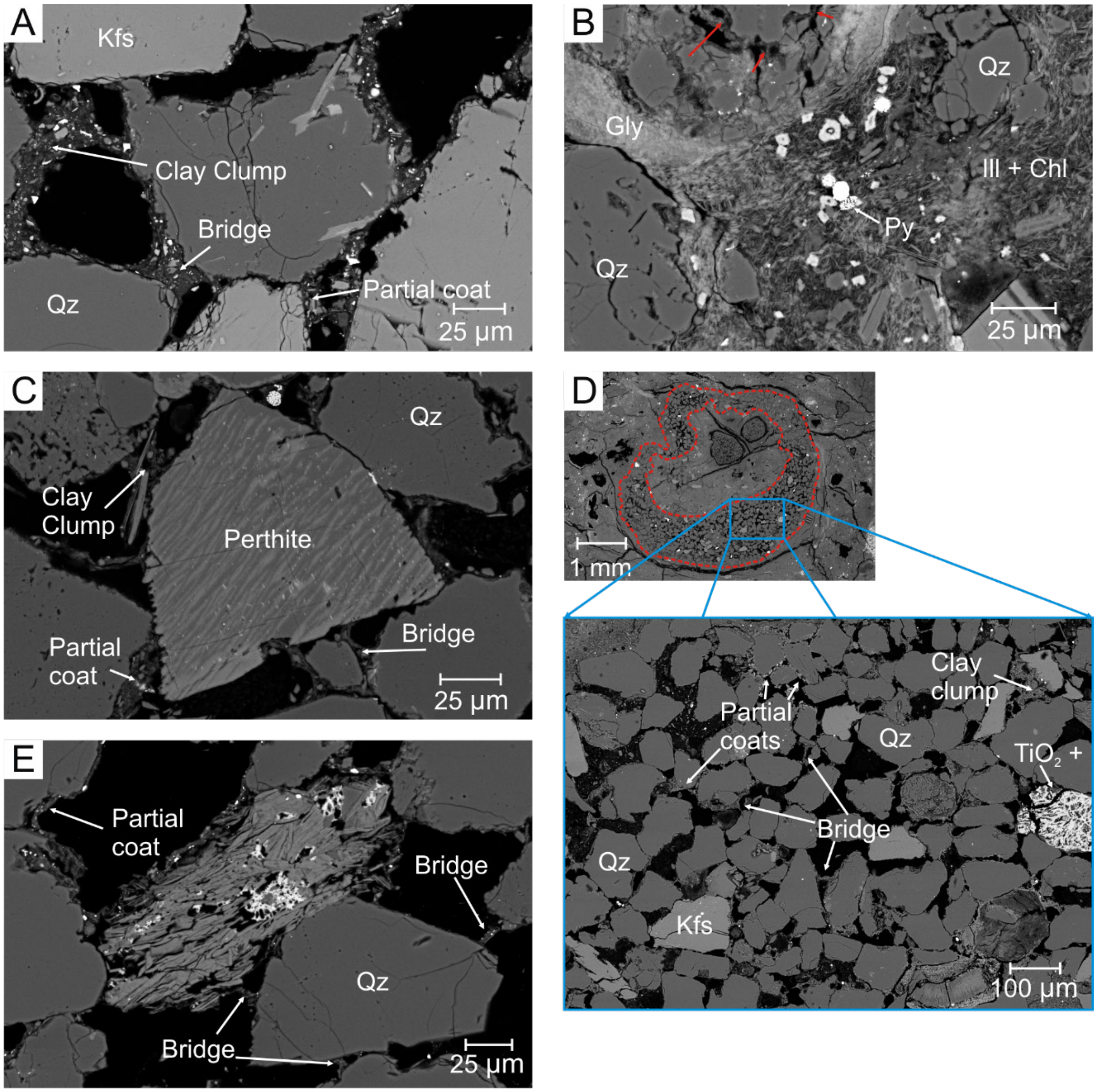

Figure 4.4.1: Representative BSE images of clay coats displayed in the studied samples.
A: Sample 2H-58 1600.27. This sample displays abundant clay coats. Bright minerals in clay coats is probably barite, suggesting that the clay coats are from drilling mud.
B: Sample 3H-58 1613.63. Possible clay coat around detrital quartz grains (red arrows). May also be matrix.
C: Sample 3H-58 1804.26. This sample consists of common partial and full clay coats, as well as bridges.
D: Sample 5H-58 1577.78. This sample contains a large biotubation patch, in which clay coats are common.
E: Sample 5H-58 1903.66. This sample contains abundant partial and full clay coats, as well as bridges. Bright minerals in clay coats is probably barite, suggesting that the clay coats are from drilling mud.

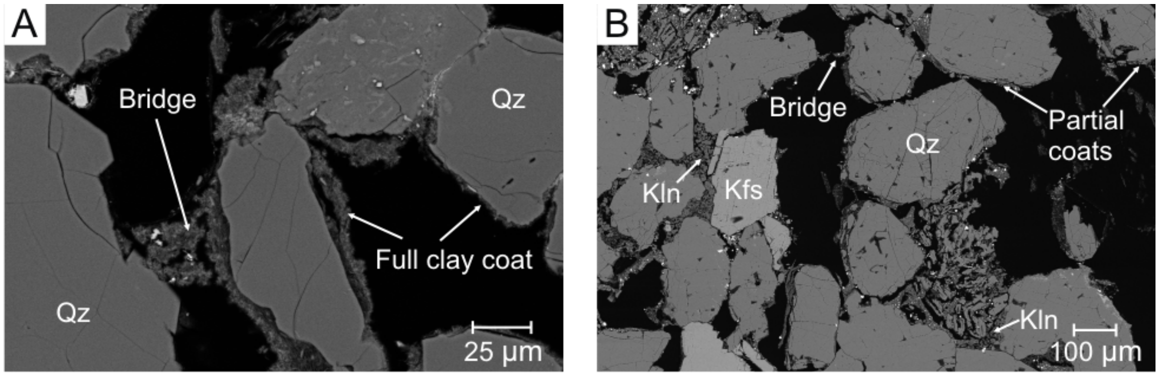

Figure 4.4.2: Representative BSE images of clay coats displayed in the studied samples.
A: Sample E-48 2244.39. This sample consists of mostly full-partial clay coats with rare bridges and clay clumps.
B: Sample E-48 2246.46. This sample consists of abundant partial and full clay coats as well as bridges. Bright minerals in clay coats is probably barite, suggesting that the clay coats are from drilling mud.

Detrital clay coats develop at or near the surface of the sediments, usually in estuary–tidal flat environments. Diagenetic clay coats occur from temperature dependent recrystallization of detrital clays with increasing burial, or they grow in situ with authigenic alteration of detrital or early diagenetic minerals interacting with early pore fluids (Wooldridge et al. 2017a). If these authigenic clays formed in a reducing, sub-tropical environment are rich in Fe, and they will be odinite (Hillier, 1995; Pe-Piper and Weir-Murphy, 2008). Odinite will alter to berthierine during shallow burial, and eventually to chamosite with increasing burial if temperatures are greater than 90 ˚C (Hillier, 1995; Pe-Piper and Weir-Murphy, 2008). In the Sable subbasin, chamosite rims are common in the Logan Canyon Formation and occur in thick-bedded sandstones that underlie transgressive surfaces (Pe-Piper and Weir-Murphy, 2008).

Bioturbation is another way to develop clay coats at or near the surface of the sediments, although, more work needs to be done to determine if it has a large enough effect in these environments (Wooldridge et al. 2017a). Bioturbation can have the ability to increase the presence of clay coats through the process of sediment mixing (Fig. 5.2.1D).

Another way to explain the presence of clay coats in intertidal systems is through the presence of biofilms. At the surface, microorganisms can excrete an adhesive substance that can partially or fully coat sand grains (Wooldridge et al. 2017b). This adhesive substance on sand grains can act as a binding agent which can cause clay minerals to stick to the sand grain. The presence of biofilms and early clay coats can act as a precursor to clay coats seen in deeply buried sandstones (Wooldridge et al. 2017b).

4.5 Coated Grains

Coated grains appear throughout some of the studied samples (E-48 2244.39, 3H-58 1613.63 and 2001.33, and 5H-58 1577.78 and 1906.89) (Figs. 4.5.1,2). Coated grains with rims of berthierine (now chlorite or Fe-chlorite), indicate that it probably formed from odinite. During burial, odinite alters into berthierine in the iron reduction zone (Pe-Piper and Weir-Murphy, 2008). With continued burial, pore-water sulfate is expelled, and siderite will precipitate on these coated grains. This can be due to the presence of organic matter, which increases pore-water alkalinity (Pe-Piper and Weir-Murphy, 2008). The two main types of coated grains in the studied samples are:

1. those with an Fe-chlorite / chlorite coat (Figs. 4.5.1A,E, 4.5.2B,C)

2. those with a siderite coat (Figs. 4.5.1C,D,F, 4.5.2A,D)

3. those with a glaucony coat (Fig. 4.5.1B)

The Fe-chlorite / chlorite coated grains commonly have a nucleus of chlorite or monazite. Their core may also be partially dissolved. The siderite coated grains commonly contain a nucleus of calcite, which may be partially dissolved. The size of the coated grains ranges from ~30 μm to ~100 μm.

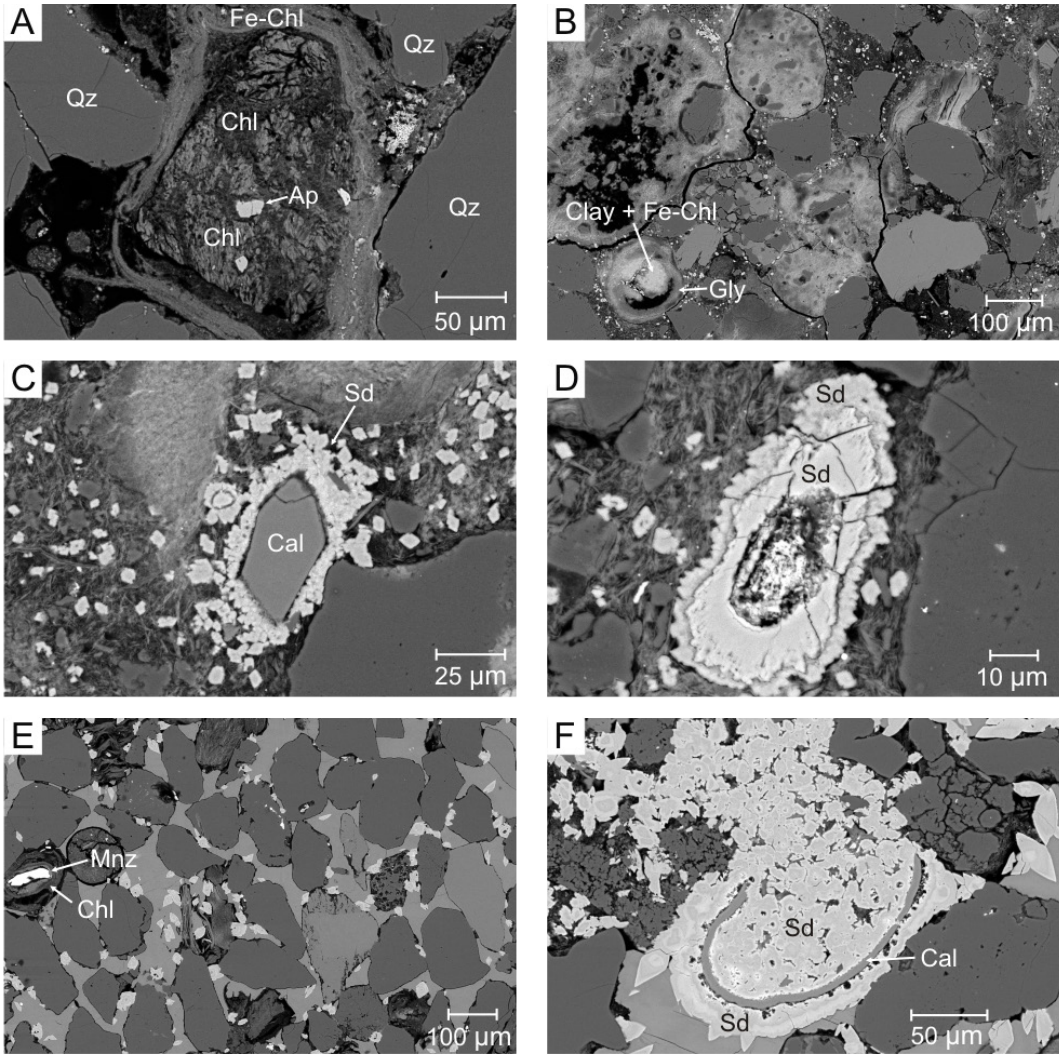

Figure 4.5.1: Representative BSE images of coated grains from the studied samples.
A: Sample E-48 2244.39 App. 1-1 site 15.1: Deformed coated grain that consists of chlorite that is being cut by chlorite. There is also a small grain of apatite. The outer coat is made up of Fe-chlorite.
B: Sample 3H-58 1613.63 App. 1-4 site 3: This coated grain has a core that consists of clay + Fe-chlorite that is coated by glaucony.
C: Sample 3H-58 1613.63 App. 1-4 site 19.2: Siderite fully coats a calcite grain.
D: Sample 3H-58 1613.63 App. 1-4 site 22.2: This coated grain consists of multiple generations of siderite. The inner core is partially dissolved.
E: Sample 3H-58 2001.33 App. 1-6 site 17: Monazite grain is coated by chlorite.
F: Sample 3H-58 2001.33 App. 1-6 site 18.1: Coated grain consisting of siderite → calcite → siderite, then pore filling calcite → further cementation by siderite

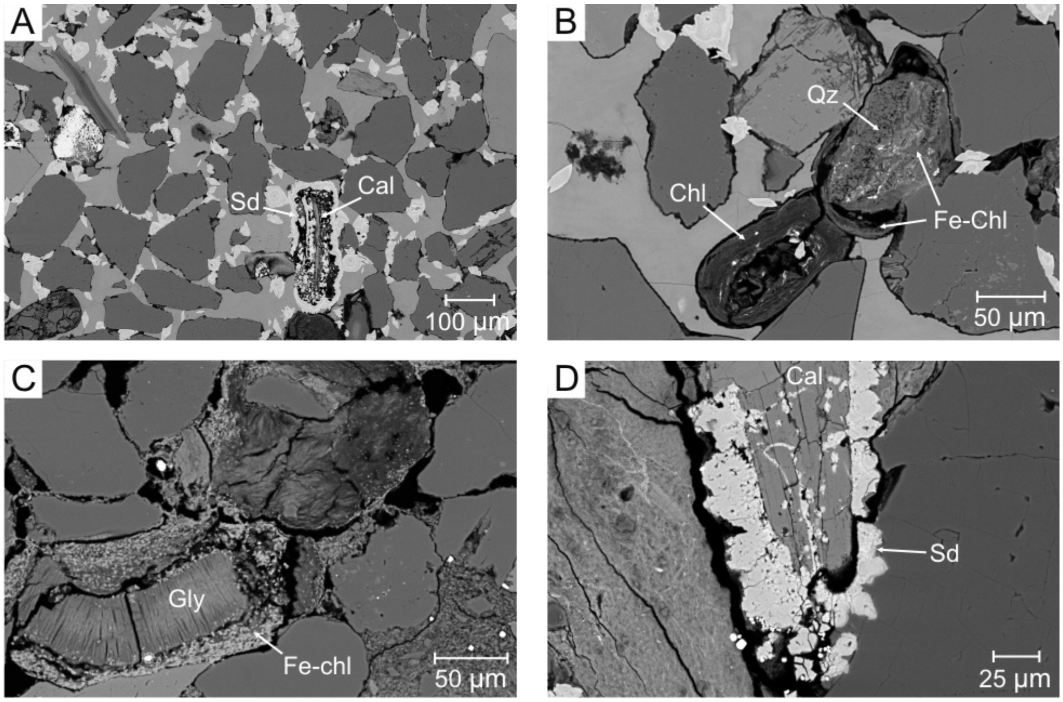

Figure 4.5.2: Representative BSE images of coated grains from the studied samples.
A: Sample 3H-58 2001.33 App. 1-6 site 24: A calcite grain (which may have replaced a previous mineral) is coated by siderite.
B: Sample 3H-58 2001.33 App. 1-6 site 25.1: There is two coated grains in this site. The first on consists of a dissolved core with a chlorite coat. The second one consists of a dissolved quartz grain that allowed for Fe-chlorite to fill the voids. This was then coated with Fe-chlorite.
C: Sample 5H-58 1577.78 App. 1-7 site 16.1: Glaucony is coated by a fine-grained Fe-chlorite.
D: Sample 5H-58 1906.89 App. 1-9 site 5.1: Siderite partially coats a large calcite grain.

4.6 Provenance Classifications

4.6.1 Sandstone Classification

The results from BSE image point counting have been plotted on the QFL diagrams of Folk (1968). The diagram is a ternary diagram with (Q_t) total quartz (monocrystalline and polycrystalline), (F) feldspars, and (L) lithic clasts (sedimentary, metamorphic, and igneous), as apices. This allows for various types of sandstones to be classified.

All studied samples plot in the subarkose field (Figs. 4.6.1, 4.6.2). However, samples from the Marmora Member appear to differ significantly within the subarkose field (Sable Island wells 2H-58 and 3H-58). This could be due to different types of sediment supply to each well. There is not a significant correlation between depth and increasing feldspar supply. Only the 3H-58 well (Marmora Member) shows an increasing feldspar trend with depth.

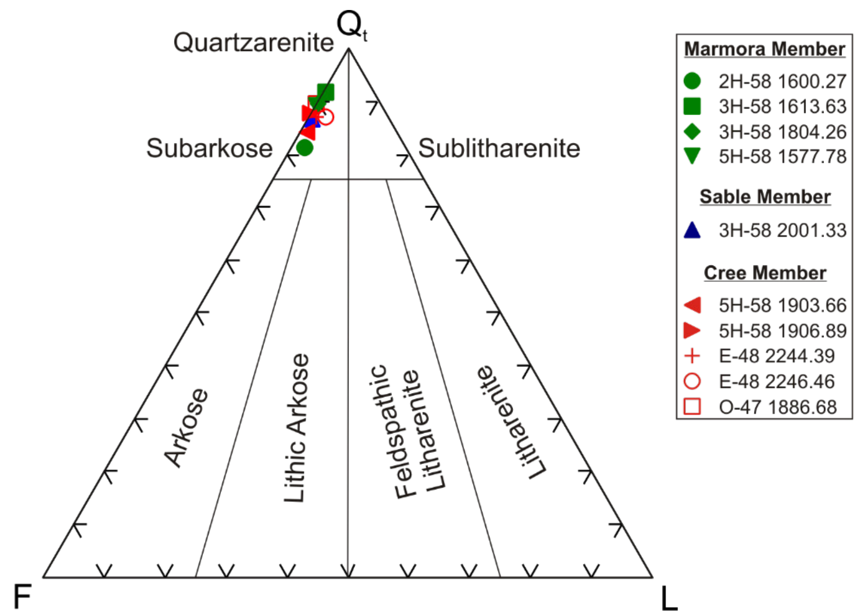

Figure 4.6.1: QFL plot using counted grains from BSE images for sandstones. Fields and nomenclature are from Folk (1968). (Q_t = monocrystalline + polycrystalline)

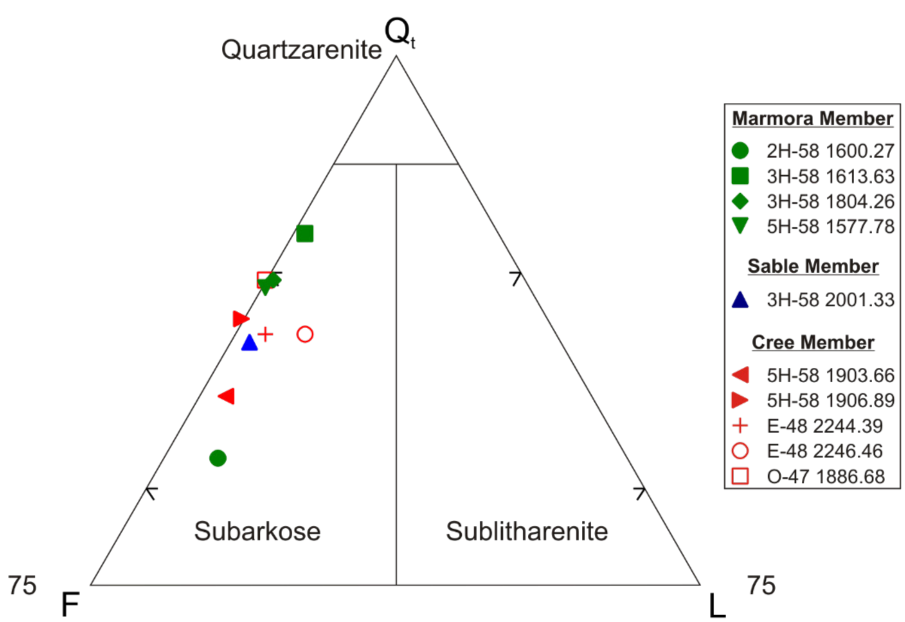

Figure 4.6.2: QFL plot using counted grains from BSE images for sandstones, with above 75 % quartz. Fields and nomenclature are from Folk (1968).

4.6.2 Paleotectonic Environment

The paleotectonic environment in which the sediment has been sourced from can be determined using diagrams from Dickenson et al. (1983). The Q_mFL_t diagram is a ternary diagram that uses (Q) monocrystalline quartz, (F) feldspars, and (L) lithic clasts + polycrystalline quartz, to determine provenance sources. The sources are: continental block (dark grey), magmatic arc (white), and recycled orogen (light grey).

All studied samples plot in the continental block provenance field (Fig. 4.6.3). They appear to be from the cratonic interior. There is some variation in the relative amount of Q_{mon}, F, and L. With increasing depth and feldspar content, the Marmora Member plots towards the bottom of the craton interior field, whereas the higher stratigraphic samples plot towards the top of the craton interior field.

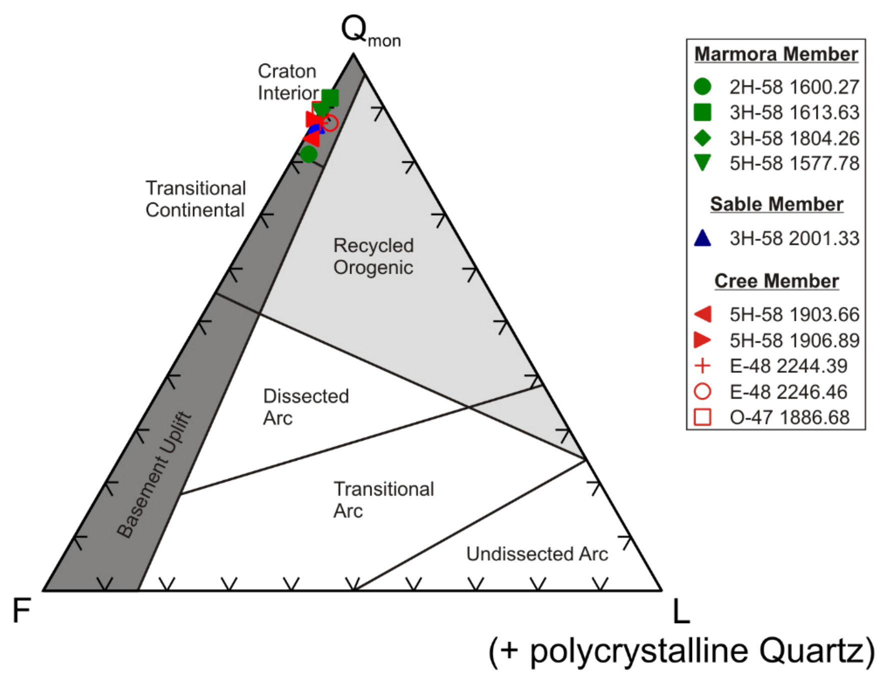

Figure 4.6.3: QFL plot for framework grains. Paleotectonic fields are from Dickinson et al. (1983). Q_{mon} = monocrystalline quartz, F = feldspars, L = lithic clasts + polycrystalline quartz.

4.6.3 Mudstone Geochemistry

Seven mudstone samples were collected for geochemistry and contain 50-60 wt. % SiO_2 (App. 2). Mudstone geochemistry is very useful for uncovering a source area. The Cree Member mudstones are from Sable Island 5H-58 and O-47 wells. They contain the highest amount of Ce, Ta, Zr, and $Ti/Al_2O_3*(10^{-4})$, when compared to Sable Member mudstones and the Wyandot Formation mudstones. These mudstones appear to have a source of from either Newfoundland or the Sable River (Fig. 4.6.4).

The Sable Member mudstones are exclusively from the Sable Island 3H-58 well. They contain a lower amount of Ce, Ta, Zr, $Ti/Al_2O_3*(10^{-4})$, when compared to Cree Member and Wyandot Formation mudstones. These mudstones appear to have a varying source from a Meguma source (Fig. 4.6.4C) to a Sable River source (Figs. 4.6.4A,B).

The Wyandot Formation (Primrose 1A-A41) was also analyzed in this study. It plots in the Meguma source (Fig. 4.6.4C) but it does not plot close to the other defined fields. It contains the lowest amounts of Ta, Zr, $Ti/Al_2O_3*(10^{-4})$, when compared to Cree and Sable Member mudstones.

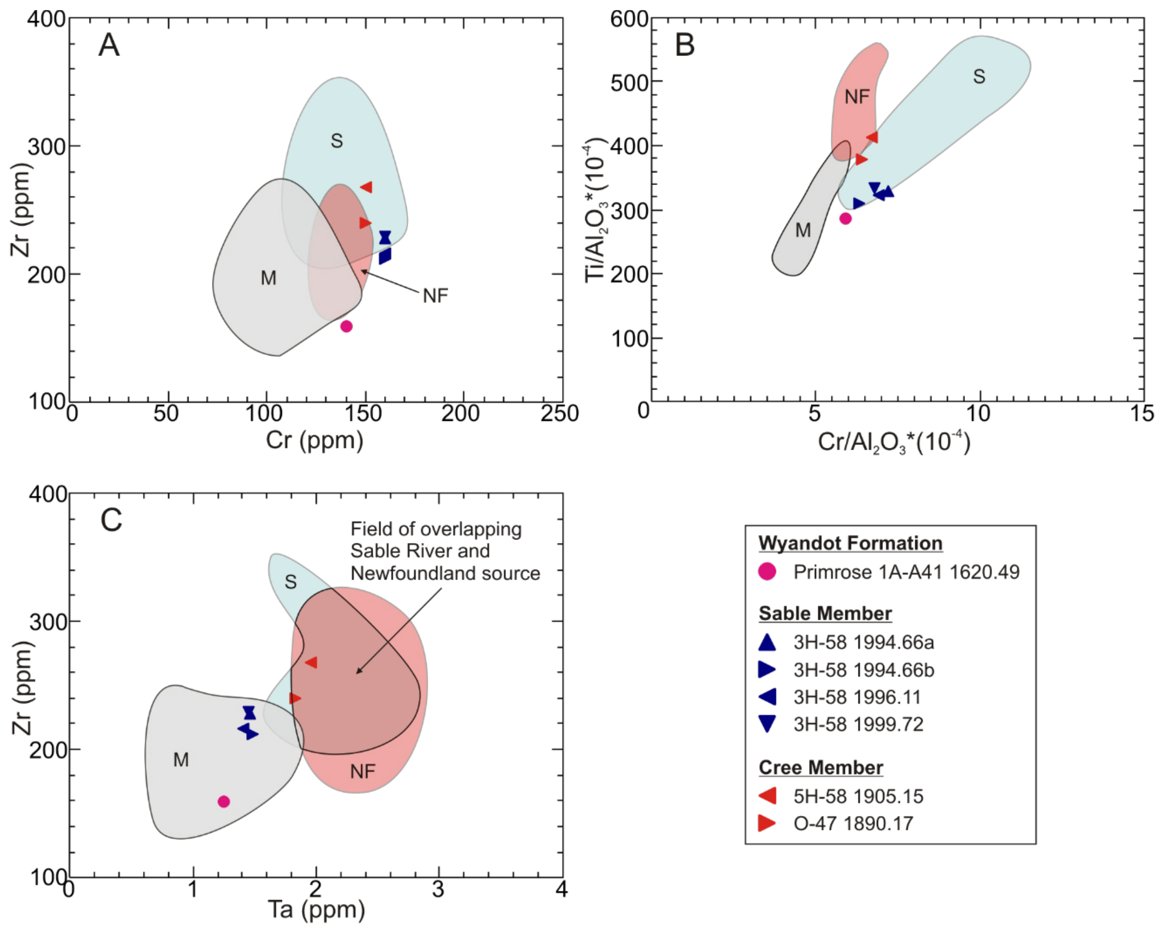

Figure 4.6.4: Variation in mudstone geochemistry from studied samples. The plots show un-normalized element variation. A) Zr vs Cr; B) Ti/Al_2O_3*(10^{-4}) vs Cr/Al_2O_3*(10^{-4}); and C) Zr vs Ta. The Meguma source field (M) is shown in grey, the Newfoundland source field (NF) is in red, and the Sable River source field (S) is in blue.

4.6.4 Geochemical Fingerprinting

Geochemical fingerprinting is a useful tool which allows provenance to be determined. It works best with heavy minerals because they are relatively stable throughout burial, and their chemical composition can point to a distinct source. The chemical analyses for muscovite, biotite, spinel/chromite, and garnet have been plotted in order to determine potential provenance.

4.6.4.1 Muscovite

Muscovite is a common phyllosilicate mineral that is seen throughout the studied samples. Since it is seen in all samples, it will be very useful in determining provenance. However, muscovite is commonly altered to chlorite, hydromuscovite, and sometimes kaolinite (in this study muscovite is commonly seen as chloritized grains). Muscovite grains with more than 4 wt. % combined contaminants (TiO_2, FeO, MgO, Na_2O, Cl, and Cr_2O_5) were not plotted. This was to ensure that only the freshest grains were plotted. Muscovite analyses were recalculated to atoms per formula unit (a.p.f.u) using Si = 8, and plotted on a binary diagram (total aluminium vs potassium) with fields from Reynolds et al. (2010) (Fig. 4.6.5).

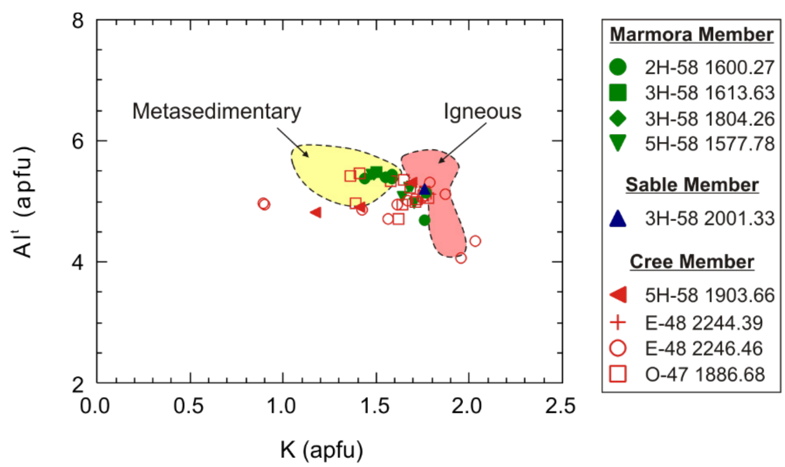

Figure 4.6.5: Al^t apfu vs K apfu variation in muscovite. Fields for igneous and metasedimentary rocks are from Reynolds et al. (2010).

Most muscovite analyses appear to plot close to the igneous source field. However, some analyses plot in the metasedimentary field, and quite a few analyses plot outside of the established fields. Muscovite for Sable Member samples plots in the igneous field, from Cree Member samples in both fields as well as outside of them, and for Marmora Member samples in the metasedimentary field, with some analyses plotting near the igneous field, and one plotting inside the igneous field. In the Cree Member, only muscovite for Sable Island O-47 well samples plots inside the metasedimentary field. For the Sable Island 3H-58 well, its lower Marmora Member was sourced by igneous muscovites, and the upper part by metasedimentary muscovites.

4.6.4.2 Biotite

Biotite is another common phyllosilicate mineral that alters very easily in a weathering environment (biotite is commonly seen as chloritized grains). Biotite geochemistry was used to determine the type of source rock. Only analyses with less than 2wt. % contaminants (CaO, Na_2O) were plotted. Analyses were recalculated as a.p.f.u. using Si = 8.

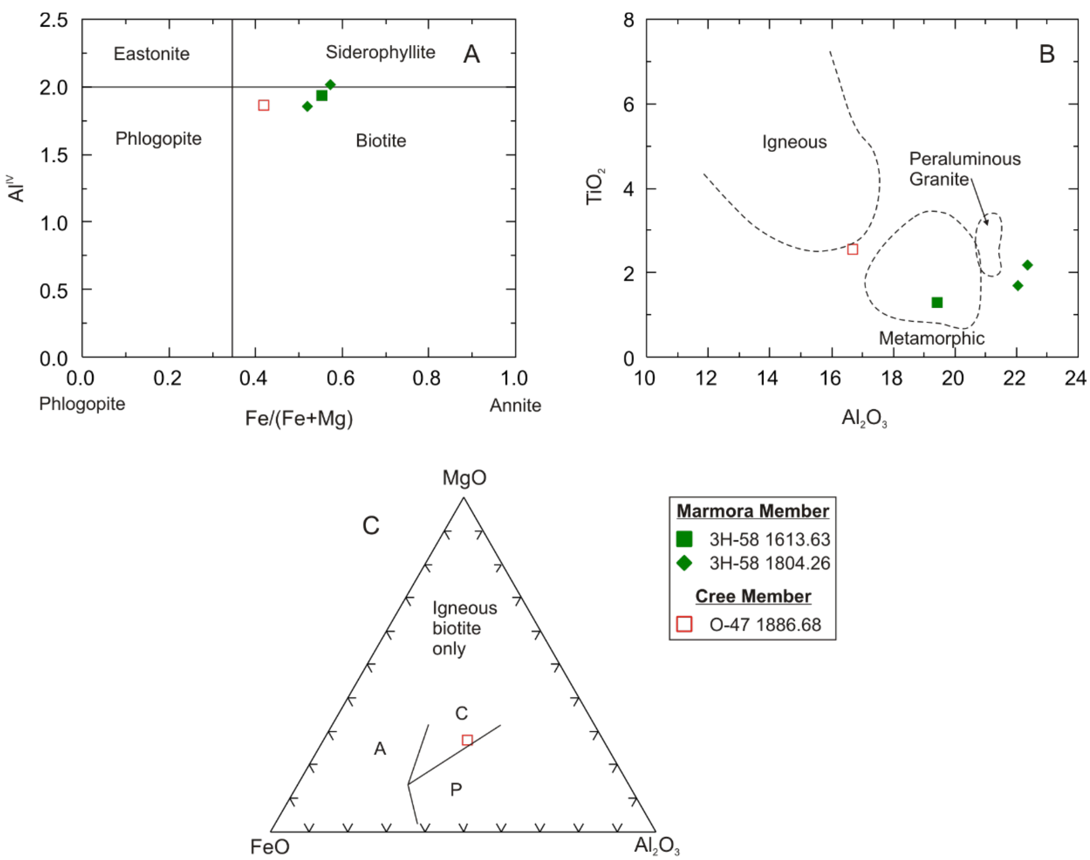

Figure 4.6.6: Chemical variations in biotite. Nomenclature and discrimination fields are from A) Deer et al. (1992); B) Fleet (2003); and C) Abdel Rahmen, (1994) A = alkali, C = calcalkali, P = peraluminous.

The few biotite analyses in Figure 4.6.6A plot generally in the biotite nomenclature field. In Figure 4.6.6B, biotite from the Marmora Member plots in the metamorphic field for the Sable Island 3H-58 well, and outside the established fields for Sable Island O-47 well. For Cree Member biotite, it plots in the igneous field. In Figure 4.6.6C the igneous biotite from the Cree Member in well O-47 is calcalkaline.

4.6.4.3 Spinel/chromite

Spinel/chromite is a stable detrital mineral that is able to persist through burial. However, due to its stability, it can be polycyclic. Spinel/chromite analyses were classified on a diagram with Cr# ((Cr/(Cr+Al))*100) vs Mg# ((Mg/(Fe+Mg))*100) (Fig. 4.6.7). The nomenclature fields are after Tsikouras et al. (2011), and the blue field indicates electron microprobe analyses of spinel/chromite from Alma, Glenelg, and North Triumph wells from the Scotian Basin.

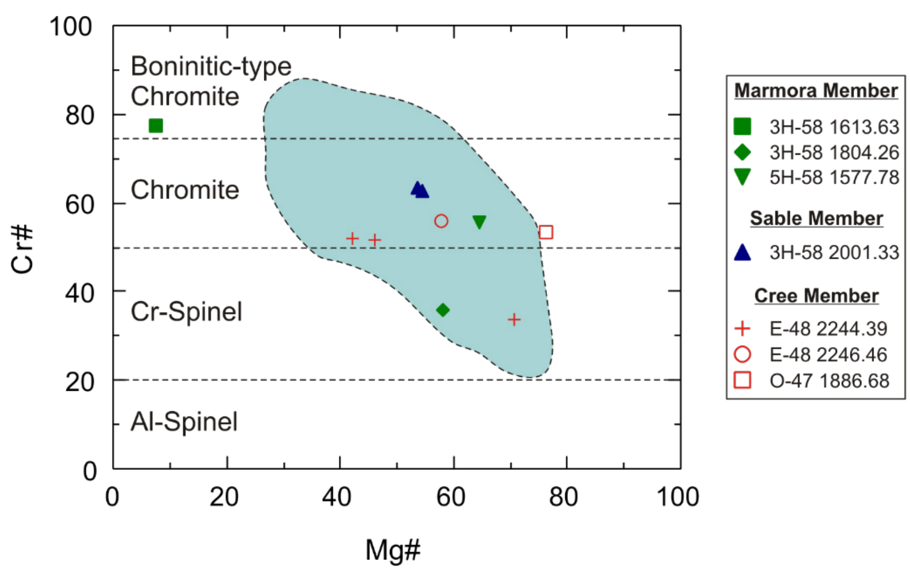

Figure 4.6.7: Chemical variation in chromite/spinel analyses from the studied samples with fields from Tsikouras et al. (2011). The blue field is that for spinel analyses from Alma, Glenelg, and North Triumph (Pe-Piper et al. 2009).

Most spinel/chromite analyses plot in the chromite field and two of them plot in the Cr-spinel field. Only two of the analyses plot outside the defined field by Pe-Piper et al. (2009). Since most analyses plot within this field, it signifies that most of the studied wells share a similar source of spinel/chromite as Alma, Glenelg, and North Triumph. Marmora Member spinel/chromite plots in the Cr-spinel field for Sable Island well 3H-58, the chromite field for Sable Island well 5H-58, and the boninitic-type chromite field for the upper part of the Sable Island 3H-58 well. Sable Member spinel/chromite plots in the chromite field. Cree Member spinel/chromite plots in the chromite field for Sable Island wells E-48 and O-47. Only one spinel/chromite analysis from Cree Member Sable Island E-48 plots in the Cr-spinel field.

Out of all the spinel/chromite analyses, only three contain measurable TiO_2, and were plotted on Cr/(Cr+Al) vs TiO_2 bi-plot, with source fields after Pearce et al. (2000) (Fig. 4.6.8). Marmora Member as well as Cree Member (Sable Island E-48) were sourced from island-arc tholeiite. Cree Member Sable Island O-47 well sourced its chromite from MORB. The source of these spinel/chromite grains appears to be from the Newfoundland Appalachians (Pe-Piper et al., 2009)

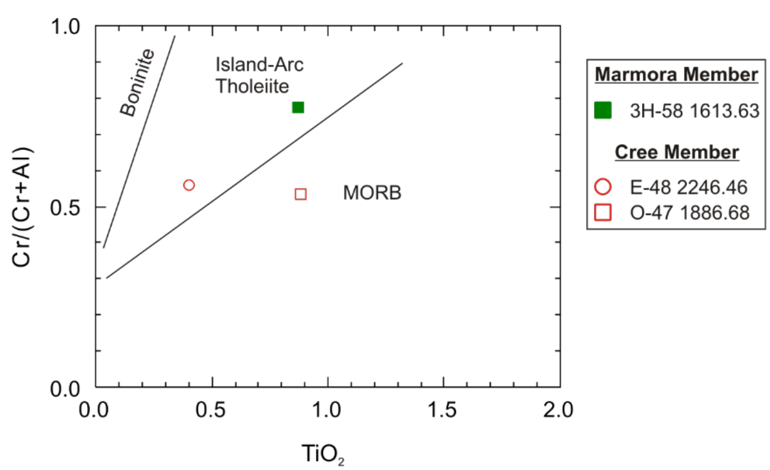

Figure 4.6.8: Discrimination diagram for chromite spinel analyses. Fields from Pearce et al. (2000).

4.6.4.4 Garnet

Garnet was found only in the Cree Member (Sable Island wells E-48 and O-47). It was then plotted on two ternary diagrams (one for pyrope < 10%, and other for spessartine < 10%) (Fig. 4.6.9). Potential provenance sources are after Deer et al. (1982) and Pe-Piper et al. (2009), as modified by Dutuc et al. (2017).

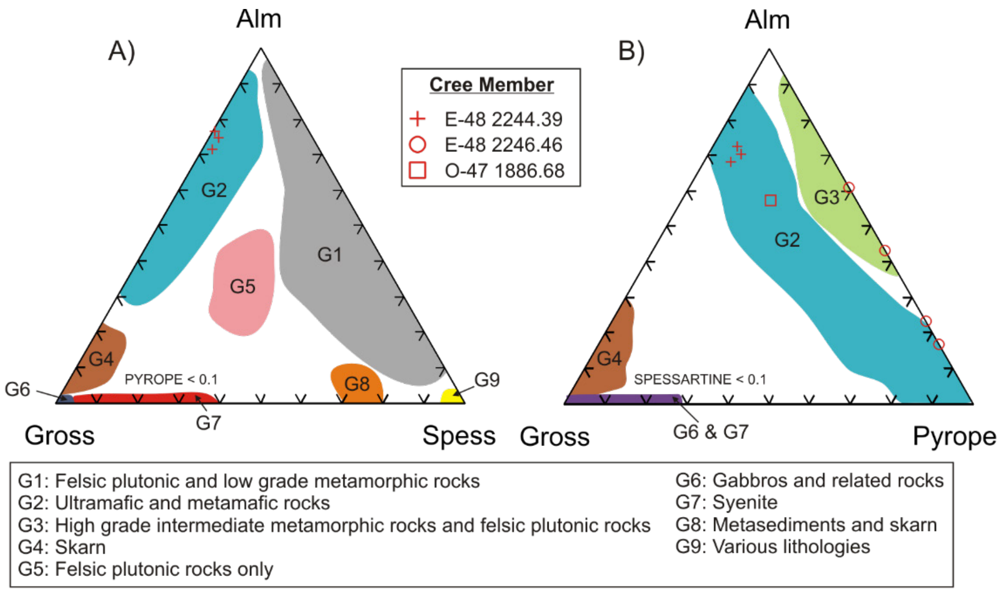

Figure 4.6.9: Chemical variation in garnet projected onto A: Almandine - Grossular - Spessartine plane, for garnets with < 10% Pyrope. and B: Almandine - Grossular - Pyrope plane, for garnets with < 10% Spessartine. Potential provenance sources from Deer et al. (1982) and Pe-Piper et al. (2009). Fields modified by Dutuc et al. (2017) with nine provenance types

The garnet analyses from Sable Island E-48 well plot in the G2 field. Two of the analyses from Sable Island O-47 well plot in the G2 field, with the other two analyses plotting in the G3 field. This indicates that garnets were mainly supplied to these wells from ultramafic and metamafic rocks, with the Sable Island O-47 well also being supplied from high grade intermediate metamorphic rocks and felsic plutonic rocks during the deposition of the Cree Member.

Chapter 5: Discussion

5.1 The Glaucony – Glauconite Problem

5.1.1 Introduction to Green Marine Clays

Green marine clays in marine environments belong to the Green Clay Facies, in which redox levels are close to the oxic – anoxic boundary (Eder et al. 2007). The Green Clay facies consists of the Verdine and Glaucony facies (Fig. 5.1.1). The Verdine facies occurs in relatively shallow marine waters that are close to terrigenous-clastic costal areas, and shallow marine depositional systems (Eder et al. 2007) (Fig. 5.1.2). These depositional systems can range from deltas, estuaries, and shallow siliclastic seas. However, Verdine facies has also been found in open marine environments. The Verdine facies appears to be confined to tropical regions. Hillier (1995) suggested that this is due to the supply of Fe by river input, which is released by intense tropical weathering conditions. This gives the shallow marine environment high loads of dissolved and colloidal forms of Fe. On the other hand, the Glaucony facies usually occurs in open marine environments, where sedimentation rates are low and there is stratigraphic condensation (Fig. 5.1.2). Glaucony is often associated with phosphatic sediments. Both facies evolve from Fe-rich clay mineral precursors that mature into authigenic minerals (Eder et al. 2007).

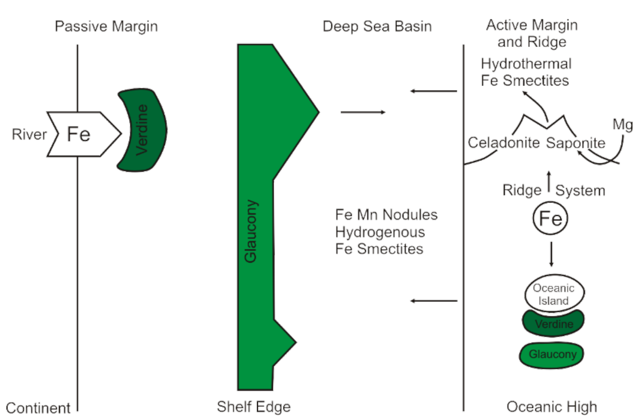

Figure 5.1.1: Distribution of the Glaucony and Verdine facies relative to each other. Fe is supplied via two main sources: rivers, and hydrothermal events (After Hillier, 1995).

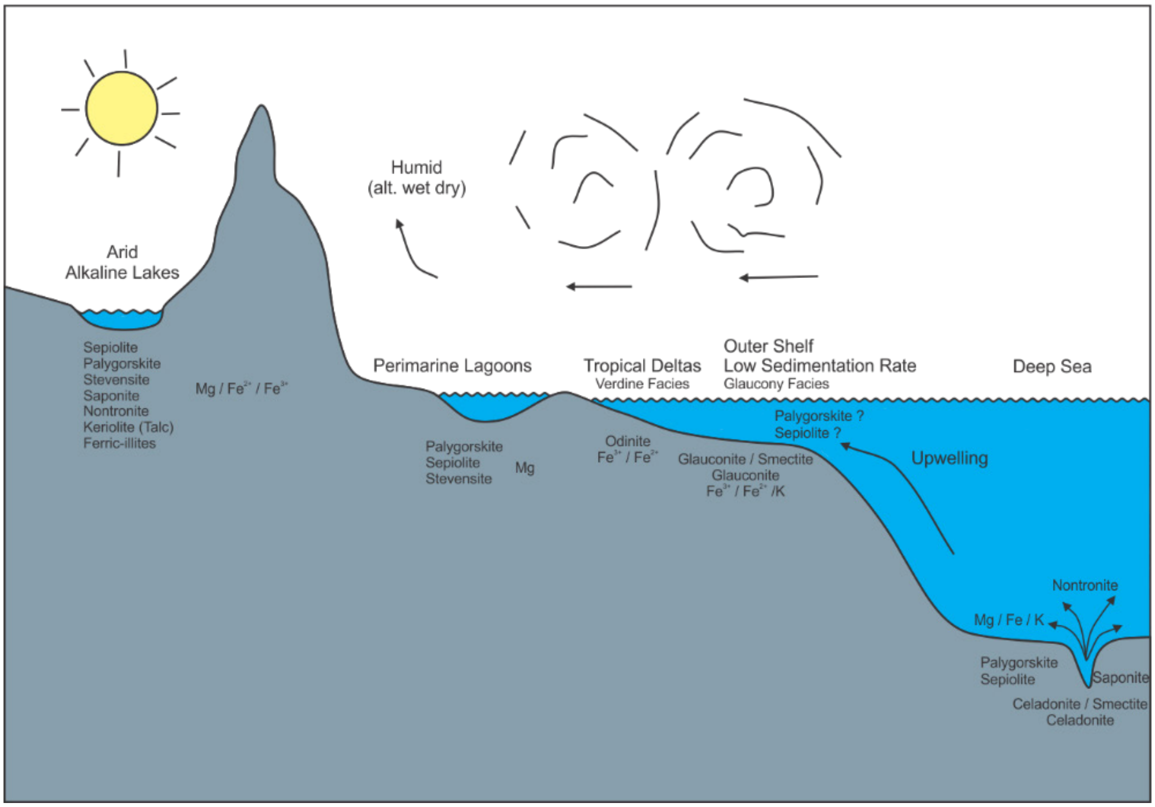

Figure 5.1.2: Cartoon of different environments in which authigenic clay minerals form (Modified from Hillier, 1995).

Glauconite typically forms on condensed sections of the outer shelf near the seawater-sediment interface (Hillier, 1995). It is the most mature version of glaucony, and it is usually a light–dark green in colour, and ranges from silt to sand size. Glauconite forms in low sedimentation rate environments because, once buried, the grain is no longer able to exchange ions and the maturation process stops.

Glaucony is a mixture of clay minerals and is K-poor, made up of Fe-rich smectite and glauconite mica. Typically, glaucony forms from fecal pellets, however other substrates are possible such as carbonate tests, rock fragments, and matrix minerals. Glaucony may even coat grains (Hillier, 1995).

5.1.2 The Formation of Glaucony and Glauconite

Glauconitization refers to the formation of a glauconitic precursor. Fe-rich smectite forms from the weathering of a poorly drained peneplain, under subtropic – temperate climates (Eder et al. 2007). This influx of terrigenous clays into the basin provides a substrate for glauconitization, along with fecal pellets, rock fragments, detrital minerals, and carbonate tests. Maturation to glauconite starts from a K-poor, Fe-rich smectite → mixed layered glaucony (layered potassium and iron-rich dioctahedral minerals with high Fe^{3+}/Fe^{2+} ratio) → progressive incorporation of K and Fe and change of mineralogical structure → glauconite mica (end member). This change is monitored by a change in colour from light to dark green, which is related to a decrease in Si, Al, Mg, Ca, and Na, and an increase in K and Fe (Eder et al. 2007). The process occurs on the seafloor, in which seawater supplies the grain with K^+ ions. If the grain becomes buried, the maturation process stops, at whatever stage it has reached, because the supply of K^+ ions is cut off. Potassium enrichment occurs after Fe enrichment of the initial Fe-rich smectite grain. The amount of iron does not appear to increase through evolution into end-member glauconite (Hillier, 1995). The process of glauconitization is also favoured by a semi-confined microenvironment, because it allows the seawater to be partially isolated from the grain due to its microporous substrate (Hillier, 1995). This causes glauconitization to favour silt–sand sized grains because smaller grains do not support this type of microenvironment. This is one reason why the core of the grain is usually glauconitized before the margin of the grain.

The mechanism of glauconitization is often divided into four stages, described initially by Odin and Matter (1981) and again in 1988 by Odin and Fullagar (Fig. 5.1.3).

The first stage is referred to as the nascent stage, and begins at the sediment-water interface. The substrate at this stage should be highly porous, with alteration occurring quickly as crystal growth fills porosity. Development of Fe-rich clay minerals give the grain a green colour. Potassium content at this stage ranges from 2-4 wt. % K_2O. As glauconitization proceeds, the minerals of the substrate become increasingly destroyed (Odin and Fullagar, 1998).

As time passes, more of the original minerals in the substrate are destroyed. Thus, additional porosity is created. This allows even more clay minerals to form within these newly created voids. The grain at this stage is referred to as slightly evolved. Potassium content ranges from 4-6 wt. % K_2O, and the grain consists mostly of glaucony. Odin and Fullagar (1988) indicated that grains at this stage can show globular, blade-like, and caterpillar-like habits.

As more time passes, evolution of the grain continues, if environmental conditions are correct. The interiors of the grain are replaced first because they have a more organized structure. This causes cracking on the margin of the grain. According to Odin and Fullager (1988), earlier studies attributed this cracking to dehydration with volume reduction, however, this is not correct. Grains at this stage are referred to as evolved, and have a K_2O from 6-8 wt. %.

If the grain is not buried, and is allowed to evolve, it will enter the highly evolved stage. At this stage, K_2O greater than 8 wt. %, and the grain has been completely replaced by end member mica, the glauconite. The cracks that were in the grain from the previous stage have been filled in with a less evolved glaucony, thus creating a more rounded grain.

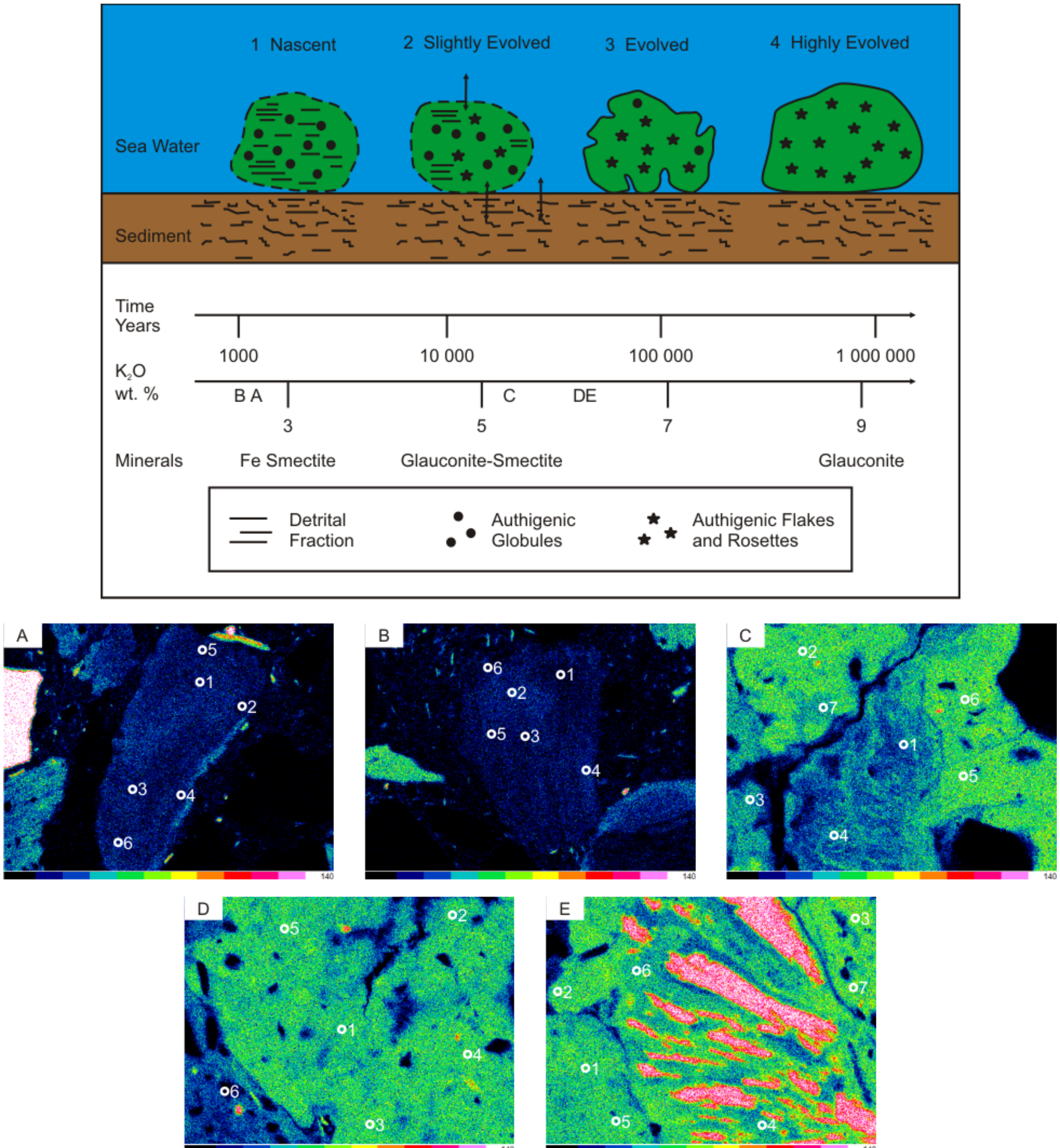

Figure 5.1.3: Cartoon demonstrating the evolution of glaucony (modified from Hillier, 1995), with X-ray maps (A-E) corresponding to average potassium of the grain, indicated on the K_2O wt. % line.

5.1.3 Comparing the Studied Glaucony and Glauconite to the Literature

Four different types of glaucony were classified by Eder et al. (2007). Their samples were studied optically and by SEM, electron probe microanalysis (EMPA), and by X-ray diffraction (XRD). Their four types of glaucony are described below:

Type 1: consists of light green glaucony grains. It has K_2O content below 6.5 wt. %, and is a less mature type of glaucony. It is mostly a mixed layered grain consisting of glauconite–smectite, and formed in the distal marine environments of the basin under dysoxic conditions.

Type 2: consists of dark green glaucony that is evolved to highly evolved. This is the most mature glaucony studied by Eder et al. (2007), and consists of K_2O up to 8.5 wt. %. This type of glaucony is consistent with high bottom areas with a low sedimentation rate.

Type 3: consists of brown glaucony grains that are poorer in K and Fe, but richer in Al and Si, than type 2 glaucony and K_2O = 5.83-6.59 wt. %. This type of glaucony is only present in strongly condensed secessions.

Type 4: This is the most Fe-rich type studied. It shows fresh yellowish–green cores, with brown rims and cracks, with K_2O cores = 7.06-7.69 wt. % and K_2O rims = 5.96-6.69 wt. %. It is slightly less mature than type 2, but is similar to type 3.

Of the samples studied in this project, only five out of the ten samples contain glaucony / glauconite. We do not have XRD data, but we have determined K_2O wt. % and colour to apply the classification scheme of Eder et al. (2007) to our grains, and estimate the amount of glauconitic mica. Analyzed spots with greater than 6 wt. % K_2O are considered to be glauconite (understanding that such grains may still contain a significant amount of smectite). Grains with less than 6 wt. % K_2O are referred to as glaucony, provided that SiO_2, Al_2O_3, and FeO contents are appropriate.

Almost all analyzed grains in the five studied samples appear to be glaucony. Grains identified as glauconite were not classified. In 3H-58 1613.63, the glaucony appears to be a light green-yellow colour, however, most grains appear to be a shade of brown (Fig. 5.3.1). The matrix also appears to be made mostly of glaucony. The grains in this sample closely resemble Type 3 glaucony, and contain 0.91-2.92 wt. % K_2O.

In sample 3H-58 1804.26, the grains are a very dark brown when found in the muddier intervals of the sample. Away from the muddy section, the grains are a green-yellow/brown (Fig. 5.3.2). These grains resemble Type 4 and Type 3, and contain 1.98-5.46 wt. % K_2O.

Sample 3H-58 2001.33 consists mostly of inmature glaucony, and contains a rare evolved glaucony grain. The grains are pale light green in colour, and can range to a yellow brown (Fig. 5.3.3). The evolved grain has a deep dark green colour. The grains in this sample resemble Type 1 and Types 3-4, with 0.69-5.77 wt. % K_2O.

In sample 5H-58 1577.78, the glaucony grains contain a brownish coloured rim with a light yellow core (Fig. 5.3.4). This sample resembles Type 4 glaucony grains, and may also contain some Type 3 grains, with 2.37-5.57 wt. % K_2O.

In sample 5H-58 1906.89, the grains are a light green colour (Fig. 5.3.5), resembling Type 1 glaucony. They also display a deeper green colour than the other Type 1 grains studied, which indicates that they are becoming closer to a Type 2 grain, and are thus more evolved. This glaucony grains contain 2.8-6.78 wt. % K_2O.

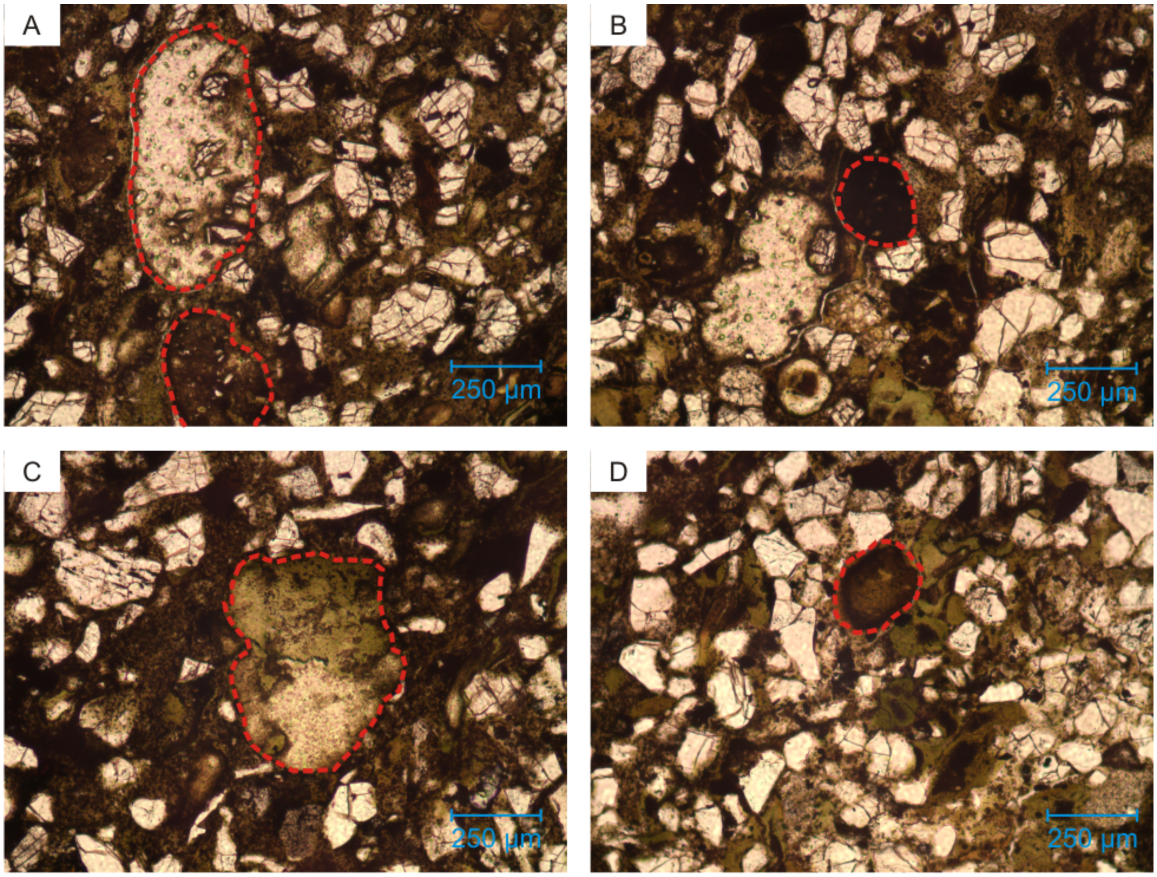

Figure 5.1.4: Representative microphotographs of glaucony/glauconite (outlined in red) from sample 3H-58 1613.63, taken at 10x in PPL.

A: This microphotograph is of site 2 in appendix 1-4. There is a large pale green glaucony grain that is partially dissolved and a dark brown grain, both outlined in red. The substrate for these grains appears to be pellets, however, for the smaller grain, it may also be matrix.

B: This microphotograph is of site 3 in appendix 1-4. It consists of a very dark brown glaucony grain outlined in red. The substrate appears to be a pellet.

C: This microphotograph is of site 12 in appendix 1-4. It consists of a large glaucony grain that is probably replacing a pellet, outlined in red. It contains a light white/yellow patch and the rest of the grain is a yellow-green colour. The substrate appears to be a pellet, but may also be matrix.

D: This microphotograph is of site 27 in appendix 1-4. It consists of small green-yellow glaucony grains, and a zoned brown grain with a light yellow-brown rim outlined in red. The substrate appears to be matrix or a pellet.

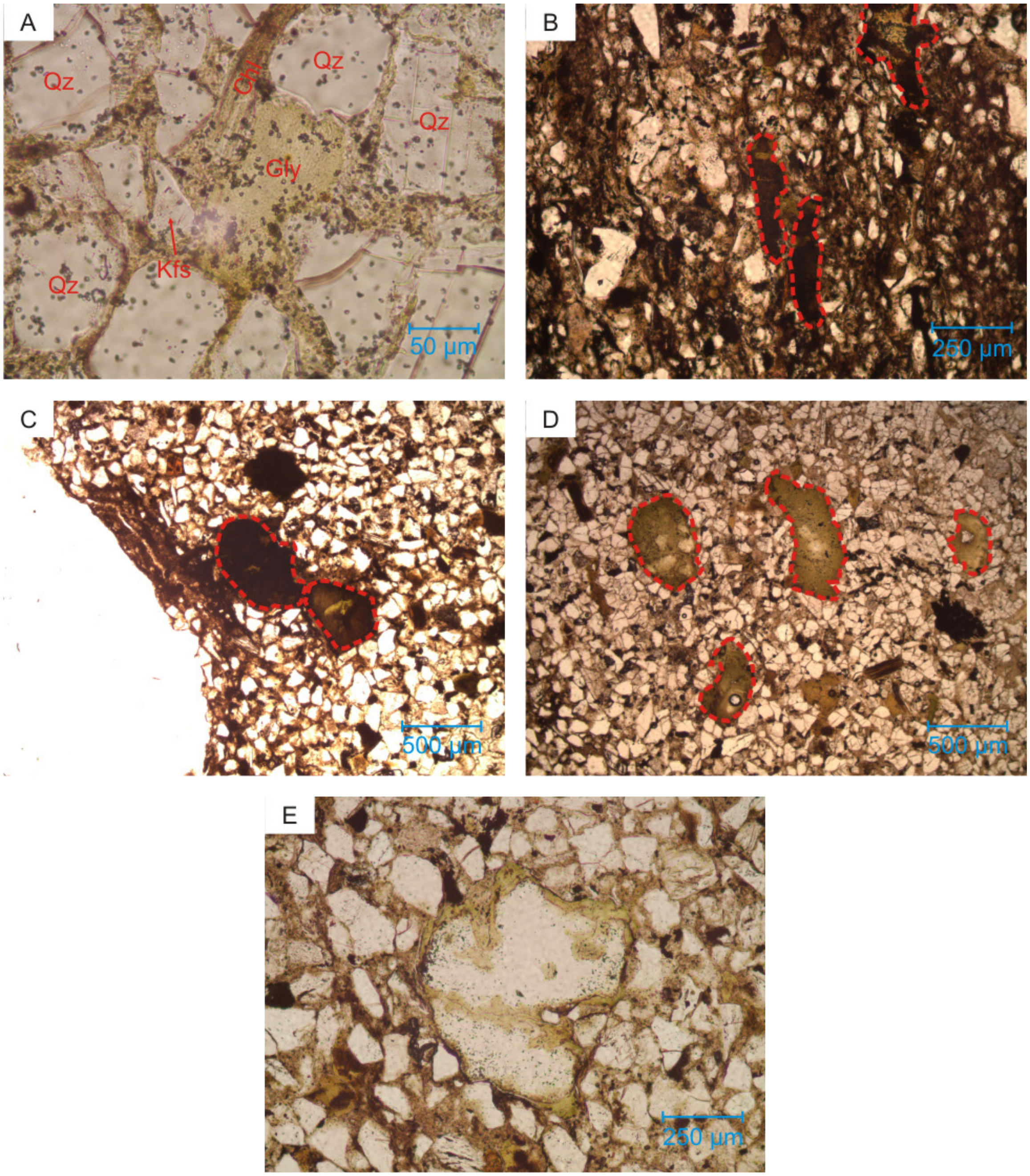

Figure 5.1.5: Representative microphotographs of glaucony/glauconite (Gly, and outlined in red) in sample 3H-58 1804.26

A: This microphotograph is of site 2, appendix 1-5. Light green glaucony appears to replace the matrix. 40x PPL. The substrate appears to be matrix.

B: This microphotograph is of site 7, appendix 1-5. Dark brown glaucony with some yellow-green is outlined in red. 10x PPL. The substrate appears to be matrix.

C: Large dark brown glaucony with light yellow-green cores are outlined in red. 4x PPL. The substrate appears to be pellets.

D: Large green glaucony with a lighter coloured core are outlined in red. 4x PPL. The substrate appears to be pellets or matrix.

E: A large grain is partially replaced by glaucony or chlorite. 10x PPL.

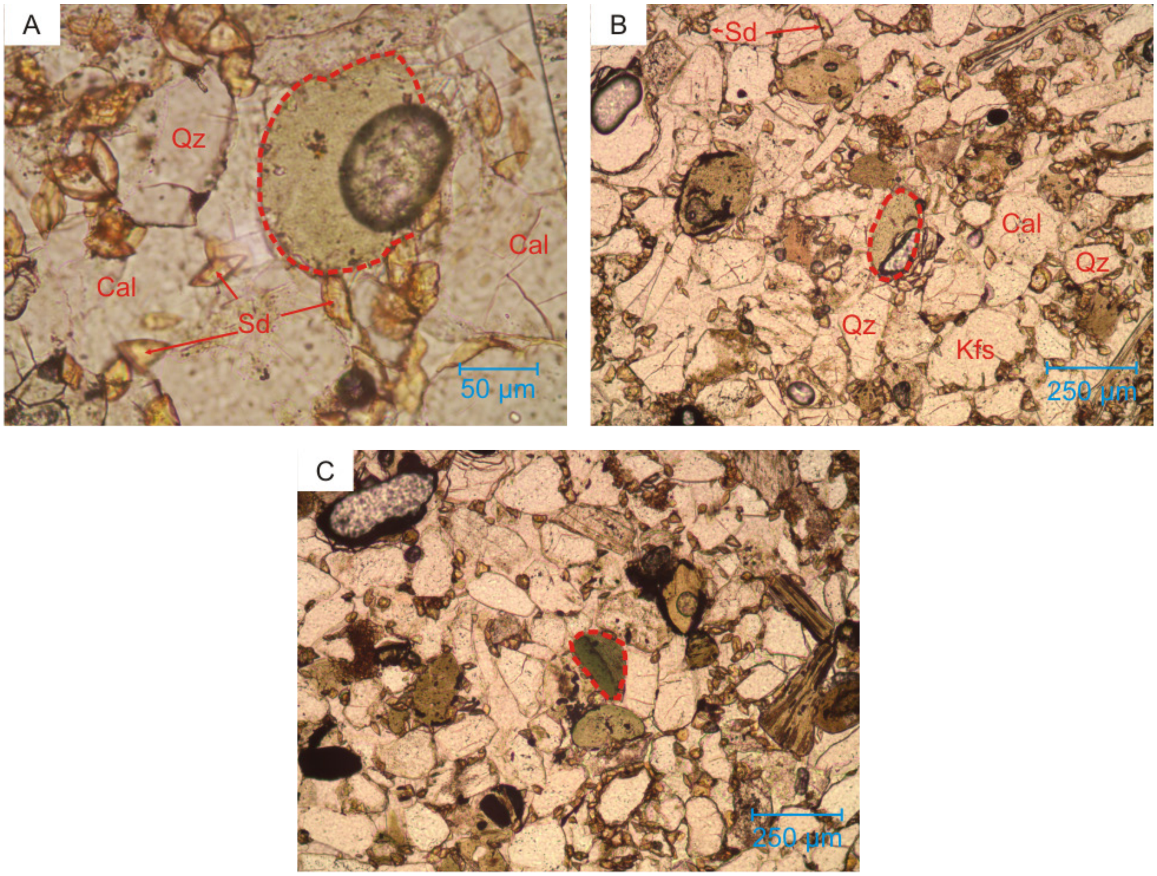

Figure 5.1.6: Representative microphotographs of glaucony/glauconite (outlined in red) from sample 3H-58 2001.33.
A: This microphotograph is of site 4, position 8, appendix 1-6. Light green glaucony, outlined in red. 40x PPL. The substrate appears to be a pellet.
B: This microphotograph is of site 8, appendix 1-6. Light green glaucony is seen (outlined in red). 10x PPL. The substrate appears to be a pellet.
C: This site consists of a dark green evolved glaucony grain, outlined in red. 10x PPL. The substrate appears to be a pellet, but may also be a detrital grain.

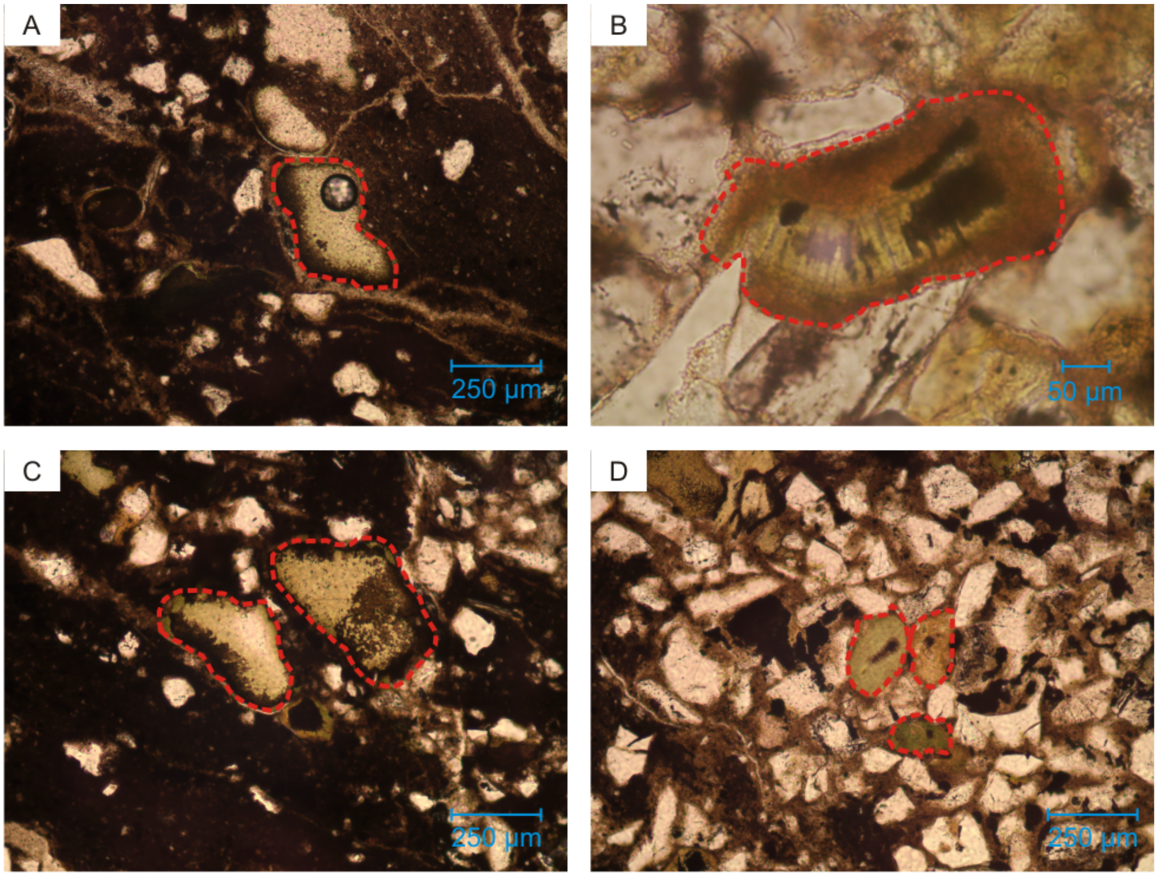

Figure 5.1.7: Representative microphotographs of glaucony/glauconite (outlined in red) from sample 5H-58 1577.78.
A: This microphotograph is of site 15, appendix 1-7. There is a light green-yellow glaucony grain with a brown rim, outlined in red. 10x PPL. The substrate appears to be pellet or matrix.
B: This microphotograph is of site 16, appendix 1-7. A glaucony grain (outlined in red) is coated by a fine-grained Fe-chlorite. 40x PPL. The substrate appears to be a detrital grain.
C: This microphotograph is of site 24, appendix 1-7. Glaucony grains appear to be a light green colour with a brown rim/core (outlined in red).10x PPL. The substrate appears to be pellets or matrix.
D: This site consists of light green, dark green, and a yellow/brown glaucony grains (outlined in red). 10x PPL. The substrate appears to be pellets.

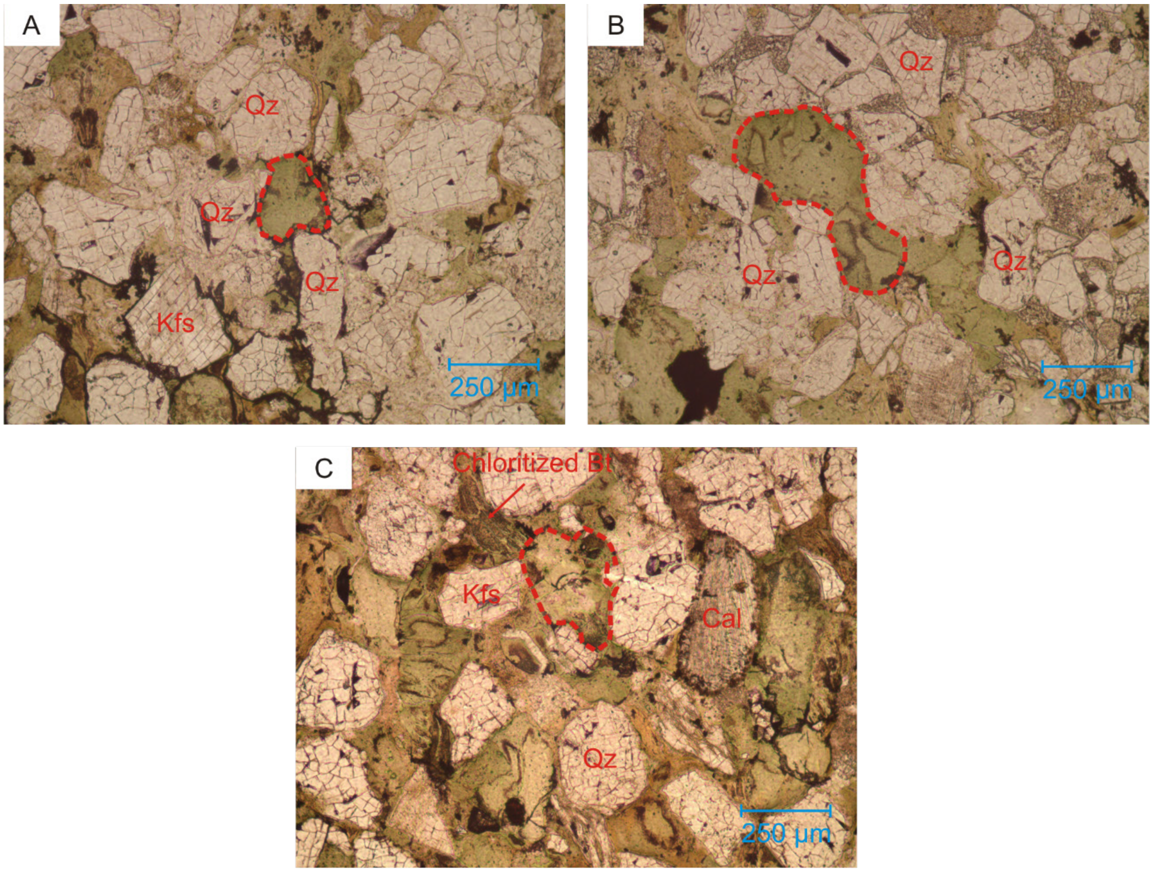

Figure 5.1.8: Representative microphotographs of glaucony/glauconite (outlined in red) from sample 5H-58 1906.89.
A: This microphotograph is of site 6, appendix 1-9. There is a light green-yellow glaucony grain, outlined in red. 10x PPL. The substrate appears to be a pellet or could also be matrix.
B: This microphotograph is of site 18, appendix 1-9. A glaucony grain appears deformed during compaction or is replacing the matrix (outlined in red). 10x PPL. The substrate appears to be matrix.
C: This microphotograph is of site 21, appendix 1-9. Glauconite (outlined in red) appears as a pale light green/yellow, with a partial darker green rim. 10x PPL. The substrate appears to be matrix.

5.1.4 X-ray Maps of Glaucony

X-ray maps were run for specific sites of interest where determination of the substrate for glauconitization was difficult (Fig. 5.1.9). EDS analyses were also taken in order to help identify the stage of glauconitization of the grain (Table 5.1.1). The full results of all X-ray maps and BSE images can be found in Appendix 3. Glaucony in Figure 5.1.9A,B appears to be very immature and probably resembles Type 4. In Figure

5.1.9C,D,E glaucony appears to be very close to evolved, and has a much higher K_2O content of ~6 wt. %.

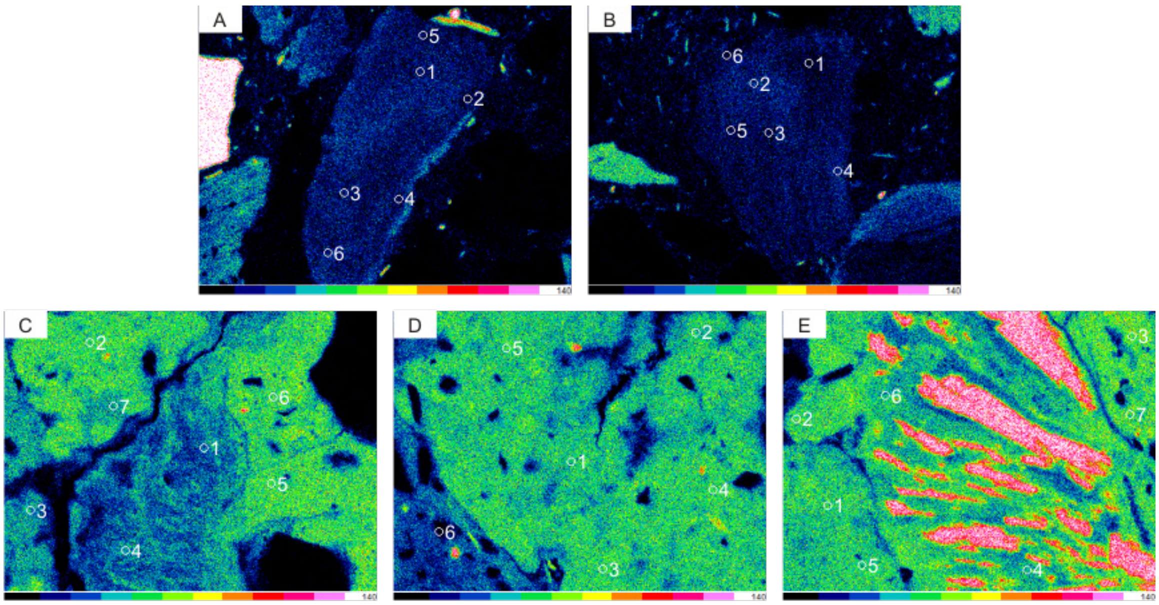

Figure 5.1.9: Potassium peak X-ray maps normalized to 140 X-ray counts.
A: Sample 3H-58 1613.63. Glaucony appears to be replacing a pellet.
B: Sample 3H-58 1613.63. Glaucony appears to be replacing a detrital grain.
C: Sample 5H-58 1906.89 site 4. Glaucony appears to be replacing the matrix.
D: Sample 5H-58 1906.89 site 4. Glaucony appears to be replacing the matrix.
E: Sample 5H-58 1906.89 site 14. Glaucony is replacing a large K-feldspar grain and possible the matrix around it.

Table 5.1.1: EDS Geochemical Analyses of Glaucony used for Fig. 5.1.9

Sample	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	3H-58 1613.63	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89
Site (Fig.)	A	A	A	A	A	A	B	B	B	B	B	B	C	C	C	C
Position	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4
SiO_2	38.21	48.22	38.18	48.99	37.47	39.35	46.81	37.20	40.57	40.55	36.48	34.73	43.53	48.71	48.24	48.26
Al_2O_3	12.53	11.75	12.76	12.58	12.76	12.86	11.05	12.32	12.64	12.08	13.76	10.38	13.27	11.01	14.53	15.52
FeO_t	29.57	21.33	29.79	19.42	30.10	27.33	23.68	30.58	27.30	27.04	29.97	37.31	21.57	17.63	15.69	13.97
MgO	4.79	4.04	4.52	4.34	4.51	4.83	3.95	4.83	4.65	4.65	5.01	3.19	4.18	2.98	2.68	3.04
K_2O	1.90	1.66	1.75	1.66	2.16	2.64	1.51	2.06	1.84	2.67	1.77	1.39	4.46	6.66	5.86	6.20
Total (rec.)	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00
Actual Total	88.52	61.81	83.96	61.68	71.40	85.80	57.72	86.61	72.70	80.91	89.70	63.22	77.32	89.96	82.41	84.20

Sample	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89	5H-58 1906.89
Site	C	C	C	D	D	D	D	D	D	E	E	E	E	E	E	E
Position	5	6	7	1	2	3	4	5	6	1	2	3	4	5	6	7
SiO_2	48.84	48.99	48.40	49.14	49.61	49.55	49.70	49.09	49.21	48.17	48.92	47.49	46.55	49.04	44.97	48.73
Al_2O_3	11.75	11.34	14.37	11.13	12.03	11.86	11.58	11.36	33.92	15.03	10.20	13.25	13.98	14.46	13.54	15.06
FeO_t	16.51	16.66	15.64	17.22	16.36	15.96	16.26	16.88	2.43	14.95	17.74	16.87	17.35	14.46	19.67	14.58
MgO	3.20	3.26	2.93	3.33	3.23	3.18	3.04	3.40	0.77	2.82	3.28	2.97	3.23	3.00	3.26	2.88
K_2O	6.70	6.74	5.66	6.18	5.77	6.46	6.42	6.26	0.68	6.04	6.86	6.42	5.89	6.04	5.55	5.75
Total (Rec.)	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00
Actual Total	93.20	93.24	84.49	86.28	91.71	90.12	90.99	94.05	85.63	89.14	80.12	96.06	89.48	92.18	85.83	100.63

5.2 Provenance

5.2.1 Introduction

Provenance interpretation in the Scotian Basin is an ongoing process that has been constantly updated. The currently proposed paleorivers (Fig. 5.2.1) are:

1. The Banquereau River, sourcing sediments from Newfoundland and transporting them to the Eastern Scotian Basin.

2. The Sable River, sourcing sediments from the Gulf of St. Lawrence and transporting them to the Central Scotian Basin.

3. Smaller rivers from the Meguma Terrance transporting sediments to the Central Scotian Basin.

4. A River from the Bay of Fundy, which most likely has a New Brunswick source and transports sediments to the Southwest Scotian Basin.

Using these proposed paleoriver pathways from the literature, potential source rocks are proposed for the mudstone geochemistry plots, geochemical fingerprinting plots, and lithic clasts.

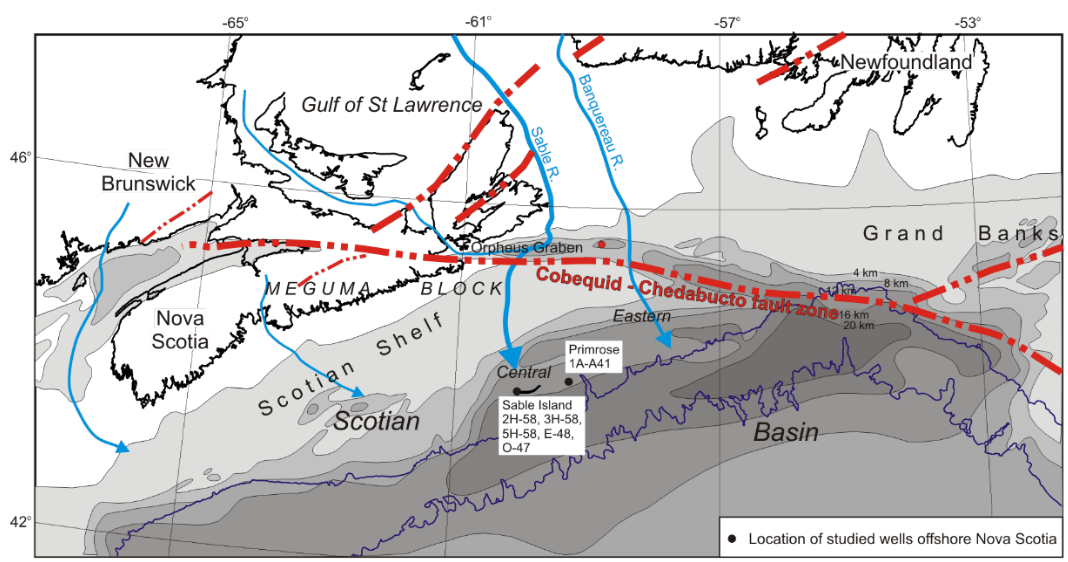

Figure 5.2.1: Isopach map showing the location of studied wells offshore Nova Scotia (after Wade and MacLean, 1990). Paleoriver paths after Pe-Piper and Piper, (2012).

5.2.2 Mudstone Geochemistry

Based on a number of studies performed in the Scotian Basin by Pe-Piper et al., there are multiple paleoriver sources that fed into the Central Scotian Basin. Rivers from the Meguma Terrane and from the Gulf of St. Lawrence (Sable River) appear to have been active during the Early Cretaceous, and supplied the Sable Member of the studied wells with sediments. The older Cree Member appears to have a source of either Sable River or Newfoundland (possible Banquereau River source). Summary table (Table 5.2.1) of possible source for the studied mudstones is presented below.

Table 5.2.1: Summary Table of Possible Source Terranes for Each of the Studied Wells.

Well	Source Terrane		
	Meguma	Sable River	Newfoundland
Sable Island 3H-58		X	
Sable Island 5H-58		X	X
Sable Island O-47		X	X
Primrose 1A-A41	?X		

5.2.3 Mineral Chemical Fingerprinting

As indicated from geochemical fingerprinting, some of the detrital minerals were sourced from the Meguma Supergroup, and the Newfoundland Appalachians. The Cree Member was most likely sourced from Newfoundland based on mudstone geochemistry. The garnet found in the Cree Member mot resembles Grenville garnets (Tsikouras et al., 2011). The Sable Member appears to have been sourced igneous muscovite. This partially agrees with the mudstone geochemistry for the Sable Member, which suggests a Meguma and Sable River source. The igneous muscovite most likely came from the granites in the Meguma Terrane. The Sable River would have also brought in detrital minerals, such as chromite possibly from the Newfoundland Appalachians. The Marmora Member appears to have been sourced by mostly metasedimentary muscovite, and metamorphic biotite. This suggests a Meguma source. Chromite is lacking in the Meguma, but is common in sediments deposited by the Sable River in the Central Scotian Basin. Tsikouras et al. (2011) argues that chromite sources are homogenized through polycyclic reworking. Therefore, changes in source cannot be deduced from individual analyses. Ilmenite is common in all of the studied intervals. Studies of the Chaswood Formation (Pe-Piper et al., 2005; Piper et al., 2007) show that it is interpreted as Appalachian sources. It is also common in the Grenville. It is therefore difficult to use as a provenance indicator. The abundance of chloritized muscovite suggests that the Meguma Terrane was an important source throughout the Logan Canyon Formation.

5.2.4 Lithic Clasts

The lithic clasts present in the studied samples appear to be sourced from multiple rock lithologies. The metasedimentary and granitic lithic clasts are most likely sourced from the Meguma Supergroup, and could have been transported by tributaries of the Sable River (as suggested by the mudstone geochemistry (Fig. 4.6.4)). However, the rhyolitic lithic clasts could have been sourced from the Avalon Terrane, and transported by the Sable River.

Chapter 6: Conclusion

1) The lithofacies for the Sable Island wells indicate that it was most likely an estuarine-tidal flat depositional environment, with minor variations. Since each lithofacies correlates to a general porosity and permeability (based on the rocks that occur in each depositional environment), they can be a useful tool in order to predict reservoir quality.
2) The evolution of glaucony in the studied samples indicates that they were not highly evolved or evolved before burial occurred. This means that there was continued sediment input deep into the basin.
3) Clay coats are important features that can help preserve primary porosity during prolonged burial, by inhibiting the growth of quartz cement. The clay coats are seen in most samples, and correspond to samples with the higher porosities.
4) Coated grains that consists of siderite for the outer coat, indicate that there was depletion in sulfate-rich pore-water, which allowed for the siderite to precipitate around calcite grains.
5) The paragenetic sequence for most of the studied wells is similar. First to form were the early seafloor diagenetic minerals (glaucony, glauconite) (if available), followed by kaolinite, then chlorite. Then calcite started precipitating followed by siderite. Finally, minor late diagenetic minerals (pyrite, titania, and rarely anhydrite) were the last to form.

6) Provenance data suggests that most of the detrital sediments were transported by the Sable River, with minor detrital sediments coming into the Central Scotian Basin from the Meguma Terrane and Newfoundland.

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Appendix 1: SEM-BSE images and EDS mineral analyses for the studied samples.

Appendix 1-1: SEM-BSE images and EDS mineral analyses for sample E-48-2244.39.

Sample E-48-2244.39: Fine-medium grained sandstone

Detrital Minerals: Albite, Apatite, Garnet, Ilmenite, K-feldspar, Muscovite, Quartz, Spinel, Titania (Figs. 24,?49), Zircon

Diagenic Minerals: Chlorite, Kaolinite, Pyrite, Siderite, Titania (Straight edges Fig. 5, veinlet Fig. 29), quartz overgrowths, K-feldspar overgrowths

Notes:

1. Siderite-cemented intraclasts are common in this sample (Figs. 12,15,25,30,33,47,54).

2. Titania veinlet cross-cuts Fe-rich chlorite (Fig. 46).

3. Quartz and K-feldspar commonly display suturing (Figs. 2, 5, 7).

4. K-feldspar and quartz display overgrowths (Fig. 4).

5. A fine-grained Fe-chlorite appears to coat detrital grains (Figs. 17,27), and occur between grains (Figs. 3,25,30,34) along with kaolinite booklets (Fig. 28).

6. Halite appears with Fe-chlorite (Figs. 35,47), and with a cubic habit (Figs. 13,14,21). The halite is present because the core was not washed well →formed in the lab.

7. Paragenetic sequence:
Kaolinite →Chlorite →Calcite →Pyrite, Titania, Siderite cemented intraclasts

↑ Figs. 17,28 ↑ Fig. 28 ↑ Figs. 7,9,12,15,25,30,46,54

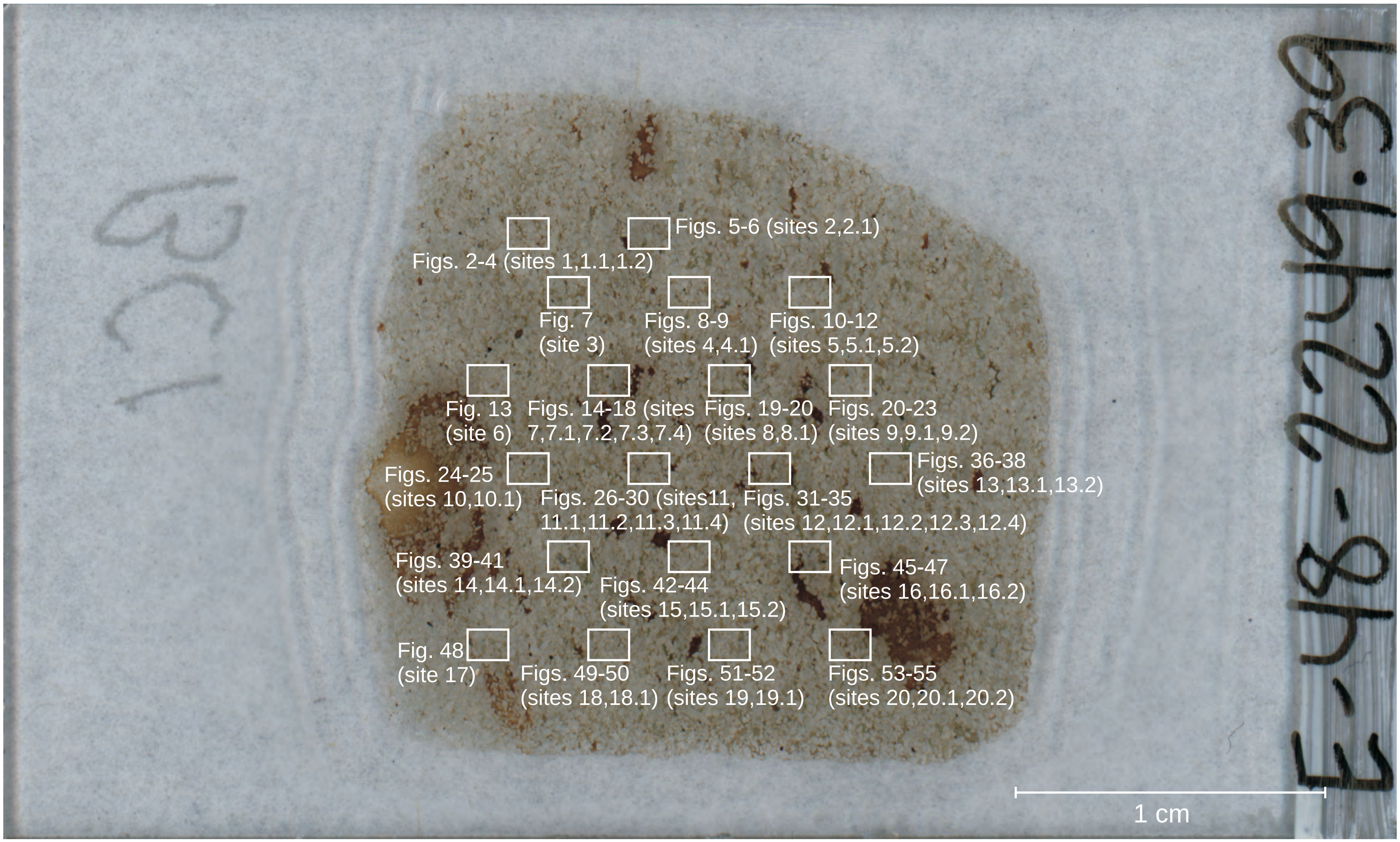
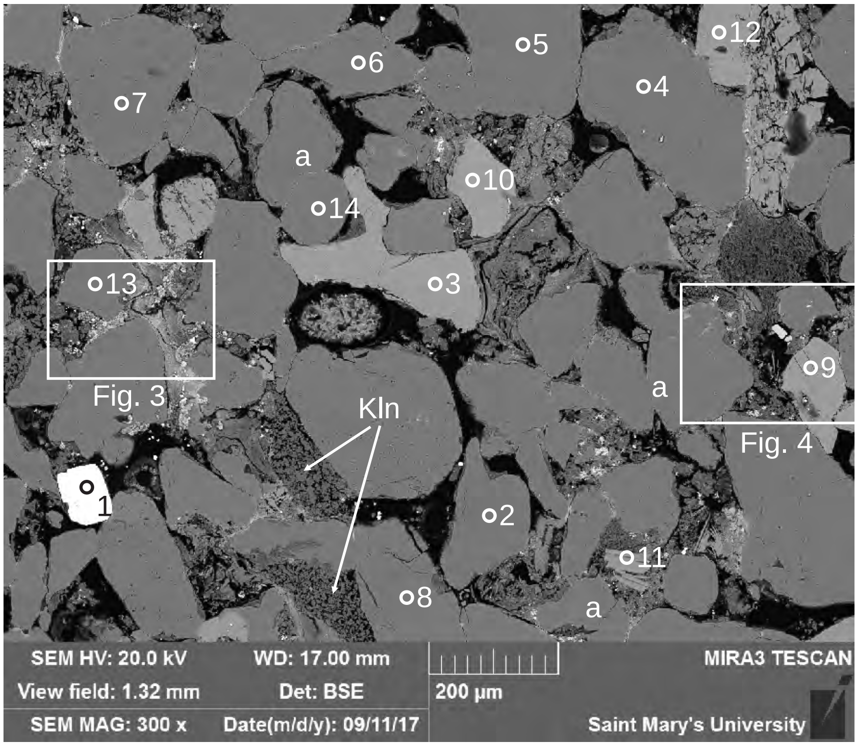
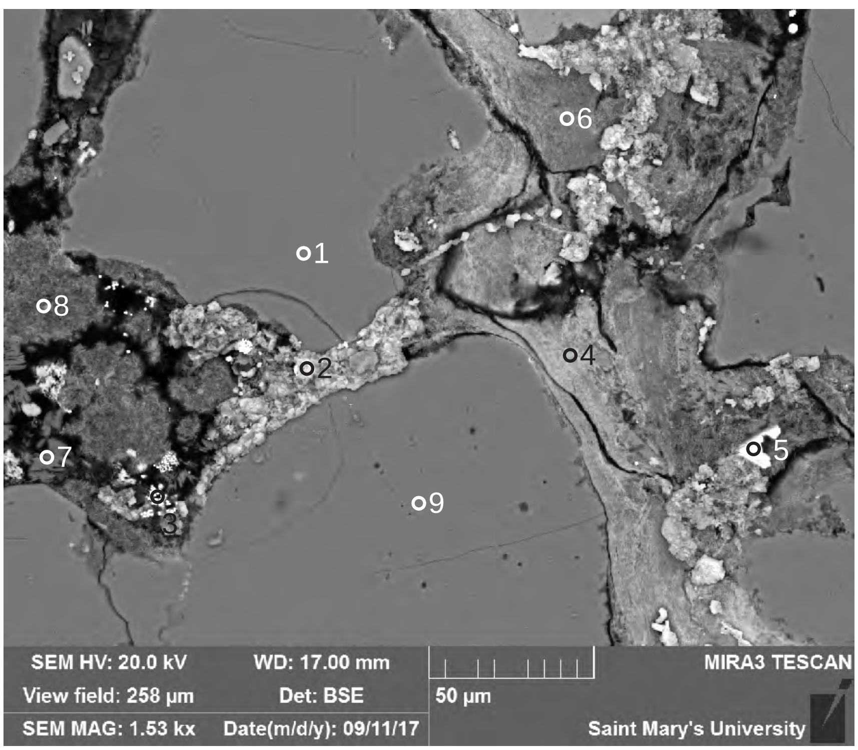


Figure 1-1.1: Scanned thin section of sample E-48-2244.39 showing the location of analyzed sites.



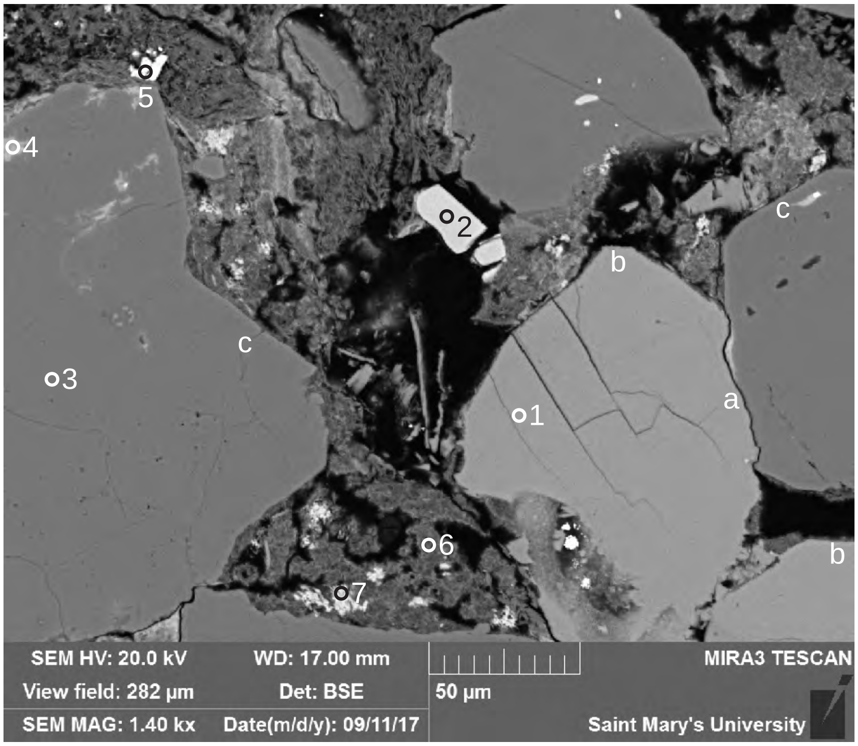
1:Zircon
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:K-feldspar
10:K-feldspar
11:Muscovite
12:K-feldspar
13:Quartz
14:Quartz

Figure 1-1.2: Sample E-48-2244.39 site 1 (SEM). This site consists of mainly quartz and K-feldspar. There is also a small crystal of detrital zircon (1). Kaolinite booklets are seen partially filling primary porosity. Suturing is common between quartz grains (positions a).



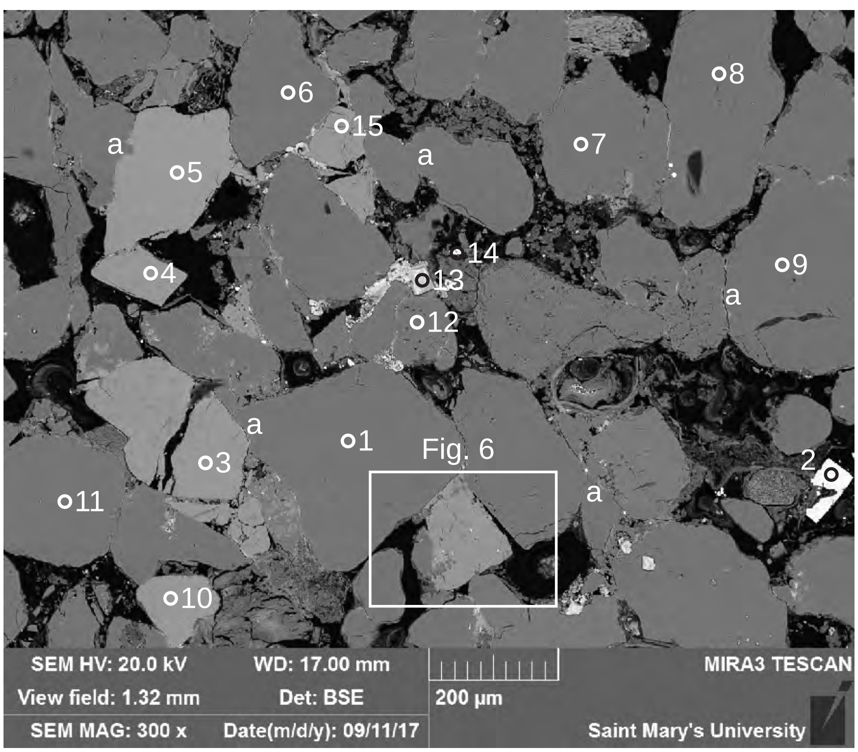
1:Quartz
2:Halite +
3:Pyrite
4:Fe-Chlorite
5:TiO_2
6:Muscovite + Chlorite
7:Kaolinite
8:Fe-Chlorite
9:Quartz

Figure 1-1.3: Sample E-48-2244.39 site 1.1 (SEM). This site consists of detrital quartz (1,9) and muscovite (6) grains with kaolinite (7), Fe-chlorite (4,8), and pyrite (6) cements. Halite (2) partially fills intergranular boundaries and has probably precipitated from salt water.



1:K-feldspar
2:Apatite
3:Quartz
4:Chlorite
5:TiO_2
6:Fe-Chlorite
7:Siderite +

Figure 1-1.4: Sample E-48-2244.39 site 1.2 (SEM). This site consists of quartz (3), and K-feldspar (1). Between grain boundaries there is kaolinite, chlorite (4,6), diagenetic apatite (2) and siderite (7). Suturing is seen between quartz and K-feldspar (position a). K-feldspar overgrowths (positions b) and quartz overgrowths (positions c) are also present.



1:Quartz
2:TiO_2
3:K-feldspar
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:K-feldspar +
11:Quartz
12:Quartz
13:Halite
14:TiO_2
15:K-feldspar

Figure 1-1.5: Sample E-48-2244.39 site 2 (SEM). This site consists of mainly K-feldspar and quartz grains. Suturing between grains is common (positions a). Diagenetic titania (2,14) appear to cross-cut some of the host. Halite (13) appears to grow along grain boundaries.

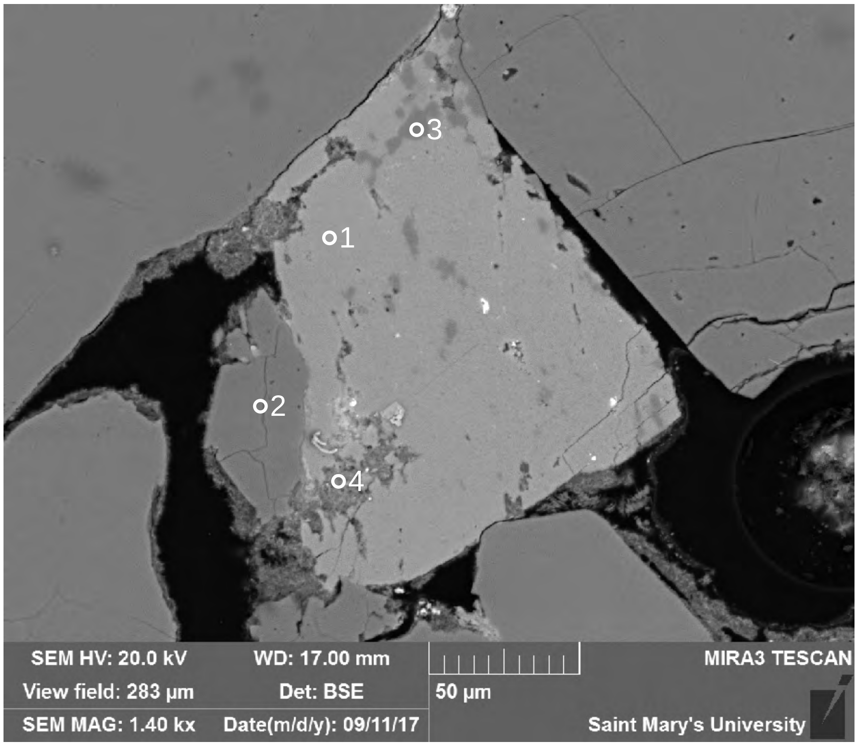


Figure 1-1.6: Sample E-48-2244.39 site 2.1 (SEM). This site consists of a lithic clast made up of albitized K-feldspar (1) and quartz (3), with Fe-chlorite (4) alteration.

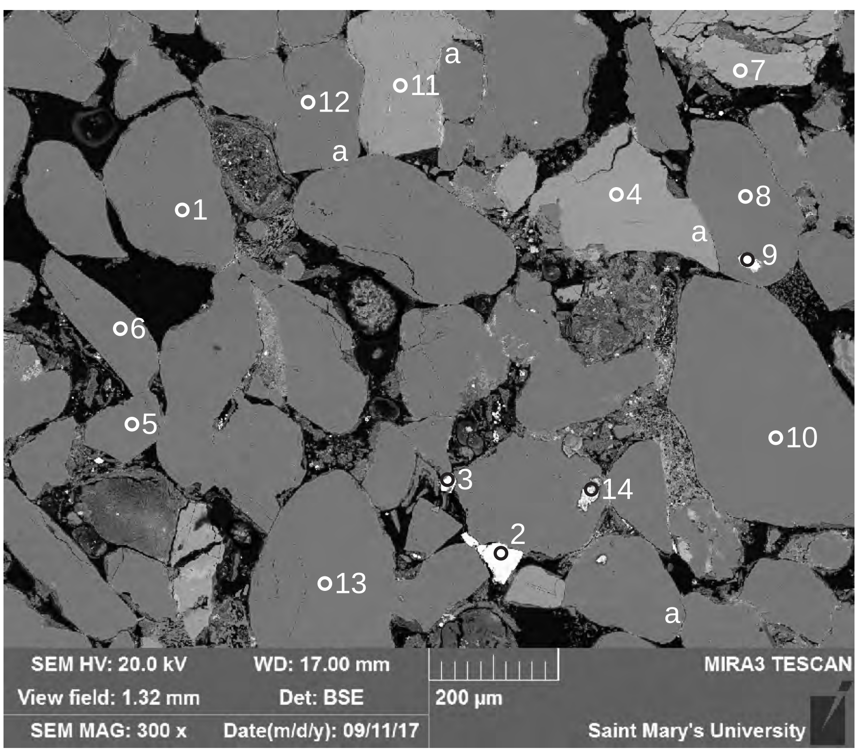
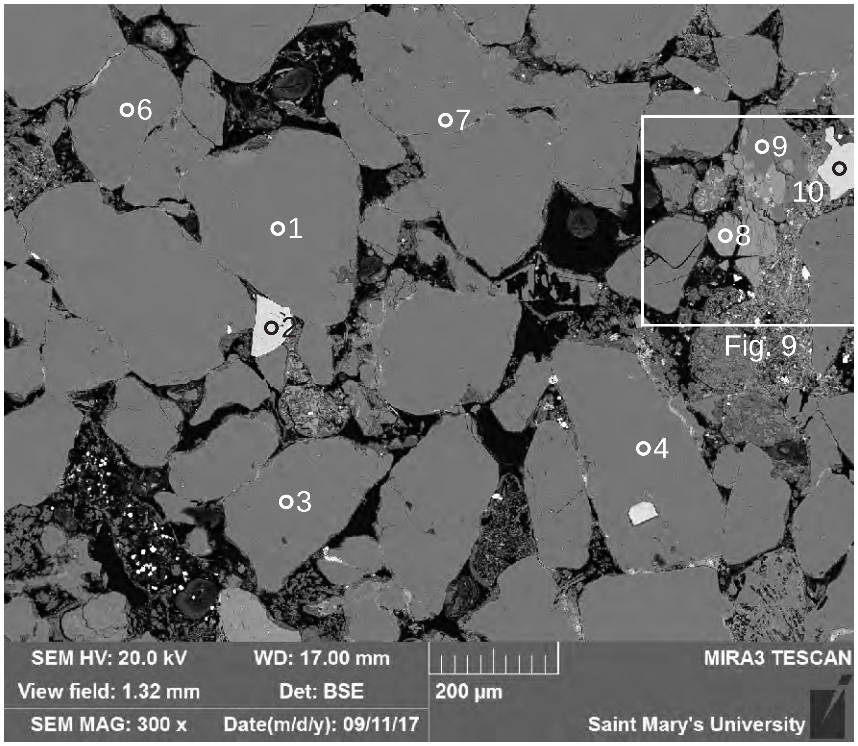
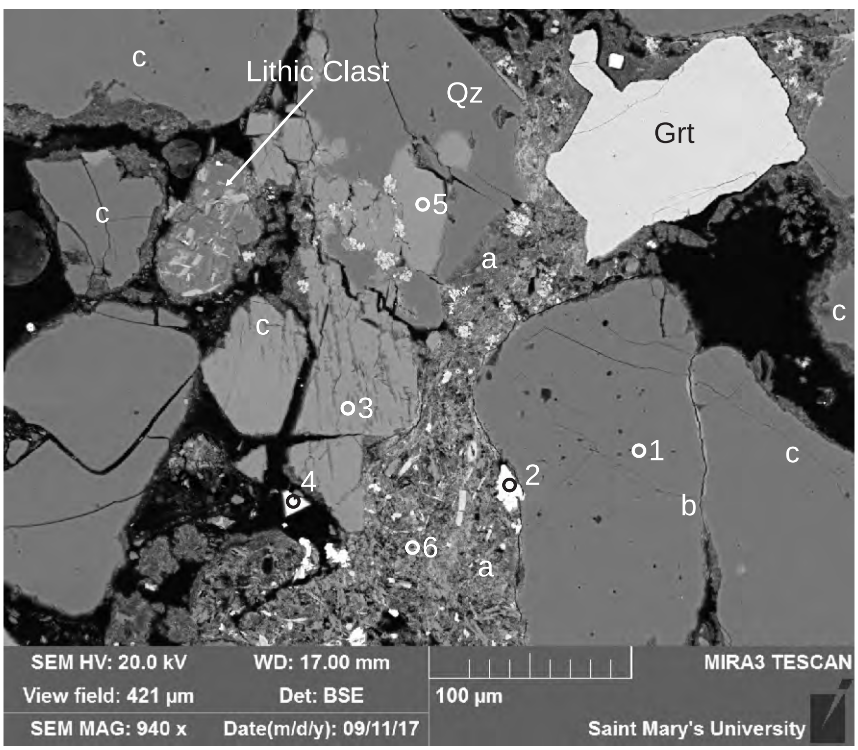


Figure 1-1.7: Sample E-48-2244.39 site 3 (SEM). This site consists of quartz and K-feldspar. Titania (2,3) appears to form along grain boundaries. Zircon (9) appears to occur as inclusion in quartz (8) grain. Halite (14) appears to fill void in quartz. Suturing is common (positions a).



1:Quartz
2:Spinel
3:Quartz
4:Quartz
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:Garnet

Figure 1-1.8: Sample E-48-2244.39 site 4 (SEM). This site consists mainly of quartz grains that display suturing, spinel (2), K-feldspar (8) appears to be altering to clays, and garnet (10).



1:Quartz
2:TiO_2
3:K-feldspar
4:TiO_2
5:K-feldspar
6:Mixture

Figure 1-1.9: Sample E-48-2244.39 site 4.1 (SEM). This site consists of detrital K-feldspar (3), quartz (1), and garnet. Titania (2,4) appears to be diagenetic. Suturing is indicated (position b). Clays appear to coat the grains (positions c). A Lithic clast appears to be made up of quartz and ?muscovite. There is also a granitoid lithic clast made up of quartz and K-feldspar (5). Between some grains (positions a) is a poorly sorted muddy lithology which may be either a deformed fine-grained lithic clast or bioturbated in muddy matrix.

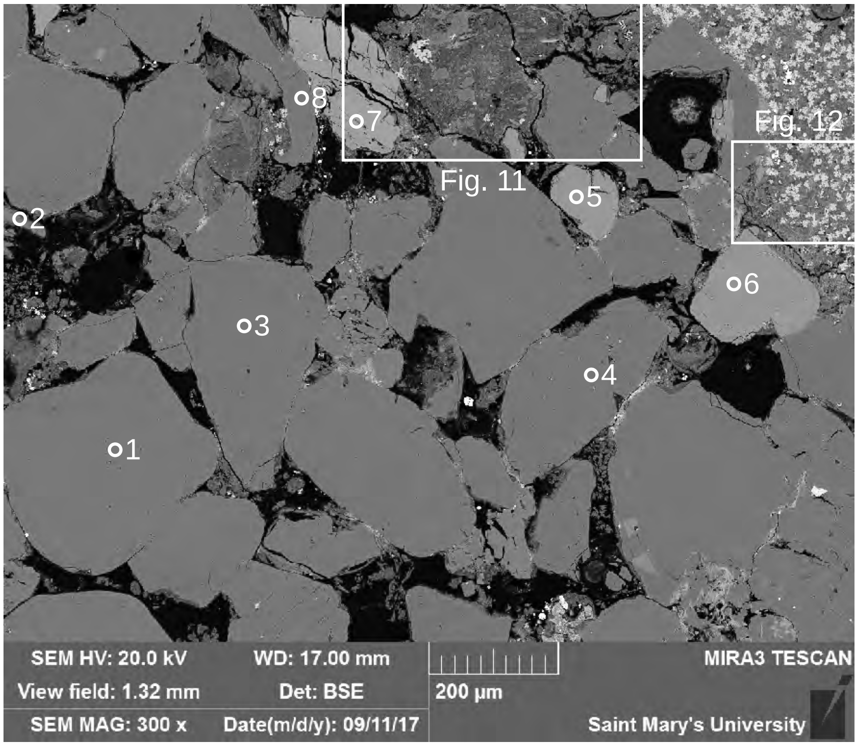


Figure 1-1.10: Sample E-48-2244.39 site 5 (SEM). This site consists of quartz (1,3-4,8), K-feldspar (5-7) that commonly display suturing. Clays (Fe-chlorite) are present between grains. Siderite cemented intraclast (Fig. 12).

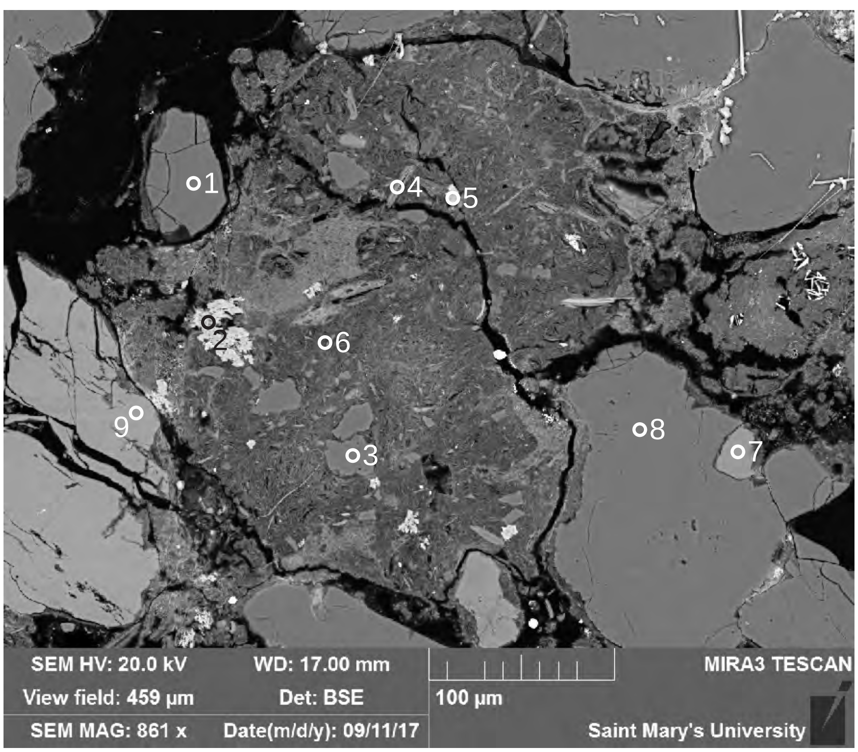
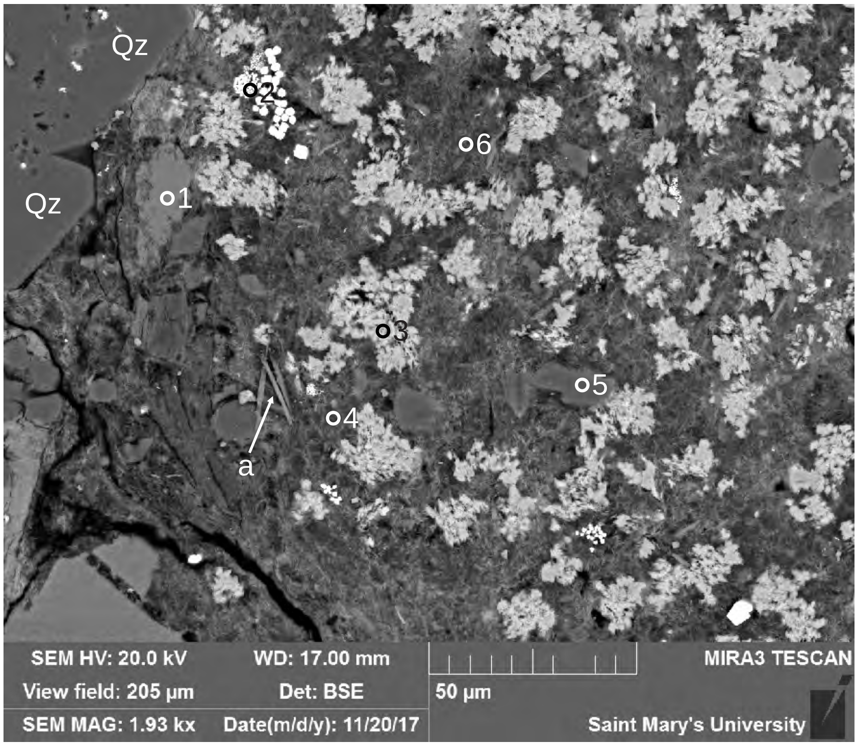
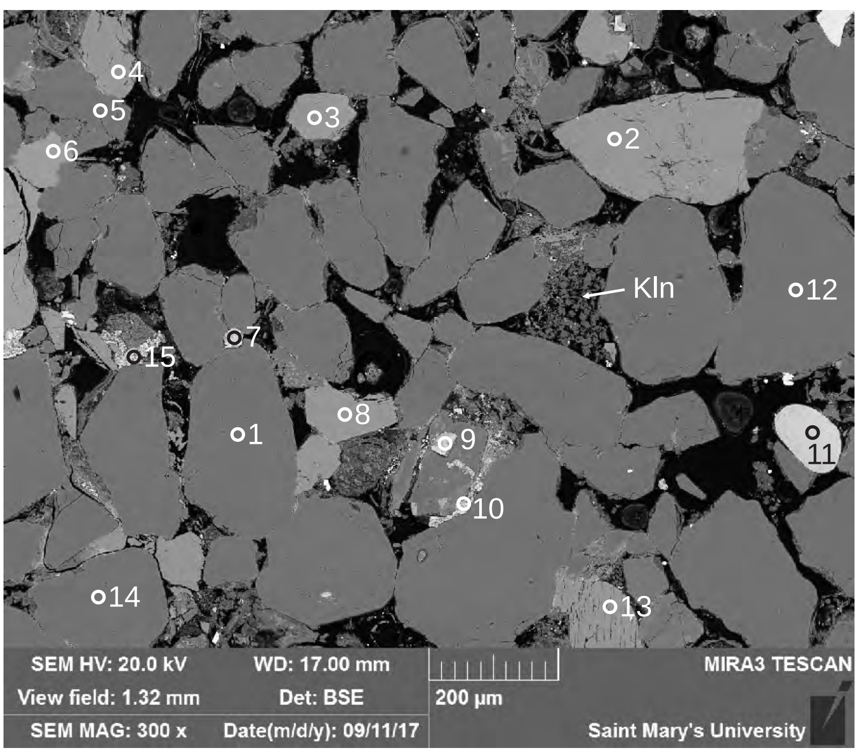


Figure 1-1.11: Sample E-48-2244.39 site 5.1 (SEM). This site consists of a lithic clast or muddy intraclast made up of illite + chlorite (6) matrix, muscovite (4), detrital K-feldspar (9) and quartz (1,8) grains, and siderite (2,5).



1:K-feldspar
2:Pyrite +
3:Siderite +
4:Chlorite + Illite
5:Quartz +
6:Chlorite + Illite

Figure 1-1.12: Sample E-48-2244.39 site 5.2 (SEM). This site consists mainly of an intraclast of silty mudstone partly cemented by siderite (3). The mudstone is made up of silt-size grains of quartz (5), K-feldspar (1), micas (position a), and chlorite + illite (4,6). The detrital quartz grains develop overgrowths.



1:Quartz
2:K-feldspar
3:K-feldspar
4:K-feldspar
5:Quartz
6:K-feldspar
7:Halite
8:K-feldspar
9:Halite
10:Halite
11:Apatite
12:Quartz
13:K-feldspar
14:Quartz
15:Halite

Figure 1-1.13: Sample E-48-2244.39 site 6 (SEM). This site consists of quartz and K-feldspar grains that commonly display suturing. There is also kaolinite booklets that occur between grains as well as halite (7,9-10,15).

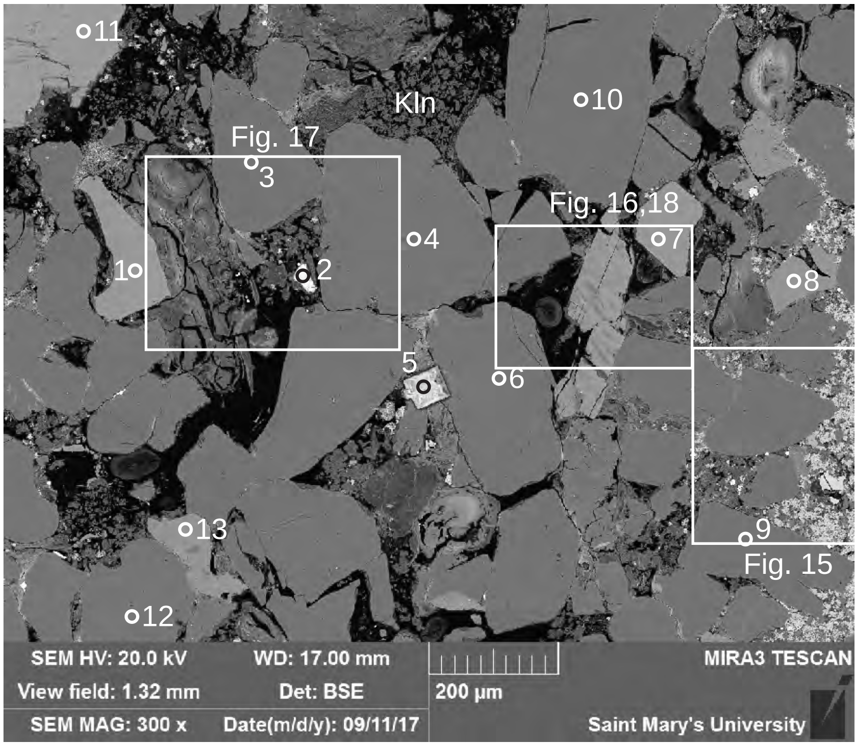


Figure 1-1.14: Sample E-48-2244.39 site 7 (SEM). This site consists of quartz grains that commonly display suturing. K-feldpar (1,11,13) and spinel (2) are also present. Clays (illite) and kaolinite booklets occur between grains.

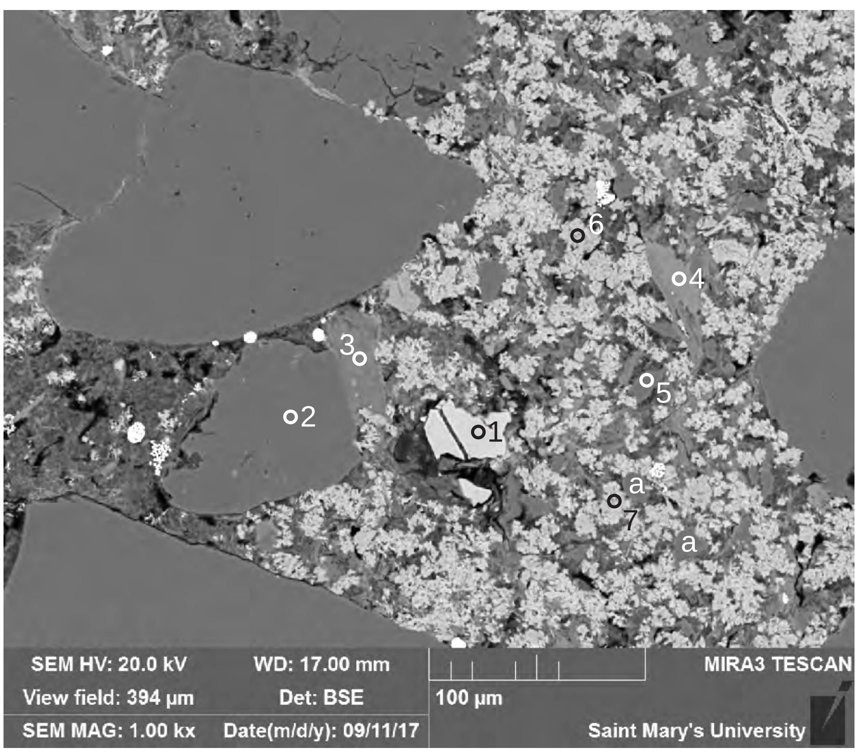
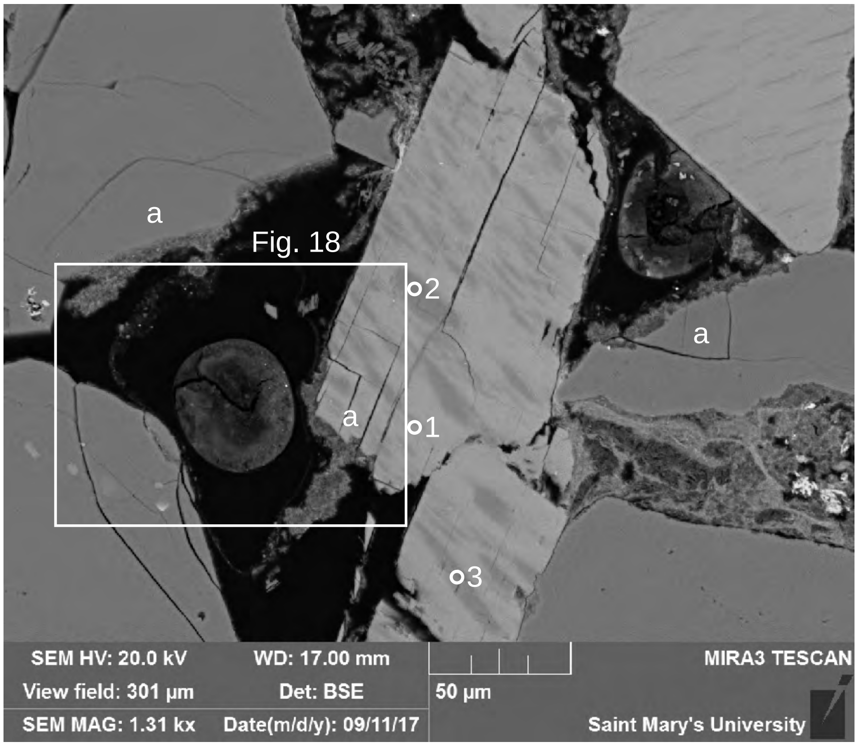
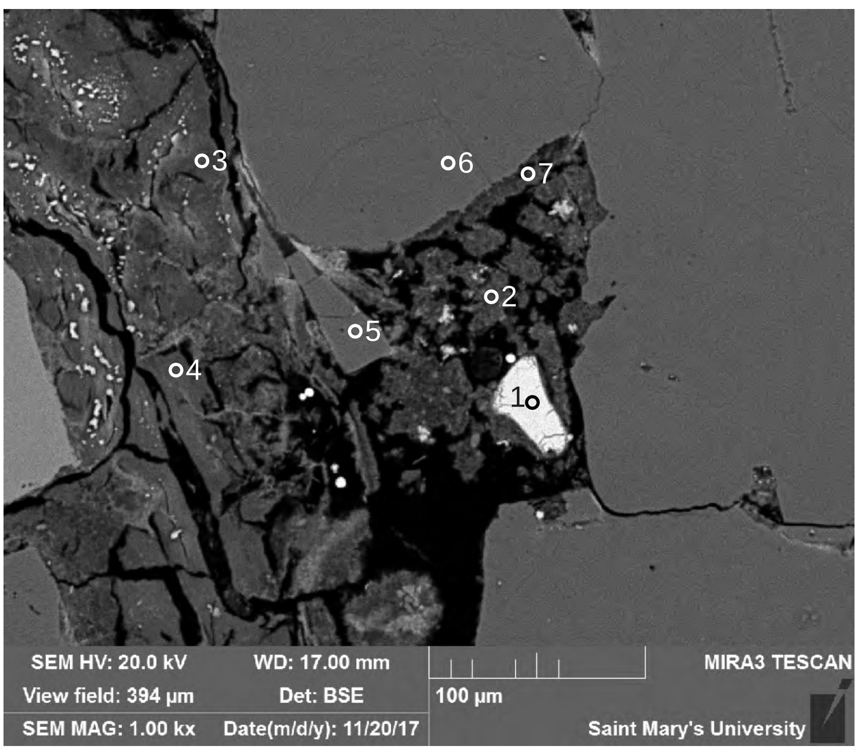


Figure 1-1.15: Sample E-48-2244.39 site 7.1 (SEM). This site consists of a silty mudstone intraclast that is partially cemented by siderite (6-7). The silt-size grains consist of K-feldspar (4), muscovite (3), garnet (1), and quartz (5,positions a). There is also large detrtial quartz (2) grains.



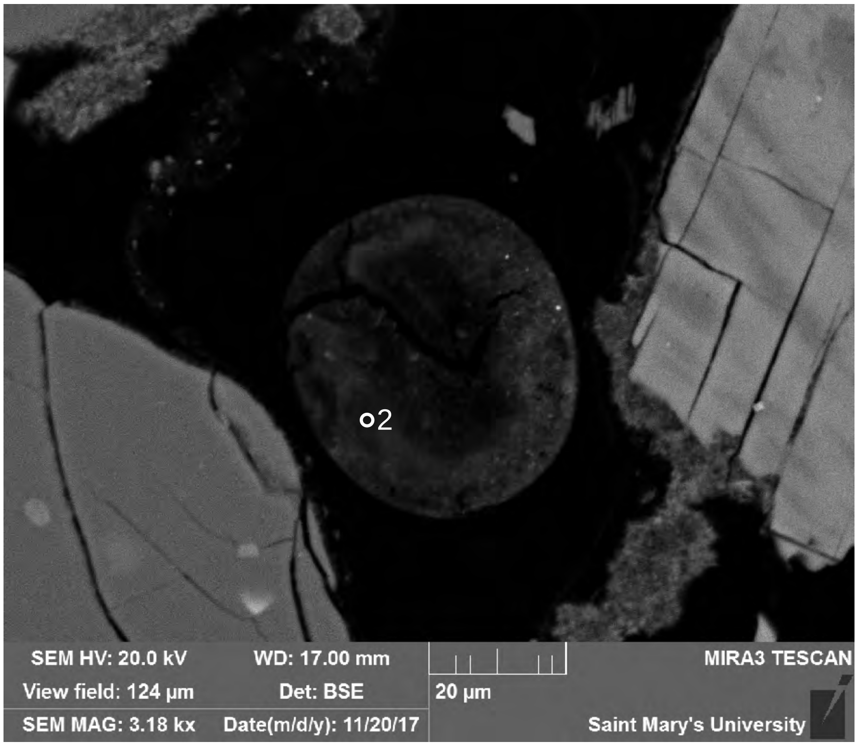
1:K-feldspar
2:Albite +
3:K-feldspar

Figure 1-1.16: Sample E-48-2244.39 site 7.2 (SEM). This site consists of perthitic K-feldspar (1,3). Clays coat the grains (positions a).



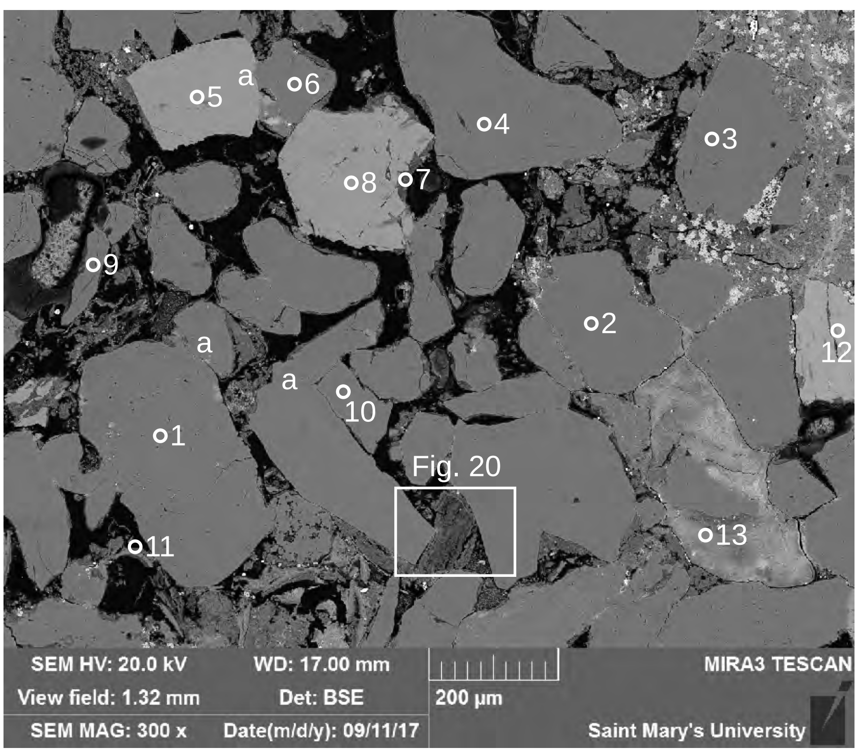
1:Spinel
2:Fe-Chlorite
3:Chlorite +Illite
4:Chlorite + Illite
5:Quartz
6:Quartz
7:Fe-Chlorite

Figure 1-1.17: Sample E-48-2244.39 site 7.3 (SEM). This site consists of a detrital spinel (1) and quartz (6) grains, with Fe-chlorite (2,7) and chlorite + illite cement (3-4).



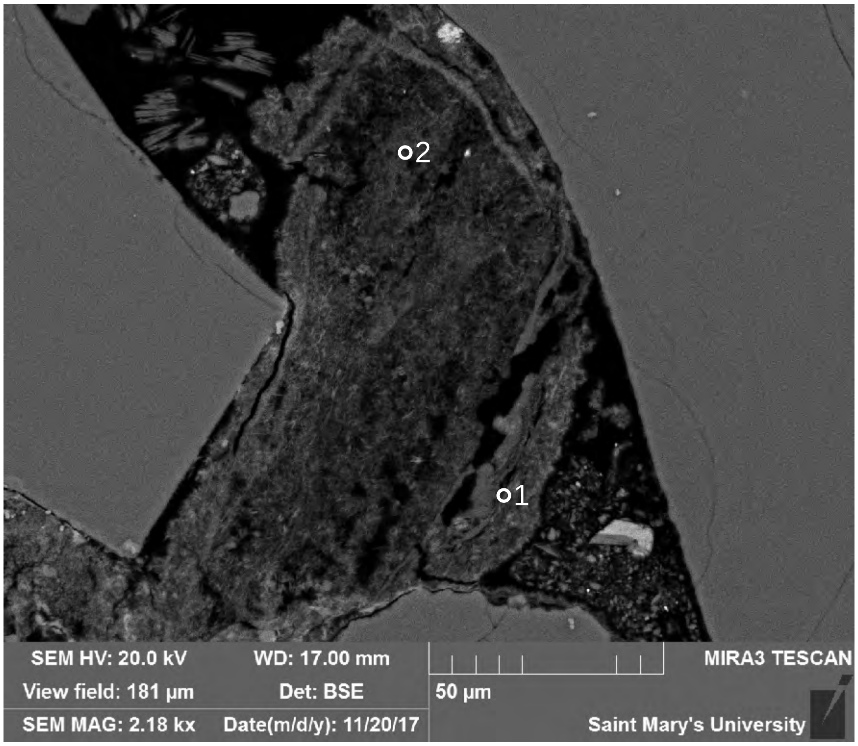
2:Hole/contaminant

Figure 1-1.18: Sample E-48-2244.39 site 7.4 (SEM). This site consists of a mixture or contaminant (2).



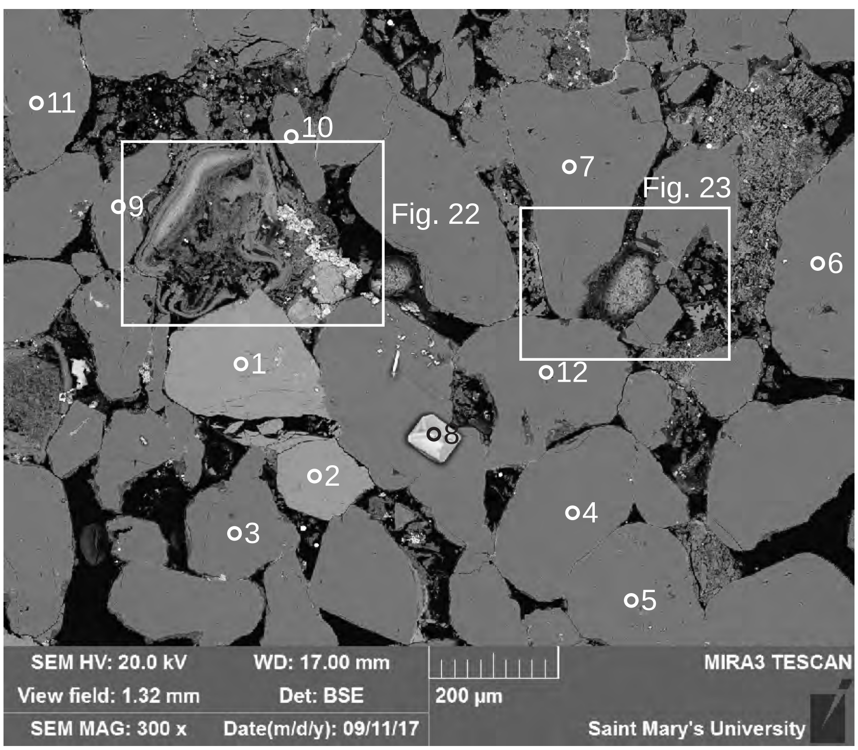
1:Quartz
2:Quartz
3:Quartz
4:Quartz
5:K-feldspar
6:Quartz
7:Chlorite + K-feldspar
8:K-feldspar
9:Quartz
10:Quartz
11:Fe-Chlorite
12:K-feldspar
13:Chlorite + K-feldspar

Figure 1-1.19: Sample E-48-2244.39 site 8 (SEM). This site consists of detrital quartz and K-feldspar grains. Suturing is common (positions a) and K-feldspar (8) appears to be altering to chlorite (7). Fe-Chlorite is common along intergranular boundaries (11,13).



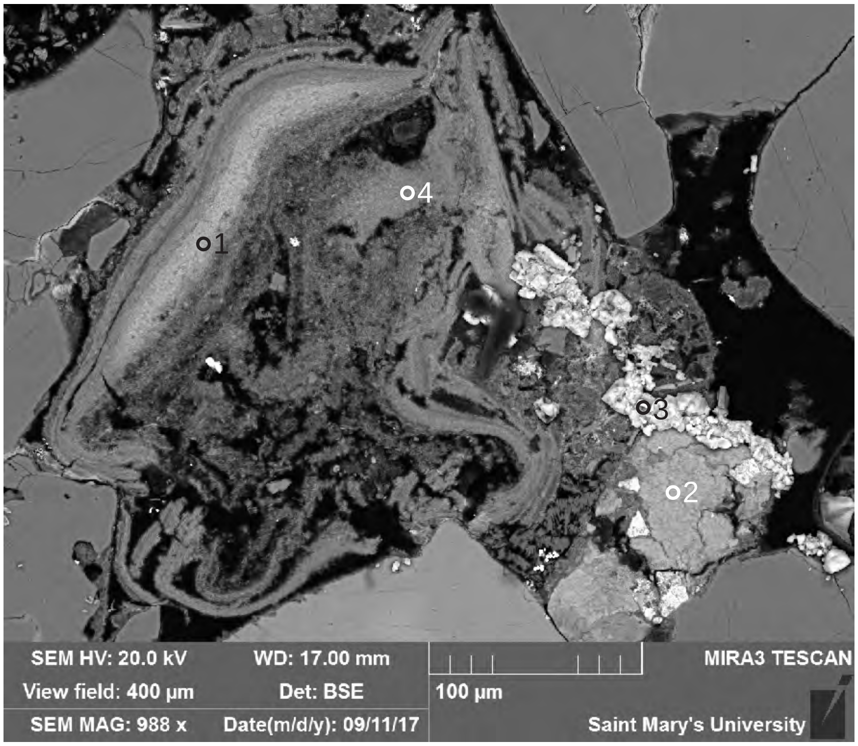
1:Chlorite + Illite
2:Chlorite + Illite

Figure 1-1.20: Sample E-48-2244.39 site 8.1 (SEM). This site consists of very fine-grained chlorite + illite (1-2)(?intraclast).



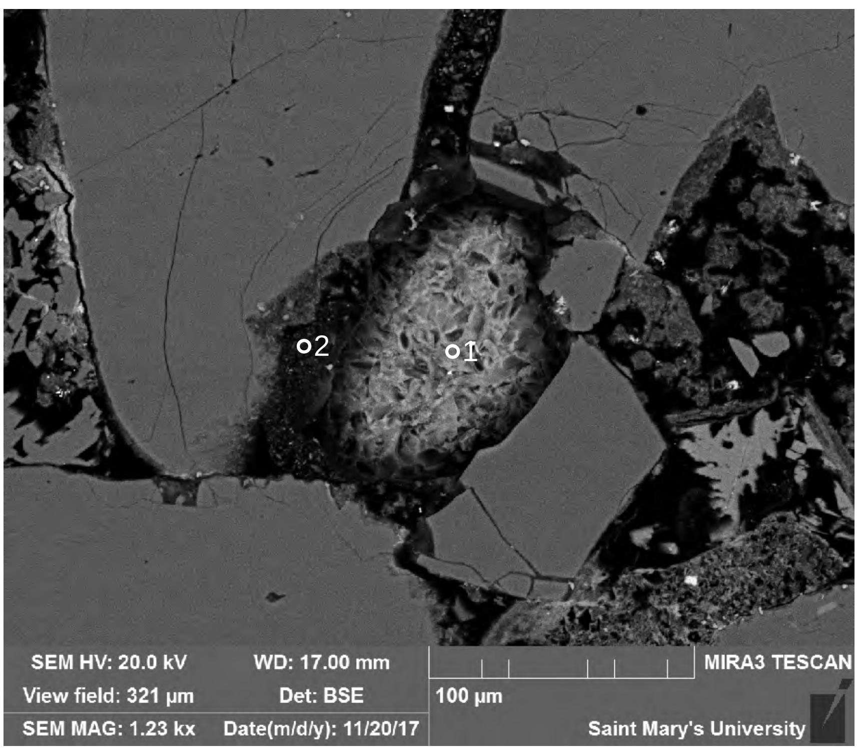
1:K-feldspar
2:K-feldspar
3:Quartz
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Halite
9:Quartz
10:Quartz
11:Quartz
12:Quartz

Figure 1-1.21: Sample E-48-2244.39 site 9 (SEM). This site consists of quartz and K-feldspar. Suturing is common with these grains. A large halite (8) crystal appears to cross-cut two quartz grains. It is unclear if it formed in secondary porosity or if it is an artifact of washing the core.



1:Chlorite + Halite
2:Chlorite
3:Halite +
4:Chlorite

Figure 1-1.22: Sample E-48-2244.39 site 9.1 (SEM). This site contains a crushed coated grain of chlorite and halite (1,4). Late growth of halite (3) is probably from salt water.



1:Contaminant
2:Contaminant

Figure 1-1.23: Sample E-48-2244.39 site 9.2 (SEM). This site consists of contaminants from the process of making the thin section.

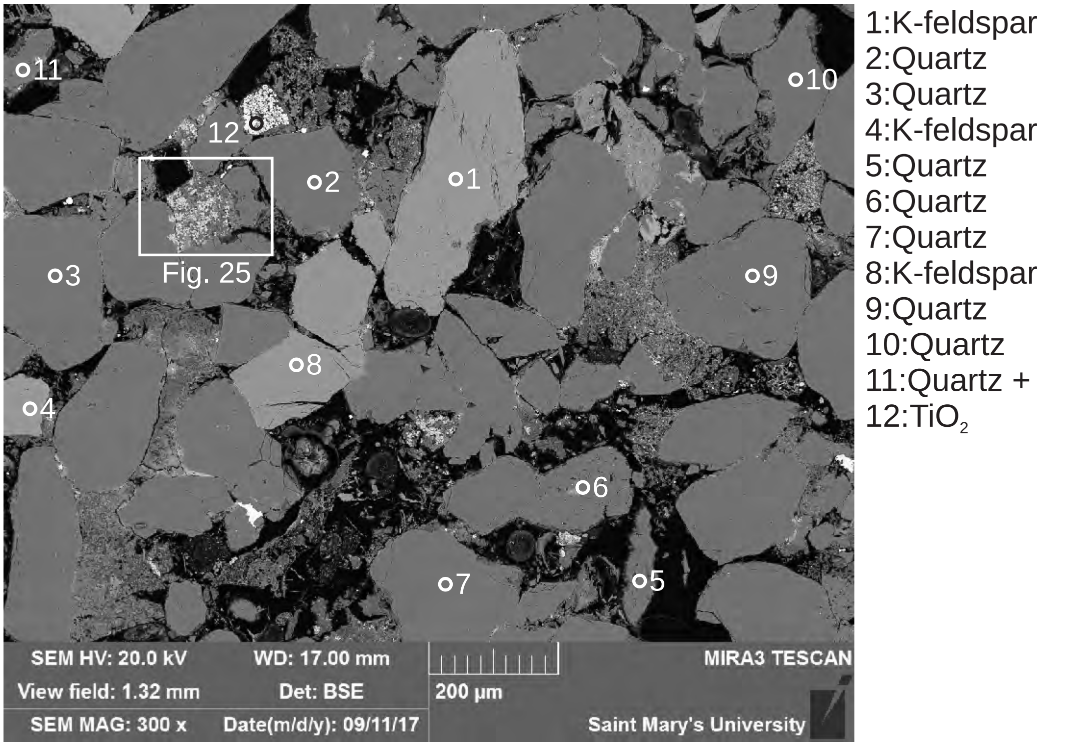


Figure 1-1.24: Sample E-48-2244.39 site 10 (SEM). This site contains mostly quartz and K-feldspar grains. There appears to be a filling of pores by kaolinite and siderite (Fig. 25). Titania (12) appears to be ?detrital.

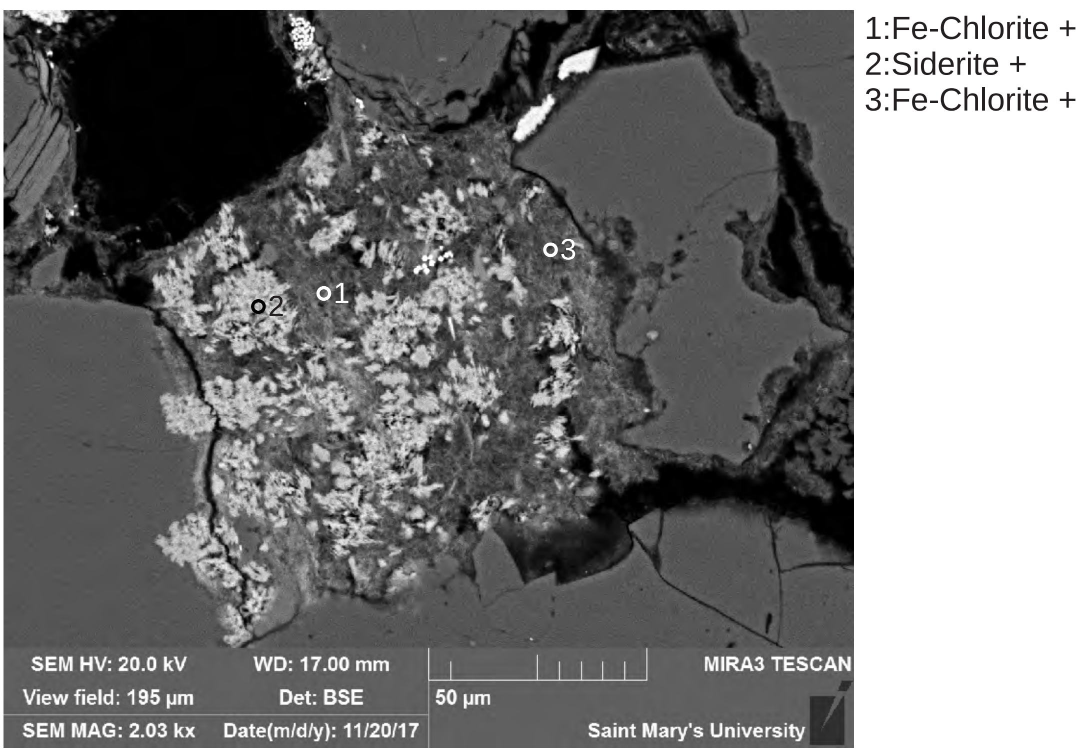
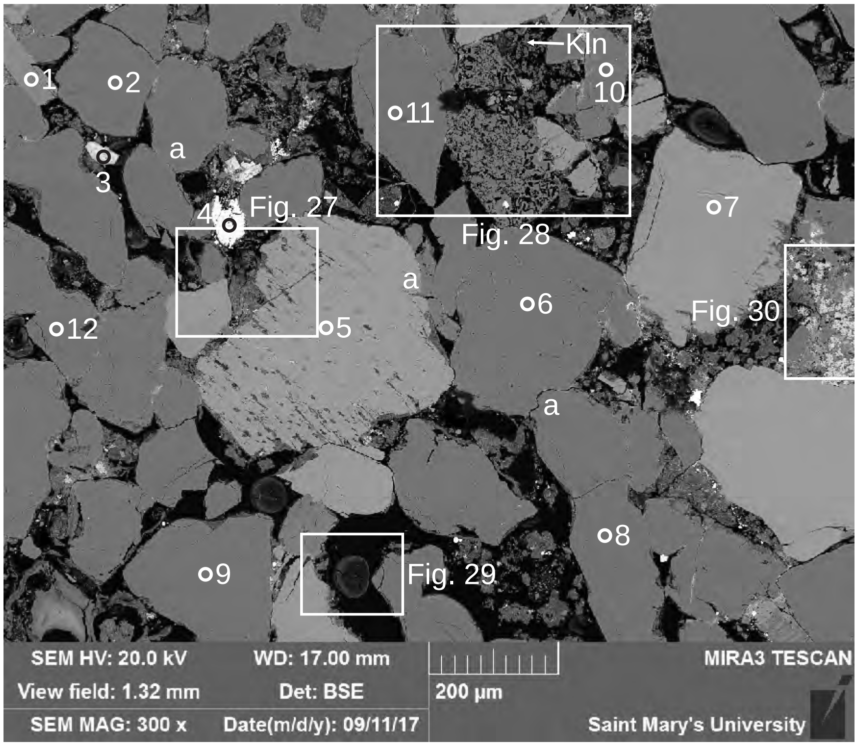
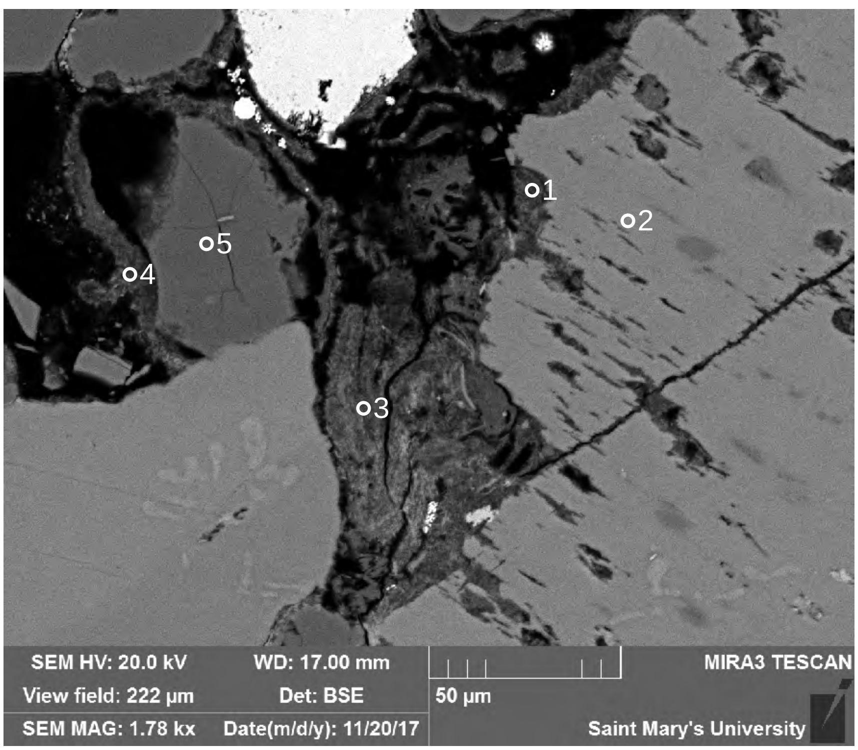


Figure 1-1.25: Sample E-48-2244.39 site 10.1 (SEM). This site consists of fine-grained intraclast of mudstone that contains Fe-chlorite + ?illite (1,3) and is cemented with siderite (2), and late siderite which precipitates in voids.



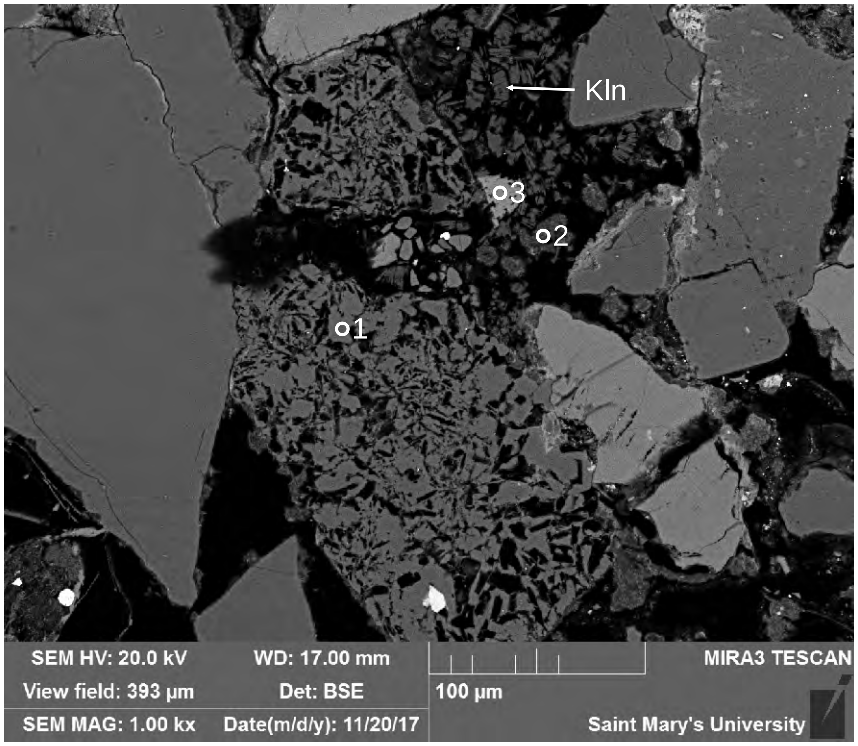
1:Muscovite
2:Quartz
3:Halite
4:TiO_2
5:K-feldspar
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz
10:Albite
11:Quartz
12:Quartz

Figure 1-1.26: Sample E-48-2244.39 site 11 (SEM). This site consists of quartz and K-feldspar (sometimes with voids - 5) grains. Titania (4) appears to grow along grain boundaries. Suturing is also common (positions a). Some of the grains are coated by clays (illite + chlorite), and kaolinite appears to fill intergranular boundaries and pores.



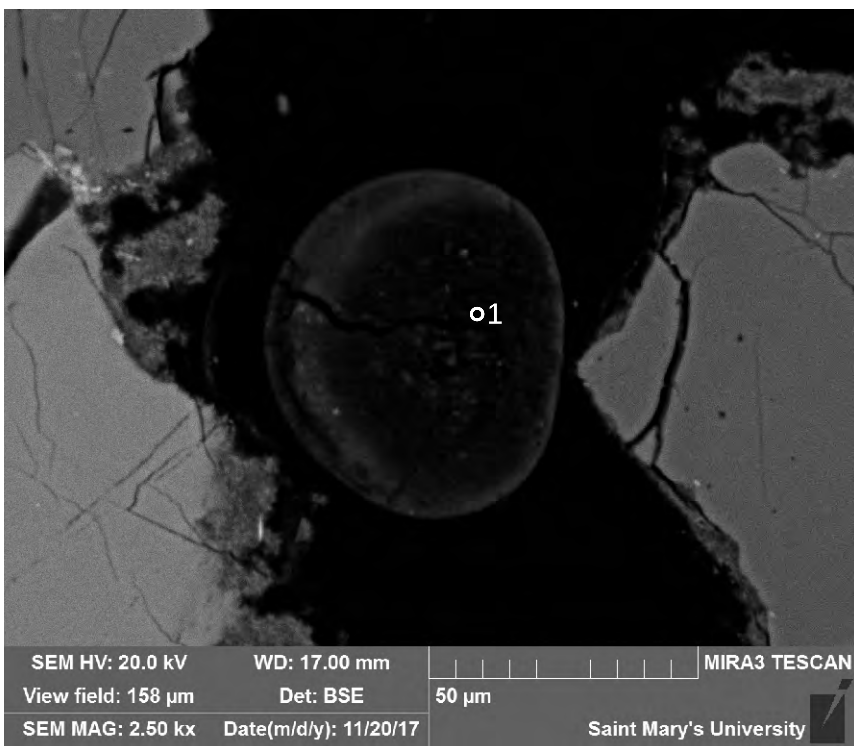
1:Fe-Chlorite
2:K-feldspar
3:Chlorite + Illite
4:Fe-Chlorite
5:Quartz

Figure 1-1.27: Sample E-48-2244.39 site 11.1 (SEM). This site consists of a fine-grained Fe-rich chlorite with very small amounts of illite that appear to form between grains.



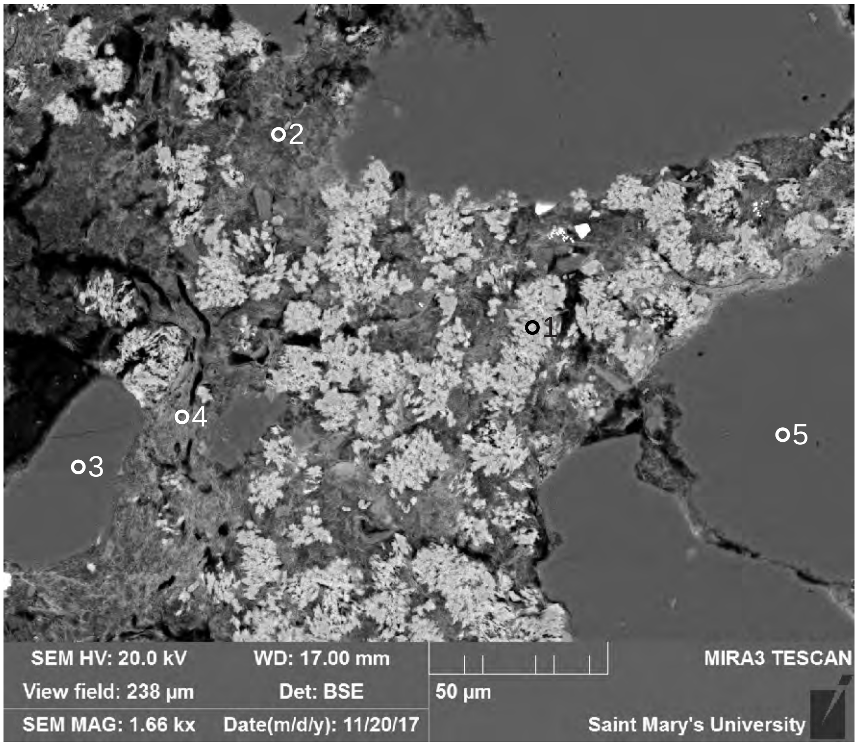
1:Quartz
2:Fe-Chlorite
3:Calcite

Figure 1-1.28: Sample E-48-2244.39 site 11.2 (SEM). This site consists of a dissolved ?rhyolite lithic clast that is made up of quartz (1). Kaolinite booklets and fine-grained Fe-chlorite (2) appear to make up some of the cement. Late calcite (3) partially fills a void.



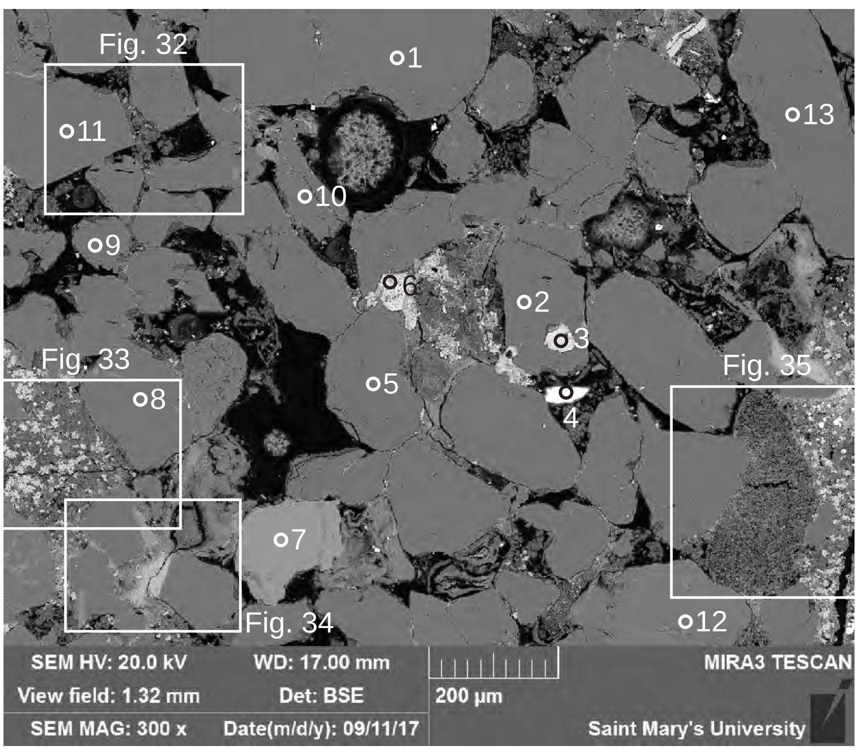
1:Hole/contaminant

Figure 1-1.29: Sample E-48-2244.39 site 11.3 (SEM). This site consists of a mixture.



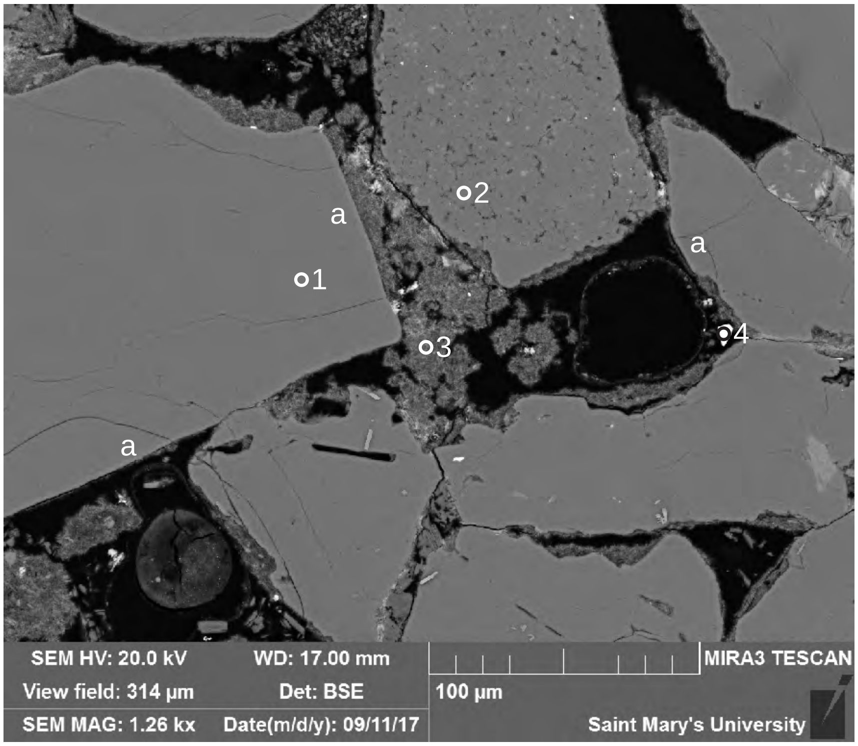
1:Siderite +
2:Chlorite + Illite
3:Quartz
4:Fe-Chlorite
5:Quartz

Figure 1-1.30: Sample E-48-2244.39 site 11.4 (SEM). This site consists of a fine-grained mudstone that is partially cemented by siderite. The silt-size grains consists of quartz (3), and Fe-Chlorite (2,4). There is also large framework grains of quartz (5).



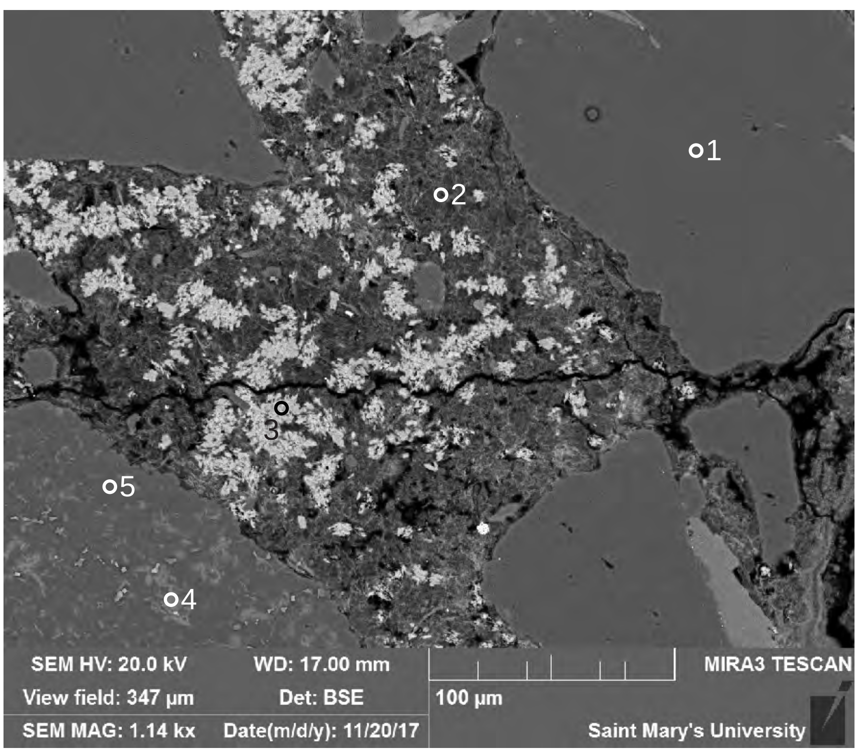
1:Quartz
2:Quartz
3:Halite
4:Zircon
5:Quartz
6:Halite
7:K-feldspar
8:Quartz
9:Quartz
10:Quartz
11:Quartz
12:Albite
13:Quartz

Figure 1-1.31: Sample E-48-2244.39 site 12 (SEM). This site contains quartz, K-feldspar (7), halite (3,6), diagenetic siderite (Fig. 33), and Fe-chlorite (Figs. 32-35). The clays commonly coat detrital grains. Zircon (4) appears to be a



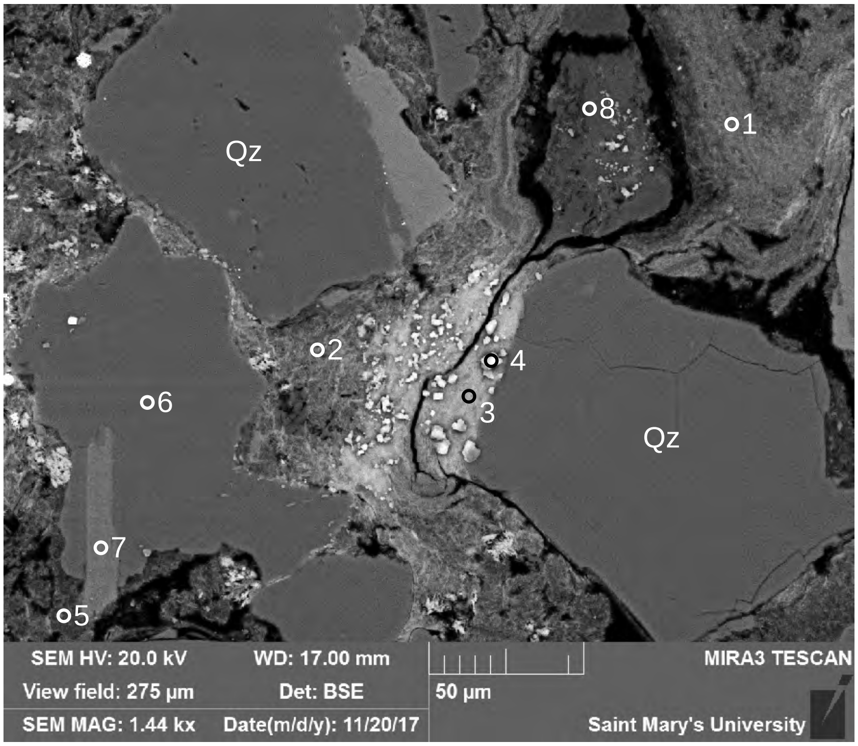
1:Quartz
2:Quartz
3:Fe-Chlorite
4:Pyrite

Figure 1-1.32: Sample E-48-2244.39 site 12.1 (SEM). This site consists of quartz grains that are coated with fine-grained Fe-chlorite (3), and diagenetic pyrite (4). There are also quartz overgrowths (positions a).



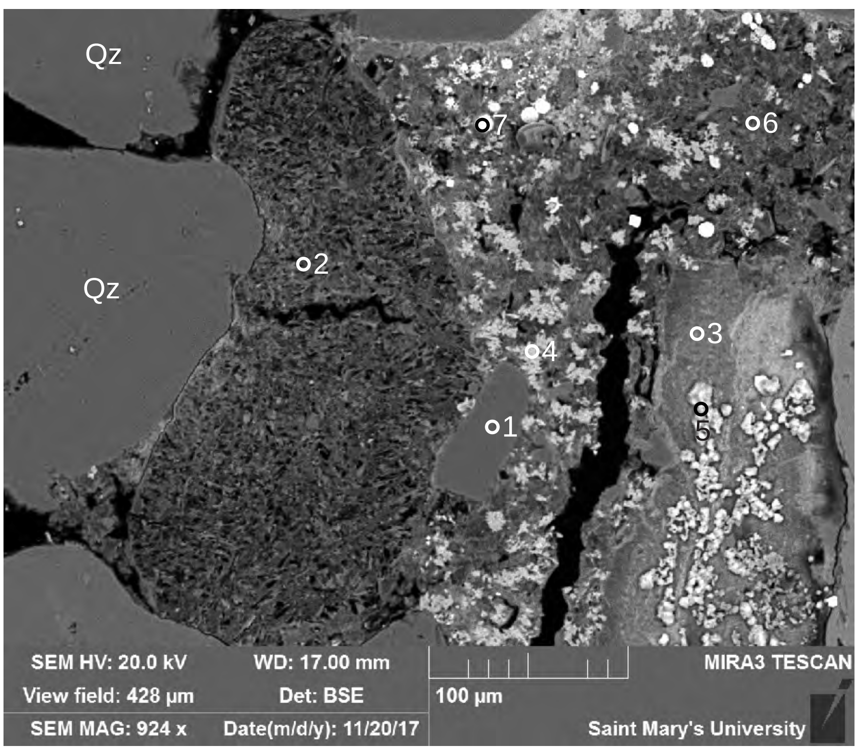
1:Quartz
2:Fe-Chlorite
3:Siderite +
4:Chlorite +
Muscovite
5:Quartz

Figure 1-1.33: Sample E-48-2244.39 site 12.2 (SEM). This site is similar to sites 5.2, 7.1, 10.1, and 11.4. There may be a granitoid lithic clast made up of quartz (5) and muscovite + chlorite (4).



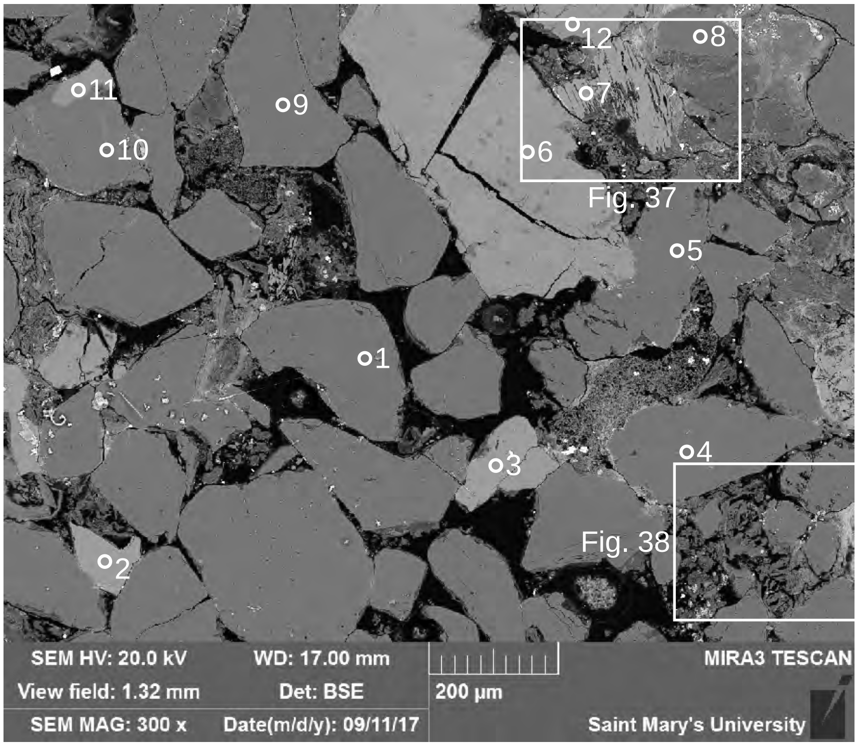
1:Fe-Chlorite
2:Fe-Chlorite
3:Fe-Chlorite
4:Halite
5:Fe-Chlorite
6:Quartz
7:Muscovite +
8:Chlorite +
Muscovite

Figure 1-1.34: Sample E-48-2244.39 site 12.3 (SEM). This site consists of detrital quartz grains with a Fe-rich chlorite (1-3,5) cement. There is a granitoid lithic clast made up of quartz (6) and chloritized muscovite (7). Halite (4) appears late and most likely formed from salt water. The site is cut by a late irregular fracture that postdates the Fe-rich chlorite (3).



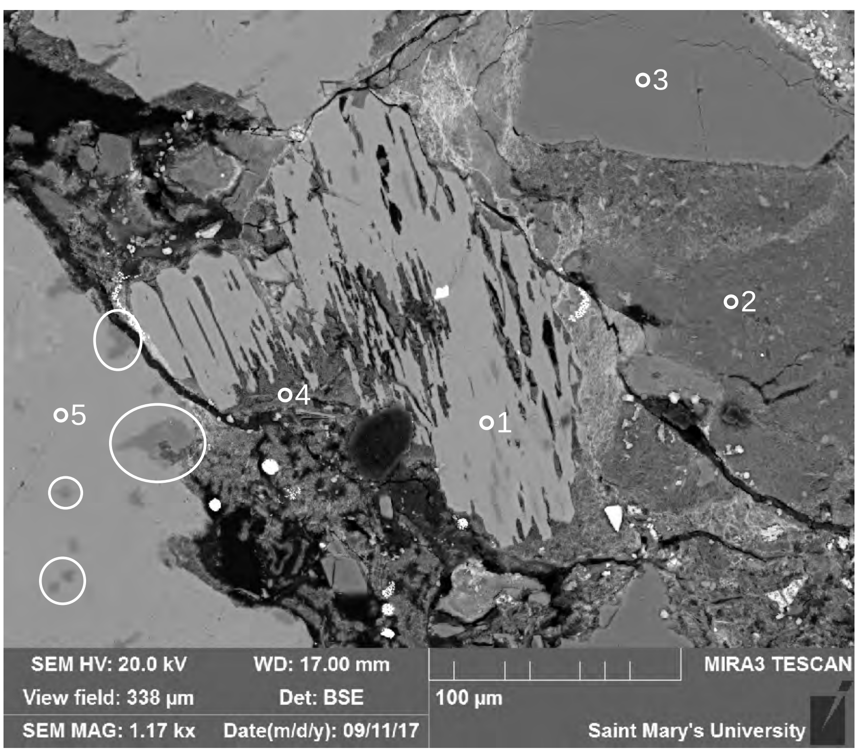
1:Quartz
2:K-feldspar +
3:Chlorite +
Muscovite
4:Siderite +
5:Halite +
6:Fe-Chlorite
7:Pyrite

Figure 1-1.35: Sample E-48-2244.39 site 12.4 (SEM). This site is similar to sites 5.2, 7.1, 10.1, 11.4, and 12.2. There is also a fine-grained lithic clast made up of K-feldspar and probably quartz. Halite (5) appears to be late and most likely precipitated from salt water.



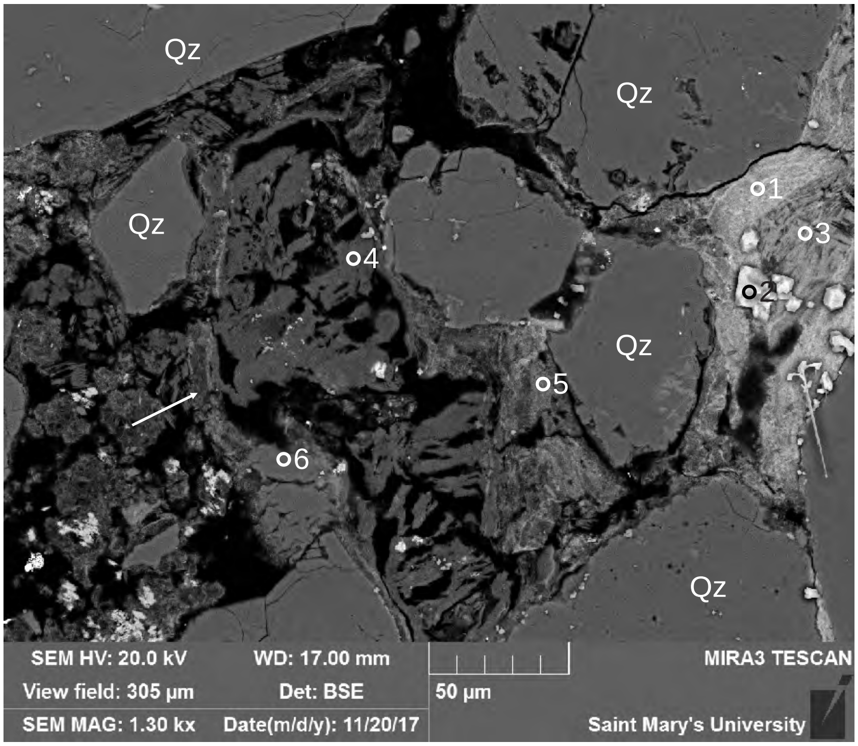
1:Quartz
2:K-feldspar
3:K-feldspar
4:Quartz
5:Quartz
6:K-feldspar
7:K-feldspar
8:Quartz
9:Quartz
10:Albite + Halite
11:K-feldspar
12:K-feldspar

Figure 1-1.36: Sample E-48-2244.39 site 13 (SEM). This site consists of quartz and K-feldspar which display suturing. K-feldspar (7) appears to be altering to ?kaolinite. Quartz appears to have small inclusions/veinlets of albite (10).



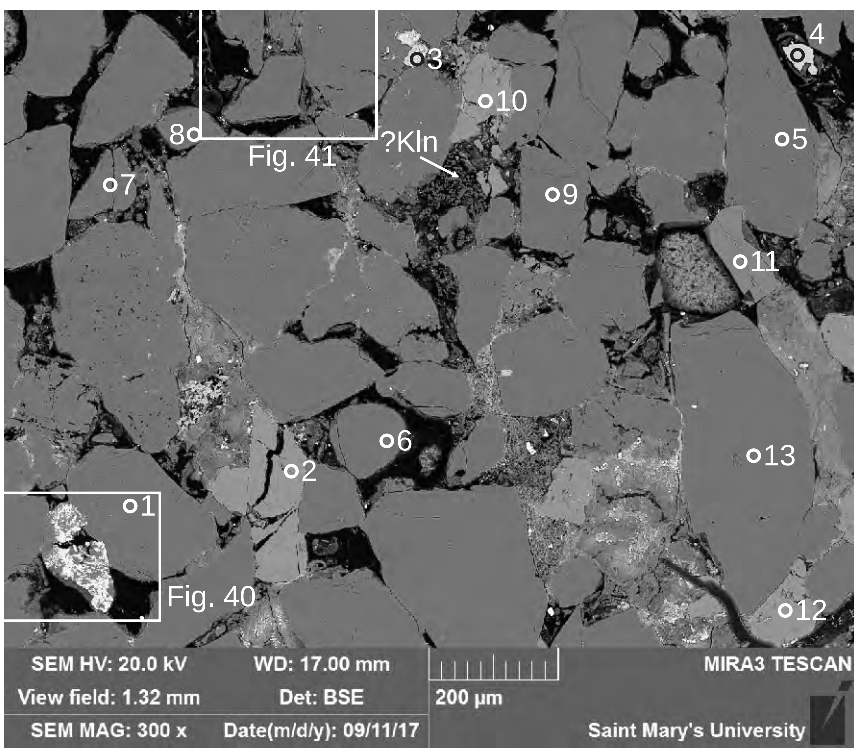
1:K-feldspar
2:Illite + Chlorite
3:Quartz
4:Chlorite
5:K-feldspar

Figure 1-1.37: Sample E-48-2244.39 site 13.1 (SEM). Zoom in of the altered K-feldspar grain from site 13. K-feldspar (1) appears to be altering to Fe-chlorite (4). K-feldspar (5) may be albitized (ellipses).



1:Fe-Chlorite
2:Halite +
3:Fe-Chlorite
4:Chlorite + Illite
5:Fe-Chlorite
6:Quartz

Figure 1-1.38: Sample E-48-2244.39 site 13.2 (SEM). This site consists of detrital quartz grains with a fine-grained Fe-chlorite (1,5) cement. There appears to be a ?collasped coated grain of chlorite + illite (4) with concentric Fe-chlorite (arrow). Late halite (2) is most likely from salt water.



1:Quartz
2:K-feldspar
3:Halite +
4:Garnet
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:K-feldspar
11:Mixture?
12:K-feldspar
13:Quartz

Figure 1-1.39: Sample E-48-2244.39 site 14 (SEM). This site contains grains of quartz, K-feldspar (2,10,12) and garnet (4). Suturing is common between grains. There also appears to be Fe-chlorite (Fig. 41) partially filling intergranular boundaries. Kaolinite booklets are common between grains.

1:"Ilmenite"
2:Quartz

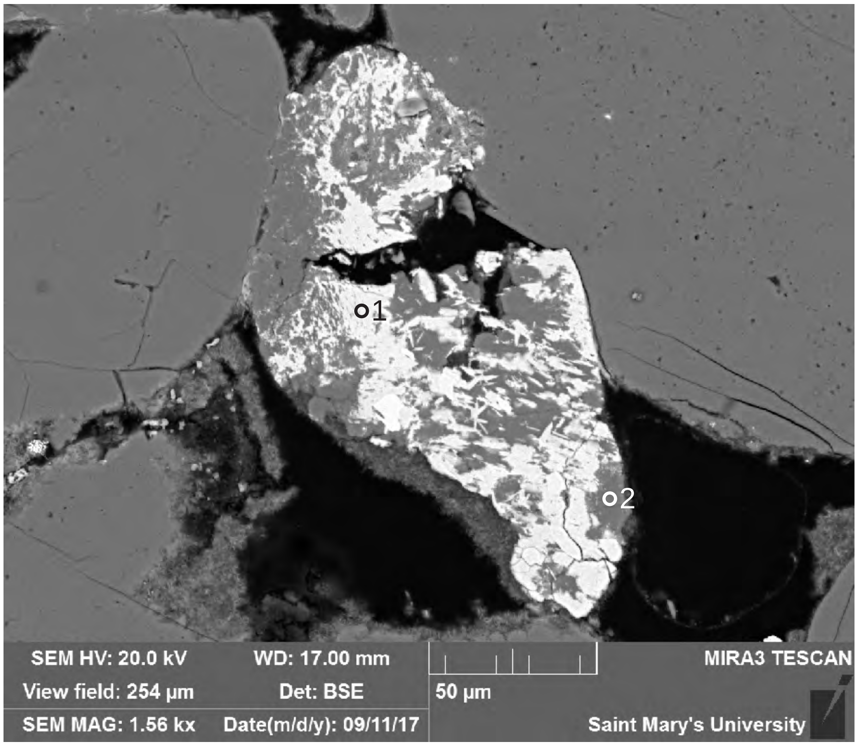


Figure 1-1.40: Sample E-48-2244.39 site 14.1 (SEM). This site consists of an altered ilmenite crystal with quartz inclusions (2).

1:Fe-Chlorite
2:Fe-Chlorite
3:Quartz

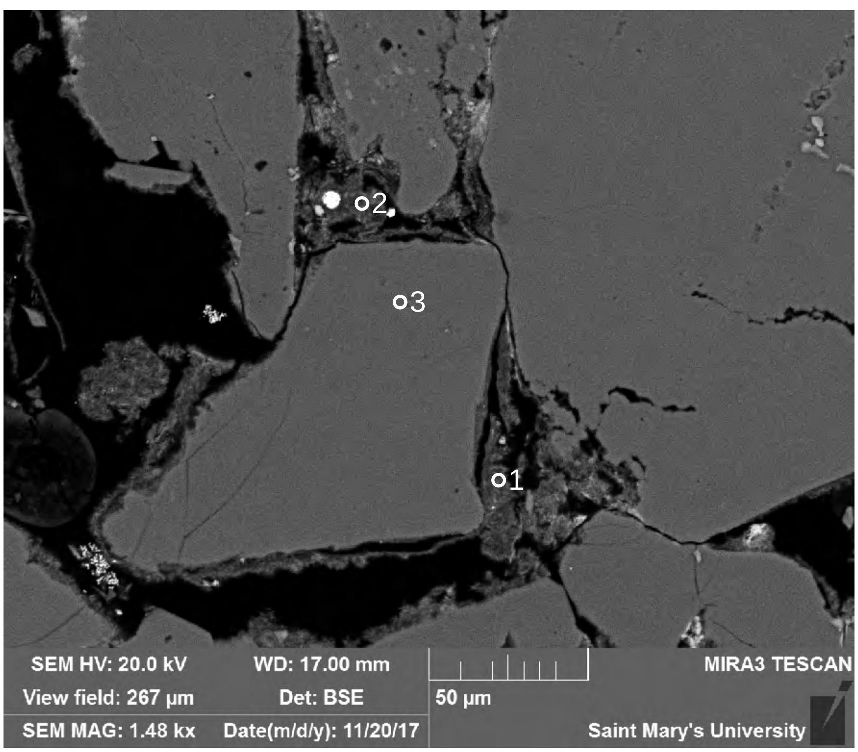
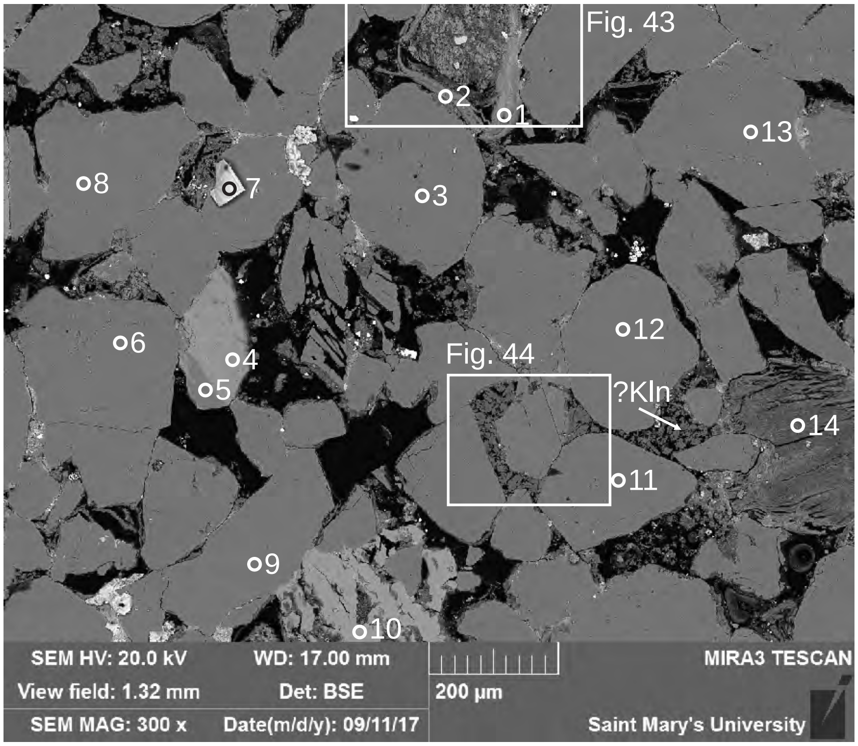
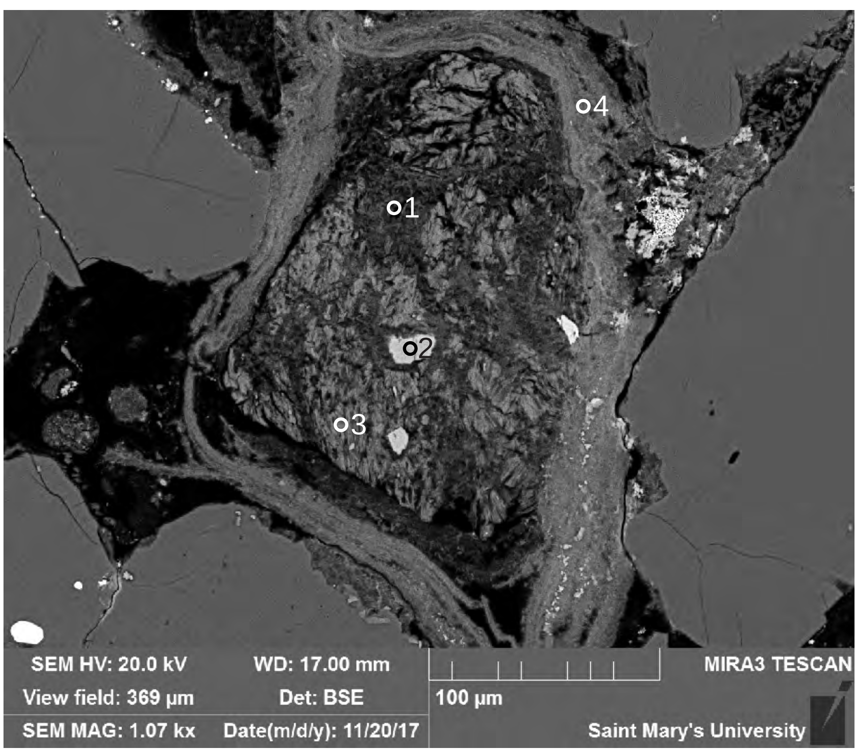


Figure 1-1.41: Sample E-48-2244.39 site 14.2 (SEM). This site consists of detrital quartz (3) grains and a cement made up of fine-grained Fe-chlorite (1-1).



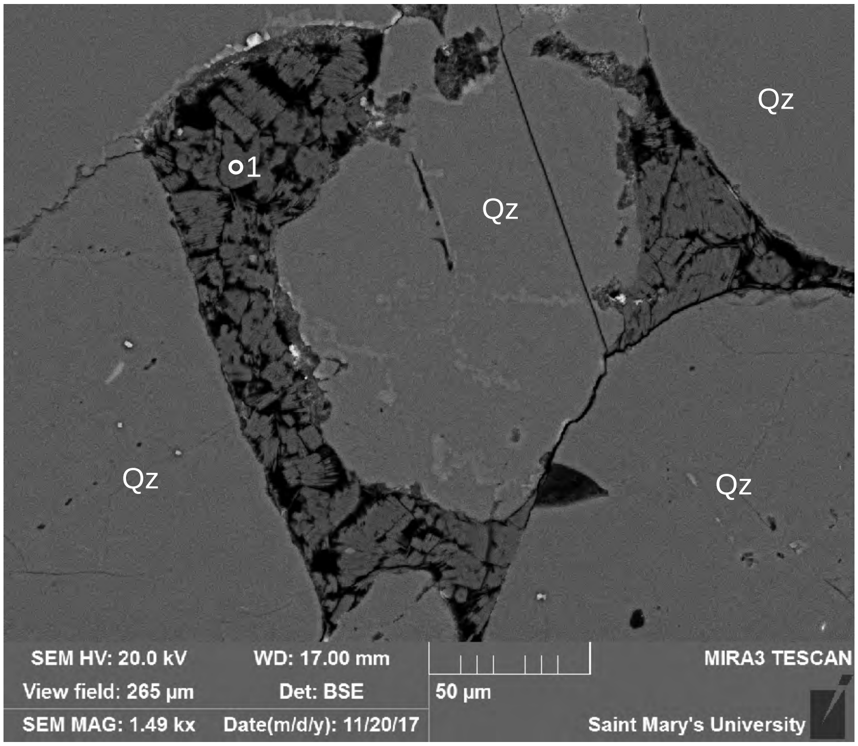
1:Fe-Chlorite
2:Fe-Chlorite
3:Quartz
4:K-feldspar
5:Albite
6:Quartz
7:Halite
8:Quartz
9:Quartz
10:K-feldspar
11:Quartz
12:Quartz
13:Quartz
14:Chlorite

Figure 1-1.42: Sample E-48-2244.39 site 15 (SEM). This site contains mostly quartz and some partly altered K-feldspar grains. K-feldsar (4) and albite (5) appear to be a granitoid lithic clast. Kaolinite booklets are common between grains.



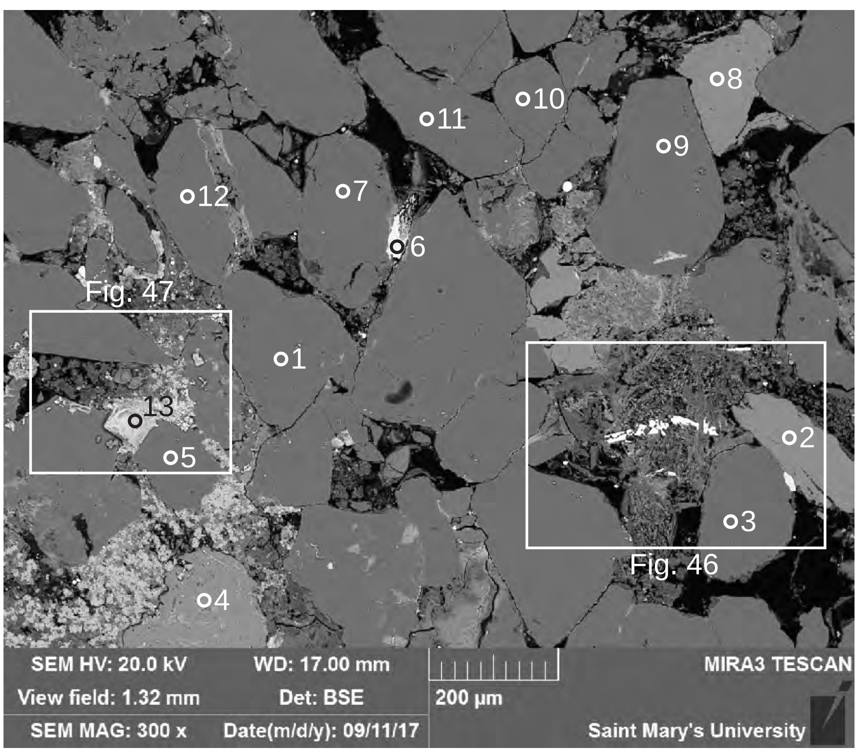
1:Chlorite
2:Apatite
3:Chlorite
4:Fe-Chlorite

Figure 1-1.43: Sample E-48-2244.39 site 15.1 (SEM). This site consists of a ?deformed coated grain that is made up of chlorite (3) with chlorite (1) veinlets cutting through it. Apatite (2) appears to be detrital and the outer coating is made up of Fe-chlorite (4).



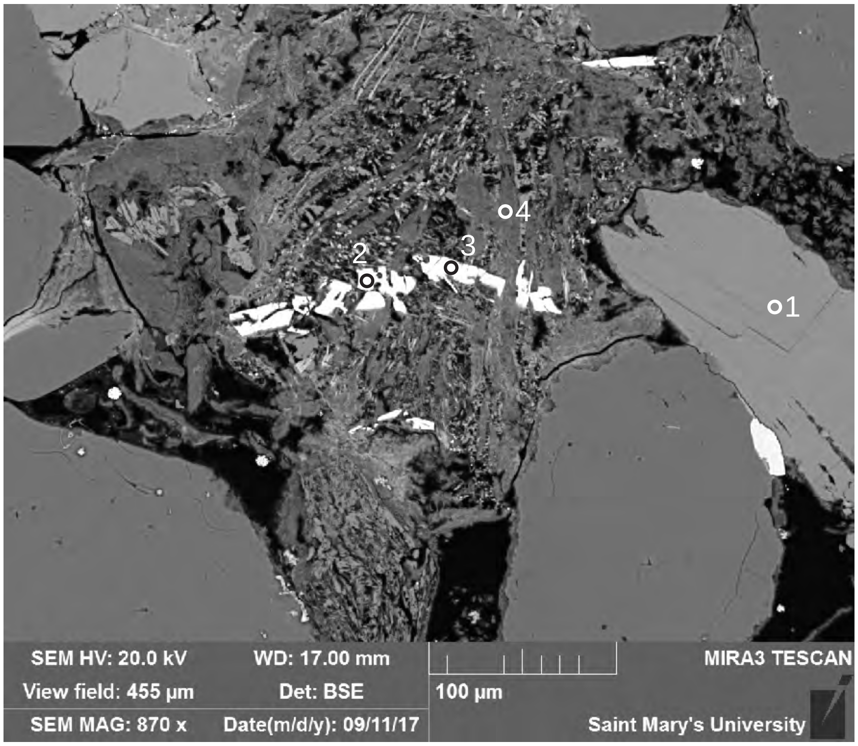
1:Kaolinite

Figure 1-1.44: Sample E-48-2244.39 site 15.2 (SEM). This site consists of kaolinite (1) forming the cement between detrital quartz grains.



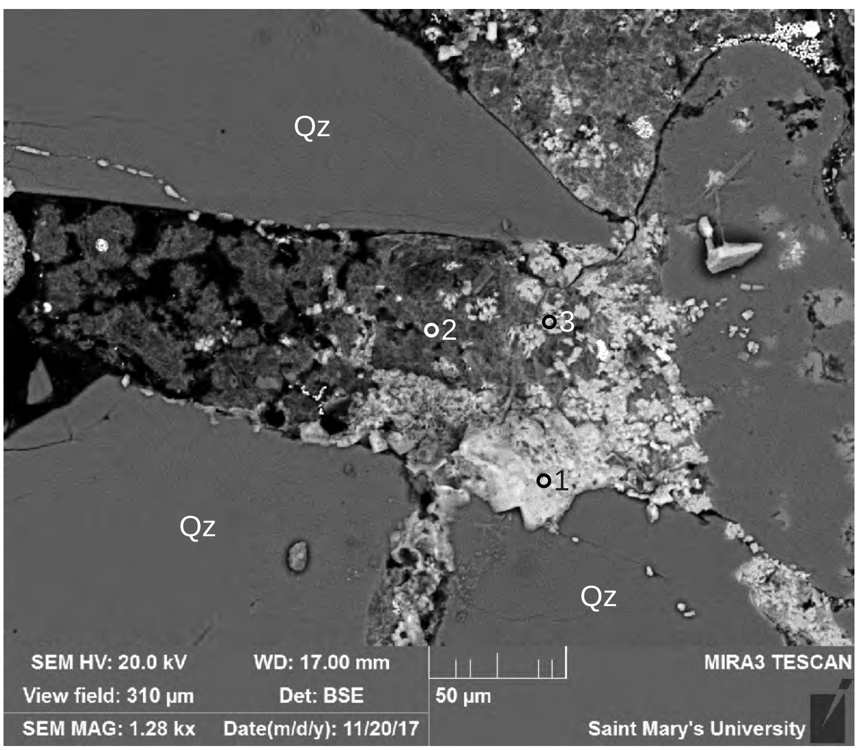
1:Quartz
2:K-feldspar
3:Quartz
4:K-feldspar
5:Quartz
6:TiO_2
7:Quartz
8:K-feldspar
9:Quartz
10:Quartz
11:Quartz
12:Quartz
13:Halite

Figure 1-1.45: Sample E-48-2244.39 site 16 (SEM). This site consists mainly of quartz with some K-feldspar (2,8) grains, Fe-chlorite cement (Figs. 44-45), late halite (13) precipitation between grain boundaries, and late titania (6) minerals.



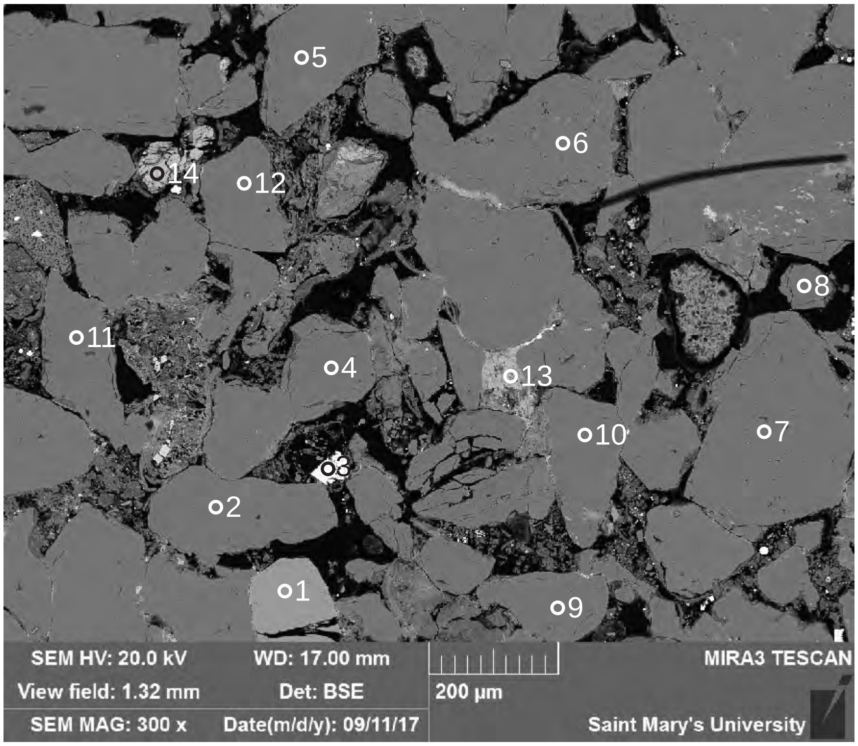
1:K-feldspar
2:TiO_2
3:TiO_2
4:Fe-Chlorite

Figure 1-1.46: Sample E-48-2244.39 site 16.1 (SEM). This site consists of a titania (2-3) mineral veinlet that is cross-cutting Fe-chlorite (4). This site may be an intraclast.



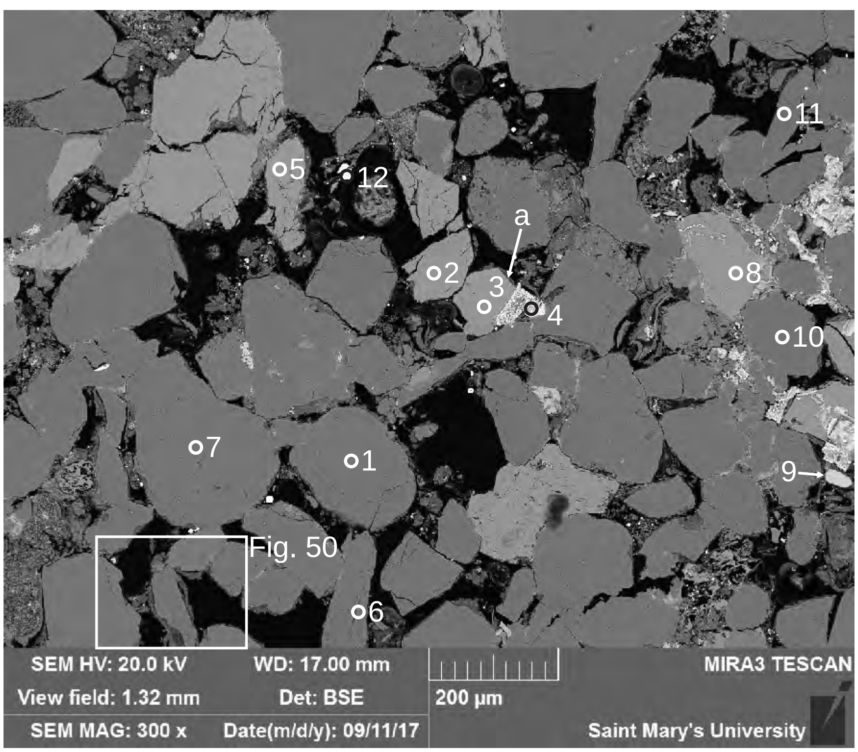
1:Halite
2:Fe-Chlorite
3:Siderite +

Figure 1-1.47: Sample E-48-2244.39 site 16.2 (SEM). Part of this site is similar to sites 5.2, 7.1, 10.1, 11.4, 12.4. Otherwise this site consists of detrital quartz grains with a fine-grained Fe-chlorite cement. Halite (1) most likely formed later by washing the core with salt water.



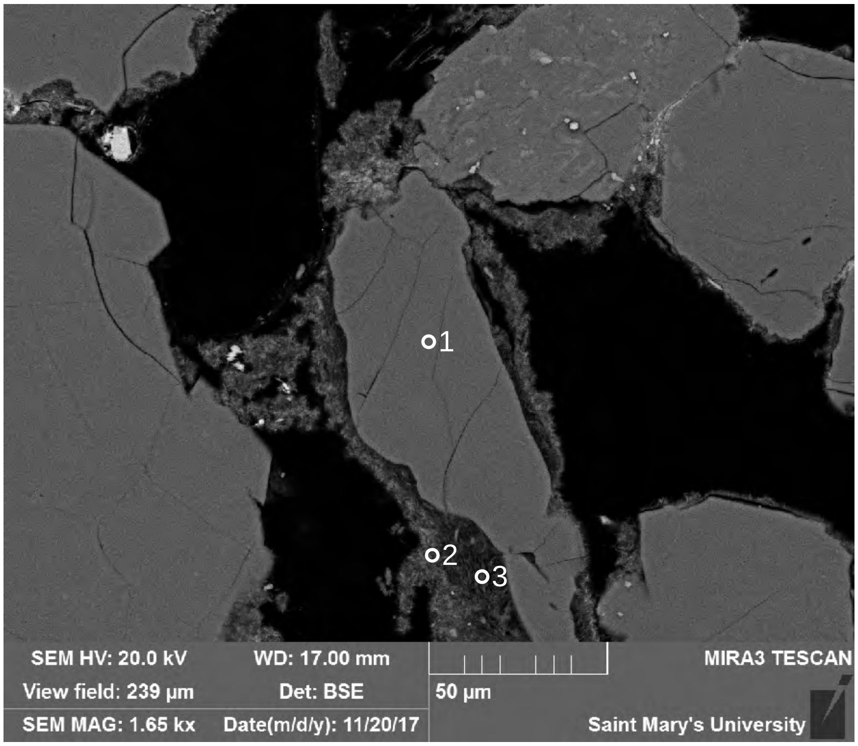
1:K-feldspar
2:Quartz
3:TiO_2
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:Quartz
11:Quartz
12:Quartz
13:Chlorite
14:Fe-Chlorite

Figure 1-1.48: Sample E-48-2244.39 site 17 (SEM). This site consists of mostly quartz grains that display suturing. Chlorite (13) appears to grow along grain boundaries or fill voids (14). Titania (3) appears to be the latest to form.



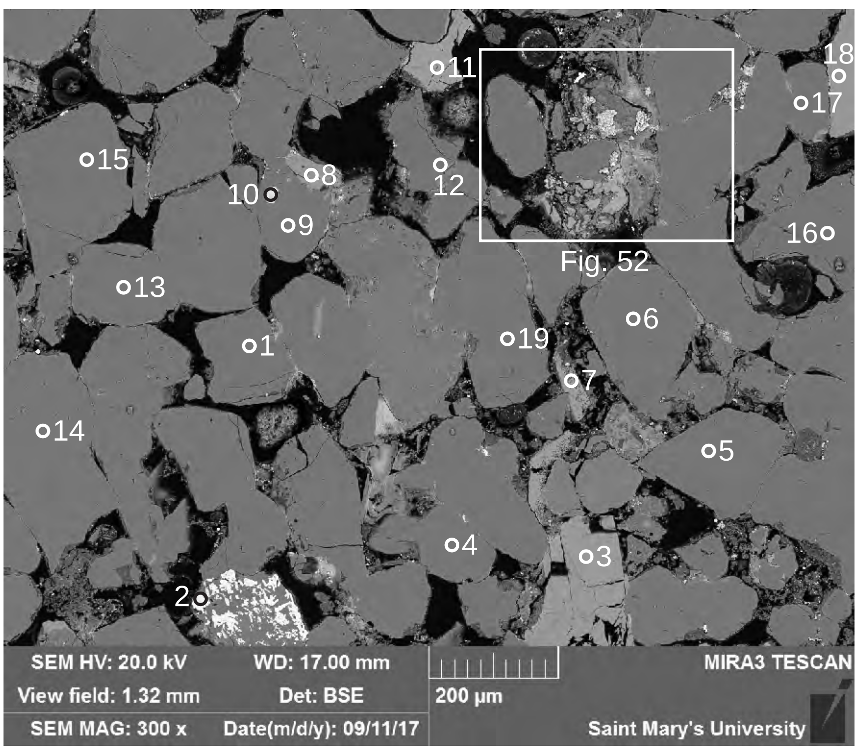
1:Quartz
2:K-feldspar
3:K-feldspar
4:TiO_2
5:K-feldspar
6:Quartz
7:Quartz
8:K-feldspar
9:Apatite
10:Quartz
11:Quartz
12:TiO_2

Figure 1-1.49: Sample E-48-2244.39 site 18 (SEM). This site consists of quartz and K-feldspar. Fe-clays (Fig. 48) commonly coat detrital grains and K-feldspar (3,5,8) contain overgrowths (position a). Apatite (9) appears to be detrital.



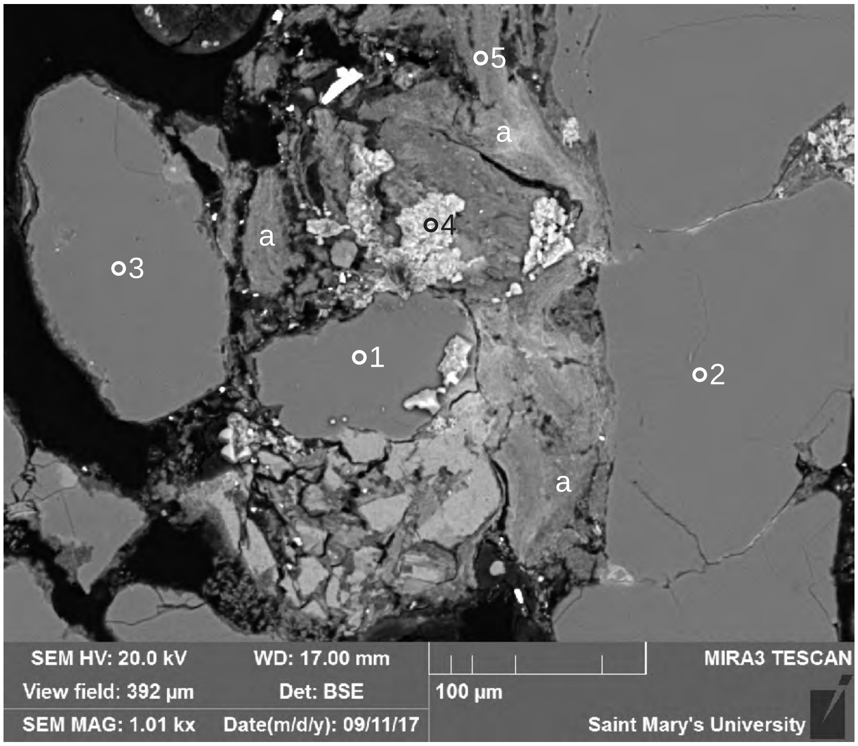
1:Quartz
2:Chlorite + Illite
3:Chlorite + Illite

Figure 1-1.50: Sample E-48-2244.39 site 18.1 (SEM). This site consists of detrital quartz (1) grains that appear to be coated by chlorite + illite (2-3).



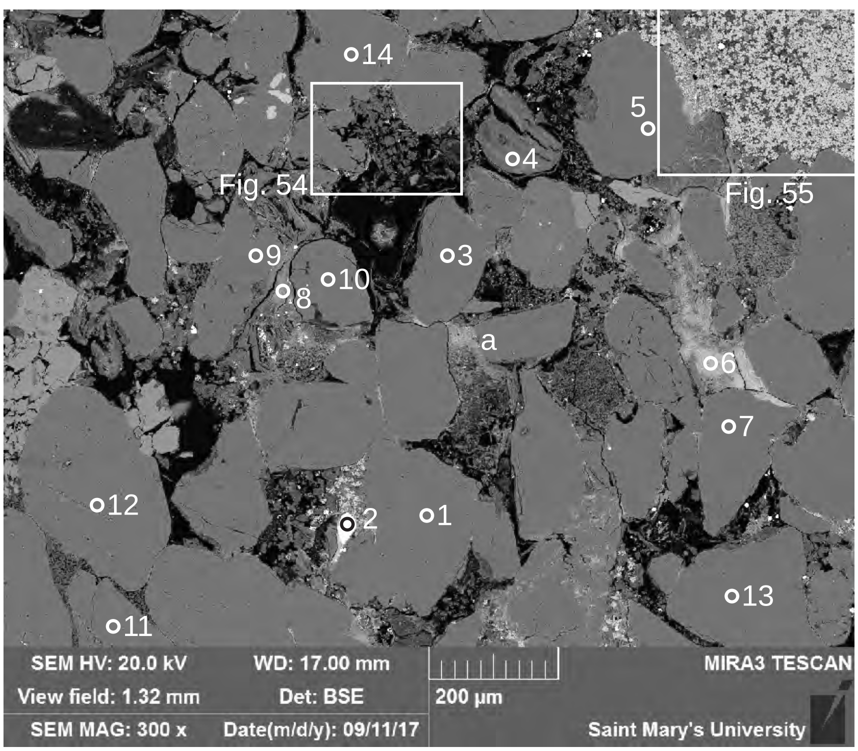
1:Quartz
2:"Ilmenite"
3:K-feldspar +
4:Quartz
5:Quartz
6:Quartz
7:Calcite
8:K-feldspar
9:Quartz
10:Apatite
11:K-feldspar
12:Quartz
13:Quartz
14:Quartz
15:Quartz
16:Quartz
17:Quartz
18:K-feldspar
19:Quartz

Figure 1-1.51: Sample E-48-2244.39 site 19 (SEM). This site is mostly made up of quartz with some K-feldspar grains. There is also an altered ilmenite grain (2).



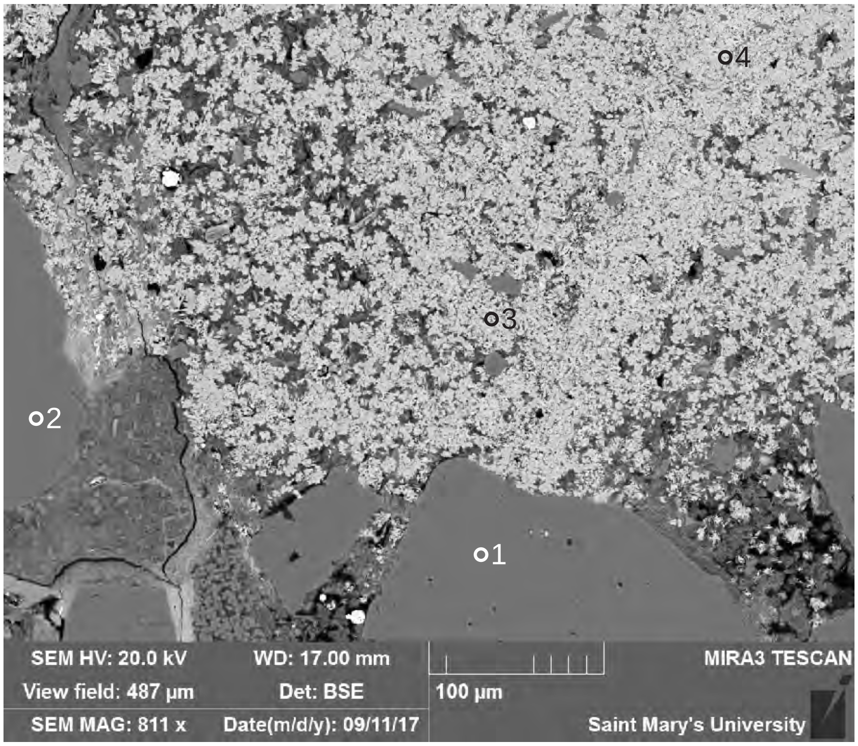
1:Quartz
2:Quartz
3:Quartz
4:Halite + Chlorite
5:Fe-Chlorite

Figure 1-1.52: Sample E-48-2244.39 site 19.1 (SEM). This site contains mostly quartz with halite (4) and fine-grained Fe-chlorite (5). Fragments of coated grains (position a) are also seen.



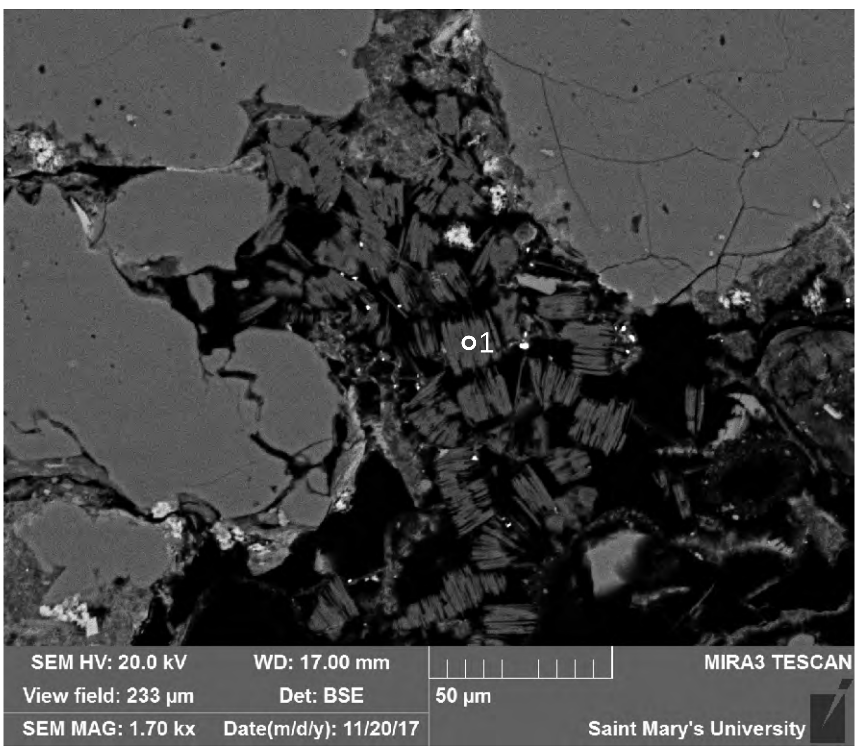
1:Quartz
2:Zircon
3:Quartz
4:Muscovite + Chlorite
5:Quartz
6:Fe-Chlorite +
7:Quartz
8:Mixture
9:Quartz
10:Quartz
11:Quartz
12:Quartz
13:Quartz
14:Quartz

Figure 1-1.53: Sample E-48-2244.39 site 20 (SEM). This site consists of quartz grains. Primary porosity appears to be partially filled by kaolinite, whereas fine-grained Fe-chlorite (6, position a) appears to fill mostly secondary porosity. There is a detrital grain of chloritized muscovite (4), and zircon (2) appears to be an inclusion in quartz.



1:Quartz
2:Quartz
3:Siderite +
4:Siderite + Chlorite

Figure 1-1.54: Sample E-48-2244.39 site 20.1 (SEM). This site is similar to sites 5.2, 7.1, 10.1, 11.4, and 12.4.



1:Kaolinite

Figure 1-1.55: Sample E-48-2244.39 site 20.2 (SEM). This site consists of detrital quartz grains with kaolinite (1) partially filling primary porosity.

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	1	1	Zrn	31.39														68.61							100	120
E-48-2244.39	1	2	Qz	100.00																					100	125
E-48-2244.39	1	3	Kfs	66.30		17.80					0.70	15.20													100	118
E-48-2244.39	1	4	Qz	100.00																					100	118
E-48-2244.39	1	5	Qz	100.00																					100	117
E-48-2244.39	1	6	Qz	100.00																					100	118
E-48-2244.39	1	7	Qz	100.00																					100	116
E-48-2244.39	1	8	Qz	100.00																					100	125
E-48-2244.39	1	9	Kfs	65.80		17.61					0.73	15.12							0.74						100	115
E-48-2244.39	1	10	Kfs	65.42		18.03					0.69	14.84							1.02						100	117
E-48-2244.39	1	11	Ms	48.69	0.87	28.38	4.19		1.88		0.42	10.57													95	114
E-48-2244.39	1	12	Kfs	66.43		18.11					1.44	14.02													100	113
E-48-2244.39	1	13	Qz	99.82			0.18																		100	119
E-48-2244.39	1	14	Qz	100.00																					100	120
E-48-2244.39	1.1	1	Qz	99.74			0.26																		100	121
E-48-2244.39	1.1	2	Hl +	2.47			15.29			0.46	25.84			38.75		17.19									100	196
E-48-2244.39	1.1	3	Py	1.47		0.29	28.28			0.22	2.59			65.22		1.91									100	144
E-48-2244.39	1.1	4	Fe-Chl	28.78		20.56	29.32		4.53		0.98	0.48				0.36									85	94
E-48-2244.39	1.1	5	TiO2		98.53	0.40	1.08																		100	109
E-48-2244.39	1.1	6	Ms + Chl	43.56		22.73	24.22		4.48		1.10	3.38				0.53									100	81
E-48-2244.39	1.1	7	Kln	49.33		36.43	0.24																		86	99
E-48-2244.39	1.1	8	Fe-Chl	30.39	0.33	20.91	26.57		5.08		0.82	0.33				0.56									85	64
E-48-2244.39	1.1	9	Qz	100.00																					100	122
E-48-2244.39	1.2	1	Kfs	66.14	0.34	17.73					0.83	14.97													100	118
E-48-2244.39	1.2	2	Ap							48.40			44.21		5.51							1.87			100	123
E-48-2244.39	1.2	3	Qz	100.00																					100	119
E-48-2244.39	1.2	4	Chl	33.10		21.04	22.78		5.87		0.94	0.90				0.37									85	98
E-48-2244.39	1.2	5	TiO2	3.32	92.85	1.57	1.84					0.42													100	102
E-48-2244.39	1.2	6	Fe-Chl	29.63	0.48	20.93	27.88		4.31		0.66	0.37				0.74									85	59
E-48-2244.39	1.2	7	Sd +	6.07		2.44	72.51	1.71	8.79	5.62	1.76	0.37				0.73									100	62
E-48-2244.39	2	1	Qz	100.00																					100	120
E-48-2244.39	2	2	TiO2	0.97	96.80	1.60	0.64																		100	109
E-48-2244.39	2	3	Kfs	66.26		17.55					0.48	15.71													100	115
E-48-2244.39	2	4	Kfs	66.19		18.08					1.24	14.50													100	112
E-48-2244.39	2	5	Kfs	65.70		17.82					0.87	14.92							0.68						100	112
E-48-2244.39	2	6	Qz	100.00																					100	115
E-48-2244.39	2	7	Qz	100.00																					100	117
E-48-2244.39	2	8	Qz	100.00																					100	114
E-48-2244.39	2	9	Qz	100.00																					100	119
E-48-2244.39	2	10	Kfs +	66.32		17.75					2.37	13.56													100	116
E-48-2244.39	2	11	Qz	100.00																					100	117
E-48-2244.39	2	12	Qz	100.00																					100	118
E-48-2244.39	2	13	Hl	0.59							50.03					49.38									100	152

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	2	14	TiO2	1.61	94.62	1.96	1.81																		100	102
E-48-2244.39	2	15	Kfs	66.26		17.89					0.65	15.20													100	112
E-48-2244.39	2.1	1	Kfs	65.98		18.12					0.45	15.46													100	119
E-48-2244.39	2.1	2	Qz	100.00																					100	122
E-48-2244.39	2.1	3	Qz	100.00																					100	122
E-48-2244.39	2.1	4	Fe-Chl	30.91	1.09	20.64	26.52		4.01		0.81	0.55				0.48									85	78
E-48-2244.39	3	1	Qz	100.00																					100	118
E-48-2244.39	3	2	TiO2	1.53	96.01	1.21	1.25																		100	109
E-48-2244.39	3	3	TiO2	1.22	96.36	1.56	0.87																		100	109
E-48-2244.39	3	4	Kfs	66.20		17.86					0.82	15.12													100	117
E-48-2244.39	3	5	Qz	100.00																					100	120
E-48-2244.39	3	6	Qz	100.00																					100	118
E-48-2244.39	3	7	Kfs	65.72		17.77					0.62	15.27							0.61						100	114
E-48-2244.39	3	8	Qz	100.00																					100	120
E-48-2244.39	3	9	Zrn	29.44		1.46	0.55			1.20	0.90					0.99		64.06			1.41				100	104
E-48-2244.39	3	10	Qz	100.00																					100	124
E-48-2244.39	3	11	Kfs	66.17		18.18					1.06	14.59													100	114
E-48-2244.39	3	12	Qz	100.00																					100	117
E-48-2244.39	3	13	Qz	100.00																					100	123
E-48-2244.39	3	14	Hl +	9.72						1.18	40.32			1.74		47.04									100	128
E-48-2244.39	4	1	Qz	100.00																					100	120
E-48-2244.39	4	2	Spl	0.46		38.40	15.62		16.55								28.97								100	110
E-48-2244.39	4	3	Qz	100.00																					100	123
E-48-2244.39	4	4	Qz	100.00																					100	125
E-48-2244.39	4	6	Qz	100.00																					100	117
E-48-2244.39	4	7	Qz	100.00																					100	118
E-48-2244.39	4	8	Kfs	66.52		17.85					0.86	14.77													100	117
E-48-2244.39	4	9	Qz	100.00																					100	118
E-48-2244.39	4	10	Grt	39.71		21.06	27.78	0.87	1.45	9.13															100	112
E-48-2244.39	4.1	1	Qz	100.00																					100	123
E-48-2244.39	4.1	2	TiO2	0.94	96.96	1.52	0.58																		100	108
E-48-2244.39	4.1	3	Kfs	66.32		17.69					0.83	15.16													100	118
E-48-2244.39	4.1	4	TiO2	0.53	97.73	0.78	0.96																		100	106
E-48-2244.39	4.1	5	Kfs	66.28		17.71					0.53	15.47													100	116
E-48-2244.39	4.1	6	Mix	52.36		19.26	12.32		1.96	2.18	0.55	9.10	2.27												100	100
E-48-2244.39	5	1	Qz	100.00																					100	121
E-48-2244.39	5	2	Fe-Chl	28.48		21.38	29.12		4.57		0.77	0.21				0.46									85	68
E-48-2244.39	5	3	Qz	100.00																					100	121
E-48-2244.39	5	4	Qz	100.00																					100	123
E-48-2244.39	5	5	Kfs	66.19		18.12					1.40	14.28													100	116
E-48-2244.39	5	6	Kfs	66.41		17.58					0.46	15.56													100	119
E-48-2244.39	5	7	Kfs	65.79		17.70					0.55	15.29							0.67						100	115
E-48-2244.39	5	8	Qz	100.00																					100	117

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	5.1	1	Qz	100.00																					100	120
E-48-2244.39	5.1	2	Sd +	1.48			68.96		15.17	14.39															100	58
E-48-2244.39	5.1	3	Qz	99.77			0.23																		100	121
E-48-2244.39	5.1	4	Ms	46.46	0.52	29.86	7.43		1.91		0.57	8.25													95	104
E-48-2244.39	5.1	5	Sd	1.22			37.06	0.39	8.44	8.21	0.68														56	61
E-48-2244.39	5.1	6	Ill + Chl	47.98	0.41	22.96	17.95		4.14		1.05	4.51				1.01									100	67
E-48-2244.39	5.1	7	Kfs	66.09		17.75	0.25				0.32	15.59													100	119
E-48-2244.39	5.1	8	Qz	100.00																					100	123
E-48-2244.39	5.1	9	Kfs	66.14		17.78					0.77	15.31													100	117
E-48-2244.39	5.2	1	Kfs	66.16		17.66	0.40				0.62	15.16													100	112
E-48-2244.39	5.2	2	Py +	2.68		1.46	33.62		0.44	0.44	0.49	0.17		60.69											100	151
E-48-2244.39	5.2	3	Sd +	4.26		1.90	72.43	1.15	10.91	7.38	1.43					0.54									100	62
E-48-2244.39	5.2	4	Chl + Ill	33.83	0.78	23.25	33.56		4.90	0.62	1.12	0.59				1.36									100	66
E-48-2244.39	5.2	5	Qz +	91.39		1.49	5.13		0.54	0.54	0.35					0.55									100	111
E-48-2244.39	5.2	6	Chl + Ill	36.58		24.13	31.98		4.97	0.31	0.92	0.68				0.43									100	67
E-48-2244.39	6	1	Qz	100.00																					100	118
E-48-2244.39	6	2	Kfs	66.31		17.94					0.89	14.86													100	113
E-48-2244.39	6	3	Kfs	65.38		18.04					0.51	15.04							1.04						100	112
E-48-2244.39	6	4	Kfs	66.22		17.87					0.70	15.21													100	109
E-48-2244.39	6	5	Qz	98.59	0.70	0.39	0.32																		100	112
E-48-2244.39	6	6	Kfs	65.19		18.14					0.66	14.47							1.54						100	111
E-48-2244.39	6	7	Hl	0.71							48.01					51.28									100	137
E-48-2244.39	6	8	Kfs	65.93		17.79					0.93	14.55							0.80						100	116
E-48-2244.39	6	9	Hl	0.99							52.98					46.03									100	157
E-48-2244.39	6	10	Hl	5.00		2.33	4.34			1.85	42.84	0.16		7.92		35.55									100	116
E-48-2244.39	6	11	Ap							48.35			44.23		5.86							1.56			100	125
E-48-2244.39	6	12	Qz	100.00																					100	118
E-48-2244.39	6	13	Kfs	65.67		17.98	0.64				0.70	15.01													100	111
E-48-2244.39	6	14	Qz	100.00																					100	117
E-48-2244.39	6	15	Hl	5.03		0.76	1.20			0.38	47.62					45.01									100	103
E-48-2244.39	7	1	Kfs	66.37		17.74					0.70	15.18													100	114
E-48-2244.39	7	2	Spl			27.68	18.16		9.83								44.33								100	105
E-48-2244.39	7	3	Qz	100.00																					100	118
E-48-2244.39	7	4	Qz	100.00																					100	119
E-48-2244.39	7	5	Hl	0.46							43.71					55.83									100	122
E-48-2244.39	7	6	Qz	100.00																					100	124
E-48-2244.39	7	7	Kfs	66.00		17.94					0.67	15.38													100	116
E-48-2244.39	7	8	Kfs	66.08		17.64	0.28				0.90	15.11													100	117
E-48-2244.39	7	9	Qz	100.00																					100	125
E-48-2244.39	7	10	Qz	100.00																					100	118
E-48-2244.39	7	11	Kfs +	66.42		17.76					2.08	13.74													100	111
E-48-2244.39	7	12	Qz	100.00																					100	120
E-48-2244.39	7	13	Kfs	66.23		17.54					0.37	15.85													100	118

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	7.1	1	Grt	39.75		20.77	29.62	0.29	1.30	8.27															100	111
E-48-2244.39	7.1	2	Qz	98.54		0.93	0.33					0.20													100	118
E-48-2244.39	7.1	3	Ms	50.27		29.97	2.64		2.16		0.65	9.32													95	104
E-48-2244.39	7.1	4	Kfs	65.85		17.87	0.49				0.95	14.84													100	115
E-48-2244.39	7.1	5	Qz	99.45			0.55																		100	119
E-48-2244.39	7.1	6	Sd	0.96		0.43	39.45	0.47	6.87	7.16	0.66														56	57
E-48-2244.39	7.1	7	Sd? +	2.11			70.33	0.79	14.11	11.79	0.87														100	61
E-48-2244.39	7.2	1	Kfs	66.37		17.64					1.11	14.88													100	114
E-48-2244.39	7.2	2	Ab +	65.06		22.05				2.97	9.34	0.57													100	116
E-48-2244.39	7.2	3	Kfs	65.70		18.83				1.03	8.73	5.72													100	119
E-48-2244.39	7.3	1	Spl			28.12	17.86		8.92								45.10								100	104
E-48-2244.39	7.3	2	Fe-Chl	29.52		21.13	27.35		4.72	0.28	0.87	0.37				0.77									85	61
E-48-2244.39	7.3	3	Chl + Ill	57.14		23.08	8.04		3.07		1.56	6.42				0.69									100	84
E-48-2244.39	7.3	4	Chl + Ill	56.35		22.67	8.71		2.95		1.52	6.75				1.05									100	84
E-48-2244.39	7.3	5	Qz	99.76			0.24																		100	119
E-48-2244.39	7.3	6	Qz	100.00																					100	118
E-48-2244.39	7.3	7	Fe-Chl	31.16		22.75	25.06		4.41		0.88					0.74									85	52
E-48-2244.39	7.4	2	Hole/contar	70.91		9.46	4.85		2.49	3.30	4.78	1.33		2.88											100	41
E-48-2244.39	8	1	Qz	100.00																					100	120
E-48-2244.39	8	2	Qz	100.00																					100	121
E-48-2244.39	8	3	Qz	100.00																					100	118
E-48-2244.39	8	4	Qz	100.00																					100	118
E-48-2244.39	8	5	Kfs	66.26		17.85					0.66	15.23													100	113
E-48-2244.39	8	6	Qz	100.00																					100	116
E-48-2244.39	8	7	Chl + Kfs	46.88		21.22	24.65		3.41		1.36	1.67				0.81									100	52
E-48-2244.39	8	8	Kfs	66.09		18.03					0.64	15.23													100	115
E-48-2244.39	8	9	Qz	100.00																					100	118
E-48-2244.39	8	10	Qz	100.00																					100	121
E-48-2244.39	8	11	Fe-Chl	29.18		20.95	28.86		4.73		0.63	0.21				0.43									85	69
E-48-2244.39	8	12	Kfs	64.27		18.48					1.18	13.53							2.54						100	118
E-48-2244.39	8	13	Chl + Kfs	52.46		18.13	16.22		3.12		1.67	7.45				0.95									100	92
E-48-2244.39	8.1	1	Chl + Ill	37.41		25.32	29.43		4.94		0.97	0.97				0.94									100	58
E-48-2244.39	8.1	2	Chl + Ill	36.14		24.74	31.35		5.28		0.97	0.70				0.83									100	56
E-48-2244.39	9	1	Kfs	65.43		18.28					1.38	14.03							0.88						100	117
E-48-2244.39	9	2	Kfs	65.71		18.07					1.39	13.97							0.86						100	120
E-48-2244.39	9	3	Qz	100.00																					100	122
E-48-2244.39	9	4	Qz	100.00																					100	124
E-48-2244.39	9	5	Qz	100.00																					100	125
E-48-2244.39	9	6	Qz	100.00																					100	121
E-48-2244.39	9	7	Qz	100.00																					100	120
E-48-2244.39	9	8	Hl	0.72						2.38	43.63			7.43		45.84									100	125
E-48-2244.39	9	9	Qz	100.00																					100	117
E-48-2244.39	9	10	Qz	100.00																					100	119

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	9	11	Qz	100.00																					100	115
E-48-2244.39	9	12	Qz	100.00																					100	123
E-48-2244.39	9.1	1	Chl + Hl	31.12		23.39	33.98		5.32		3.53					2.65									100	85
E-48-2244.39	9.1	2	Chl	30.82	0.44	15.28	28.44		8.40		1.16	0.21				0.26									85	90
E-48-2244.39	9.1	3	Hl +	6.22		3.52	8.82		0.37		36.96					42.42							1.68		100	86
E-48-2244.39	9.1	4	Chl	28.35		20.83	29.84		4.34		0.74	0.24				0.66									85	72
E-48-2244.39	9.2	1	Contaminat	74.94		1.31	0.23		4.43	7.31	11.28	0.51													100	97
E-48-2244.39	9.2	2	Contaminat	67.96		12.95	12.73		1.80	0.53	1.20	1.80				1.03									100	42
E-48-2244.39	10	1	Kfs	66.19		17.75					0.47	15.59													100	114
E-48-2244.39	10	2	Qz	100.00																					100	118
E-48-2244.39	10	3	Qz	100.00																					100	116
E-48-2244.39	10	4	Kfs	66.00		18.03					0.55	15.42													100	113
E-48-2244.39	10	5	Qz	100.00																					100	124
E-48-2244.39	10	6	Qz	96.13		3.15	0.45									0.28									100	107
E-48-2244.39	10	7	Qz	100.00																					100	123
E-48-2244.39	10	8	Kfs	66.23		17.75					0.70	15.32													100	115
E-48-2244.39	10	9	Qz	100.00																					100	119
E-48-2244.39	10	10	Qz	100.00																					100	116
E-48-2244.39	10	11	Qz +	94.90		3.56	0.72					0.82													100	112
E-48-2244.39	10	12	TiO2	0.60	98.56		0.84																		100	103
E-48-2244.39	10.1	1	Fe-Chl +	29.83	0.44	20.54	27.55		4.20		0.75	0.79				0.91									85	71
E-48-2244.39	10.1	2	Sd +	4.18		1.22	74.86	1.48	9.33	6.48	1.82					0.63									100	59
E-48-2244.39	10.1	3	Fe-Chl +	30.22	0.32	20.91	26.85		4.47		0.61	0.76				0.86									85	66
E-48-2244.39	11	1	Ms	47.72	1.04	32.60	1.57		1.07		0.47	10.54													95	103
E-48-2244.39	11	2	Qz	100.00																					100	114
E-48-2244.39	11	3	Hl	0.49							49.09					50.42									100	140
E-48-2244.39	11	4	TiO2	0.87	96.61	1.07	1.45																		100	103
E-48-2244.39	11	5	Kfs	66.08		17.98					0.78	15.17													100	115
E-48-2244.39	11	6	Qz	100.00																					100	119
E-48-2244.39	11	7	Kfs	66.48	0.28	17.87					1.81	13.56													100	114
E-48-2244.39	11	8	Qz	100.00																					100	123
E-48-2244.39	11	9	Qz	100.00																					100	120
E-48-2244.39	11	10	Ab	69.45		18.72					11.83														100	113
E-48-2244.39	11	11	Qz	100.00																					100	116
E-48-2244.39	11	12	Qz	100.00																					100	117
E-48-2244.39	11.1	1	Fe-Chl	30.89		21.14	26.40		4.39		0.77	0.73				0.69									85	59
E-48-2244.39	11.1	2	Kfs	65.78		18.04					0.91	14.72							0.55						100	114
E-48-2244.39	11.1	3	Chl + Ill	40.44		24.80	26.53		4.71		0.89	1.98				0.64									100	64
E-48-2244.39	11.1	4	Fe-Chl	31.39		21.28	25.64		4.38		0.88	0.62				0.80									85	59
E-48-2244.39	11.1	5	Qz	100.00																					100	117
E-48-2244.39	11.2	1	Qz	99.30		0.55						0.16													100	114
E-48-2244.39	11.2	2	Fe-Chl	29.38		21.26	28.61		4.67			0.50				0.59									85	60
E-48-2244.39	11.2	3	Cal				1.67		0.48	53.86															56	54

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	11.3	1	Hole/contar	57.22		7.74	4.05		3.69	5.56	5.47	1.55	11.25	2.51		0.96									100	22
E-48-2244.39	11.4	1	Sd +	3.68		1.49	74.78	1.88	9.19	6.91	1.59					0.49									100	61
E-48-2244.39	11.4	2	Chl + Ill	46.08		22.25	25.26		3.55		1.09	0.72				1.06									100	72
E-48-2244.39	11.4	3	Qz	99.57			0.37					0.06													100	114
E-48-2244.39	11.4	4	Fe-Chl	29.08	0.34	20.85	28.84		4.42		0.65	0.39				0.43									85	80
E-48-2244.39	11.4	5	Qz	100.00																					100	117
E-48-2244.39	12	1	Qz	100.00																					100	116
E-48-2244.39	12	2	Qz	100.00																					100	120
E-48-2244.39	12	3	Hl	0.60							46.24					53.16									100	135
E-48-2244.39	12	4	Zrn	30.86														67.31			1.83				100	121
E-48-2244.39	12	5	Qz	100.00																					100	121
E-48-2244.39	12	6	Hl	1.08		0.28	0.26				47.51					50.88									100	143
E-48-2244.39	12	7	Kfs	66.34		17.91					1.13	14.63													100	117
E-48-2244.39	12	8	Qz	100.00																					100	119
E-48-2244.39	12	9	Qz	100.00																					100	118
E-48-2244.39	12	10	Qz	100.00																					100	118
E-48-2244.39	12	11	Qz	100.00																					100	115
E-48-2244.39	12	12	Ab	69.60		19.02					11.38														100	123
E-48-2244.39	12	13	Qz	100.00																					100	116
E-48-2244.39	12.1	1	Qz	100.00																					100	119
E-48-2244.39	12.1	2	Qz	99.57						0.43															100	115
E-48-2244.39	12.1	3	Fe-Chl	28.79		20.42	29.99		4.45		0.54	0.24				0.58									85	60
E-48-2244.39	12.1	4	Py	0.63			28.96							70.40											100	219
E-48-2244.39	12.2	1	Qz	100.00																					100	115
E-48-2244.39	12.2	2	Fe-Chl	31.27		20.60	26.58		4.52		0.72	0.62				0.68									85	70
E-48-2244.39	12.2	3	Sd +	7.22		1.54	73.56	1.30	7.74	6.35	1.51					0.77									100	62
E-48-2244.39	12.2	4	Chl + Ms	51.34		27.94	7.08		2.57		0.92	9.51				0.64									100	105
E-48-2244.39	12.2	5	Qz	100.00																					100	115
E-48-2244.39	12.3	1	Fe-Chl	28.56		21.15	29.27		4.66		0.71					0.65									85	73
E-48-2244.39	12.3	2	Fe-Chl	29.32		20.52	29.22		4.11		0.68	0.47				0.68									85	68
E-48-2244.39	12.3	3	Fe-Chl	27.96		20.61	28.73		4.89	0.37	1.67	0.20				0.58									85	98
E-48-2244.39	12.3	4	Hl	4.78		1.12	0.97				50.50					42.63									100	154
E-48-2244.39	12.3	5	Fe-Chl	30.15		20.90	27.40		4.61		0.84	0.57				0.53									85	63
E-48-2244.39	12.3	6	Qz	99.72			0.28																		100	116
E-48-2244.39	12.3	7	Ms +	49.84		34.42	3.72		0.78		0.87	10.37													100	104
E-48-2244.39	12.3	8	Chl + Ms	55.39		22.54	10.18		2.54		1.35	6.96				1.04									100	77
E-48-2244.39	12.4	1	Qz	100.00																					100	119
E-48-2244.39	12.4	2	Kfs +	60.57		16.27	1.15			3.04	1.02	12.36	4.14			0.28				1.17					100	82
E-48-2244.39	12.4	3	Chl + Ms	52.20		20.23	12.89		3.23	1.80	2.04	6.78		0.62		0.21									100	100
E-48-2244.39	12.4	4	Sd +	3.98		1.91	74.49	1.40	9.59	6.54	1.69					0.40									100	62
E-48-2244.39	12.4	5	Hl +	17.87		6.58	5.58		0.93	0.71	35.89	2.33		0.68		29.43									100	125
E-48-2244.39	12.4	6	Fe-Chl	30.73		21.09	26.27		4.43	0.22	0.80	0.78				0.67									85	69
E-48-2244.39	12.4	7	Py	0.22			29.18							70.60											100	220

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	13	1	Qz	97.79							0.97					1.24									100	121
E-48-2244.39	13	2	Kfs	65.69		17.89					0.79	14.84							0.80						100	117
E-48-2244.39	13	3	Kfs	65.48		18.06					1.22	14.16							1.08						100	120
E-48-2244.39	13	4	Qz	100.00																					100	125
E-48-2244.39	13	5	Qz	100.00																					100	121
E-48-2244.39	13	6	Kfs	66.17		17.77					0.42	15.64													100	116
E-48-2244.39	13	7	Kfs	65.69		18.05					1.02	14.24							1.00						100	114
E-48-2244.39	13	8	Qz	100.00																					100	117
E-48-2244.39	13	9	Qz	100.00																					100	119
E-48-2244.39	13	10	Ab + Hl	63.74		17.19					15.72					3.36									100	118
E-48-2244.39	13	11	Kfs	66.00		17.86					0.43	15.71													100	114
E-48-2244.39	13	12	Kfs	66.15		17.72					0.57	15.56													100	109
E-48-2244.39	13.1	1	Kfs	66.02		18.77					2.86	11.42							0.93						100	116
E-48-2244.39	13.1	2	Ill + Chl	53.18		20.10	15.18		3.44		0.89	6.46				0.75									100	74
E-48-2244.39	13.1	3	Qz	100.00																					100	119
E-48-2244.39	13.1	4	Fe-Chl	30.82		20.84	26.63		4.40		0.78	0.86				0.66									85	66
E-48-2244.39	13.1	5	Kfs	66.27		17.61					0.37	15.76													100	115
E-48-2244.39	13.2	1	Fe-Chl	26.32		19.86	31.03		4.55	1.39	1.33			0.54											85	90
E-48-2244.39	13.2	2	Hl +	1.30		0.43	0.77				46.37					51.13									100	128
E-48-2244.39	13.2	3	Fe-Chl	29.47		18.79	24.37		11.55		0.82														85	91
E-48-2244.39	13.2	4	Chl + Ill	51.34		22.44	10.79		9.30		1.31	4.14				0.68									100	89
E-48-2244.39	13.2	5	Fe-Chl	28.64		20.76	29.82		4.66		0.67					0.44									85	75
E-48-2244.39	13.2	6	Qz	100.00																					100	119
E-48-2244.39	14	1	Qz	100.00																					100	118
E-48-2244.39	14	2	Kfs	66.34		17.47					0.43	15.76													100	118
E-48-2244.39	14	3	Hl +	1.75		0.54	1.40			1.49	40.55			7.50		46.77									100	102
E-48-2244.39	14	4	Grt	39.71		21.02	28.63	0.79	1.71	8.15															100	108
E-48-2244.39	14	5	Qz	100.00																					100	117
E-48-2244.39	14	6	Qz	100.00																					100	120
E-48-2244.39	14	7	Qz	100.00																					100	116
E-48-2244.39	14	8	Qz	100.00																					100	117
E-48-2244.39	14	9	Qz	100.00																					100	118
E-48-2244.39	14	10	Kfs	66.44		17.62						15.94													100	112
E-48-2244.39	14	11	Mix?	43.82	2.05	30.83	9.05		9.18	2.45	2.63														100	96
E-48-2244.39	14	12	Kfs	66.14		18.08					1.10	14.68													100	121
E-48-2244.39	14	13	Qz	100.00																					100	122
E-48-2244.39	14.1	1	"Ilm"	1.52	97.64	0.45	0.39																		100	104
E-48-2244.39	14.1	2	Qz	99.47	0.53																				100	118
E-48-2244.39	14.2	1	Fe-Chl	29.65		20.98	27.91		4.56		0.77	0.38				0.75									85	56
E-48-2244.39	14.2	2	Fe-Chl	29.21		21.39	27.74		4.68		0.94	0.24				0.79									85	64
E-48-2244.39	14.2	3	Qz	100.00																					100	119
E-48-2244.39	15	1	Fe-Chl	27.76		21.17	29.96		4.70		0.72					0.69									85	71
E-48-2244.39	15	2	Fe-Chl	28.48		20.96	29.28		4.88		0.69					0.71									85	72

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	15	3	Qz	100.00																					100	119
E-48-2244.39	15	4	Kfs	66.55		17.53					1.08	14.84													100	116
E-48-2244.39	15	5	Ab	68.67		18.64	1.24			0.24	11.21														100	114
E-48-2244.39	15	6	Qz	100.00																					100	118
E-48-2244.39	15	7	Hl	0.59							50.72					48.69									100	141
E-48-2244.39	15	8	Qz	100.00																					100	117
E-48-2244.39	15	9	Qz	100.00																					100	121
E-48-2244.39	15	10	Kfs	66.21		17.90					0.72	15.17													100	119
E-48-2244.39	15	11	Qz	100.00																					100	123
E-48-2244.39	15	12	Qz	100.00																					100	121
E-48-2244.39	15	13	Qz	100.00																					100	117
E-48-2244.39	15	14	Chl	31.53		23.07	24.85		3.85		0.76	0.31				0.64									85	64
E-48-2244.39	15.1	1	Chl	32.69		20.07	20.49		9.50		0.80	0.32				1.12									85	34
E-48-2244.39	15.1	2	Ap				0.60			48.10			43.76		5.85							1.69			100	120
E-48-2244.39	15.1	3	Chl	32.01		17.39	18.83		15.63		0.41	0.73													85	83
E-48-2244.39	15.1	4	Fe-Chl	30.11		21.34	27.27		4.51		0.77	0.21				0.80									85	73
E-48-2244.39	15.2	1	Kln	48.93		37.07																			86	99
E-48-2244.39	16	1	Qz	100.00																					100	116
E-48-2244.39	16	2	Kfs	66.26		17.76					0.52	15.46													100	117
E-48-2244.39	16	3	Qz	100.00																					100	121
E-48-2244.39	16	4	Kfs	65.99		17.97					1.05	14.98													100	111
E-48-2244.39	16	5	Qz	100.00																					100	116
E-48-2244.39	16	6	TiO2	1.06	96.88	1.45	0.61																		100	103
E-48-2244.39	16	7	Qz	100.00																					100	114
E-48-2244.39	16	8	Kfs	66.34		17.83					1.19	14.63													100	110
E-48-2244.39	16	9	Qz	100.00																					100	114
E-48-2244.39	16	10	Qz	100.00																					100	113
E-48-2244.39	16	11	Qz	100.00																					100	113
E-48-2244.39	16	12	Qz	100.00																					100	113
E-48-2244.39	16	13	Hl	0.56			0.38				41.42					57.64									100	103
E-48-2244.39	16.1	1	Kfs	66.10		17.77					0.60	15.53													100	115
E-48-2244.39	16.1	2	TiO2	0.64	53.47		44.00	0.88	0.71	0.29															100	100
E-48-2244.39	16.1	3	TiO2	0.53	53.20		44.32	0.75	0.98			0.22													100	100
E-48-2244.39	16.1	4	Fe-Chl	29.46		21.51	27.65		5.02		0.73					0.63									85	64
E-48-2244.39	16.2	1	Hl	1.93			0.58				42.25					55.23									100	115
E-48-2244.39	16.2	2	Fe-Chl	29.51		21.29	27.24		4.48		1.18	0.46				0.83									85	61
E-48-2244.39	16.2	3	Sd +	3.95		1.76	72.76	1.64	10.47	6.66	2.12					0.63									100	59
E-48-2244.39	17	1	Kfs	66.11	0.28	17.85					1.02	14.74													100	118
E-48-2244.39	17	2	Qz	100.00																					100	120
E-48-2244.39	17	3	TiO2	2.13	95.25	1.36	1.26																		100	104
E-48-2244.39	17	4	Qz	100.00																					100	120
E-48-2244.39	17	5	Qz	100.00																					100	115
E-48-2244.39	17	6	Qz	100.00																					100	117

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	17	7	Qz	100.00																					100	123
E-48-2244.39	17	8	Qz	100.00																					100	120
E-48-2244.39	17	9	Qz	100.00																					100	124
E-48-2244.39	17	10	Qz	100.00																					100	122
E-48-2244.39	17	11	Qz	100.00																					100	118
E-48-2244.39	17	12	Qz	100.00																					100	117
E-48-2244.39	17	13	Chl	31.63		20.10	23.02		7.34	0.31	0.61	1.80				0.19									85	86
E-48-2244.39	17	14	Fe-Chl	26.90		18.52	29.12	0.36	9.66		0.43														85	96
E-48-2244.39	18	1	Qz	100.00																					100	121
E-48-2244.39	18	2	Kfs	66.02		17.75	0.23				0.73	15.27													100	116
E-48-2244.39	18	3	Kfs	65.58		17.84					0.45	15.40							0.73						100	117
E-48-2244.39	18	4	TiO2	0.62	96.38		3.00																		100	97
E-48-2244.39	18	5	Kfs	65.83		17.84					0.52	15.22							0.60						100	113
E-48-2244.39	18	6	Qz	100.00																					100	120
E-48-2244.39	18	7	Qz	100.00																					100	119
E-48-2244.39	18	8	Kfs	66.28		17.61					0.46	15.66													100	116
E-48-2244.39	18	9	Ap							49.08			43.96		5.22							1.74			100	124
E-48-2244.39	18	10	Qz	100.00																					100	120
E-48-2244.39	18	11	Qz	100.00																					100	116
E-48-2244.39	18	12	TiO2	0.51	97.62	1.48	0.39																		100	104
E-48-2244.39	18.1	1	Qz	100.00																					100	117
E-48-2244.39	18.1	2	Chl + Ill	42.00		22.67	27.25		4.86		0.71	1.68				0.83									100	62
E-48-2244.39	18.1	3	Chl + Ill	52.11		22.74	14.84		3.70		0.97	4.78				0.86									100	65
E-48-2244.39	19	1	Qz	100.00																					100	121
E-48-2244.39	19	2	"Ilm"	0.99	97.21		1.79																		100	108
E-48-2244.39	19	3	Kfs +	61.84		17.16					4.76	13.96				2.28									100	128
E-48-2244.39	19	4	Qz	100.00																					100	125
E-48-2244.39	19	5	Qz	100.00																					100	125
E-48-2244.39	19	6	Qz	100.00																					100	122
E-48-2244.39	19	7	Cal						0.85	54.75	0.41														56	55
E-48-2244.39	19	8	Kfs	65.92		18.06					0.90	15.12													100	116
E-48-2244.39	19	9	Qz	100.00																					100	120
E-48-2244.39	19	10	Ap	0.65			0.77	1.70		45.23			43.93		6.45							1.27			100	122
E-48-2244.39	19	11	Kfs	65.55		17.99					1.29	13.93							1.24						100	114
E-48-2244.39	19	12	Qz	100.00																					100	119
E-48-2244.39	19	13	Qz	100.00																					100	119
E-48-2244.39	19	14	Qz	100.00																					100	118
E-48-2244.39	19	15	Qz	100.00																					100	118
E-48-2244.39	19	16	Qz	100.00																					100	121
E-48-2244.39	19	17	Qz	100.00																					100	118
E-48-2244.39	19	18	Kfs	66.32		17.59					0.65	15.43													100	113
E-48-2244.39	19	19	Qz	100.00																					100	122
E-48-2244.39	19.1	1	Qz	100.00																					100	122

Table 1-1.1: EDS analyses of sample E-48-2244.39.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	ZrO2	BaO	Ce2O3	HfO2	WO3	PbO	B2O3	Total	Actual Total
E-48-2244.39	19.1	2	Qz	100.00																					100	124
E-48-2244.39	19.1	3	Qz	100.00																					100	122
E-48-2244.39	19.1	4	Hl + Chl	16.54		8.99	4.28		1.77		36.46	1.31				30.66									100	135
E-48-2244.39	19.1	5	Fe-Chl	29.55		21.83	27.07		4.28		1.03	0.74				0.51									85	77
E-48-2244.39	20	1	Qz	100.00																					100	121
E-48-2244.39	20	2	Zrn	31.01			0.33											67.02			1.64				100	125
E-48-2244.39	20	3	Qz	100.00																					100	118
E-48-2244.39	20	4	Ms + Chl	49.42		23.49	10.46		9.07		2.09	3.71		0.54		1.21									100	87
E-48-2244.39	20	5	Qz	100.00																					100	116
E-48-2244.39	20	6	Fe-Chl +	27.22		19.82	28.12		4.45	1.44	2.11	0.40		0.68		0.76									85	96
E-48-2244.39	20	7	Qz	100.00																					100	121
E-48-2244.39	20	8	Mix	44.29	1.28	20.91	15.10		3.61	3.72	3.58	4.44		1.35		1.72									100	96
E-48-2244.39	20	9	Qz	100.00																					100	118
E-48-2244.39	20	10	Qz	100.00																					100	119
E-48-2244.39	20	11	Qz	100.00																					100	119
E-48-2244.39	20	12	Qz	99.72							0.28														100	107
E-48-2244.39	20	13	Qz	100.00																					100	125
E-48-2244.39	20	14	Qz	100.00																					100	115
E-48-2244.39	20.1	1	Qz	100.00																					100	121
E-48-2244.39	20.1	2	Qz	100.00																					100	119
E-48-2244.39	20.1	3	Sd +	2.00			72.06	1.66	13.85	8.91	1.18					0.34									100	59
E-48-2244.39	20.1	4	Sd + Chl	6.80		4.06	65.29	1.03	13.86	7.75	0.81	0.41													100	63
E-48-2244.39	20.2	1	Kln	48.44		37.20					0.36														86	92.3

Notes
1: + indicates more than one mineral present
2: " " indicates an altered grian

Appendix 1-2: SEM-BSE images and EDS mineral analyses for sample E-48-2246.46.

Sample E-48-2246.46: Very fine-grained sandstone?

Diagenetic Minerals: ?Apatite, Calcite, kaolinite, pyrite, titania minerals

Detrital Minerals: Albite, Apatite, Chromite, Ilmenite, K-feldspar, Muscovite, Quartz, Sphalerite (Fig. 25), Zircon (Fig. 28).

Notes:

1. Quartz and K-feldspar commonly display suturing.

2. Quartz and K-feldspar (Fig. 4) contain overgrowths.

3. Barite appears to be mostly drilling mud because it fills voids and intergranular boundaries (Fig. 23).

4. Kaolinite appears to be the main clay cement.

5. Clay minerals sometimes coat quartz and K-feldspar grains (Figs. 31, 32).

6. The garnet in this sample is a solid solution of almandine-pyrope.

7. Several albitized K-feldspar grains have been seen (e.g. Figs. 32, 38, 40).

8. Paragenetic sequence: Kaolinite →Calcite →Pyrite ± Titania ± Siderite
Fig. 6 Fig. 14 Fig. 19 Fig. 15

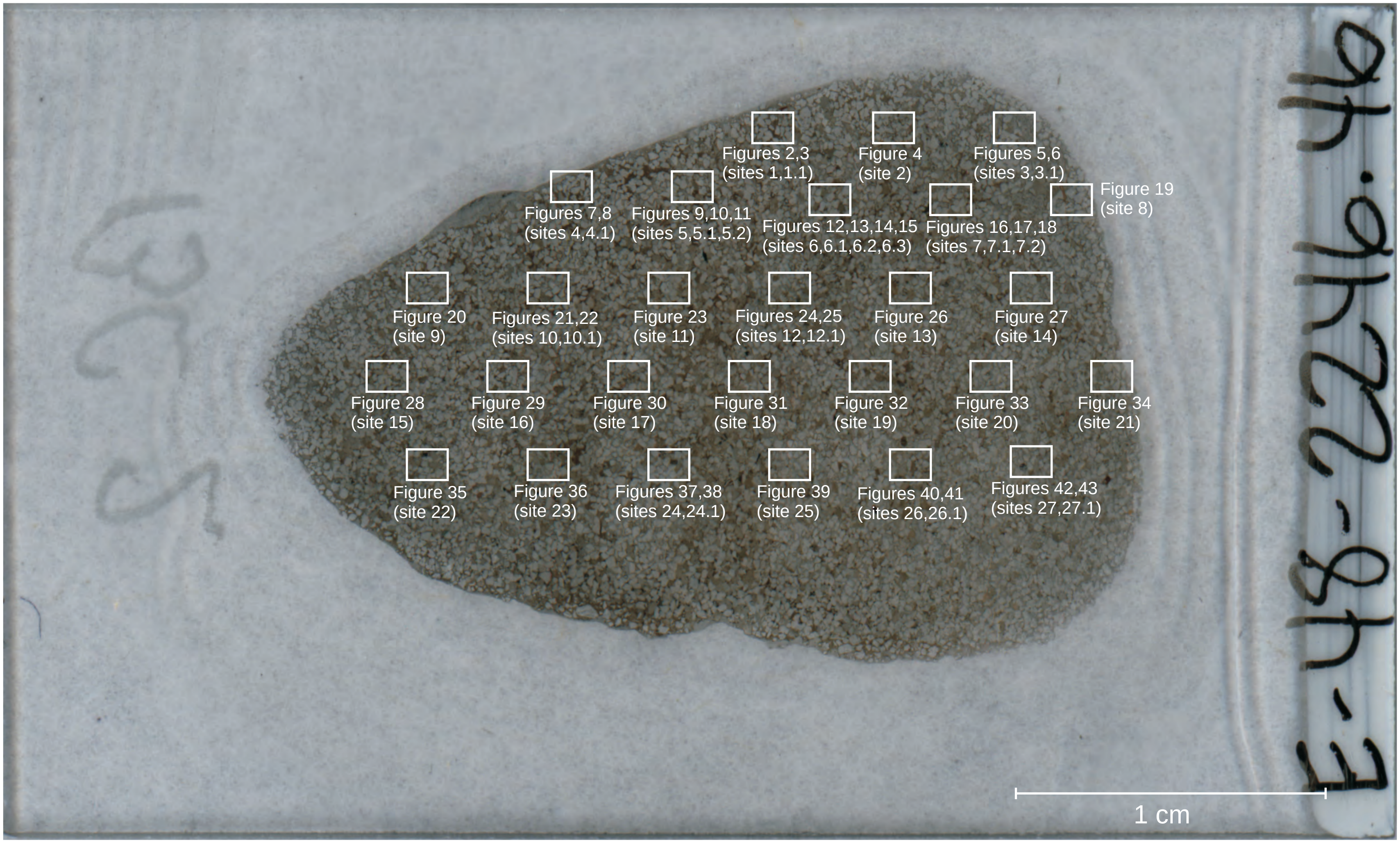
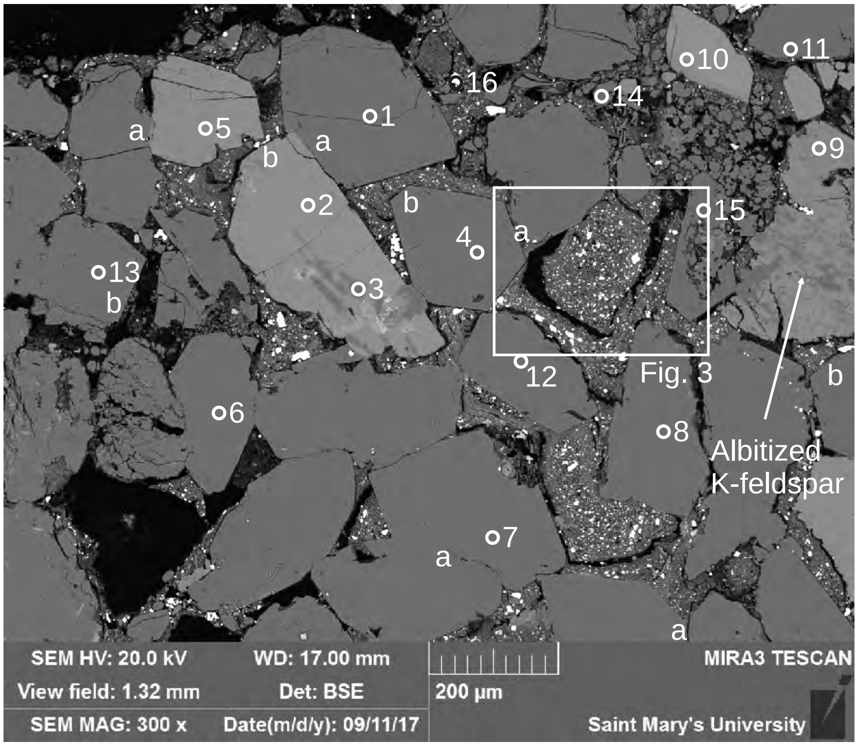
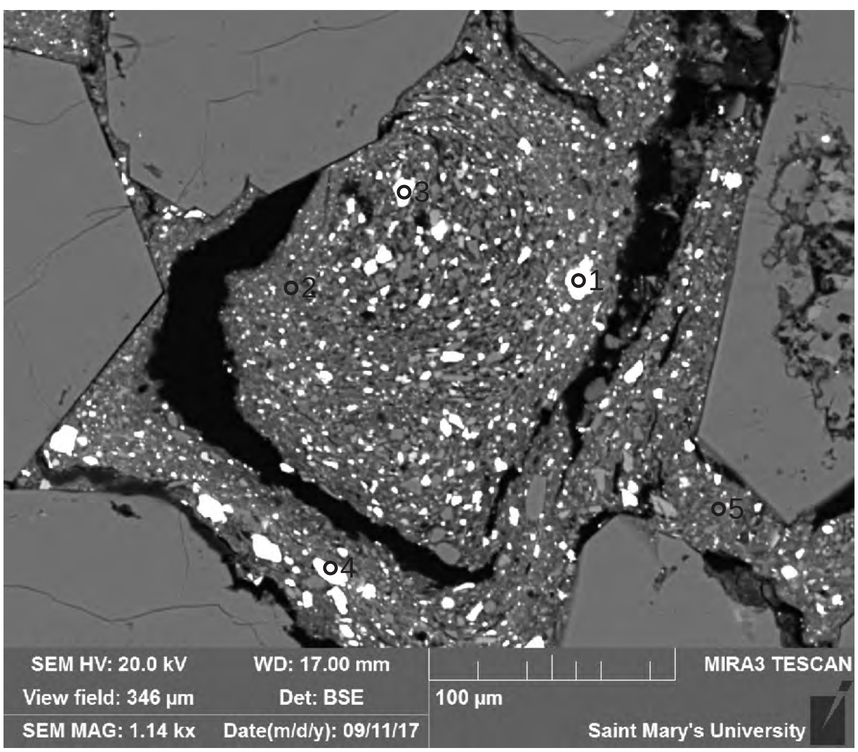


Figure 1-2.1: Scanned thin section of sample E48-2246.46 showing the location of analyzed sites.



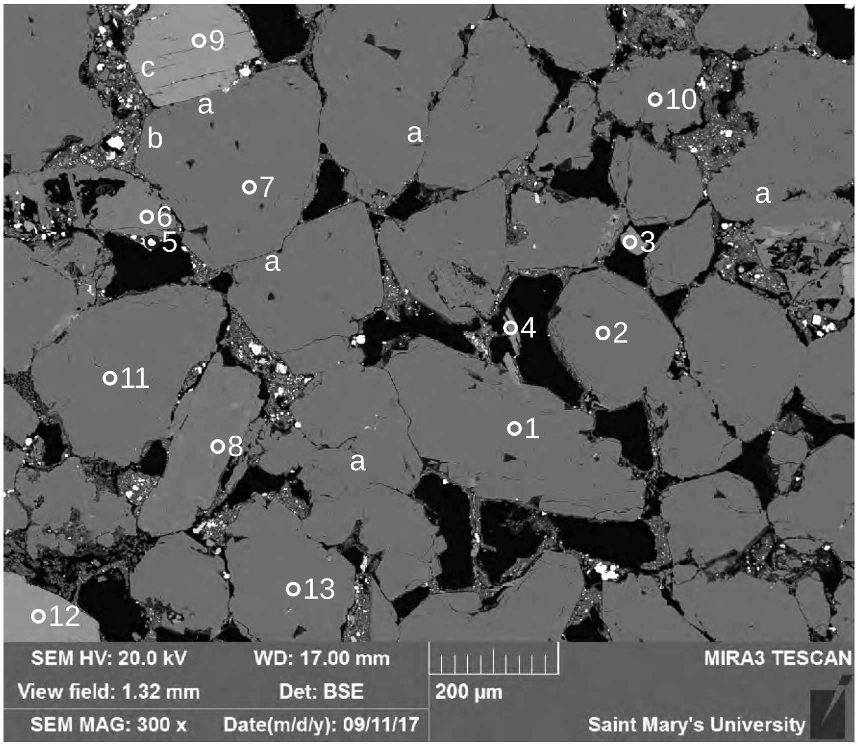
1:Quartz
2:K-feldspar
3:Albite
4:Quartz
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:K-feldspar
10:K-feldspar
11:Quartz
12:Quartz
13:Quartz
14:Quartz
15:Quartz
16:Barite

Figure 1-2.2: Sample E-48-2246.46 site 1 (SEM). This site consists of quartz and K-feldspar that contains some porosity, that has been invaded by drilling mud (16). Some of the quartz and K-feldspar crystals display suturing (positions a), and overgrowths (positions b). The large K-felspar grain (2) shows albitization (3).



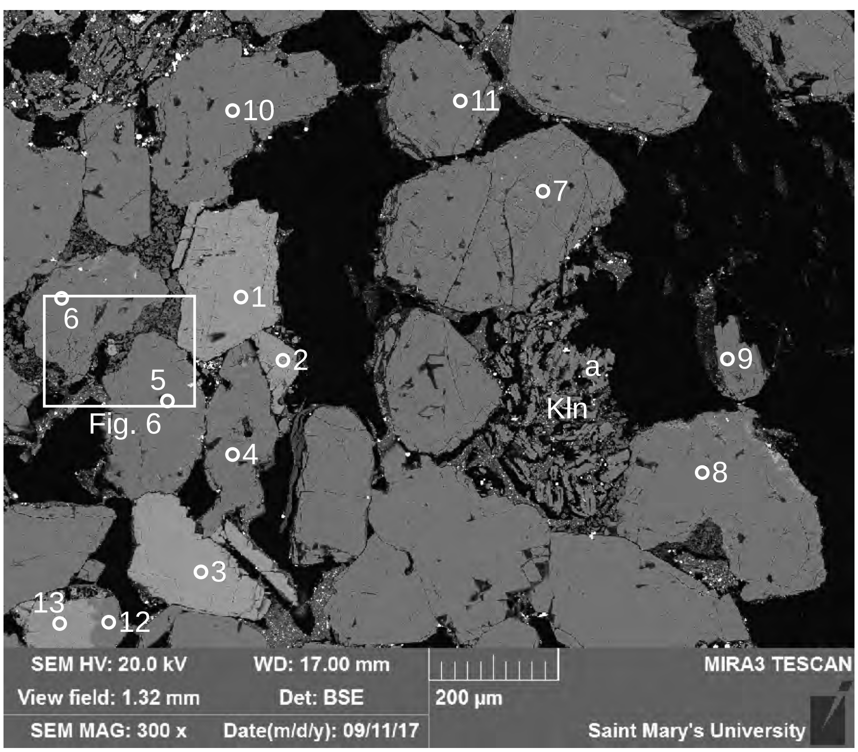
1:Barite
2:Smectite +
3:Barite
4:Barite
5:Smectite +

Figure 1-2.3: Sample E-48-2246.46 site 1.1 (SEM). Zoom in of the drilling mud in Figure 2. It consists of barite (1,3-4) and smectite (2,5).



1:Quartz
2:Quartz
3:K-feldspar
4:K-feldspar
5:Barite
6:Plagioclase
7:Quartz
8:Albite
9:K-feldspar
10:Quartz
11:Quartz
12:K-feldspar
13:Quartz

Figure 1-2.4: Sample E-48-2246.46 site 2 (SEM). This site consists of mainly quartz crystals (1-2,7,10-11, 13) and K-feldspar (3-4,9,12). K-feldspar appears to be albitized (8). Suturing and dissolution are common (positions a), and overgrowths are less common, quartz overgrowth (position b) and K-feldspar overgrowth (position c). Drilling mud made of barite partially fills primary porosity.



1:K-feldspar
2:K-feldspar
3:K-feldspar
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:Quartz
11:Quartz
12:Quartz
13:K-feldspar

Figure 1-2.5: Sample E-48-2246.46 site 3 (SEM).This site consists mainly of quartz (4-12), K-feldspar (1-3,13), and kaolinite along grain boundaries or filling pores (position a).

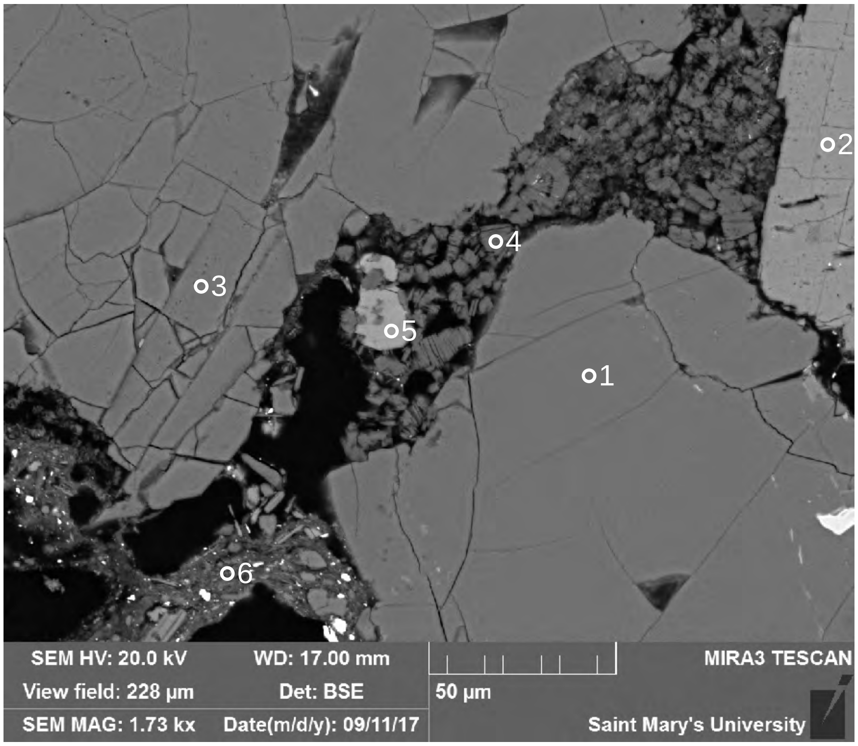


Figure 1-2.6: Sample E-48-2246.46 site 3.1 (SEM). Kaolinite (4) forms along grain boundaries and is the cement between quartz (1,3) and K-feldspar (2) grains. Calcite (5) is another cement postdating the kaolinite.

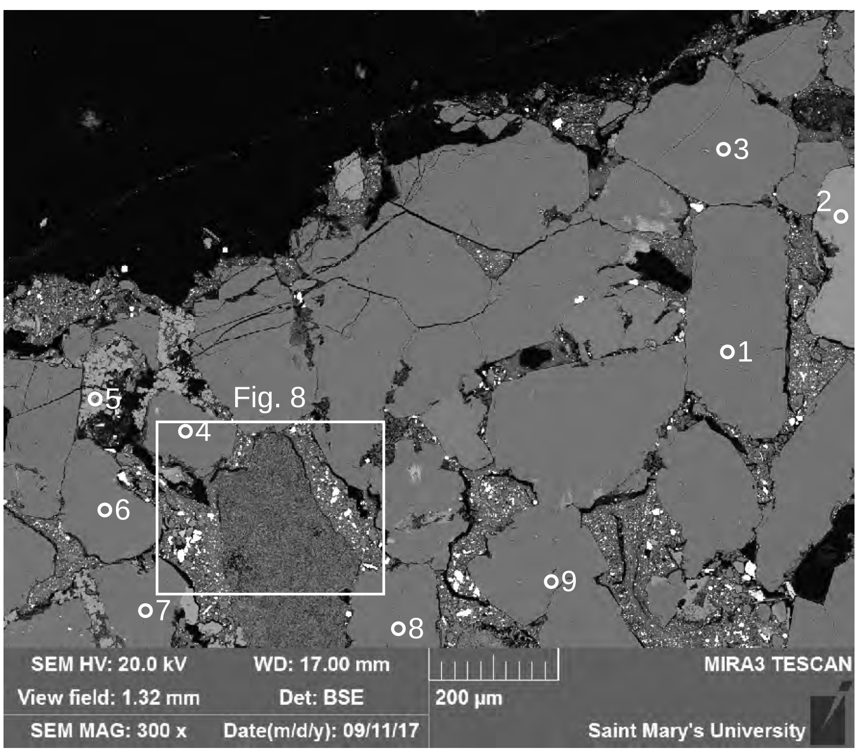
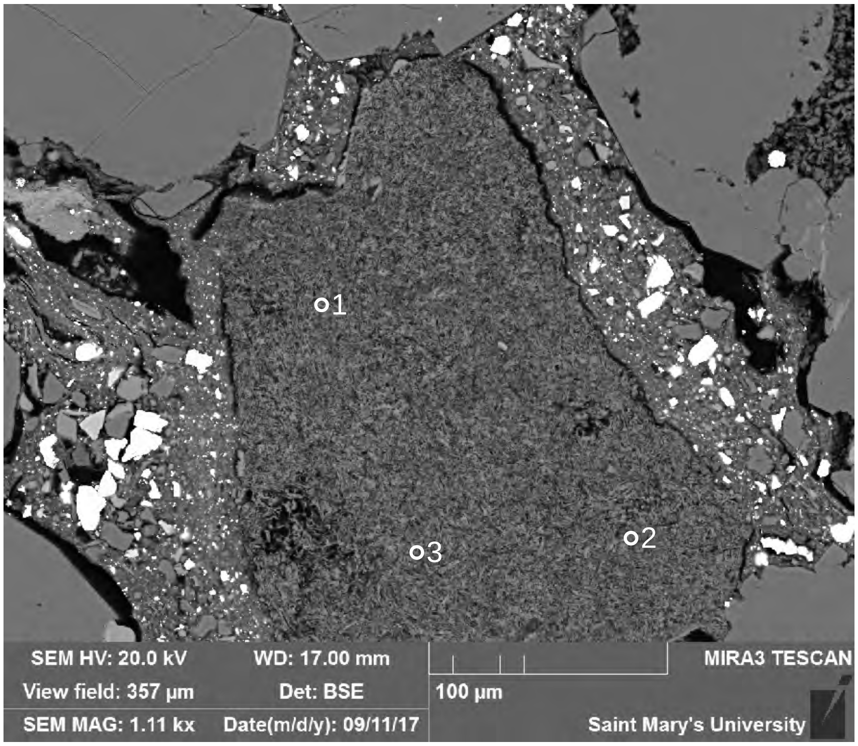
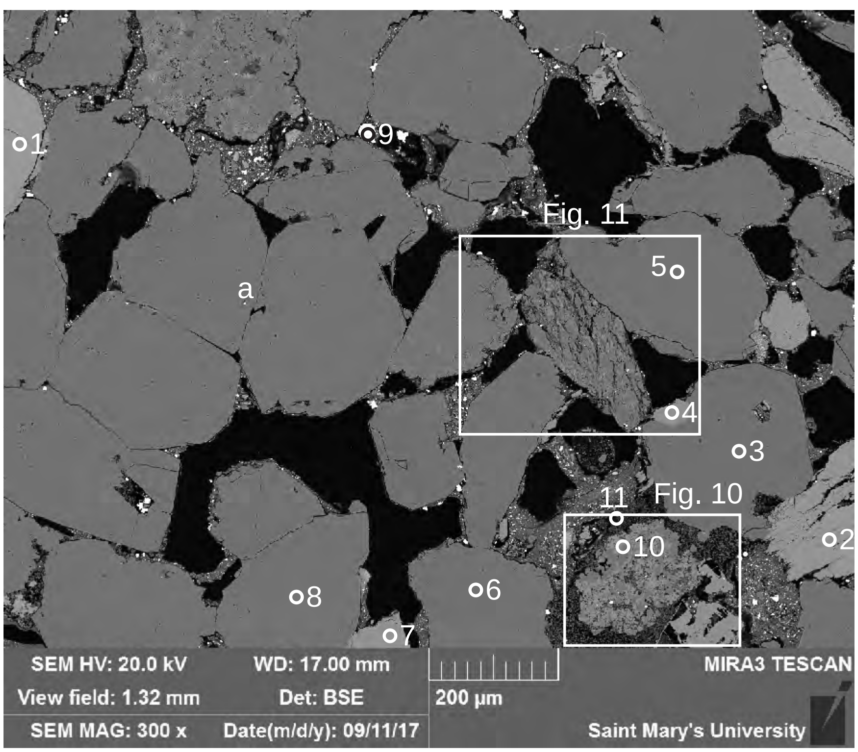


Figure 1-2.7: Sample E-48-2246.46 site 4 (SEM). This site shows suturing between detrital grains, quartz (6,9) and K-feldspar (2). Drilling mud fills primary porosity.



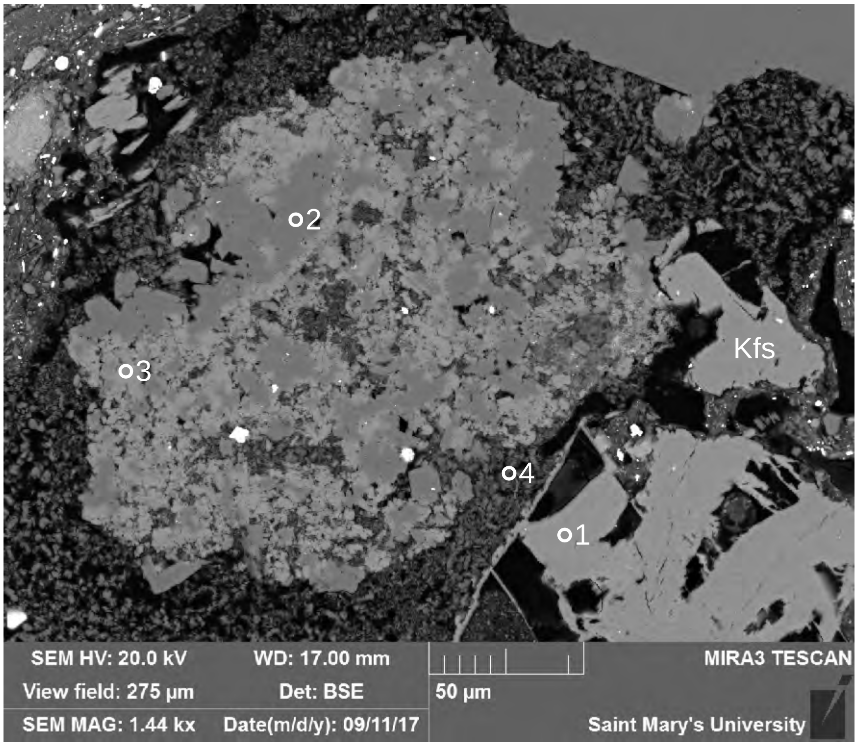
1:K-feldspar
2:K-feldspar
3:K-feldspar

Figure 1-2.8: Sample E-48-2246.46 site 4.1 (SEM). Lithic clast (1-3) of granophyre/rhyolite that appears to be altering to clay.



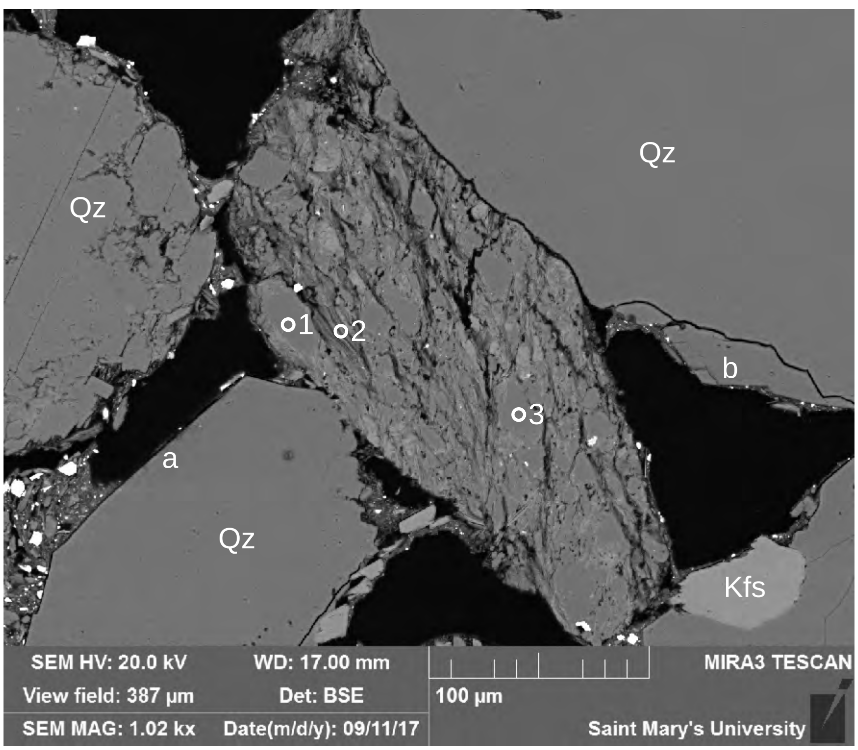
1:K-feldspar
2:K-feldspar
3:Quartz
4:K-feldspar
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:Pyrite
10:Albite
11:Kaolinite

Figure 1-2.9: Sample E-48-2246.46 site 5 (SEM). This site consists of quartz (3,5-6,8) and K-feldspar (1-2,4,7) grains, and shows primary porosity and suturing (position a). Pyrite (9) is diagenetic. Albite (10) appears to be altering to kaolinite (11).



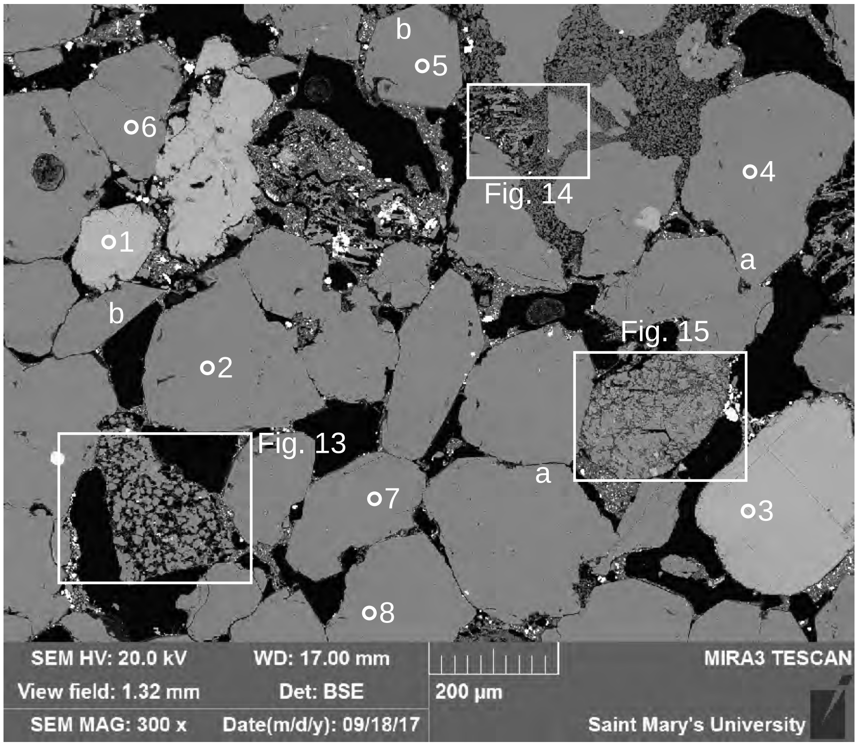
1:K-feldspar
2:Albite
3:K-feldspar
4:Kaolinite

Figure 1-2.10: Sample E-48-2246.46 site 5.1 (SEM). This site consists of a partially dissolved K-feldspar (1) grain and a lithic clast made up of K-feldspar (3) and albite (2), that are altering to kaolinite (4). The lithic clast appears to be from a subvolcanic rhyolite.



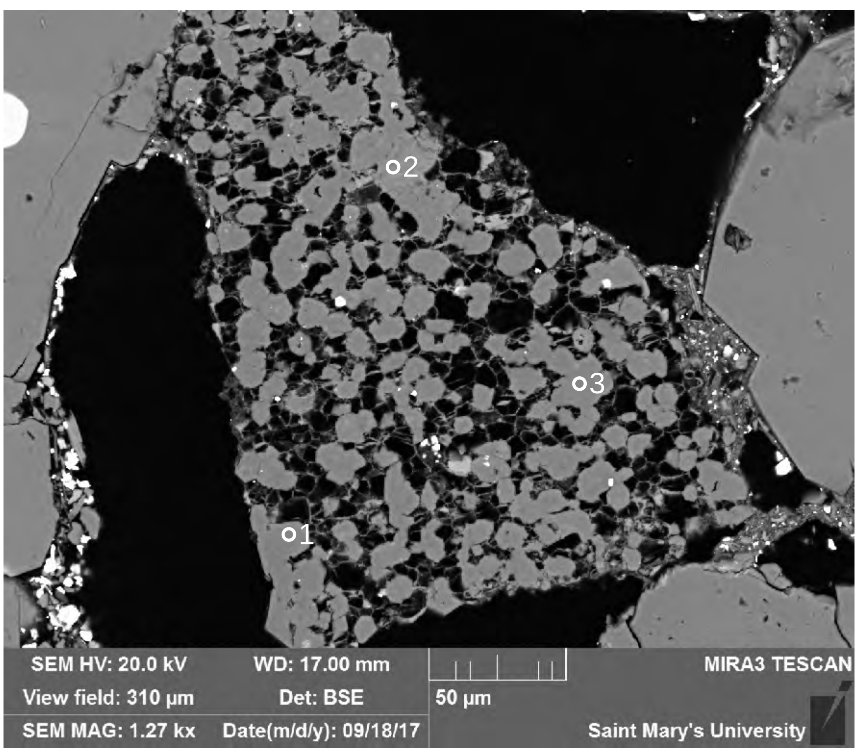
1:Quartz
2:Muscovite
3:Quartz

Figure 1-2.11: Sample E-48-2246.46 site 5.2 (SEM). This site consists of a) a deformed lithic clast that consists of quartz (1,3) and muscovite (2), probably from a schist and b) detrital grains of quartz either with quartz overgrowth (position a) or sometimes with an apparently corroded margin (position b) and K-feldspar.



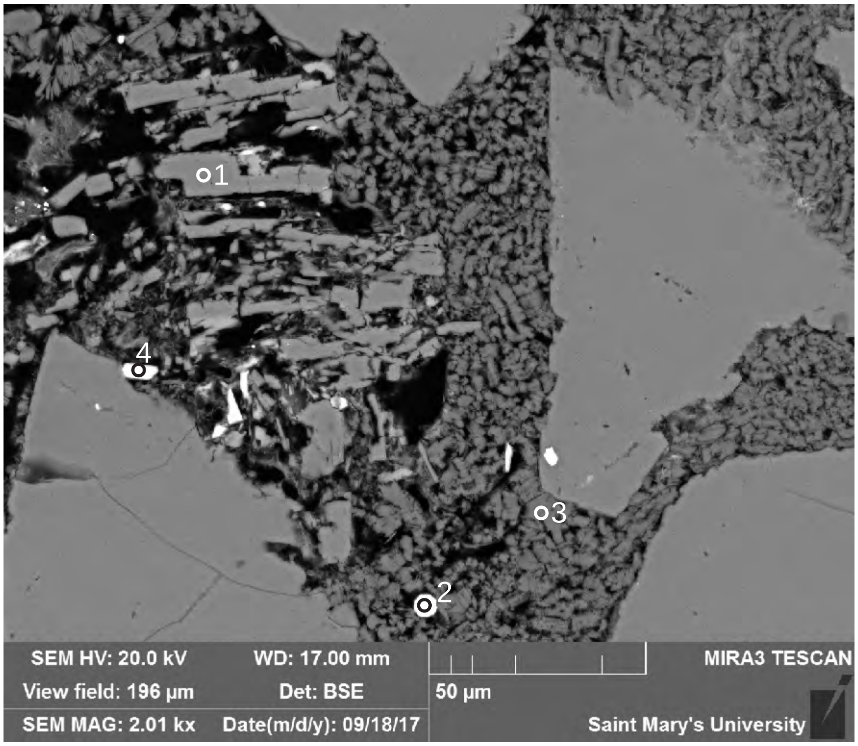
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Quartz

Figure 1-2.12: Sample E-48-2246.46 site 6 (SEM). This site consists of quartz grains with suturing (positions a) and overgrowths (positions b).



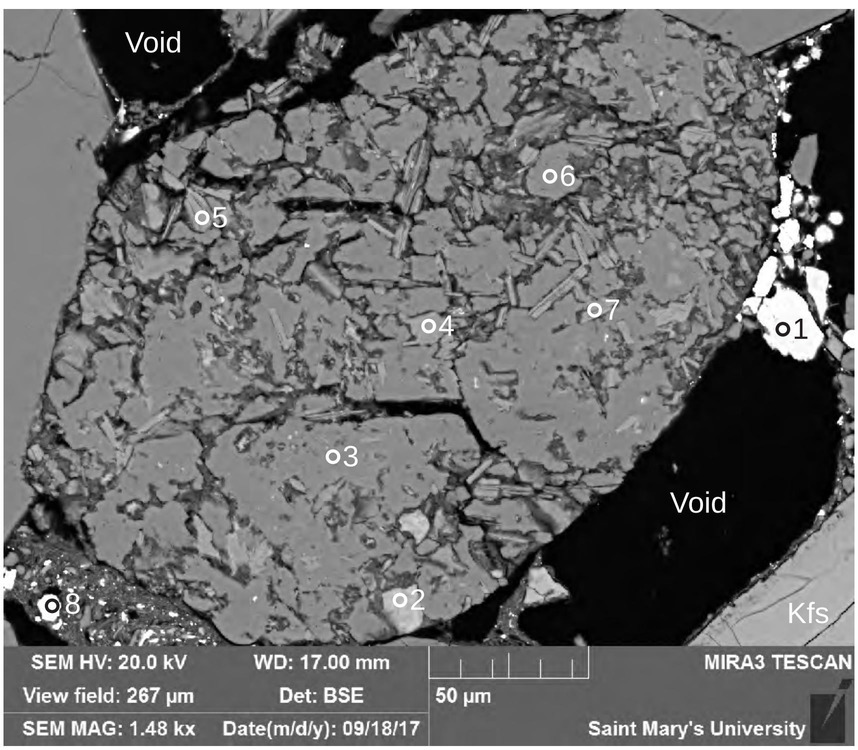
1:Quartz
2:Muscovite
3:Quartz

Figure 1-2.13: Sample E-48-2246.46 site 6.1 (SEM). This site consists of a lithic clast that is a clay-cemented sandstone with some framework grains that have dissolved out.



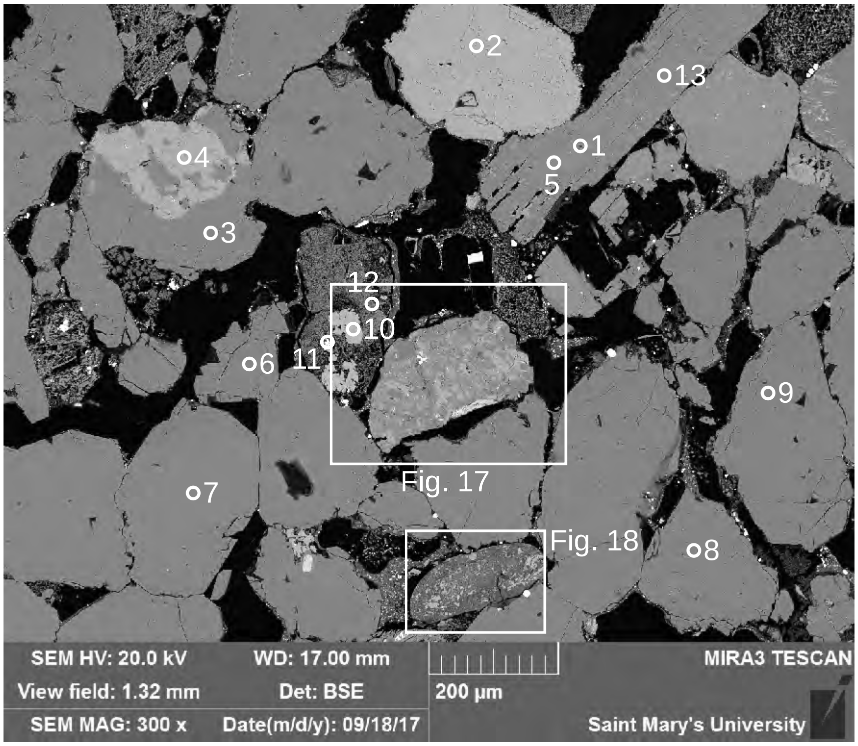
1:Albite
2:Pyrite
3:Kaolinite
4:Apatite

Figure 1-2.14: Sample E-48-2246.46 site 6.2 (SEM). This site consists of slightly deformed perthite with K-feldspar altered to kaolinite (3) and albite (1) remains. Late pyrite (2) and apatite (4) appear to be diagenetic.



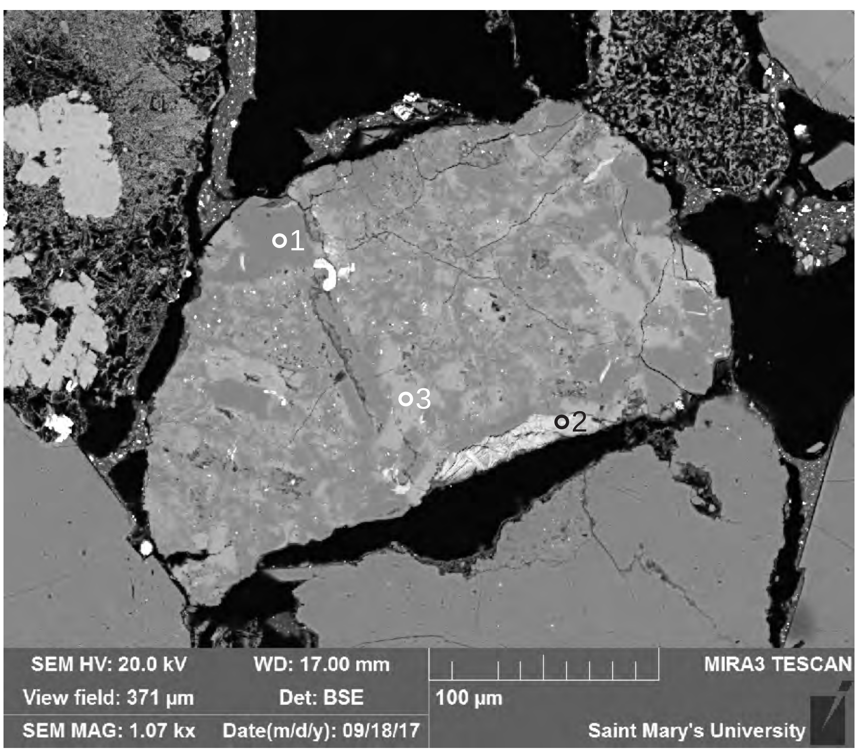
1:Siderite
2:Garnet
3:Albite
4:Muscovite
5:Muscovite
6:Albite
7:Muscovite
8:Pyrite

Figure 1-2.15: Sample E-48-2246.46 site 6.3 (SEM). Lithic clast that consists of partially corroded albite (3,6), muscovite (4-5,7), and garnet (2) (almandine-pyrope). Diagenetic siderite (1) and pyrite (8) appear to partially fill porosity.



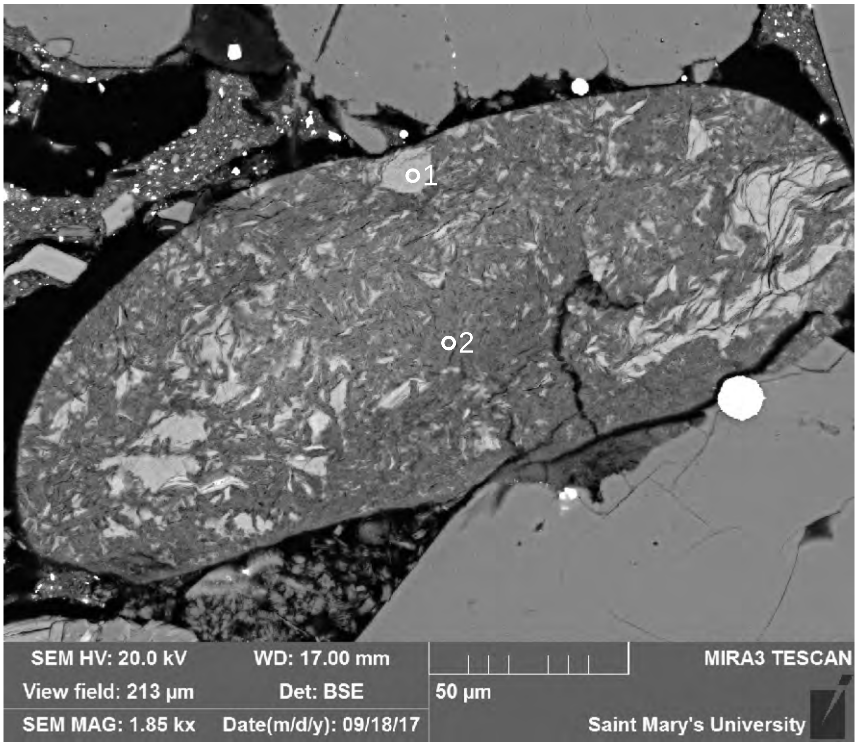
1:Albite
2:K-feldspar
3:Quartz
4:K-feldspar
5:Albite
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:Calcite
11:TiO_2
12:K-feldspar
13:Albite

Figure 1-2.16: Sample E-48-2246.46 site 7 (SEM). This site consists of quartz (6-9), K-feldspar (2,12), and late calcite (10) and titania (11). A lithic clast of fine-grained albite (1,5,13) and of quartz (3) and K-feldspar (4).



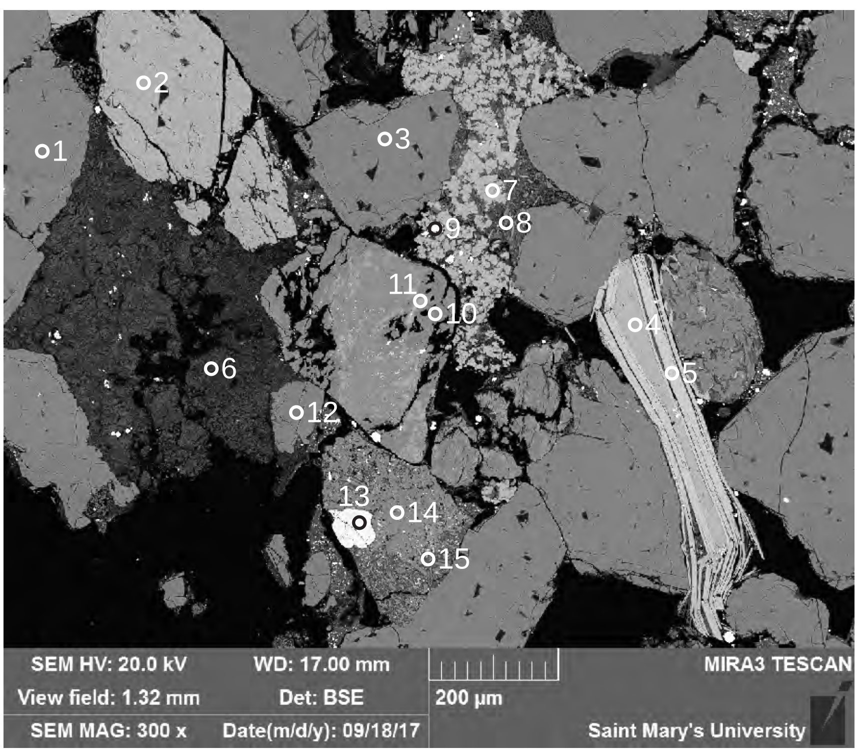
1:Quartz
2:Garnet
3:K-feldspar

Figure 1-2.17: Sample E-48-2246.46 site 7.1 (SEM). Lithic clast of quartz (1), garnet (2) (almandine-pyrope), and K-feldspar (3).



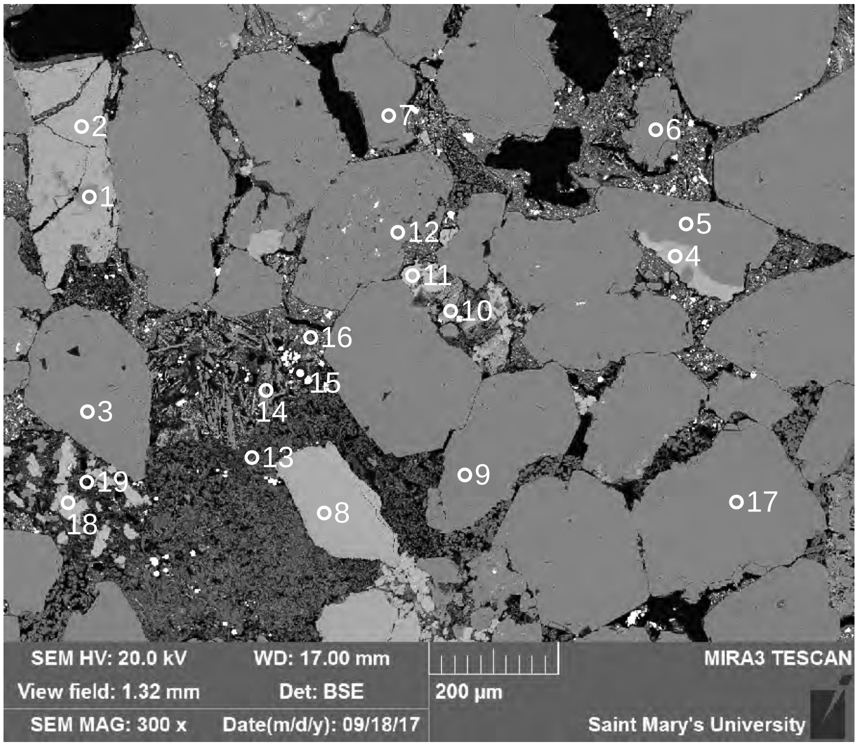
1:Garnet
2:Smectite

Figure 1-2.18: Sample E-48-2246.46 site 7.2 (SEM). Lithic clast of garnet (1) and clay (smectite (2)).



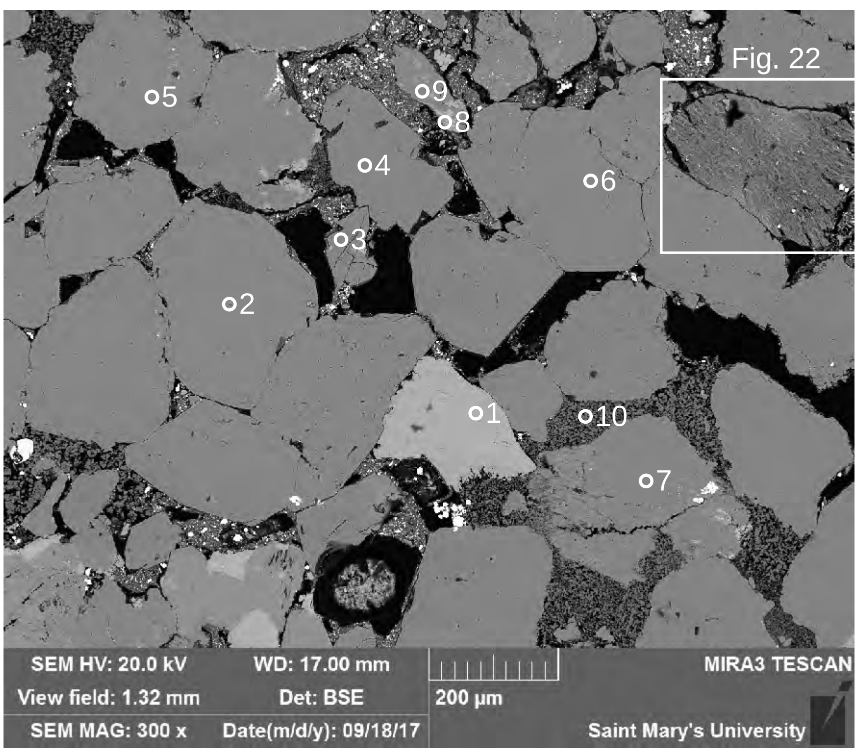
1:Quartz
2:K-feldspar
3:Quartz
4:Calcite
5:Muscovite +
6:Kaolinite
7:Calcite +
8:Quartz
9:TiO2
10:Albite
11:K-feldspar
12:Quartz
13:Apatite
14:Quartz +
15:Mixture

Figure 1-2.19: Sample E-48-2246.46 site 8 (SEM). This site consists of detrital quartz and K-feldspar grains. Kaolinite (6) appears to form between the grains and is cut by calcite (7). Calcite (4) also appears to have formed along the cleavage of muscovite (5). Quartz (14) appears to be cross-cut by clays and late apatite (13).



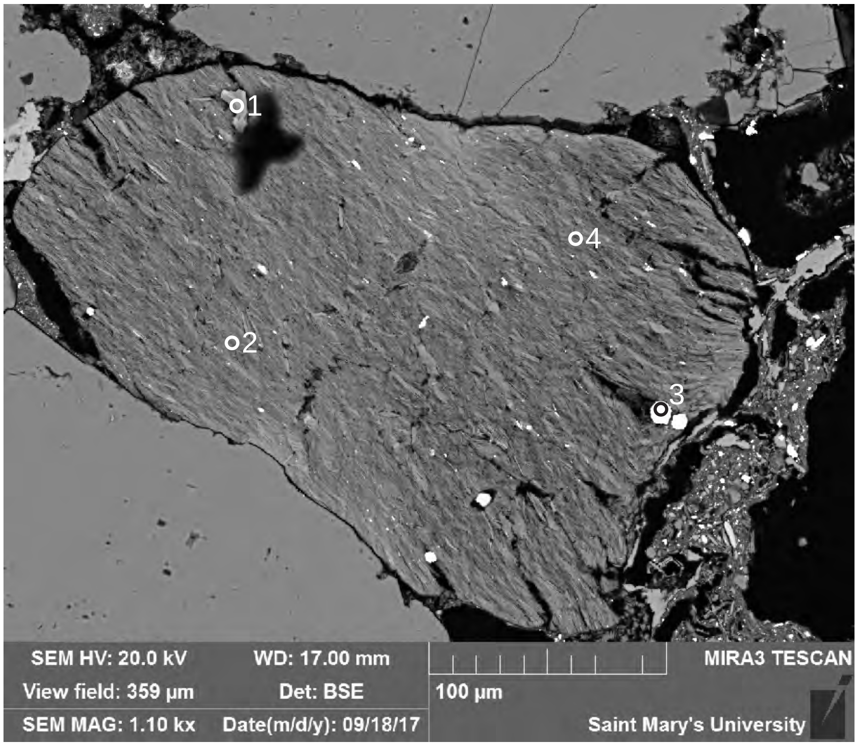
1:Albite
2:K-feldspar
3:Quartz
4:K-feldspar
5:Quartz
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:Muscovite
11:Calcite +
12:Quartz
13:Albite
14:Albite
15:Pyrite
16:Kaolinite +
17:Quartz
18:Calcite
19:K-feldspar +

Figure 1-2.20: Sample E-48-2246.46 site 9 (SEM). Quartz and K-feldspar commonly display suturing. Albite (14) appears to have been partly replaced by a clay. Diagenetic calcite (11) appears to cross-cut the clays.



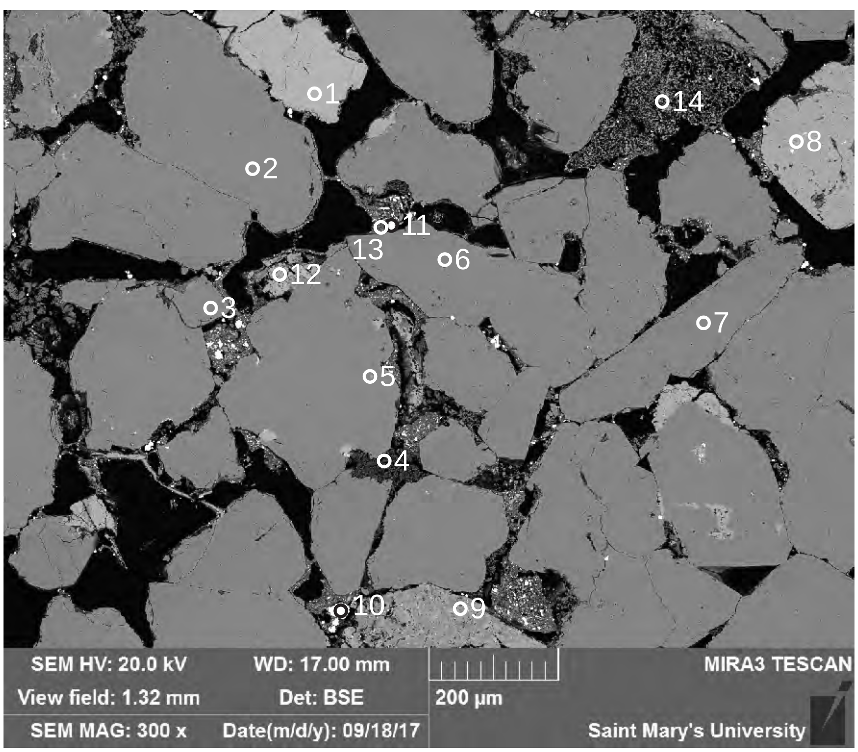
1:K-feldspar
2:Quartz
3:Albite
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Garnet
9:Quartz
10:Kaolinite

Figure 1-2.21: Sample E-48-2246.46 site 10 (SEM). This site consists mainly of detrital quartz and K-feldspar. Kaolinite (10) appears to be forming the cement between grains. A lithic clast of probably metasandstone is made up of quartz (9) and garnet (8).



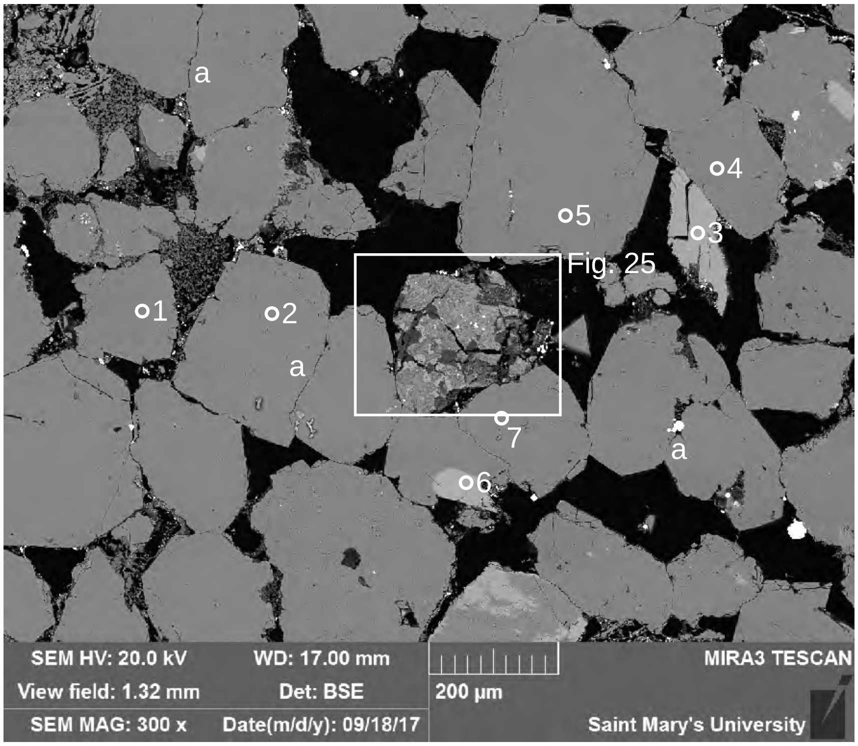
1:Quartz
2:Muscovite
3:Pyrite
4:Muscovite

Figure 1-2.22: Sample E-48-2246.46 site 10.1 (SEM). Lithic clast of slate that is made up of muscovite (2,4) and quartz (1). Late diagenetic pyrite (3) appears to fill voids in the clast.



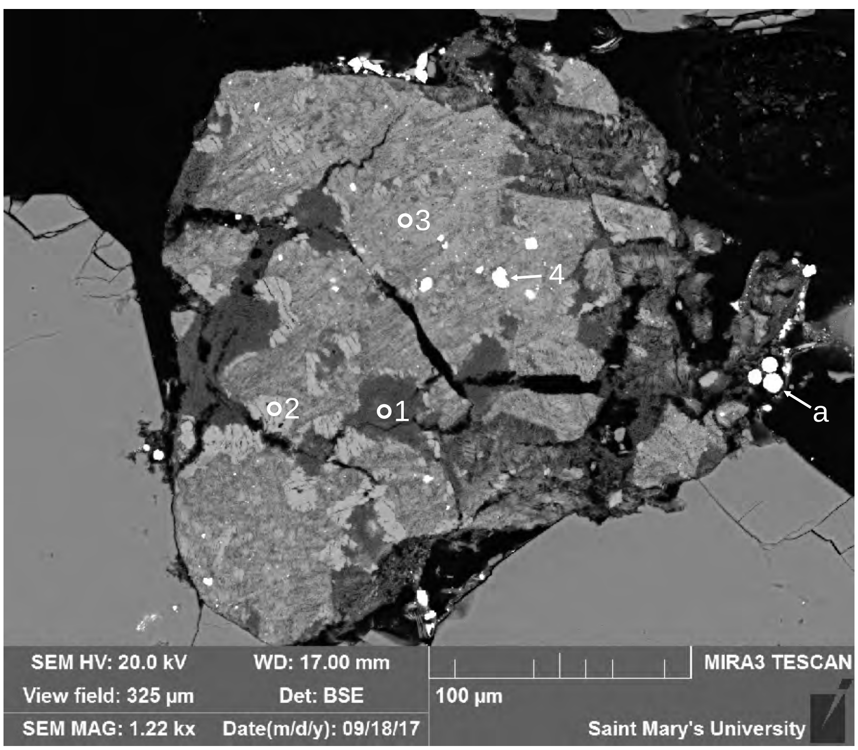
1:K-feldspar
2:Quartz
3:Quartz
4:Kaolinite +
5:Quartz
6:Quartz
7:Quartz
8:K-feldspar
9:K-feldspar
10:Pyrite
11:Barite
12:K-feldspar
13:Smectite
14:K-feldspar

Figure 1-2.23: Sample E-48-2246.46 site 11 (SEM). This site consists of mainly quartz that displays suturing. K-feldspar (14) appears to be altering to clay. Diagenetic pyrite (10) and ?barite (11) appear to partially fill porosity.



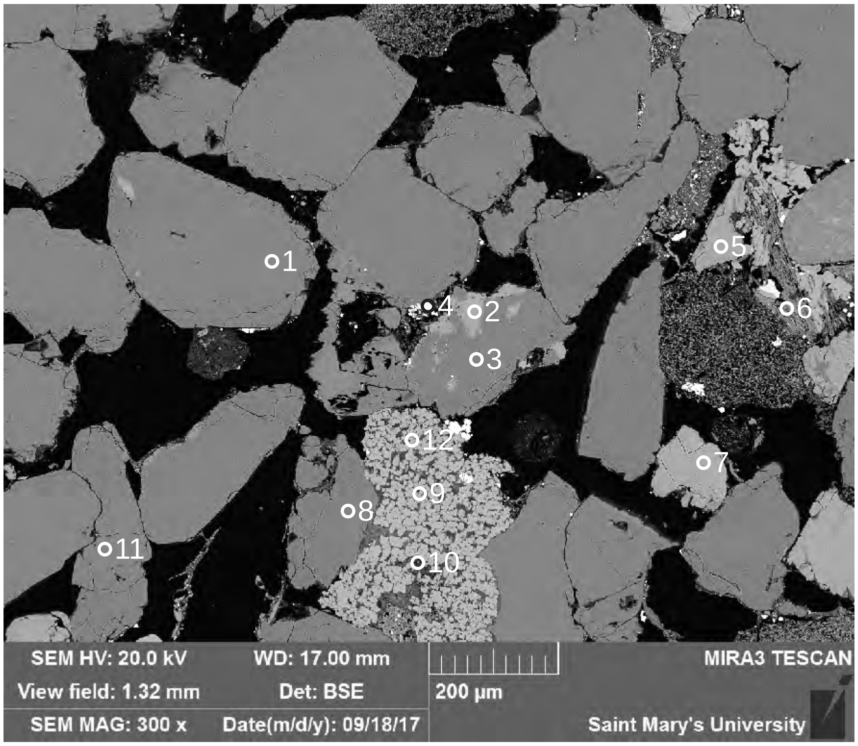
1:Quartz
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:K-feldspar
7:Quartz

Figure 1-2.24: Sample E-48-2246.46 site 12 (SEM). This site consists of quartz and K-feldspar, which commonly display suturing (positions a).



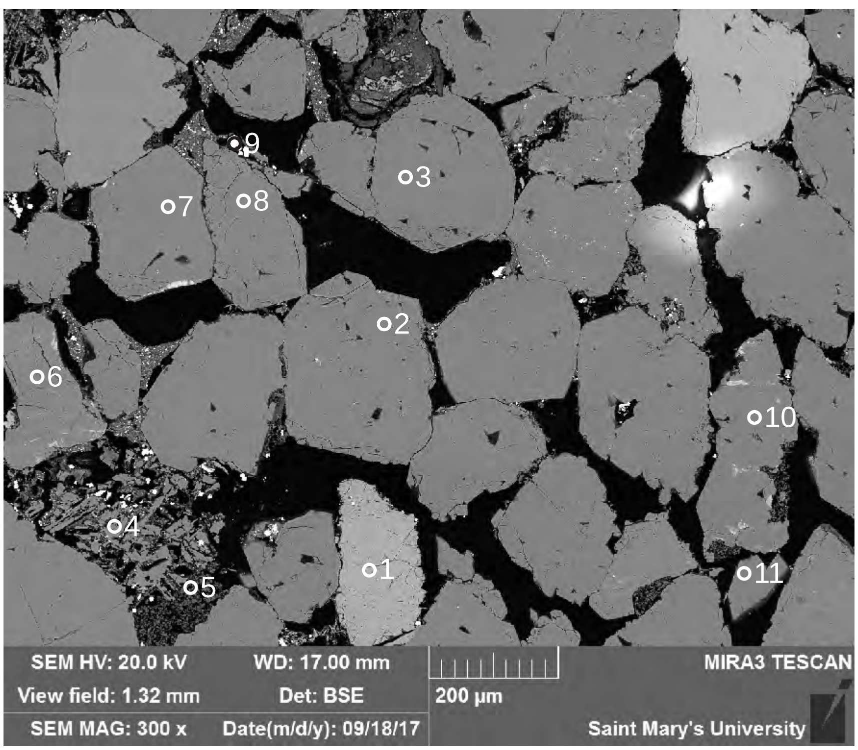
1:?Chlorite
2:K-feldspar
3:K-feldspar
4:Sphalerite

Figure 1-2.25: Sample E-48-2246.46 site 12.1 (SEM). Lithic clast that consists of ?chlorite (1), K-feldspar (2,3), sphalerite (4) and pyrite framboids (position a).



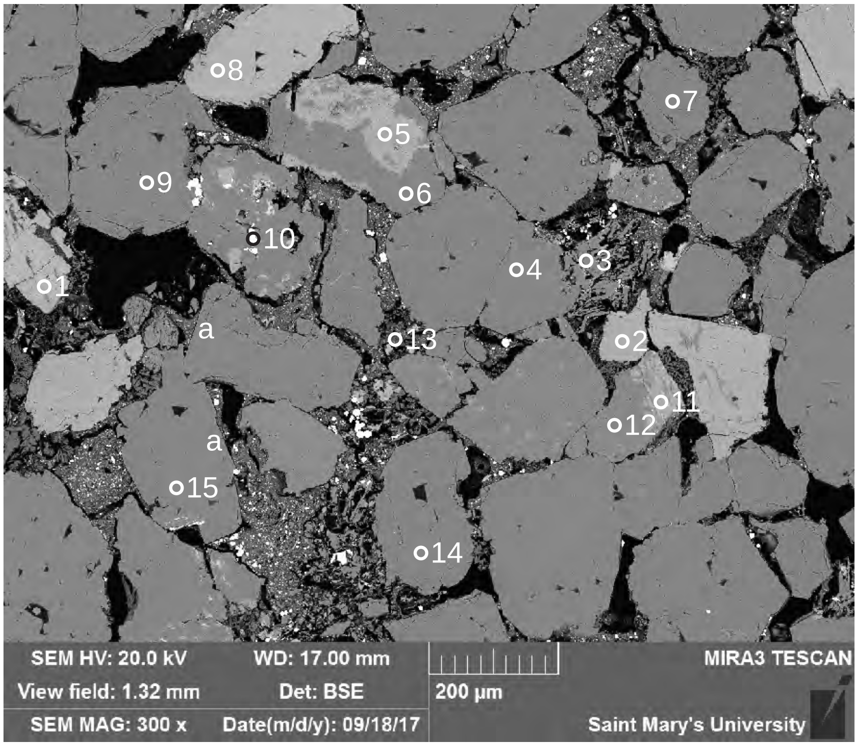
1:Quartz
2:K-feldspar
3:Quartz
4:Pyrite
5:K-feldspar
6:Muscovite
7:K-feldspar
8:Quartz
9:Calcite
10:Mixture
11:Quartz
12:Calcite +

Figure 1-2.26: Sample E-48-2246.46 site 13 (SEM). This site consists mainly of detrital quartz and K-feldspar (5,7). Calcite (12) and pyrite (4) appear to be diagenetic. A lithic clast of quartz (3) and K-feldspar (2) is also seen.



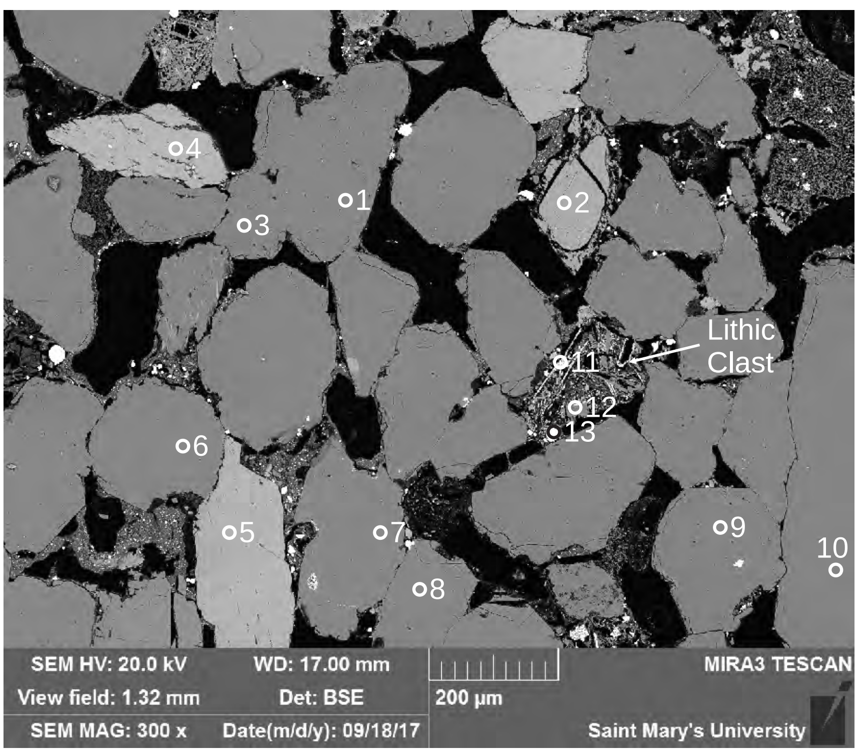
1:K-feldspar
2:Quartz
3:Quartz
4:Albite
5:Kaolinite
6:Albite
7:Quartz
8:Quartz
9:Pyrite
10:Quartz
11:Quartz

Figure 1-2.27: Sample E-48-2246.46 site 14 (SEM). This site consists mainly of quartz. Albite (4) appears to be altering to clay. Pyrite (9) is diagenetic.



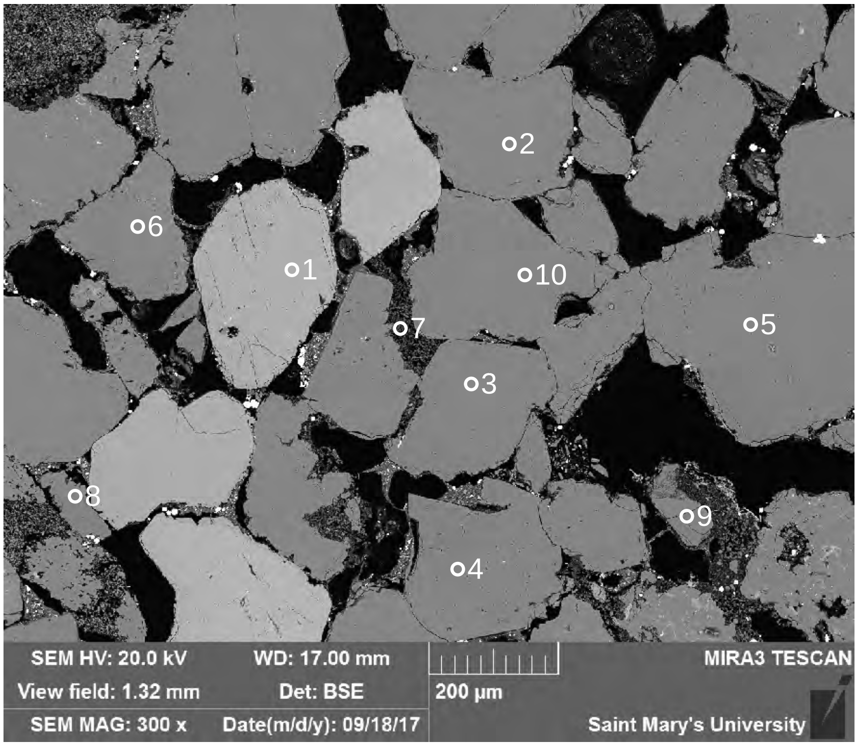
1:K-feldspar
2:K-feldspar
3:Albite
4:Quartz
5:K-feldspar
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:Zircon
11:Muscovite
12:Albite
13:Mixture
14:Quartz
15:Quartz

Figure 1-2.28: Sample E-48-2246.46 site 15 (SEM). This site consists of detrital quartz and K-feldspar (8). Some quartz grains show overgrowths (positions a). There are also lithic clasts of quartz (6) and K-feldspar (5), and albite (12) and muscovite (11). Zircon (10) is also seen in one of the clasts made up of quartz and K-feldspar. Albite (3) appears to be altering.



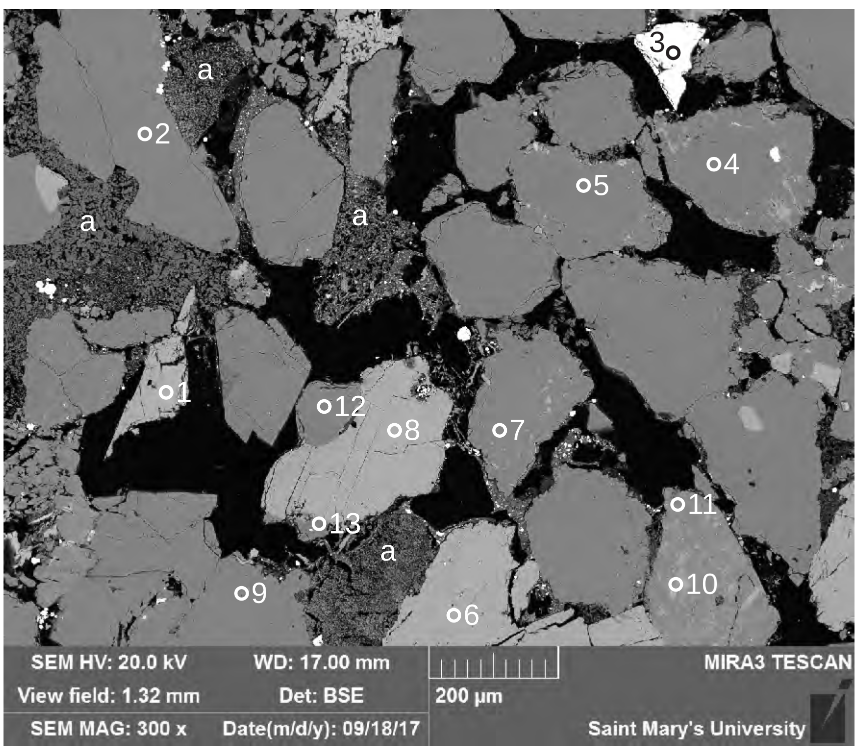
1:Quartz
2:K-feldspar
3:Quartz
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:Quartz
11:"Ilmenite"
12:Albite
13:Pyrite

Figure 1-2.29: Sample E-48-2246.46 site 16 (SEM). This site consists of quartz and K-feldspar grains. Albite (12) appears to be replaced by clays. Diagenetic pyrite (13) appears to fill void and altered ilmenite (11) is also seen. Probably ilmenite (11) and albite (12) are part of a lithic clast.



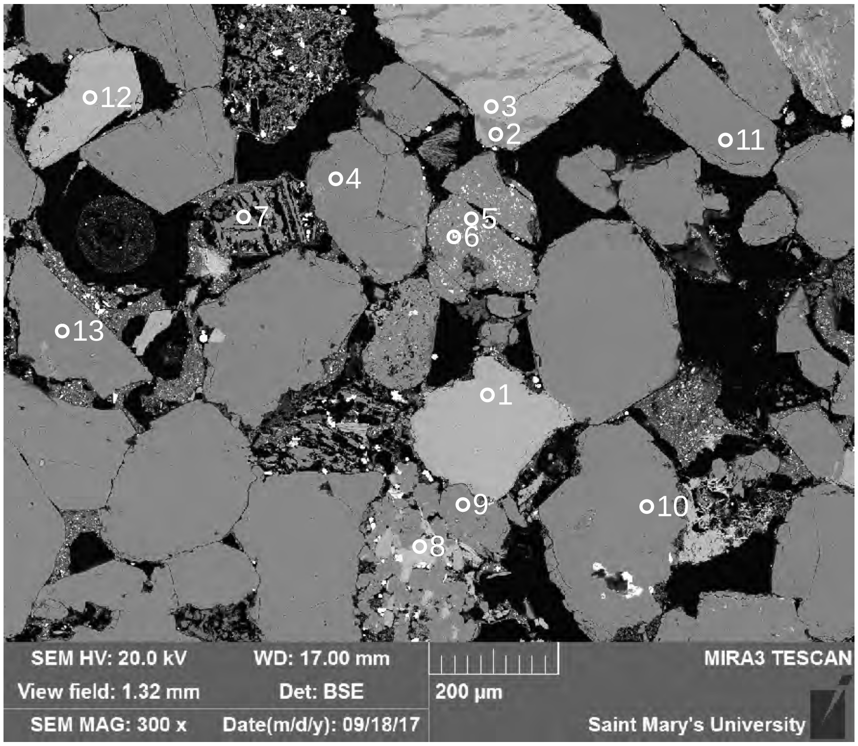
1:K-feldspar
2:Quartz
3:Quartz
4:Quartz
5:Quartz
6:Quartz
7:Kaolinite
8:Quartz
9:Quartz
10:Quartz

Figure 1-2.30: Sample E-48-2246.46 site 17 (SEM). This site consists of mainly quartz and K-feldspar. Kaolinite (7) forms along grain boundaries.



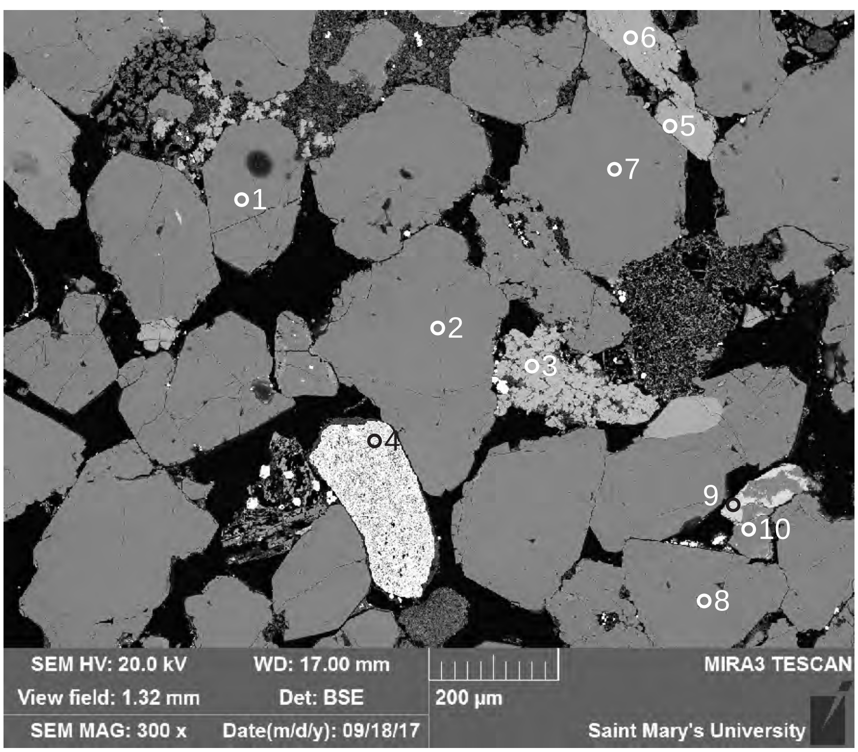
1:K-feldspar
2:Quartz
3:Chromite
4:Quartz
5:Quartz
6:K-feldspar
7:Albite
8:K-feldspar
9:Quartz
10:Muscovite
11:Albite + Muscovite
12:Quartz
13:Quartz

Figure 1-2.31: Sample E-48-2246.46 site 18 (SEM). This site is made up of quartz, K-feldspar, a chromite (3) grain, and intergranular kaolinite (positions a). A large albite (7) grain appears to be coated with clays. There is also a lithic clast made up of albite (11) and muscovite (10).



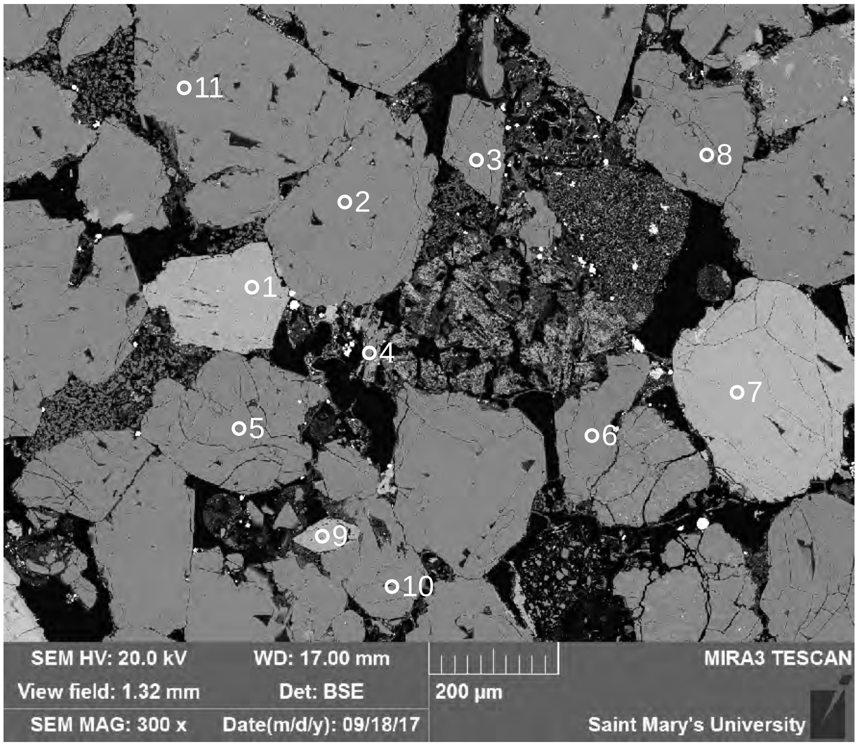
1:K-feldspar
2:Albite
3:K-feldspar
4:Quartz
5:Albite
6:Mixture
7:Albite
8:Calcite
9:Quartz
10:Quartz
11:Quartz
12:K-feldspar
13:Quartz

Figure 1-2.32: Sample E-48-2246.46 site 19 (SEM). This site consists mainly of quartz. Albite (7) appears partially dissolved. Calcite (8) cement partially fills voids in polycrystalline quartz (9) or lithic clast made up of quartz and calcite. K-feldspar (1) and quartz (4,10,13) appear to be coated by clays and drilling mud. There is also an albitized K-feldspar (2-3).



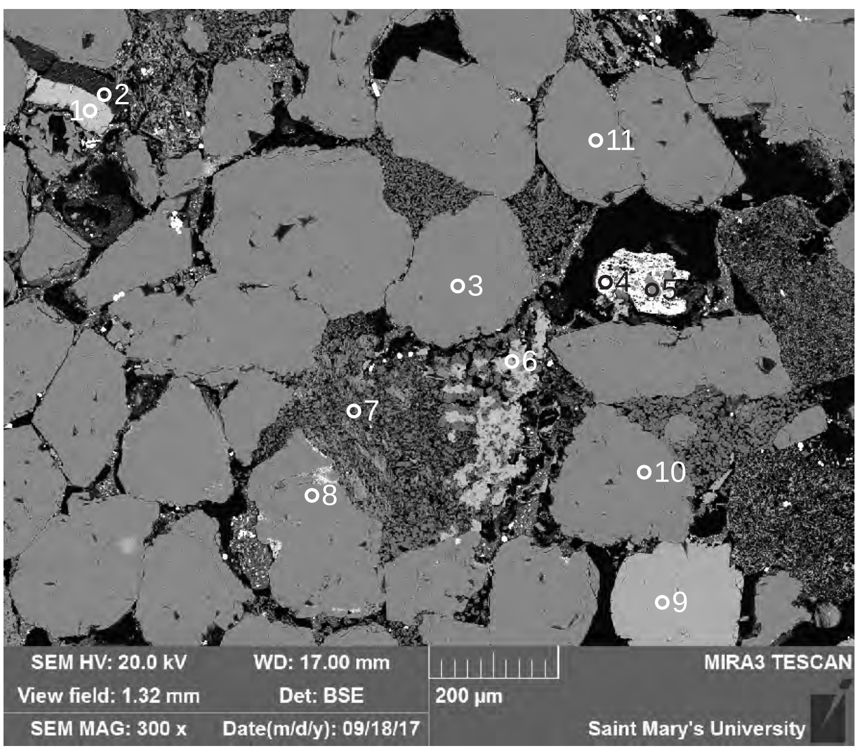
1:Quartz
2:Quartz
3:Calcite
4:Altered Ilmenite
5:K-feldspar
6:K-feldspar
7:Quartz
8:Quartz
9:Chlorite
10:Quartz

Figure 1-2.33: Sample E-48-2246.46 site 20 (SEM). This site consists of quartz and K-feldspar (5-6) grains showing suturing. Calcite (3) appears to cross-cut clays. Altered ilmenite grain (4) has also been seen. There is also a metasandstone lithic clast made up of quartz (10) and chlorite (9).



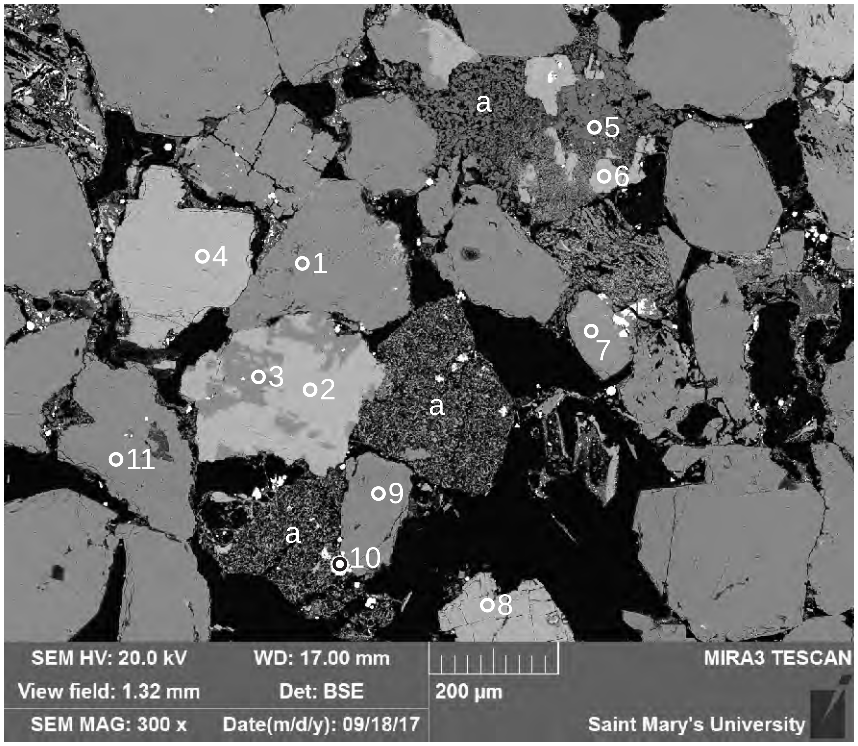
1:K-feldspar
2:Quartz
3:Quartz
4:Albite
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-2.34: Sample E-48-2246.46 site 21 (SEM). This site consists of quartz that appears to be more fractured and contains voids. Albite (4) appears to have beem parlty replaced by clays. K-feldspar (1,7,9) also appears to be fractured.



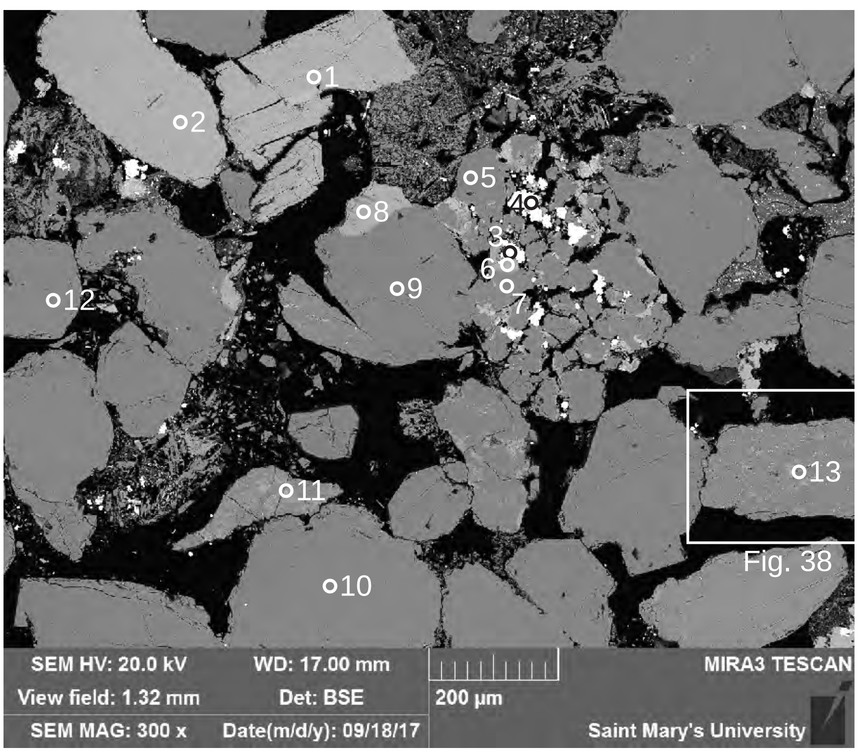
1:K-feldspar
2:TiO_2 +?
3:Quartz
4:Ilmenite
5:Quartz
6:Calcite +
7:Kaolinite
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-2.35: Sample E-48-2246.46 site 22 (SEM). This site consists of quartz and K-feldspar. Kaolinite (7) appears to form commonly between grains. There is also an altered ilmenite grain (4) with quartz inclusions (5), and titania (2) mineral alteration.



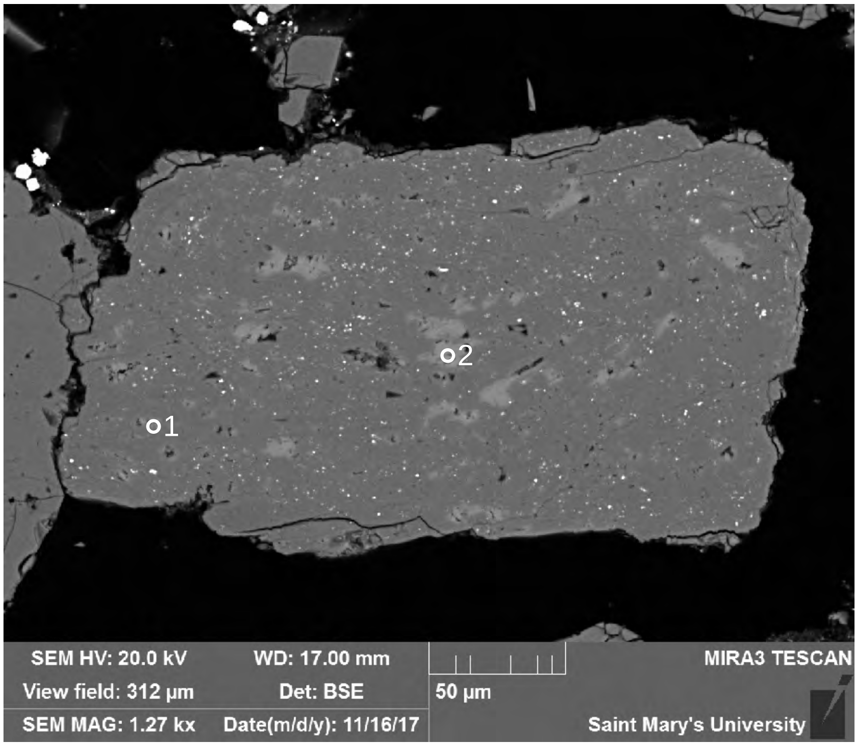
1:Quartz
2:K-feldspar
3:Albite
4:K-feldspar
5:Kaolinite
6:K-feldspar
7:Oligoclase
8:K-feldspar
9:Quartz
10:Pyrite
11:Quartz

Figure 1-2.36: Sample E-48-2246.46 site 23 (SEM). This site consists of quartz and K-feldpsar. There is an albitized K-feldspar (2-3) detrital grain. Pyrite (10) appears to be diagenetic, and a large amount of kaolinite can be seen (5, positions a).



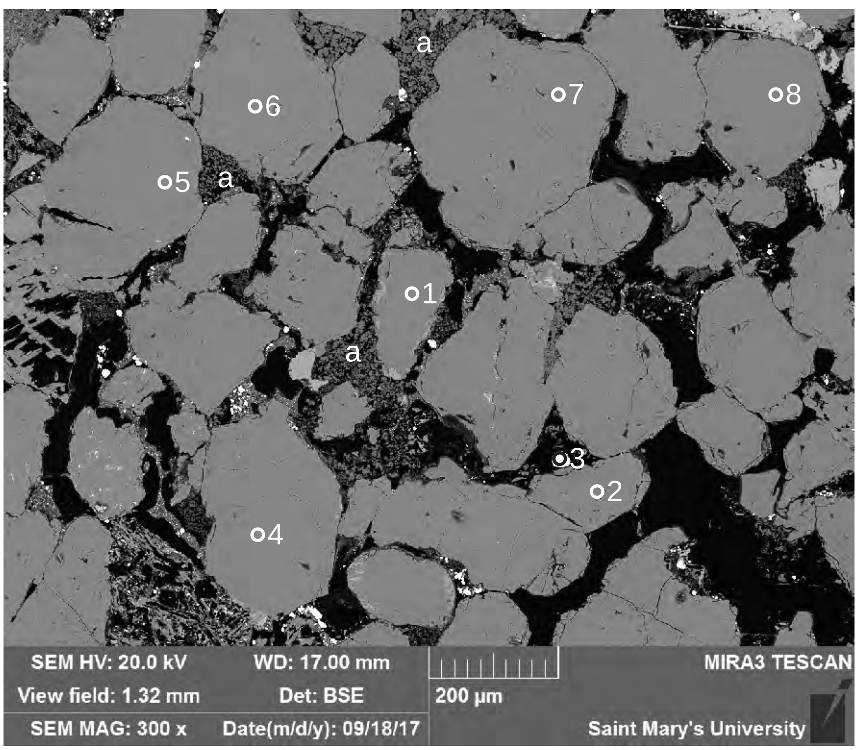
1:K-feldspar
2:K-feldspar
3:Pyrite
4:Pyrite
5:Quartz
6:K-feldspar
7:Albite
8:K-feldspar
9:Quartz
10:Quartz
11:Quartz + K-feldspar
12:Quartz
13:Albite

Figure 1-2.37: Sample E-48-2246.46 site 24 (SEM). This site consists of K-feldspar (1), albite (7), both also appear fractured, and diagenetic pyrite (3-4) filling voids. There are lithic clasts of quartz (9) and K-feldspar (8), and probably quartz and albite (13). There is also another finer grained, probably subvolcanic lithic clast made up of quartz and K-feldspar (11).



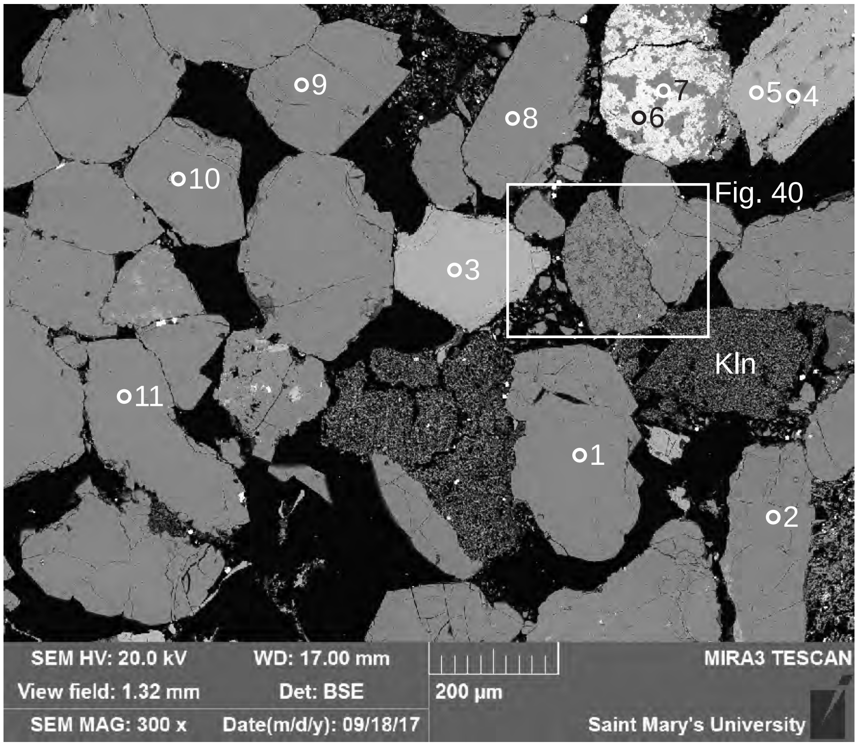
1:Albite
2:K-feldspar

Figure 1-2.38: Sample E-48-2246.46 site 24.1 (SEM). This site contains a lithic clast that consists of K-feldspar (2), albite (1) and scattered high reflectivity very small mineral grains.



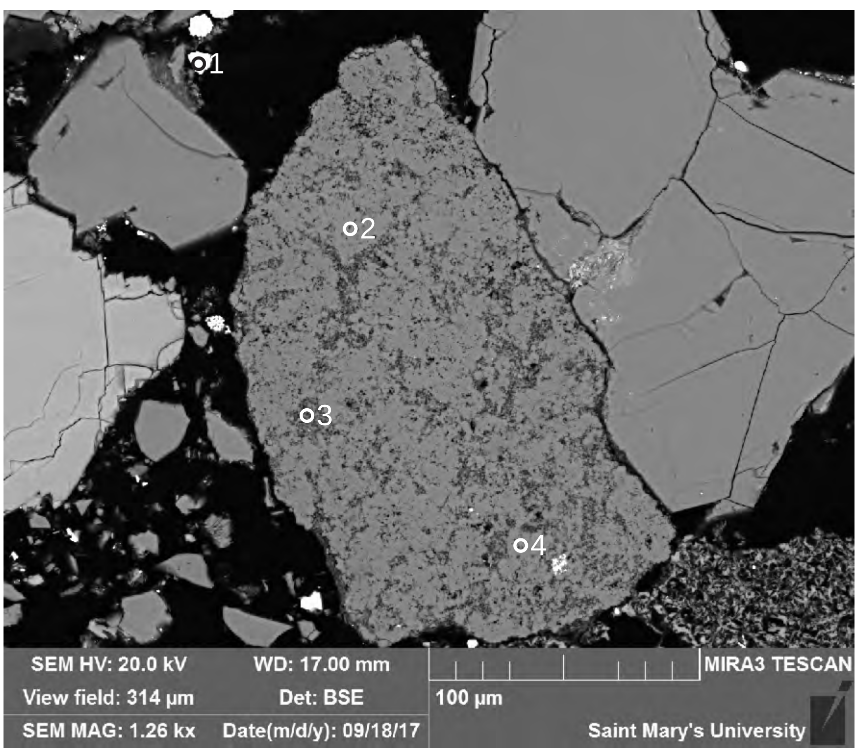
1:Quartz
2:Quartz
3:Barite
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Quartz

Figure 1-2.39: Sample E-48-2246.46 site 25 (SEM). This site consists of mainly quartz with kaolinite (positions a) partially filling intergranular boundaries and drilling mud (3).



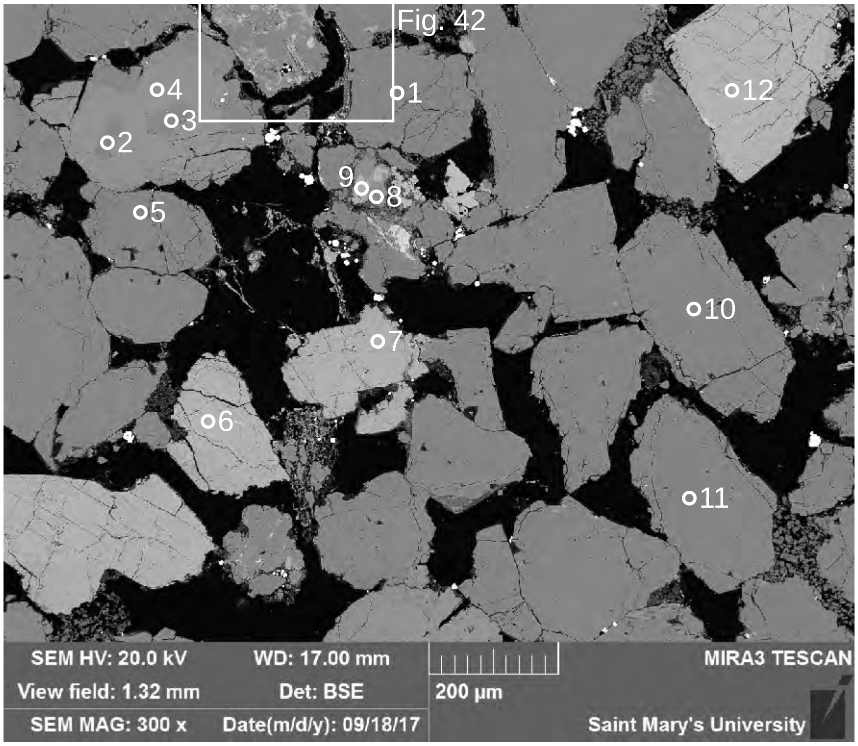
1:Quartz
2:Quartz
3:K-feldspar
4:Albite
5:K-feldspar
6:Apatite
7:Quartz
8:Albite
9:Quartz
10:Quartz
11:Quartz

Figure 1-2.40: Sample E-48-2246.46 site 26 (SEM). This site consists of quartz, K-feldspar (2-3), and albite (8). There is a lithic clast made up of apatite (6) and quartz (7) (?pegmatite), and an albitized (4) K-feldspar (5) detrital grain.



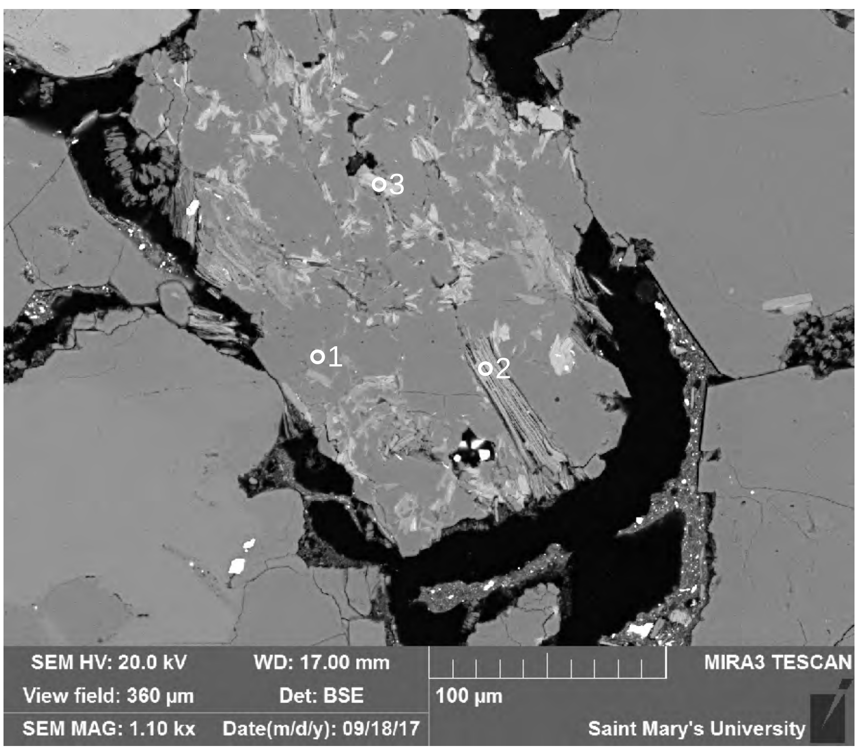
1:Barite
2:Quartz
3:Quartz + Clay
4:Quartz

Figure 1-2.41: Sample E-48-2246.46 site 26.1 (SEM). Lithic clast made up of quartz and clays (quartz vein). Barite (1) forms in the space between grains (probably drilling mud).



1:Quartz
2:Quartz
3:Oligoclase
4:Oligoclase
5:Quartz
6:K-feldspar
7:K-feldspar
8:Albite
9:K-feldspar
10:Quartz
11:Quartz
12:K-feldspar

Figure 1-2.42: Sample E-48-2246.46 site 27 (SEM). This site consists mainly of quartz and K-feldspar. There are lithic clasts made up of oligoclase (3,4) and quartz (2) and albite (8) and K-feldspar (9).



1:Quartz + Muscovite
2:Muscovite
3:Muscovite + Chlorite

Figure 1-2.43: Sample E-48-2246.46 site 27.1 (SEM). Lithic clast of quartz (1), and muscovite (2).

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	1	1	Qz	100.00																						100	113
E-48-2246.46	1	2	Kfs	66.44		17.64					0.64	15.29														100	111
E-48-2246.46	1	3	Ab	69.42		18.63					11.57	0.38														100	113
E-48-2246.46	1	4	Qz	100.00																						100	116
E-48-2246.46	1	5	Kfs	66.38		17.78					1.28	14.56														100	110
E-48-2246.46	1	6	Qz	100.00																						100	116
E-48-2246.46	1	7	Qz	100.00																						100	119
E-48-2246.46	1	8	Qz	100.00																						100	119
E-48-2246.46	1	9	Kfs	66.75		17.84					1.68	13.73														100	110
E-48-2246.46	1	10	Kfs	65.49		17.96					1.11	14.35												1.09		100	109
E-48-2246.46	1	11	Qz	100.00																						100	112
E-48-2246.46	1	12	Qz	100.00																						100	117
E-48-2246.46	1	13	Qz	100.00																						100	113
E-48-2246.46	1	14	Qz	96.83		1.82	0.53		0.55			0.27														100	110
E-48-2246.46	1	15	Qz	100.00																						100	111
E-48-2246.46	1	16	Brt											36.81								1.80		61.38		100	107
E-48-2246.46	1.1	1	Brt											36.98										63.02		100	111
E-48-2246.46	1.1	2	Sme +	63.86	0.61	18.47	7.72		2.50	2.50	0.95	1.53	0.64	0.87		0.36										100	82
E-48-2246.46	1.1	3	Brt	0.75										36.58								2.10		60.58		100	111
E-48-2246.46	1.1	4	Brt											36.95										63.05		100	108
E-48-2246.46	1.1	5	Sme +	50.16		22.19	6.59		2.29	2.22	1.22	2.27		4.99		0.59								7.47		100	83
E-48-2246.46	2	1	Qz	100.00																						100	119
E-48-2246.46	2	2	Qz	100.00																						100	119
E-48-2246.46	2	3	Kfs	66.16		17.68					0.54	15.62														100	113
E-48-2246.46	2	4	Kfs	67.14		17.71						15.15														100	113
E-48-2246.46	2	5	Brt											37.01										62.99		100	109
E-48-2246.46	2	6	Plag	63.67		22.80				4.50	8.80	0.22														100	111
E-48-2246.46	2	7	Qz	100.00																						100	114
E-48-2246.46	2	8	Ab	67.31		20.35				0.96	10.48	0.91														100	114
E-48-2246.46	2	9	Kfs	65.91		17.72					0.89	14.94												0.55		100	109
E-48-2246.46	2	10	Qz	98.55	0.36	1.09																				100	111
E-48-2246.46	2	11	Qz	100.00																						100	115
E-48-2246.46	2	12	Kfs	66.07		17.77					0.67	15.48														100	112
E-48-2246.46	2	13	Qz	100.00																						100	119
E-48-2246.46	3	1	Kfs	66.54		17.62					0.98	14.86														100	113
E-48-2246.46	3	2	Kfs	66.00		17.96					0.53	15.52														100	116
E-48-2246.46	3	3	Kfs	65.77		17.58					0.49	15.37												0.80		100	118
E-48-2246.46	3	4	Qz	100.00																						100	121
E-48-2246.46	3	5	Qz	100.00																						100	120
E-48-2246.46	3	6	Qz	100.00																						100	117
E-48-2246.46	3	7	Qz	100.00																						100	118
E-48-2246.46	3	8	Qz	100.00																						100	124
E-48-2246.46	3	9	Qz	100.00																						100	122
E-48-2246.46	3	10	Qz	100.00																						100	117
E-48-2246.46	3	11	Qz	100.00																						100	117
E-48-2246.46	3	12	Qz	100.00																						100	120

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	3	13	Kfs	66.17		17.87						15.96														100	115
E-48-2246.46	3.1	1	Qz	100.00																						100	120
E-48-2246.46	3.1	2	Kfs	66.26		17.52					0.49	15.73														100	116
E-48-2246.46	3.1	3	Qz	100.00																						100	118
E-48-2246.46	3.1	4	Kln	48.76		37.24																				86	92
E-48-2246.46	3.1	5	Cal	1.81		1.06	1.20	0.53		51.40																56	56
E-48-2246.46	3.1	6	Mix	41.76	3.71	21.70	8.66		2.32	15.11	0.70	1.52		0.88		0.63										97	74
E-48-2246.46	4	1	Qz	100.00																						100	121
E-48-2246.46	4	2	Kfs	66.22		17.64					0.90	15.24														100	115
E-48-2246.46	4	3	Qz	100.00																						100	119
E-48-2246.46	4	4	Qz	100.00																						100	120
E-48-2246.46	4	5	Mix	31.14		18.25	1.84	0.48	1.70	42.25		4.34														100	81
E-48-2246.46	4	6	Qz	100.00																						100	119
E-48-2246.46	4	7	Qz	100.00																						100	119
E-48-2246.46	4	8	Qz	100.00																						100	124
E-48-2246.46	4	9	Qz	100.00																						100	125
E-48-2246.46	4.1	1	Kfs	65.94		16.97	0.46			0.88	0.45	14.65				0.65										100	87
E-48-2246.46	4.1	2	Kfs	67.01		17.11					0.66	14.39				0.83										100	84
E-48-2246.46	4.1	3	Kfs	66.44		17.22					0.59	14.32				1.42										100	80
E-48-2246.46	5	1	Kfs	66.04	0.29	17.91					0.90	14.86														100	112
E-48-2246.46	5	2	Kfs	66.09		17.52					0.42	15.98														100	118
E-48-2246.46	5	3	Qz	100.00																						100	123
E-48-2246.46	5	4	Kfs	66.18		17.82					0.79	15.21														100	120
E-48-2246.46	5	5	Qz	100.00																						100	119
E-48-2246.46	5	6	Qz	100.00																						100	123
E-48-2246.46	5	7	Kfs	66.30		17.55					0.82	15.33														100	118
E-48-2246.46	5	8	Qz	100.00																						100	121
E-48-2246.46	5	9	Py	0.31			29.28				0.27			70.15												100	213
E-48-2246.46	5	10	Ab	69.69		18.86					11.45															100	121
E-48-2246.46	5	11	Kln	48.02		33.79										4.19										86	47
E-48-2246.46	5.1	1	Kfs	66.38		17.78						15.85														100	117
E-48-2246.46	5.1	2	Ab	69.91		18.74					11.17	0.17														100	115
E-48-2246.46	5.1	3	Kfs	66.74		17.25	0.26				0.45	15.30														100	114
E-48-2246.46	5.1	4	Kln	48.18	0.65	34.75	0.37				0.31	0.34				1.40										86	72
E-48-2246.46	5.2	1	Qz	100.00																						100	120
E-48-2246.46	5.2	2	Ms	50.93	0.90	31.37	1.43		0.78		0.56	8.47				0.26		0.30								95	98
E-48-2246.46	5.2	3	Qz	100.00																						100	121
E-48-2246.46	6	1	Kfs	65.68		17.77					0.63	15.13												0.79		100	113
E-48-2246.46	6	2	Qz	100.00																						100	120
E-48-2246.46	6	3	Kfs	66.06		17.69					0.61	15.63														100	119
E-48-2246.46	6	4	Qz	100.00																						100	118
E-48-2246.46	6	5	Qz	100.00																						100	116
E-48-2246.46	6	6	Qz	100.00																						100	116
E-48-2246.46	6	7	Qz	100.00																						100	123
E-48-2246.46	6	8	Qz	100.00																						100	124
E-48-2246.46	6.1	1	Qz	98.96		0.61						0.43														100	122

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	6.1	2	Ms	58.27		27.45	3.77		1.25		0.41	8.65				0.19										100	102
E-48-2246.46	6.1	3	Qz	100.00																						100	122
E-48-2246.46	6.2	1	Ab	69.79		18.65					11.56															100	117
E-48-2246.46	6.2	2	Py	0.40			28.08							71.52												100	230
E-48-2246.46	6.2	3	Kln	48.42		37.10	0.30									0.18										86	90
E-48-2246.46	6.2	4	Ap	1.42		0.66	0.47			46.81			42.88		5.69	0.26									1.81	100	122
E-48-2246.46	6.3	1	Sd	1.35		0.53	43.36	0.35	5.84	4.14	0.44															56	63
E-48-2246.46	6.3	2	Grt	38.81		24.50	25.75	0.31	8.80		0.86	0.97														100	99
E-48-2246.46	6.3	3	Ab	68.36		19.57				0.89	11.03	0.14														100	119
E-48-2246.46	6.3	4	Ms	48.38		32.60	1.43		1.27		0.33	10.98														95	107
E-48-2246.46	6.3	5	Ms	48.31		34.06	1.01		0.78		0.28	10.56														95	107
E-48-2246.46	6.3	6	Ab	67.44		20.53				1.33	10.32	0.37														100	116
E-48-2246.46	6.3	7	Ms	49.56		32.25	1.11		1.82		0.36	9.89														95	110
E-48-2246.46	6.3	8	Py	0.38			28.26							71.11						0.25						100	226
E-48-2246.46	7	1	Ab	68.16		19.79				0.89	10.85	0.31														100	116
E-48-2246.46	7	2	Kfs	66.16		17.77					0.34	15.74														100	113
E-48-2246.46	7	3	Qz	100.00																						100	119
E-48-2246.46	7	4	Kfs	66.30		17.66					0.74	15.30														100	115
E-48-2246.46	7	5	Ab	68.24		19.67				0.36	11.07	0.66														100	117
E-48-2246.46	7	6	Qz	100.00																						100	121
E-48-2246.46	7	7	Qz	100.00																						100	122
E-48-2246.46	7	8	Qz	100.00																						100	126
E-48-2246.46	7	9	Qz	100.00																						100	124
E-48-2246.46	7	10	Cal	0.99			0.67	0.29	0.31	53.35		0.39														56	58
E-48-2246.46	7	11	TiO2	1.99	94.87	0.80	1.11			0.40		0.83														100	107
E-48-2246.46	7	12	Kfs	66.77		17.18					0.49	15.13				0.42										100	99
E-48-2246.46	7	13	Ab	68.41		19.13	0.31			0.31	11.23	0.61														100	114
E-48-2246.46	7.1	1	Qz	99.44		0.56																				100	121
E-48-2246.46	7.1	2	Grt	35.00		20.70	31.88	0.44	11.32		0.66															100	100
E-48-2246.46	7.1	3	Kfs	66.77		17.28					0.52	14.85												0.57		100	119
E-48-2246.46	7.2	1	Grt	37.33		18.51	25.12	0.43	18.06		0.54															100	90
E-48-2246.46	7.2	2	Sme	50.38		24.12	5.82		15.50		1.27	1.89				1.02										100	91
E-48-2246.46	8	1	Qz	100.00																						100	115
E-48-2246.46	8	2	Kfs	65.74		17.96					1.56	13.73												1.01		100	112
E-48-2246.46	8	3	Qz	100.00																						100	118
E-48-2246.46	8	4	Cal				1.86	0.74	0.44	52.96																56	57
E-48-2246.46	8	5	Ms +	40.25	9.29	13.32	11.25	0.27	15.45		1.04	9.13														100	110
E-48-2246.46	8	6	Kln	48.26		34.18	0.69					0.23		0.53		2.11										86	60
E-48-2246.46	8	7	Cal +	9.27		5.38	2.05	0.87	0.94	80.32		1.16														100	62
E-48-2246.46	8	8	Qz	96.22	0.22	3.08						0.48														100	113
E-48-2246.46	8	9	TiO2	3.17	92.82	1.46	1.20			0.93		0.42														100	98
E-48-2246.46	8	10	Ab	66.53		18.92				0.39	10.41	0.78		1.82							1.15					100	118
E-48-2246.46	8	11	Kfs	66.08	0.26	17.74					0.53	15.40														100	116
E-48-2246.46	8	12	Qz	100.00																						100	120
E-48-2246.46	8	13	Ap	0.54					0.32	48.09			43.45		5.68	0.29									1.63	100	125
E-48-2246.46	8	14	Qz +	96.23		2.04					0.76	0.96														100	120

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	8	15	Mix	58.24	0.78	15.06	0.49			5.93	0.58	12.81	5.21			0.90										100	86
E-48-2246.46	9	1	Ab	69.41		19.03					11.56															100	115
E-48-2246.46	9	2	Kfs	66.27		17.56					0.74	15.43														100	109
E-48-2246.46	9	3	Qz	100.00																						100	118
E-48-2246.46	9	4	Kfs	66.84		17.18					0.27	15.00												0.72		100	117
E-48-2246.46	9	5	Qz	100.00																						100	121
E-48-2246.46	9	6	Qz	99.44		0.56																				100	117
E-48-2246.46	9	7	Qz	100.00																						100	117
E-48-2246.46	9	8	Kfs	66.23		17.72					0.68	15.37														100	119
E-48-2246.46	9	9	Qz	100.00																						100	123
E-48-2246.46	9	10	Ms	48.00		31.95	2.50		1.09	0.61	0.65	10.20														95	108
E-48-2246.46	9	11	Cal +	1.74		0.99	1.63	0.72	0.39	50.43		0.10														56	59
E-48-2246.46	9	12	Qz	100.00																						100	119
E-48-2246.46	9	13	Ab	66.60		23.76	0.35				9.11					0.17										100	104
E-48-2246.46	9	14	Ab	69.05		18.70				0.40	11.08	0.77														100	116
E-48-2246.46	9	15	Py	0.23			28.83							70.94												100	225
E-48-2246.46	9	16	Kln +	54.32	0.72	29.63	4.32		1.16	1.55	0.67	1.97		2.23		0.76								2.67		100	74
E-48-2246.46	9	17	Qz	100.00																						100	125
E-48-2246.46	9	18	Cal	1.37		0.31	1.02	0.38		52.63		0.29														56	57
E-48-2246.46	9	19	Kfs +	65.15		16.20	0.70				0.72	13.62				3.60										100	44
E-48-2246.46	10	1	Kfs	65.98		17.63					0.61	15.77														100	119
E-48-2246.46	10	2	Qz	100.00																						100	118
E-48-2246.46	10	3	Ab	69.74		18.71					11.55															100	118
E-48-2246.46	10	4	Qz	100.00																						100	119
E-48-2246.46	10	5	Qz	98.70			1.30																			100	117
E-48-2246.46	10	6	Qz	100.00																						100	120
E-48-2246.46	10	7	Qz	100.00																						100	124
E-48-2246.46	10	8	Grt	38.37		21.62	19.15		19.63		0.35	0.66				0.22										100	91
E-48-2246.46	10	9	Qz	98.78		0.87						0.36														100	118
E-48-2246.46	10	10	Kln	48.25		37.14						0.19				0.42										86	77
E-48-2246.46	10.1	1	Qz	99.59		0.41																				100	211
E-48-2246.46	10.1	2	Ms	52.42	0.50	32.69	1.73		1.22		0.53	5.42				0.48										95	88
E-48-2246.46	10.1	3	Py	0.35			28.38							71.27												100	234
E-48-2246.46	10.1	4	Ms	52.65		32.64	1.72		1.46		0.48	5.47				0.58										95	85
E-48-2246.46	11	1	Kfs	65.68		17.88					0.73	15.16												0.55		100	115
E-48-2246.46	11	2	Qz	100.00																						100	119
E-48-2246.46	11	3	Qz	100.00																						100	120
E-48-2246.46	11	4	Kln +	56.73		38.75	0.34					0.48				3.70										100	62
E-48-2246.46	11	5	Qz	100.00																						100	121
E-48-2246.46	11	6	Qz	100.00																						100	122
E-48-2246.46	11	7	Qz	100.00																						100	123
E-48-2246.46	11	8	Kfs	66.41		17.67					1.81	14.11														100	113
E-48-2246.46	11	9	Kfs	66.32		17.75					2.93	12.83				0.16										100	111
E-48-2246.46	11	10	Py	0.34			29.16				0.32			70.18												100	226
E-48-2246.46	11	11	Brt	0.78										36.98										62.24		100	118
E-48-2246.46	11	12	Kfs	64.54	1.47	17.31	0.76		1.33			14.28				0.32										100	101

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	11	13	Sme	62.44	0.68	20.90	5.19		1.71	1.85	0.63	2.09		1.73		0.99								1.77		100	78
E-48-2246.46	11	14	Kfs	66.31		17.66					0.43	14.63				0.96										100	79
E-48-2246.46	12	1	Qz	100.00																						100	118
E-48-2246.46	12	2	Qz	100.00																						100	121
E-48-2246.46	12	3	Kfs	66.39		17.48					0.49	15.65														100	117
E-48-2246.46	12	4	Qz	98.93		0.39	0.34				0.33															100	108
E-48-2246.46	12	5	Qz	100.00																						100	120
E-48-2246.46	12	6	Kfs	65.98		17.77					0.32	15.93														100	119
E-48-2246.46	12	7	Qz	100.00																						100	124
E-48-2246.46	12.1	1	?Chl	42.75		18.70	16.75		18.57		0.99	0.50				1.74										100	60
E-48-2246.46	12.1	2	Kfs	66.51		17.35	0.34				0.28	15.52														100	116
E-48-2246.46	12.1	3	Kfs	66.75		18.94	0.66		0.68		3.87	9.10														100	111
E-48-2246.46	12.1	4	Sp	3.38		0.98	0.55					0.54		47.60							46.94					100	184
E-48-2246.46	13	1	Qz	100.00																						100	120
E-48-2246.46	13	2	Kfs	66.27		17.74					0.38	15.62														100	117
E-48-2246.46	13	3	Qz	100.00																						100	122
E-48-2246.46	13	4	Py	0.32			28.61							71.07												100	226
E-48-2246.46	13	5	Kfs	66.27		17.57					0.63	15.53														100	117
E-48-2246.46	13	6	Ms	50.47	0.39	30.09	2.43		1.82		0.29	9.23				0.27										95	97
E-48-2246.46	13	7	Kfs	66.20		17.77					0.76	15.26														100	121
E-48-2246.46	13	8	Qz	100.00																						100	121
E-48-2246.46	13	9	Cal	0.77		0.56	1.32	0.62		52.73																56	59
E-48-2246.46	13	10	Mix	57.82		28.95	2.16		2.30	1.07	0.49	5.26				1.95										100	71
E-48-2246.46	13	11	Qz	100.00																						100	115
E-48-2246.46	13	12	Cal +	8.36	1.53	4.40	3.17	1.02	0.74	79.96		0.84														100	61
E-48-2246.46	14	1	Kfs	66.34		17.79					2.13	13.74														100	121
E-48-2246.46	14	2	Qz	100.00																						100	121
E-48-2246.46	14	3	Qz	100.00																						100	120
E-48-2246.46	14	4	Ab	69.31		19.14					11.55															100	119
E-48-2246.46	14	5	Kln	50.20		36.39	9.04		2.17	0.26	0.59					1.37										100	66
E-48-2246.46	14	6	Ab	69.42		19.07				0.24	11.26															100	116
E-48-2246.46	14	7	Qz	100.00																						100	118
E-48-2246.46	14	8	Qz	100.00																						100	119
E-48-2246.46	14	9	Py	0.21			28.93							70.86												100	221
E-48-2246.46	14	10	Qz	100.00																						100	123
E-48-2246.46	14	11	Qz	100.00																						100	125
E-48-2246.46	15	1	Kfs	67.45		18.25					1.23	13.07														100	112
E-48-2246.46	15	2	Kfs	65.97		17.85					0.58	15.60														100	118
E-48-2246.46	15	3	Ab	69.45		18.81					11.75															100	119
E-48-2246.46	15	4	Qz	100.00																						100	121
E-48-2246.46	15	5	Kfs	66.38		17.52					1.63	14.47														100	114
E-48-2246.46	15	6	Qz	100.00																						100	120
E-48-2246.46	15	7	Qz	100.00																						100	119
E-48-2246.46	15	8	Kfs	65.71		17.98					0.76	14.90												0.64		100	116
E-48-2246.46	15	9	Qz	100.00																						100	118
E-48-2246.46	15	10	Zrn	31.47		1.81	0.77			1.02							0.87						64.05			100	99

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	15	11	Ms	53.70		27.75	1.07		0.46			12.02														95	116
E-48-2246.46	15	12	Ab	69.49		18.85				0.23	11.43															100	119
E-48-2246.46	15	13	Mix	53.07	4.85	26.72	6.69		1.83	1.69	0.95	1.83		1.56		0.83										100	77
E-48-2246.46	15	14	Qz	100.00																						100	124
E-48-2246.46	15	15	Qz	100.00																						100	122
E-48-2246.46	16	1	Qz	100.00																						100	120
E-48-2246.46	16	2	Kfs	66.19		17.73					0.43	15.65														100	117
E-48-2246.46	16	3	Qz	100.00																						100	120
E-48-2246.46	16	4	Kfs	65.65		17.74					0.61	15.41												0.59		100	116
E-48-2246.46	16	5	Kfs	65.94		17.97					0.86	15.23														100	118
E-48-2246.46	16	6	Qz	100.00																						100	121
E-48-2246.46	16	7	Qz	100.00																						100	125
E-48-2246.46	16	8	Qz	100.00																						100	126
E-48-2246.46	16	9	Qz	100.00																						100	126
E-48-2246.46	16	10	Qz	100.00																						100	127
E-48-2246.46	16	11	"Ilm"	1.76	71.74	0.65	24.04		0.62	0.79						0.40										100	85
E-48-2246.46	16	12	Ab	69.40		18.61	0.29				11.70															100	120
E-48-2246.46	16	13	Py	0.31			28.97							70.73												100	232
E-48-2246.46	17	1	Kfs	65.92		18.12					1.03	14.94														100	117
E-48-2246.46	17	2	Qz	100.00																						100	119
E-48-2246.46	17	3	Qz	100.00																						100	123
E-48-2246.46	17	4	Qz	100.00																						100	124
E-48-2246.46	17	5	Qz	100.00																						100	122
E-48-2246.46	17	6	Qz	99.58		0.42																				100	117
E-48-2246.46	17	7	Kln	46.06		33.20						0.39				6.35										86	29
E-48-2246.46	17	8	Qz	100.00																						100	120
E-48-2246.46	17	9	Qz	100.00																						100	126
E-48-2246.46	17	10	Qz	100.00																						100	120
E-48-2246.46	18	1	Kfs	65.38		17.95					0.80	14.95												0.93		100	116
E-48-2246.46	18	2	Qz	100.00																						100	116
E-48-2246.46	18	3	Chr		0.40	23.03	20.61		12.43									43.53								100	105
E-48-2246.46	18	4	Qz	100.00																						100	117
E-48-2246.46	18	5	Qz	100.00																						100	118
E-48-2246.46	18	6	Kfs	66.20		17.59					0.65	15.56														100	120
E-48-2246.46	18	7	Ab	69.60		18.76					11.64															100	119
E-48-2246.46	18	8	Kfs	66.22		17.90					1.09	14.79														100	117
E-48-2246.46	18	9	Qz	100.00																						100	121
E-48-2246.46	18	10	Ms	50.83		31.83	0.73		0.59		1.43	9.58														95	110
E-48-2246.46	18	11	Ab + Ms	64.11		23.04	0.24			0.58	9.13	2.90														100	119
E-48-2246.46	18	12	Qz	100.00																						100	120
E-48-2246.46	18	13	Qz	100.00																						100	121
E-48-2246.46	19	1	Kfs	65.36		17.94					0.97	14.73												1.00		100	121
E-48-2246.46	19	2	Ab	66.90		20.47				2.04	10.36	0.22														100	117
E-48-2246.46	19	3	Kfs	66.66		17.82					1.71	13.81														100	116
E-48-2246.46	19	4	Qz	100.00																						100	120
E-48-2246.46	19	5	Ab	69.63		18.80					11.57															100	118

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	19	6	Mix	17.74	69.83	5.88	1.03		0.45		4.84					0.24										100	113
E-48-2246.46	19	7	Ab	69.74		18.61					11.65															100	117
E-48-2246.46	19	8	Cal	0.43			1.95	0.92	0.53	52.17																56	59
E-48-2246.46	19	9	Qz	100.00																						100	125
E-48-2246.46	19	10	Qz	100.00																						100	125
E-48-2246.46	19	11	Qz	100.00																						100	119
E-48-2246.46	19	12	Kfs	66.57		17.64					0.63	15.16														100	112
E-48-2246.46	19	13	Qz	100.00																						100	117
E-48-2246.46	20	1	Qz	100.00																						100	118
E-48-2246.46	20	2	Qz	100.00																						100	121
E-48-2246.46	20	3	Cal	0.74			2.50	1.23	0.66	94.87																100	58
E-48-2246.46	20	4	"Ilm"	1.39	96.44	0.79	0.94									0.44										100	91
E-48-2246.46	20	5	Kfs	66.12		17.63					0.57	15.68														100	115
E-48-2246.46	20	6	Kfs	65.94		17.97					0.54	15.55														100	112
E-48-2246.46	20	7	Qz	100.00																						100	119
E-48-2246.46	20	8	Qz	100.00																						100	126
E-48-2246.46	20	9	Chl	27.17		19.12	27.69	0.63	10.39																	85	107
E-48-2246.46	20	10	Qz	99.79			0.21																			100	126
E-48-2246.46	21	1	Kfs	65.06		17.69	1.89				1.32	14.04														100	115
E-48-2246.46	21	2	Qz	100.00																						100	120
E-48-2246.46	21	3	Qz	100.00																						100	120
E-48-2246.46	21	4	Ab	69.16		18.66				0.26	11.28	0.63														100	118
E-48-2246.46	21	5	Qz	100.00																						100	123
E-48-2246.46	21	6	Qz	100.00																						100	125
E-48-2246.46	21	7	Kfs	66.07		17.89					0.88	15.16														100	120
E-48-2246.46	21	8	Qz	100.00																						100	120
E-48-2246.46	21	9	Kfs	64.38		17.51					0.29	15.89		0.47										1.46		100	117
E-48-2246.46	21	10	Qz	100.00																						100	125
E-48-2246.46	21	11	Qz	100.00																						100	118
E-48-2246.46	22	1	Kfs	63.67		18.51					1.09	13.55												3.19		100	114
E-48-2246.46	22	2	TiO2 +?	2.77	79.85	5.65	3.13				1.62					5.44					1.54					100	28
E-48-2246.46	22	3	Qz	100.00																						100	122
E-48-2246.46	22	4	Ilm	0.81	76.54	0.77	21.02	0.41			0.46															100	101
E-48-2246.46	22	5	Qz	99.55	0.45																					100	123
E-48-2246.46	22	6	Cal +	6.76		6.27	1.37	0.62		84.98																100	63
E-48-2246.46	22	7	Kln	46.45	2.98	32.64	0.52		0.35			1.98				1.08										86	68
E-48-2246.46	22	8	Qz	100.00																						100	124
E-48-2246.46	22	9	Kfs	66.30		17.67					0.71	15.31														100	123
E-48-2246.46	22	10	Qz	100.00																						100	126
E-48-2246.46	22	11	Qz	100.00																						100	120
E-48-2246.46	23	1	Qz	98.98		0.70				0.32																100	121
E-48-2246.46	23	2	Kfs	65.42		17.81					0.27	15.92												0.58		100	120
E-48-2246.46	23	3	Ab	69.68		18.63					11.69															100	122
E-48-2246.46	23	4	Kfs	65.95		17.76					0.63	15.65														100	118
E-48-2246.46	23	5	Kln	48.54		37.46																				86	96
E-48-2246.46	23	6	Kfs	66.10		17.77					0.60	15.53														100	118

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	23	7	Oligo	63.43		23.00				4.77	8.51	0.30														100	120
E-48-2246.46	23	8	Kfs	66.05		17.64					0.63	15.69														100	125
E-48-2246.46	23	9	Qz	100.00																						100	126
E-48-2246.46	23	10	Py				28.73							71.27												100	236
E-48-2246.46	23	11	Qz	100.00																						100	123
E-48-2246.46	24	1	Kfs	66.06		17.93					0.59	15.43														100	114
E-48-2246.46	24	2	Kfs	66.17		17.77					0.78	15.28														100	114
E-48-2246.46	24	3	Py	0.21			28.44				0.49			70.86												100	230
E-48-2246.46	24	4	Py	0.16			28.82							71.02												100	227
E-48-2246.46	24	5	Qz	100.00																						100	120
E-48-2246.46	24	6	Kfs	65.70		17.72	0.24				0.43	15.19												0.72		100	117
E-48-2246.46	24	7	Ab	69.79		18.63					11.57															100	119
E-48-2246.46	24	8	Kfs	66.27		17.80					0.43	15.51														100	117
E-48-2246.46	24	9	Qz	100.00																						100	122
E-48-2246.46	24	10	Qz	100.00																						100	124
E-48-2246.46	24	11	Qz + Kfs	86.05		7.65					0.55	5.76														100	120
E-48-2246.46	24	12	Qz	100.00																						100	119
E-48-2246.46	24	13	Ab	69.31		18.55	0.33				11.43			0.38												100	122
E-48-2246.48	24.1	1	Ab	69.58		18.4	0.25				11.37	0.39														100	119
E-48-2246.49	24.1	2	Kfs	67.61		17.79					0.52	14.08														100	111
E-48-2246.46	25	1	Qz	100.00																						100	122
E-48-2246.46	25	2	Qz	100.00																						100	123
E-48-2246.46	25	3	Brt	0.53										36.71										62.76		100	122
E-48-2246.46	25	4	Qz	100.00																						100	123
E-48-2246.46	25	5	Qz	100.00																						100	118
E-48-2246.46	25	6	Qz	100.00																						100	118
E-48-2246.46	25	7	Qz	100.00																						100	117
E-48-2246.46	25	8	Qz	100.00																						100	118
E-48-2246.46	26	1	Qz	100.00																						100	125
E-48-2246.46	26	2	Qz	100.00																						100	127
E-48-2246.46	26	3	Kfs	66.26		17.59					0.68	15.48														100	118
E-48-2246.46	26	4	Ab	68.54		19.48				0.69	11.12	0.16														100	115
E-48-2246.46	26	5	Kfs	66.23		17.79					0.87	15.11														100	115
E-48-2246.46	26	6	Ap	5.21						46.19	0.29		41.01		7.31											100	118
E-48-2246.46	26	7	Qz	100.00																						100	117
E-48-2246.46	26	8	Ab	69.97		18.56					11.47															100	116
E-48-2246.46	26	9	Qz	100.00																						100	118
E-48-2246.46	26	10	Qz	100.00																						100	119
E-48-2246.46	26	11	Qz	100.00																						100	119
E-48-2246.46	26.1	1	Brt	0.85										36.28										62.87		100	115
E-48-2246.46	26.1	2	Qz	99.61												0.39										100	96
E-48-2246.46	26.1	3	Qz + Clay	81.26		13.40	1.00		0.69		0.37	2.32				0.97										100	84
E-48-2246.46	26.1	4	Qz	99.60		0.40																				100	119
E-48-2246.46	27	1	Qz	100.00																						100	119
E-48-2246.46	27	2	Qz	100.00																						100	118
E-48-2246.46	27	3	Oligo	66.77		20.53				2.30	10.39															100	116

Table 1-2.1: EDS geochemical analyses of sample E-48-2246.46.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	CoO	NiO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
E-48-2246.46	27	4	Oligo	65.37		21.63				3.25	9.75															100	114
E-48-2246.46	27	5	Qz	100.00																						100	120
E-48-2246.46	27	6	Kfs	65.71		17.77					0.72	15.23												0.57		100	118
E-48-2246.46	27	7	Kfs	66.16		17.78					0.60	15.46														100	119
E-48-2246.46	27	8	Ab	69.27		18.94				0.25	11.54															100	117
E-48-2246.46	27	9	Kfs	65.61		17.74					0.44	15.28												0.94		100	116
E-48-2246.46	27	10	Qz	100.00																						100	123
E-48-2246.46	27	11	Qz	100.00																						100	126
E-48-2246.46	27	12	Kfs	65.69		17.84					0.76	15.09												0.62		100	110
E-48-2246.46	27.1	1	Qz + Ms	84.22		9.67	1.06		0.97		0.61	3.46														100	122
E-48-2246.46	27.1	2	Ms	47.80	0.55	24.79	7.37		2.23	0.78		10.99				0.48										95	90
E-48-2246.46	27.1	3	Ms + Chl	37.44		24.53	21.47		12.69		0.39	3.48														100	98

Notes
1. + indicates more than one mineral present
2. " " indicated altered grain

Appendix 1-2: SEM-BSE images and EDS mineral analyses for sample 2H-58 1600.27.

Sample 2H-58 1600.27: Medium-fine grained sandstone

Detrital Minerals: Albite, Chlorite (Fig. 40), Ilmenite, K-feldspar, Muscovite, Oligoclase, Quartz, Titania (Fig. 33), Zircon (Fig. 47)

Diagenetic Minerals: Chlorite, Kaolinite, Pyrite, Siderite, Titania,

Notes:

1. Suturing is present mainly in quartz and K-feldspar grains (i.e. Figs. 2,4,6).

2. Overgrowths are rare and occur in quartz (Figs. 2,10).

3. Primary porosity has been preserved.

4. Chlorite appears to have expanded along cleavage and has allowed for diagenetic siderite to precipitate (Figs. 40,44).

5. Drilling mud has partially coated grains thoughout this sample (i.e. Figs. 37,38,40,45,48,54).

6. Pargenetic sequence: Kaolinite →Chlorite →Siderite ± Pyrite ± Titania

Kaolinite ↑ Fig. 34; Chlorite ↑ Figs. 40,44; Titania ↑ Fig. 19

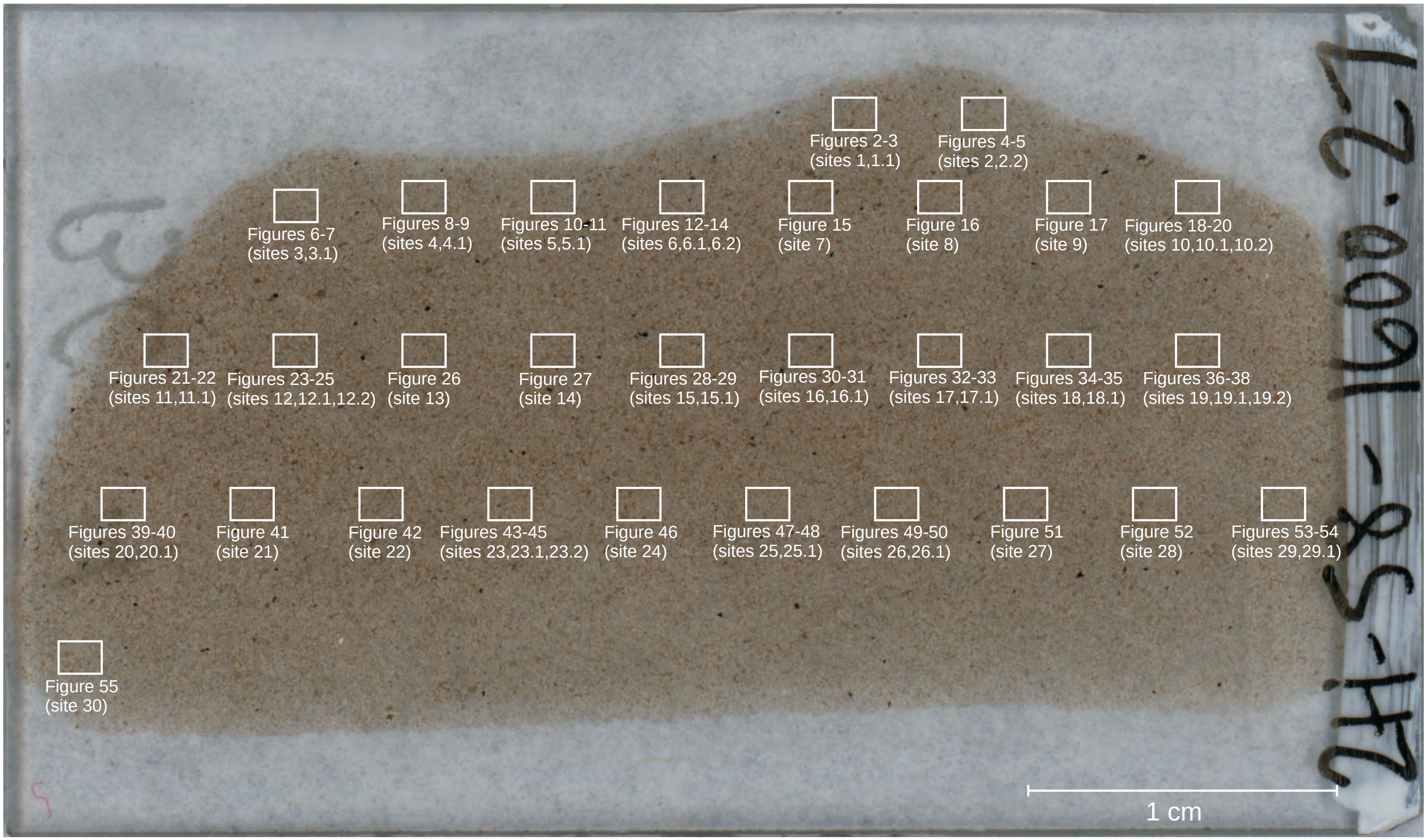
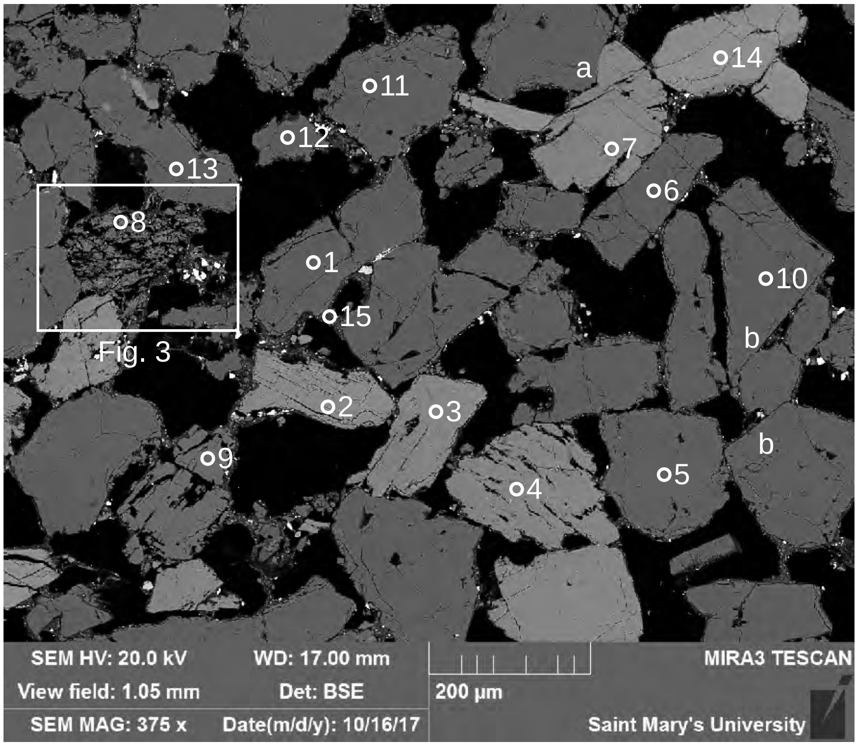
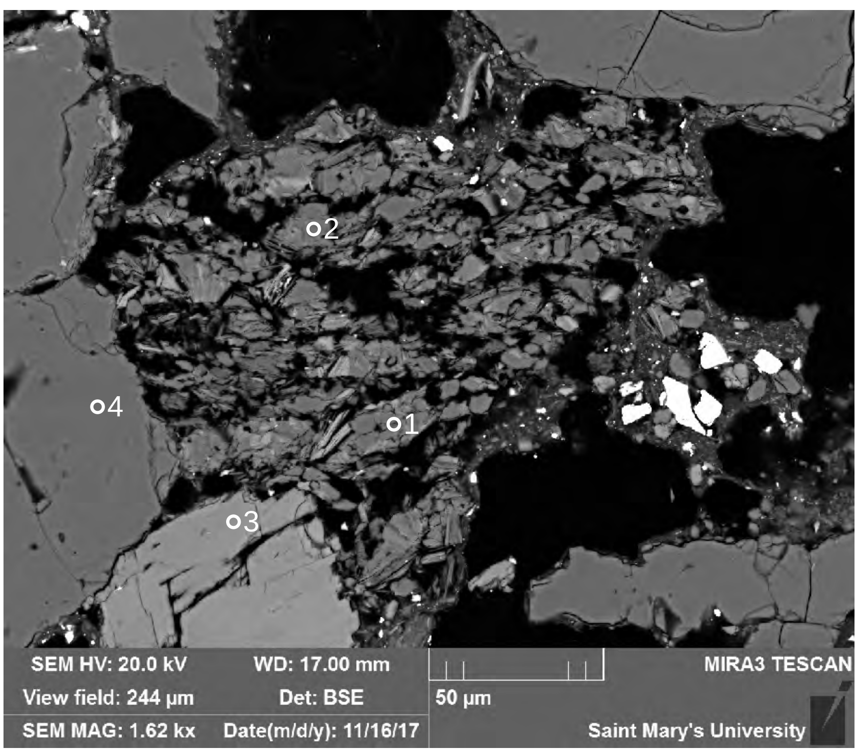


Figure 1-3.1: Scanned thin section of sample 2H-58 1600.27 showing the location of analyzed sites.



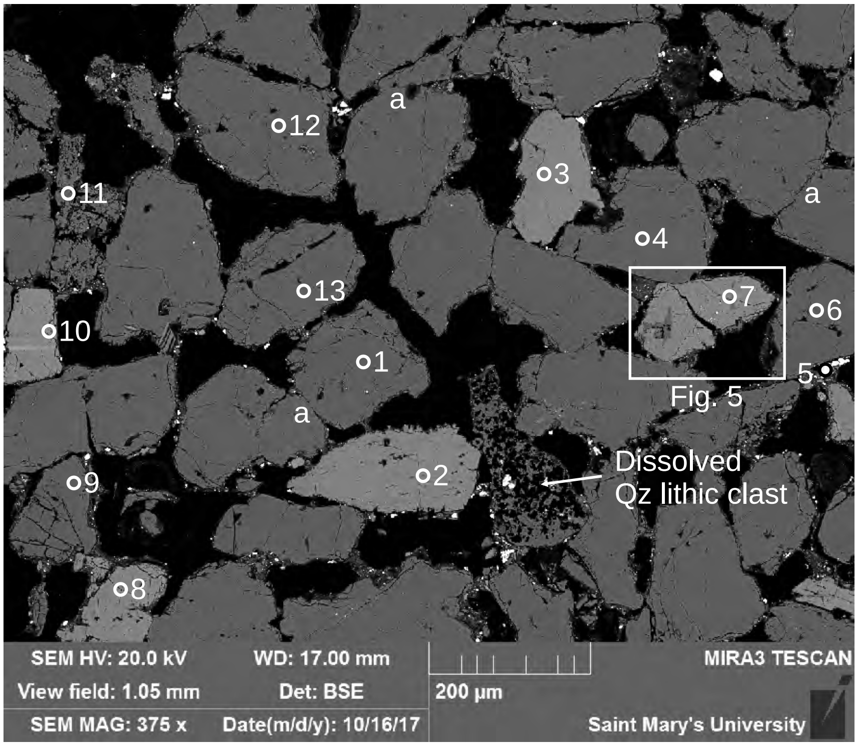
1:Quartz
2:K-feldspar
3:K-feldspar
4:K-feldspar
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz +
9:Oligoclase
10:Quartz
11:Quartz
12:Quartz
13:Quartz
14:K-feldspar
15:Mixture

Figure 1-3.2: Sample 2H-58 1600.27 (SEM) site 1. This site consists of mostly quartz and K-feldspar grains. Most grains seem to be coated in clays. Some suturing is seem (position a) and overgrowths are seen in quartz (positions b).



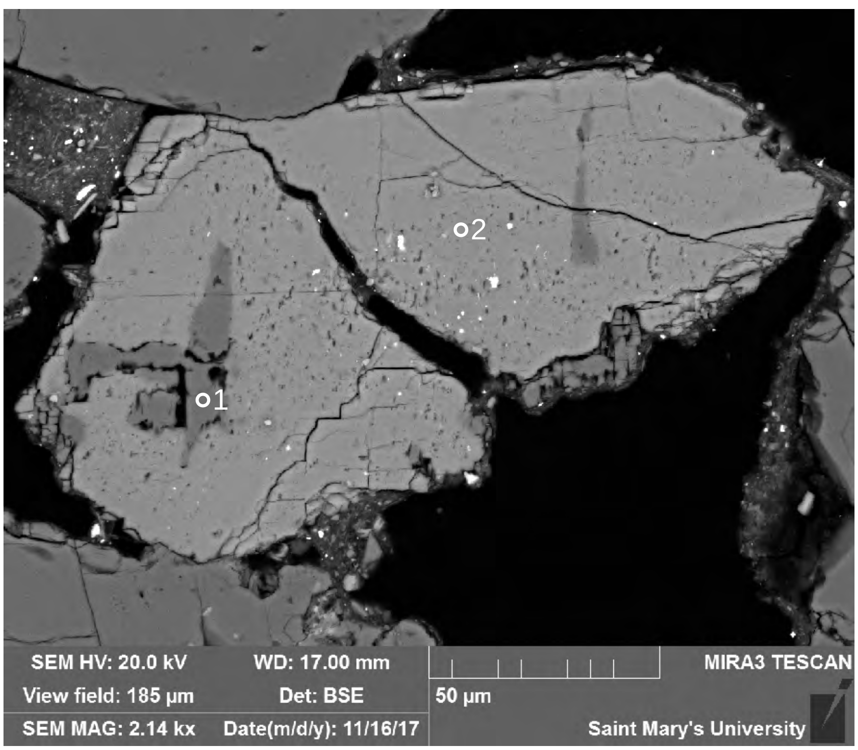
1:Quartz + K-feldspar + Chlorite
2:Quartz +
3:K-feldspar
4:Quartz

Figure 1-3.3: Sample 2H-58 1600.27 (SEM) site 1.1. This site consists of a metasiltstone lithic clast made up of quartz + K-feldspar + chlorite (1).



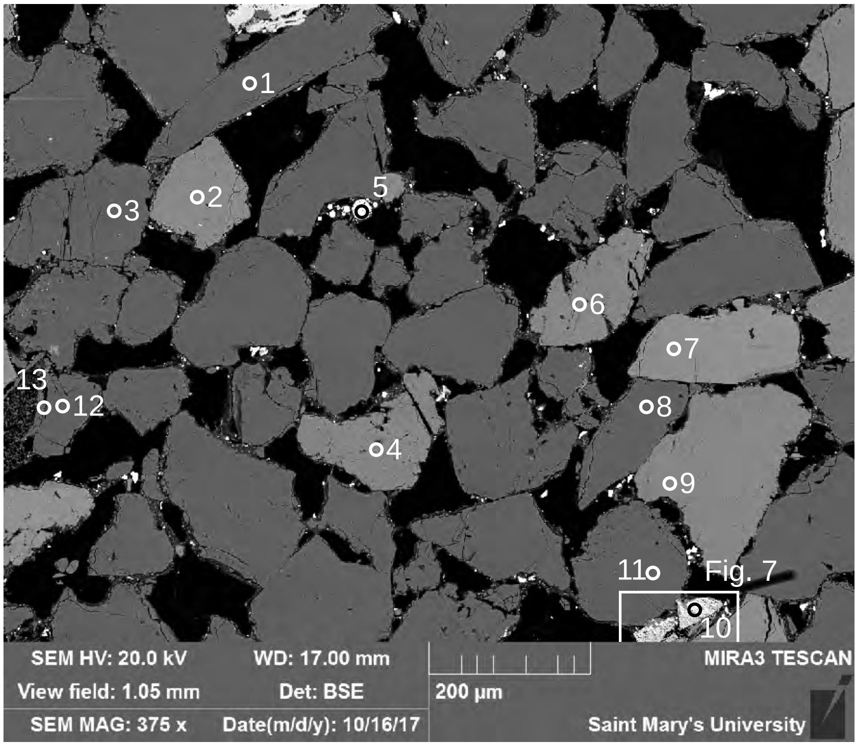
1:Quartz
2:K-feldspar
3:K-feldspar
4:Quartz
5:Pyrite
6:Quartz
7:K-feldspar + Albite
8:K-feldspar
9:Quartz
10:K-feldspar
11:Quartz
12:Quartz
13:Quartz

Figure 1-3.4: Sample 2H-58 1600.27 (SEM) site 2. This site consists of mainly quartz and K-feldspar grains. A quartz aggregate (11) appears to have clays forming along grain boundaries. There is also a lithic clast of dissolved quartz, and an albitized K-feldspar (7) grain. Suturing is seen in positions a.



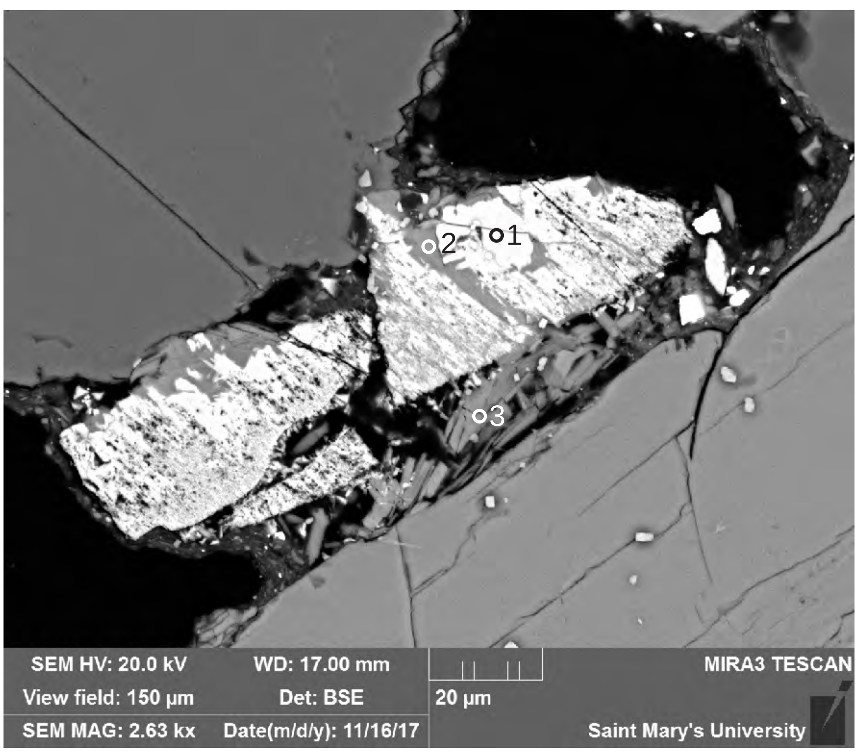
1:Albite
2:K-feldspar

Figure 1-3.5: Sample 2H-58 1600.27 (SEM) site 2.1. This site consists of an albitized K-feldspar grain.



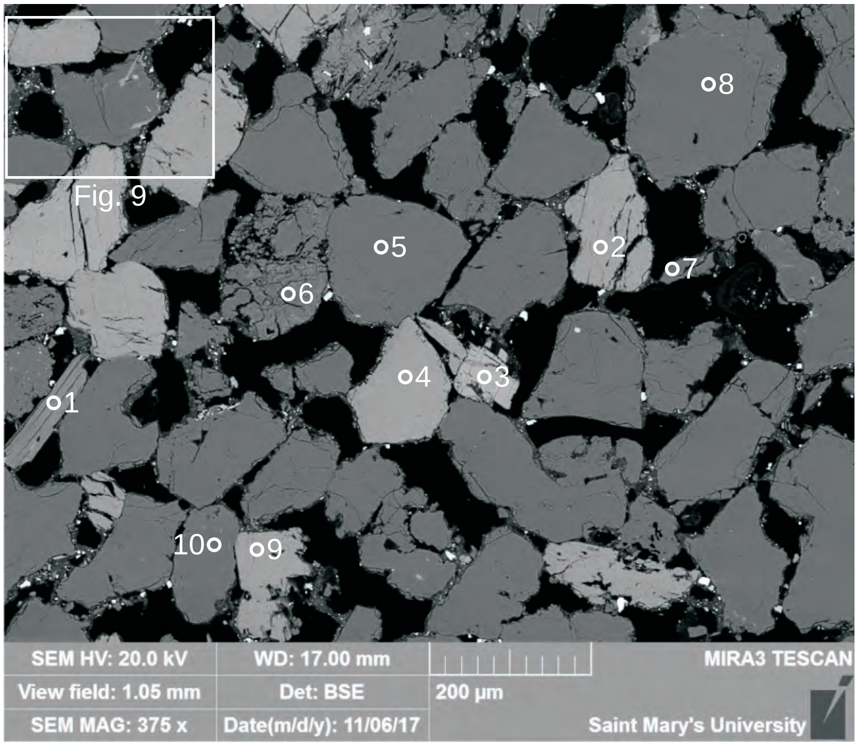
1:Quartz
2:K-feldspar
3:Quartz
4:K-feldspar
5:Pyrite
6:K-feldspar
7:K-feldspar
8:Quartz
9:K-feldspar
10:TiO_2
11:Quartz
12:Quartz
13:Quartz

Figure 1-3.6: Sample 2H-58 1600.27 (SEM) site 3. This site consists mainly of quartz and K-feldspar, with some diagenetic pyrite (5). Clays appear to coat grains. There is a clast of altered ilmenite (10). Suturing between grains is common.



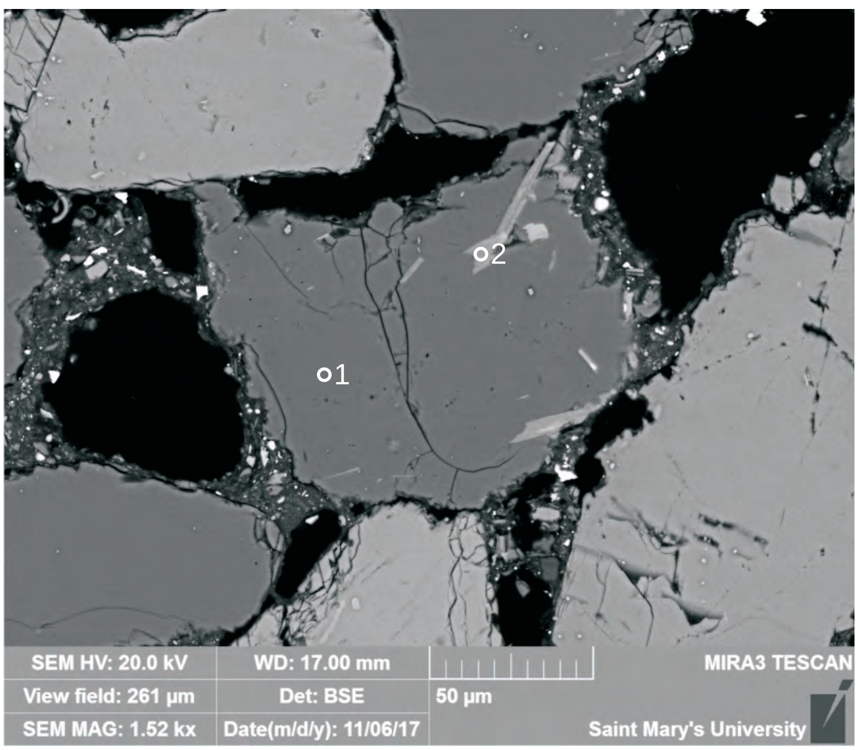
1:TiO_2
2:Chlorite +
3:Chlorite +
Muscovite

Figure 1-3.7: Sample 2H-58 1600.27 (SEM) site 3.1. This site consists of a TiO_2 mineral (?rutile) grain (1) and chlorite. This site may be an argillite lithic clast.



1:Muscovite
2:K-feldspar
3:K-feldspar
4:K-feldspar
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:K-feldspar
10:Quartz

Figure 1-3.8: Sample 2H-58 1600.27 (SEM) site 4. This site consists of mainly quartz and K-feldspar, with a rare muscovite (1) grain.



1:Quartz
2:Muscovite +

Figure 1-3.9: Sample 2H-58 1600.27 (SEM) site 4.1. This site contains a granitoid lithic clast made up of quartz (1) and muscovite (2).

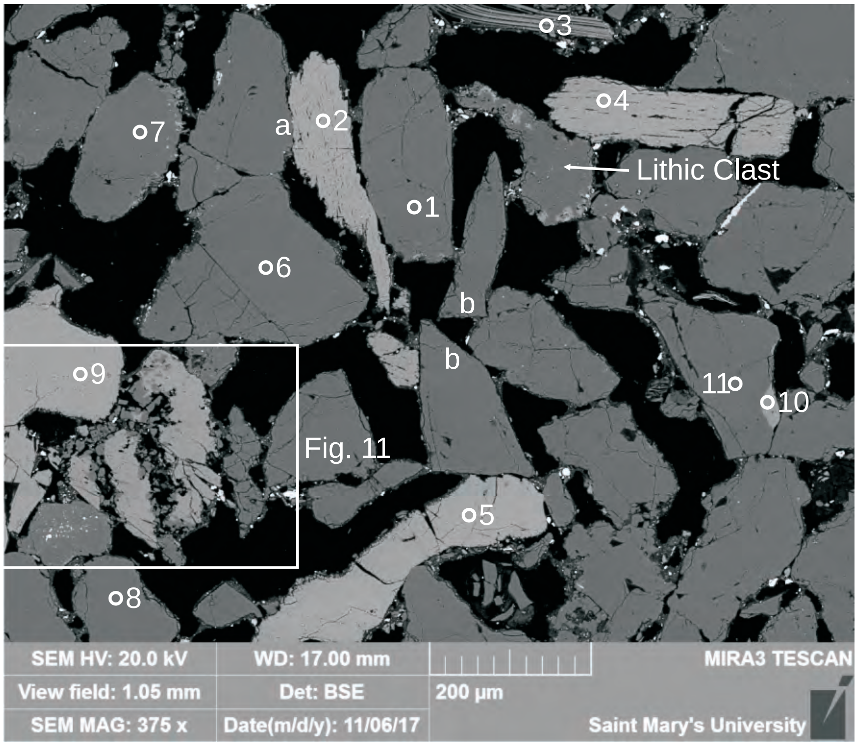


Figure 1-3.10: Sample 2H-58 1600.27 (SEM) site 5. This site is mostly made up of quartz and K-feldspar. There is a rare muscovite (3) grain and all grains appear to be coated or partially coated by clays. There appears to be a lithic clast made up of quartz and K-feldspar. Suturing is common (position a) and overgrowths occur in quartz grains (positions b).

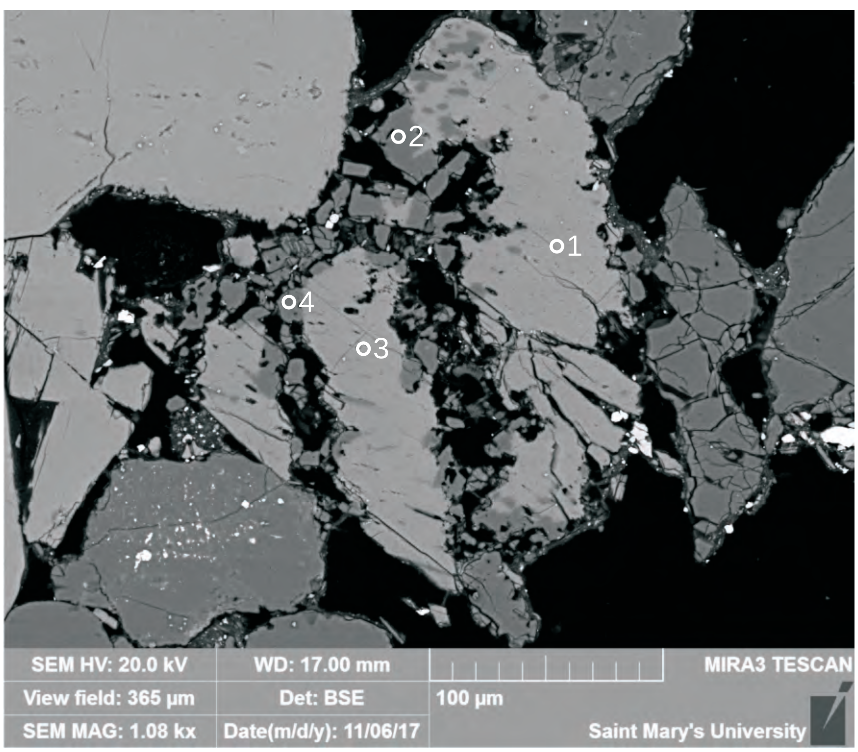
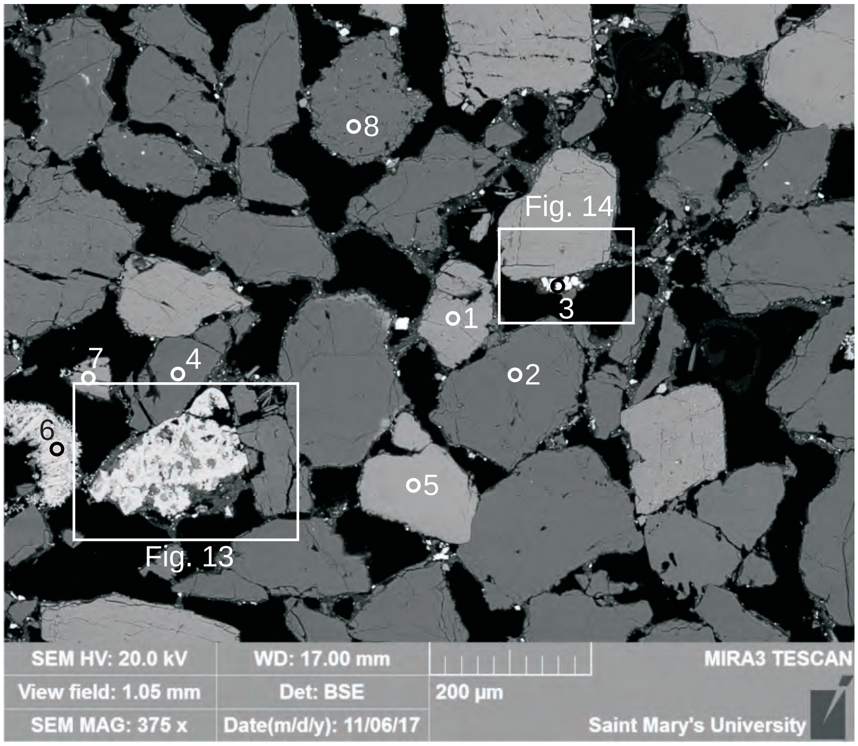
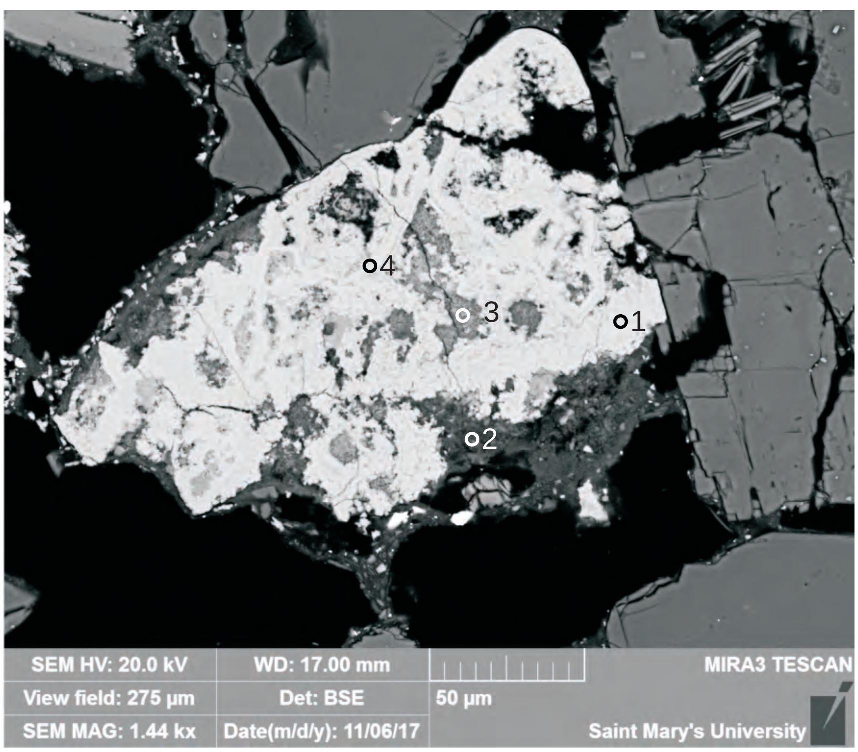


Figure 1-3.11: Sample 2H-58 1600.27 (SEM) site 5.1. This site contains a transported albitized K-feldspar grain with K-feldspar dissolving.



1:K-feldspar
2:Quartz
3:Barite
4:Quartz
5:K-feldspar
6:Siderite +
7:K-feldspar
8:Quartz

Figure 1-3.12: Sample 2H-58 1600.27 (SEM) site 6. This site consists mostly of quartz and K-feldspar grains that are coated in clays. There is also a grain of needily siderite (6).



1:TiO_2 +
2:Chlorite + ?Albite
3:Chlorite + ?Albite
4:TiO_2 +

Figure 1-3.13: Sample 2H-58 1600.27 (SEM) site 6.1. This site consists of a clast of TiO_2 mineral (?rutile) and chlorite mixed with albite, probably from an argillite.

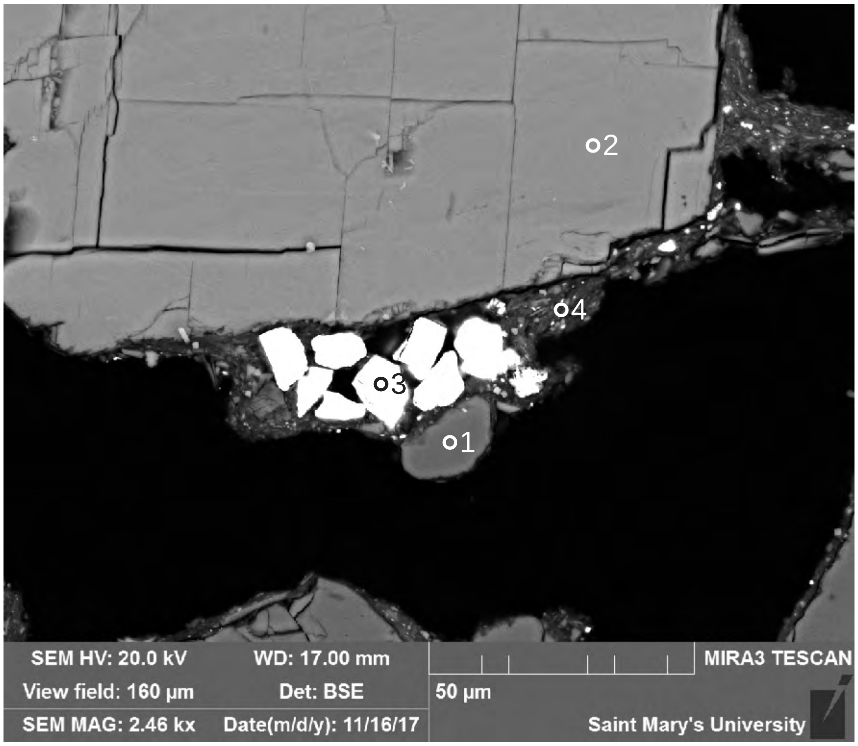


Figure 1-3.14: Sample 2H-58 1600.27 (SEM) site 6.2. This site consists of K-feldspar (2) grain surrounded by matrix (1,4) mixed with drilling mud (3).

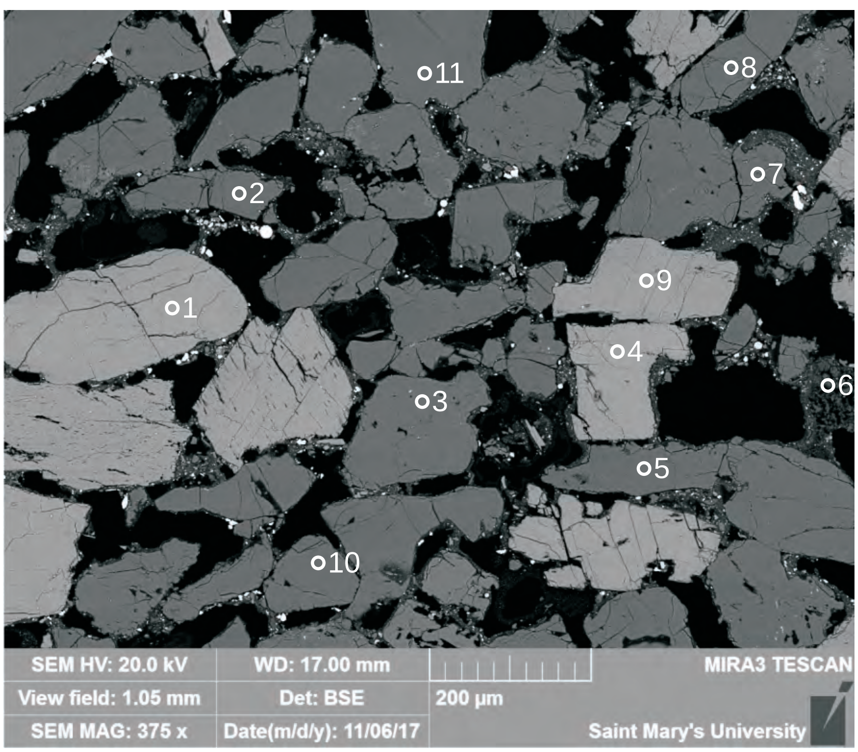
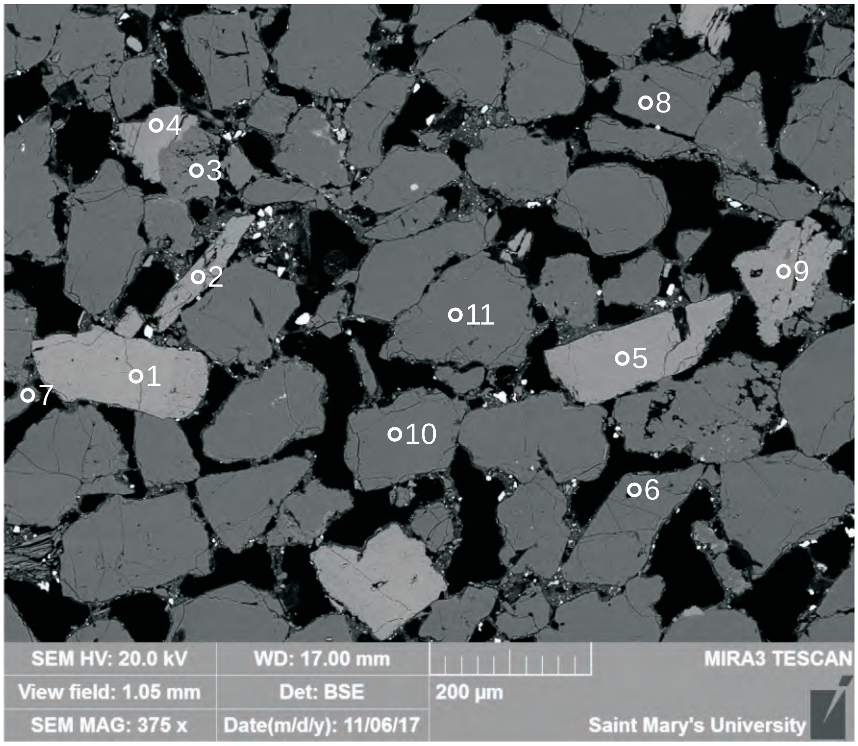
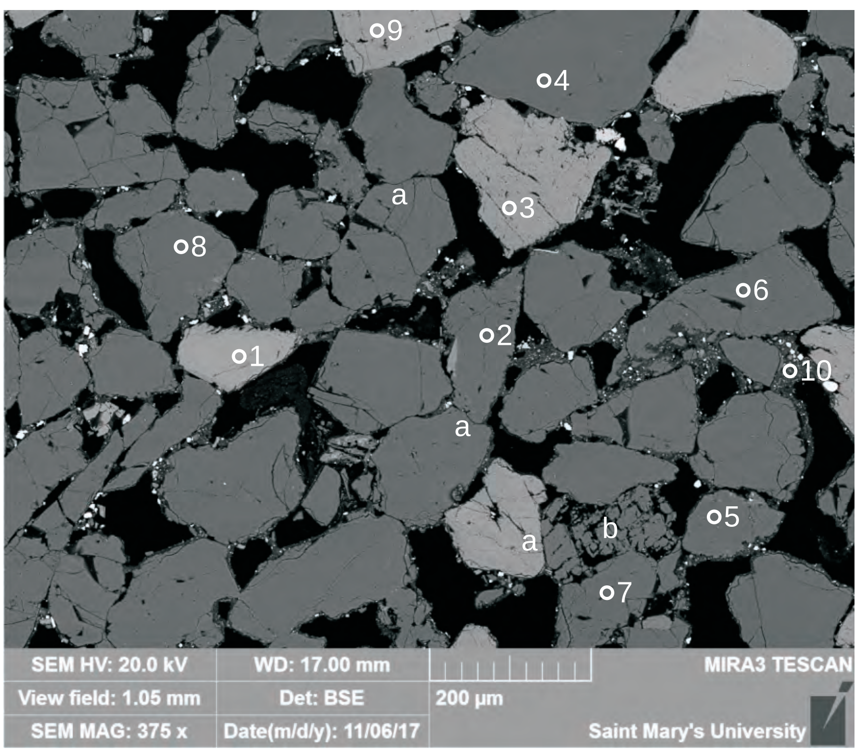


Figure 1-3.15: Sample 2H-58 1600.27 (SEM) site 7. This site is similar to previous sites consisting of quartz, K-feldspar, and clays (kaolinite (6)).



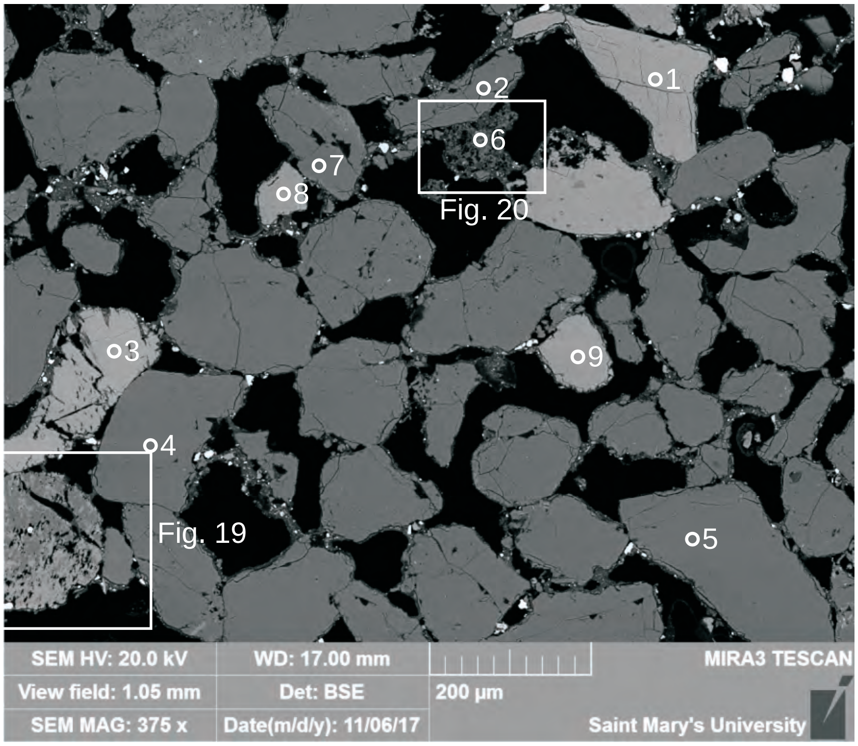
1:K-feldspar
2:K-feldspar
3:Oligoclase
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-3.16: Sample 2H-58 1600.27 (SEM) site 8. This site is similar to previous sites. There appears to be a ?lithic clast of quartz (3) and K-feldspar (4).



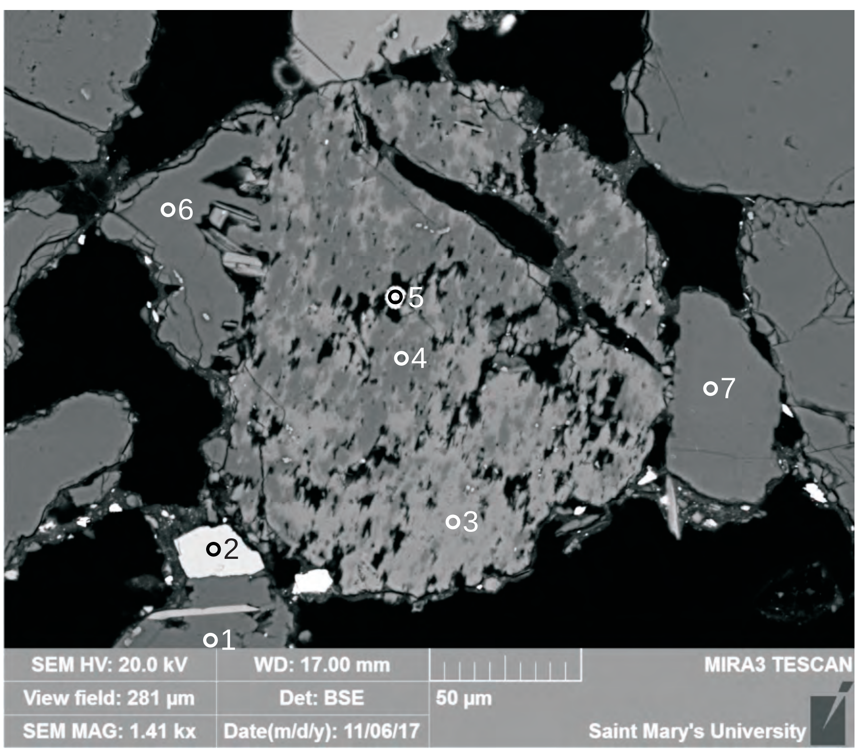
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:K-feldspar
10:Smectite

Figure 1-3.17: Sample 2H-58 1600.27 (SEM) site 9. This site is similar to previous sites. Suturing is common (positions a). Some of the quartz appears partially dissolved (position b).



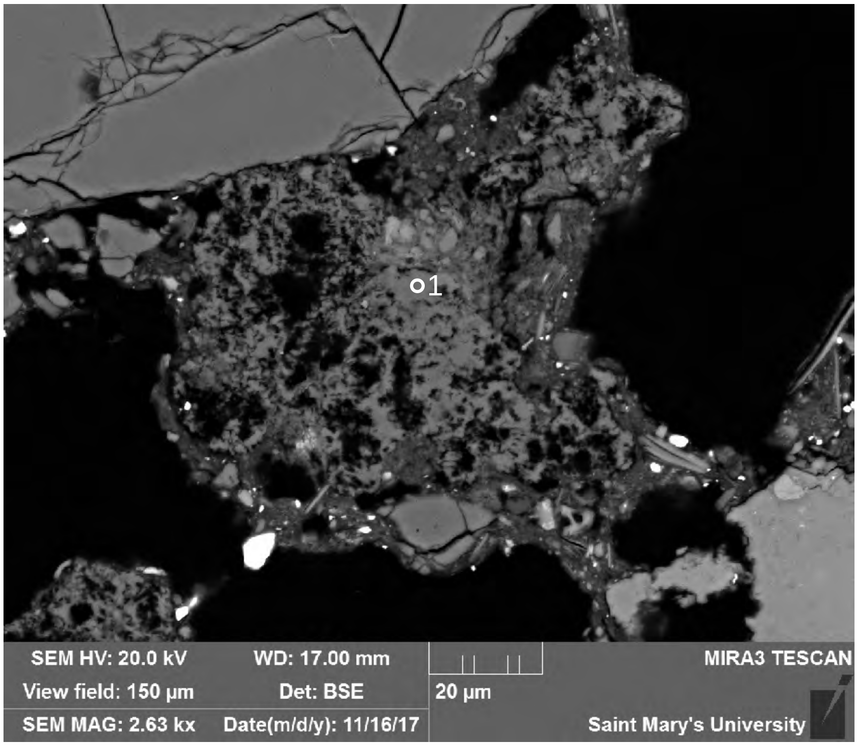
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:Mixture
7:Quartz
8:K-feldspar
9:K-feldspar

Figure 1-3.18: Sample 2H-58 1600.27 (SEM) site 10. This site is similar to previous sites. Clays appear to coat quartz and K-feldspar grains. Suturing is common.



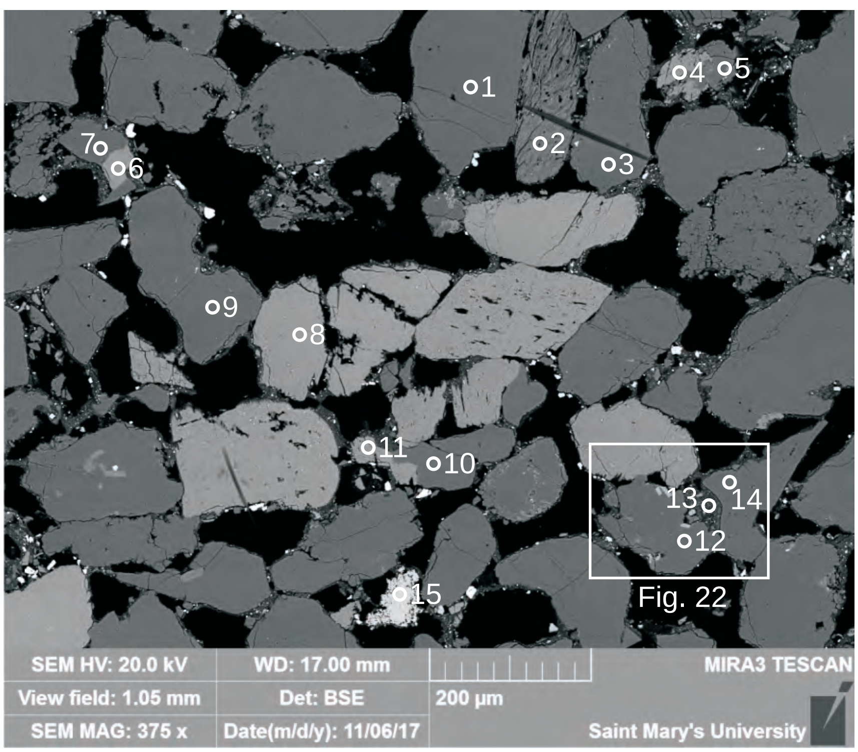
1:Quartz
2:TiO_2
3:K-feldspar
4:Albite
5:Pyrite
6:Albite
7:Albite

Figure 1-3.19: Sample 2H-58 1600.27 (SEM) site 10.1. This site contains a granitoid clast of K-feldspar (3) and albite (4). Diagenetic pyrite (5) partially fills voids in the lithic clast. Titania (2) appears to be diagenetic.



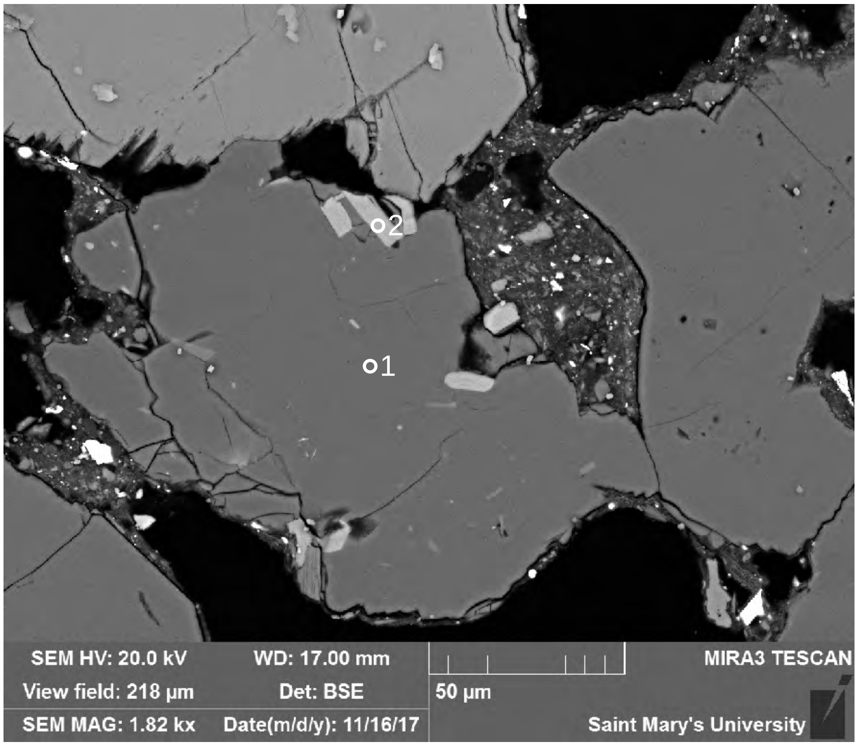
1:Quartz

Figure 1-3.20: Sample 2H-58 1600.27 (SEM) site 10.2. This site consists of a dissolved quartz grain (1) and drilling mud.



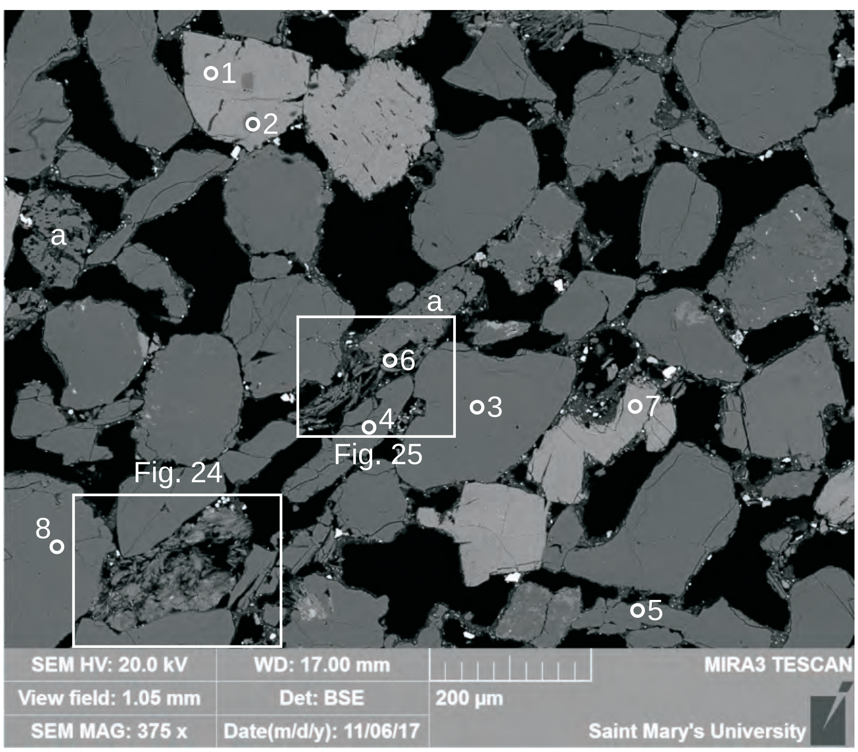
1:Quartz
2:Muscovite
3:Quartz
4:K-feldspar
5:Quartz
6:K-feldspar
7:Quartz
8:K-feldspar
9:Quartz
10:Quartz
11:K-feldspar
12:Quartz
13:Mixture
14:Quartz
15:Siderite

Figure 1-3.21: Sample 2H-58 1600.27 (SEM) site 11. This site is similar to previous sites, with suturing present. There appears to be a lithic clast of quartz (7) and K-feldspar (6). Muscovite (2) appears fine-grained and may be a lithic clast as well.



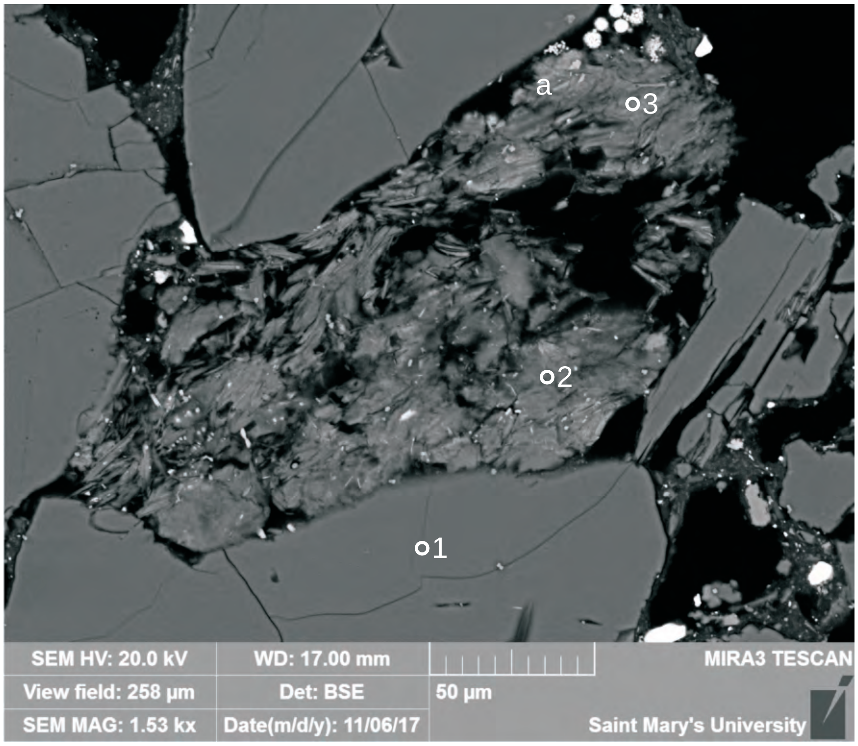
1:Quartz
2:Chlorite

Figure 1-3.22: Sample 2H-58 1600.27 (SEM) site 11.1. This site consists of a clast that is made up of quartz (1), probably from a granite, with chlorite (2) inclusions (altered magmatic mineral).



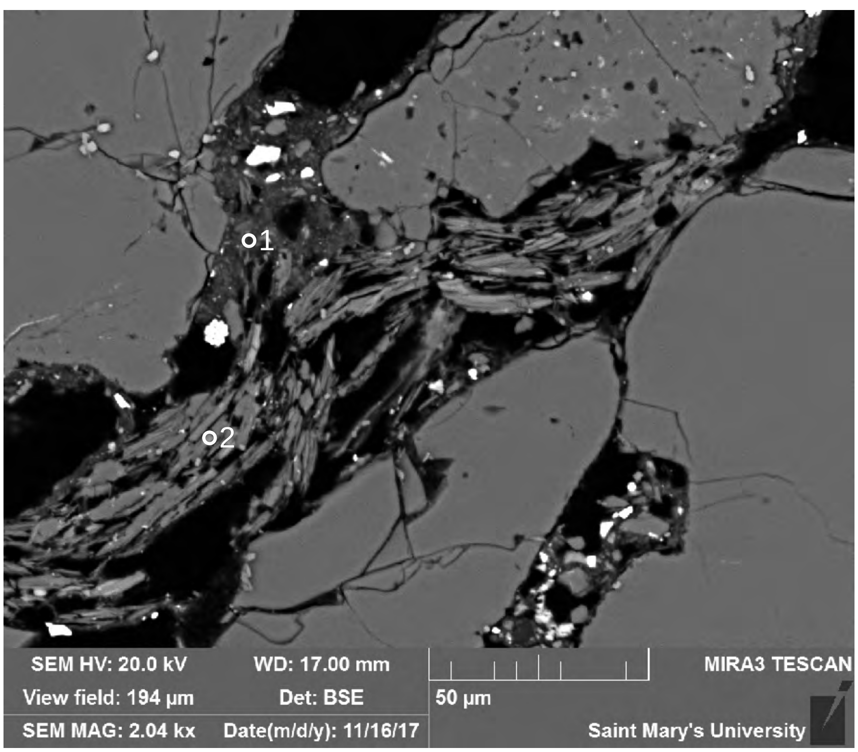
1:K-feldspar
2:Quartz
3:Quartz
4:Quartz
5:Quartz
6:Mixture
7:K-feldspar
8:Quartz

Figure 1-3.23: Sample 2H-58 1600.27 (SEM) site 12. This site is similar to previous sites. There appears to be a clast of K-feldspar (1) with quartz (2) inclusions. Some quartz grains (positions a) appear porous.



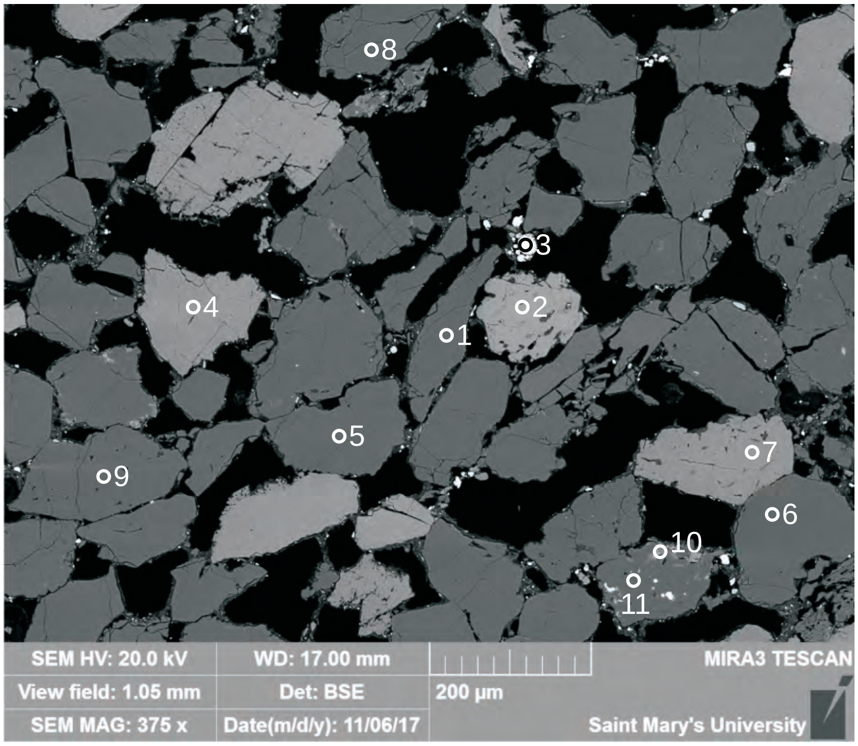
1:Quartz
2:Muscovite (Ill)
3:Muscovite (Ill)

Figure 1-3.24: Sample 2H-58 1600.27 (SEM) site 12.1. This site contains a metasiltstone lithic clast (slate) made up of muscovite (Ill) (2-3) and probably fibrous chlorite (position a).



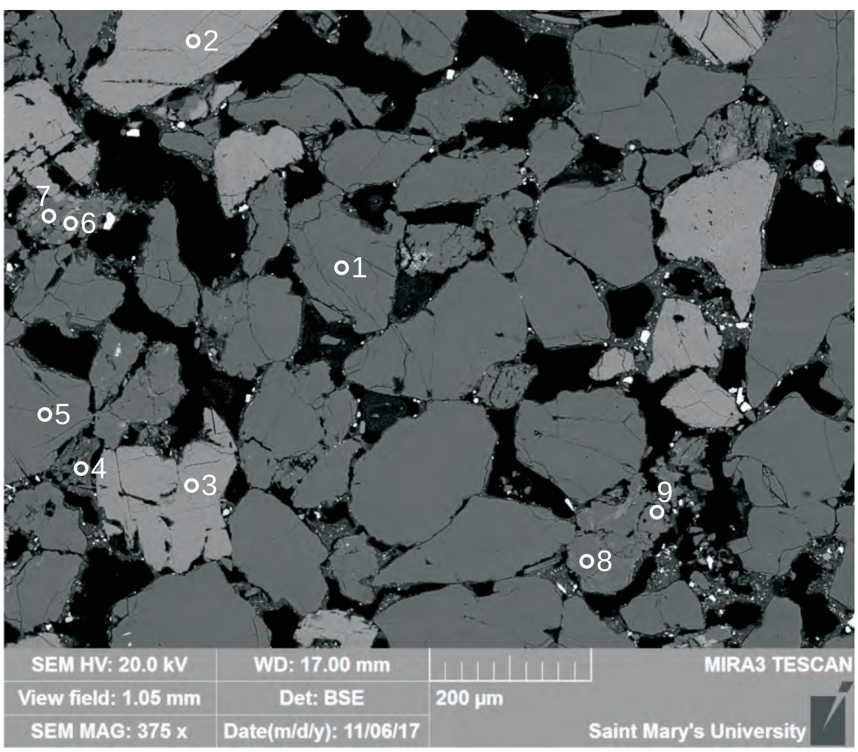
1:Muscovite + Chlorite
2:Muscovite + Chlorite

Figure 1-3.25: Sample 2H-58 1600.27 (SEM) site 12.2. This site consists of a metasiltstone lithic clast made up of an altered muscovite (Ill) grain (2), fibrous chlorite and scattered high reflectivity minute grains, probably diagenetic pyrite and titania.



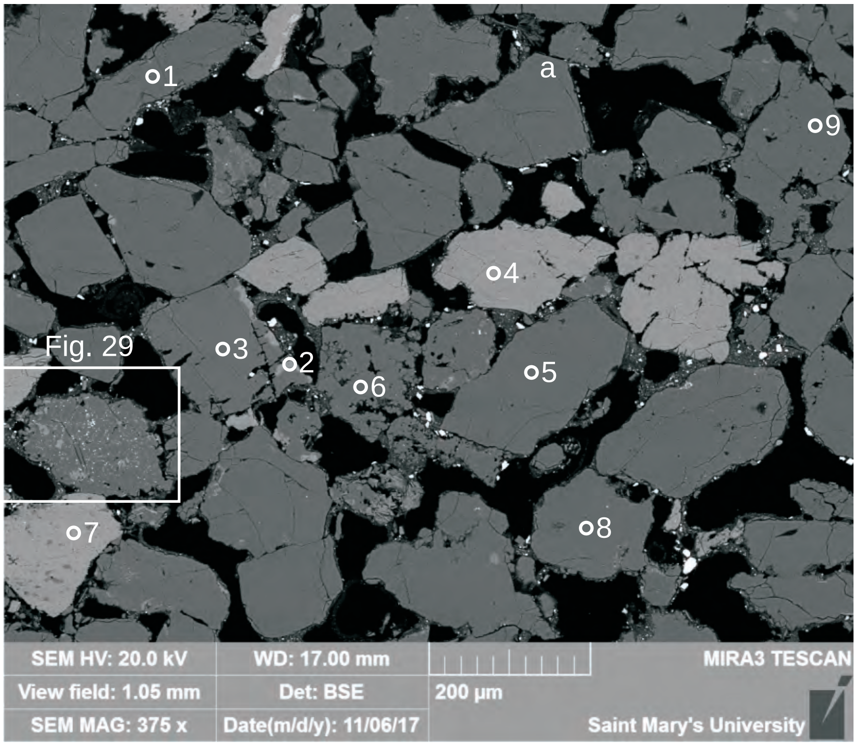
1:Quartz
2:K-feldspar
3:Pyrite
4:K-feldspar
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz
10:Muscovite
11:Quartz

Figure 1-3.26: Sample 2H-58 1600.27 (SEM) site 13. This site is similar to previous sites. Diagenetic pyrite (3) appears to partially fill primary porosity. There is also a lithic clast of quartz (11) and muscovite (10).



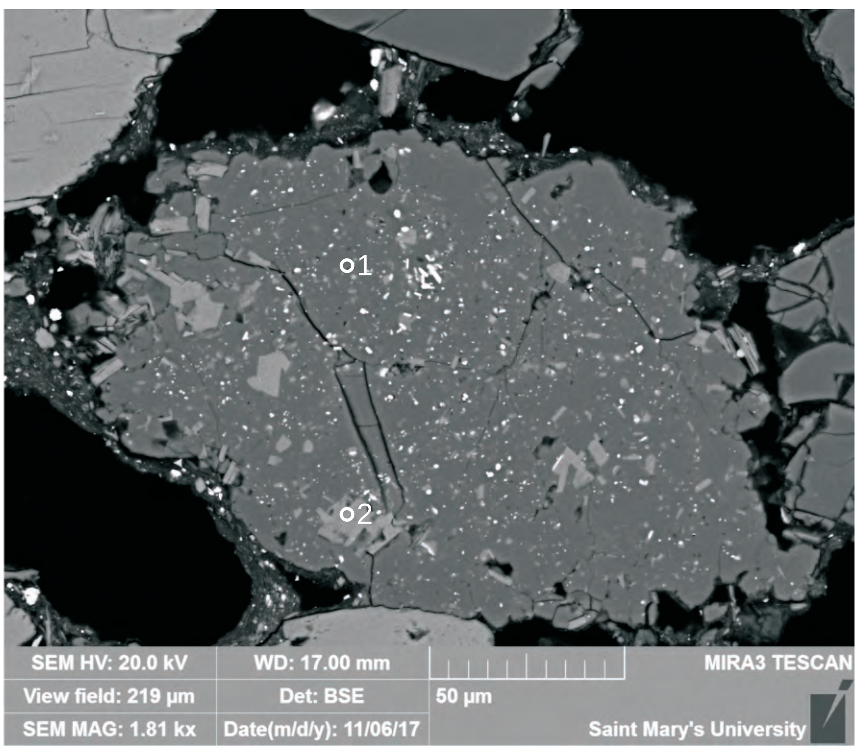
1:Quartz
2:K-feldspar
3:K-feldspar
4:Muscovite +
5:Quartz
6:Quartz +
7:Quartz
8:Quartz
9:Albite

Figure 1-3.27: Sample 2H-58 1600.27 (SEM) site 14. This site consists of mainly quartz and K-feldspar. There is a lithic clast made up of quartz (7) and probably K-feldspar (6). Another lithic clast appears to be made up of albite (9) and quartz (8). Suturing is common in this site.



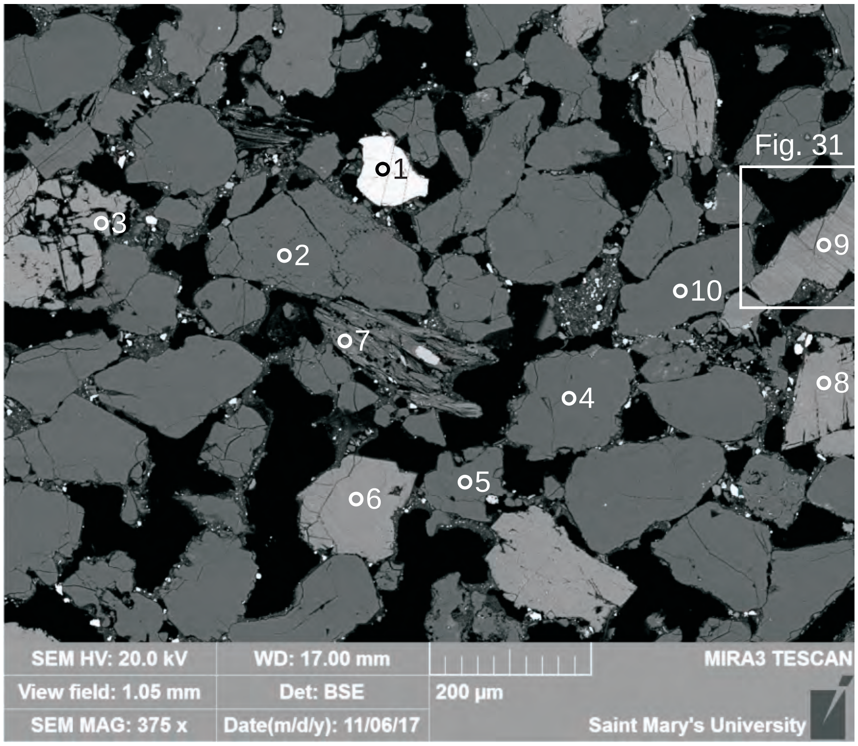
1:Quartz
2:K-feldspar
3:Albite
4:K-feldspar
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz

Figure 1-3.28: Sample 2H-58 1600.27 (SEM) site 15. This site is similar to previous sites. There is a lithic clast of K-feldspar (2) and albite (3). Suturing is common and quartz appears to contain overgrowths (position a).



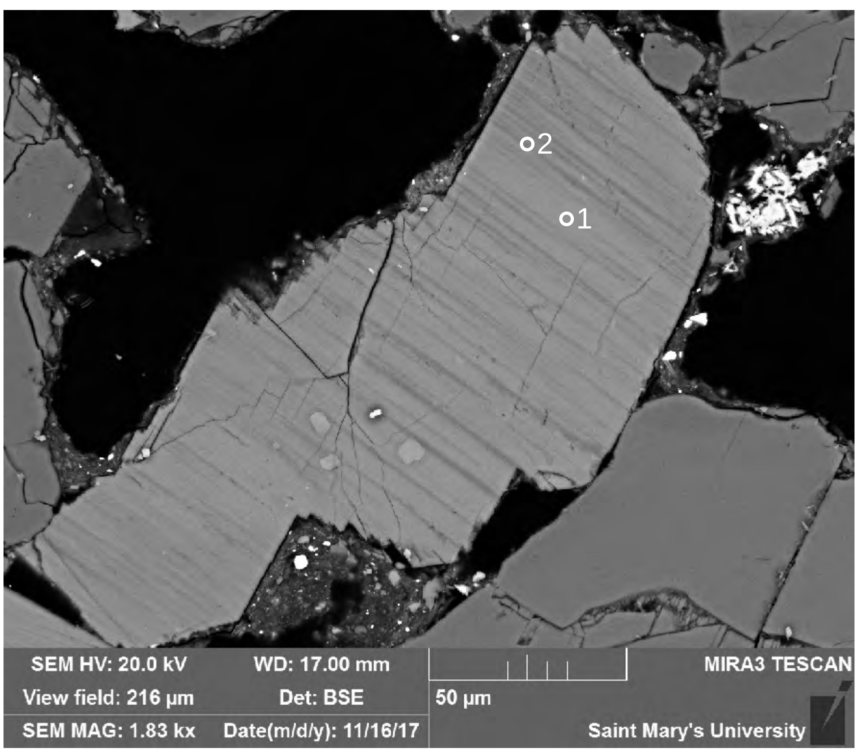
1:Quartz
2:Muscovite

Figure 1-3.29: Sample 2H-58 1600.27 (SEM) site 15.1. This site consists probably of a peraluminous granitic clast made up of quartz (1) and muscovite (2).



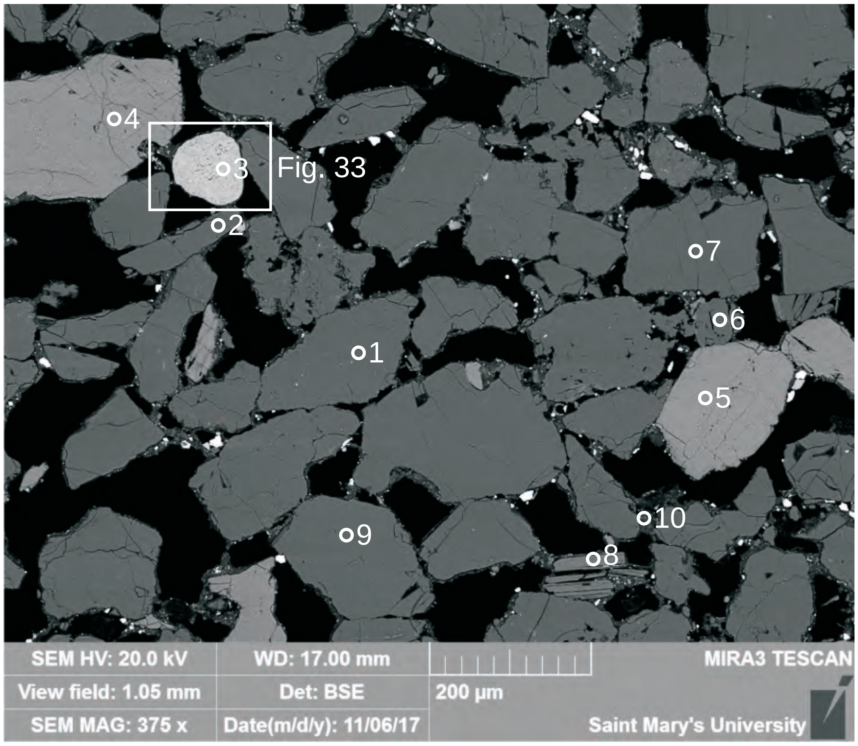
1:Ilmenite
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:K-feldspar
7:Muscovite
8:K-feldspar
9:K-feldspar + Albite
10:Quartz

Figure 1-3.30: Sample 2H-58 1600.27 (SEM) site 16. This site is similar to previous sites. Suturing is common and there is a rare grain of ilmenite (1).



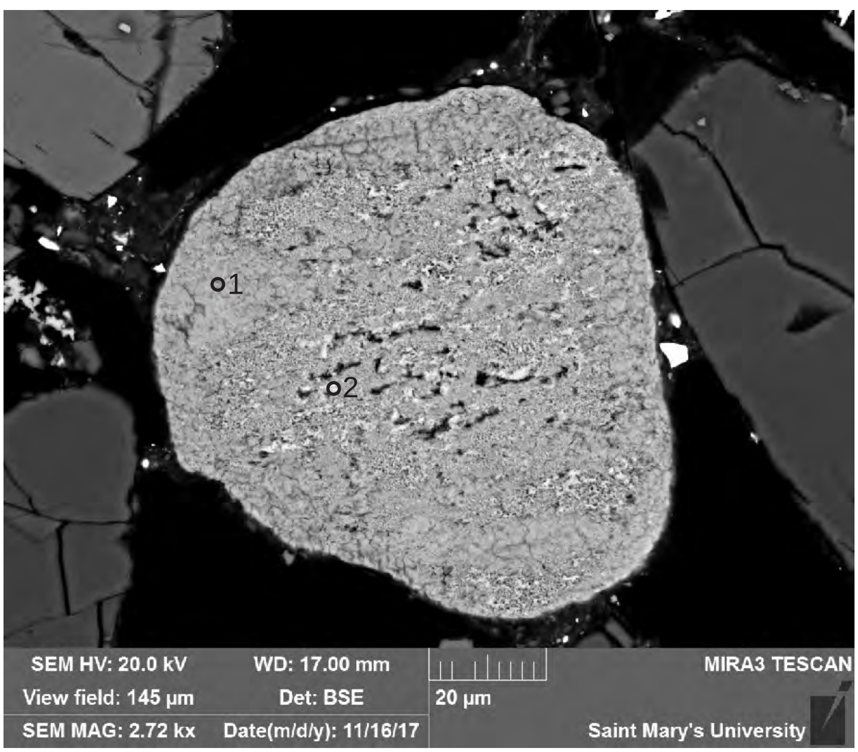
1:K-feldspar
2:Albite + K-feldspar

Figure 1-3.31: Sample 2H-58 1600.27 (SEM) site 16.1. This site consists of a detrital grain of perthitic K-feldspar (1).



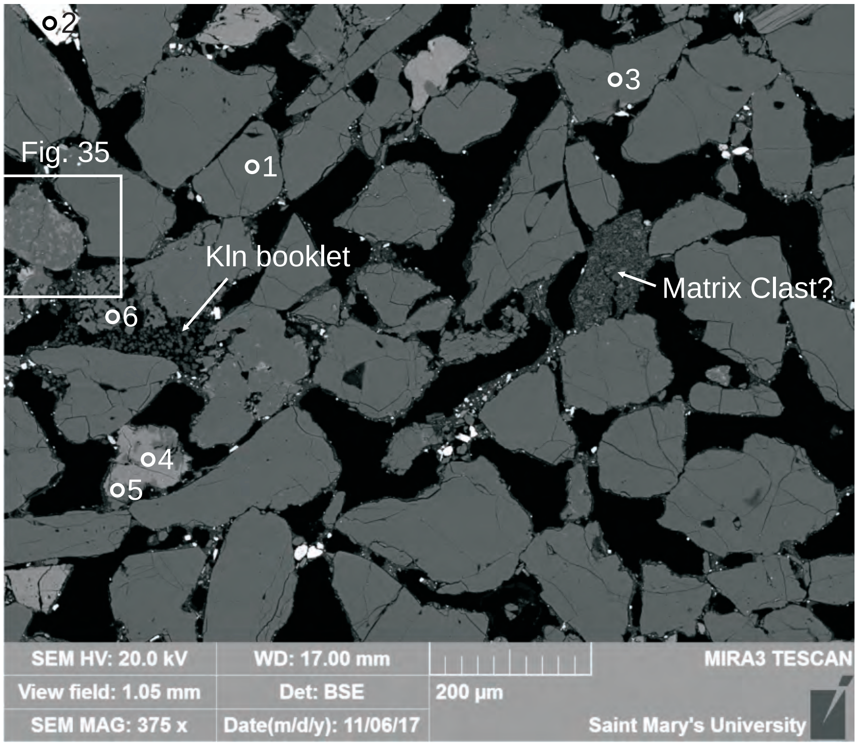
1:Quartz
2:Quartz
3:TiO_2
4:K-feldspar
5:K-feldspar
6:Albite
7:Quartz
8:Muscovite
9:Quartz
10:Mixture

Figure 1-3.32: Sample 2H-58 1600.27 (SEM) site 17. This site is similar to previous sites. Clays commonly coat grains and suturing is present. A grain of titania is seen.



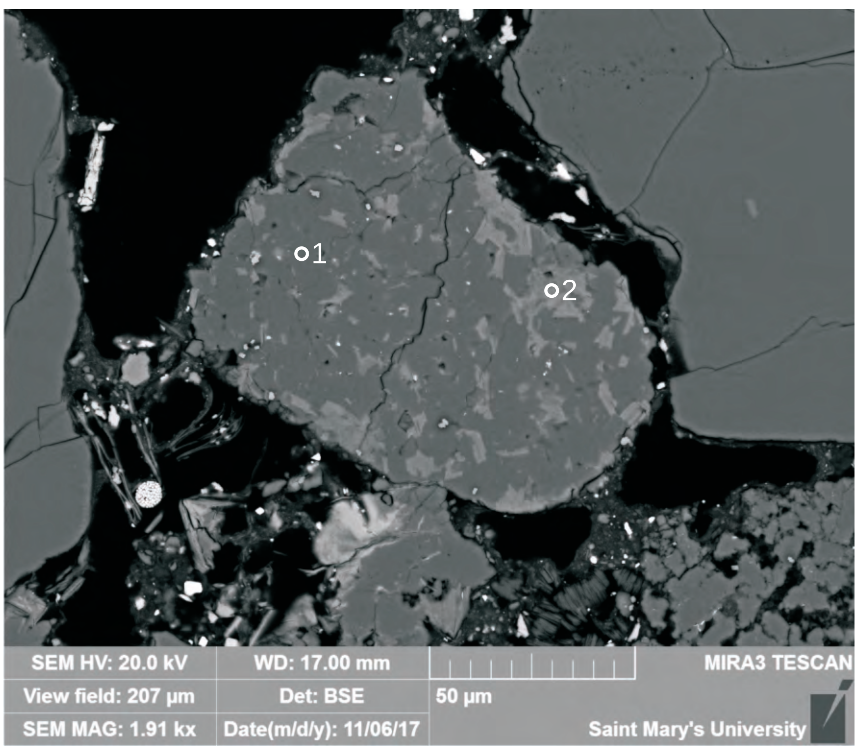
1:TiO_2 +
2:TiO_2

Figure 1-3.33: Sample 2H-58 1600.27 (SEM) site 17.1. This site consists of a detrital titania grain (1-2).



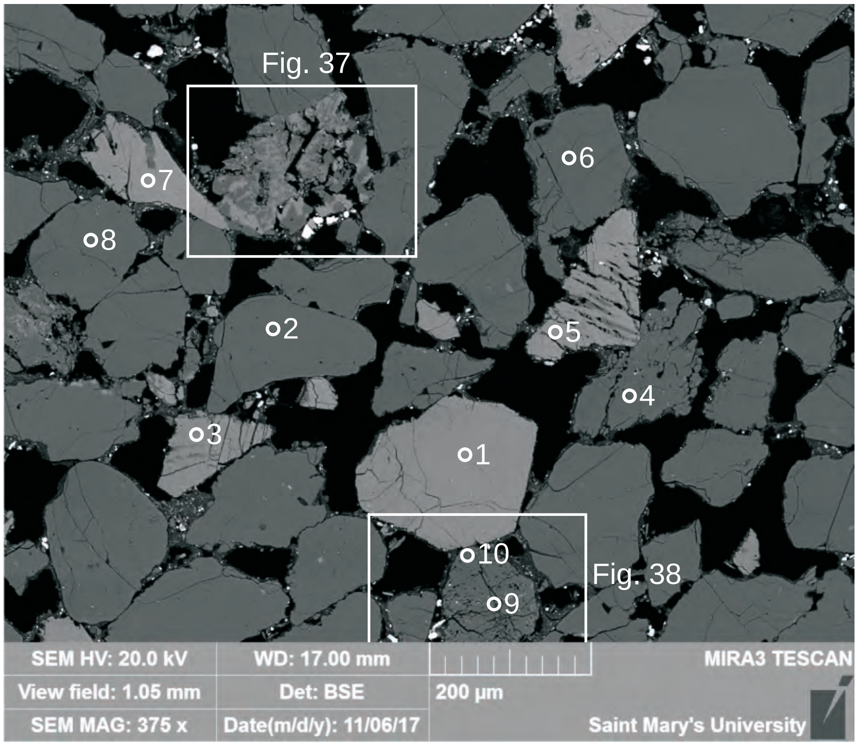
1:Quartz
2:Zircon
3:Quartz
4:K-feldspar
5:Albite
6:Quartz

Figure 1-3.34: Sample 2H-58 1600.27 (SEM) site 18. This site is similar to previous sites. Zircon (2) appears to be detrital. There is also kaolinite booklets between some of the quartz grains and a ?matrix clast. A lithic clast of K-feldspar (4) and albite (5) is seen.



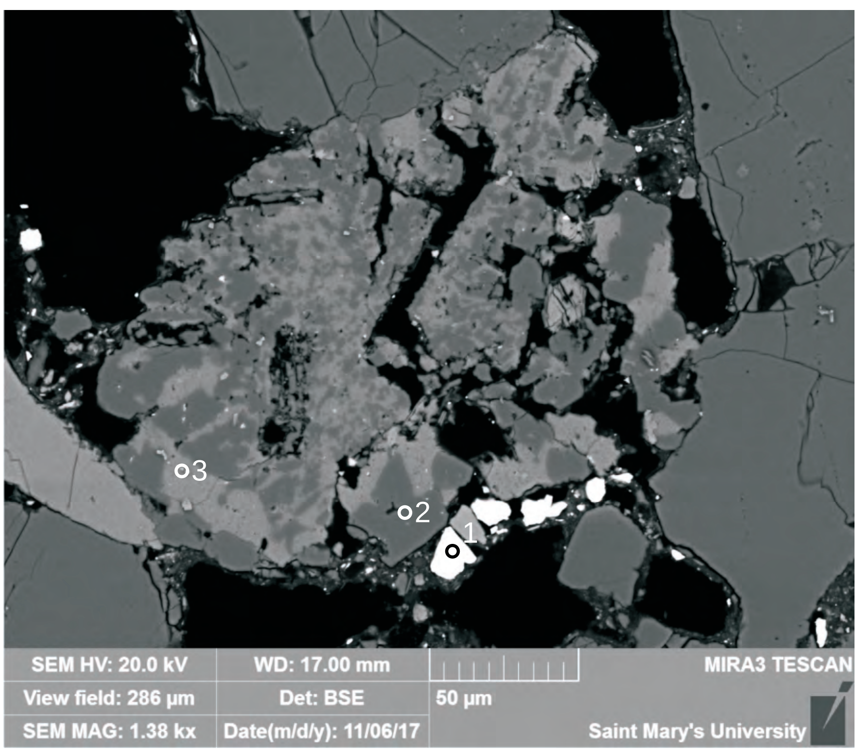
1:Quartz
2:Muscovite + Chlorite

Figure 1-3.35: Sample 2H-58 1600.27 (SEM) site 18.1. This site contains a probably peraluminous granitic lithic clast made up of quartz (1) and muscovite (2).



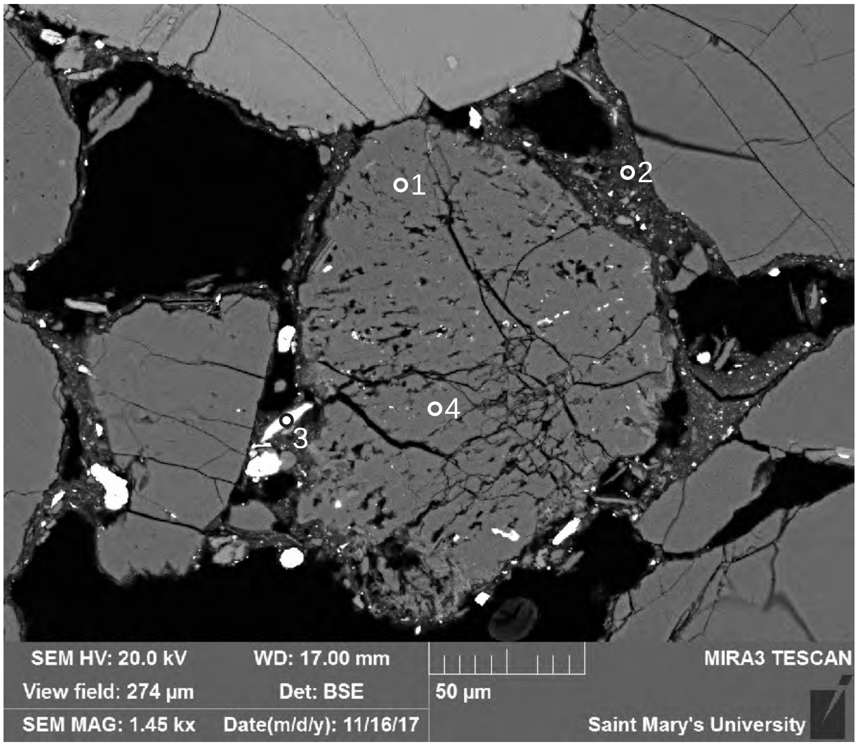
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:K-feldspar
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz + Albite
10:Quartz + Albite

Figure 1-3.36: Sample 2H-58 1600.27 (SEM) site 19. This site is similar to previous sites. Clays coat grains and suturing is common.



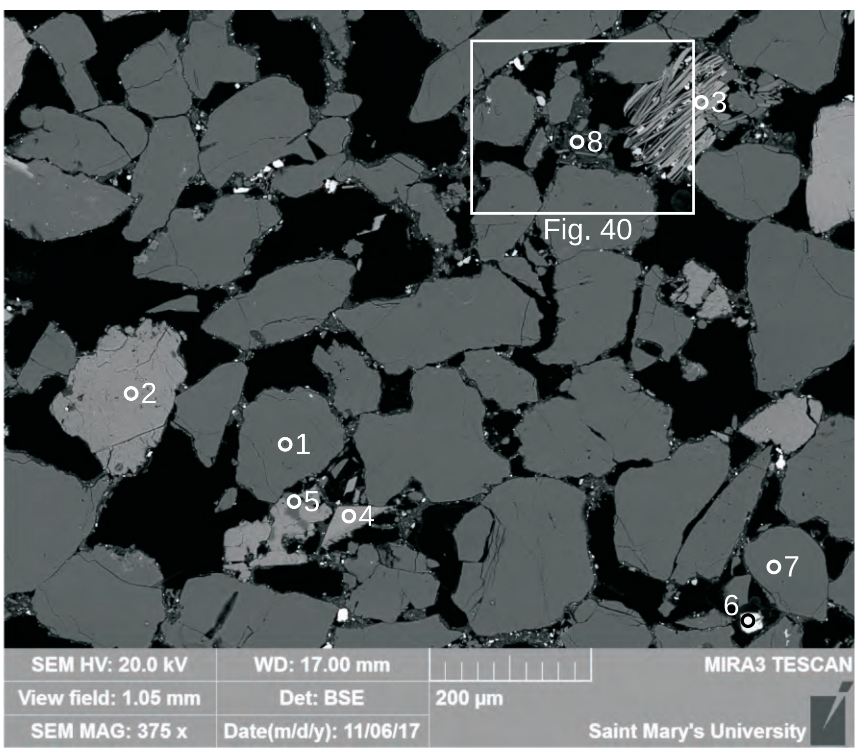
1:Barite
2:Quartz
3:K-feldspar

Figure 1-3.37: Sample 2H-58 1600.27 (SEM) site 19.1. This site consists of a microgranite lithic clast made up of K-feldspar (3) and quartz (2). Barite (1) appears to be drilling mud.



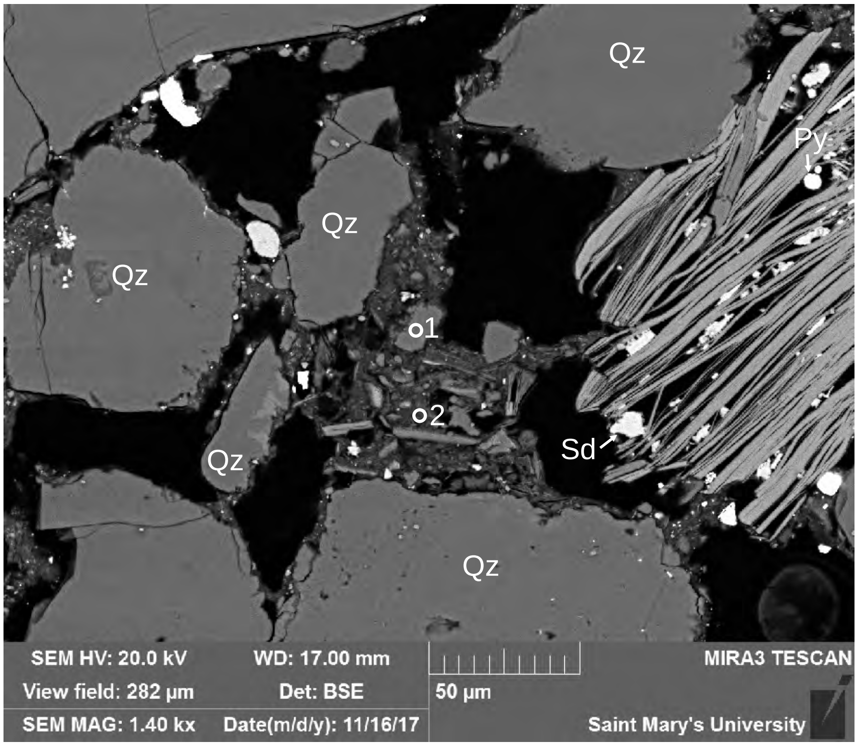
1:Quartz
2:Mixture
3:Barite
4:Quartz

Figure 1-3.38: Sample 2H-58 1600.27 (SEM) site 19.2. This site consists of a fractured and partially dissolved quartz grain with barite (3) and clay (2) (most likely drilling mud) partially coating it.



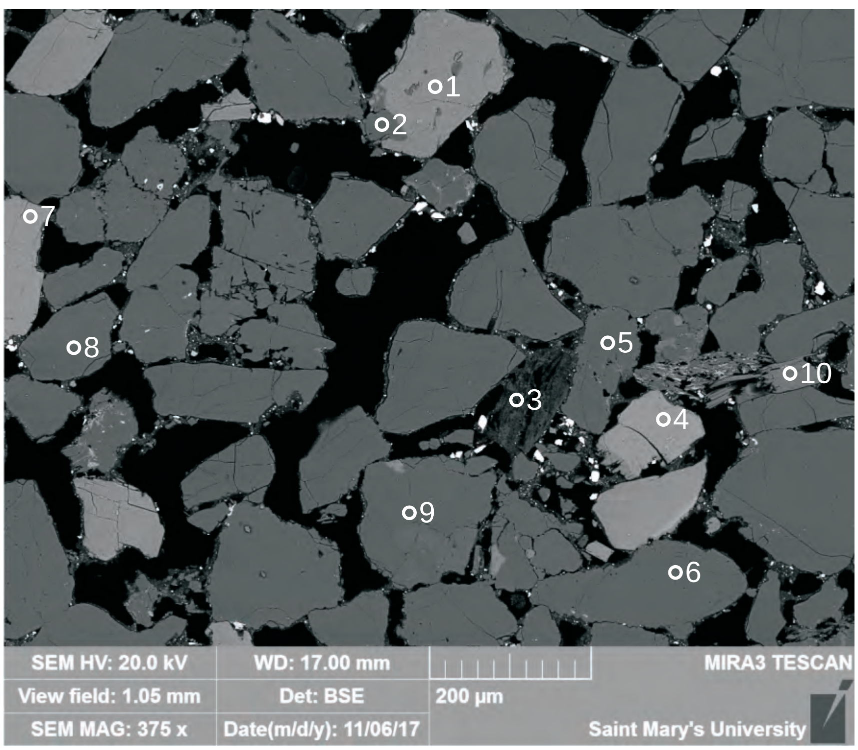
1:Quartz
2:K-feldspar
3:Chlorite
4:K-feldspar
5:Quartz
6:Limonite +
7:Quartz
8:Chlorite + Illite

Figure 1-3.39: Sample 2H-58 1600.27 (SEM) site 20. This site is similar to previous sites. Chlorite (3) appears to have slit open along cleavage and allowed a diagenetic mineral to form. There is also a lithic clast of quartz (5) and K-feldspar (4).



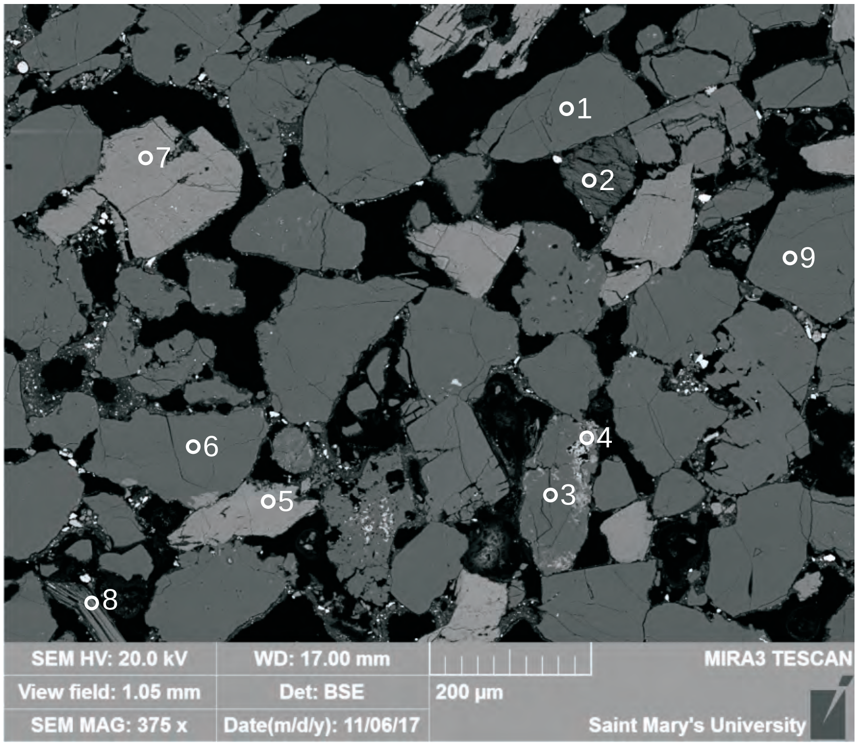
1:Quartz
2:Illite + Chlorite

Figure 1-3.40: Sample 2H-58 1600.27 (SEM) site 20.1. This site consists of a plastically deformed chloritized muscovite with siderite precipitating along the expanded cleavage planes of the chloritized muscovite, quartz grains and drilling mud made up of silt-size quartz and clays (illite + chlorite) (2).



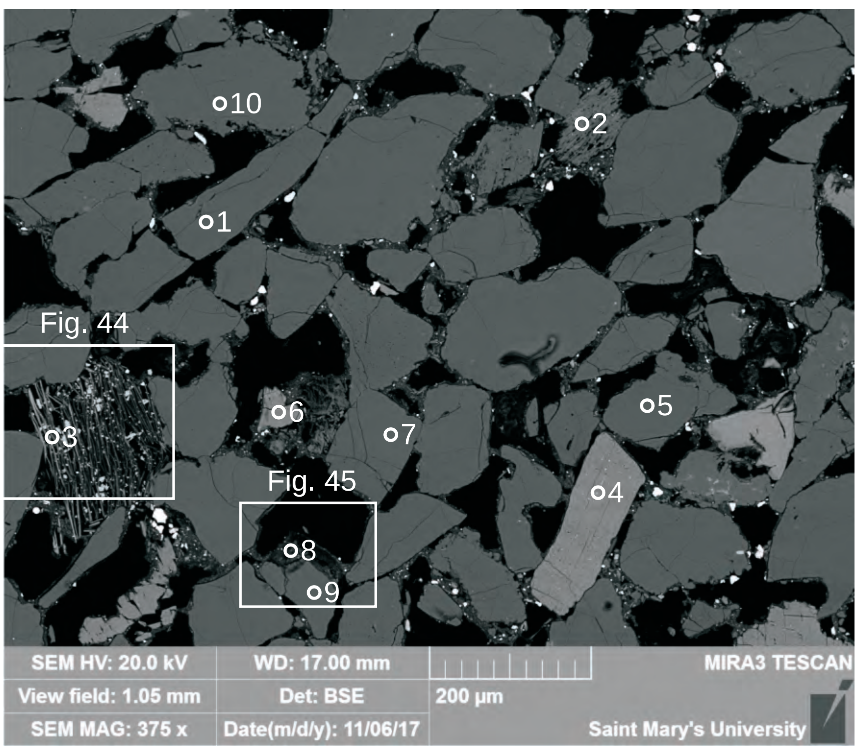
1:K-feldspar
2:Albite
3:Kaolinite
4:K-feldspar
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz
10:Muscovite

Figure 1-3.41: Sample 2H-58 1600.27 (SEM) site 21. This site is similar to previous sites. Kaolinite (3) appears to be the alteration product of a previous mineral. There is also a lithic clast of K-feldspar (1) and albite (2).



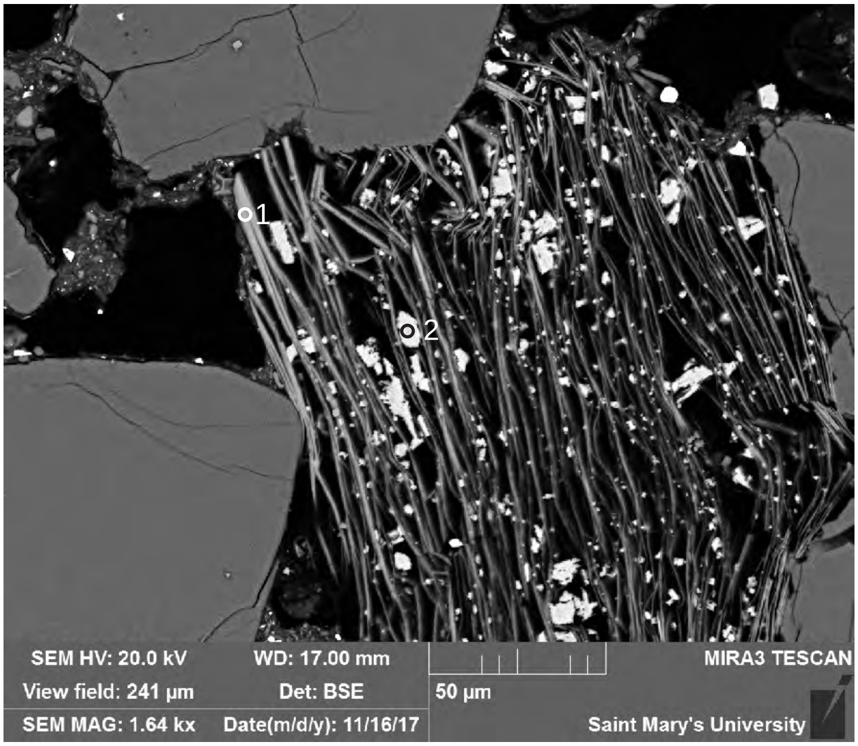
1:Quartz
2:Kaolinite
3:Quartz
4:Chlorite
5:K-feldspar
6:Quartz
7:K-feldspar
8:Muscovite
9:Quartz

Figure 1-3.42: Sample 2H-58 1600.27 (SEM) site 22. This site is similar to previous sites. There appears to be a lithic clast made up of quartz (3) and ?chlorite (4). Kaolinite (2) may also be a lithic clast as it appears to pseudomorph a mica.



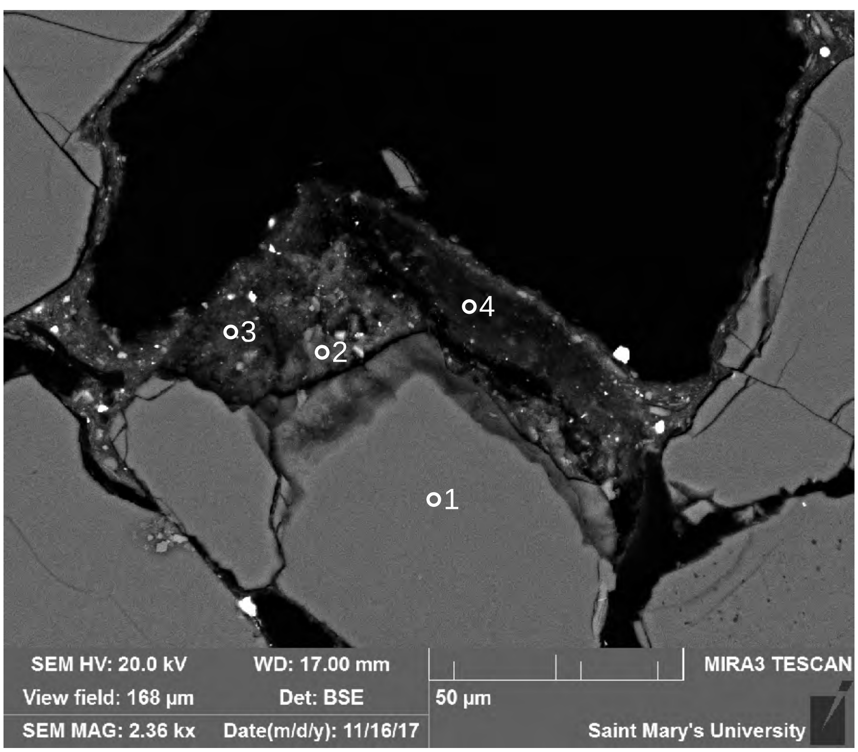
1:Quartz
2:Muscovite
3:Chloritized ?Feldspar
4:K-feldspar
5:Quartz
6:K-feldspar
7:Quartz
8:K-feldspar + Chlorite
9:Quartz
10:Quartz

Figure 1-3.43: Sample 2H-58 1600.27 (SEM) site 23. This site is similar to previous sites. ?Feldspars appear to be chloritized. Suturing is common between quartz grains.



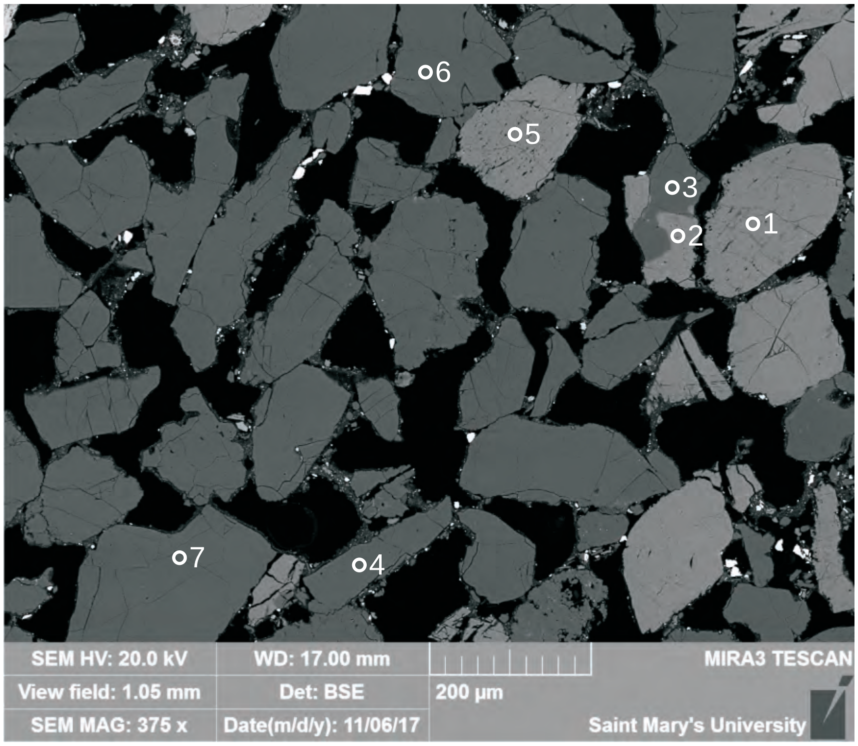
1:Biotite
2:Siderite

Figure 1-3.44: Sample 2H-58 1600.27 (SEM) site 23.1. This site consists of partially dissoved and altered biotite (1) that has expanded along cleavage planes and allowed late diagenetic siderite (2) to precipitate.



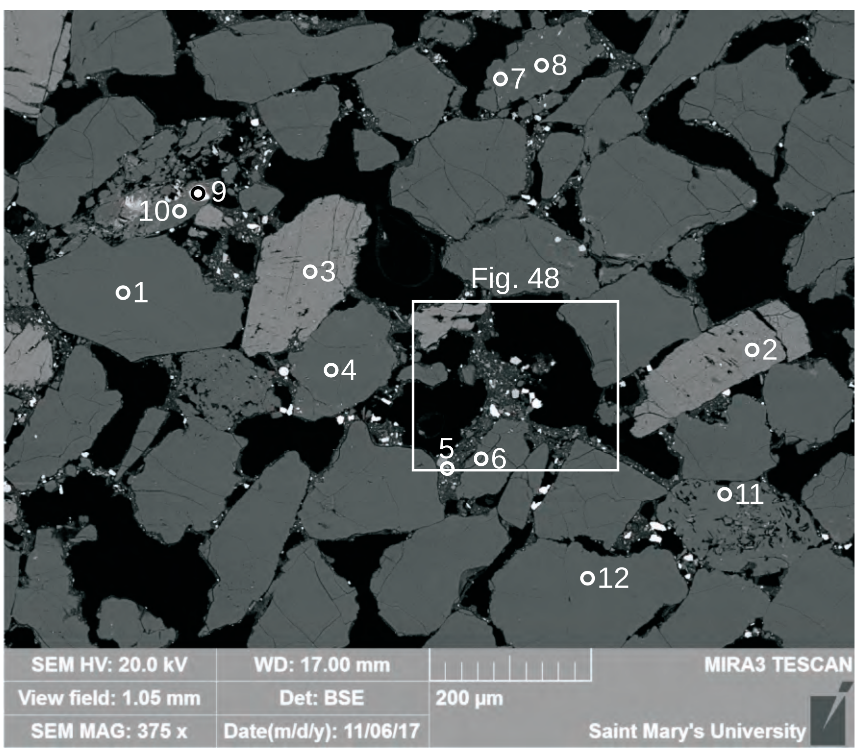
1:Quartz
2:Clays
3:Clays
4:Quartz + Chlorite
+

Figure 1-3.45: Sample 2H-58 1600.27 (SEM) site 23.2. This site consists of a detrital quartz (1) grain that is partially coated by drilling mud made up of clays, probably chlorite + illite (3), and quartz (4).



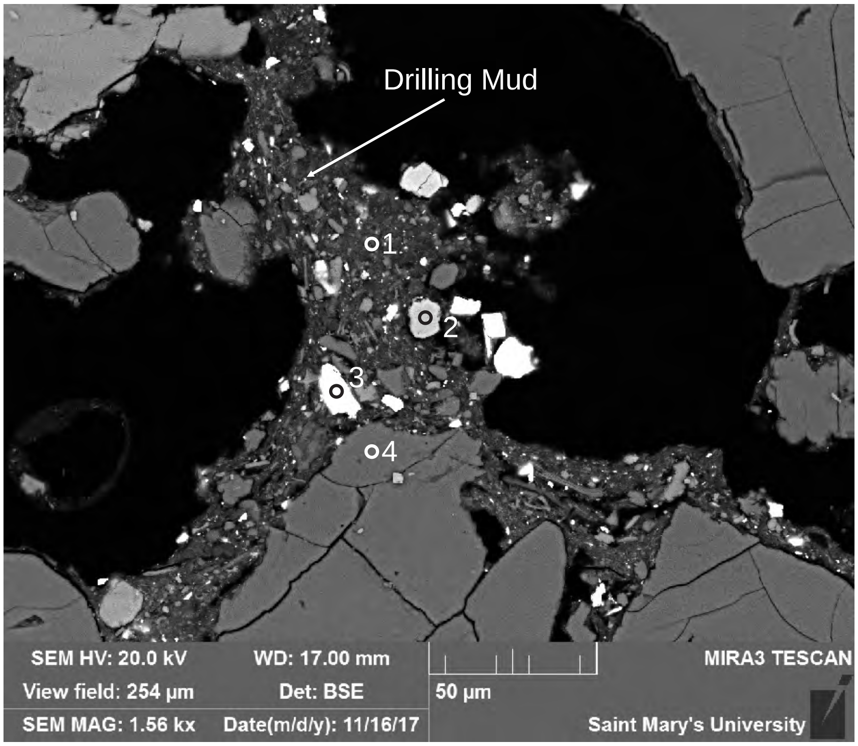
1:K-feldspar
2:K-feldspar
3:Quartz
4:Quartz
5:K-feldspar
6:Quartz
7:Quartz

Figure 1-3.46: Sample 2H-58 1600.27 (SEM) site 24 This site is similar to previous sites. There is a lithic clast made up of quartz (3) and K-feldspar (2).



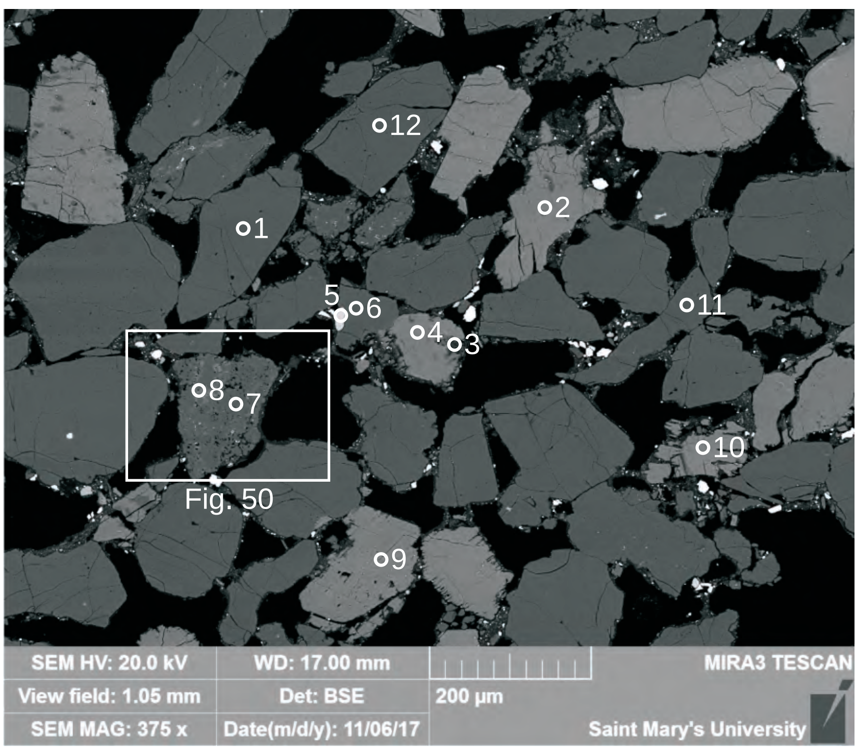
1:Quartz
2:K-feldspar
3:K-feldspar
4:Quartz
5:Mixture
6:Quartz
7:Muscovite
8:Quartz
9:Zircon
10:Quartz
11:Albite
12:Quartz

Figure 1-3.47: Sample 2H-58 1600.27 (SEM) site 25. This site is similar to previous sites. Zircon (9) appears to be an inclusion in a quartz grain (10). Albite (11) appears to be altered.



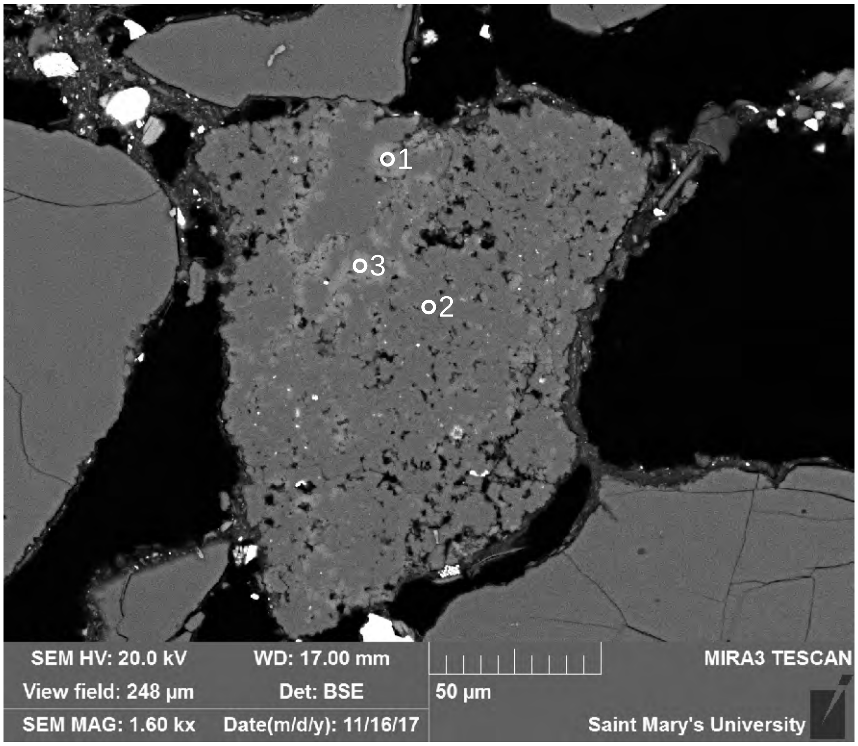
1:Clays
2:Siderite
3:Barite
4:Quartz

Figure 1-3.48: Sample 2H-58 1600.27 (SEM) site 25.1. This site consists of the clays that partially coat detrital quartz grains (4). It appears to be made up of barite (3), quartz (4), and late siderite (2). They all may be from drilling mud.



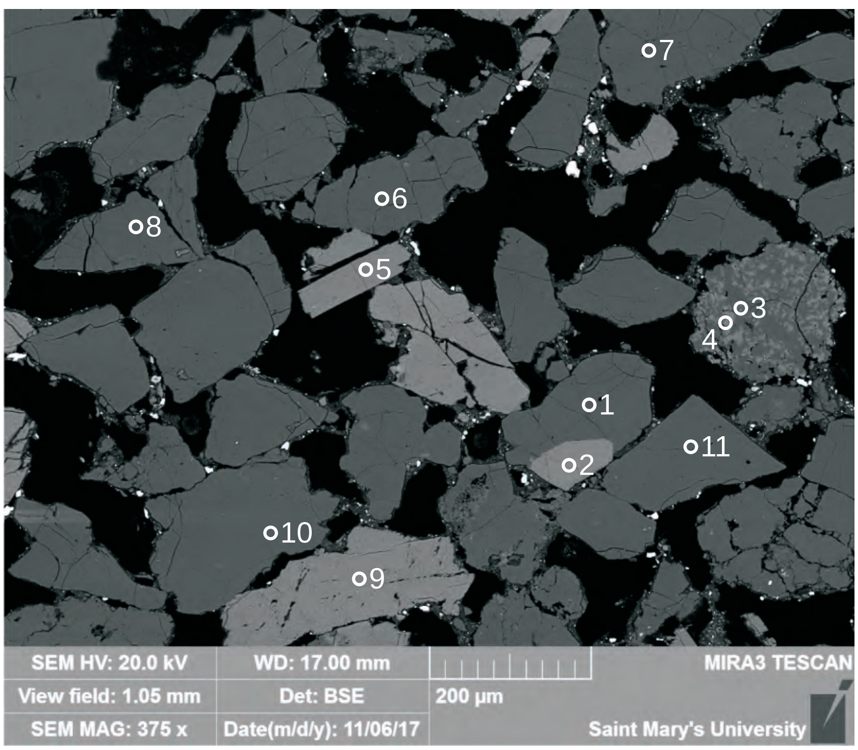
1:Quartz
2:K-feldspar
3:Kaolinite
4:K-feldspar
5:TiO_2
6:Quartz
7:Quartz + K-feldspar
8:K-feldspar
9:K-feldspar
10:K-feldspar
11:Quartz
12:Quartz

Figure 1-3.49: Sample 2H-58 1600.27 (SEM) site 26. This site is similar to the previous sites. There is a rhyolite lithic clast of quartz (7) and K-feldspar (8).



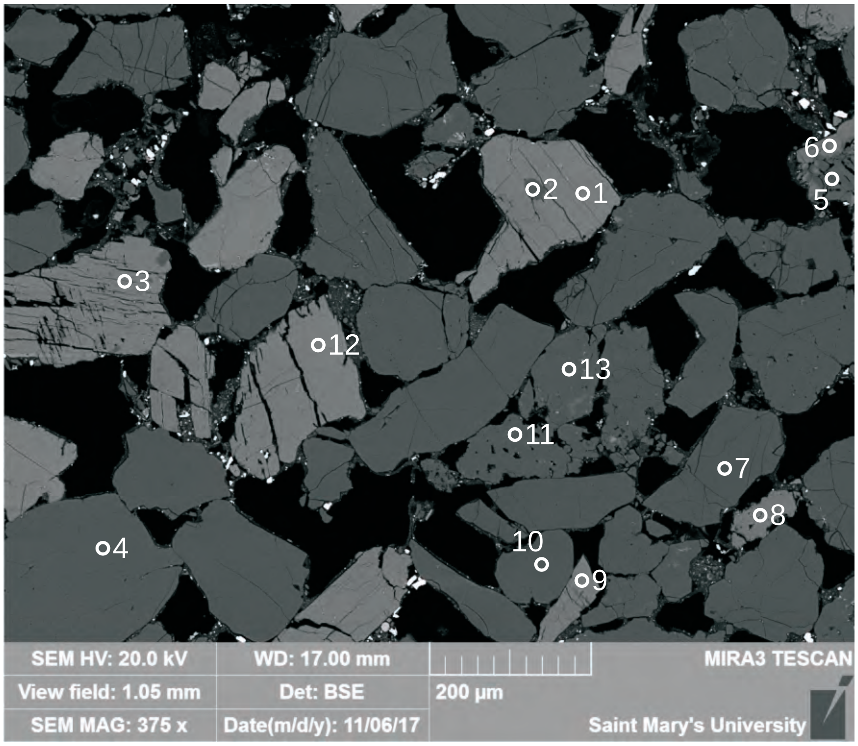
1:K-feldspar
2:Quartz
3:K-feldspar

Figure 1-3.50: Sample 2H-58 1600.27 (SEM) site 26.1. This site consists of a rhyolite lithic clast that is made up of quartz (2) and K-feldspar (1,3).



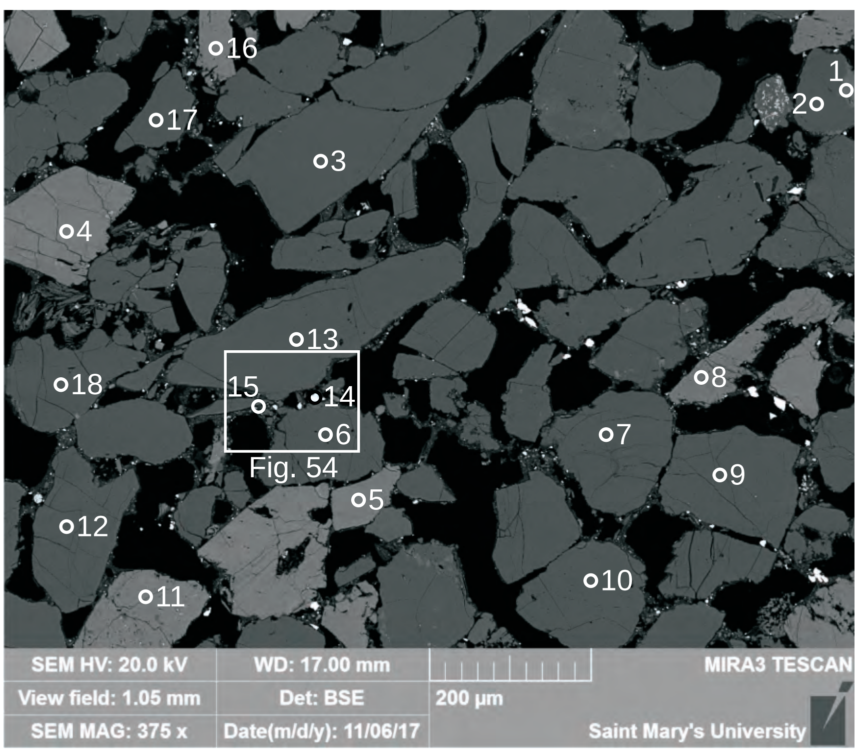
1:Quartz
2:K-feldspar
3:Quartz
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-3.51: Sample 2H-58 1600.27 (SEM) site 27. This site is similar to previous sites. There is a lithic clast of quartz (3) and K-feldspar (4) and possibly quartz (1) and K-feldspar (2). Suturing is common in this site.



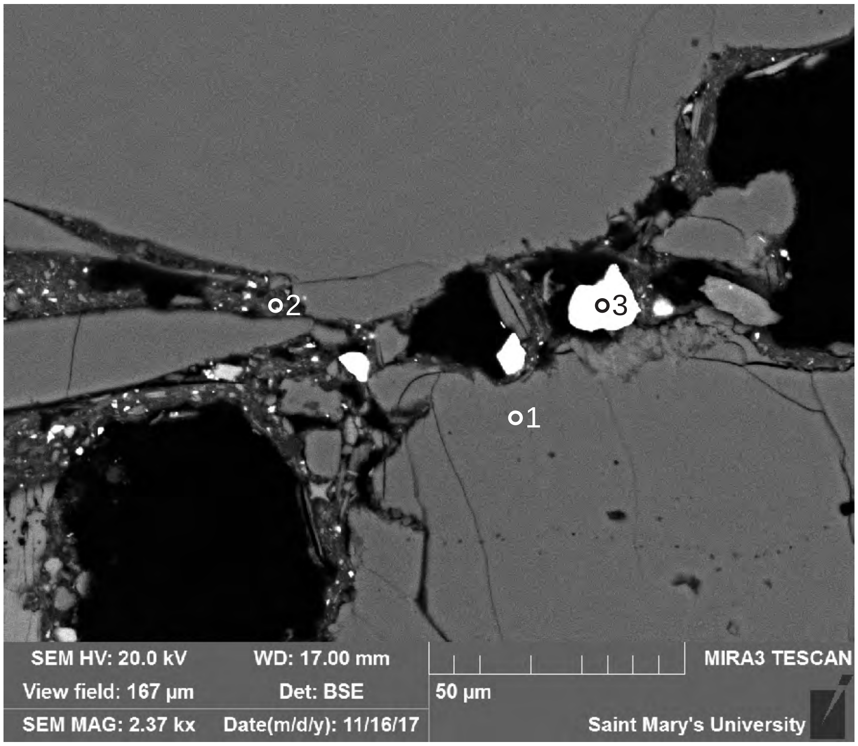
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:Oligoclase
6:K-feldspar
7:Quartz
8:K-feldspar
9:K-feldspar
10:Quartz
11:Quartz
12:K-feldspar
13:Quartz

Figure 1-3.52: Sample 2H-58 1600.27 (SEM) site 28. This site is similar to previous sites. Clays coat grains and there is a lithic clast of oligoclase (5) and K-feldspar (6).



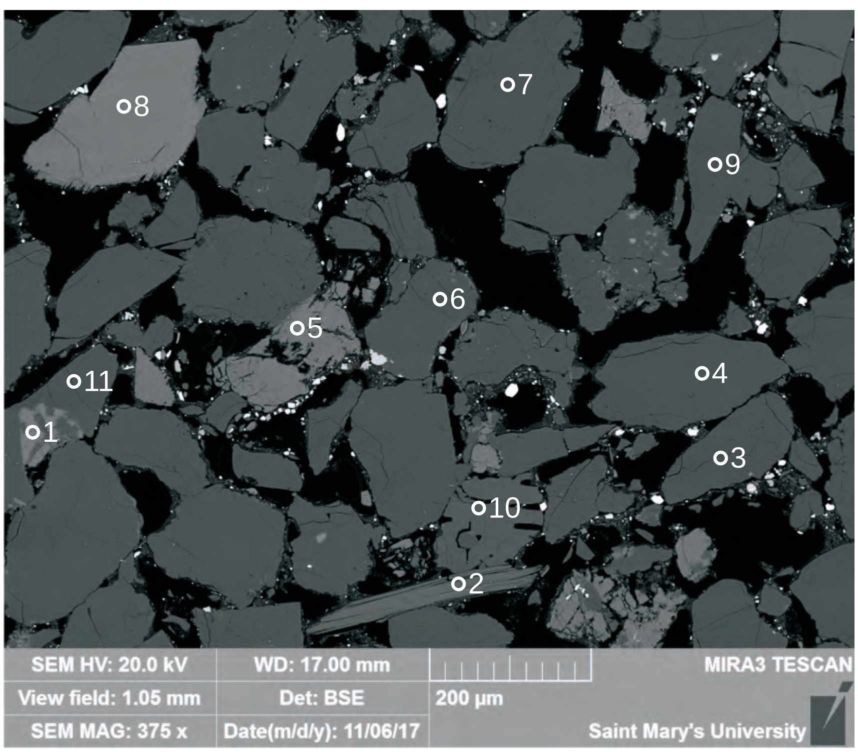
1:Muscovite
2:Quartz
3:Quartz
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:Quartz
11:K-feldspar
12:Quartz
13:Quartz
14:Barite
15:Clays
16:K-feldspar
17:Quartz
18:Quartz

Figure 1-3.53: Sample 2H-58 1600.27 (SEM) site 29. This site is similar to previous sites. There is a lithic clast of muscovite (1) and quartz (2).



1:Quartz
2:Clays
3:Barite

Figure 1-3.54: Sample 2H-58 1600.27 (SEM) site 29.1. This site shows the clays (drilling mud) that partially coat detrital grains, such as quartz (1). The barite (3) appears to be drilling mud.



1:K-feldspar
2:Muscovite
3:Quartz
4:Quartz
5:K-feldspar + Pyrite
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:Albite
11:Quartz

Figure 1-3.55: Sample 2H-58 1600.27 (SEM) site 30. This site is similar to previous sites. There is a lithic clast of quartz (11) and K-feldspar (1). Muscovite (2) does not appear deformed.

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	1	1	Qz	100.00																			100	122
2H-58 1600.27	1	2	Kfs	65.35		17.89					1.57	13.98								1.20			100	113
2H-58 1600.27	1	3	Kfs	66.34		17.74					0.68	15.24											100	120
2H-58 1600.27	1	4	Kfs	66.40		17.65					0.46	15.49											100	120
2H-58 1600.27	1	5	Qz	100.00																			100	125
2H-58 1600.27	1	6	Qz	100.00																			100	121
2H-58 1600.27	1	7	Kfs	66.23		18.13					1.00	14.64											100	117
2H-58 1600.27	1	8	Qz +	75.70	0.37	14.22	3.51		1.54		0.49	3.92			0.25								100	100
2H-58 1600.27	1	9	Oligo	64.61		21.93				3.84	9.47	0.15											100	120
2H-58 1600.27	1	10	Qz	100.00																			100	123
2H-58 1600.27	1	11	Qz	100.00																			100	121
2H-58 1600.27	1	12	Qz	100.00																			100	119
2H-58 1600.27	1	13	Qz	100.00																			100	119
2H-58 1600.27	1	14	Kfs	65.01		18.12					1.10	14.10								1.67			100	116
2H-58 1600.27	1	15	Mix	53.84		20.54	10.13		1.82	5.03	1.18	2.44		2.05	0.95					2.01			100	76
2H-58 1600.27	1.1	1	Qz + Kfs + Chl	74.51	1.16	14.07	5.11		1.28		0.48	3.09			0.31								100	97
2H-58 1600.27	1.1	2	Qz +	94.88		3.35	0.60		0.34			0.83											100	113
2H-58 1600.27	1.1	3	Kfs	66.23		17.66					0.38	15.74											100	117
2H-58 1600.27	1.1	4	Qz	100.00																			100	120
2H-58 1600.27	2	1	Qz	100.00																			100	123
2H-58 1600.27	2	2	Kfs	66.45		17.50					0.93	15.12											100	120
2H-58 1600.27	2	3	Kfs	66.30		17.72					0.87	15.11											100	117
2H-58 1600.27	2	4	Qz	100.00																			100	122
2H-58 1600.27	2	5	Py	0.35			29.13							70.52									100	227
2H-58 1600.27	2	6	Qz	100.00																			100	123
2H-58 1600.27	2	7	Kfs + Ab	67.88		18.04					4.38	9.69											100	118
2H-58 1600.27	2	8	Kfs	66.15		17.76					0.46	15.64											100	119
2H-58 1600.27	2	9	Qz	100.00																			100	121
2H-58 1600.27	2	10	Kfs	66.19		17.95					1.05	14.81											100	114
2H-58 1600.27	2	11	Qz	100.00																			100	118
2H-58 1600.27	2	12	Qz	100.00																			100	119
2H-58 1600.27	2	13	Qz	100.00																			100	122
2H-58 1600.27	2.1	1	Ab	68.77		19.22				0.54	11.34	0.13											100	119
2H-58 1600.27	2.1	2	Kfs	66.34		17.72					0.54	15.40											100	116
2H-58 1600.27	3	1	Qz	100.00																			100	121
2H-58 1600.27	3	2	Kfs	66.26		17.75					0.63	15.36											100	118
2H-58 1600.27	3	3	Qz	100.00																			100	121
2H-58 1600.27	3	4	Kfs	66.58		17.75					1.10	14.58											100	123
2H-58 1600.27	3	5	Py	0.50			29.91				0.46			69.13									100	211
2H-58 1600.27	3	6	Kfs	65.57		17.33					0.48	16.62											100	105
2H-58 1600.27	3	7	Kfs	65.05		18.28					1.39	13.58								1.69			100	121
2H-58 1600.27	3	8	Qz	100.00																			100	126
2H-58 1600.27	3	9	Kfs	65.12		17.51					2.01	14.74			0.62								100	125
2H-58 1600.27	3	10	TiO2	2.58	92.31	1.64	2.48		0.99														100	113

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	3	11	Qz	100.00																			100	127
2H-58 1600.27	3	12	Qz	100.00																			100	123
2H-58 1600.27	3	13	Qz	96.56		0.48	0.25				1.81				0.90								100	119
2H-58 1600.27	3.1	1	TiO2	0.48	98.60		0.47			0.45													100	107
2H-58 1600.27	3.1	2	Chl +	26.68	4.23	20.16	18.82	0.31	14.80														85	99
2H-58 1600.27	3.1	3	Chl + Ms	43.50	0.52	28.92	14.84		5.97		0.70	5.16			0.39								100	82
2H-58 1600.27	4	1	Ms	47.19	0.59	34.89	1.06		0.48		1.02	9.77											95	107
2H-58 1600.27	4	2	Kfs	66.02		18.01					0.60	15.37											100	116
2H-58 1600.27	4	3	Kfs	64.14		18.42					0.99	13.77								2.68			100	119
2H-58 1600.27	4	4	Kfs	66.04		17.96					0.98	14.48								0.54			100	118
2H-58 1600.27	4	5	Qz	100.00																			100	120
2H-58 1600.27	4	6	Qz	100.00																			100	119
2H-58 1600.27	4	7	Qz	100.00																			100	122
2H-58 1600.27	4	8	Qz	100.00																			100	118
2H-58 1600.27	4	9	Kfs	66.40		18.00					1.19	14.41											100	117
2H-58 1600.27	4	10	Qz	100.00																			100	120
2H-58 1600.27	4.1	1	Qz	100.00																			100	120
2H-58 1600.27	4.1	2	Ms +	58.98	0.43	25.13	4.26		1.74			9.46											100	110
2H-58 1600.27	5	1	Qz	100.00																			100	119
2H-58 1600.27	5	2	Kfs	65.79	0.30	19.34					0.41	14.17											100	108
2H-58 1600.27	5	3	Ms	49.13	0.58	30.22	2.59		0.58		0.81	9.97			1.12								95	74
2H-58 1600.27	5	4	Kfs	66.32		18.21					1.54	13.93											100	114
2H-58 1600.27	5	5	Kfs	65.35		17.85					1.71	13.75								1.35			100	120
2H-58 1600.27	5	6	Qz	100.00																			100	119
2H-58 1600.27	5	7	Qz	100.00																			100	117
2H-58 1600.27	5	8	Qz	100.00																			100	120
2H-58 1600.27	5	9	Kfs	66.45		17.67					0.70	15.18											100	114
2H-58 1600.27	5	10	Kfs	66.03		17.55					0.43	15.99											100	119
2H-58 1600.27	5	11	Qz	100.00																			100	122
2H-58 1600.27	5.1	1	Kfs	66.15		17.78					0.45	15.62											100	117
2H-58 1600.27	5.1	2	Ab	69.16		18.99				0.48	11.37												100	118
2H-58 1600.27	5.1	3	Kfs	66.61		17.48					0.37	15.53											100	118
2H-58 1600.27	5.1	4	Ab	68.82		19.16				0.50	11.52												100	118
2H-58 1600.27	6	1	Kfs	66.27		17.94					1.37	14.42											100	116
2H-58 1600.27	6	2	Qz	100.00																			100	121
2H-58 1600.27	6	3	Brt	0.68										36.69			-0.20			62.83			100	115
2H-58 1600.27	6	4	Qz	100.00																			100	118
2H-58 1600.27	6	5	Kfs	65.20		18.06					0.84	14.75								1.15			100	119
2H-58 1600.27	6	6	Sd +	0.94			48.47	2.26	1.06	1.51	1.52				0.24								56	62
2H-58 1600.27	6	7	Kfs	65.16		17.76					1.46	14.55			0.30					0.77			100	116
2H-58 1600.27	6	8	Qz	99.73	0.27																		100	117
2H-58 1600.27	6.1	1	TiO2 +	1.34	88.94	3.28	1.99			0.96	1.65		1.06		0.78								100	99
2H-58 1600.27	6.1	2	Chl + ?Ab	37.88	2.36	16.90	35.93		2.12	0.35	2.10	0.51			1.85								100	60
2H-58 1600.27	6.1	3	Chl + ?Ab	33.99	2.77	12.87	40.98		1.78	0.31	3.14			2.16	2.00								100	76

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	6.1	4	TiO2 +	1.82	88.44	3.21	2.64			0.76	1.62		1.14		0.37								100	98
2H-58 1600.27	6.2	1	Qz	100.00																			100	122
2H-58 1600.27	6.2	2	Kfs	66.30		17.82					0.98	14.91											100	115
2H-58 1600.27	6.2	3	Brt	0.68										36.31			-0.22			63.22			100	115
2H-58 1600.27	6.2	4	Mix	57.02	0.38	20.57	6.28		1.67	8.22	1.53	1.62		1.18	1.52								100	65
2H-58 1600.27	7	1	Kfs	66.20		17.63					0.41	15.76											100	114
2H-58 1600.27	7	2	Qz	100.00																			100	116
2H-58 1600.27	7	3	Qz	100.00																			100	120
2H-58 1600.27	7	4	Kfs	65.53		17.97					1.00	14.46								1.04			100	116
2H-58 1600.27	7	5	Qz	100.00																			100	121
2H-58 1600.27	7	6	Kln +	47.84		35.73	3.99			2.14	1.28	0.93			8.09								100	28
2H-58 1600.27	7	7	Qz	100.00																			100	120
2H-58 1600.27	7	8	Qz	100.00																			100	115
2H-58 1600.27	7	9	Kfs	66.02		17.76					0.51	15.71											100	114
2H-58 1600.27	7	10	Qz	100.00																			100	120
2H-58 1600.27	7	11	Qz	100.00																			100	116
2H-58 1600.27	8	1	Kfs	65.84		17.91					0.79	14.94								0.52			100	114
2H-58 1600.27	8	2	Kfs	66.56		17.47					0.32	15.65											100	114
2H-58 1600.27	8	3	Oligo	64.32		22.22				4.09	9.37												100	114
2H-58 1600.27	8	4	Kfs	65.69		17.97					0.65	15.00								0.68			100	112
2H-58 1600.27	8	5	Kfs	66.41		17.76					1.02	14.81											100	116
2H-58 1600.27	8	6	Qz	100.00																			100	121
2H-58 1600.27	8	7	Qz	100.00																			100	117
2H-58 1600.27	8	8	Qz	100.00																			100	116
2H-58 1600.27	8	9	Kfs	66.26		17.56					0.58	15.59											100	115
2H-58 1600.27	8	10	Qz	100.00																			100	120
2H-58 1600.27	8	11	Qz	100.00																			100	119
2H-58 1600.27	9	1	Kfs	65.37		18.12					1.19	14.12								1.20			100	114
2H-58 1600.27	9	2	Qz	100.00																			100	120
2H-58 1600.27	9	3	Kfs	65.89		18.12					1.39	14.02								0.58			100	115
2H-58 1600.27	9	4	Qz	100.00																			100	115
2H-58 1600.27	9	5	Qz	100.00																			100	122
2H-58 1600.27	9	6	Qz	100.00																			100	118
2H-58 1600.27	9	7	Qz	100.00																			100	122
2H-58 1600.27	9	8	Qz	100.00																			100	117
2H-58 1600.27	9	9	Kfs	66.41		17.79					1.05	14.75											100	111
2H-58 1600.27	9	10	Sme	43.21	0.47	18.38	4.63	0.87	1.34	6.95	0.96	1.11		1.02	1.05								80	64
2H-58 1600.27	10	1	Kfs	66.05	0.31	17.91					1.12	14.60											100	113
2H-58 1600.27	10	2	Qz	100.00																			100	117
2H-58 1600.27	10	3	Kfs	66.05		17.91					0.70	15.35											100	115
2H-58 1600.27	10	4	Qz	100.00																			100	119
2H-58 1600.27	10	5	Qz	100.00																			100	124
2H-58 1600.27	10	6	Mix	62.06	1.09	21.34	8.44		1.62	0.68	1.42	2.57			0.78								100	87
2H-58 1600.27	10	7	Qz	100.00																			100	117

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	10	8	Kfs	66.05		17.75	0.23				0.97	15.00											100	114
2H-58 1600.27	10	9	Kfs	66.58		17.79					1.43	14.20											100	117
2H-58 1600.27	10.1	1	Qz	100.00																			100	120
2H-58 1600.27	10.1	2	TiO2	0.84	95.78		3.37																100	104
2H-58 1600.27	10.1	3	Kfs	66.18		17.54					0.33	15.95											100	116
2H-58 1600.27	10.1	4	Ab	69.63		18.48					11.73	0.16											100	117
2H-58 1600.27	10.1	5	Py	0.69			28.73				1.25			69.34									100	210
2H-58 1600.27	10.1	6	Ab	69.41		18.68					11.91												100	116
2H-58 1600.27	10.1	7	Ab	69.40		18.86					11.74												100	117
2H-58 1600.27	10.2	1	Qz	100.00																			100	119
2H-58 1600.27	11	1	Qz	100.00																			100	115
2H-58 1600.27	11	2	Ms	50.64	0.57	28.88	2.80		2.01		0.87	9.22											95	100
2H-58 1600.27	11	3	Qz	100.00																			100	116
2H-58 1600.27	11	4	Kfs	66.02	0.25	17.67					0.46	15.59											100	110
2H-58 1600.27	11	5	Qz	100.00																			100	112
2H-58 1600.27	11	6	Kfs	66.43		17.70					0.98	14.89											100	109
2H-58 1600.27	11	7	Qz	100.00																			100	114
2H-58 1600.27	11	8	Kfs	66.08		17.86					1.00	15.06											100	113
2H-58 1600.27	11	9	Qz	100.00																			100	117
2H-58 1600.27	11	10	Qz	100.00																			100	120
2H-58 1600.27	11	11	Kfs	66.16		17.86					0.57	15.41											100	115
2H-58 1600.27	11	12	Qz	100.00																			100	121
2H-58 1600.27	11	13	Mix	65.97		18.50	4.69		1.61	2.44	1.61	1.04		1.31	1.60					1.22			100	76
2H-58 1600.27	11	14	Qz	100.00																			100	121
2H-58 1600.27	11	15	Sd	0.47			49.88	2.15	0.72	2.04			0.73										56	61
2H-58 1600.27	11.1	1	Qz	100.00																			100	121
2H-58 1600.27	11.1	2	Chl	25.77		21.83	25.76	0.22	11.42														85	100
2H-58 1600.27	12	1	Kfs	66.17		17.84					0.59	15.40											100	110
2H-58 1600.27	12	2	Qz	100.00																			100	113
2H-58 1600.27	12	3	Qz	100.00																			100	118
2H-58 1600.27	12	4	Qz	100.00																			100	118
2H-58 1600.27	12	5	Qz	100.00																			100	121
2H-58 1600.27	12	6	Mix	48.73		29.20	11.59		5.07		0.58	4.54			0.29								100	93
2H-58 1600.27	12	7	Kfs	65.88		17.80					0.67	15.04								0.61			100	116
2H-58 1600.27	12	8	Qz	100.00																			100	115
2H-58 1600.27	12.1	1	Qz	100.00																			100	118
2H-58 1600.27	12.1	2	Ms (Ill)	52.39		35.01	3.13		1.99		1.48	5.62			0.39								100	90
2H-58 1600.27	12.1	3	Ms (Ill)	49.25		32.17	3.25		2.47		0.92	6.75			0.18								95	97
2H-58 1600.27	12.2	1	Ms + Chl	52.74	0.83	24.74	8.31		2.66	3.70	1.54	3.04			2.45								100	61
2H-58 1600.27	12.2	2	Ms + Chl	49.34	5.74	28.78	5.06		3.24		0.55	7.09			0.20								100	101
2H-58 1600.27	13	1	Qz	100.00																			100	117
2H-58 1600.27	13	2	Kfs	64.58		18.42					1.09	14.01								1.89			100	113
2H-58 1600.27	13	3	Py	0.37			29.87				0.36			69.39									100	206
2H-58 1600.27	13	4	Kfs	66.39		17.70					1.11	14.79											100	112

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	13	5	Qz	100.00																			100	117
2H-58 1600.27	13	6	Qz	100.00																			100	120
2H-58 1600.27	13	7	Kfs	66.45		17.73					1.27	14.56											100	115
2H-58 1600.27	13	8	Qz	100.00																			100	113
2H-58 1600.27	13	9	Qz	100.00																			100	114
2H-58 1600.27	13	10	Ms	50.60	0.64	28.86	2.48		2.11		0.46	9.86											95	107
2H-58 1600.27	13	11	Qz	98.79		0.82					0.39												100	119
2H-58 1600.27	14	1	Qz	100.00																			100	116
2H-58 1600.27	14	2	Kfs	66.51		17.73					0.78	14.97											100	110
2H-58 1600.27	14	3	Kfs	66.62		17.56					0.60	15.22											100	115
2H-58 1600.27	14	4	Ms +	54.31		26.39	4.53		1.96		0.58	6.10			1.14								95	76
2H-58 1600.27	14	5	Qz	99.73						0.27													100	108
2H-58 1600.27	14	6	Qz +	90.60		3.89	2.39				0.49	2.43			0.20								100	102
2H-58 1600.27	14	7	Qz	100.00																			100	114
2H-58 1600.27	14	8	Qz	100.00																			100	120
2H-58 1600.27	14	9	Ab	72.40	0.35	16.93				0.32	9.84	0.16											100	109
2H-58 1600.27	15	1	Qz	100.00																			100	113
2H-58 1600.27	15	2	Kfs	65.88		17.58	0.40				0.44	15.70											100	113
2H-58 1600.27	15	3	Ab	69.23		18.87				0.47	11.43												100	114
2H-58 1600.27	15	4	Kfs	66.17		17.87					0.98	14.98											100	113
2H-58 1600.27	15	5	Qz	100.00																			100	117
2H-58 1600.27	15	6	Qz	99.41		0.59																	100	115
2H-58 1600.27	15	7	Kfs	65.47		17.73					0.52	15.50								0.79			100	113
2H-58 1600.27	15	8	Qz	100.00																			100	116
2H-58 1600.27	15	9	Qz	100.00																			100	114
2H-58 1600.27	15.1	1	Qz	98.54			1.32					0.14											100	117
2H-58 1600.27	15.1	2	Ms	49.92	0.49	26.04	5.81		2.00			10.73											95	105
2H-58 1600.27	16	1	Ilm		54.43		44.54	1.03															100	100
2H-58 1600.27	16	2	Qz	100.00																			100	114
2H-58 1600.27	16	3	Kfs	65.69		17.85					0.42	15.38								0.66			100	110
2H-58 1600.27	16	4	Qz	100.00																			100	118
2H-58 1600.27	16	5	Qz	100.00																			100	118
2H-58 1600.27	16	6	Kfs	66.52		17.66					0.71	15.11											100	114
2H-58 1600.27	16	7	Ms	47.32	0.39	25.56	3.88		2.64	3.40		9.12	2.69										95	105
2H-58 1600.27	16	8	Kfs	65.93		17.75					0.45	15.86											100	114
2H-58 1600.27	16	9	Kfs + Ab	67.41	0.25	18.29					6.49	7.57											100	113
2H-58 1600.27	16	10	Qz	100.00																			100	117
2H-58 1600.27	16.1	1	Kfs	66.33		17.78					1.67	13.50								0.72			100	117
2H-58 1600.27	16.1	2	Ab + Kfs (Perthite)	67.45		18.38					4.91	8.68								0.58			100	117
2H-58 1600.27	17	1	Qz	100.00																			100	114
2H-58 1600.27	17	2	Qz	100.00																			100	113
2H-58 1600.27	17	3	TiO2	0.57	98.26		0.89								0.28								100	87
2H-58 1600.27	17	4	Kfs	66.17		18.00					0.53	15.29											100	107
2H-58 1600.27	17	5	Kfs	65.45		17.87					0.82	14.87								1.00			100	112

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	17	6	Ab	68.90		18.42				0.83	11.86												100	110
2H-58 1600.27	17	7	Qz	100.00																			100	114
2H-58 1600.27	17	8	Ms	47.59	0.65	34.92	0.71		0.40		1.34	9.40											95	106
2H-58 1600.27	17	9	Qz	100.00																			100	116
2H-58 1600.27	17	10	Mix	50.25		21.84	7.44		1.82	3.15	1.72	1.67		1.14	10.96								100	41
2H-58 1600.27	17.1	1	TiO2 +	4.41	88.40	2.56	2.93			0.25	0.79	0.42			0.24								100	97
2H-58 1600.27	17.1	2	TiO2	0.99	95.83	0.59	1.89				0.47				0.24								100	97
2H-58 1600.27	18	1	Qz	100.00																			100	111
2H-58 1600.27	18	2	Zrn	28.79		0.89	1.05			1.83	0.52					0.66			66.27				100	91
2H-58 1600.27	18	3	Qz	100.00																			100	110
2H-58 1600.27	18	4	Kfs	66.17		17.73					0.35	15.76											100	109
2H-58 1600.27	18	5	Ab	69.19		18.88					11.55	0.37											100	110
2H-58 1600.27	18	6	Qz	100.00																			100	110
2H-58 1600.27	18.1	1	Qz	100.00																			100	113
2H-58 1600.27	18.1	2	Ms + Chl	52.38		25.45	4.20		3.15			9.81											95	104
2H-58 1600.27	19	1	Kfs	66.51		17.39					0.89	15.21											100	108
2H-58 1600.27	19	2	Qz	100.00																			100	113
2H-58 1600.27	19	3	Kfs	66.27		17.78					0.54	15.41											100	109
2H-58 1600.27	19	4	Qz	100.00																			100	114
2H-58 1600.27	19	5	Kfs	65.67		17.97					0.50	15.31								0.55			100	110
2H-58 1600.27	19	6	Qz	100.00																			100	111
2H-58 1600.27	19	7	Kfs	65.67		18.01					1.16	14.16								0.99			100	107
2H-58 1600.27	19	8	Qz	100.00																			100	110
2H-58 1600.27	19	9	Qz + Ab	95.96		2.50					1.30				0.24								100	90
2H-58 1600.27	19	10	Qz + Ab	88.60		6.11	0.68				3.87			0.74									100	111
2H-58 1600.27	19.1	1	Brt											37.16			0.01			62.83			100	108
2H-58 1600.27	19.1	2	Qz	100.00																			100	114
2H-58 1600.27	19.1	3	Kfs	65.45		17.63	0.24				0.87	15.56			0.24								100	111
2H-58 1600.27	19.2	1	Qz	97.90		1.34					0.75												100	120
2H-58 1600.27	19.2	2	Mix	53.98	2.37	21.54	6.80		1.76	6.39	1.39	1.98		1.77	2.02								100	63
2H-58 1600.27	19.2	3	Brt			0.93								37.31			-0.21			59.26		2.71	100	118
2H-58 1600.27	19.2	4	Qz	97.05		1.81					1.14												100	122
2H-58 1600.27	20	1	Qz	100.00																			100	114
2H-58 1600.27	20	2	Kfs	65.82		17.30					0.48	15.73	0.67										100	106
2H-58 1600.27	20	3	Chl	27.45		19.46	22.10	0.94	15.05														85	79
2H-58 1600.27	20	4	Kfs	65.05		18.05					0.90	14.42								1.57			100	109
2H-58 1600.27	20	5	Qz	100.00																			100	113
2H-58 1600.27	20	6	Lm +	2.60			87.47	1.40	0.94	2.04	3.70			0.97	0.88								100	77
2H-58 1600.27	20	7	Qz	100.00																			100	116
2H-58 1600.27	20	8	Chl + Ill	43.50	0.53	21.64	6.43		3.42	0.32	0.98	2.46			0.72								80	73
2H-58 1600.27	20.1	1	Qz	99.01		0.82						0.17											100	120
2H-58 1600.27	20.1	2	Ill + Chl	54.31	0.63	29.24	4.05		1.50		1.05	3.04			1.19								95	78
2H-58 1600.27	21	1	Kfs	66.65		17.59					0.97	14.78											100	107
2H-58 1600.27	21	2	Ab	69.42		18.59					11.85	0.15											100	109

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	21	3	Kln	48.26		34.61	1.82				0.58	0.27			0.46								86	81
2H-58 1600.27	21	4	Kfs	65.13		17.86					0.87	14.50								1.63			100	110
2H-58 1600.27	21	5	Qz	100.00																			100	114
2H-58 1600.27	21	6	Qz	100.00																			100	116
2H-58 1600.27	21	7	Kfs	65.61		17.89					0.95	14.70								0.85			100	106
2H-58 1600.27	21	8	Qz	100.00																			100	110
2H-58 1600.27	21	9	Qz	100.00																			100	114
2H-58 1600.27	21	10	Ms	47.72	0.74	34.50	0.97		0.60		1.07	9.40											95	105
2H-58 1600.27	22	1	Qz	100.00																			100	110
2H-58 1600.27	22	2	Kln	47.35		34.44	2.81		0.46		0.38	0.37			0.19								86	82
2H-58 1600.27	22	3	Qz	100.00																			100	115
2H-58 1600.27	22	4	Chl	31.19		21.71	28.93	0.84	16.90	0.43													100	90
2H-58 1600.27	22	5	Kfs	65.53		17.89					0.78	14.99								0.82			100	109
2H-58 1600.27	22	6	Qz	100.00																			100	112
2H-58 1600.27	22	7	Kfs	66.33		17.68					0.36	15.63											100	106
2H-58 1600.27	22	8	Ms	47.50	1.05	34.52	0.92		0.48		2.00	8.53											95	99
2H-58 1600.27	22	9	Qz	100.00																			100	112
2H-58 1600.27	23	1	Qz	100.00																			100	108
2H-58 1600.27	23	2	Ms	53.30	0.34	30.32	2.38		1.03		0.61	7.03											95	89
2H-58 1600.27	23	3	Chloritized ?feld	38.69	1.46	17.81	22.49		7.18		2.85	7.57			1.95								100	53
2H-58 1600.27	23	4	Kfs	66.02		17.78					0.50	15.70											100	108
2H-58 1600.27	23	5	Qz	100.00																			100	111
2H-58 1600.27	23	6	Kfs	65.99		17.74					0.80	15.47											100	105
2H-58 1600.27	23	7	Qz	100.00																			100	111
2H-58 1600.27	23	8	Kfs + Chl	57.77	0.49	26.61	6.91		1.95	1.54	1.35	2.07			1.30								100	61
2H-58 1600.27	23	9	Qz	100.00																			100	111
2H-58 1600.27	23	10	Qz	100.00																			100	106
2H-58 1600.27	23.1	1	Bt	39.34	1.30	19.42	19.15		8.64		0.65	7.51											96	99
2H-58 1600.27	23.1	2	Sd	0.46			53.72	0.80		1.02													56	59
2H-58 1600.27	23.2	1	Qz	100.00																			100	120
2H-58 1600.27	23.2	2	Clays	52.53	1.08	26.29	5.17		1.29	9.24	1.03	1.43		0.67	1.27								100	63
2H-58 1600.27	23.2	3	Clays	53.51		14.54	14.05		0.88	5.30	0.66	3.09		1.33	6.63								100	23
2H-58 1600.27	23.2	4	Qz + Chl +	71.74		11.77	8.50		1.22	1.84	1.40	0.88			2.65								100	56
2H-58 1600.27	24	1	Kfs	66.55		17.74					1.21	14.50											100	106
2H-58 1600.27	24	2	Kfs	65.71		17.66					0.26	15.72								0.64			100	107
2H-58 1600.27	24	3	Qz	100.00																			100	110
2H-58 1600.27	24	4	Qz	100.00																			100	112
2H-58 1600.27	24	5	Kfs	66.27		17.89					0.81	15.03											100	105
2H-58 1600.27	24	6	Qz	100.00																			100	107
2H-58 1600.27	24	7	Qz	100.00																			100	111
2H-58 1600.27	25	1	Qz	100.00																			100	108
2H-58 1600.27	25	2	Kfs	66.52		17.71					0.83	14.94											100	107
2H-58 1600.27	25	3	Kfs	66.33		17.98					0.30	15.39											100	103
2H-58 1600.27	25	4	Qz	100.00																			100	108

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	25	5	Mix	60.24	0.46	22.01	5.62		1.82	3.84	1.69	1.88		1.37	1.07								100	69
2H-58 1600.27	25	6	Qz	100.00																			100	110
2H-58 1600.27	25	7	Ms	50.75		29.98	1.77		1.80		0.31	10.39											95	96
2H-58 1600.27	25	8	Qz	99.89								0.11											100	104
2H-58 1600.27	25	9	Zrn	31.85															68.15				100	103
2H-58 1600.27	25	10	Qz	100.00																			100	105
2H-58 1600.27	25	11	Ab	69.36		18.78				0.26	11.61												100	107
2H-58 1600.27	25	12	Qz	100.00																			100	112
2H-58 1600.27	25.1	1	Clays	57.45		21.91	6.16		1.88	5.21	1.22	1.58		1.52	1.73					1.34			100	66
2H-58 1600.27	25.1	2	Sd	1.65		0.68	41.09	1.16	6.58	4.83								0.02					56	60
2H-58 1600.27	25.1	3	Brt	0.54										36.03			-0.17			63.60			100	115
2H-58 1600.27	25.1	4	Qz	100.00																			100	121
2H-58 1600.27	26	1	Qz	100.00																			100	106
2H-58 1600.27	26	2	Kfs	65.86		17.75					0.80	14.88								0.71			100	105
2H-58 1600.27	26	3	Kln	48.31		34.02	1.22				0.66	1.32			0.46								86	72
2H-58 1600.27	26	4	Kfs	66.57		17.58					0.63	15.22											100	105
2H-58 1600.27	26	5	TiO2	1.62	97.41		0.97																100	93
2H-58 1600.27	26	6	Qz	100.00																			100	108
2H-58 1600.27	26	7	Qz + Kfs	88.41		6.13						5.46											100	105
2H-58 1600.27	26	8	Kfs	67.42	1.04	17.92	0.34				0.40	12.88											100	96
2H-58 1600.27	26	9	Kfs	66.02		17.70					0.40	15.88											100	106
2H-58 1600.27	26	10	Kfs	66.21		17.80					0.36	15.62											100	107
2H-58 1600.27	26	11	Qz	100.00																			100	108
2H-58 1600.27	26	12	Qz	100.00																			100	106
2H-58 1600.27	26.1	1	Kfs	66.19		17.87					0.44	15.50											100	114
2H-58 1600.27	26.1	2	Qz	98.95		0.84						0.21											100	114
2H-58 1600.27	26.1	3	Kfs	66.84		17.43					0.34	15.39											100	115
2H-58 1600.27	27	1	Qz	100.00																			100	110
2H-58 1600.27	27	2	Kfs	65.61		17.98					1.17	14.23								1.01			100	106
2H-58 1600.27	27	3	Qz	99.88								0.12											100	108
2H-58 1600.27	27	4	Kfs	68.95		16.23						14.82											100	105
2H-58 1600.27	27	5	Kfs	66.20		17.78					0.72	15.30											100	104
2H-58 1600.27	27	6	Qz	100.00																			100	107
2H-58 1600.27	27	7	Qz	100.00																			100	105
2H-58 1600.27	27	8	Qz	100.00																			100	107
2H-58 1600.27	27	9	Kfs	65.57		18.12					0.97	14.62								0.71			100	107
2H-58 1600.27	27	10	Qz	100.00																			100	109
2H-58 1600.27	27	11	Qz	100.00																			100	111
2H-58 1600.27	28	1	Kfs	66.16		17.57					0.61	15.16								0.50			100	103
2H-58 1600.27	28	2	Qz	100.00																			100	105
2H-58 1600.27	28	3	Kfs	66.31		17.81					0.77	15.10											100	101
2H-58 1600.27	28	4	Qz	100.00																			100	106
2H-58 1600.27	28	5	Oligo	60.21		28.71	0.32				4.81	5.95											100	97
2H-58 1600.27	28	6	Kfs	66.50		17.83						15.67											100	102

Table 1-3.1: EDS geochemical analyses of sample 2H-58 1600.27.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	CoO	ZnO	ZrO2	BaO	Yb2O3	WO3	Total	Actual Total
2H-58 1600.27	28	7	Qz	100.00																			100	108
2H-58 1600.27	28	8	Kfs	66.27		17.58					0.51	15.64											100	105
2H-58 1600.27	28	9	Kfs	66.41		17.56					0.77	15.25											100	106
2H-58 1600.27	28	10	Qz	100.00																			100	109
2H-58 1600.27	28	11	Qz	100.00																			100	106
2H-58 1600.27	28	12	Kfs	65.66		17.94					0.65	15.18								0.58			100	102
2H-58 1600.27	28	13	Qz	98.84		0.60	0.31		0.25														100	107
2H-58 1600.27	29	1	Ms	48.38	0.30	32.76	1.43		1.21		0.52	10.40											95	93
2H-58 1600.27	29	2	Qz	100.00																			100	104
2H-58 1600.27	29	3	Qz	100.00																			100	103
2H-58 1600.27	29	4	Kfs	66.36		17.69					0.78	15.17											100	100
2H-58 1600.27	29	5	Kfs	66.07		17.80					0.85	15.28											100	104
2H-58 1600.27	29	6	Qz	100.00																			100	106
2H-58 1600.27	29	7	Qz	100.00																			100	108
2H-58 1600.27	29	8	Kfs	66.64		17.56					0.71	15.08											100	106
2H-58 1600.27	29	9	Qz	100.00																			100	108
2H-58 1600.27	29	10	Qz	100.00																			100	108
2H-58 1600.27	29	11	Kfs	66.42		17.54					0.99	15.05											100	103
2H-58 1600.27	29	12	Qz	100.00																			100	105
2H-58 1600.27	29	13	Qz	100.00																			100	105
2H-58 1600.27	29	14	Brt											36.77			0.03			63.20			100	99
2H-58 1600.27	29	15	Clays	49.11		24.16	5.20		1.62	4.32	1.42	1.56		2.98	5.32					4.30			100	49
2H-58 1600.27	29	16	Kfs	66.09		17.79					1.58	14.04								0.51			100	99
2H-58 1600.27	29	17	Qz	100.00																			100	102
2H-58 1600.27	29	18	Qz	100.00																			100	103
2H-58 1600.27	29.1	1	Qz	100.00																			100	119
2H-58 1600.27	29.1	2	Clays	47.94		19.48	5.31		1.26	8.24	1.59	1.21		5.59	0.82					8.56			100	83
2H-58 1600.27	29.1	3	Brt											36.63			-0.05			63.42			100	112
2H-58 1600.27	30	1	Kfs	65.85	0.35	17.82					0.45	15.53											100	99
2H-58 1600.27	30	2	Ms	47.41	0.55	34.55	1.18		0.41		1.75	9.15											95	94
2H-58 1600.27	30	3	Qz	100.00																			100	105
2H-58 1600.27	30	4	Qz	100.00																			100	106
2H-58 1600.27	30	5	Kfs + Py	56.37		15.45	4.38				0.75	12.81		10.24									100	108
2H-58 1600.27	30	6	Qz	100.00																			100	104
2H-58 1600.27	30	7	Qz	100.00																			100	101
2H-58 1600.27	30	8	Kfs	65.78	0.28	17.86					0.99	15.09											100	97
2H-58 1600.27	30	9	Qz	100.00																			100	102
2H-58 1600.27	30	10	Ab	66.67		20.47				2.19	10.50	0.16											100	104
2H-58 1600.27	30	11	Qz	100.00																			100	101

Notes

1. + indicates more than one mineral present

Appendix 1-4: SEM-BSE images and EDS mineral analyses for sample 3H-58 1613.63.

Sample 3H-58 1613.63: Fine-medium grained sandstone with glauconitic cement

Detrital Minerals: Albite, Fe-Chlorite, Illite + Chlorite, Ilmenite, "Ilmenite", K-feldspar, Monazite, Muscovite, Quartz, Titania (Fig. 3), Zircon

Diagenetic Minerals: Glauconite, Glaucony, Pyrite, Siderite, Titania (Fig. 26)

Notes:

1. Gluacony grains appear to have been affected by volume reduction (Fig. 2).

2. There is a coated grain made up of multiple generations of siderite (Fig. 32).

3. Siderite is usually late diagenetic mineral, partially filling voids (Figs. 2-4,24,26) and rims grains (Fig. 24).

4. The matrix appears to be made up usually of a fine-grained illite + chlorite mixture (Figs. 5,24,26,33).

5: Common substrates for glaucony appear to be pellets, detrital grains, and matrix or possibly intraclasts (i.e. FIgs. 2,34,8).

6. Paragenetic sequence: Glaucony → Glauconite → Pyrite, Siderite, Titania

↑ Figs. i.e. 1-3,15,21 ↑ Fig. 8 ↑ Figs. 24,29

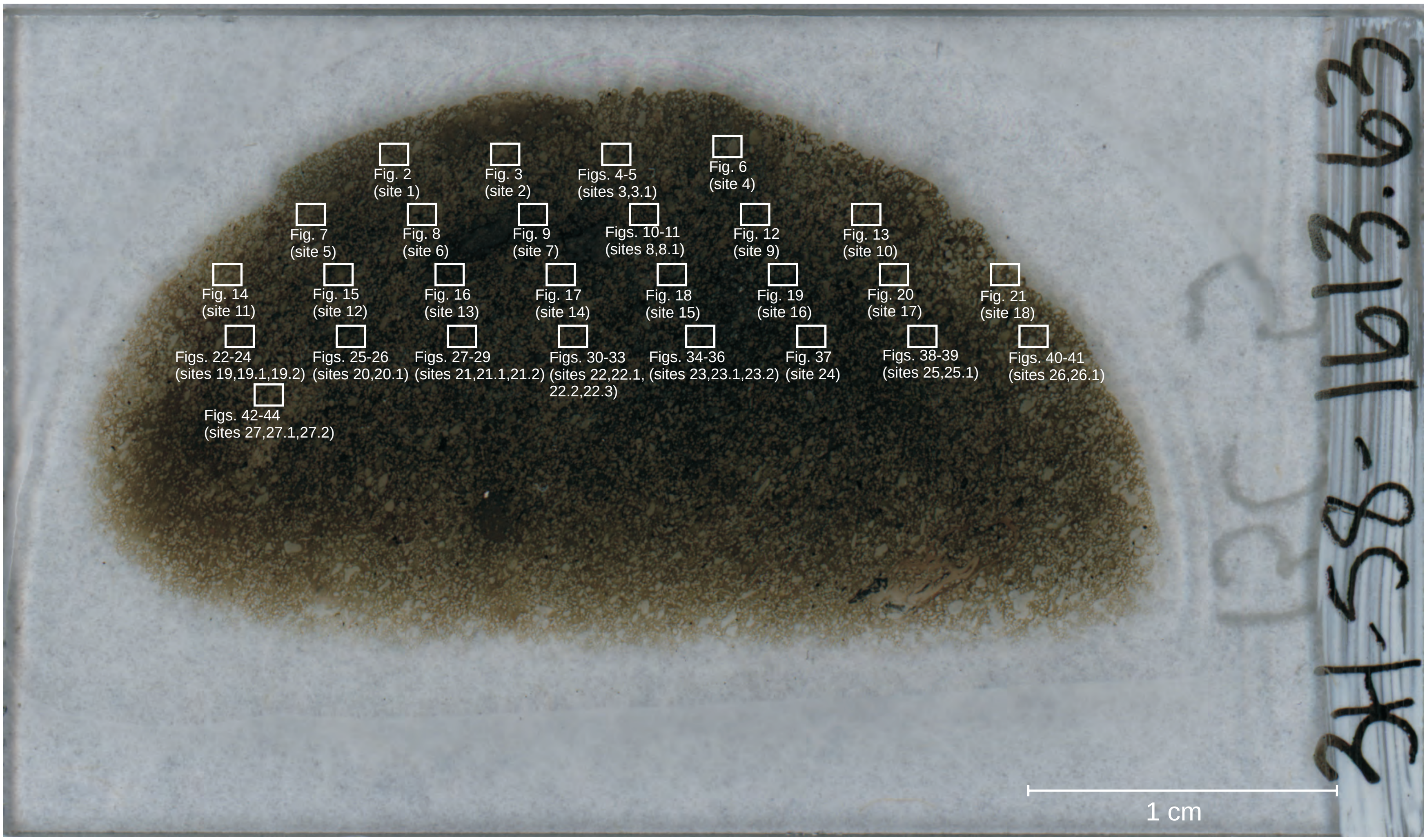
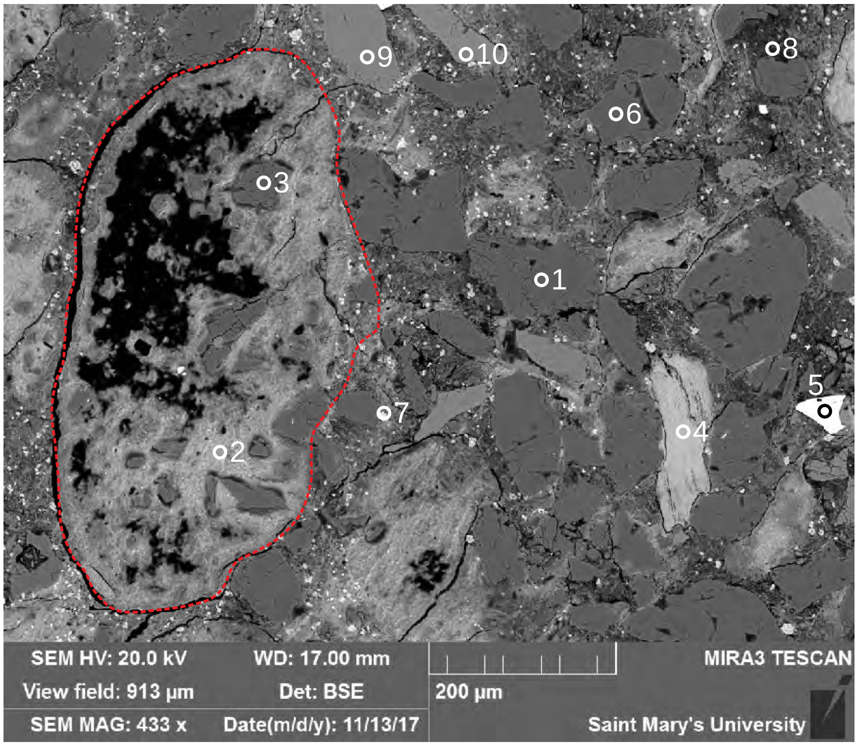
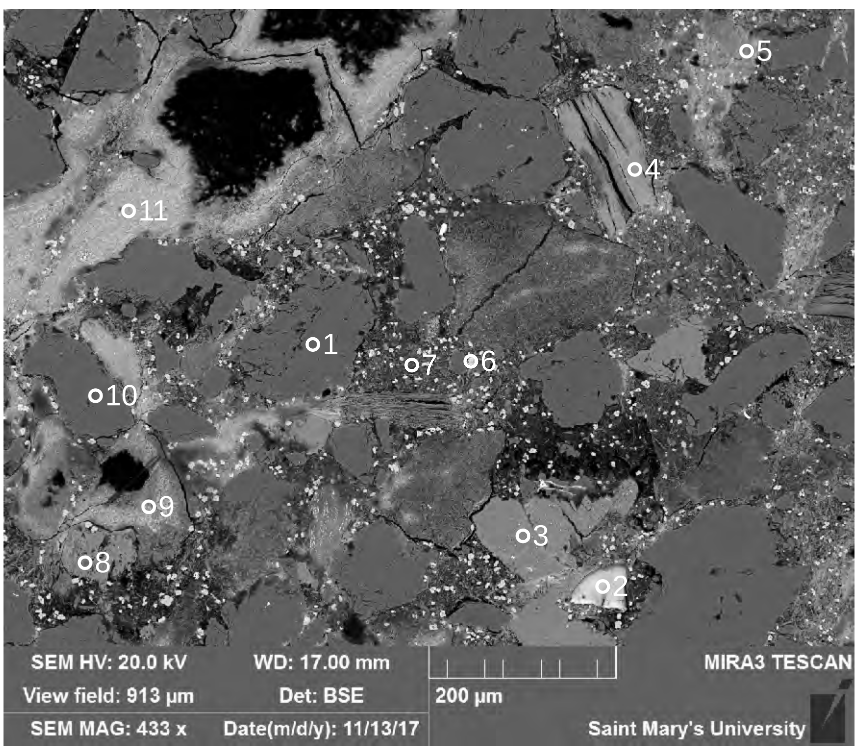


Figure 1-4.1: Scanned thin section of sample 3H-58 1613.63 showing the location of analyzed sites.



1:Quartz
2:Glaucony
3:Quartz
4:Fe-Chlorite
5:"Ilmenite"
6:Quartz
7:Siderite +
8:Chlorite + Illite
9:K-feldspar
10:K-feldspar

Figure 1-4.2: Sample 3H-58 1613.63 (SEM) site 1. This site consists of detrital quartz (1,3,6), K-felspar (9-10), Fe-chlorite (4), and ilmenite (5) grains. There appears to be a large glaucony (2) pellet with volume reduction (outlined in red). The matrix appears to be made up of illite + chlorite (8), and diagenetic siderite (7) partially fills voids.



1:Quartz
2:TiO_2
3:K-feldspar
4:Glaucony +
5:Glaucony
6:Siderite
7:Illite + Chlorite
8:K-feldspar
9:Glaucony
10:Quartz
11:Glaucony

Figure 1-4.3: Sample 3H-58 1613.63 (SEM) site 2. This site consists of detrital quartz (1,10), K-feldspar (3,8), and titania (2) grains. Illite + chlorite (7) make up the matrix, and glaucony (4,5,9,11) make up the early diagenetic minerals. Siderite (6) is late diagenetic and cross-cuts the matrix.

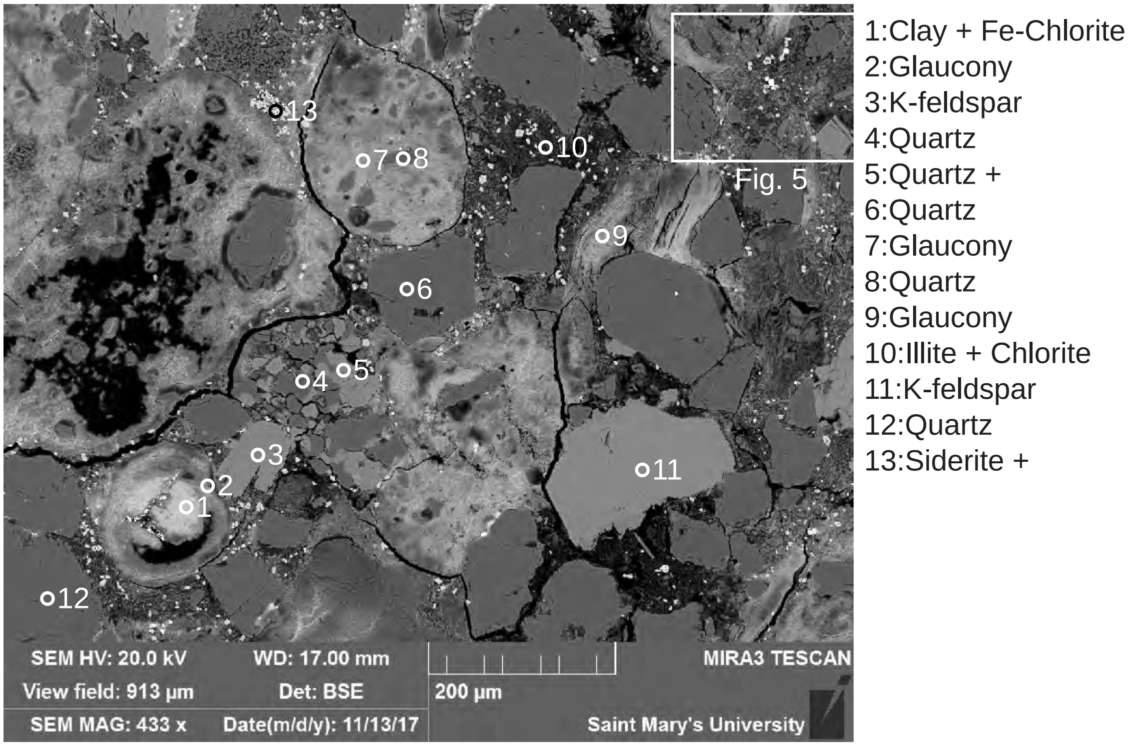


Figure 1-4.4: Sample 3H-58 1613.63 (SEM) site 3. This site consists of detrital quartz (4-6,8,12), and K-feldspar (3,11) grains. The matrix is made up of illite + chlorite (10), and diagenetic glaucony (7,9). Late siderite (13) partially fills voids. There is also a coated grain made up of clay + Fe-chlorite (1) and glaucony (2).

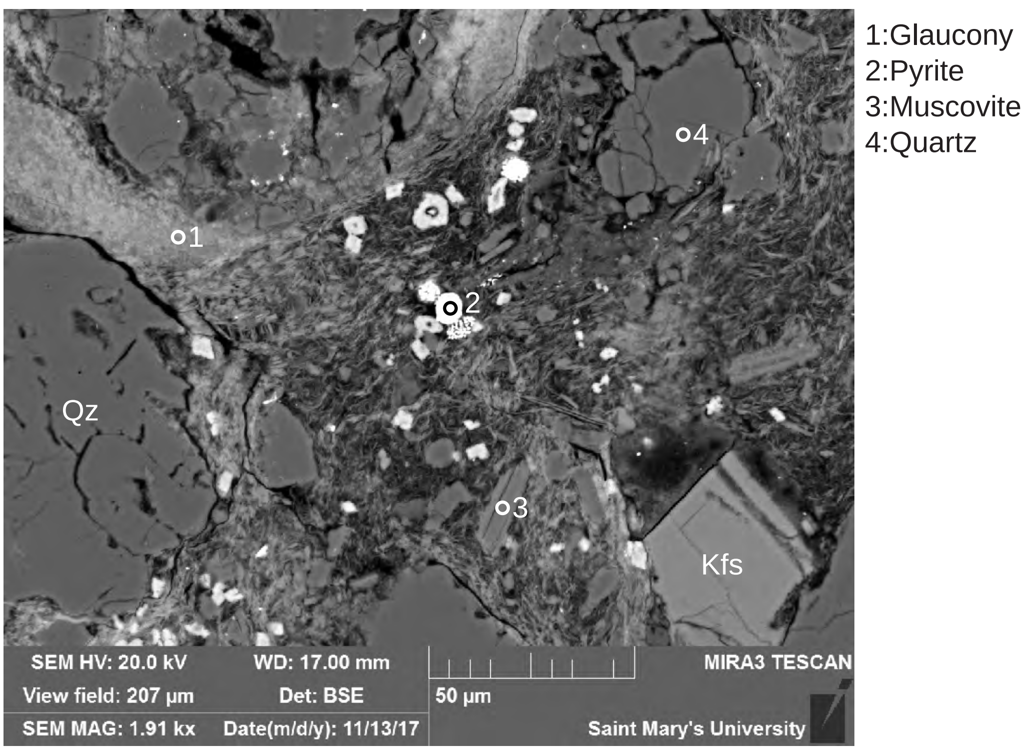


Figure 1-4.5: Sample 3H-58 1613.63 (SEM) site 3.1. This site consists of detrital quartz grains (4), K-feldspar, and muscovite (3) grains. There is a early diagenetic glaucony (1) grain, and late diagenetic pyrite (2).

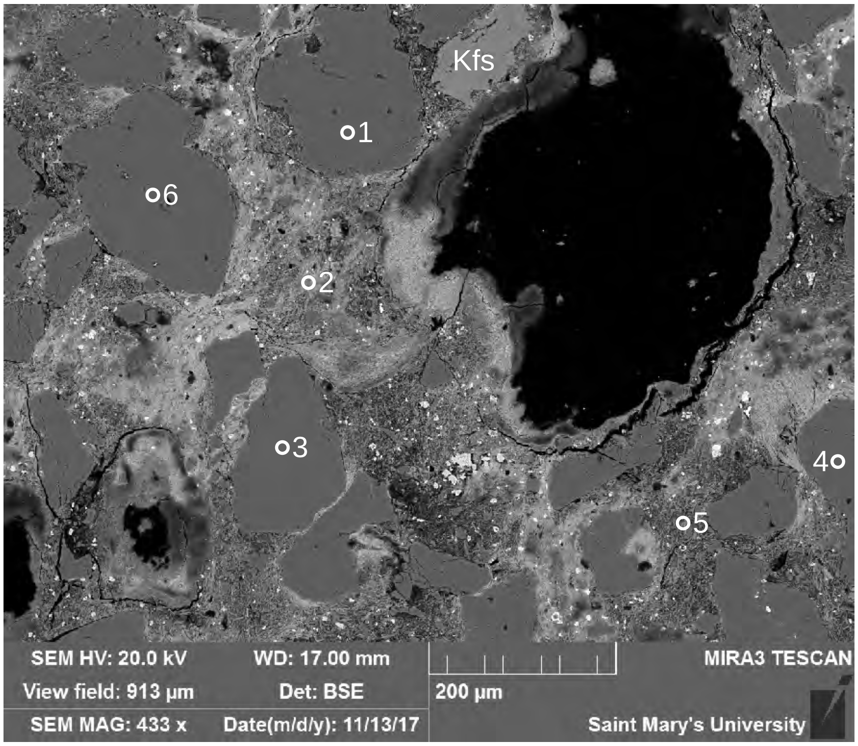


Figure 1-4.6: Sample 3H-58 1613.63 (SEM) site 4. This site consists of detrital quartz (1,3-4,6), and K-feldspar grains. The matrix is made up of illite + chlorite (2,5).

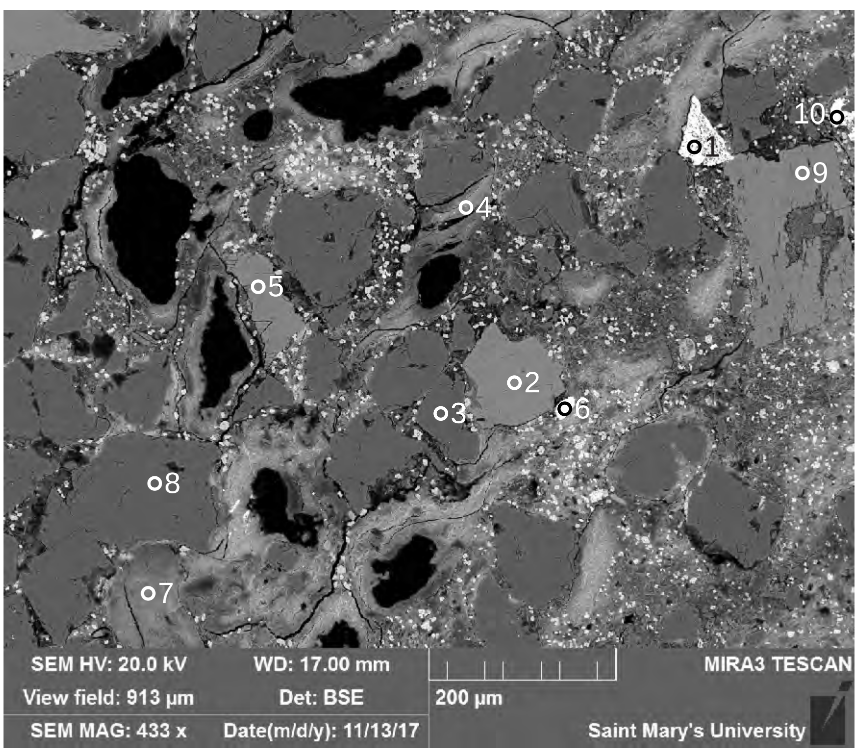
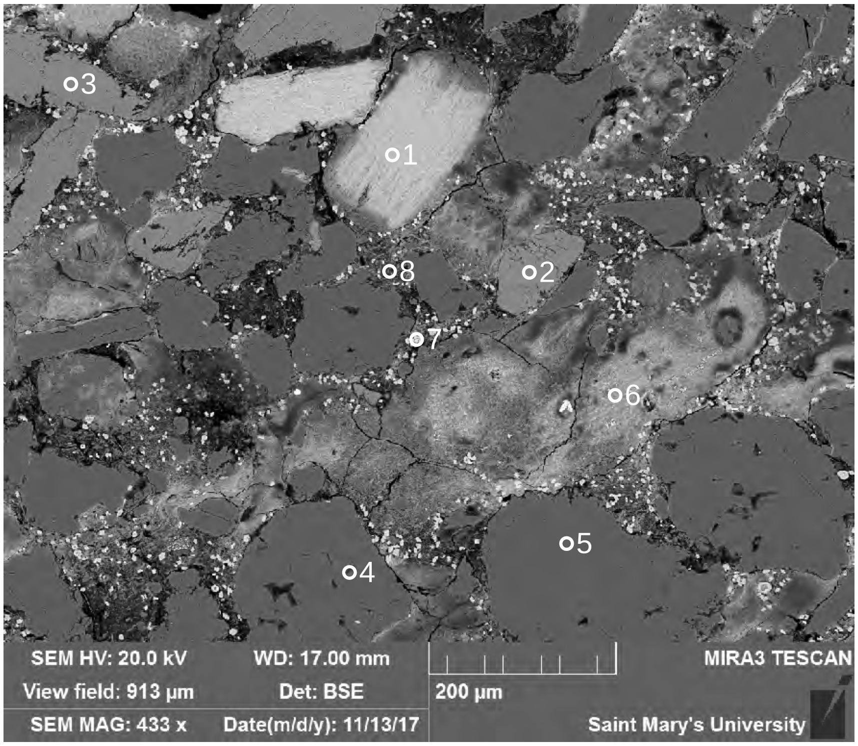
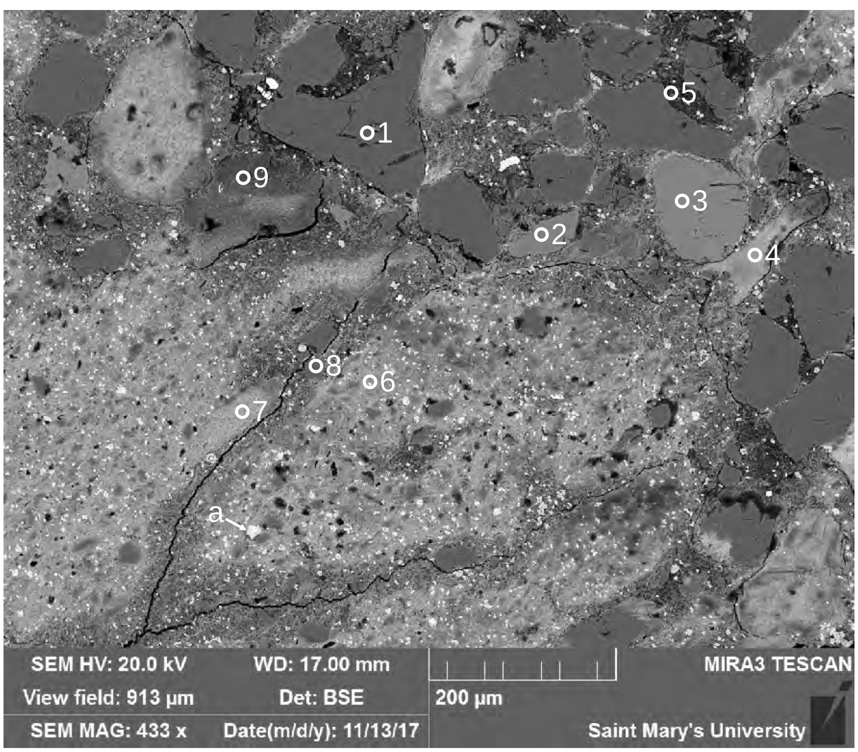


Figure 1-4.7: Sample 3H-58 1613.63 (SEM) site 5. This site consists of detrital quartz (3,8), K-feldspar (2,5,9), ilmenite (1), and zircon (6) grains. Glaucony (4) appears to replace a detrital grain. Chlorite + muscovite (7) make up the matrix. Probably late diagenetic siderite cross-cuts the matrix.



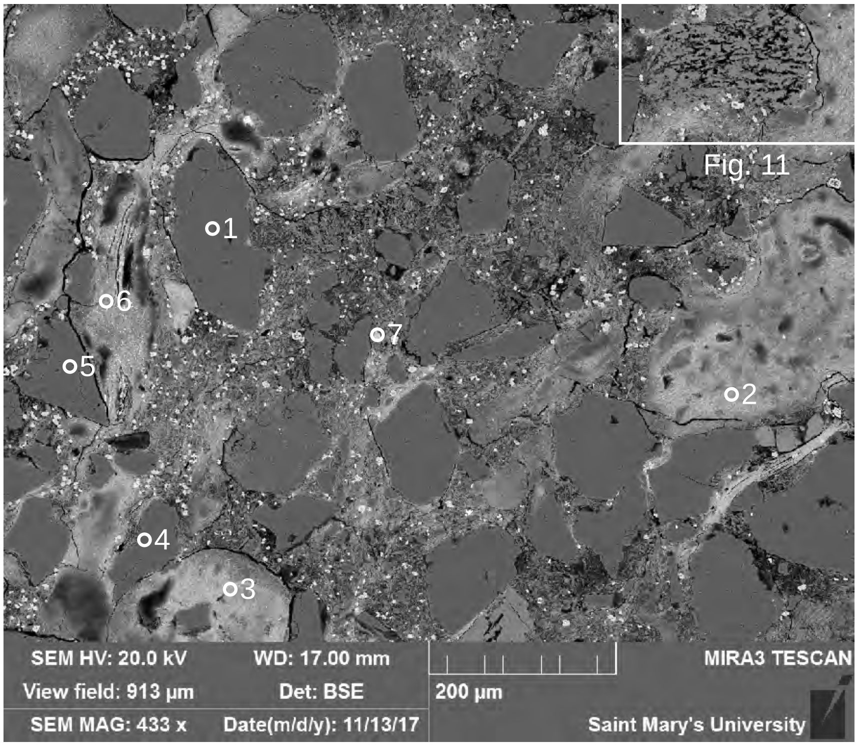
1:Fe-Chlorite
2:K-feldspar
3:K-feldspar
4:Quartz
5:Quartz
6:Glaucony
7:Siderite +
8:Illite + Chlorite

Figure 1-4.8: Sample 3H-58 1613.63 (SEM) site 6. This site consists of detrital quartz (4-5), K-feldspar (2-3), and Fe-chlorite (1) grains. The matrix is made up of illite + chlorite (8), and glaucony (6) appears to be replacing the matrix.



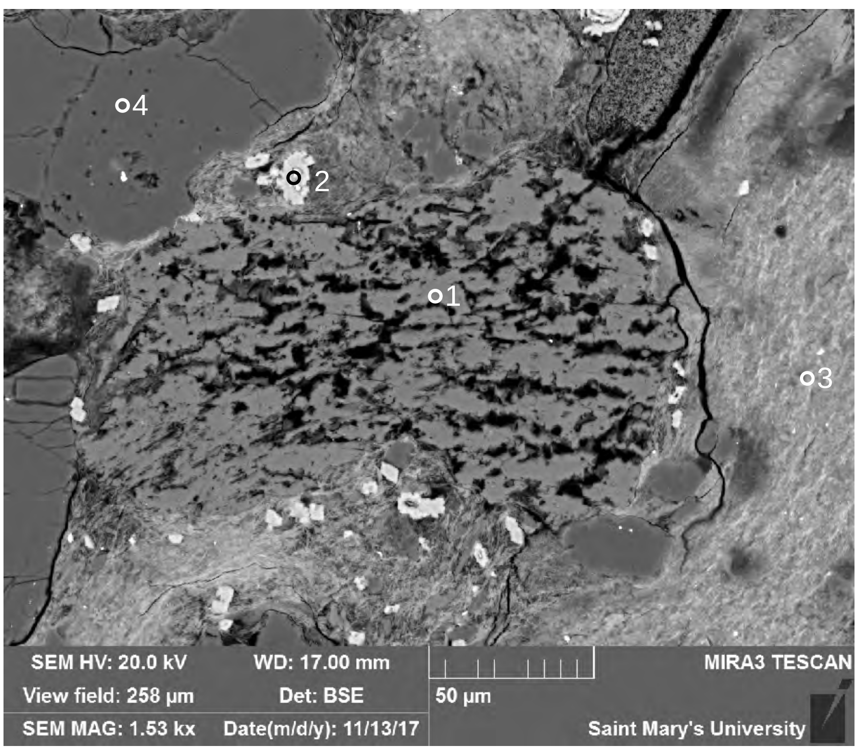
1:Quartz
2:K-feldspar
3:K-feldspar
4:Glaucony
5:Illite + Chlorite
6:Fe-Chlorite +
7:Glaucony
8:Quartz
9:Glaucony

Figure 1-4.9: Sample 3H-58 1613.63 (SEM) site 7. This site consists of detrital quartz (1,8), and K-feldspar (2-3) grains. The matrix consists of illite + chlorite (5), and diagenetic Fe-chlorite (6). glaucony (7) appears to replace a detrital grain, and glaucony (9) may be a pellet. Probably late diagenetic siderite cross-cuts the matrix (position a).



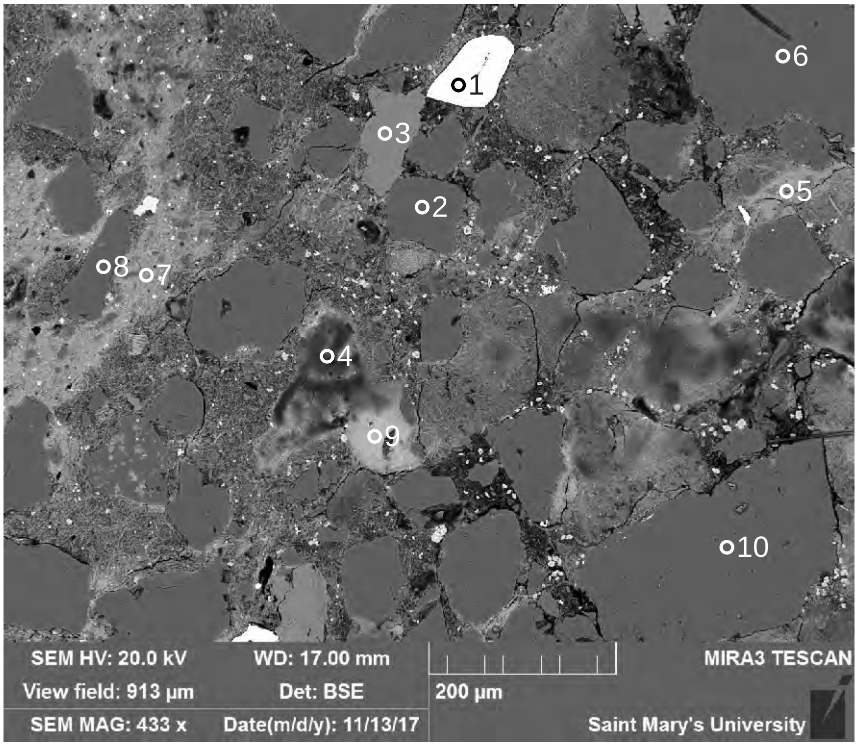
1:Quartz
2:Glaucony
3:Clay + Fe-Chlorite
4:Quartz
5:Quartz
6:Glauconite
7:Siderite

Figure 1-4.10: Sample 3H-58 1613.63 (SEM) site 8. This site consists of detrital quartz (1,4-5) grains. Glaucony (2) replaces matrix, and glauconite (6) replaces a detrital grain. Siderite (7) partially fills voids and is the latest diagenetic mineral to form.



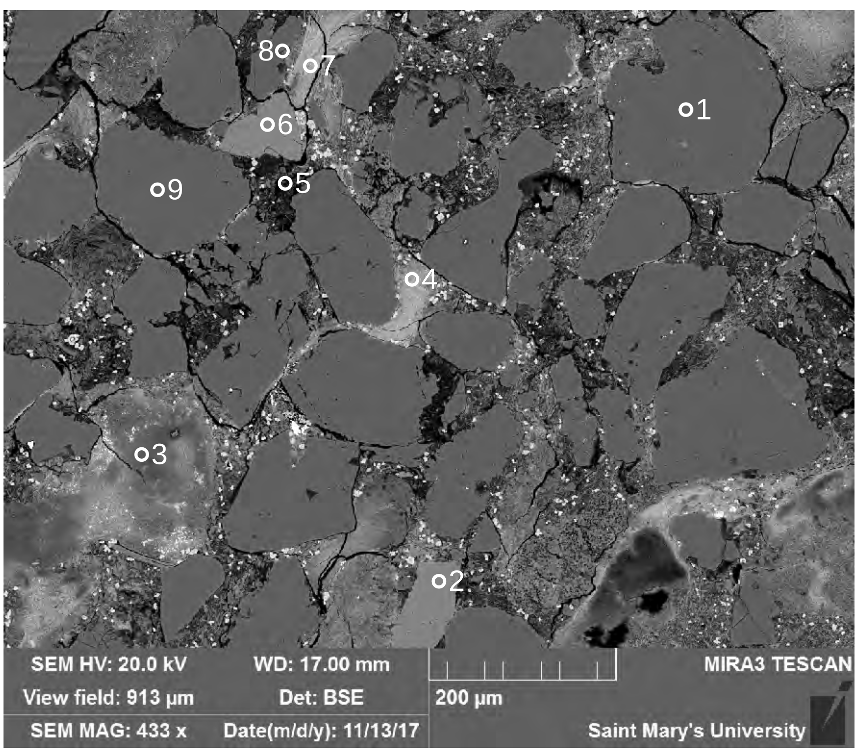
1:K-feldspar
2:Siderite
3:Fe-Chlorite +
?Glaucony
4:Quartz

Figure 1-4.11: Sample 3H-58 1613.63 (SEM) site 8.1. This site consists of a partially dissolved K-feldspar (1) grain and detrital quartz (4). Fe-chlorite + glaucony (3) partially make up the early diagenetic minerals. Late diagenetic siderite (2) cross-cuts the matrix.



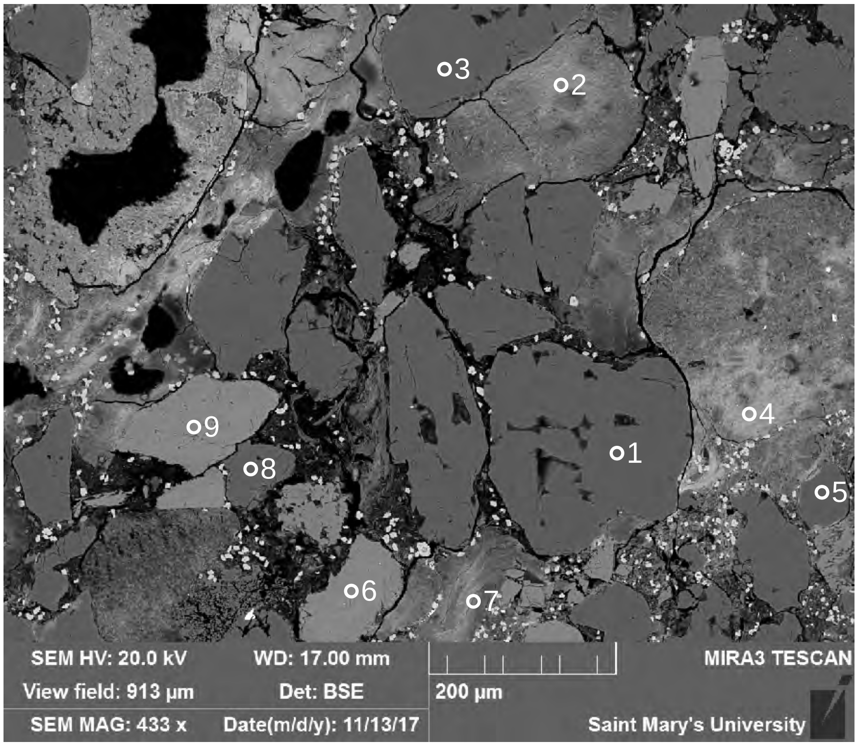
1:"Ilmenite"
2:Quartz
3:K-feldspar
4:Mixture
5:Illite + Chlorite
6:Quartz
7:Glaucony
8:Quartz
9:Clay + Fe-Chlorite
10:Quartz

Figure 1-4.12: Sample 3H-58 1613.63 (SEM) site 9. This site consists of detrital quartz (2,6,10), K-feldspar (3), and altered ilmenite (1) grains. The matrix is made up of illite + chlorite (5), and glaucony (7) makes up the early diagenetic minerals and appears to replace the matrix.



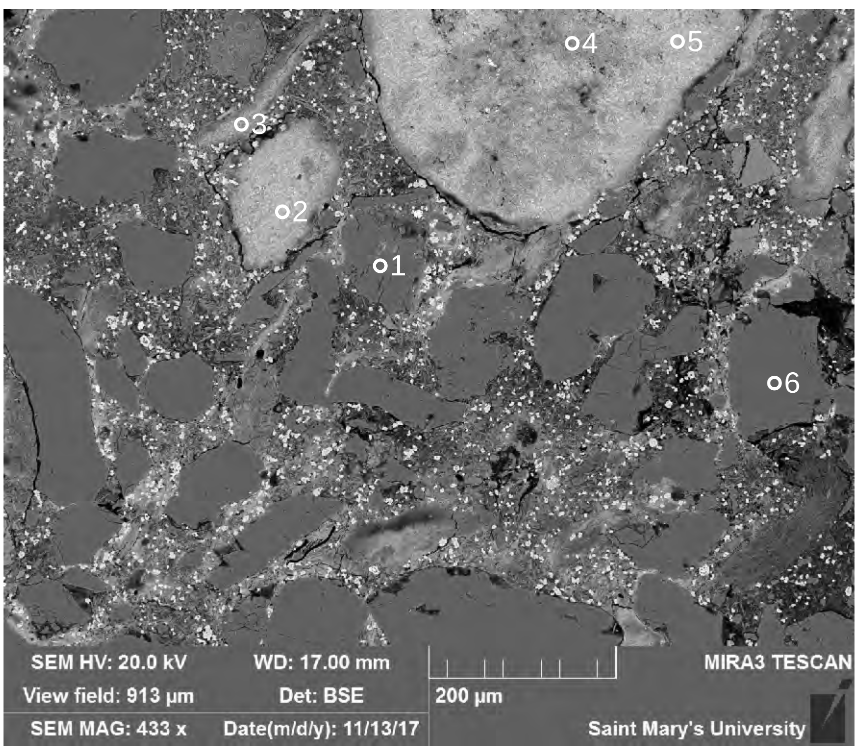
1:Quartz
2:K-feldspar
3:Glaucony
4:Glaucony
5:Illite + Chlorite
6:K-feldspar
7:Fe-Chlorite +
8:Quartz
9:Quartz

Figure 1-4.13: Sample 3H-58 1613.63 (SEM) site 10. This site consists of detrital quartz (1,8-9), Fe-chlorite (7), and K-feldspar (2,6) grains. The matrix is made up of illite + chlorite (5), and the early diagenetic minerals are made up of glaucony (3-4), which appear to replace matrix.



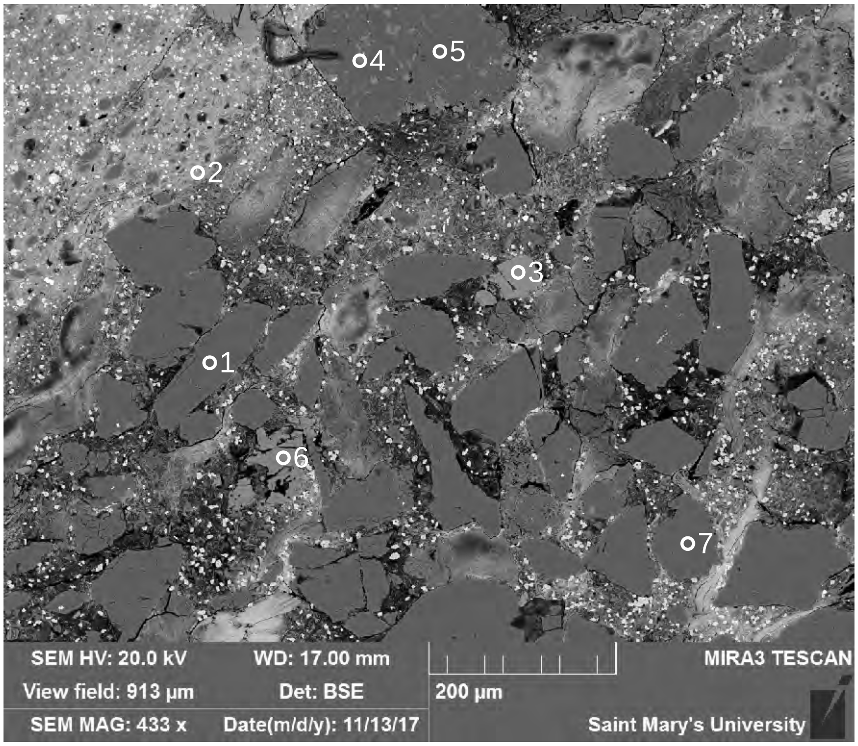
1:Quartz
2:Glaucony
3:Quartz
4:Glaucony
5:Quartz
6:K-feldspar
7:Glaucony
8:Quartz
9:K-feldspar

Figure 1-4.14: Sample 3H-58 1613.63 (SEM) site 11. This site consists of detrital quartz (1,3,5,8), and K-feldspar (6,9) grains. The early diagenetic minerals are made up of glaucony (2,4,7), which appear to replace a detrital mineral (2,7) and (4) may be replacing matrix.



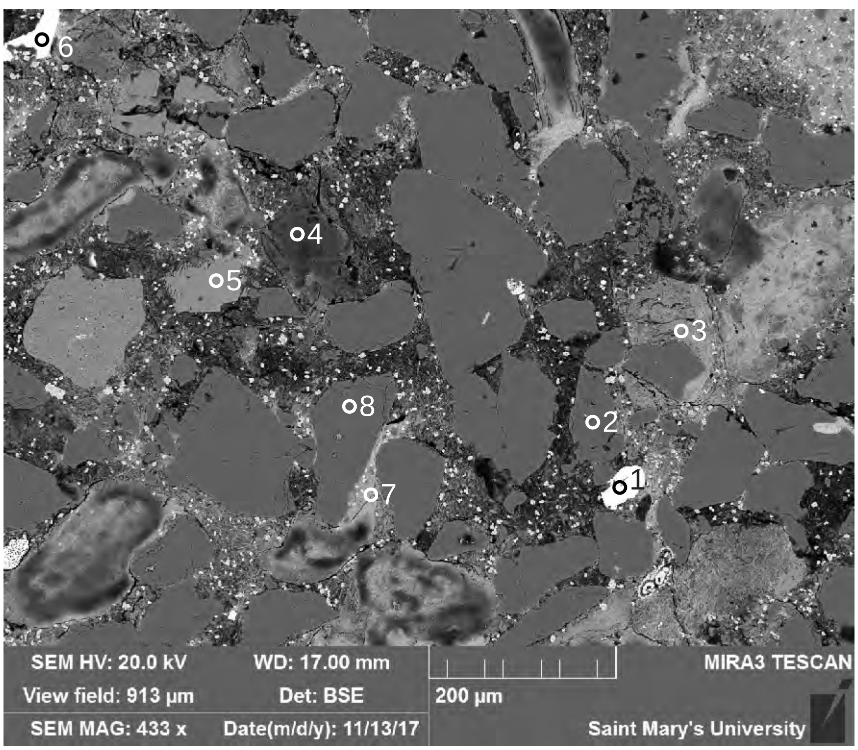
1:Albite
2:Clay + Fe-Chlorite
3:Glaucony
4:Glaucony
5:Glaucony
6:Quartz

Figure 1-4.15: Sample 3H-58 1613.63 (SEM) site 12. This site consists of detrital albite (1), and quartz (6) grains. Glaucony (3-5) is early diagenetic and appear to either replace the matrix (3) or be a pellet (4,5).



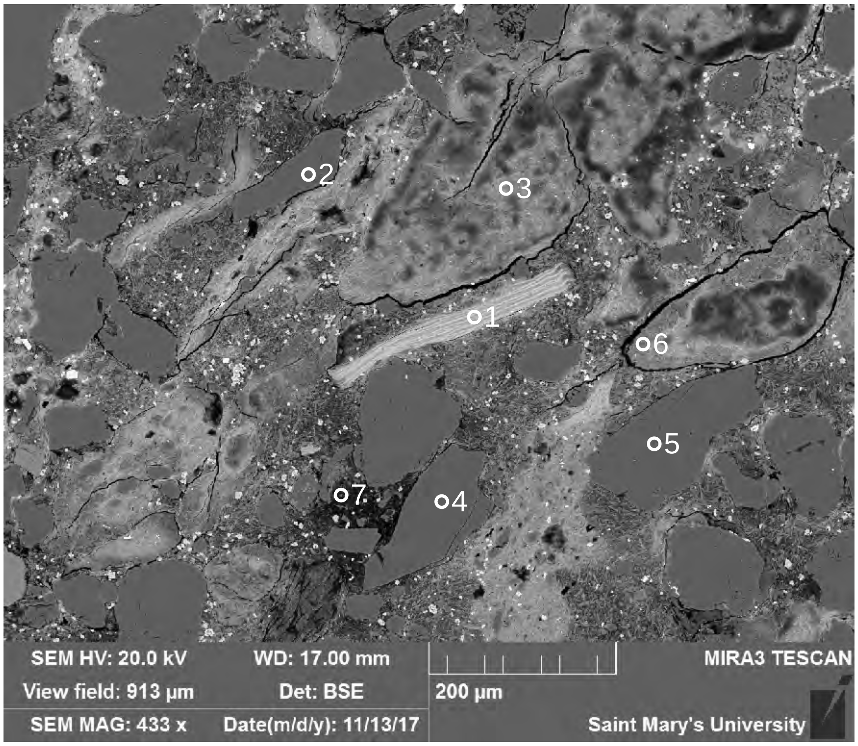
1:Quartz
2:Glaucony
3:K-feldspar
4:Muscovite +
5:Quartz
6:K-feldspar
7:Quartz

Figure 1-4.16: Sample 3H-58 1613.63 (SEM) site 13. This site consists of detrital quartz (1,7), K-feldspar (3,6), and a peraluminous granitic lithic clast made up of muscovite (4), and quartz (5). The early diagenetic mineral is glaucony (2), and it appears to replace the matrix.



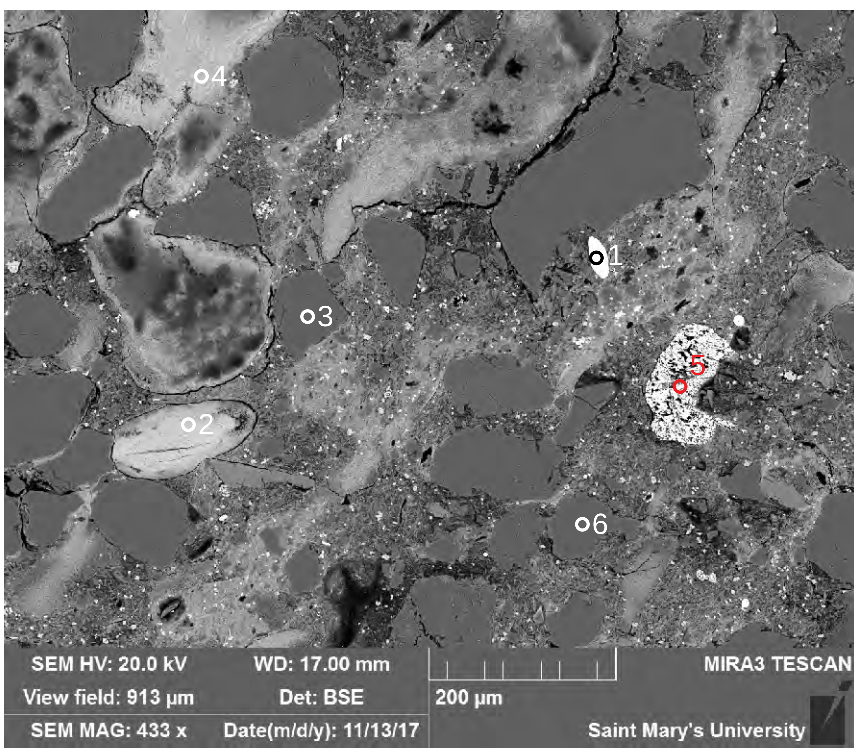
1:Zircon
2:Quartz
3:Mixture
4:Chlorite + Mixture
5:K-feldspar
6:Zircon
7:Glaucony
8:Quartz

Figure 1-4.17: Sample 3H-58 1613.63 (SEM) site 14. This site consists of detrital quartz (2,8), K-feldspar (5), and zircon (1,6) grains. The early diagenetic minerals are made up of glaucony (7).



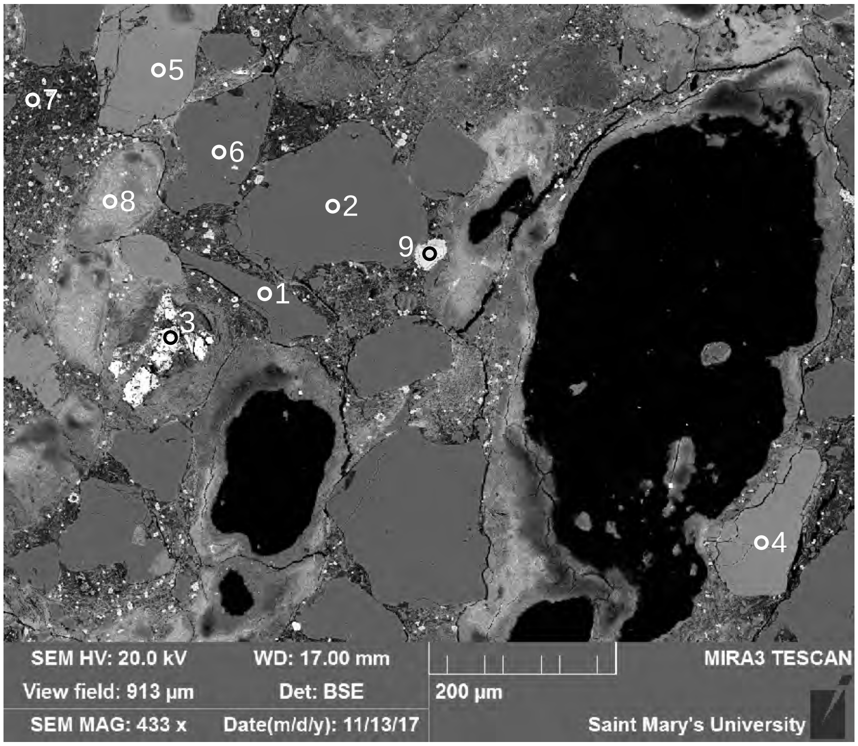
1:Fe-Chlorite
2:Quartz
3:Glaucony
4:Quartz
5:Quartz
6:Glaucony
7:Illite + Chlorite

Figure 1-4.18: Sample 3H-58 1613.63 (SEM) site 15. This site consists of detrital quartz (2,4-5), and Fe-chlorite (1) grains. The matrix appears to be made up of illite + chlorite (7), and glaucony (3,6) appear to replace probably pellets.



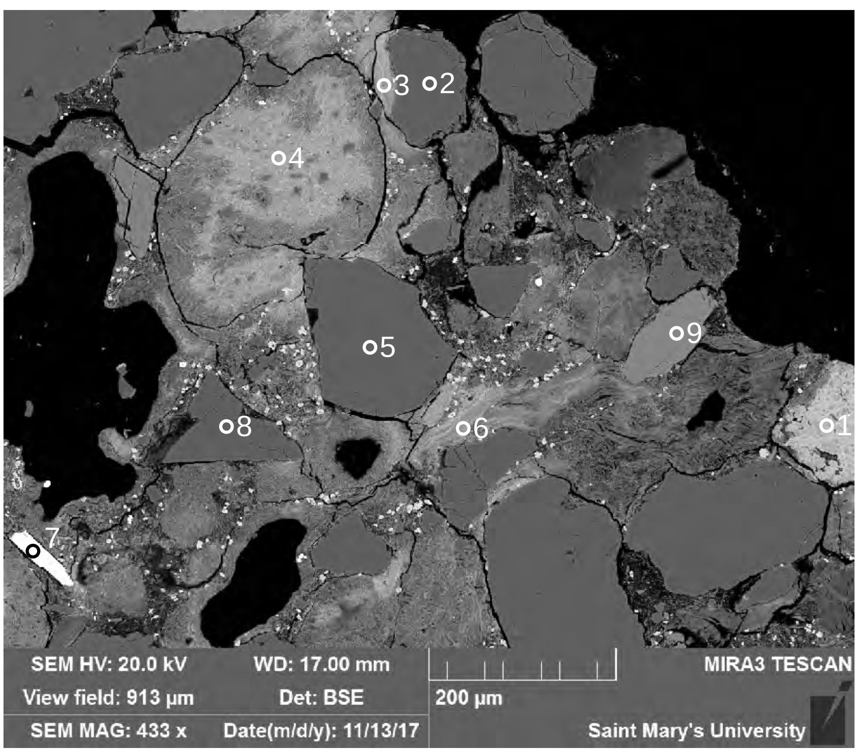
1:Ilmenite
2:Fe-Chlorite ?
3:Quartz
4:Fe-Chlorite +
5:"Ilmenite"
6:Quartz

Figure 1-4.19: Sample 3H-58 1613.63 (SEM) site 16. This site consists of detrital quartz (3,6), ilmenite (1), and altered ilmenite (5) grains. The early diagenetic minerals are made up of glaucony (4). There is also a pellet of ?Fe-chlorite (2).



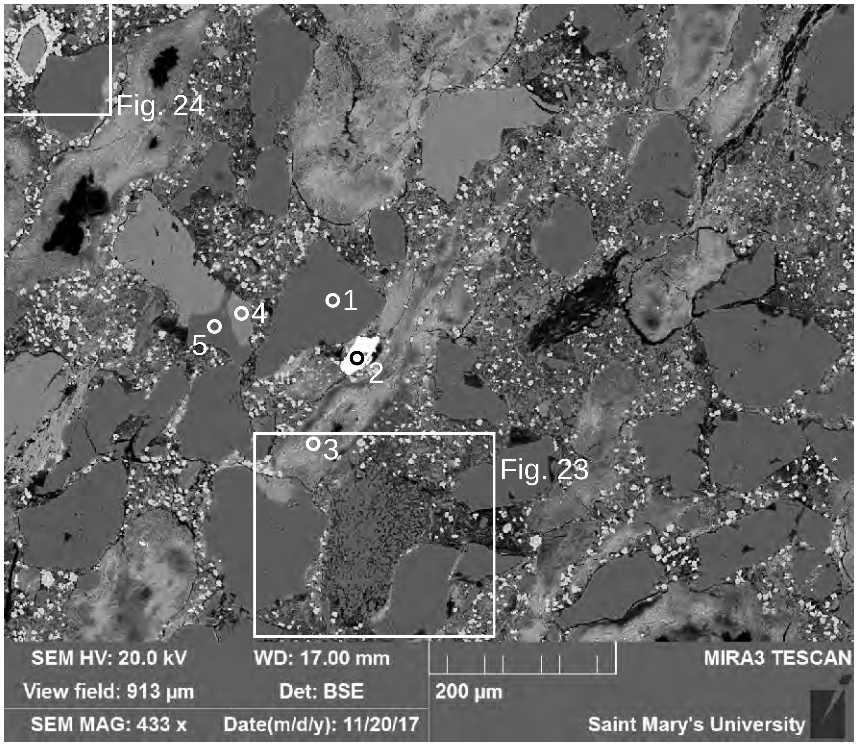
1:Quartz
2:Quartz
3:Ilmenite
4:K-feldspar
5:K-feldspar
6:Quartz
7:Illite + Chlorite
8:Glaucony
9:Siderite

Figure 1-4.20: Sample 3H-58 1613.63 (SEM) site 17. This site consists of detrital quartz (1-2,6), K-feldspar (4-5), and ilmenite (3) grains. The matrix is made up of illite + chlorite (7), and the early diagenetic mineral is glaucony (8), which may be replacing a pellet.



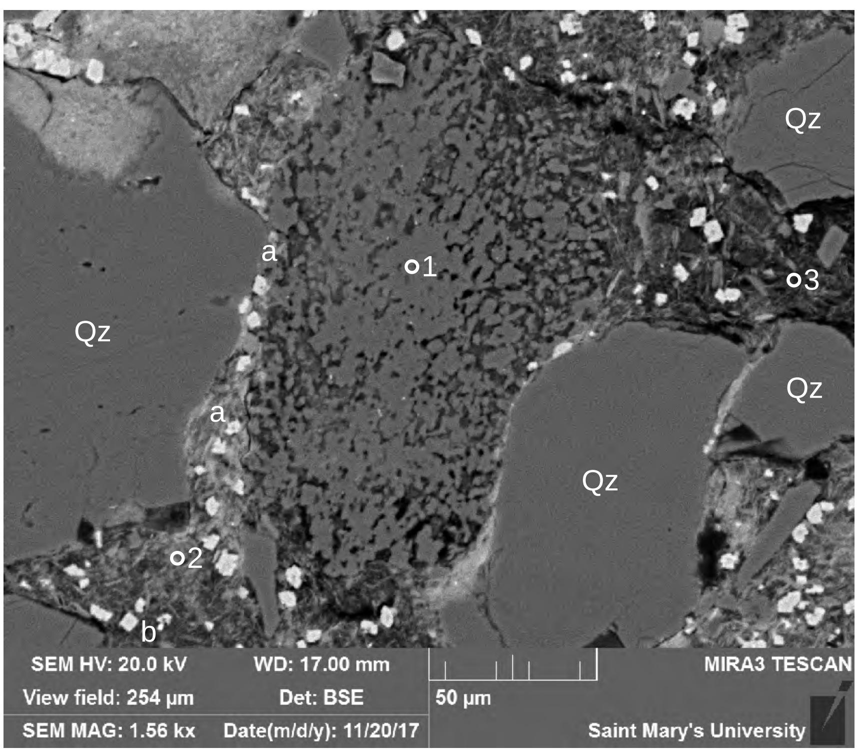
1:Fe-Chlorite +
2:Quartz
3:Chlorite?
4:Glaucony
5:Quartz
6:Glaucony
7:Ilmenite
8:Quartz
9:K-feldspar

Figure 1-4.21: Sample 3H-58 1613.63 (SEM) site 18. This site consists of detrital quartz (2,8), ?chlorite (3), K-feldspar (9), and ilmenite (7). Glaucony (4,6) replace a pellet and detrital grain respectively.



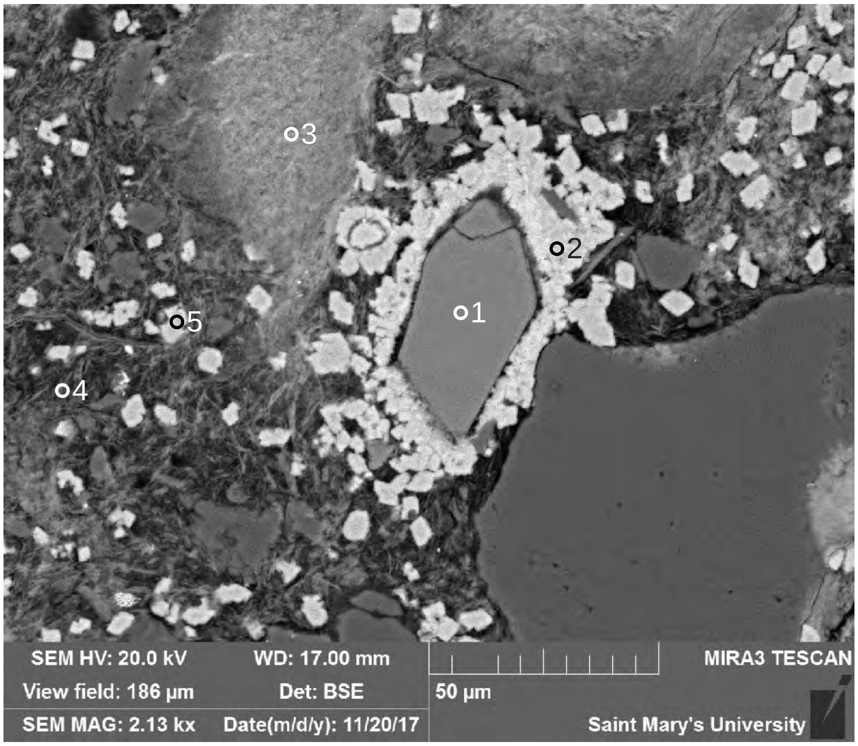
1:Quartz
2:Ilmenite
3:Glaucony
4:K-feldspar
5:Quartz

Figure 1-4.22: Sample 3H-58 1613.63 (SEM) site 19. This site consists of detrital quartz (1,5), K-feldspar (4), and ilmenite (2) grains. Glaucony (3) appears to replace the matrix. The matrix in particular is riddled with diagenetic siderite.



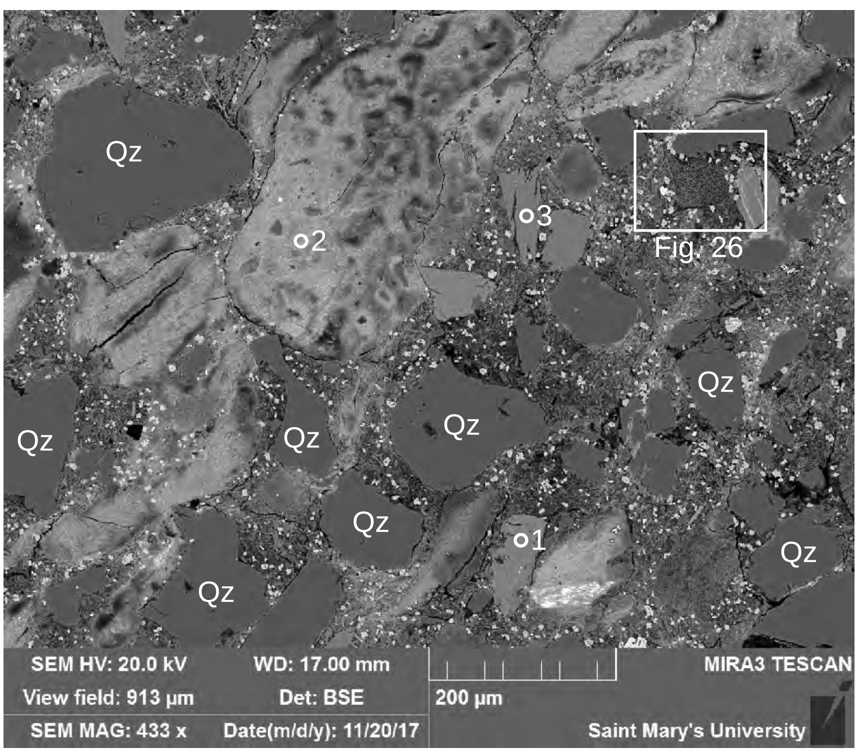
1:Quartz
2:Illite + Chlorite
3:Illite + Chlorite

Figure 1-4.23: Sample 3H-58 1613.63 (SEM) site 19.1. This site consists of detrital quartz and a partially dissolved rhyolitic or polycrystalline quartz (quartzite) lithic clast made up of quartz (1) rimmed by siderite (positions a). The matrix around the grains consists of illite + chlorite (2-3), that is cross-cut by siderite (position b).



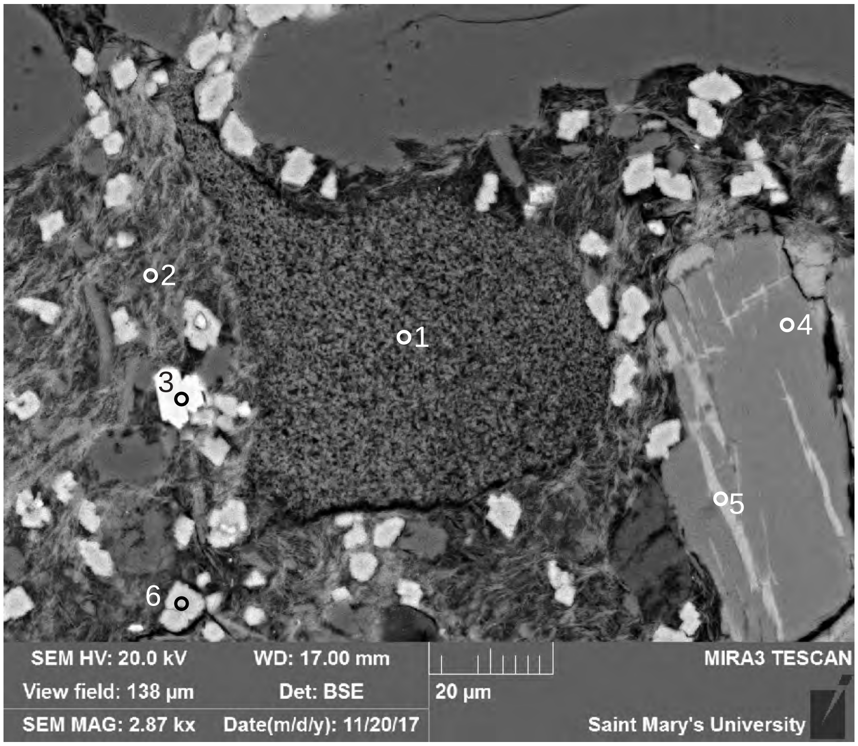
1:Calcite
2:Siderite
3:Glaucony
4:Glaucony
5:Siderite

Figure 1-4.24: Sample 3H-58 1613.63 (SEM) site 19.2. This site consists of a calcite (1) grain that is coated by late diagenetic siderite (2). The early diagenetic minerals are made up of glaucony (3-4), with late cross-cutting diagenetic siderite (5).



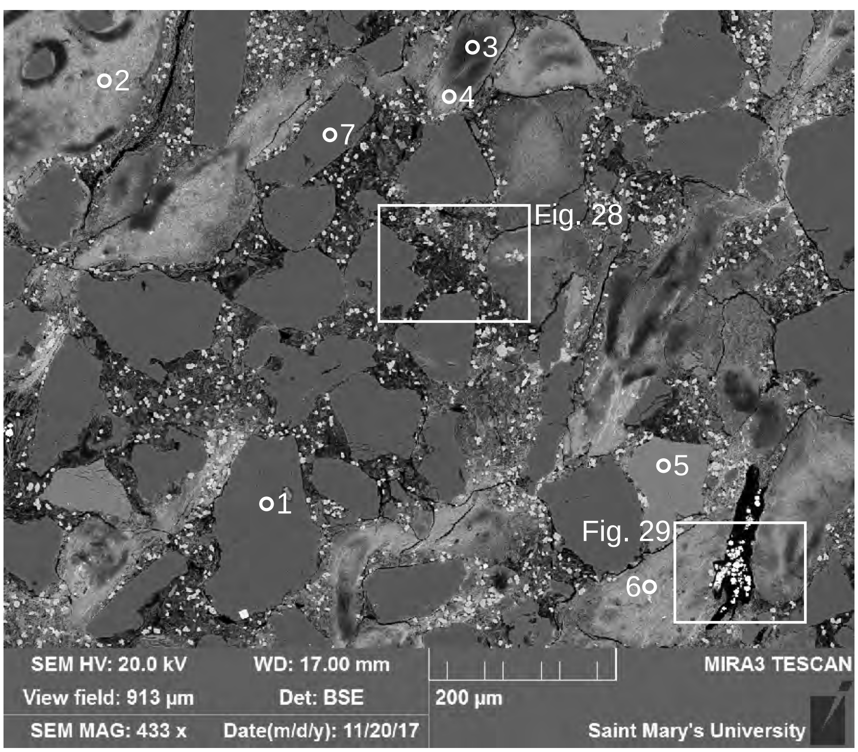
1:K-feldspar
2:Clay + Fe-Chlorite
3:K-feldspar

Figure 1-4.25: Sample 3H-58 1613.63 (SEM) site 20. This site consists of detrital quartz, and K-feldspar (1,3) grains. The matrix is riddled with diagenetic siderite (bright spots).



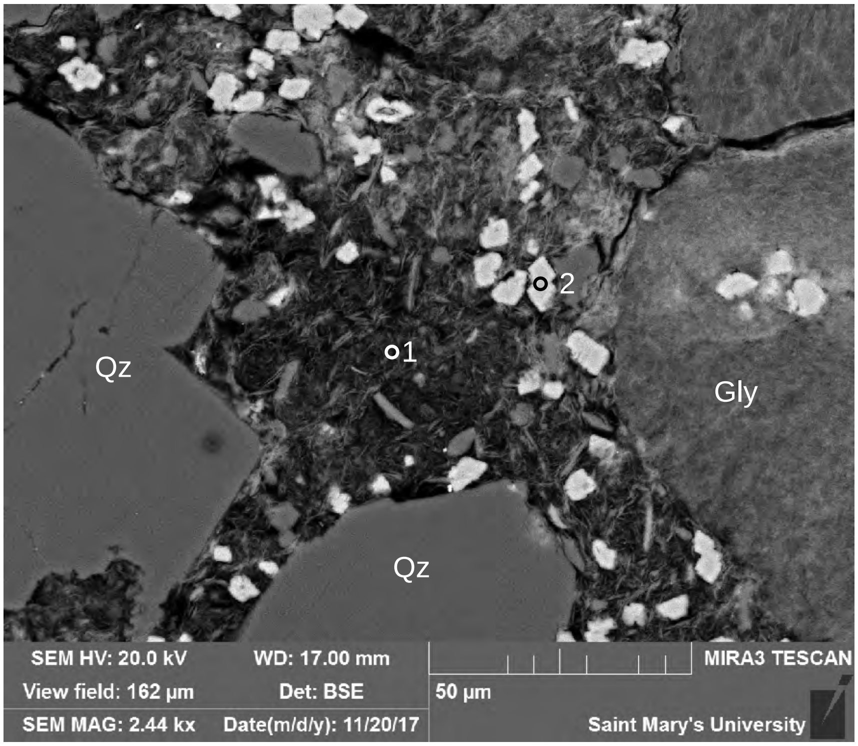
1:Calcite
2:Illite + Chlorite
3:TiO_2
4:K-feldspar
5:Fe-Chlorite?
6:Siderite

Figure 1-4.26: Sample 3H-58 1613.63 (SEM) site 20.1. This site consists of a calcitic intraclast?, and a perthitic (granitic) K-feldspar (4) crystal that has had its albite altered to Fe-chlorite. The matrix is made up of illite + chlorite (2), with late diagenetic titania (3) and siderite (6) partially filling voids.



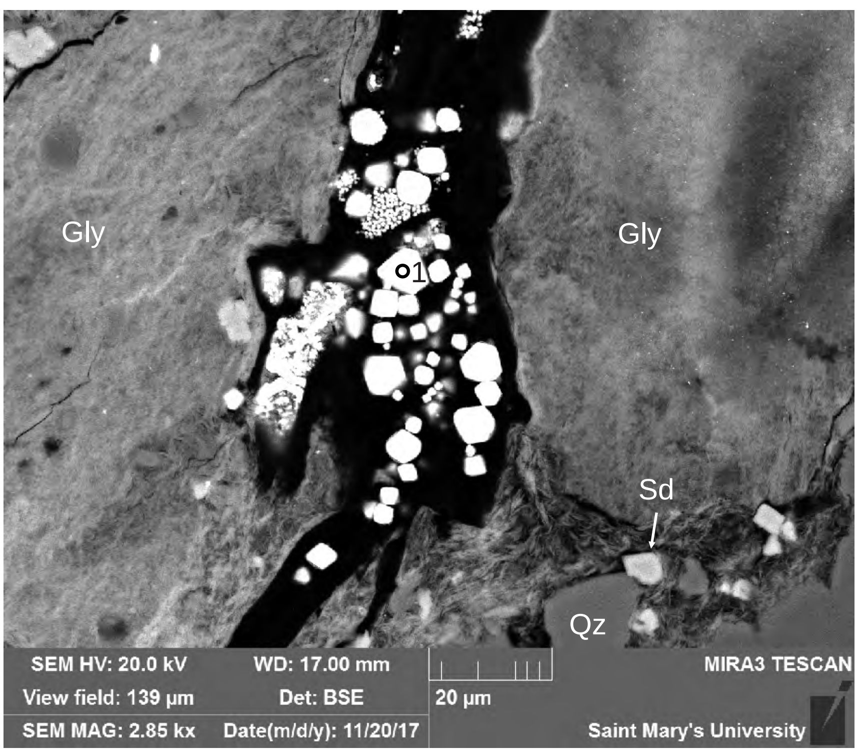
1:Quartz
2:Glaucony
3:Glaucony
4:Glaucony
5:K-feldspar
6:Glaucony
7:Quartz

Figure 1-4.27: Sample 3H-58 1613.63 (SEM) site 21. This site consists of detrital quartz (1,7), K-feldspar (5), and muscovite + chlorite (3-4) grains, and glaucony (2,6).



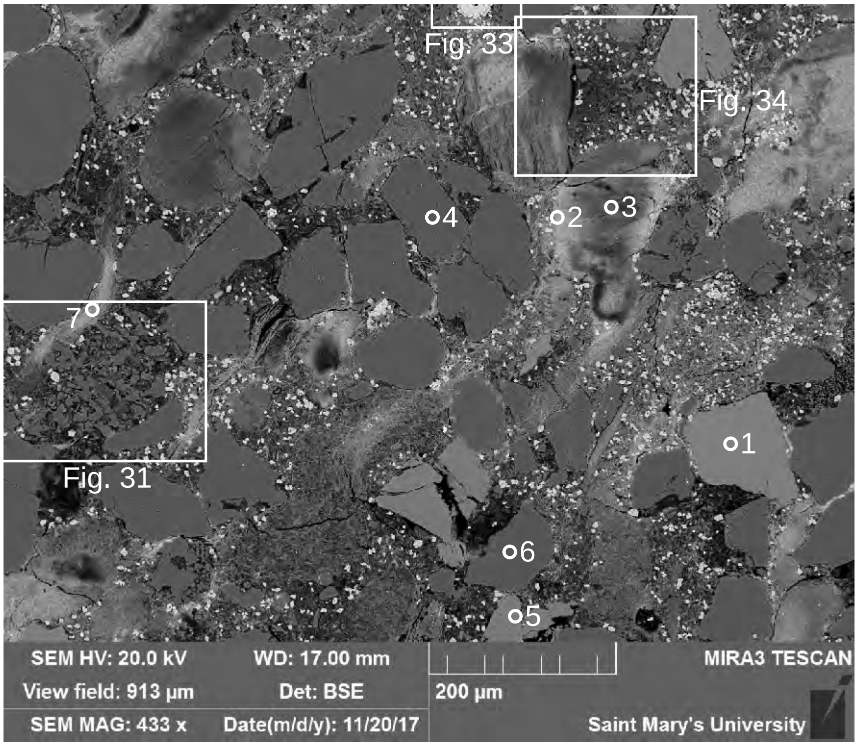
1:Illite + Chlorite
2:Siderite

Figure 1-4.28: Sample 3H-58 1613.63 (SEM) site 21.1. This site consists of detrital quartz grains, glaucony grains, and a matrix made up of illite + chlorite (1). Late diagenetic siderite partially fills voids.



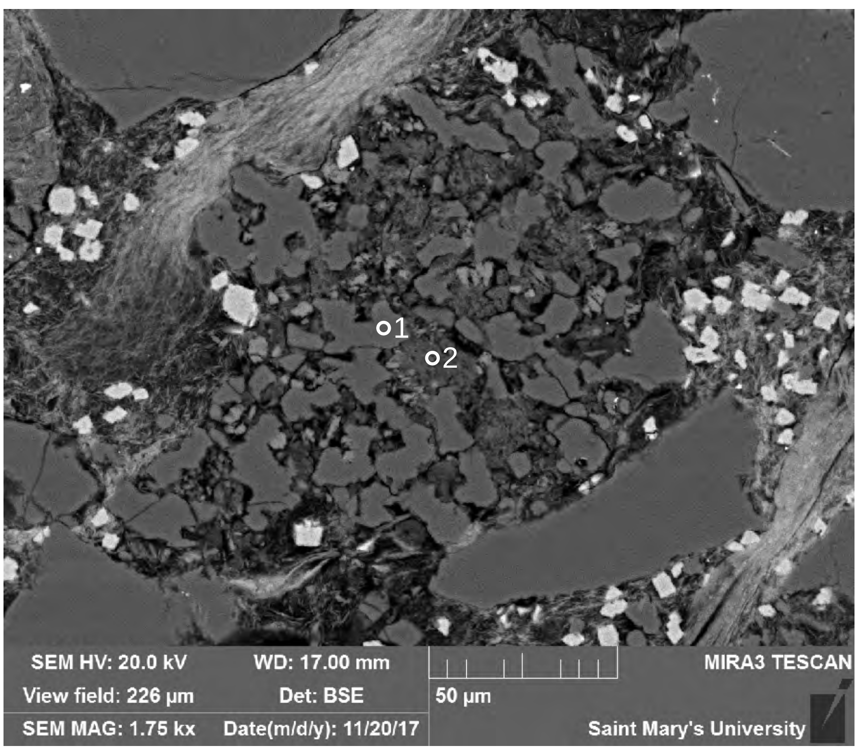
1:Pyrite

Figure 1-4.29: Sample 3H-58 1613.63 (SEM) site 21.2. This site consists of diagenetic pyrite (1), that partially fills a void between glaucony grains.



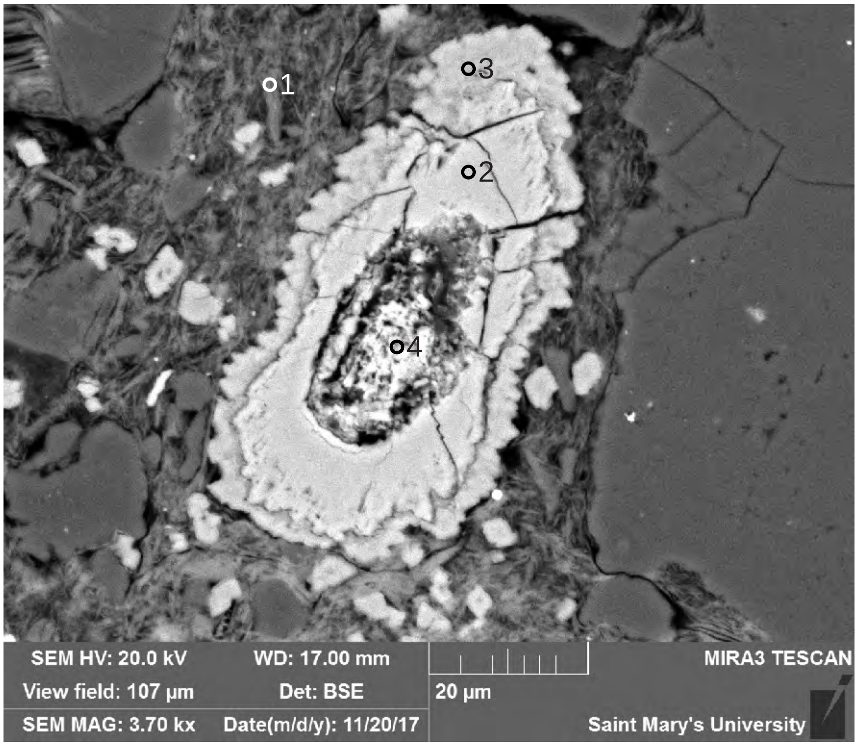
1:K-feldspar
2:Glaucony
3:Glaucony
4:Quartz
5:K-feldspar
6:Quartz
7:Glaucony

Figure 1-4.30: Sample 3H-58 1613.63 (SEM) site 22. This site consists of detrital quartz (4,6), and K-feldspar (1,5) grains (2-3,7), and glaucony (2-3,7).



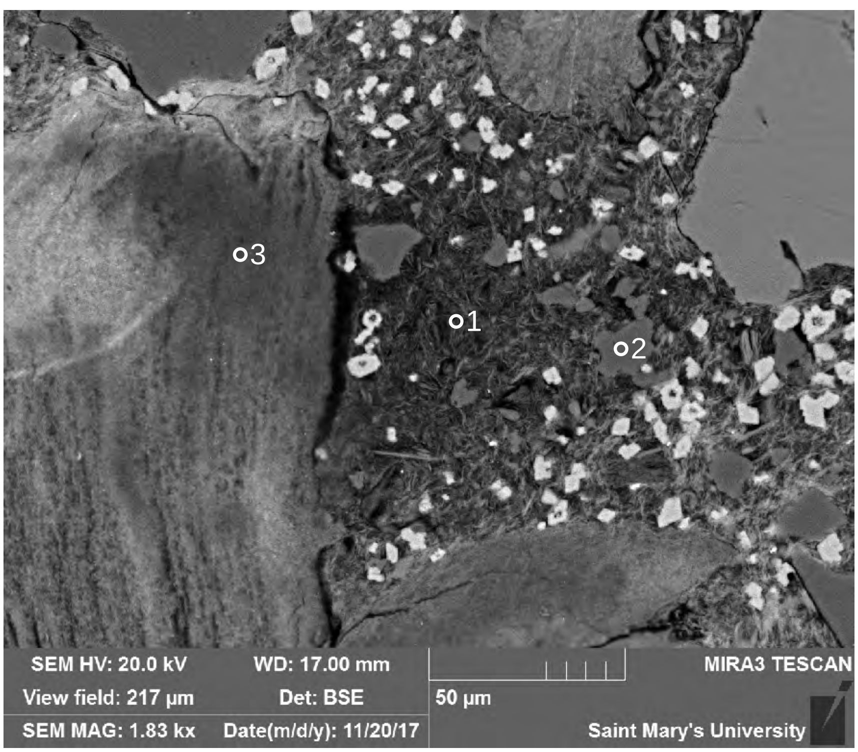
1:Quartz
2:Illite + Chlorite

Figure 1-4.31: Sample 3H-58 1613.63 (SEM) site 22.1. This site consists of a lithic clast that is made up of partially dissolved quartz (1) and probably altered K-feldspar (2) grains.



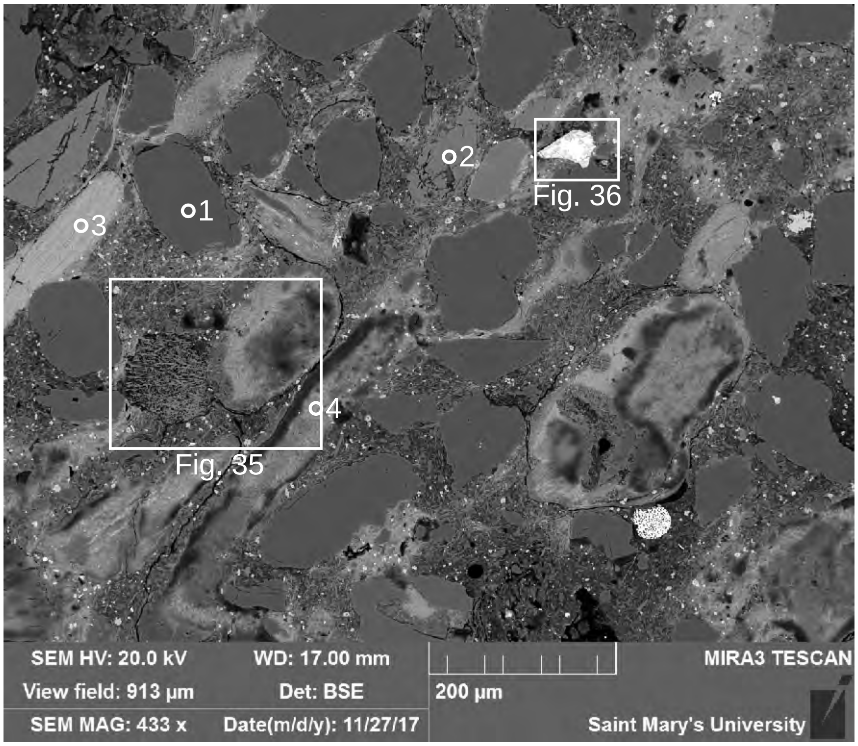
1:Illite + Chlorite
2:Siderite
3:Siderite +
4:Siderite

Figure 1-4.32: Sample 3H-58 1613.63 (SEM) site 22.2. This site consists of a coated grain with multiple layers of siderite, some of which is partially dissolved. The matrix is made up of illite + chlorite (1).



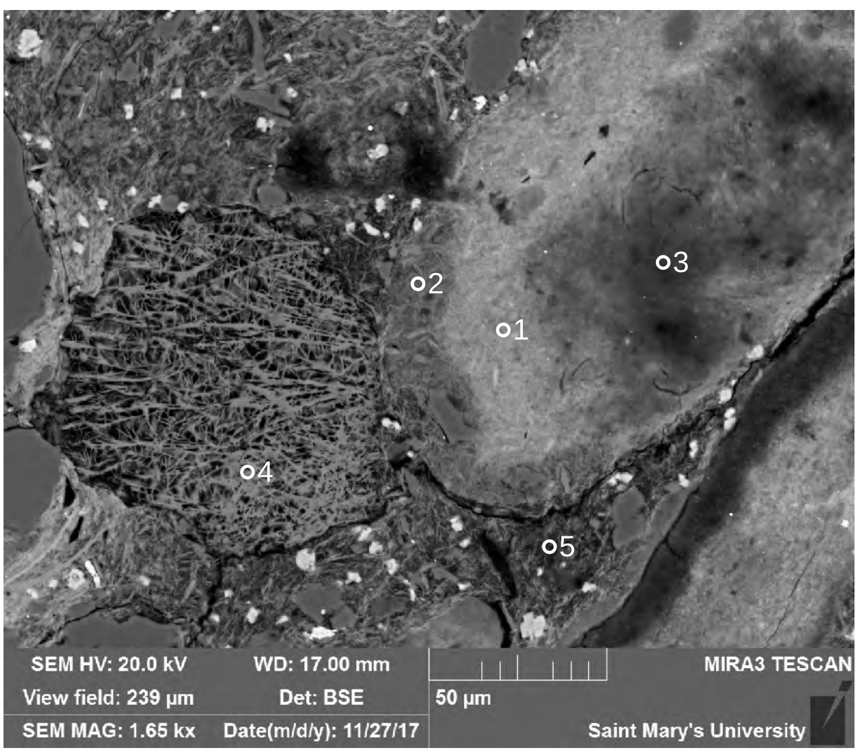
1:Illite + Chlorite
2:Quartz
3:Glaucony

Figure 1-4.33: Sample 3H-58 1613.63 (SEM) site 22.3. This site consists of mainly matrix that is made up of illite + chlorite (1), and silt sized quartz (2) fragments. A large glaucony (3) grain probably replaces a detrital mineral.



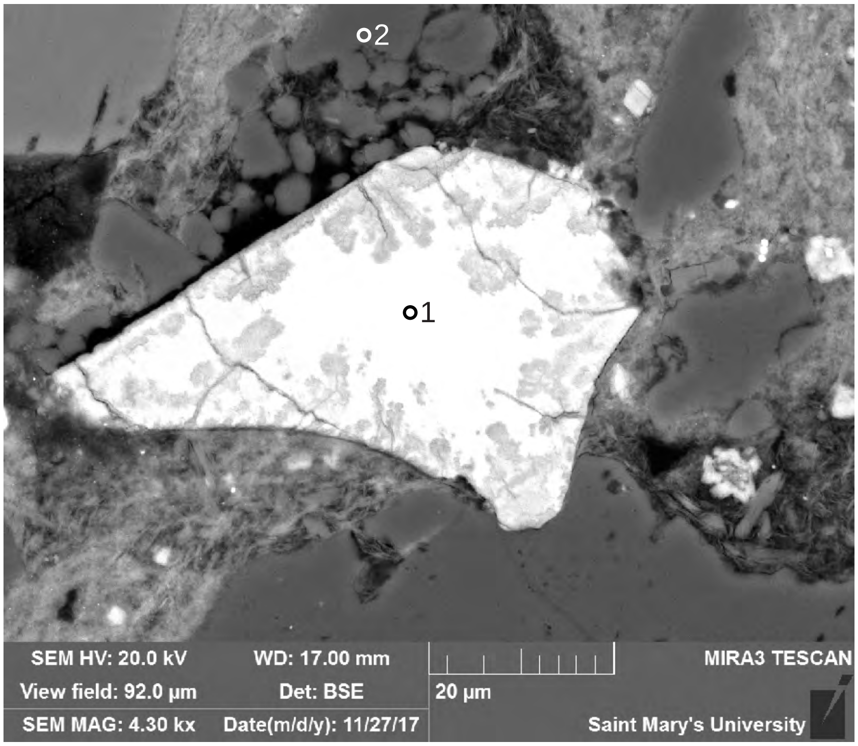
1:Quartz
2:K-feldspar
3:Illite + Chlorite
4:Glaucony

Figure 1-4.34: Sample 3H-58 1613.63 (SEM) site 23. This site consists of detrital quartz (1), and K-feldspar (2) grains. The matrix is made up of illite + chlorite (3), with early diagenetic glaucony (4) grains.



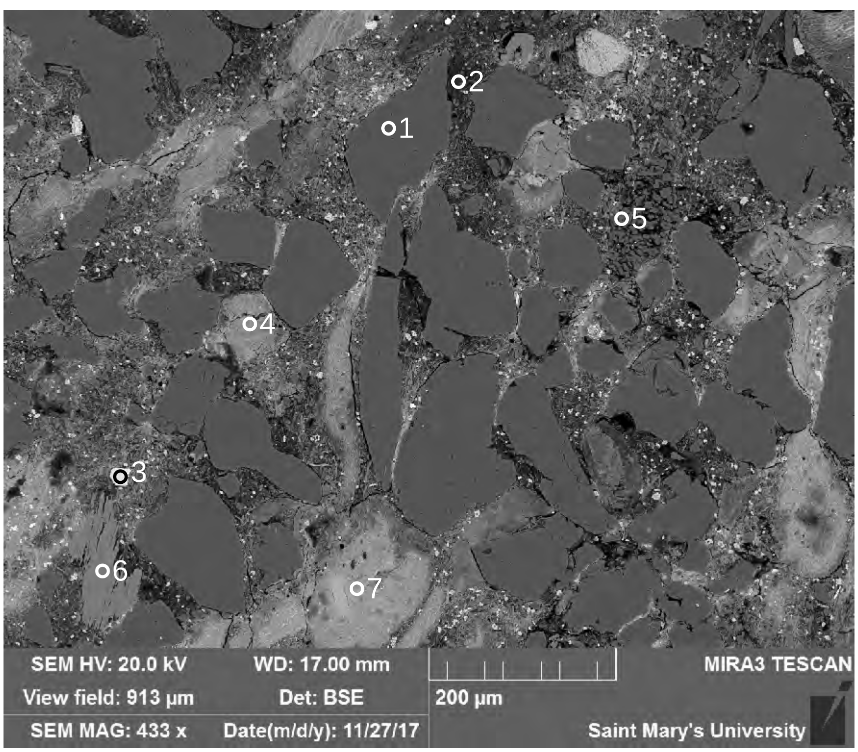
1:Glaucony
2:Glaucony
3:Glaucony
4:Calcite
5:Illite + Chlorite

Figure 1-4.35: Sample 3H-58 1613.63 (SEM) site 23.1. This site consists of an ?altered calcite (4) grain. A ?coated grain of glaucony (1-3). Glaucony and illite + chlorite (5) make up the matrix. Late diagenetic siderite cross-cuts the matrix.



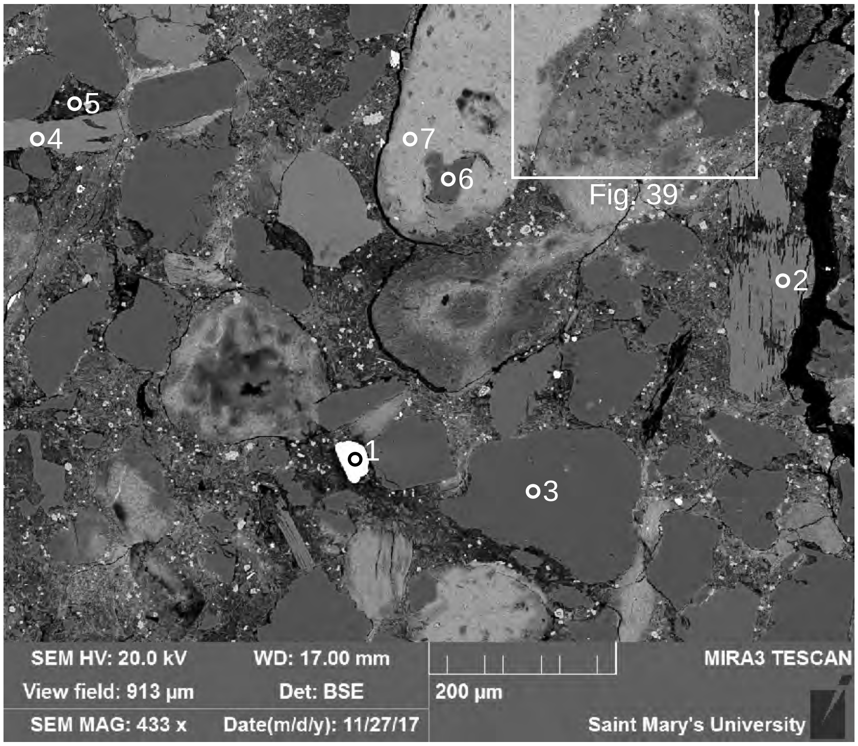
1:"Ilmenite"
2:Quartz

Figure 1-4.36: Sample 3H-58 1613.63 (SEM) site 23.2. The site consists of detrital quartz (2) grains and an altered ilmenite (1) grain.



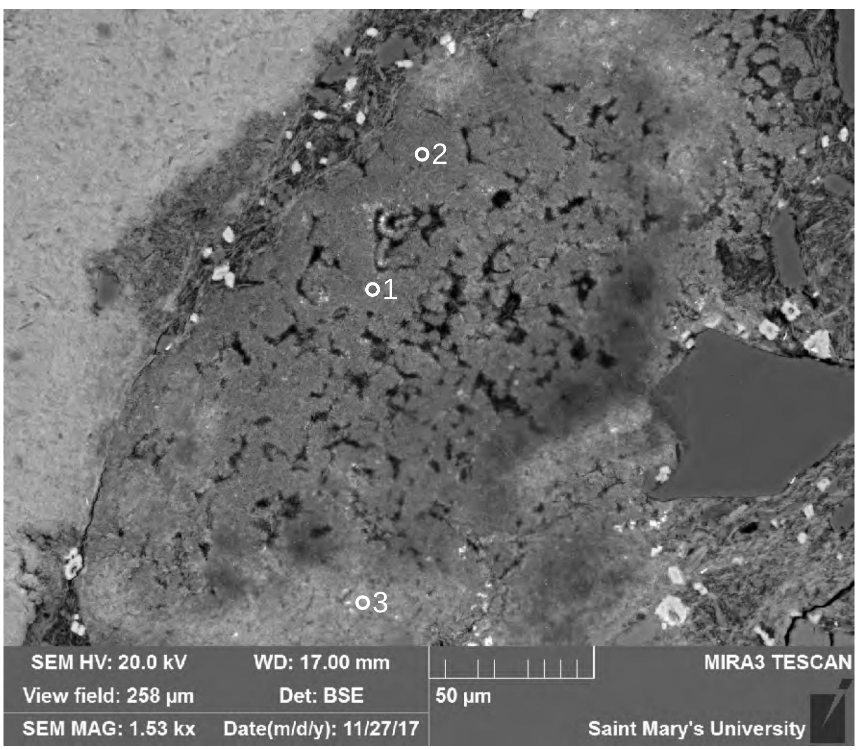
1:Quartz
2:Glaucony
3:TiO_2
4:Glaucony
5:Quartz
6:K-feldspar
7:Glaucony

Figure 1-4.37: Sample 3H-58 1613.63 (SEM) site 24. This site is similar to site 21. Titania (3) appear to be diagenetic.



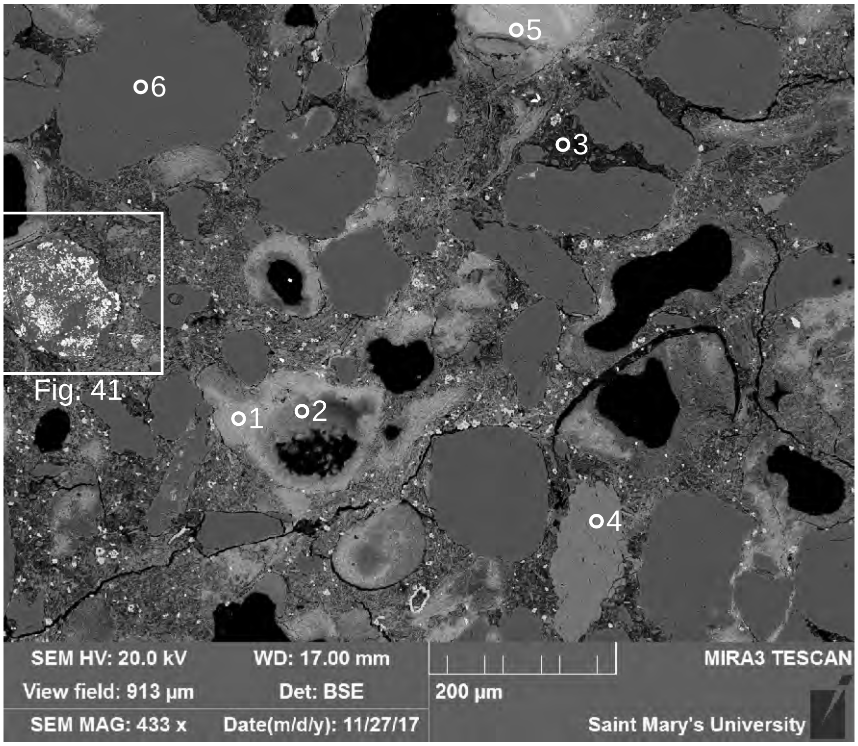
1:Monazite
2:K-feldspar
3:Quartz
4:K-feldspar
5:Illite? + Chlorite
6:Quartz
7:Clay + Fe-Chlorite

Figure 1-4.38: Sample 3H-58 1613.63 (SEM) site 25. This site consists of detrital quartz (3,6), K-feldspar (2,4), and monazite (1) grains. The matrix is made up of illite + chlorite (5). Late diagenetic siderite cross-cuts the matrix.



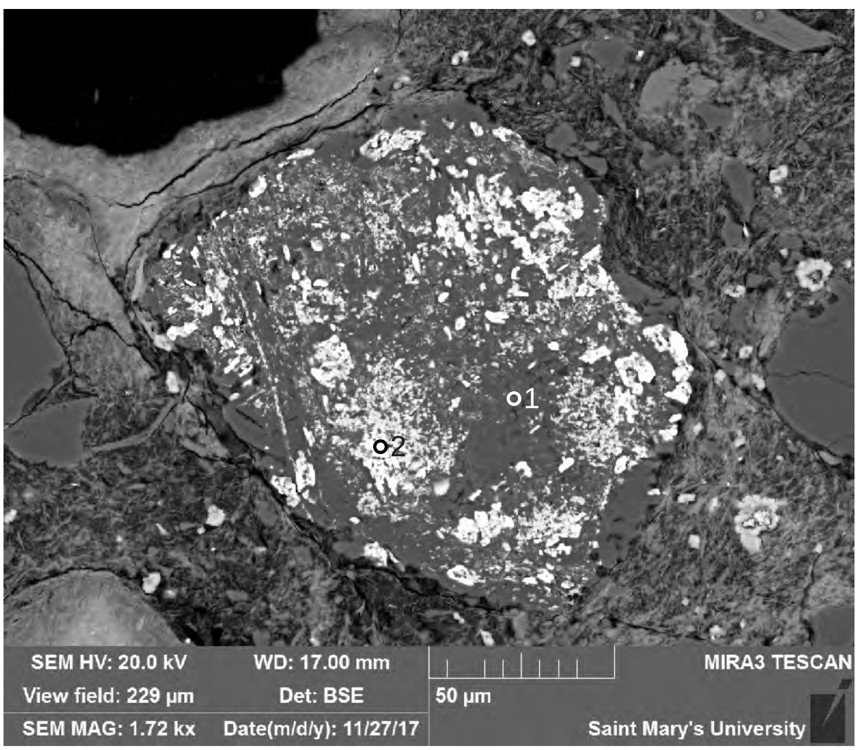
1:Glaucony
2:Glaucony
3:Glaucony

Figure 1-4.39: Sample 3H-58 1613.63 (SEM) site 25.1. This site consists of a glaucony (1-3) ?pellet that is surround by illite + chlorite matrix. The glaucony may be replacing the matrix. Late diagenetic siderite cross-cuts the matrix.



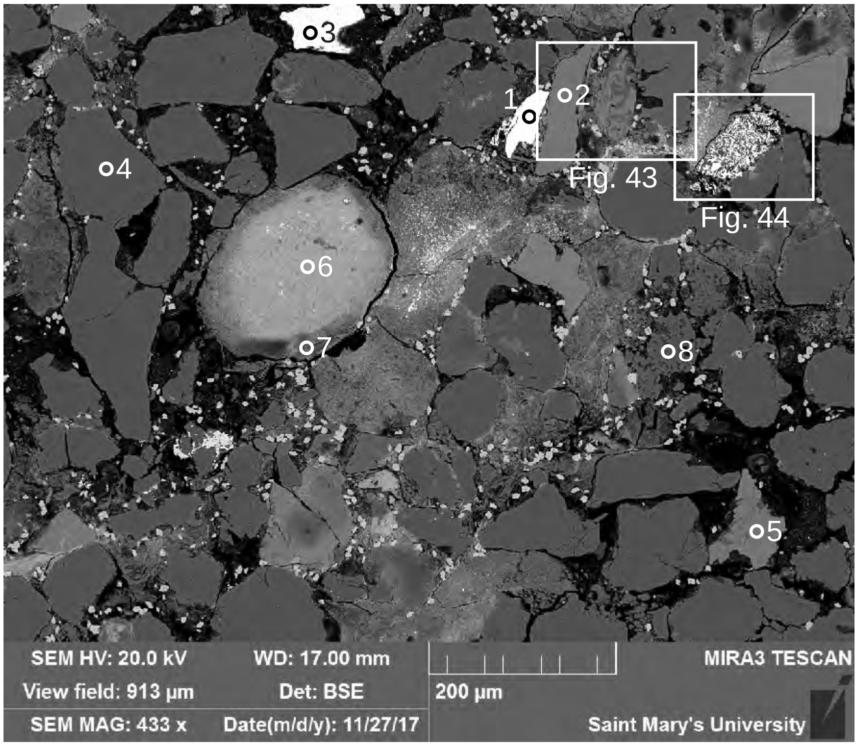
1:Glaucony
2:Glaucony
3:Illite + Chlorite
4:K-feldspar
5:Clay + Fe-Chlorite
6:Quartz

Figure 1-4.40: Sample 3H-58 1613.63 (SEM) site 26. This site consists of detrital quartz (6), and K-feldspar (4) grains. The matrix consists of illite + chlorite (3), with early diagenetic glaucony (1-2) grains. There also appears to be late cross-cutting diagenetic siderite.



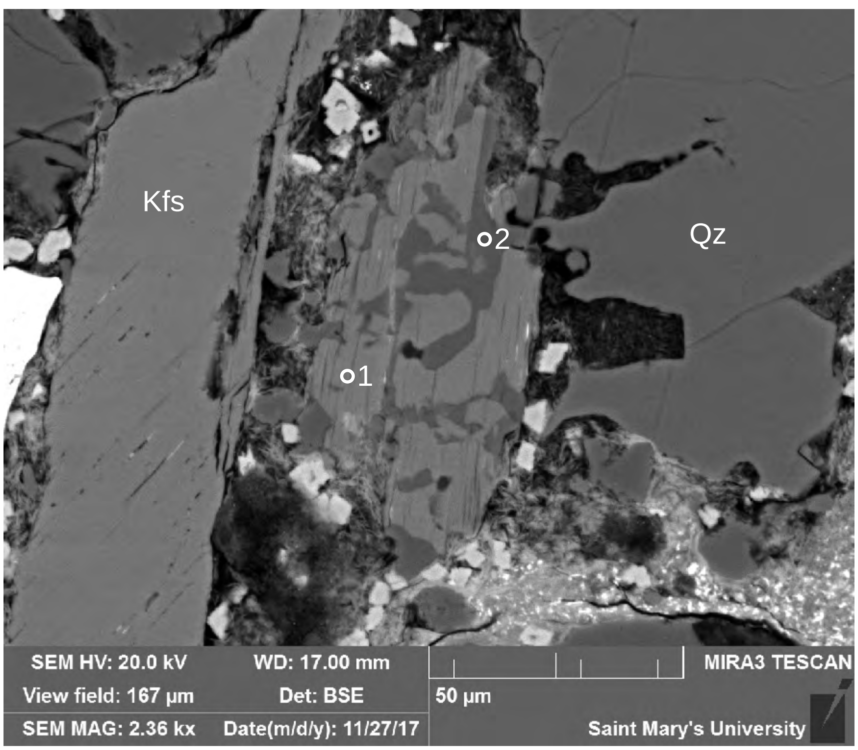
1:Quartz
2:"Ilmenite”

Figure 1-4.41: Sample 3H-58 1613.63 (SEM) site 26.1. This site consists of a large altered ilmenite grain (1-2), that is surrounded by probably an illite + chlorite matrix.



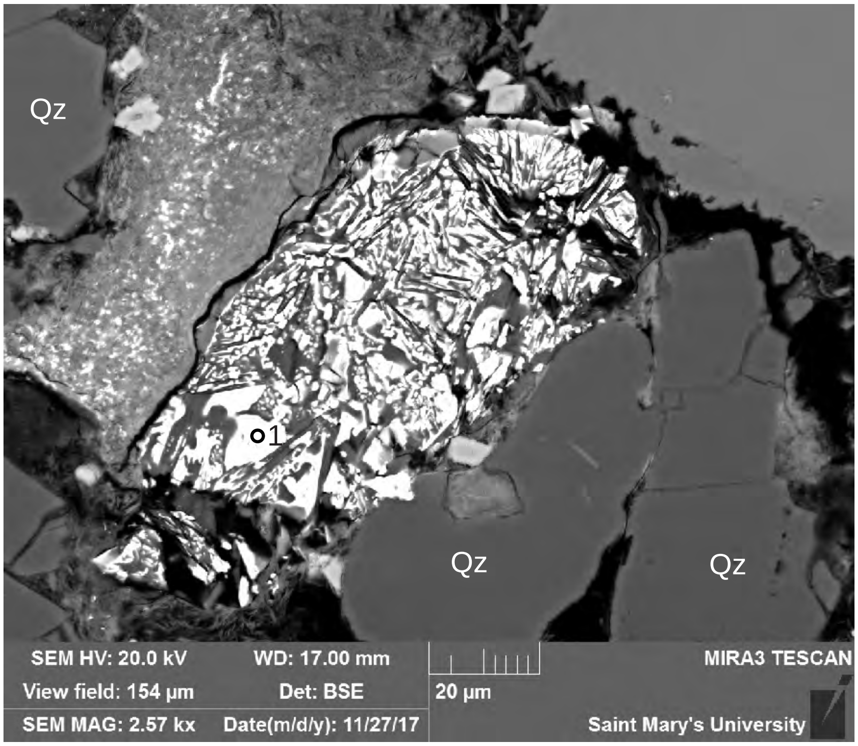
1:Ilmenite
2:K-feldspar
3:"Ilmenite"
4:Quartz
5:K-feldspar
6:Glaucony
7:Glaucony
8:Quartz

Figure 1-4.42: Sample 3H-58 1613.63 (SEM) site 27. This site consists of detrital quartz (4,8), K-feldspar (2,5), ilmenite (1), and altered ilmenite (3) grains. The matrix appears to be made up of illite + chlorite, and late cross-cutting diagenetic siderite. Glaucony (6-7) appears to replace a pellet or a coated grain.



1:Muscovite +
2:Quartz

Figure 1-4.43: Sample 3H-58 1613.63 (SEM) site 27.1. This site consists of detrital quartz, and K-feldspar, as well as a peraluminous granitic clast made up of quartz (2) and muscovite (1).



1:"Chromite"

Figure 1-4.44: Sample 3H-58 1613.63 (SEM) site 27.2. This site consists of detrital quartz and altered chromite (1) grains.

Table 1-4.1: EDS geochemical analyses of sample 3H-58 1613.63.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	ZnO	As2O3	ZrO2	Ag2O	BaO	La2O3	Ce2O3	Nd2O3	HfO2	Total	Actual Total
3H-58 1613.63	1	1	Qz	100.00																								100	120
3H-58 1613.63	1	2	Gly	42.98		10.24	23.40		3.05	0.67	1.04	4.58	0.85			0.19												87	96
3H-58 1613.63	1	3	Qz	100.00																								100	118
3H-58 1613.63	1	4	Fe-Chl	32.06		12.81	34.40		3.29	0.48	1.63					0.32												85	97
3H-58 1613.63	1	5	"Ilm"	0.59	63.06		32.27	4.08																				100	101
3H-58 1613.63	1	6	Qz	100.00																								100	119
3H-58 1613.63	1	7	Sd +	11.67		3.13	71.69	1.12	1.82	5.29	2.16		2.50			0.62												100	79
3H-58 1613.63	1	8	Chl + Ill	38.81	0.47	17.90	34.16		3.60	1.48	1.22	1.24				1.11												100	57
3H-58 1613.63	1	9	Kfs	66.54		17.77					1.16	14.53																100	113
3H-58 1613.63	1	10	Kfs	65.72		17.86	0.24				1.16	14.21											0.82					100	115
3H-58 1613.63	2	1	Qz	99.77			0.23																					100	121
3H-58 1613.63	2	2	TiO2	1.10	91.00	1.74	3.12			0.99	0.81		0.93			0.31												100	95
3H-58 1613.63	2	3	Kfs	65.22		17.67	1.31				0.29	15.50																100	120
3H-58 1613.63	2	4	Gly +	42.86		16.29	28.20		4.64	2.83	2.16	1.99		0.65		0.39												100	96
3H-58 1613.63	2	5	Gly	38.04		16.51	23.97		2.54	1.55	2.41	1.09		0.64		0.25												87	96
3H-58 1613.63	2	6	Sd	2.05		0.67	38.80	2.82	5.78	5.68						0.20												56	63
3H-58 1613.63	2	7	Ill + Chl	42.87		18.92	30.94		3.14	0.58	1.78	0.93				0.85												100	62
3H-58 1613.63	2	8	Kfs	64.02		17.18	3.62				0.31	14.35		0.51														100	122
3H-58 1613.63	2	9	Gly	46.08		9.54	20.16		3.40	0.43	1.57	5.34				0.49												87	94
3H-58 1613.63	2	10	Qz	100.00																								100	121
3H-58 1613.63	2	11	Gly	37.95		11.94	28.33		3.71	0.50	1.58	2.72				0.26												87	98
3H-58 1613.63	3	1	Clay + Fe-Ch	37.27		10.93	42.51	0.51	4.56	1.05	2.01	0.73				0.41												100	94
3H-58 1613.63	3	2	Gly	43.03		10.88	22.79		2.91	0.81	1.79	4.54				0.25												87	98
3H-58 1613.63	3	3	Kfs	66.17		17.86					0.72	15.25																100	117
3H-58 1613.63	3	4	Qz	100.00																								100	121
3H-58 1613.63	3	5	Qz +	91.61		4.64	0.31					3.44																100	116
3H-58 1613.63	3	6	Qz	100.00																								100	121
3H-58 1613.63	3	7	Gly	38.27	0.31	14.85	26.66		3.02	0.78	1.90	0.91				0.30												87	92
3H-58 1613.63	3	8	Qz	99.48			0.52																					100	120
3H-58 1613.63	3	9	Gly	43.49		9.42	23.68		3.09	0.86	1.18	5.27																87	96
3H-58 1613.63	3	10	Ill + Chl	45.60	0.45	21.49	24.58		3.15	1.02	1.95	1.04				0.71												100	62
3H-58 1613.63	3	11	Kfs	65.74		17.98					1.01	14.44											0.83					100	119
3H-58 1613.63	3	12	Qz	100.00																								100	120
3H-58 1613.63	3	13	Sd +	6.53			82.83	2.33	1.33	3.15	1.01		1.02			1.80												100	63
3H-58 1613.63	3.1	1	Gly	41.60		10.56	23.89		3.37	1.50	1.79	3.44		0.56		0.30												87	90
3H-58 1613.63	3.1	2	Py	0.35			29.45							69.66						0.54								100	221
3H-58 1613.63	3.1	3	Ms	47.89	0.24	35.35	1.27		0.41		0.92	8.92																95	112
3H-58 1613.63	3.1	4	Qz	99.79			0.21																					100	122
3H-58 1613.63	4	1	Qz	100.00																								100	119
3H-58 1613.63	4	2	Ill + Chl	46.25		21.44	25.28		2.80	0.78	1.82	1.62																100	81
3H-58 1613.63	4	3	Qz	100.00																								100	122
3H-58 1613.63	4	4	Qz	100.00																								100	124
3H-58 1613.63	4	5	Ill + Chl	52.19	0.72	15.92	22.83	0.26	4.56	0.31	1.11	1.81				0.29												100	94
3H-58 1613.63	4	6	Qz	100.00																								100	119
3H-58 1613.63	5	1	Ilm		52.79		41.35	5.87																				100	104
3H-58 1613.63	5	2	Kfs	65.59		17.87					0.73	15.10											0.71					100	118
3H-58 1613.63	5	3	Qz	100.00																								100	121
3H-58 1613.63	5	4	Gly	43.46		12.28	19.87		3.60	1.57	1.39	4.59				0.23												87	97
3H-58 1613.63	5	5	Kfs	66.26		17.86					0.77	15.11																100	116
3H-58 1613.63	5	6	Zrn	29.93		0.55	1.06			0.49							0.59				64.89						2.49	100	113
3H-58 1613.63	5	7	Chl + Ms	45.70		29.50	19.55		2.26	0.64	1.51	0.65				0.19												100	98
3H-58 1613.63	5	8	Qz	100.00																								100	120
3H-58 1613.63	5	9	Kfs	66.07		17.45	0.40				0.35	15.73																100	116
3H-58 1613.63	5	10	"Ilm"?	0.84	65.57		31.94	1.65																				100	99

Table 1-4.1: EDS geochemical analyses of sample 3H-58 1613.63.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	ZnO	As2O3	ZrO2	Ag2O	BaO	La2O3	Ce2O3	Nd2O3	HfO2	Total	Actual Total
3H-58 1613.63	6	1	Fe-Chl	31.65		11.00	35.20	0.36	3.65	0.85	1.63	0.41				0.26												85	94
3H-58 1613.63	6	2	Kfs	65.51		17.87	0.23				0.47	15.17											0.75					100	117
3H-58 1613.63	6	3	Kfs	66.17		18.08	0.21				1.18	14.36																100	114
3H-58 1613.63	6	4	Qz	100.00																								100	123
3H-58 1613.63	6	5	Qz	100.00																								100	125
3H-58 1613.63	6	6	Gly	41.99		10.81	23.38		3.38	1.77	1.56	3.90				0.22												87	99
3H-58 1613.63	6	7	Sd +	5.25		1.12	76.93	4.87	3.07	6.54	0.76					1.46												100	62
3H-58 1613.63	6	8	Ill + Chl	39.75		18.71	35.08		3.46		1.17	0.81				1.03												100	63
3H-58 1613.63	7	1	Qz	100.00																								100	120
3H-58 1613.63	7	2	Kfs	65.99		17.59	0.46				0.47	15.50																100	118
3H-58 1613.63	7	3	Kfs	66.30		17.75					0.53	15.42																100	117
3H-58 1613.63	7	4	Gly	34.92	0.67	15.36	25.66	0.27	5.21	1.14	1.54	1.96				0.27												87	101
3H-58 1613.63	7	5	Ill + Chl	41.96		18.77	31.48		2.96	0.99	1.42	1.11				1.32												100	49
3H-58 1613.63	7	6	Fe-Chl +	31.75		14.63	43.38	0.66	3.63	2.72	2.12	0.84				0.27												100	89
3H-58 1613.63	7	7	Gly	45.20		10.06	21.54		2.98	0.31	1.16	5.76																87	105
3H-58 1613.63	7	8	Qz	99.49			0.51																					100	122
3H-58 1613.63	7	9	Gly	40.49		11.44	26.08		3.46	0.38	1.10	3.45				0.59												87	66
3H-58 1613.63	8	1	Qz	99.78			0.22																					100	120
3H-58 1613.63	8	2	Gly	44.23		12.50	20.21		2.49	0.71	3.85	2.44		0.57														87	102
3H-58 1613.63	8	3	Clay + Fe-Ch	39.05		15.36	34.90		4.90	1.91	2.14	0.88		0.60		0.27												100	96
3H-58 1613.63	8	4	Qz	99.62			0.38																					100	123
3H-58 1613.63	8	5	Qz	99.77			0.23																					100	120
3H-58 1613.63	8	6	Glt	42.16		8.06	26.33		2.55	0.55	0.84	6.28				0.23												87	77
3H-58 1613.63	8	7	Sd	1.93		0.73	39.64	2.45	5.85	5.42																		56	62
3H-58 1613.63	8.1	1	Kfs	66.23		17.43	0.39				0.63	15.33																100	116
3H-58 1613.63	8.1	2	Sd	2.02			43.36	2.39	3.54	3.59	0.57					0.54												56	62
3H-58 1613.63	8.1	3	Fe-Chl + ?Gl	41.67		13.06	35.90		3.24	1.15	2.03	2.71				0.23												100	90
3H-58 1613.63	8.1	4	Qz	100.00																								100	119
3H-58 1613.63	9	1	"Ilm"		61.48		38.09	0.43																				100	99
3H-58 1613.63	9	2	Qz	100.00																								100	120
3H-58 1613.63	9	3	Kfs	65.68		17.76	0.31				0.57	15.02											0.66					100	117
3H-58 1613.63	9	4	Mix	46.98	0.54	11.40	23.73		2.77	5.09	4.14	2.60		1.32		0.85			0.57									100	68
3H-58 1613.63	9	5	Ill + Chl	45.90		16.53	28.55		3.75	0.45	1.69	2.62				0.50												100	95
3H-58 1613.63	9	6	Qz	100.00																								100	119
3H-58 1613.63	9	7	Gly	36.38	1.10	18.10	25.96		2.59	0.49	1.20	1.17																87	93
3H-58 1613.63	9	8	Qz	99.77			0.23																					100	120
3H-58 1613.63	9	9	Clay + Fe-Ch	39.45		12.96	37.30	0.29	5.65	0.76	1.95	1.35				0.29												100	98
3H-58 1613.63	9	10	Qz	100.00																								100	125
3H-58 1613.63	10	1	Qz	100.00																								100	121
3H-58 1613.63	10	2	Kfs	66.10		17.63	0.25				0.72	15.30																100	123
3H-58 1613.63	10	3	Gly	46.79	0.35	7.07	17.76		2.64	3.11	3.29	5.08				0.91												87	70
3H-58 1613.63	10	4	Gly	42.08		10.84	20.03		2.76	0.85	1.57	5.04	1.96			0.67									1.20			87	101
3H-58 1613.63	10	5	Ill + Chl	45.43		20.37	25.19		2.95		1.47	1.32		1.55		1.72												100	40
3H-58 1613.63	10	6	Kfs	66.36		17.80					0.84	15.00																100	117
3H-58 1613.63	10	7	Fe-Chl +	36.79		8.22	16.24		2.33	1.00	19.96	4.36				11.09												100	120
3H-58 1613.63	10	8	Qz	99.66			0.34																					100	118
3H-58 1613.63	10	9	Qz	100.00																								100	121
3H-58 1613.63	11	1	Qz	100.00																								100	123
3H-58 1613.63	11	2	Gly	40.86		12.68	25.09		3.40	0.45	1.65	2.32				0.53												87	89
3H-58 1613.63	11	3	Qz	100.00																								100	117
3H-58 1613.63	11	4	Gly	36.26		15.15	25.88		4.18	1.98	1.94	1.41				0.20												87	97
3H-58 1613.63	11	5	Qz	100.00																								100	123
3H-58 1613.63	11	6	Kfs	66.09		17.94					0.74	15.23																100	119
3H-58 1613.63	11	7	Gly	44.81		11.43	19.92		4.10		1.40	4.22				1.11												87	86

Table 1-4.1: EDS geochemical analyses of sample 3H-58 1613.63.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	ZnO	As2O3	ZrO2	Ag2O	BaO	La2O3	Ce2O3	Nd2O3	HfO2	Total	Actual Total
3H-58 1613.63	11	8	Qz	100.00																								100	120
3H-58 1613.63	11	9	Kfs	65.61		17.81					0.34	15.60											0.65					100	115
3H-58 1613.63	12	1	Ab	68.03		18.41	1.16			0.58	11.63	0.21																100	120
3H-58 1613.63	12	2	Clay + Fe-Ch	40.24		15.18	35.48		4.61	0.49	2.03	1.68				0.30												100	101
3H-58 1613.63	12	3	Gly	42.93		10.23	22.65		2.73	1.51	1.28	5.67																87	95
3H-58 1613.63	12	4	Gly	39.36		10.90	27.98		3.99	0.39	1.10	2.58				0.69												87	62
3H-58 1613.63	12	5	Gly	39.59		9.91	26.79		3.45	1.98	1.61	3.43				0.25												87	97
3H-58 1613.63	12	6	Qz	99.75			0.25																					100	123
3H-58 1613.63	13	1	Qz	99.77			0.23																					100	122
3H-58 1613.63	13	2	Gly	37.63		14.77	28.67		2.63	0.76	1.02	1.52																87	93
3H-58 1613.63	13	3	Kfs	65.04		18.29	0.27				0.92	14.10											1.38					100	119
3H-58 1613.63	13	4	Ms +	53.12	0.26	28.17	5.22		2.16		0.33	10.75																100	108
3H-58 1613.63	13	5	Qz	98.91		0.97						0.12																100	119
3H-58 1613.63	13	6	Kfs	65.81		17.68	0.22				0.35	15.94																100	119
3H-58 1613.63	13	7	Qz	99.71			0.29																					100	125
3H-58 1613.63	14	1	Zrn	48.15			0.87														50.99							100	123
3H-58 1613.63	14	2	Qz	99.81			0.19																					100	124
3H-58 1613.63	14	3	Mix	38.71		15.68	35.58		5.59	0.46	1.63	0.78				1.57												100	77
3H-58 1613.63	14	4	Chl + Mix	50.61		19.42	11.03		2.22	8.33	3.56	1.40		1.77		1.05			0.61									100	72
3H-58 1613.63	14	5	Kfs	65.00		18.16	0.22				1.20	13.90											1.52					100	118
3H-58 1613.63	14	6	Zrn	31.15			0.34														68.51							100	117
3H-58 1613.63	14	7	Gly	41.03		12.40	22.97		3.14	1.76	1.52	3.91				0.28												87	103
3H-58 1613.63	14	8	Qz	100.00																								100	123
3H-58 1613.63	15	1	Fe-Chl	33.21	0.39	11.86	31.59		4.28	0.34	1.47	1.68				0.19												85	98
3H-58 1613.63	15	2	Qz	99.77			0.23																					100	120
3H-58 1613.63	15	3	Gly	43.73		10.22	20.57		2.57	1.07	2.18	3.87	0.99	0.64		0.29									0.86			87	89
3H-58 1613.63	15	4	Qz	100.00																								100	123
3H-58 1613.63	15	5	Qz	100.00																								100	123
3H-58 1613.63	15	6	Gly	36.34		12.83	29.21		4.94	0.36	1.30	1.61				0.41												87	85
3H-58 1613.63	15	7	Ill + Chl	46.17		21.08	26.59		2.84		0.86	1.73				0.74												100	51
3H-58 1613.63	16	1	Ilm		51.41		44.23	4.35																				100	106
3H-58 1613.63	16	2	Fe-Chl ?	37.35		11.98	42.73	0.50	4.21	0.61	1.85	0.33				0.44												100	99
3H-58 1613.63	16	3	Qz	99.80			0.20																					100	122
3H-58 1613.63	16	4	Fe-Chl +	37.85		13.71	39.44		5.10	1.00	1.82	0.76				0.32												100	95
3H-58 1613.63	16	5	"Ilm"	2.51	79.64	1.00	16.40	0.45																				100	98
3H-58 1613.63	16	6	Qz	100.00																								100	125
3H-58 1613.63	17	1	Qz	99.79			0.21																					100	122
3H-58 1613.63	17	2	Qz	100.00																								100	121
3H-58 1613.63	17	3	Ilm	0.60	53.01		43.17	3.23																				100	107
3H-58 1613.63	17	4	Kfs	65.76		17.82					0.50	15.26											0.66					100	125
3H-58 1613.63	17	5	Kfs	66.31		17.91					1.01	14.76																100	115
3H-58 1613.63	17	6	Qz	100.00																								100	120
3H-58 1613.63	17	7	Ill + Chl	49.67	0.40	25.23	15.84		3.36	0.38	0.90	3.74				0.49												100	82
3H-58 1613.63	17	8	Gly	42.29		9.75	22.68		2.79	2.22	1.80	5.05				0.42												87	99
3H-58 1613.63	17	9	Sd				50.47	1.32	1.27	2.95																		56	60
3H-58 1613.63	18	1	Fe-Chl +	37.44		12.03	41.92	0.60	4.45	0.60	2.18	0.40				0.39												100	98
3H-58 1613.63	18	2	Qz	99.63			0.37																					100	118
3H-58 1613.63	18	3	Chl?	43.18		15.44	30.64		4.06	1.29	1.88	3.14				0.36												100	94
3H-58 1613.63	18	4	Gly	36.59		14.67	27.96		3.18	1.15	1.77	1.47				0.22												87	95
3H-58 1613.63	18	5	Qz	100.00																								100	123
3H-58 1613.63	18	6	Gly	40.88	0.30	13.14	22.82		2.79	1.31	1.57	3.82				0.37												87	98
3H-58 1613.63	18	7	Ilm		54.54		44.09	0.92	0.45																			100	107
3H-58 1613.63	18	8	Qz	100.00																								100	123
3H-58 1613.63	18	9	Kfs	66.16		17.85					0.59	15.41																100	120

Table 1-4.1: EDS geochemical analyses of sample 3H-58 1613.63.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	ZnO	As2O3	ZrO2	Ag2O	BaO	La2O3	Ce2O3	Nd2O3	HfO2	Total	Actual Total
3H-58 1613.63	19	1	Qz	100.00																								100	117
3H-58 1613.63	19	2	Ilm		53.92		44.35	1.74																				100	102
3H-58 1613.63	19	3	Gly	45.94		9.42	20.96		2.88	0.69	1.04	5.72				0.36												87	81
3H-58 1613.63	19	4	Kfs	65.98		17.90	0.31				0.86	14.95																100	114
3H-58 1613.63	19	5	Qz	100.00																								100	117
3H-58 1613.63	19.1	1	Qz	96.22		1.45	1.33			0.34	0.53	0.13																100	107
3H-58 1613.63	19.1	2	Ill + Chl	40.48		18.68	33.57		3.12	0.41	1.31	1.61				0.82												100	71
3H-58 1613.63	19.1	3	Ill + Chl	45.06		21.86	24.88		3.20	0.40	1.59	1.37				1.64												100	55
3H-58 1613.63	19.2	1	Cal				0.50		1.50	53.66	0.35																	56	55
3H-58 1613.63	19.2	2	Sd	2.00			40.32	3.38	4.08	4.49	0.68		0.54			0.52												56	62
3H-58 1613.63	19.2	3	Gly	45.19		9.66	19.85		2.90	2.27	1.47	5.66																87	97
3H-58 1613.63	19.2	4	Gly	36.64	0.86	17.82	25.74		2.73	0.35	1.20	1.09				0.57												87	70
3H-58 1613.63	19.2	5	Sd	1.63		0.58	39.93	2.14	6.23	5.49																		56	59
3H-58 1613.63	20	1	Kfs	65.16		17.95	0.33				1.08	14.15											1.34					100	114
3H-58 1613.63	20	2	Clay + Fe-Ch	40.70		13.51	37.47		3.71	0.84	1.72	2.06																100	88
3H-58 1613.63	20	3	Kfs	66.54		17.98					1.55	13.93																100	112
3H-58 1613.63	20.1	1	Cal				0.60			54.77	0.41					0.21												56	42
3H-58 1613.63	20.1	2	Ill + Chl	44.29		19.52	29.36		2.73	0.41	1.00	1.79				0.90												100	69
3H-58 1613.63	20.1	3	TiO2	0.74	96.66		2.31			0.29																		100	101
3H-58 1613.63	20.1	4	Kfs	66.19		17.86	0.58				1.20	14.16																100	113
3H-58 1613.63	20.1	5	Fe-Chl?	42.22		15.28	33.81	0.41	3.09	0.42	1.50	3.01				0.25												100	100
3H-58 1613.63	20.1	6	Sd	2.13		0.74	38.61	2.98	5.67	5.86																		56	58
3H-58 1613.63	21	1	Qz	100.00																								100	117
3H-58 1613.63	21	2	Gly	38.76		10.93	27.22		3.37	1.73	1.91	2.82				0.27												87	87
3H-58 1613.63	21	3	Gly	42.70	0.44	9.07	19.87		2.67	4.54	4.05	1.49		1.25		0.91												87	59
3H-58 1613.63	21	4	Gly	37.62	0.55	11.01	24.10		4.19	3.14	3.03	2.14		0.75		0.47												87	84
3H-58 1613.63	21	5	Kfs	65.64		17.74	0.21				0.62	15.04											0.75					100	115
3H-58 1613.63	21	6	Gly	41.53	0.30	13.29	24.02		2.91	0.42	1.24	2.84				0.44												87	93
3H-58 1613.63	21	7	Qz	100.00																								100	115
3H-58 1613.63	21.1	1	Ill + Chl	46.53		19.06	28.53		3.36		0.98	0.73				0.80												100	56
3H-58 1613.63	21.1	2	Sd	1.16		0.43	37.27	3.89	5.86	7.39																		56	59
3H-58 1613.63	21.2	1	Py	0.18			29.00							70.82														100	218
3H-58 1613.63	22	1	Kfs	65.60		17.76					0.68	15.09											0.87					100	114
3H-58 1613.63	22	2	Gly	35.86		13.34	29.55		3.67	0.79	1.57	1.98				0.23												87	93
3H-58 1613.63	22	3	Gly	38.76	0.43	10.06	26.03		2.83	2.50	3.98	1.04		0.92		0.45												87	77
3H-58 1613.63	22	4	Qz	100.00																								100	114
3H-58 1613.63	22	5	Kfs	65.87		17.75	0.78				0.29	15.30																100	111
3H-58 1613.63	22	6	Qz	100.00																								100	117
3H-58 1613.63	22	7	Gly	37.91		12.28	26.91		3.52	1.74	1.14	3.30				0.19												87	90
3H-58 1613.63	22.1	1	Qz	99.71			0.29																					100	115
3H-58 1613.63	22.1	2	Ill + Chl	53.87		28.09	10.57		1.95	0.34	0.79	4.00				0.38												100	78
3H-58 1613.63	22.2	1	Ill + Chl	50.16		28.22	12.63		2.64		0.81	5.32				0.22												100	90
3H-58 1613.63	22.2	2	Sd				52.00	0.68		2.65			0.67															56	55
3H-58 1613.63	22.2	3	Sd +	4.19		1.30	71.72	4.67	8.43	9.25						0.43												100	58
3H-58 1613.63	22.2	4	Sd	1.06			45.36	5.16	0.62	0.97	1.00			0.55		1.28												56	61
3H-58 1613.63	22.3	1	Ill + Chl	42.91		20.33	30.18		3.11		1.39	1.13				0.95												100	59
3H-58 1613.63	22.3	2	Qz	99.45			0.55																					100	115
3H-58 1613.63	22.3	3	Gly	41.72	0.52	9.79	20.48		3.21	2.76	3.47	1.77		1.71		0.70			0.84	0.04								87	64
3H-58 1613.63	23	1	Qz	100.00																								100	118
3H-58 1613.63	23	2	Kfs	66.00		17.77	0.42				0.46	15.35																100	115
3H-58 1613.63	23	3	Ill + Chl	39.72	0.34	14.39	35.27		6.08	0.48	1.48	2.24																100	97
3H-58 1613.63	23	4	Gly	44.40		9.74	21.16		3.33	1.98	1.46	4.93																87	99
3H-58 1613.63	23.1	1	Gly	38.71		14.00	25.75		3.25	1.20	1.74	2.14				0.22												87	96
3H-58 1613.63	23.1	2	Gly	41.89		15.23	22.34		2.76	0.35	0.97	3.12				0.35												87	80

Table 1-4.1: EDS geochemical analyses of sample 3H-58 1613.63.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	ZnO	As2O3	ZrO2	Ag2O	BaO	La2O3	Ce2O3	Nd2O3	HfO2	Total	Actual Total
3H-58 1613.63	23.1	3	Gly	40.40	0.48	13.31	21.31		2.60	2.65	3.60	1.12		1.08		0.44												87	78
3H-58 1613.63	23.1	4	Cal	2.01			0.93		1.06	51.35	0.65																	56	54
3H-58 1613.63	23.1	5	Ill + Chl	43.54		19.82	30.36		2.76	0.41	1.01	1.25				0.86												100	58
3H-58 1613.63	23.2	1	"Ilm"	0.77	60.10	0.63	33.23	0.77	4.49																			100	105
3H-58 1613.63	23.2	2	Qz	99.60			0.40																					100	122
3H-58 1613.63	24	1	Qz	99.75			0.25																					100	122
3H-58 1613.63	24	2	Gly	38.75		20.09	21.34		2.72	0.31	1.15	2.08				0.55												87	67
3H-58 1613.63	24	3	TiO2		99.04		0.96																					100	109
3H-58 1613.63	24	4	Gly	39.53		19.29	21.24		2.16	0.37	1.26	2.92				0.23												87	99
3H-58 1613.63	24	5	Qz	97.61		1.40	0.84					0.15																100	117
3H-58 1613.63	24	6	Kfs	66.22	0.27	18.09					1.41	14.01																100	118
3H-58 1613.63	24	7	Gly	35.49	1.01	14.75	28.64		3.40	0.25	1.71	1.23				0.52												87	101
3H-58 1613.63	25	1	Monazite							0.82			37.69									2.20		16.49	31.31	11.68		100	104
3H-58 1613.63	25	2	Kfs	66.07		17.83					0.52	15.58																100	117
3H-58 1613.63	25	3	Qz	100.00																								100	124
3H-58 1613.63	25	4	Kfs	65.76	0.42	17.85	0.27				0.78	14.92																100	114
3H-58 1613.63	25	5	Ill? + Chl	46.92	2.74	23.95	19.25		2.67	0.31	1.39	1.86				0.92												100	58
3H-58 1613.63	25	6	Qz	99.65			0.35																					100	120
3H-58 1613.63	25	7	Clay + Fe-Ch	39.89		15.18	35.87		5.79	0.44	1.69	0.84				0.30												100	96
3H-58 1613.63	25.1	1	Gly	41.69		9.64	26.97		3.18		1.10	3.85				0.58												87	83
3H-58 1613.63	25.1	2	Gly	43.21		9.61	25.09		2.88	0.26	0.97	4.57				0.42												87	83
3H-58 1613.63	25.1	3	Gly	40.23		8.41	23.15		2.84	5.38	1.83	4.24		0.68		0.23												87	92
3H-58 1613.63	26	1	Gly	42.30		9.54	23.77		2.76	1.93	1.36	5.16				0.18												87	97
3H-58 1613.63	26	2	Gly	39.61		10.68	25.63		2.89	1.21	3.26	1.93		1.09		0.70												87	74
3H-58 1613.63	26	3	Ill + Chl	44.36		18.83	31.24		2.66		1.05	0.97				0.87												100	50
3H-58 1613.63	26	4	Kfs	66.25		17.64					0.35	15.76																100	120
3H-58 1613.63	26	5	Clay + Fe-Ch	37.72		12.65	40.60	0.42	5.20	0.58	1.97	0.62				0.24												100	92
3H-58 1613.63	26	6	Qz	100.00																								100	117
3H-58 1613.63	26.1	1	Qz	95.65	0.38	2.15	1.30				0.36	0.17																100	118
3H-58 1613.63	26.1	2	"Ilm"	4.22	70.55		23.80	1.43																				100	103
3H-58 1613.63	27	1	Ilm		52.84		44.97	1.23	0.95																			100	104
3H-58 1613.63	27	2	Kfs	65.84		17.97	0.27				0.98	14.95																100	116
3H-58 1613.63	27	3	"Ilm"	0.59	67.08		30.70	1.62																				100	98
3H-58 1613.63	27	4	Qz	100.00																								100	118
3H-58 1613.63	27	5	Kfs	66.48		17.75						15.77																100	121
3H-58 1613.63	27	6	Gly	39.28		9.23	28.14		3.68	0.99	1.51	3.78				0.38												87	96
3H-58 1613.63	27	7	Gly	37.34		14.03	27.81		4.39	0.39	1.24	1.06				0.72												87	80
3H-58 1613.63	27	8	Qz	100.00																								100	122
3H-58 1613.63	27.1	1	Ms +	50.15		29.74	7.75		2.22		0.44	9.72																100	106
3H-58 1613.63	27.1	2	Qz	99.78			0.22																					100	120
3H-58 1613.63	27.2	1	"Chr"		0.87	7.18	53.17	0.88	1.35									36.55										100	101

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain
3. Gly refers to the mixture glaucony

Appendix 1-5: SEM-BSE images and EDS mineral analyses for sample 3H-58 1804.26.

Sample 3H-58 1804.26: Fine-grained Sandstone with local shale laminae

Detrital Minerals: Albite, Biotite, Chlorite, Illite + Chlorite (Figs. 3-4 (matrix)), Ilmenite, K-feldspar, Muscovite, Quartz, Spinel (Fig. 12), Zircon

Diagenetic Minerals: Fe-chlorite, Kaolinite, Pyrite, Titania (Fig. 13)

Notes:

1. Halite appears to be contamination from washing the core in salt water (Fig. 33).

2. Micas appear to follow bedding planes (Figs. 9,17,22,23,29).

3. Illite + chlorite forms matrix (Figs. 3,14), and intraclasts (Fig. 21).

4. Chlorite is often seen along cleavages of either micas (Ms, Bt) or K-feldspar (Fig. 2). It is difficult to say if chlorite in such grains is detrital,or formed during burial diagenesis, or both.

5. Glaucony has been seen replacing pellets (Fig. 19,28-29), detrital grains, matrix (Figs. 19,23), and lithic clasts.

6. Paragenetic sequence: Kaolinite, Chlorite → Pyrite, Titania

↑ Fig. 33 ↑ ?Fig. 2 ↑ Fig. 19 ↑ Fig. 13

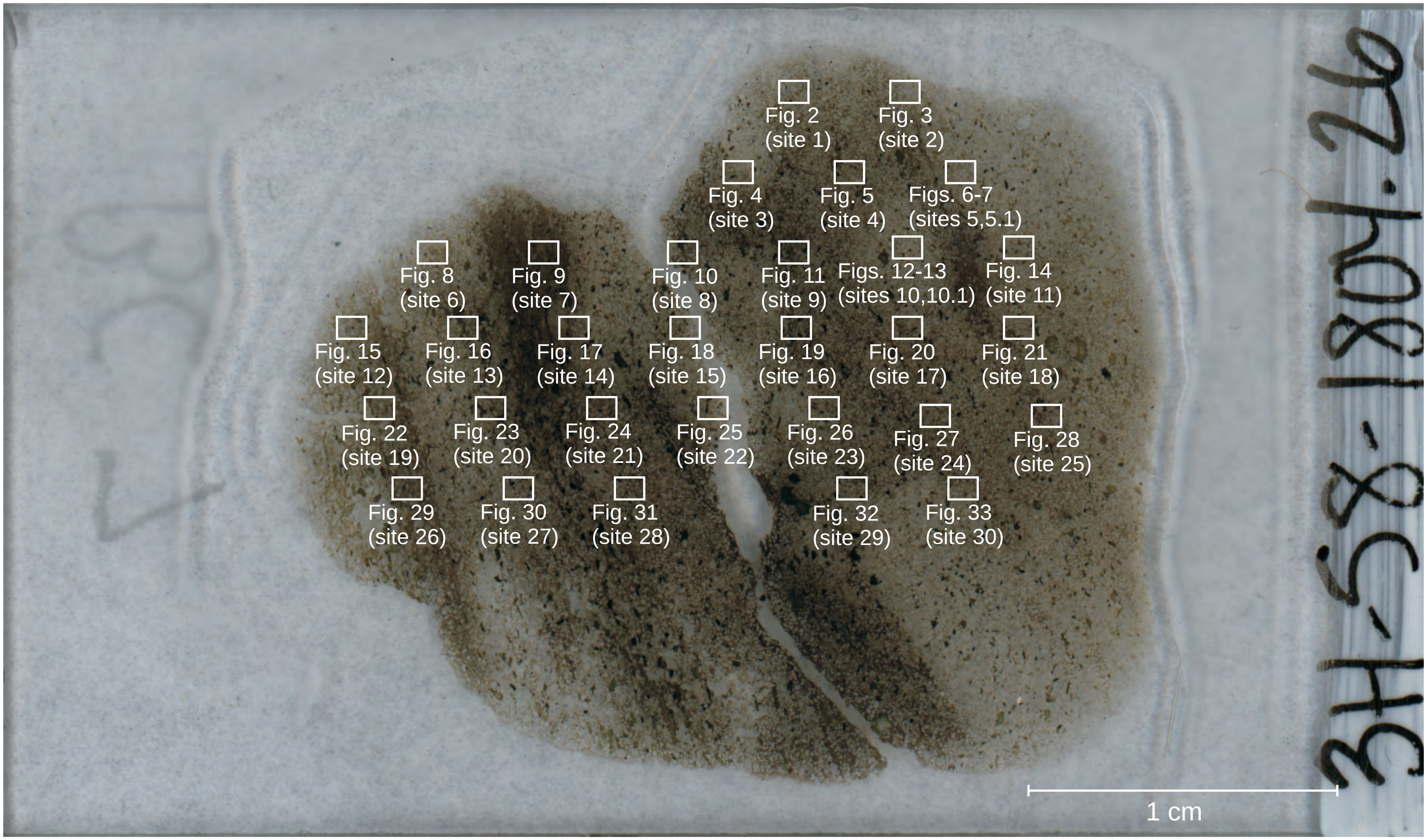
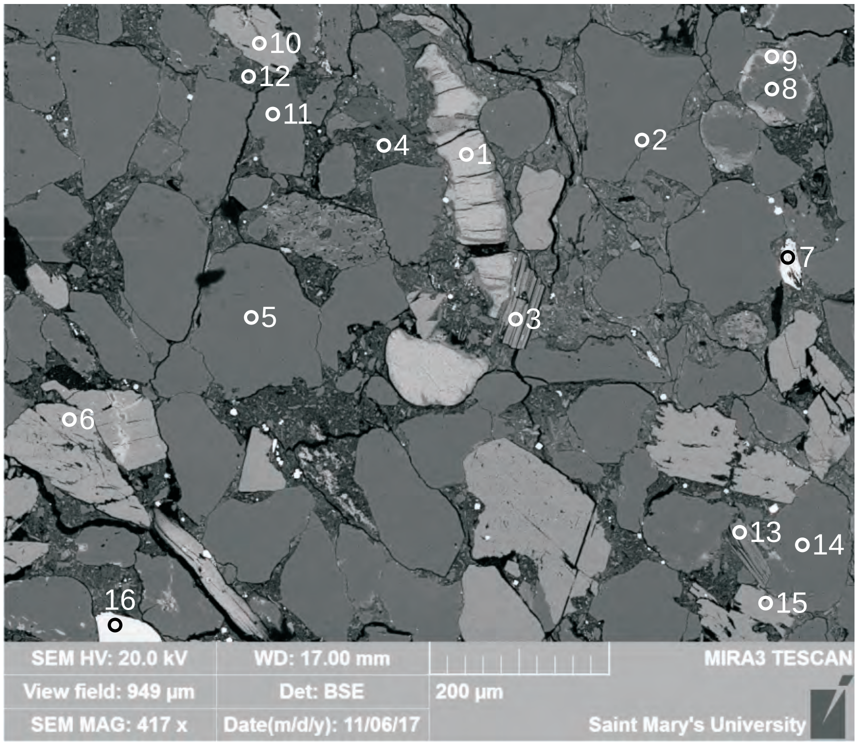
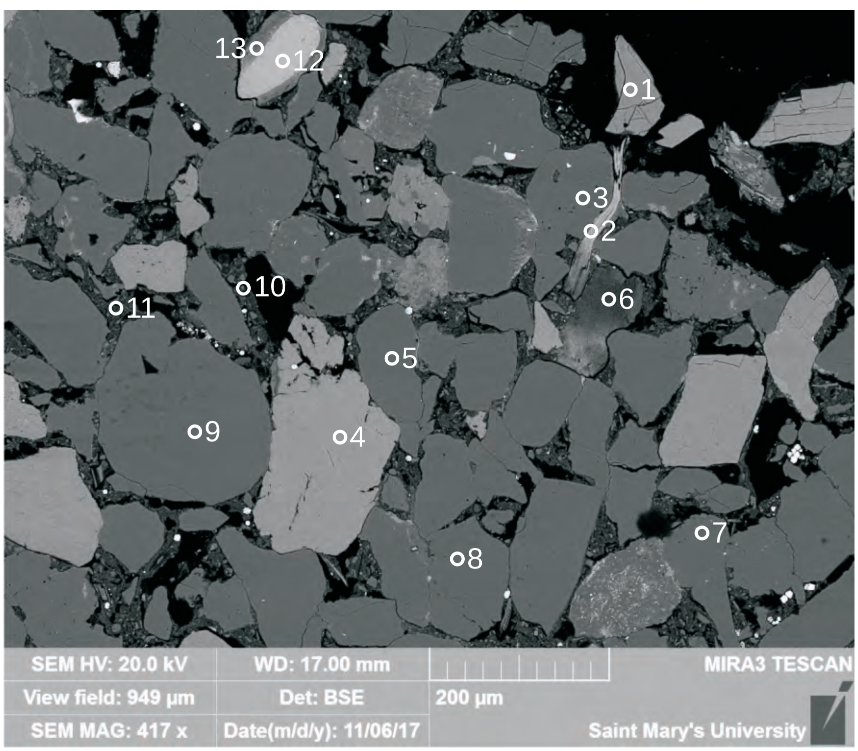


Figure 1-5.1: Scanned thin section of sample 3H-58 1804.26 showing the location of analyzed sites.



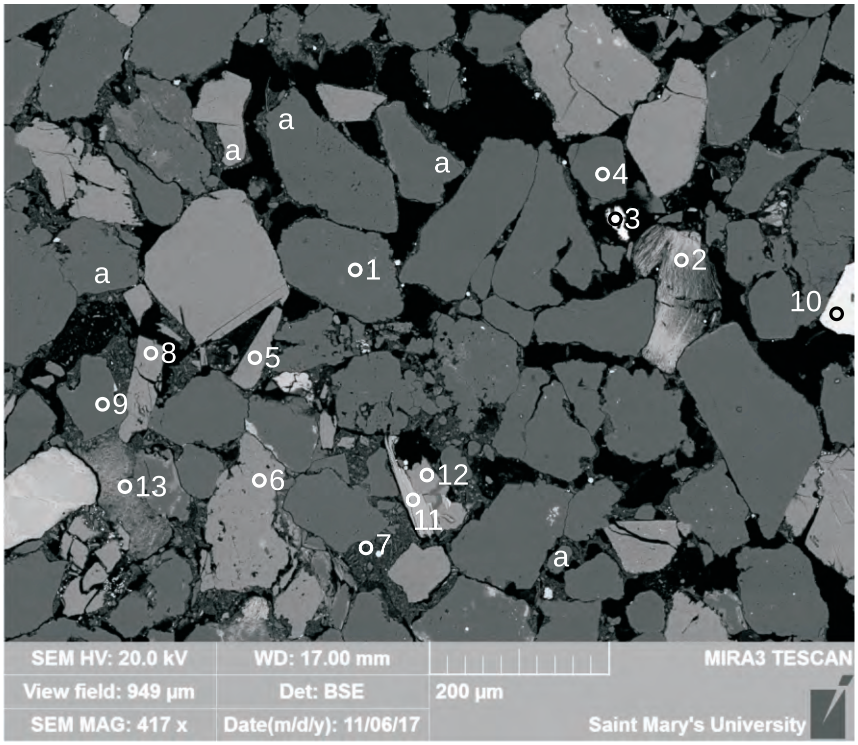
1:Chlorite + K-feldspar
2:Quartz
3:Muscovite + Chlorite
4:Kaolinite
5:Quartz
6:K-feldspar
7:Ilmenite
8:Mixture
9:Fe-Chlorite +
10:K-feldspar + Chlorite
11:Quartz
12:Illite + Chlorite
13:Muscovite
14:Quartz
15:K-feldspar
16:Ilmenite

Figure 1-5.2: Sample 3H-58 1804.26 (SEM) site 1. This site consists of detrital quartz (2,11,14), K-feldspar (6,15), ilmenite (7), muscovite (13), chlorite + muscovite (3), and K-feldspar + chlorite (1,10). The matrix is made up of illite + chlorite (12) and kaolinite (4). Fe-chlorite (9) rims a mineral (8).



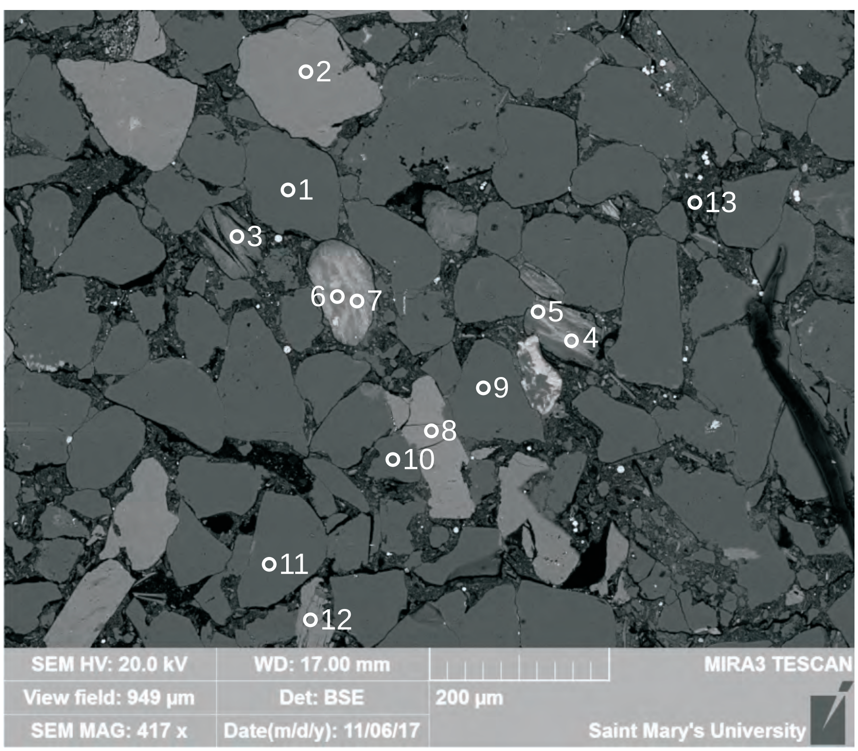
1:K-feldspar
2:Chlorite
3:Quartz
4:K-feldspar
5:Quartz
6:Glaucony
7:Quartz
8:Quartz
9:Quartz
10:Illite + Chlorite +
11:Illite + Chlorite
12:Clay + Fe-Chlorite
13:Glaucony

Figure 1-5.3: Sample 3H-58 1804.26 (SEM) site 2. This site consists of detrital quartz (3,5,7-9), K-feldspar (1,4), and chlorite (2). The matrix is made up of illite + chlorite (10-11). Glaucony (13) rims a clay + Fe-chlorite (12) ?pellet.



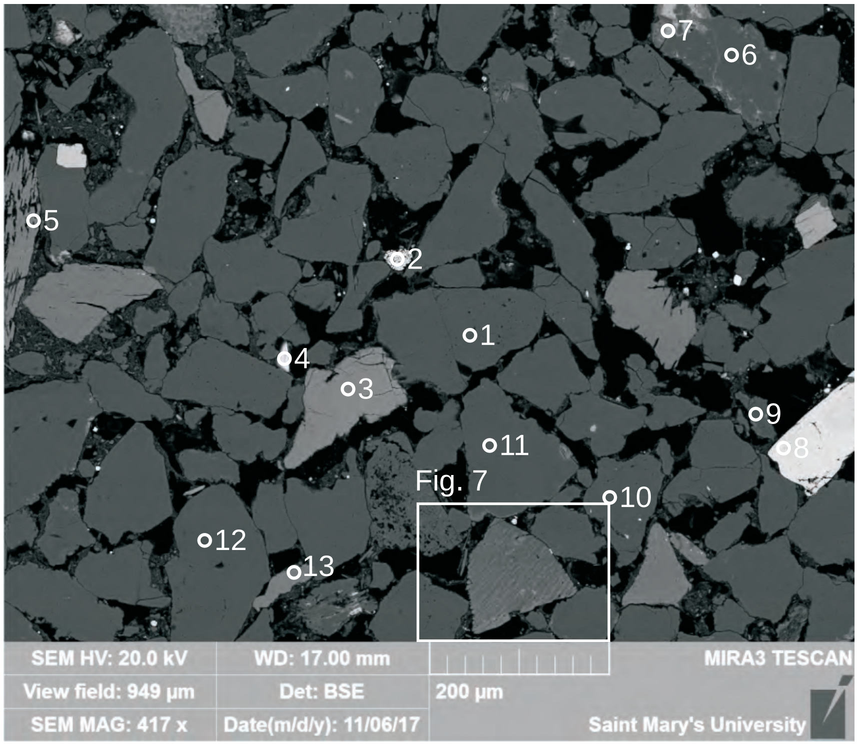
1:Quartz
2:Fe-Chlorite +
3:Quartz +
Monazite-(Ce)
4:Quartz
5:K-feldspar
6:K-feldspar
7:Illite + Chlorite
8:K-feldspar
9:Quartz
10:Ilmenite
11:Chlorite +
12:K-feldspar
13:K-feldspar +
Chlorite

Figure 1-5.4: Sample 3H-58 1804.26 (SEM) site 3. This site consists of detrital quartz (1,4,9), K-feldspar (5-6,8,12), ilmenite (10), and K-feldspar + chlorite (2,13) grains. The matrix is made up of illite + chlorite (7) and clays partially rim detrital minerals (positions a).



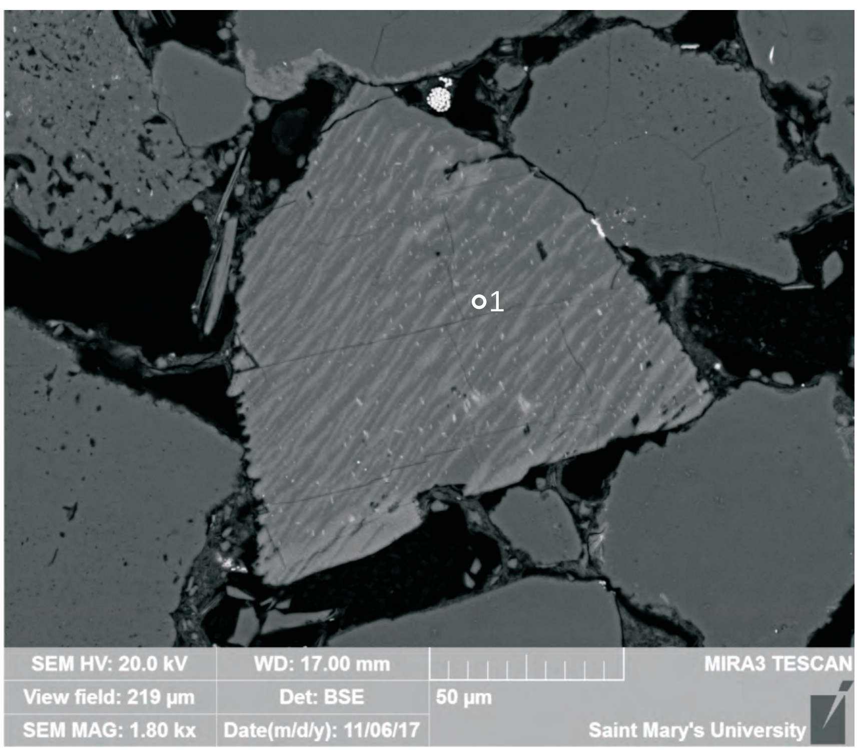
1:Quartz
2:K-feldspar
3:Fe-Clay
4:Fe-Clay
5:Fe-Chlorite ?
6:Muscovite +
Chlorite
7:Muscovite +
Chlorite
8:K-feldspar
9:Quartz
10:Quartz
11:Quartz
12:K-feldspar
13:Quartz +
Kaolinite +

Figure 1-5.5: Sample 3H-58 1804.26 (SEM) site 4. This site consists of detrital quartz (1,9-11), chlorite + muscovite (6-7), and K-feldspar (2,12) grains. The matrix is probably made up of illite + chlorite.



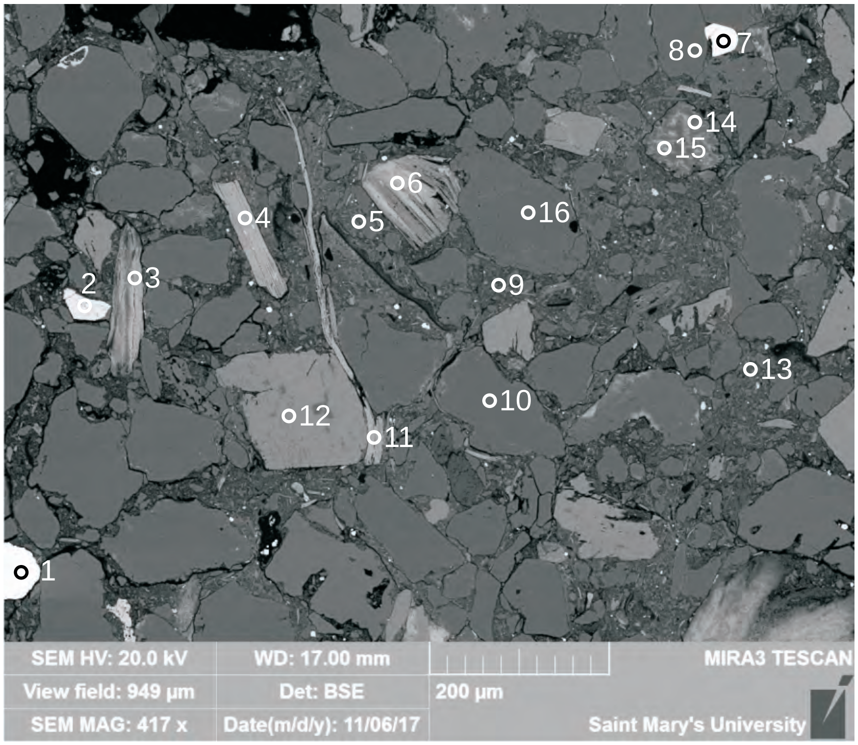
1:Quartz
2:Pyrite
3:K-feldspar
4:Ilmenite
5:K-feldspar
6:Quartz
7:Mixture
8:"Ilmenite"
9:Quartz
10:Quartz
11:Quartz
12:Quartz
13:K-feldspar

Figure 1-5.6: Sample 3H-58 1804.26 (SEM) site 5. This site consists of detrital quartz (1,6,8-12), ilmenite (4), K-feldspar (3,5,13), and altered ilmenite (8) grains. Diagenetic pyrite (2) is the latest mineral to form.



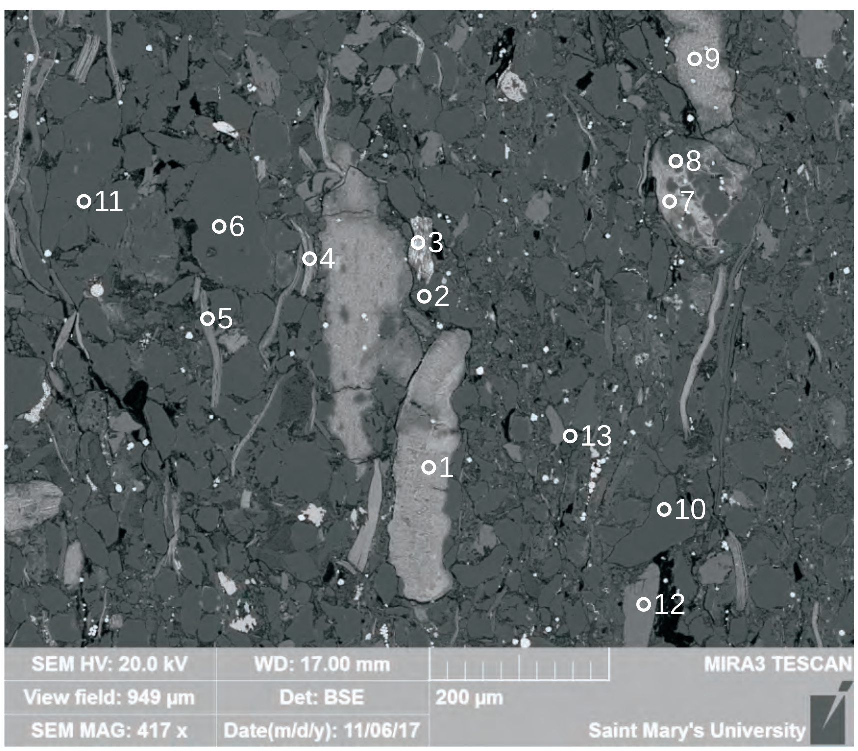
1:Albite + K-feldspar

Figure 1-5.7: Sample 3H-58 1804.26 (SEM) site 5.1. This site consists of a very small grain of microperthite (K-feldspar + albite).



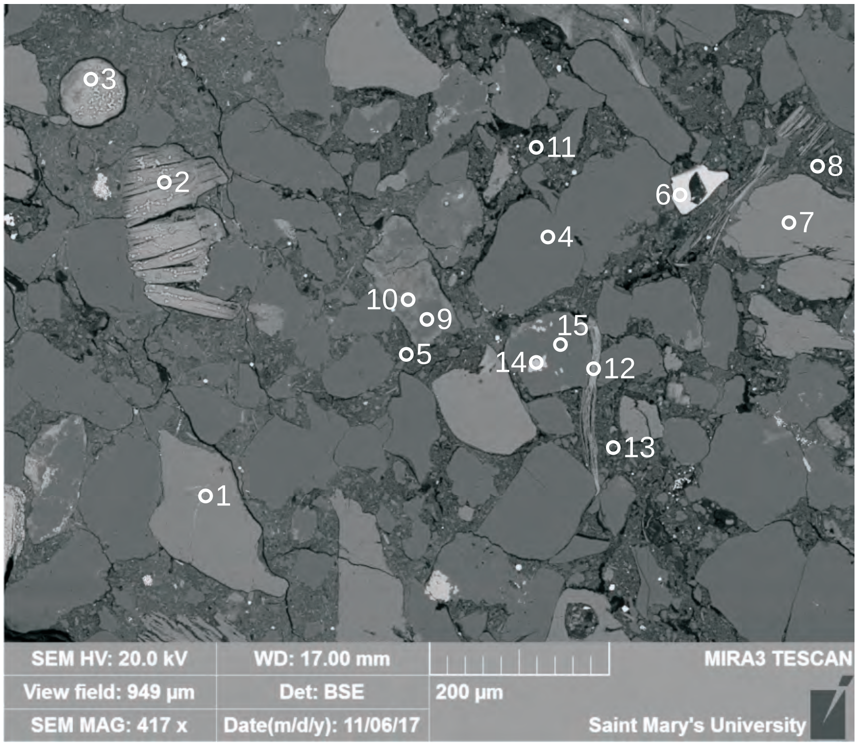
1:Zircon
2:Ilmenite
3:Chlorite
4:Biotite?
5:Illite + Chlorite
6:Chlorite + Biotite
7:Zircon
8:Quartz
9:Illite + Chlorite
10:Quartz
11:Biotite
12:K-feldspar
13:Illite + Chlorite
14:K-feldspar +
15:Quartz + K-feldspar
16:Quartz

Figure 1-5.8: Sample 3H-58 1804.26 (SEM) site 6. This site consists of detrital zircon (1), ilmenite (2), quartz (8,10,16), chlorite (3), biotite (4,11), K-feldspar (12), and a granitic lithic clast made up of quartz + K-feldspar (14-15). The matrix is made up of illite + chlorite (5,9,13).



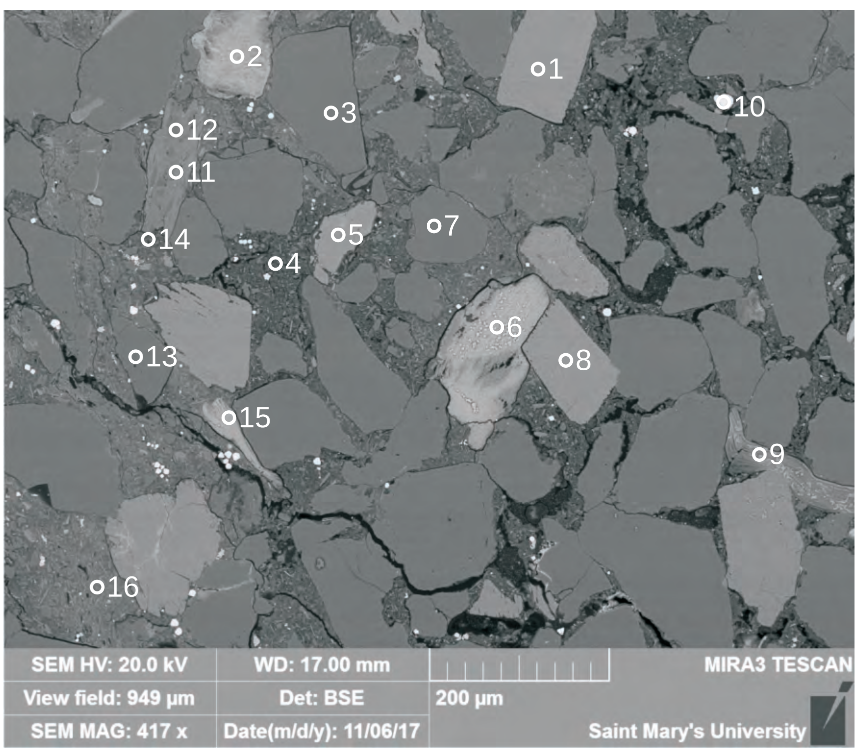
1:Glaucony
2:Quartz
3:Monazite + Mixture
4:Chlorite + Biotite
5:Biotite
6:Quartz
7:Glaucony +
8:Quartz +
9:Glaucony +
10:Quartz
11:Quartz
12:K-feldspar
13:Kaolinite

Figure 1-5.9: Sample 3H-58 1804.26 (SEM) site 7. This site consists of detrital quartz (2,6,8,10-11) K-feldspar (12), chlorite + biotite (4), and biotite (5). The micas in this site appears to follow bedding planes. The matrix is probably made up of illite + chlorite, and kaolinite (13) in the cement. Glaucony (1) appears to be replacing a pellet, while glaucony (7,9) appear to be replacing matrix.



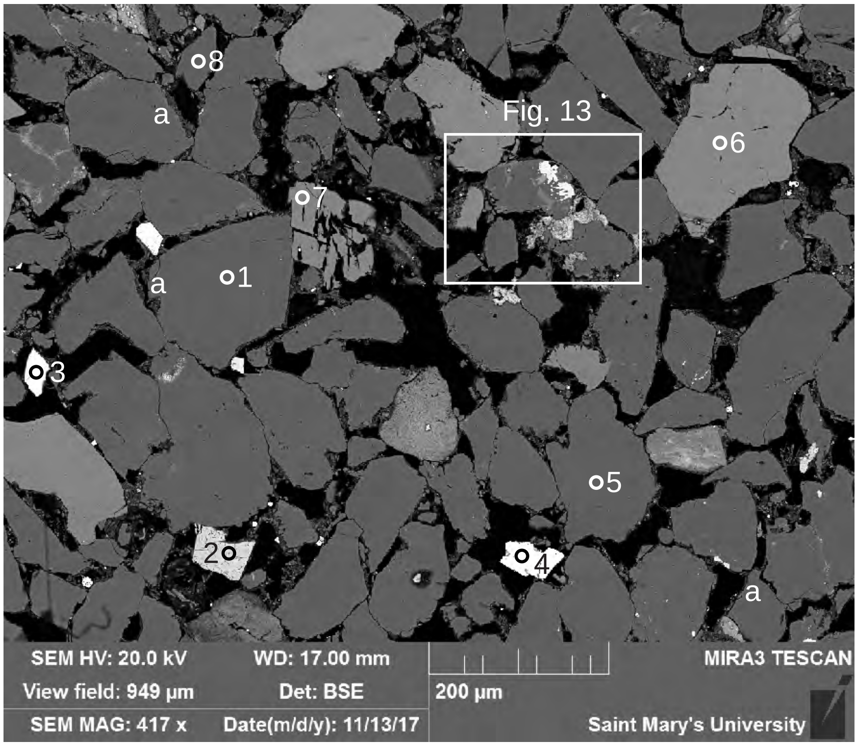
1:K-feldspar
2:Chlorite + Muscovite
3:Glaucony ? + Halite
4:Quartz
5:Illite + Chlorite
6:Ilmenite
7:K-feldspar
8:Quartz +
9:Quartz
10:K-feldspar
11:Illite + Chlorite
12:Chlorite + Biotite
13:Mixture
14:TiO_2
15:Quartz

Figure 1-5.10: Sample 3H-58 1804.26 (SEM) site 8. This sample is similar to site 6. There is also diagenetic titania (14) filling voids in quartz.



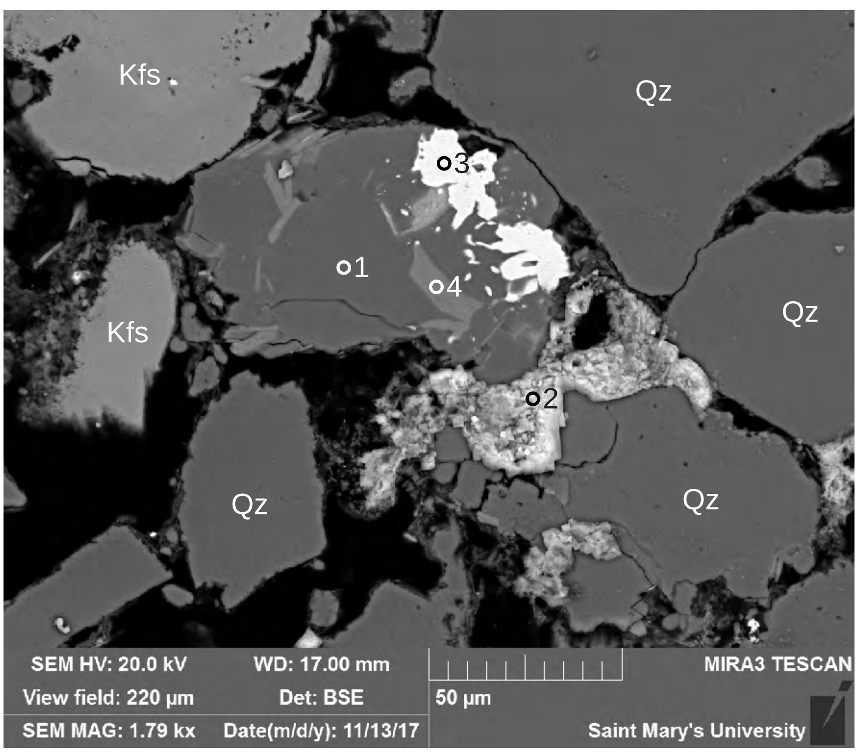
1:K-feldspar
2:Glaucony
3:Quartz
4:Illite + Chlorite
5:K-feldspar
6:Glaucony ? + Halite
7:Quartz
8:K-feldspar
9:Chlorite? + Halite
10:Pyrite
11:Muscovite + Chlorite
12:Quartz
13:Quartz
14:Illite + Chlorite
15:Chlorite + Biotite?
16:Illite + Chlorite + Quartz

Figure 1-5.11: Sample 3H-58 1804.26 (SEM) site 9. This site is similar to site 6. Muscovite + halite (9) appear to be plastically deformed. Glaucony (6) appear to be replacing pellet. The halite in this site is made up of very fine-grained crystals, that appear to be very late; possibly due to washing the core in salt water.



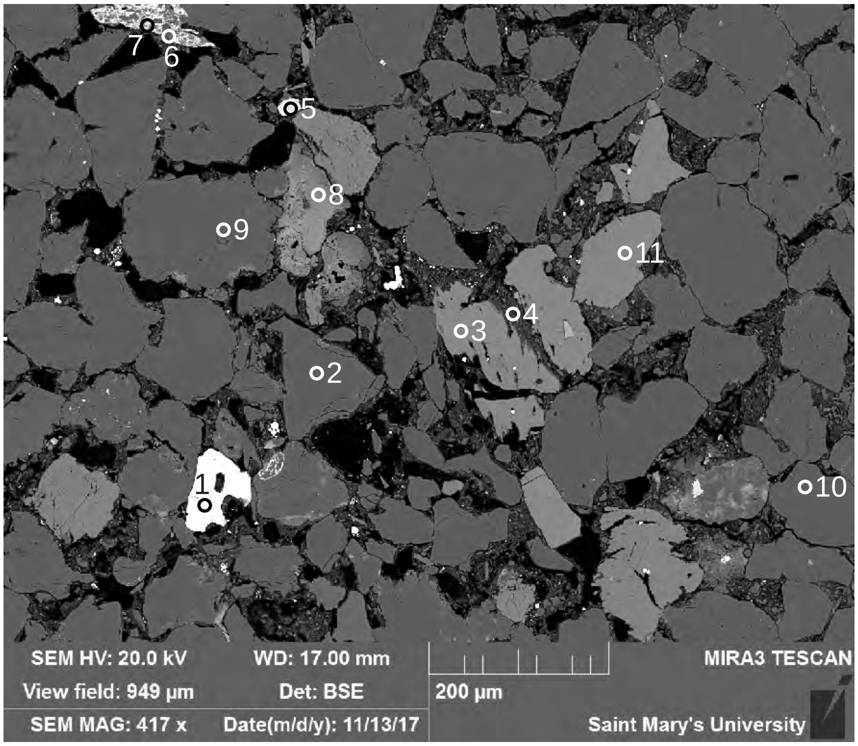
1:Quartz
2:Spinel
3:Ilmenite
4:Ilmenite
5:Quartz
6:K-feldspar
7:K-feldspar
8:Quartz

Figure 1-5.12: Sample 3H-58 1804.26 (SEM) site 10. This site consists of detrital quartz (1,5,8), K-feldspar (6-7), ilmenite (3-4), and spinel (2). Clays (probably made up of illite + chlorite) partially coat grains (positions a).



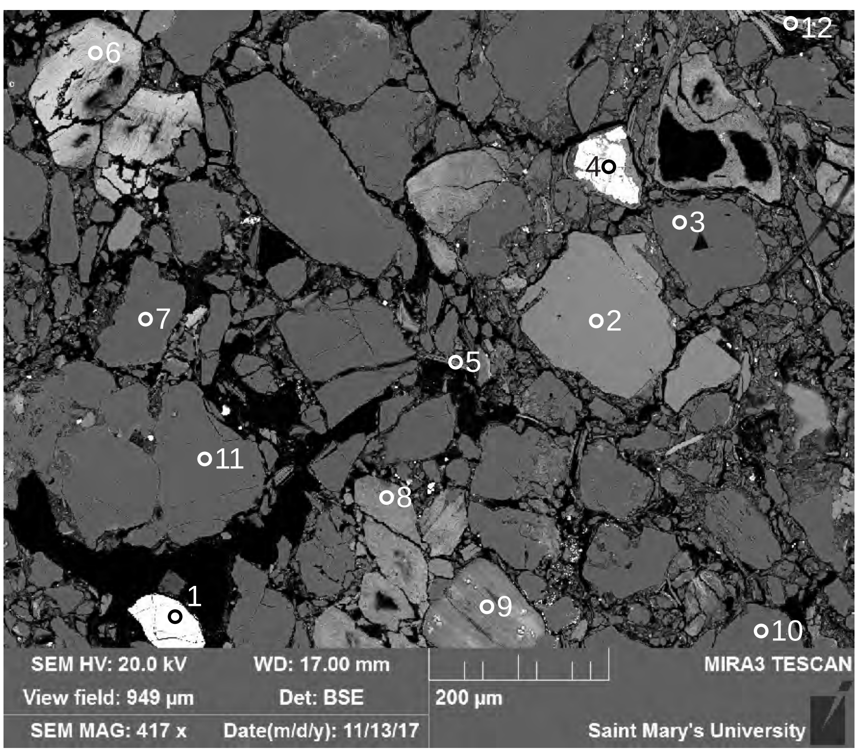
1:Quartz
2:Halite
3:TiO_2
4:Muscovite + Chlorite

Figure 1-5.13: Sample 3H-58 1804.26 (SEM) site 10.1. This site consists of a peraluminous felsic lithic clast made up of quartz (1) and muscovite + chlorite (4). The titania (3) is late diagenetic, and the halite (2) is most likely from washing the core in salt water.



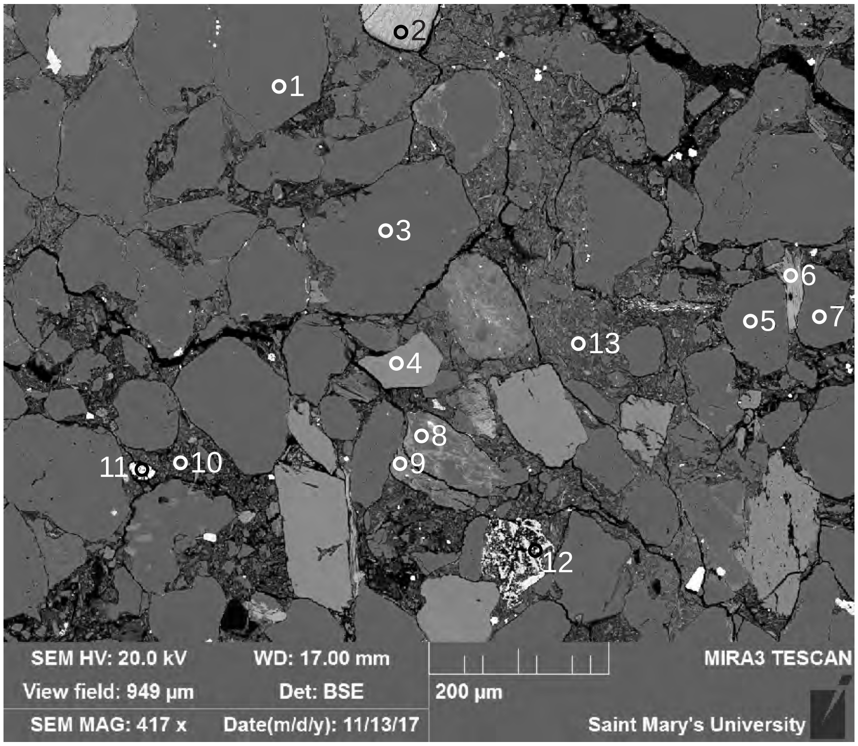
1:Ilmenite
2:Quartz
3:K-feldspar
4:Illite + Chlorite
5:TiO_2
6:Quartz
7:TIO_2
8:Clay + Fe-Chlorite
9:Quartz
10:Quartz
11:K-feldspar

Figure 1-5.14: Sample 3H-58 1804.26 (SEM) site 11. This site consists of detrital quartz (2,6,9-10), K-feldspar (3,11), ilmenite (1), and altered ilmenite (now titania) (7) with quartz (6) inclusions. The matrix is made up of illite + chlorite (4), and diagenetic titania (5) partially fills a void in the matrix. Clay + Fe-chlorite may be an ?altered grain.



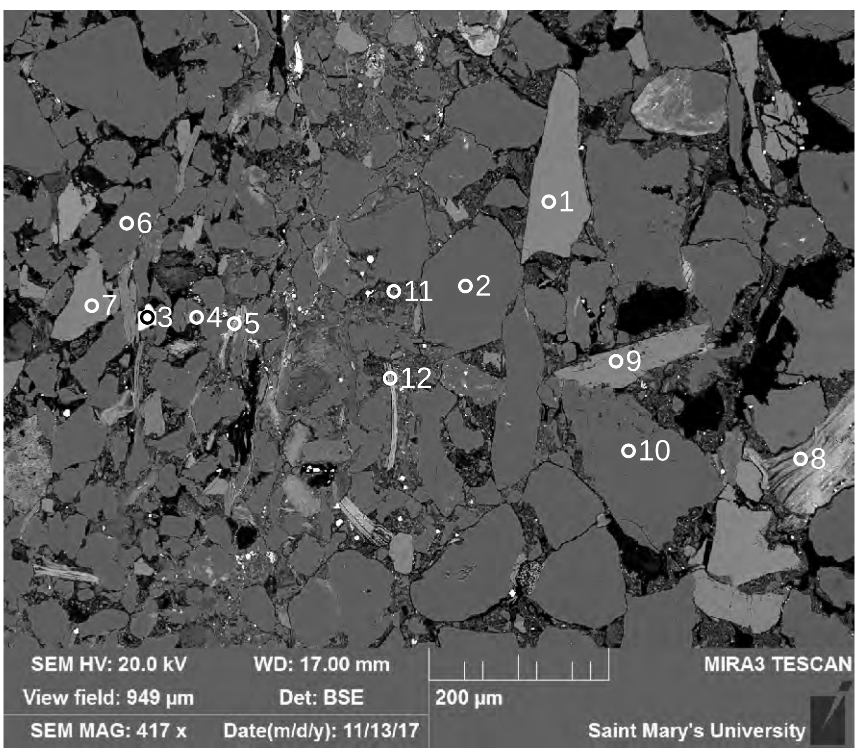
1:Ilmenite
2:K-feldspar
3:Quartz
4:"Ilmenite"
5:Muscovite + Chlorite
6:Clay + Fe-Chlorite
7:Quartz
8:Glaucony
9:Fe-Clay
10:Quartz
11:Quartz
12:Chlorite +

Figure 1-5.15: Sample 3H-58 1804.26 (SEM) site 12. This site is similar to site 11. There is also detrital chlorite (12), muscovite + chlorite (5) grains, and a glaucony (8) grain. The matrix in this site appears to be made up of illite + chlorite.



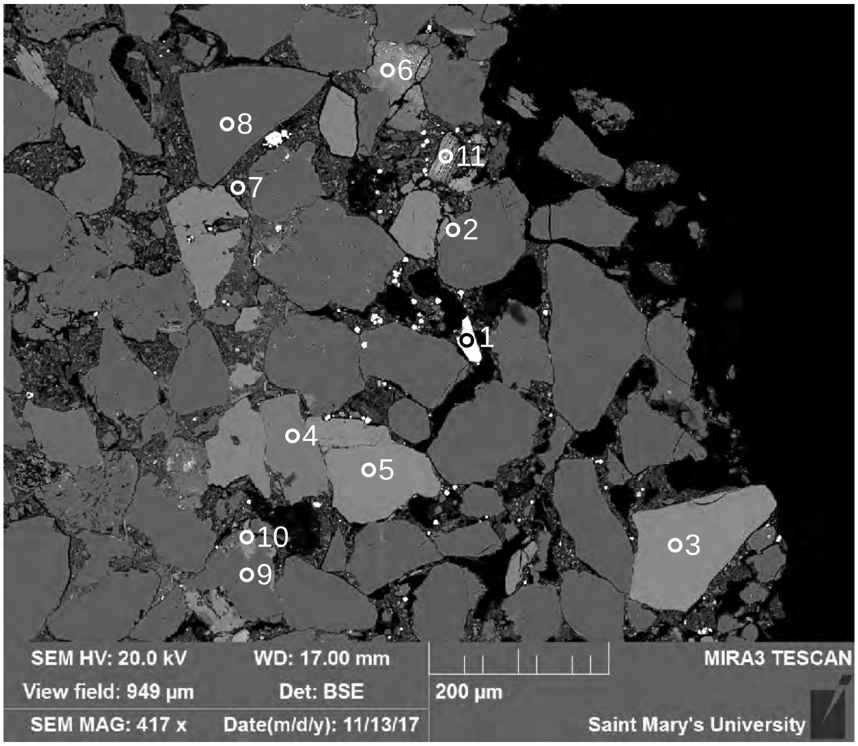
1:Quartz
2:Glaucony + Fe-Chlorite ?
3:Quartz
4:K-feldspar
5:Quartz
6:Chlorite +
7:Quartz
8:Quartz
9:Chlorite + Muscovite
10:Quartz +
11:Pyrite
12:TiO_2 +
13:Illite + Chlorite

Figure 1-5.16: Sample 3H-58 1804.26 (SEM) site 13. This site is similar to site 11. Pyrite (11) and ?titania (12) are late diagenetic minerals. The matrix is made up of illite + chlorite (13). There is also a glaucony + Fe-chlorite grain (2).



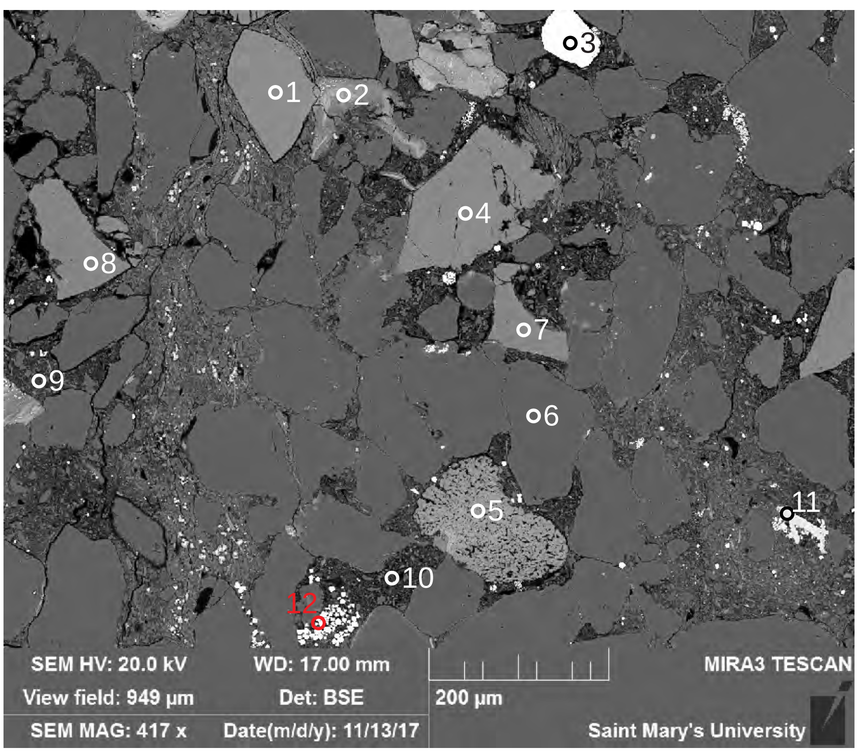
1:K-feldspar
2:Quartz
3:Ilmenite
4:Quartz
5:Chlorite
6:Quartz
7:K-feldspar
8:Fe-Chlorite
9:K-feldspar
10:Quartz
11:Illite + Chlorite
12:Chlorite +

Figure 1-5.17: Sample 3H-58 1804.26 (SEM) site 14. This site is similar to site 7. Micas appear to follow bedding planes. The matrix consists of illite + chlorite (11).



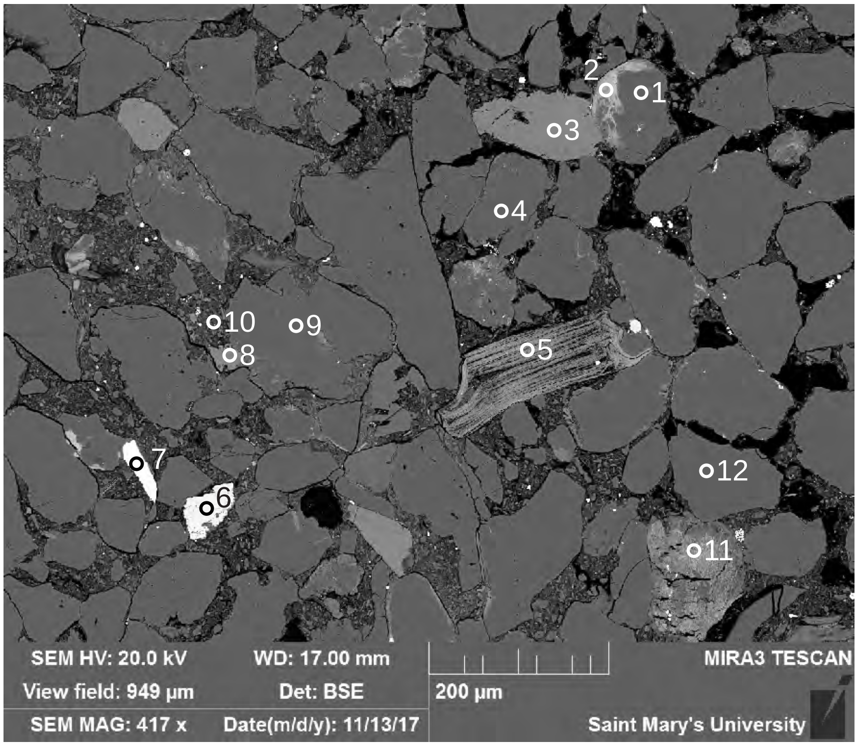
1:Zircon
2:Quartz
3:K-feldspar
4:Albite + K-feldspar
5:K-feldspar
6:Glaucony? + Halite
7:Illite + Chlorite
8:Quartz
9:Quartz
10:K-feldspar
11:Chlorite + Biotite

Figure 1-5.18: Sample 3H-58 1804.26 (SEM) site 15. This site is similar to site 11. There is also detrital zircon (1), a mixture of albite + K-feldspar (4), probably microperthite, and chlorite + biotite (11). The matrix is made up of illite + chlorite (7). There is also glaucony + halite (6) mixture that appears to replace the matrix.



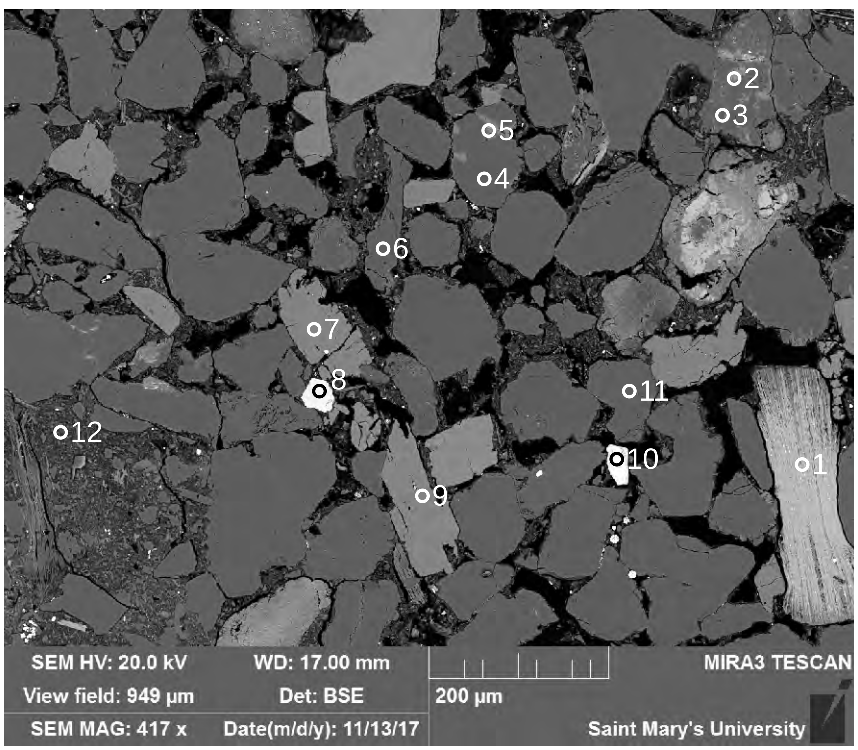
1:K-feldspar
2:Glaucony
3:Ilmenite
4:K-feldspar
5:Glaucony +
6:Quartz
7:K-feldspar
8:K-feldspar
9:Illite + Chlorite
10:Illite + Chlorite
11:TiO_2 +
12:Pyrite

Figure 1-5.19: Sample 3H-58 1804.26 (SEM) site 16. This site is similar to site 15. There is also diagenetic pyrite (12) and titania (11). Glaucony (2) appears to be replacing matrix, and glaucony (5) is replacing a pellet.



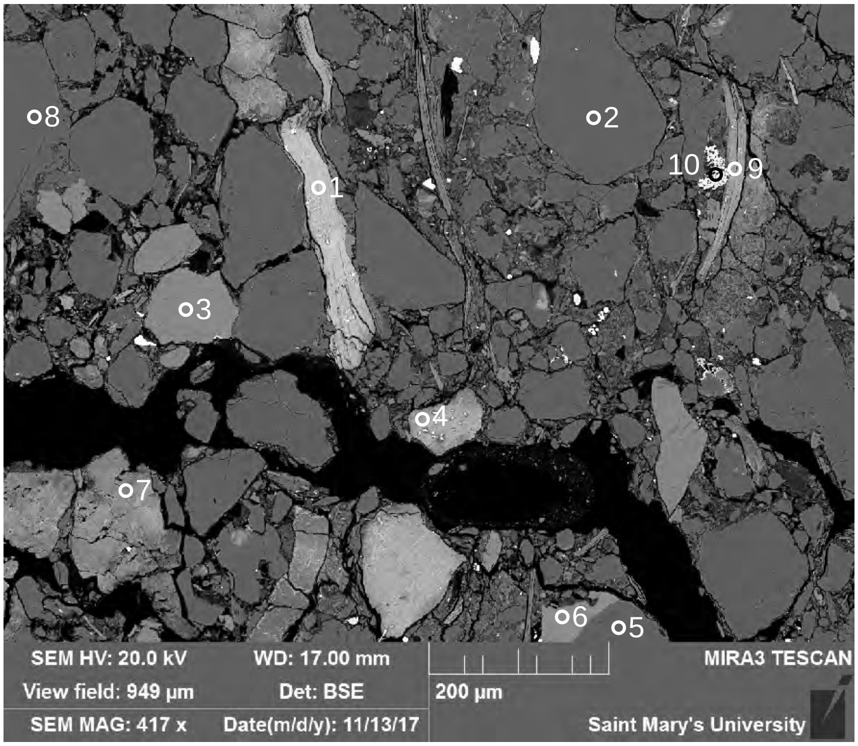
1:Quartz
2:Fe-Chlorite +
3:K-feldspar
4:Quartz
5:Chlorite +
6:TiO_2
7:Ilmenite
8:K-feldspar
9:Quartz
10:Illite + Chlorite
11:Clay + Fe-Chlorite
12:Quartz

Figure 1-5.20: Sample 3H-58 1804.26 (SEM) site 17. This site consists of detrital quartz (1,4,9,12), K-feldspar (3,8), ilmenite (7), and chlorite (5). The matrix is made up of illite + chlorite (10). Titania (6) appears to be diagenetic. Fe-chlorite (2) rims a quartz (1) grain, most likely replacing a Fe-rich clay coat.



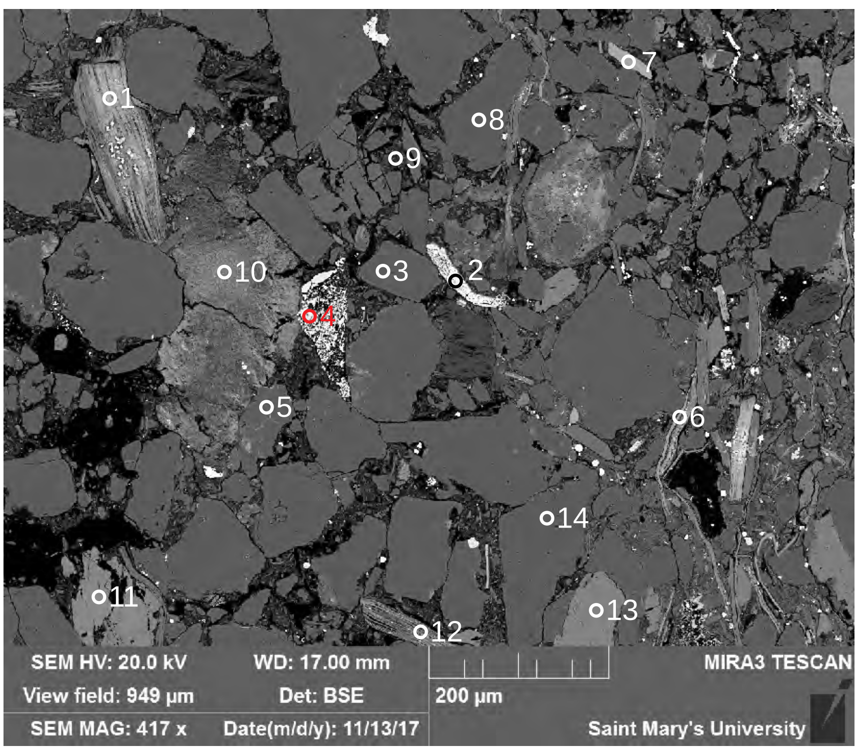
1:Fe-Chlorite
2:Fe-Chlorite +
3:Quartz +
4:Quartz
5:Fe-Chlorite ?
6:Quartz
7:K-feldspar
8:TiO_2
9:K-feldspar
10:"Ilmenite"
11:Quartz
12:Illite + Chlorite

Figure 1-5.21: Sample 3H-58 1804.26 (SEM) site 18. This site is similar to site 17. The matrix at this site is made up of probably illite + chlorite, and there is also an illite + chlorite intraclast (12).



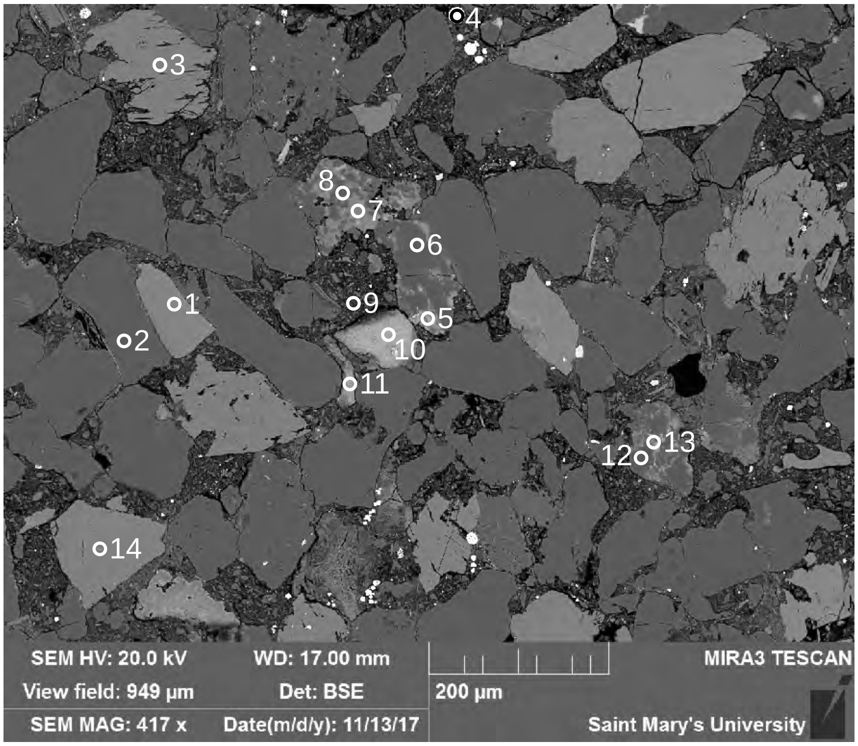
1:Fe-Chlorite
2:Quartz
3:K-feldspar
4:Glaucony
5:Quartz
6:K-feldspar
7:Glaucony
8:Quartz
9:Chlorite + Mica
10:TiO_2 +

Figure 1-5.22: Sample 3H-58 1804.26 (SEM) site 19. This site is similar to site 7. The micas appear to follow bedding planes. There is a late fracture that cuts through this site, and late diagenetic titania (10). Glaucony (4) appears to replace a grain, and (7) appears to replace matrix.



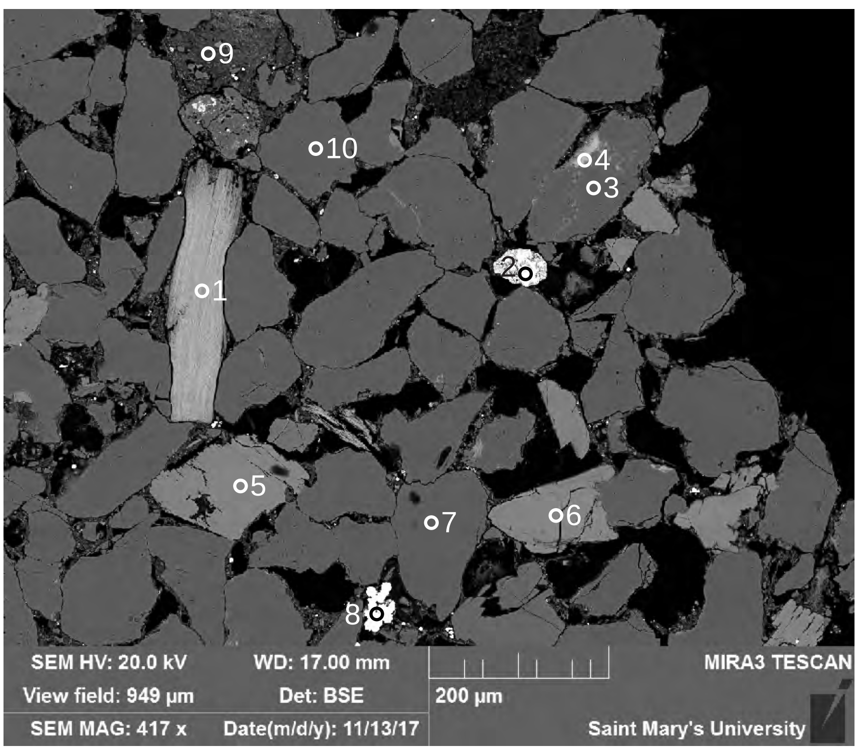
1:Fe-Chlorite + Mica
2:"Ilmenite"
3:Quartz
4:"Ilmenite"
5:Quartz
6:Chlorite +
7:Fe-Chlorite
8:Quartz
9:Illite + Chlorite
10:Glaucony +
11:K-feldspar
12:Chlorite + Biotite?
13:K-feldspar
14:Quartz

Figure 1-5.23: Sample 3H-58 1804.26 (SEM) site 20. This site is similar to site 19. Micas tend to follow bedding planes and the matrix is made up of illite + chlorite (9). Glaucony (10) appears to be replacing the matrix.



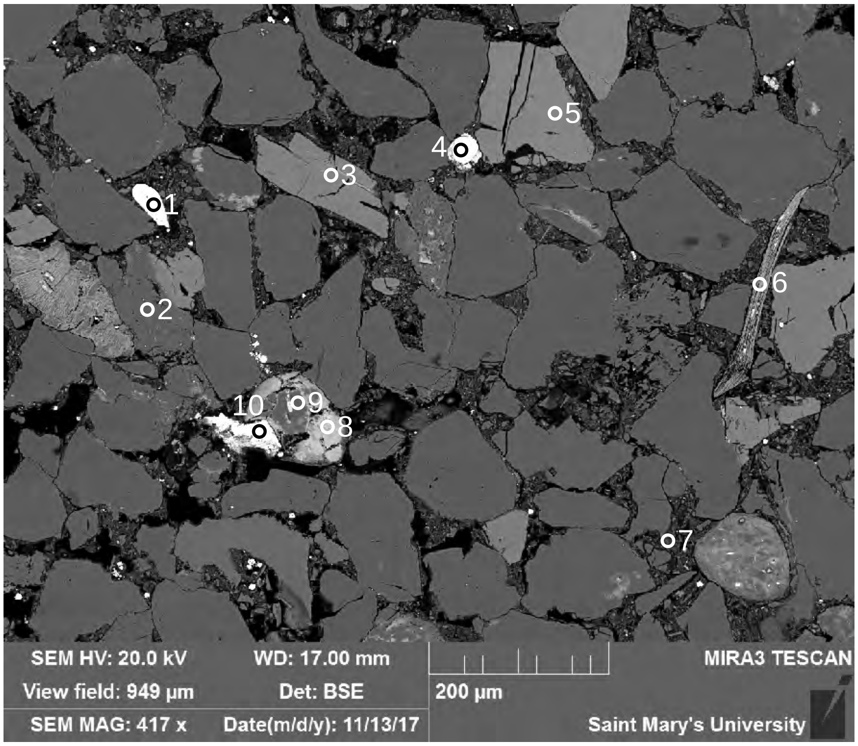
1:K-feldspar
2:Quartz
3:K-feldspar
4:Pyrite
5:Chlorite + Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:Illite + Chlorite
10:Clay + Fe-Chlorite
11:Clay + Fe-Chlorite
12:Quartz
13:Fe-Chlorite
14:K-feldspar

Figure 1-5.24: Sample 3H-58 1804.26 (SEM) site 21. This site consists of detrital quartz (2,12), K-feldspar (1,3,14), and a granitic lithic clast made up of quartz (6,8) and K-feldspar (7). The matrix in this site consists of illite + chlorite (9). Late frambodial diagenetic pyrite (4) partially fills voids in the matrix.



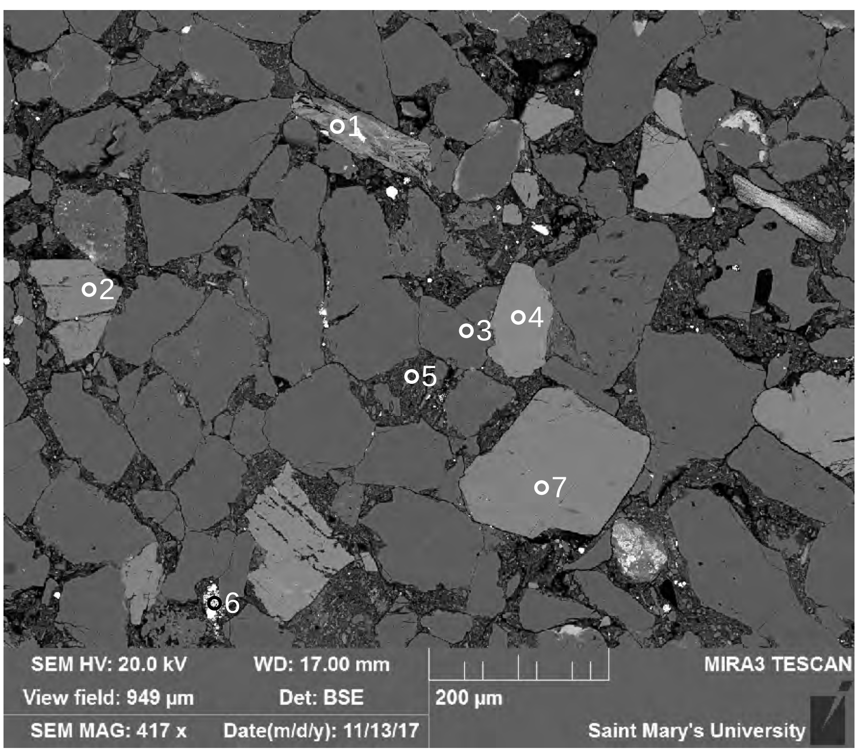
1:Chlorite + Muscovite
2:"Ilmenite"
3:Quartz
4:Fe-Chlorite
5:K-feldspar
6:K-feldspar
7:Quartz
8:Pyrite
9:Illite + Chlorite
10:Quartz

Figure 1-5.25: Sample 3H-58 1804.26 (SEM) site 22. This site consists of detrital quartz (3,7,10), K-feldspar (5-6), ilmenite (2), and chloritized muscovite (1) grains. The matrix is made up of illite + chlorite (9), with late diagenetic pyrite (8) partially filling voids.



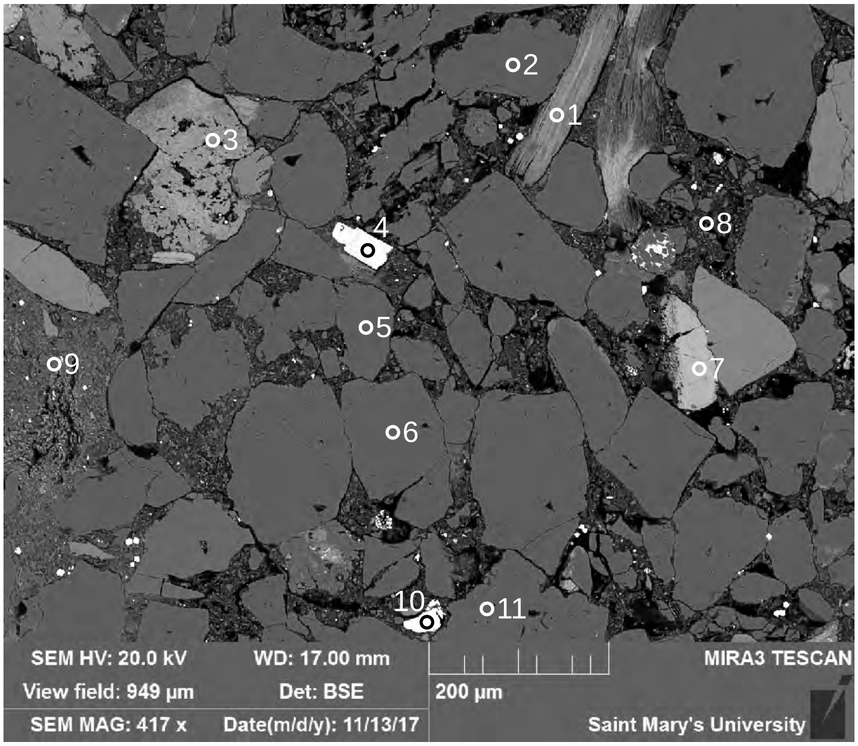
1:Zircon
2:Quartz
3:K-feldspar
4:Ilmenite
5:K-feldspar
6:Chlorite + Biotite
7:Illite + Chlorite
8:Clay + Fe-Chlorite
9:Quartz
10:Ilmenite

Figure 1-5.26: Sample 3H-58 1804.26 (SEM) site 23. This site is similar to site 21. There is also a detrital zircon (1), and ilmenite (10) grain. Diagenetic pyrite (4) is the latest mineral to form. Clay + Fe-chlorite (8) coat a quartz (9) grain.



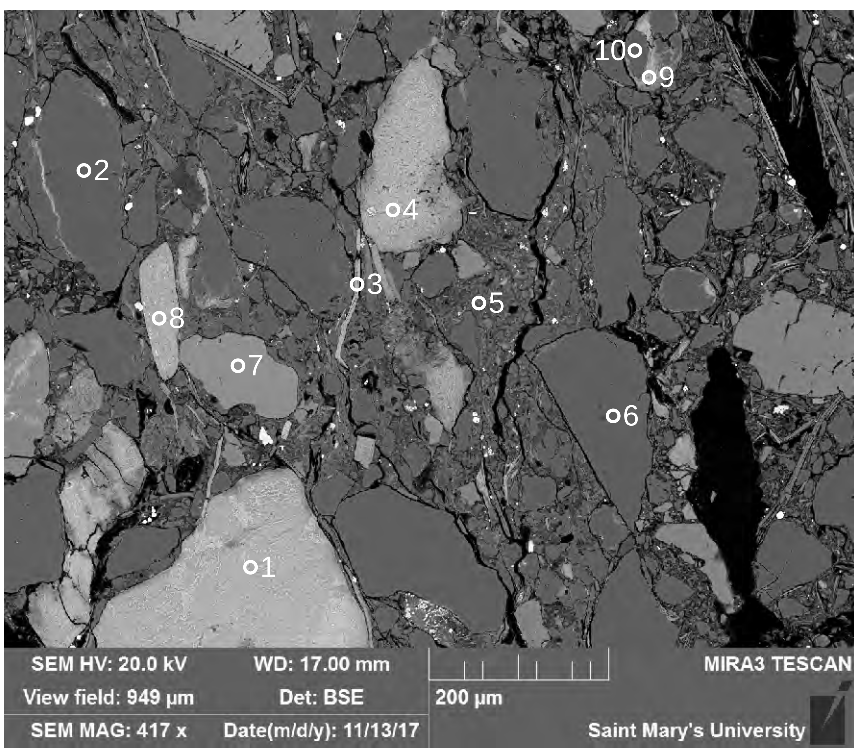
1:Chlorite +
2:K-feldspar
3:Quartz
4:K-feldspar
5:Illite + Chlorite
6:Pyrite
7:K-feldspar

Figure 1-5.27: Sample 3H-58 1804.26 (SEM) site 24. This site consists of detrital quartz (3), K-feldspar (2,4,7), and a chloritized mica (?biotite) (1). The matrix is made up of illlite + chlorite (5), with late diagenetic pyrite (6) partially filling voids.



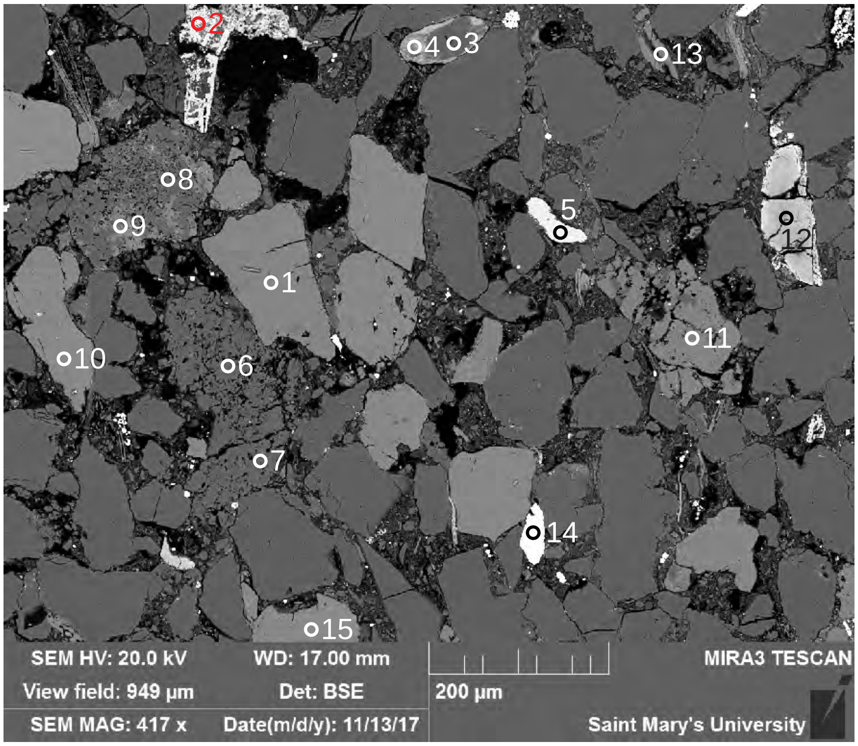
1:Chlorite + Muscovite
2:Quartz
3:Glaucony
4:"Ilmenite"
5:Quartz
6:Quartz
7:Fe-Chlorite
8:Illite + Chlorite
9:Illite + Chlorite
10:Ilmenite
11:Quartz

Figure 1-5.28: Sample 3H-58 1804.26 (SEM) site 25. This site is similar to site 18. The micas appear to be plastically deformed. There is also detrital ilmenite (4,10), and the matrix is made up of illite + chlorite (8-9). Glaucony (3) appears to be replacing a detrital grain or lithic clast.



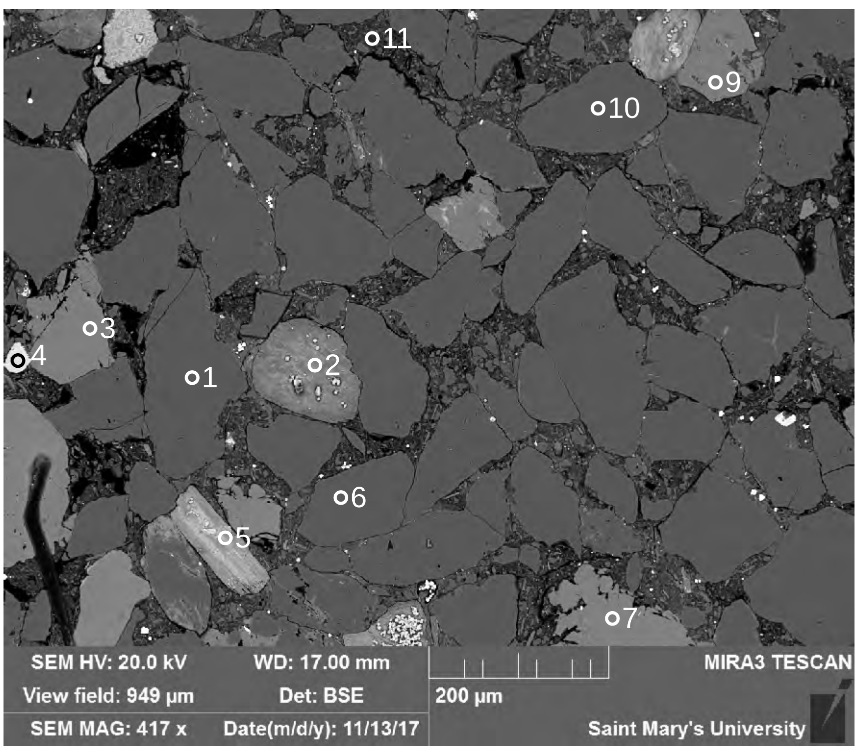
1:Glaucony
2:Quartz
3:Chlorite
4:Glaucony
5:Quartz + K-feldspar
6:Quartz
7:K-feldspar
8:Fe-Chlorite +
9:Fe-Chlorite +
10:Quartz

Figure 1-5.29: Sample 3H-58 1804.26 (SEM) site 26. This site is similar to site 7. Micas appear to be following bedding planes, but it is difficult to tell. Glacuony (1,4) appears to be replacing pellets. Fe-chlorite (8) appears as a pellet and Fe-chlorite (9) appears to have replaced an earlier mineral in quartz (10).



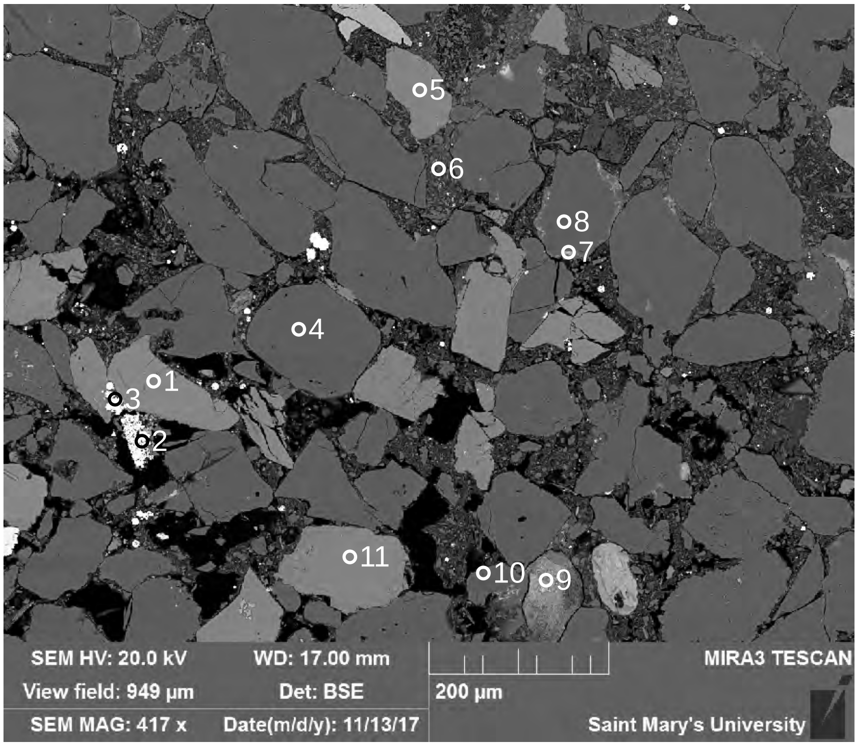
1:K-feldspar
2:"Ilmenite"
3:Quartz
4:Muscovite + Chlorite
5:TiO_2
6:Albite
7:Albite +
8:Albite
9:K-feldspar + Albite
10:K-feldspar
11:K-feldspar
12:TiO_2 +
13:K-feldspar
14:Zircon
15:K-feldspar

Figure 1-5.30: Sample 3H-58 1804.26 (SEM) site 27. This site consists of detrital quartz (3), K-feldspar (1,10-11,13,15), zircon (14), altered ilmenite (2), partially dissolved albite (6-7), and albitized K-feldspar (8-9) grains. The matrix is made up of probably illite + chlorite, and diagenetic titania (5).



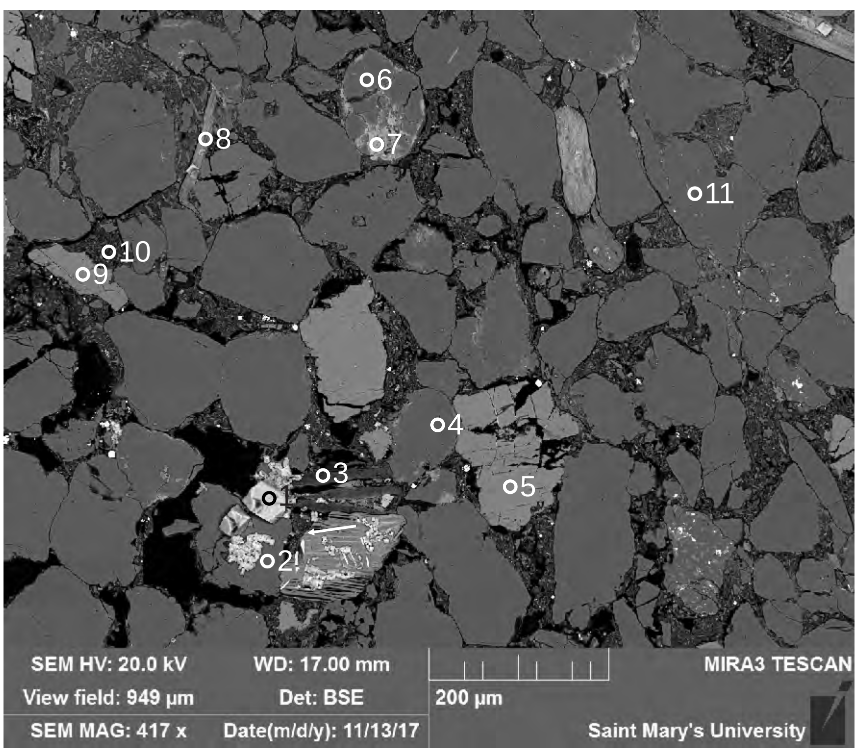
1:Quartz
2:Chlorite +
3:K-feldspar
4:TiO_2
5:Chlorite +
6:Quartz
7:K-feldspar
9:K-feldspar
10:Quartz
11:Illite + Chlorite

Figure 1-5.31: Sample 3H-58 1804.26 (SEM) site 28. This site is similar to site 27. There is also detrital chloritized grain probably albite (5). The matrix is made up of illite + chlorite (11).



1:K-feldspar
2:Pyrite
3:Pyrite
4:Quartz
5:K-feldspar
6:Illite + Chlorite
7:Fe-Chlorite + Quartz
8:Quartz
9:Glaucony + Halite
10:Quartz
11:K-feldspar

Figure 1-5.32: Sample 3H-58 1804.26 (SEM) site 29. This site consists of detrital quartz (4,8,10), and K-feldspar (1,5,11) grains. The matrix is made up of illite + chlorite (6), with late diagenetic pyrite (2-3) partially filling voids in the matrix or along intergranular boundaries (3).



1:Halite
2:Quartz
3:Kaolinite
4:Quartz
5:K-feldspar
6:Quartz
7:Fe-Chlorite +
8:Chlorite + Mica
9:K-feldspar
10:Illite + Chlorite
11:Quartz

Figure 1-5.33: Sample 3H-58 1804.26 (SEM) site 30. This site is similar to site 29. Kaolinite fills a pore (arrow) adjacent to a kaolinitized mica or K-feldspar (3).

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	1	1	Chl + Kfs	48.56		11.33	27.31		3.06		2.22	6.37			1.15											100	80
3H-58 1804.26	1	2	Qz	100.00																						100	100
3H-58 1804.26	1	3	Ms + Chl	51.93	0.31	28.87	5.43		2.94			10.51														100	90
3H-58 1804.26	1	4	Kln	46.63		33.87	2.77		0.54	0.34	0.52	0.16		0.76	0.42											86	74
3H-58 1804.26	1	5	Qz	100.00																						100	100
3H-58 1804.26	1	6	Kfs	66.05		17.60					0.58	15.77														100	94
3H-58 1804.26	1	7	Ilm	1.00	49.27		47.29	2.12							0.32											100	75
3H-58 1804.26	1	8	Mix	64.05	0.55	15.52	12.69		2.17		1.23	2.82			0.95											100	78
3H-58 1804.26	1	9	Fe-Chl +	42.87		21.28	27.89		3.64		2.14	1.42			0.75											100	80
3H-58 1804.26	1	10	Kfs + Chl	60.52		17.94	6.13		0.71		1.20	12.62			0.19					0.68						100	85
3H-58 1804.26	1	11	Qz	100.00																						100	97
3H-58 1804.26	1	12	Ill + Chl	63.29	0.55	24.76	5.15		1.35		0.72	3.55			0.61											100	64
3H-58 1804.26	1	13	Ms	47.41	0.92	35.00	0.60		0.59		1.66	8.83														95	90
3H-58 1804.26	1	14	Qz	100.00																						100	103
3H-58 1804.26	1	15	Kfs	66.35		17.65					0.59	15.41														100	101
3H-58 1804.26	1	16	Ilm	0.50	51.29		42.89	0.50	4.81																	100	89
3H-58 1804.26	2	1	Kfs	66.31		17.78					0.98	14.93														100	94
3H-58 1804.26	2	2	Chl	36.09	1.16	20.03	19.43		4.60		0.57	3.12														85	79
3H-58 1804.26	2	3	Qz	100.00																						100	99
3H-58 1804.26	2	4	Kfs	65.78		17.95					0.83	14.77								0.68						100	97
3H-58 1804.26	2	5	Qz	100.00																						100	100
3H-58 1804.26	2	6	Gly	41.12		15.72	22.31		3.00		0.93	2.81			1.10											87.00	40
3H-58 1804.26	2	7	Qz	100.00																						100	102
3H-58 1804.26	2	8	Qz	100.00																						100	101
3H-58 1804.26	2	9	Qz	100.00																						100	99
3H-58 1804.26	2	10	Ill + Chl +	49.57		30.32	8.22		1.44	2.24	0.80	1.48		5.03	0.90											100	49
3H-58 1804.26	2	11	Ill + Chl	56.27		27.58	9.03	0.39	3.70		0.75	1.56			0.72											100	56
3H-58 1804.26	2	12	Clay + Fe-Chl	45.42		15.61	30.23		3.68		1.11	3.71			0.25											100	77
3H-58 1804.26	2	13	Gly	44.16		13.08	21.78		2.57		0.78	3.65			0.97											87.00	61
3H-58 1804.26	3	1	Qz	100.00																						100	98
3H-58 1804.26	3	2	Fe-Chl +	37.99	0.46	16.12	35.12		4.72		1.17	2.70			1.71											100	54
3H-58 1804.26	3	3	Qz + Mnz-(Ce)	39.36		1.37						0.83	18.74								10.33	22.19	7.17			100	95
3H-58 1804.26	3	4	Qz	100.00																						100	97
3H-58 1804.26	3	5	Kfs	66.20		17.55					0.75	14.93								0.57						100	95
3H-58 1804.26	3	6	Kfs	66.09		17.90					0.90	15.11														100	96
3H-58 1804.26	3	7	Ill + Chl	51.91	2.00	29.53	9.56		1.79	0.38	1.45	2.19			1.18											100	47
3H-58 1804.26	3	8	Kfs	66.04		18.04					1.29	13.89								0.75						100	93
3H-58 1804.26	3	9	Qz	100.00																						100	96
3H-58 1804.26	3	10	Ilm	0.56	52.49		45.48		1.47																	100	85
3H-58 1804.26	3	11	Chl +	28.50	16.77	18.01	26.05		9.18		0.62	0.62			0.24											100	76
3H-58 1804.26	3	12	Kfs	65.78		17.78					0.50	15.21								0.73						100	94
3H-58 1804.26	3	13	Kfs + Chl	51.97		13.66	22.98		3.21		1.13	6.34			0.71											100	71
3H-58 1804.26	4	1	Qz	100.00																						100	92
3H-58 1804.26	4	2	Kfs	66.39		17.71					0.69	15.21														100	89
3H-58 1804.26	4	3	Fe-Clay	48.33		30.00	17.17		2.24		1.17	0.64			0.46											100	72
3H-58 1804.26	4	4	Fe-Clay	49.00		30.02	16.32		1.65		1.32	1.25			0.44											100	74
3H-58 1804.26	4	5	Fe-Chl ?	42.96		19.90	29.56		2.93		1.73	1.87			1.06											100	65
3H-58 1804.26	4	6	Ms + Chl	49.46		32.85	7.21		0.99		0.99	8.30			0.21											100	81
3H-58 1804.26	4	7	Ms + Chl	45.29		26.89	18.34		1.78		1.44	5.92			0.35											100	78
3H-58 1804.26	4	8	Kfs	65.53		18.04					1.53	13.55								1.35						100	90
3H-58 1804.26	4	9	Qz	100.00																						100	93

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	4	10	Qz	100.00																						100	92
3H-58 1804.26	4	11	Qz	100.00																						100	93
3H-58 1804.26	4	12	Kfs	66.40		17.71					0.83	15.05														100	90
3H-58 1804.26	4	13	Qz + Kln +	74.98	0.41	16.32	4.19		1.10		0.80	1.75			0.45											100	66
3H-58 1804.26	5	1	Qz	100.00																						100	89
3H-58 1804.26	5	2	Py	0.60			37.50							61.59	0.32											100	89
3H-58 1804.26	5	3	Kfs	64.40		18.19					1.16	13.68								2.58						100	86
3H-58 1804.26	5	4	Ilm	1.02	57.14		40.47	1.37																		100	75
3H-58 1804.26	5	5	Kfs	66.31		18.14					0.64	14.91														100	77
3H-58 1804.26	5	6	Qz	100.00																						100	86
3H-58 1804.26	5	7	Mix	66.92		7.41	21.28		2.15		1.45	0.45			0.34											100	77
3H-58 1804.26	5	8	"Ilm"	0.99	70.87		26.08	2.05																		100	76
3H-58 1804.26	5	9	Qz	100.00																						100	88
3H-58 1804.26	5	10	Qz	100.00																						100	89
3H-58 1804.26	5	11	Qz	100.00																						100	88
3H-58 1804.26	5	12	Qz	100.00																						100	86
3H-58 1804.26	5	13	Kfs	65.55		17.75					0.65	15.17								0.89						100	84
3H-58 1804.26	5.1	1	Ab + Kfs	67.05	0.34	19.02				0.93	7.90	4.76														100	82
3H-58 1804.26	6	1	Zrn	31.20															68.80							100	81
3H-58 1804.26	6	2	Ilm	0.70	55.99		40.78	2.54																		100	71
3H-58 1804.26	6	3	Chl	36.10	0.64	17.28	22.24		3.86		1.62	2.64			0.62											85	64
3H-58 1804.26	6	4	Bt?	40.47	1.98	19.91	23.61	0.47	7.90	0.44	0.98	4.02			0.22											100	63
3H-58 1804.26	6	5	Ill + Chl	55.90	1.15	30.88	5.79		1.61		1.37	2.76			0.54											100	63
3H-58 1804.26	6	6	Chl + Bt	37.94		16.37	36.05	0.49	5.00		2.40	1.28			0.47											100	62
3H-58 1804.26	6	7	Zrn	31.38															68.62							100	75
3H-58 1804.26	6	8	Qz	100.00																						100	76
3H-58 1804.26	6	9	Ill + Chl	52.62	0.57	32.33	8.00		2.46		0.81	2.71			0.50											100	58
3H-58 1804.26	6	10	Qz	100.00																						100	78
3H-58 1804.26	6	11	Bt	39.80	1.70	22.05	19.24		8.04	0.37	0.81	3.99														96	63
3H-58 1804.26	6	12	Kfs	66.34		17.71					0.38	15.58														100	75
3H-58 1804.26	6	13	Ill + Chl	47.99		15.83	26.50		3.02		1.49	4.36			0.80											100	55
3H-58 1804.26	6	14	Kfs +	71.57		16.39	5.40		0.69		0.63	5.13			0.18											100	66
3H-58 1804.26	6	15	Qz + Kfs	88.64	0.73	5.74	1.34		0.42			3.12														100	71
3H-58 1804.26	6	16	Qz	100.00																						100	75
3H-58 1804.26	7	1	Gly	38.15		12.88	28.13		2.39		1.55	3.32			0.57											87.00	61
3H-58 1804.26	7	2	Qz	99.02		0.65	0.32																			100	72
3H-58 1804.26	7	3	Mnz + Mix	22.27		12.38	6.32		0.98	19.85	1.01	2.29	23.57								2.50	6.45	2.38			100	56
3H-58 1804.26	7	4	Chl + Bt	40.23	0.72	21.98	28.17		5.55	0.49	1.24	1.30			0.31											100	55
3H-58 1804.26	7	5	Bt	41.21	2.17	22.37	15.82		8.21		0.44	4.97		0.60	0.22											96	57
3H-58 1804.26	7	6	Qz	99.07		0.74						0.19														100	69
3H-58 1804.26	7	7	Gly +	43.38		16.79	27.48		2.58	2.88	2.43	3.67			0.80											100	54
3H-58 1804.26	7	8	Qz +	80.68		4.03	13.06		0.64		0.64			0.75	0.21											100	63
3H-58 1804.26	7	9	Gly +	40.97		16.95	33.46		3.00		2.71	2.33			0.58											100	55
3H-58 1804.26	7	10	Qz	100.00																						100	71
3H-58 1804.26	7	11	Qz	100.00																						100	67
3H-58 1804.26	7	12	Kfs	65.99		17.75					0.65	15.62														100	67
3H-58 1804.26	7	13	Kln	47.83		36.45	1.08				0.40	0.25														86	48
3H-58 1804.26	8	1	Kfs	65.56		17.78					0.54	15.40								0.72						100	63
3H-58 1804.26	8	2	Chl + Ms	43.50		19.74	27.78		3.36		2.20	2.35			1.07											100	52
3H-58 1804.26	8	3	Gly ? + Hl	39.53		14.56	34.58		4.06		3.92	1.74			1.60											100	49
3H-58 1804.26	8	4	Qz	100.00																						100	63

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	8	5	Ill + Chl	54.21	0.74	30.81	8.05		1.65		0.96	2.58			0.99											100	36
3H-58 1804.26	8	6	Ilm	0.77	51.16		43.72	0.64	3.72																	100	54
3H-58 1804.26	8	7	Kfs	66.62		18.09					1.49	13.80														100	59
3H-58 1804.26	8	8	Qz +	87.72		8.21	1.95		0.50		0.43	0.93			0.26											100	46
3H-58 1804.26	8	9	Qz	99.19			0.81																			100	59
3H-58 1804.26	8	10	Kfs	66.19		16.97	1.71				0.47	14.67														100	57
3H-58 1804.26	8	11	Ill + Chl	51.53		33.99	10.77		1.83		0.87	0.39			0.62											100	36
3H-58 1804.26	8	12	Chl + Bt	39.31	1.57	18.25	27.91		6.27		1.18	4.35		0.70	0.46											100	46
3H-58 1804.26	8	13	Mix	47.39		22.88	4.91		1.83	6.43	0.78	3.13		11.08	1.57											100	19
3H-58 1804.26	8	14	TiO2	1.00	98.51		0.49																			100	53
3H-58 1804.26	8	15	Qz	98.83		0.84						0.33														100	58
3H-58 1804.26	9	1	Kfs	66.11		18.03					0.81	15.04														100	47
3H-58 1804.26	9	2	Gly	37.32		15.35	26.93		2.77		2.05	1.98			0.60											87.00	39
3H-58 1804.26	9	3	Qz	100.00																							100	47
3H-58 1804.26	9	4	Ill + Chl	55.31		30.76	7.56		1.58		1.00	2.55			1.24											100	26
3H-58 1804.26	9	5	Kfs	65.80	0.40	17.85					0.58	15.37														100	45
3H-58 1804.26	9	6	Gly ? + Hl	38.89		12.22	31.09		3.43		7.22	3.33			3.81											100	40
3H-58 1804.26	9	7	Qz	100.00																							100	46
3H-58 1804.26	9	8	Kfs	66.51		17.99					1.12	14.38														100	45
3H-58 1804.26	9	9	Chl? + Hl	31.81		20.85	8.03		1.28		22.03	1.18			14.82											100	42
3H-58 1804.26	9	10	Py	0.50			28.63				0.41			70.46												100	82
3H-58 1804.26	9	11	Ms + Chl	51.41		32.27	4.69		1.54		1.36	8.72														100	39
3H-58 1804.26	9	12	Qz	98.65		1.00	0.36																			100	42
3H-58 1804.26	9	13	Qz	100.00																							100	43
3H-58 1804.26	9	14	Ill + Chl	56.39		29.47	7.23		1.94		0.99	3.25			0.73											100	27
3H-58 1804.26	9	15	Chl + Bt?	42.20	1.63	18.22	22.01		8.85		2.10	4.03			0.95											100	37
3H-58 1804.26	9	16	Ilt + Chl + Qz	62.03	0.79	23.77	6.35		1.56		1.70	2.88			0.91											100	34
3H-58 1804.26	10	1	Qz	100.00																							100	120
3H-58 1804.26	10	2	Spl			37.08	18.76		13.22									30.94								100	109
3H-58 1804.26	10	3	Ilm	0.53	51.68		44.62	0.51	2.65																	100	105
3H-58 1804.26	10	4	Ilm		52.25		45.15	0.82	1.78																	100	109
3H-58 1804.26	10	5	Qz	100.00																							100	123
3H-58 1804.26	10	6	Kfs	66.28		17.66					0.63	15.43														100	115
3H-58 1804.26	10	7	Kfs	66.51		17.75					1.36	14.38														100	116
3H-58 1804.26	10	8	Qz	100.00																							100	118
3H-58 1804.26	10.1	1	Qz	100.00																							100	120
3H-58 1804.26	10.1	2	Hl	4.74		1.02	0.65			4.19	47.39				42.01											100	133
3H-58 1804.26	10.1	3	TiO2	1.19	98.25		0.56																			100	106
3H-58 1804.26	10.1	4	Ms + Chl	53.24	0.91	30.26	2.24		2.16		0.29	10.91														100	108
3H-58 1804.26	11	1	Ilm		51.44	0.48	43.76	0.63	3.70																	100	107
3H-58 1804.26	11	2	Qz	100.00																							100	121
3H-58 1804.26	11	3	Kfs	65.60		18.14					1.16	14.14								0.97						100	117
3H-58 1804.26	11	4	Ill + Chl	55.46	0.75	33.02	5.87		1.27		0.82	2.11			0.70											100	77
3H-58 1804.26	11	5	TiO2	0.97	98.18	0.47	0.38																			100	105
3H-58 1804.26	11	6	Qz	99.76	0.24																						100	117
3H-58 1804.26	11	7	TIO2	10.99	86.61	0.92	1.48																			100	103
3H-58 1804.26	11	8	Clay + Fe-Chl	38.29		14.71	37.84		3.92		2.34	1.13		0.66	1.10											100	83
3H-58 1804.26	11	9	Qz	100.00																							100	119
3H-58 1804.26	11	10	Qz	100.00																							100	124
3H-58 1804.26	11	11	Kfs	66.09		17.98					0.80	15.13														100	116
3H-58 1804.26	12	1	Ilm		52.23		46.37	1.40																		100	108

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	12	2	Kfs	65.75		17.82					0.63	15.31								0.49						100	118
3H-58 1804.26	12	3	Qz	100.00																						100	121
3H-58 1804.26	12	4	"Ilm"	1.08	73.00	0.54	17.73	4.11		0.65			2.89													100	95
3H-58 1804.26	12	5	Ms + Chl	50.32		33.62	3.71		0.83		0.68	10.84														100	104
3H-58 1804.26	12	6	Clay + Fe-Chl	37.15		14.28	42.07		3.61		1.52	1.01			0.37											100	87
3H-58 1804.26	12	7	Qz	100.00																						100	120
3H-58 1804.26	12	8	Gly	40.86		11.08	26.00		2.81		1.07	4.52			0.68											87.00	87
3H-58 1804.26	12	9	Fe-Clay	49.66		32.28	15.46		1.30		0.83	0.47														100	101
3H-58 1804.26	12	10	Qz	100.00																						100	126
3H-58 1804.26	12	11	Qz	100.00																						100	121
3H-58 1804.26	12	12	Chl +	38.03	2.02	19.76	25.38	0.47	6.84	1.33	1.03	3.42	1.26		0.47											100	83
3H-58 1804.26	13	1	Qz	100.00																						100	120
3H-58 1804.26	13	2	Gly + Fe-Chl ?	42.25		15.27	33.36		3.75		1.51	3.45			0.41											100	97
3H-58 1804.26	13	3	Qz	100.00																						100	122
3H-58 1804.26	13	4	Kfs	65.82		17.87					0.82	14.88								0.61						100	120
3H-58 1804.26	13	5	Qz	100.00																						100	124
3H-58 1804.26	13	6	Chl +	42.73	1.74	21.84	20.73	0.45	7.01		0.69	4.57			0.23											100	102
3H-58 1804.26	13	7	Qz	100.00																						100	123
3H-58 1804.26	13	8	Qz	100.00																						100	124
3H-58 1804.26	13	9	Chl + Ms	51.85		30.44	10.85		1.63		0.84	4.40														100	100
3H-58 1804.26	13	10	Qz +	90.05		8.15	1.01		0.26			0.34			0.19											100	106
3H-58 1804.26	13	11	Py	0.24			28.98							70.78												100	229
3H-58 1804.26	13	12	TiO2 +	4.34	87.09	4.23	1.92			0.48			1.27		0.65											100	72
3H-58 1804.26	13	13	Ill + Chl	55.38	3.52	27.18	7.46		1.64		0.85	3.10			0.85											100	88
3H-58 1804.26	14	1	Kfs	66.38		17.92					0.88	14.82														100	116
3H-58 1804.26	14	2	Qz	100.00																						100	121
3H-58 1804.26	14	3	Ilm	0.51	53.94		42.42	0.77	2.36																	100	104
3H-58 1804.26	14	4	Qz	95.87		2.33	1.40					0.15			0.25											100	92
3H-58 1804.26	14	5	Chl	33.89		21.26	23.86	0.23	3.46		0.48	1.03		0.63	0.15											85	101
3H-58 1804.26	14	6	Qz	100.00																						100	119
3H-58 1804.26	14	7	Kfs	66.61		17.65					1.07	14.66														100	115
3H-58 1804.26	14	8	Fe-Chl	29.89	0.91	15.63	29.35	0.38	7.00	0.36	1.06				0.42											85.00	81
3H-58 1804.26	14	9	Kfs	66.00		17.94					0.73	15.33														100	117
3H-58 1804.26	14	10	Qz	100.00																						100	124
3H-58 1804.26	14	11	Ill + Chl	53.92	0.42	31.27	7.94		1.78		1.23	2.72			0.70											100	83
3H-58 1804.26	14	12	Chl +	41.52	1.76	21.25	21.63	0.27	6.91		0.46	5.23		0.79	0.19											100	101
3H-58 1804.26	15	1	Zrn	31.37															68.63							100	121
3H-58 1804.26	15	2	Qz	100.00																						100	122
3H-58 1804.26	15	3	Kfs	65.47		17.96					1.07	14.32								1.18						100	121
3H-58 1804.26	15	4	Ab + Kfs	67.62		18.14	0.27				6.98	6.52								0.47						100	119
3H-58 1804.26	15	5	Kfs	65.45		18.17					0.81	14.67								0.89						100	119
3H-58 1804.26	15	6	Gly? + Hl	42.98		18.01	17.23		2.16		11.08	3.47			5.07											100	106
3H-58 1804.26	15	7	Ill + Chl	53.82	1.19	29.72	8.32		1.71		0.94	3.56			0.75											100	76
3H-58 1804.26	15	8	Qz	100.00																						100	118
3H-58 1804.26	15	9	Qz	100.00																						100	123
3H-58 1804.26	15	10	Kfs	66.27		17.48	0.25				0.46	15.54														100	120
3H-58 1804.26	15	11	Chl + Bt	25.24	1.11	12.75	16.97		4.55	0.44	22.52	2.88		0.64	12.90											100	117
3H-58 1804.26	16	1	Kfs	65.14		17.89					0.72	15.09								1.16						100	116
3H-58 1804.26	16	2	Gly	40.71		12.59	24.31		2.51		1.76	4.45			0.67											87.00	95
3H-58 1804.26	16	3	Ilm		51.43		46.79	1.79																		100	105
3H-58 1804.26	16	4	Kfs	65.47		18.00					0.65	15.15								0.73						100	118

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	16	5	Gly +	43.73		13.71	33.64		3.32		1.35	3.47			0.79											100	94
3H-58 1804.26	16	6	Qz	100.00																						100	124
3H-58 1804.26	16	7	Kfs	65.93		17.89					1.06	14.57								0.55						100	120
3H-58 1804.26	16	8	Kfs	66.31		17.65					0.42	15.62														100	117
3H-58 1804.26	16	9	Ill + Chl	55.39	1.52	28.99	8.34		1.49		1.06	2.39			0.81											100	79
3H-58 1804.26	16	10	Ill + Chl	67.34	0.27	21.05	6.96		1.17		0.80	1.66			0.76											100	86
3H-58 1804.26	16	11	TiO2 +	1.23	90.67	3.78	1.97				0.58		1.77													100	109
3H-58 1804.26	16	12	Py	0.26			29.24							70.51												100	233
3H-58 1804.26	17	1	Qz	98.11		1.31				0.23	0.35															100	121
3H-58 1804.26	17	2	Fe-Chl +	44.66		20.44	28.15	0.32	2.20		1.16	2.81			0.26											100	101
3H-58 1804.26	17	3	Kfs	66.20		17.85						15.95														100	117
3H-58 1804.26	17	4	Qz	100.00																						100	122
3H-58 1804.26	17	5	Chl +	41.93		21.40	29.41		3.72		2.09	0.75			0.72											100	96
3H-58 1804.26	17	6	TiO2	0.52	98.80		0.68																			100	108
3H-58 1804.26	17	7	Ilm		46.02		48.78	1.09	4.11																	100	105
3H-58 1804.26	17	8	Kfs	66.19		17.56	0.29					15.96														100	120
3H-58 1804.26	17	9	Qz	100.00																						100	121
3H-58 1804.26	17	10	Ill + Chl	57.90	1.38	28.72	6.27		1.38		0.82	2.67			0.86											100	82
3H-58 1804.26	17	11	Clay + Fe-Chl	40.23		14.12	36.90	0.33	4.30		1.68	1.76			0.67											100	93
3H-58 1804.26	17	12	Qz	100.00																						100	125
3H-58 1804.26	18	1	Fe-Chl	32.66		14.47	31.32		3.59		1.22	1.53			0.22											85.00	99
3H-58 1804.26	18	2	Fe-Chl +	42.47		19.03	30.60		3.15		2.42	1.47			0.86											100	91
3H-58 1804.26	18	3	Qz +	84.54	8.08	2.76	3.46		0.52		0.43	0.21														100	116
3H-58 1804.26	18	4	Qz	100.00																						100	120
3H-58 1804.26	18	5	Fe-Chl ?	38.04		13.65	38.58	0.33	4.87		2.97	0.45			1.12											100	86
3H-58 1804.26	18	6	Qz	100.00																						100	121
3H-58 1804.26	18	7	Kfs	66.42		17.75					0.72	15.12														100	117
3H-58 1804.26	18	8	TiO2	0.81	98.77		0.42																			100	106
3H-58 1804.26	18	9	Kfs	66.37		17.78					0.70	15.15														100	120
3H-58 1804.26	18	10	"Ilm"	1.45	77.85	2.64	16.34		0.40		0.57				0.25			0.51								100	104
3H-58 1804.26	18	11	Qz	100.00																						100	123
3H-58 1804.26	18	12	Ill + Chl	58.77	0.51	27.73	7.44		1.26		0.97	2.84			0.48											100	83
3H-58 1804.26	19	1	Fe-Chl	31.35	0.36	12.70	31.98		4.79		2.36	0.98			0.49											85.00	99
3H-58 1804.26	19	2	Qz	100.00																						100	121
3H-58 1804.26	19	3	Kfs	65.66		17.79					0.67	15.22								0.66						100	116
3H-58 1804.26	19	4	Gly	39.21		12.01	26.62		2.87	0.22	1.57	4.14			0.36											87.00	96
3H-58 1804.26	19	5	Qz	100.00																						100	124
3H-58 1804.26	19	6	Kfs	65.70		17.76					0.66	14.84								1.03						100	122
3H-58 1804.26	19	7	Gly	40.53		11.96	25.35		2.67		1.19	4.51			0.78											87.00	88
3H-58 1804.26	19	8	Qz	100.00																						100	117
3H-58 1804.26	19	9	Chl + Mica	42.68	0.68	25.03	25.72		3.19		1.10	1.35			0.25											100	96
3H-58 1804.26	19	10	TiO2 +	1.16	92.32	2.32	2.06			0.34	0.70		0.75		0.35											100	94
3H-58 1804.26	20	1	Fe-Chl + Mica	36.97	0.55	18.10	35.92		4.16		1.70	2.06			0.53											100	87
3H-58 1804.26	20	2	"Ilm"	1.32	73.12	0.75	24.31		0.50																	100	96
3H-58 1804.26	20	3	Qz	100.00																						100	120
3H-58 1804.26	20	4	"Ilm"	0.84	92.44		6.72																			100	105
3H-58 1804.26	20	5	Qz	100.00																						100	122
3H-58 1804.26	20	6	Chl +	42.94	0.50	21.82	14.42		9.09	0.71	0.59	4.36	2.54	1.03	0.20							1.80				100	104
3H-58 1804.26	20	7	Fe-Chl	24.74		21.54	27.34	0.59	9.55	0.43				0.80												85.00	98
3H-58 1804.26	20	8	Qz	100.00																						100	118
3H-58 1804.26	20	9	Ill + Chl	55.73	0.95	27.09	6.17		1.49	1.64	1.01	2.40	2.11	0.60	0.81											100	66

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	20	10	Gly +	43.01		15.05	32.77		3.27		1.48	3.42			1.00											100	84
3H-58 1804.26	20	11	Kfs	65.61		17.84					0.34	15.43								0.78						100	117
3H-58 1804.26	20	12	Chl + Bt?	42.06	1.58	21.48	19.63		7.36	0.68	0.59	4.98		1.19	0.45											100	94
3H-58 1804.26	20	13	Kfs	65.78		17.70					0.67	15.85														100	112
3H-58 1804.26	20	14	Qz	100.00																						100	123
3H-58 1804.26	21	1	Kfs	65.74		17.71					0.64	15.19								0.71						100	115
3H-58 1804.26	21	2	Qz	100.00																						100	118
3H-58 1804.26	21	3	Kfs	66.35		17.80					1.26	14.59														100	113
3H-58 1804.26	21	4	Py	0.30			28.86							70.84												100	219
3H-58 1804.26	21	5	Chl + Qz	49.70		14.77	25.64	0.38	7.92	0.20	1.17				0.22											100	98
3H-58 1804.26	21	6	Qz	100.00																						100	118
3H-58 1804.26	21	7	Kfs	65.66		17.57	0.42				0.68	14.98								0.70						100	115
3H-58 1804.26	21	8	Qz	100.00																						100	118
3H-58 1804.26	21	9	Ill + Chl	53.77	0.29	29.48	9.21		2.62		1.10	2.75			0.78											100	80
3H-58 1804.26	21	10	Clay + Fe-Chl	41.50		14.48	33.76		3.81	1.46	1.86	2.79			0.35											100	95
3H-58 1804.26	21	11	Clay + Fe-Chl	41.71		16.12	32.15		5.15		1.80	2.59			0.48											100	95
3H-58 1804.26	21	12	Qz	99.77			0.23																			100	123
3H-58 1804.26	21	13	Fe-Chl	32.73		16.18	29.14		4.59	0.22	1.21	0.57			0.37											85.00	96
3H-58 1804.26	21	14	Kfs	66.38		17.71					0.54	15.37														100	115
3H-58 1804.26	22	1	Chl + Ms	42.81		24.27	27.13	0.28	2.77		1.39	1.06			0.28											100	95
3H-58 1804.26	22	2	"Ilm"	1.28	73.80	1.17	22.40	0.96										0.38								100	101
3H-58 1804.26	22	3	Qz	100.00																						100	119
3H-58 1804.26	22	4	Fe-Chl	31.82		11.82	34.67	0.51	3.30		2.03	0.30			0.54											85.00	95
3H-58 1804.26	22	5	Kfs	66.49		17.78					1.14	14.59														100	117
3H-58 1804.26	22	6	Kfs	66.11		17.74					0.72	15.43														100	114
3H-58 1804.26	22	7	Qz	100.00																						100	122
3H-58 1804.26	22	8	Py	0.23			29.18							70.59												100	225
3H-58 1804.26	22	9	Ill + Chl	43.83		17.68	29.22		3.44		1.76	2.83			1.24											100	64
3H-58 1804.26	22	10	Qz	100.00																						100	119
3H-58 1804.26	23	1	Zrn	26.76		1.99	0.88			4.21	1.11				0.52	1.31			61.15					2.08		100	81
3H-58 1804.26	23	2	Qz	100.00																						100	118
3H-58 1804.26	23	3	Kfs	66.08		17.82	0.44				1.26	14.40														100	114
3H-58 1804.26	23	4	Ilm	0.47	50.06		46.57	2.46	0.44																	100	104
3H-58 1804.26	23	5	Kfs	66.14		17.91					0.51	15.44														100	115
3H-58 1804.26	23	6	Chl + Bt	41.79	1.72	18.25	19.39	0.26	11.25		0.65	6.19		0.51												100	103
3H-58 1804.26	23	7	Ill + Chl	54.09	1.23	31.84	6.48		1.28		1.24	2.66			1.19											100	77
3H-58 1804.26	23	8	Clay + Fe-Chl	36.35		13.80	42.75	0.47	3.66		2.05	0.29			0.62											100	95
3H-58 1804.26	23	9	Qz	99.10		0.52	0.38																			100	120
3H-58 1804.26	23	10	Ilm	0.82	55.63		39.40	4.15																		100	102
3H-58 1804.26	24	1	Chl	39.74		30.09	17.06		9.15		1.67	2.29														100	95
3H-58 1804.26	24	2	Kfs	66.26		17.85					0.75	15.15														100	115
3H-58 1804.26	24	3	Qz	100.00																						100	121
3H-58 1804.26	24	4	Kfs	65.26		18.18					0.92	14.65								0.99						100	117
3H-58 1804.26	24	5	Ill + Chl	55.27	0.70	27.62	9.57		1.66		1.50	2.40			1.27											100	64
3H-58 1804.26	24	6	Py	0.30			28.89				0.28			70.53												100	222
3H-58 1804.26	24	7	Kfs	66.20		17.75					0.46	15.59														100	119
3H-58 1804.26	25	1	Chl + Ms	48.03	0.65	25.55	20.22		2.02		0.75	2.59			0.20											100	95
3H-58 1804.26	25	2	Qz	100.00																						100	117
3H-58 1804.26	25	3	Gly	39.80		11.71	27.25		2.71		1.21	3.61			0.71											87.00	87
3H-58 1804.26	25	4	"Ilm"	0.67	69.72	0.78	28.19	0.65																		100	102
3H-58 1804.26	25	5	Qz	100.00																						100	120

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	25	6	Qz	100.00																						100	122
3H-58 1804.26	25	7	Fe-Chl	31.51		11.83	35.18	0.37	3.84		1.53	0.36			0.37											85.00	97
3H-58 1804.26	25	8	Ill + Chl	53.53	0.97	31.36	8.32		1.66		1.23	2.24			0.69											100	65
3H-58 1804.26	25	9	Ill + Chl	53.21	0.48	31.09	7.80		1.84		1.29	4.00			0.29											100	93
3H-58 1804.26	25	10	Ilm		50.86		46.06	1.02	1.02								1.02									100	108
3H-58 1804.26	25	11	Qz	100.00																						100	124
3H-58 1804.26	26	1	Gly	41.95		10.76	24.90		2.70		0.99	5.46			0.23											87.00	101
3H-58 1804.26	26	2	Qz	100.00																						100	118
3H-58 1804.26	26	3	Chl	30.80	1.80	17.19	27.63		6.35	0.29	0.76				0.19											85	92
3H-58 1804.26	26	4	Gly	39.76		10.80	27.82		3.04		1.18	4.17			0.23											87.00	97
3H-58 1804.26	26	5	Qz + Kfs	76.44	0.33	14.38	4.00		2.52		0.51	1.57			0.26											100	99
3H-58 1804.26	26	6	Qz	100.00																						100	123
3H-58 1804.26	26	7	Kfs	65.08		18.01					1.12	14.10								1.70						100	117
3H-58 1804.26	26	8	Fe-Chl +	38.62	1.44	18.16	25.03	0.25	8.62	1.02	0.94	5.13	0.78													100	102
3H-58 1804.26	26	9	Fe-Chl +	42.12	0.40	20.78	29.99	0.39	3.28		1.23	1.58			0.23											100	94
3H-58 1804.26	26	10	Qz	100.00																						100	119
3H-58 1804.26	27	1	Kfs	66.30		17.65					0.59	15.46														100	118
3H-58 1804.26	27	2	"Ilm"	1.09	90.84	1.57	2.49			0.62	1.00		1.20		0.70			0.50								100	96
3H-58 1804.26	27	3	Qz	99.70							0.30															100	119
3H-58 1804.26	27	4	Ms + Chl	52.75	0.41	25.04	12.72		2.84		0.61	5.63														100	104
3H-58 1804.26	27	5	TiO2	0.39	99.61																					100	109
3H-58 1804.26	27	6	Ab	69.39		18.93					11.68															100	119
3H-58 1804.26	27	7	Ab +	67.84		21.63	0.60				8.10	1.84														100	90
3H-58 1804.26	27	8	Ab	68.16		19.01	0.98				11.35	0.51														100	116
3H-58 1804.26	27	9	Kfs + Ab	66.66		17.87					3.82	11.64														100	106
3H-58 1804.26	27	10	Kfs	66.05		17.92					0.51	15.52														100	117
3H-58 1804.26	27	11	Kfs	63.17		17.02					3.40	14.76			1.65											100	123
3H-58 1804.26	27	12	TiO2 +	1.01	93.41	1.10	2.79			0.57	0.76				0.36											100	85
3H-58 1804.26	27	13	Kfs	66.27		17.65					0.45	15.63														100	112
3H-58 1804.26	27	14	Zrn	31.52															68.48							100	119
3H-58 1804.26	27	15	Kfs	65.38		18.06					0.92	14.79								0.84						100	119
3H-58 1804.26	28	1	Qz	100.00																						100	117
3H-58 1804.26	28	2	Chl +	45.33	0.30	23.29	21.82		3.11		1.67	3.51			0.98											100	100
3H-58 1804.26	28	3	Kfs	66.13		17.68					0.72	15.47														100	113
3H-58 1804.26	28	4	TiO2		99.34		0.66																			100	104
3H-58 1804.26	28	5	Chl +	38.04		18.98	32.43	0.28	3.04		4.91	0.51			1.83											100	97
3H-58 1804.26	28	6	Qz	100.00																						100	120
3H-58 1804.26	28	7	Kfs	65.75		17.95					1.09	14.48								0.73						100	118
3H-58 1804.26	28	9	Kfs	66.54		17.52					0.82	15.11														100	113
3H-58 1804.26	28	10	Qz	100.00																						100	117
3H-58 1804.26	28	11	Ill + Chl	54.55	0.50	34.33	5.07		1.26	0.31	1.06	1.81		0.59	0.52											100	80
3H-58 1804.26	29	1	Kfs	65.73		17.86					0.92	14.86								0.63						100	117
3H-58 1804.26	29	2	Py	0.98			56.52			0.27	0.60			40.49	1.14											100	107
3H-58 1804.26	29	3	Py	0.24			28.86				0.31			70.59												100	221
3H-58 1804.26	29	4	Qz	100.00																						100	121
3H-58 1804.26	29	5	Kfs	65.92		18.05					0.57	15.46														100	116
3H-58 1804.26	29	6	Ill + Chl	54.78	0.32	29.74	9.02		2.05		0.97	2.45			0.66											100	85
3H-58 1804.26	29	7	Fe-Chl + Qz	49.52		17.50	25.34	0.30	5.34		1.10	0.71			0.19											100	102
3H-58 1804.26	29	8	Qz	100.00																						100	121
3H-58 1804.26	29	9	Gly + Hl	37.33		11.87	25.01		3.09		9.65	4.04			9.00											100	102
3H-58 1804.26	29	10	Qz	100.00																						100	124

Table 1-5.1: EDS geochemical analyses of sample 3H-58 1804.26.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Sc2O3	V2O5	Cr2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	UO3	B2O3	Total	Actual Total
3H-58 1804.26	29	11	Kfs	66.18		17.51					0.39	15.74			0.17											100	120
3H-58 1804.26	30	1	Hl	0.42							46.51				53.07											100	135
3H-58 1804.26	30	2	Qz	100.00																						100	120
3H-58 1804.26	30	3	Fe-Clay	50.21		35.02	12.18		0.91		0.98				0.70											100	80
3H-58 1804.26	30	4	Qz	100.00																						100	121
3H-58 1804.26	30	5	Kfs	66.41		17.87					1.12	14.60														100	118
3H-58 1804.26	30	6	Qz	99.34			0.66																			100	115
3H-58 1804.26	30	7	Kln	41.09		16.92	33.31	0.41	3.85		2.19	1.51			0.72											100	90
3H-58 1804.26	30	8	Chl + Mica	43.98	0.82	27.73	19.09		3.61	0.67	1.69	1.13	0.69		0.59											100	89
3H-58 1804.26	30	9	Kfs	65.92		17.48					0.89	15.53			0.18											100	114
3H-58 1804.26	30	10	Ill + Chl	61.46	0.29	25.11	6.18		1.74		0.63	4.00			0.59											100	78
3H-58 1804.26	30	11	Qz	99.78			0.22																			100	117

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain
3. Gly refers to the mixture glaucony

Appendix 1-6: SEM-BSE images and EDS mineral analyses for sample 3H-58 2001.33.

Sample 3H-58 2001.33: Medium-fine grained sandstone with calcitic cement

Detrital Minerals: Albite, Chlorite, Chromite, Ilmenite, K-feldspar, Monazite-(Ce), Muscovite, Oligoclase, Quartz

Diageneitc Minerals: Calcite, Chlorite, Illite, Glauconite, Glaucony, Kaolinite, Pyrite, Siderite, Titania, ?Quartz overgrowths

Notes:

1. Siderite commonly appears to partially fill secondary porosity

2. Chloritized muscovite, probably detrital (Figs. 24,26)

3. Suturing is not usually seen

4. Carbonates coat detrital grains (Figs. 39,58)

5. There are rare kaolinite booklets, filling usually primary porosity (Figs. 19,25)

6. Glauconite commonly occurs in various forms, sometimes displaying volume reduction Fig. 16)

7. More than one generation of calcite has been seen (Fig. 45)

8. Paragenetic sequence:
Glaucony, Glauconite →Kaolinite ± Chlorite →Calcite →Siderite →Pyrite, Titania
↑ ↑ ↑ ↑
Figs. (i.e. 33,40,42,47,65) Fig. 19 Fig. 39 Fig. ?64

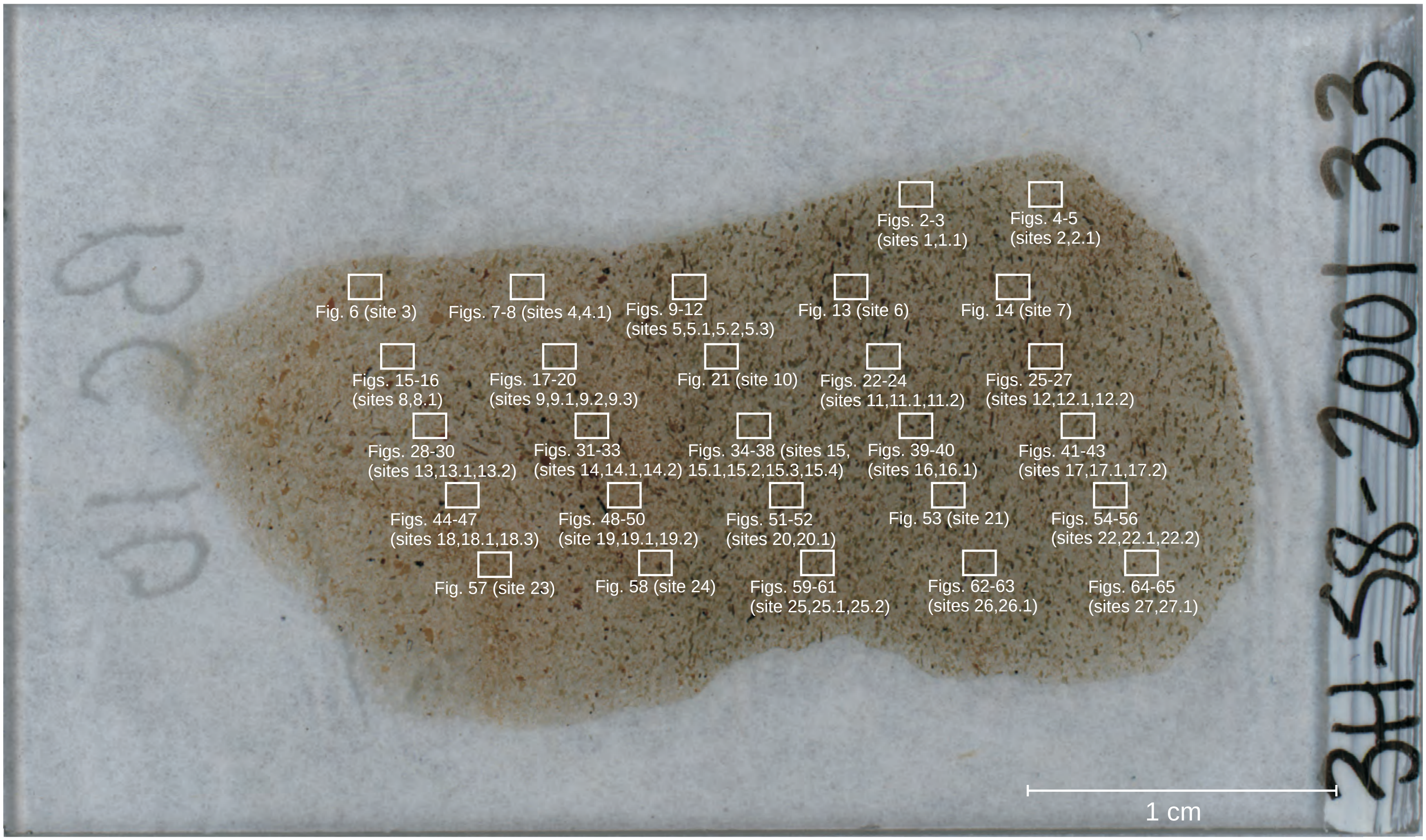
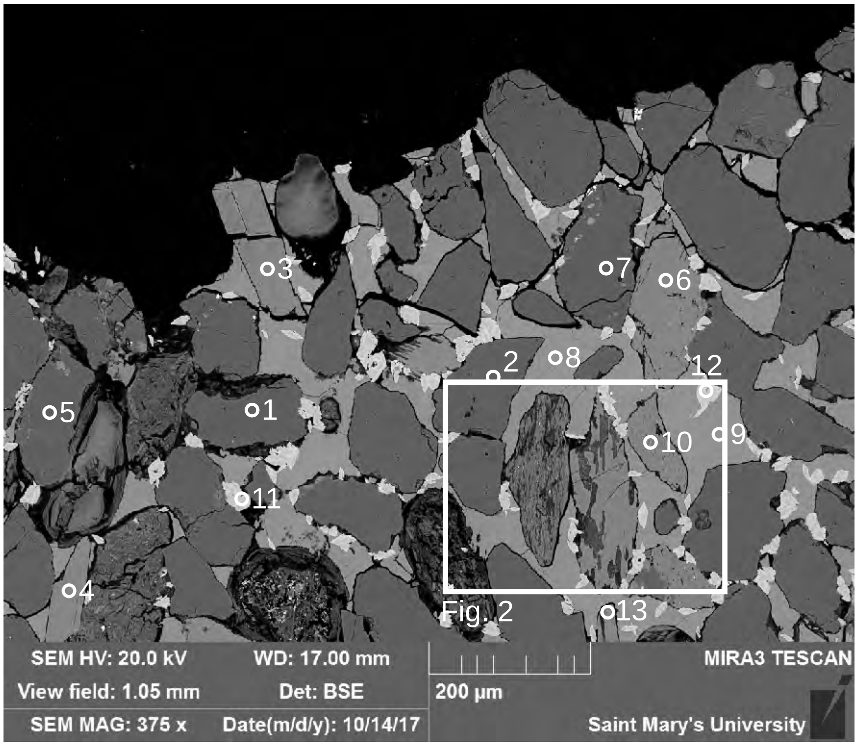
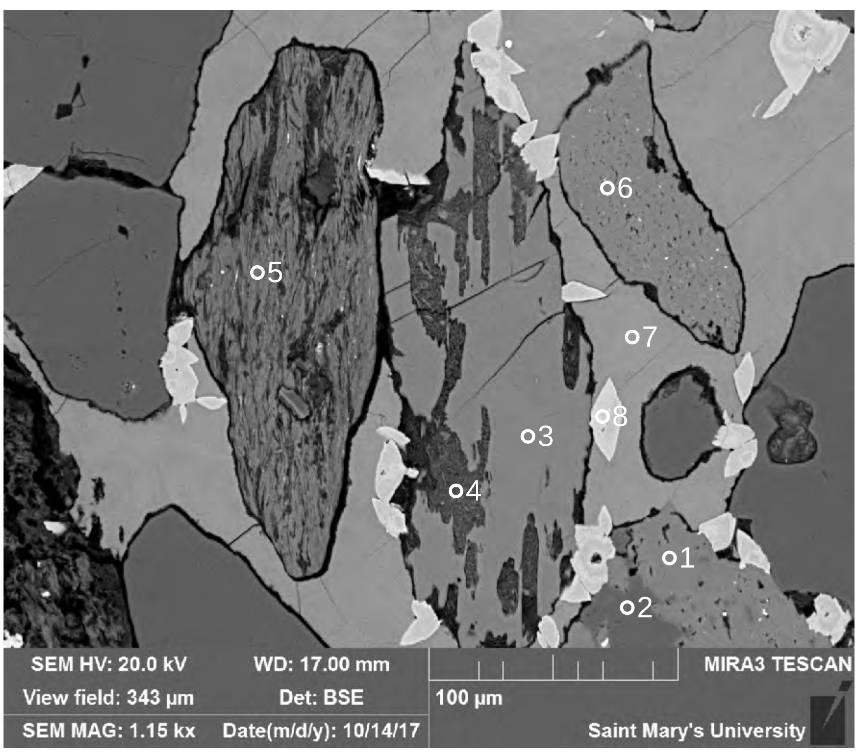


Figure 1-6.1: Scanned thin section of sample 3H-58 2001.33 showing the location of analyzed sites.



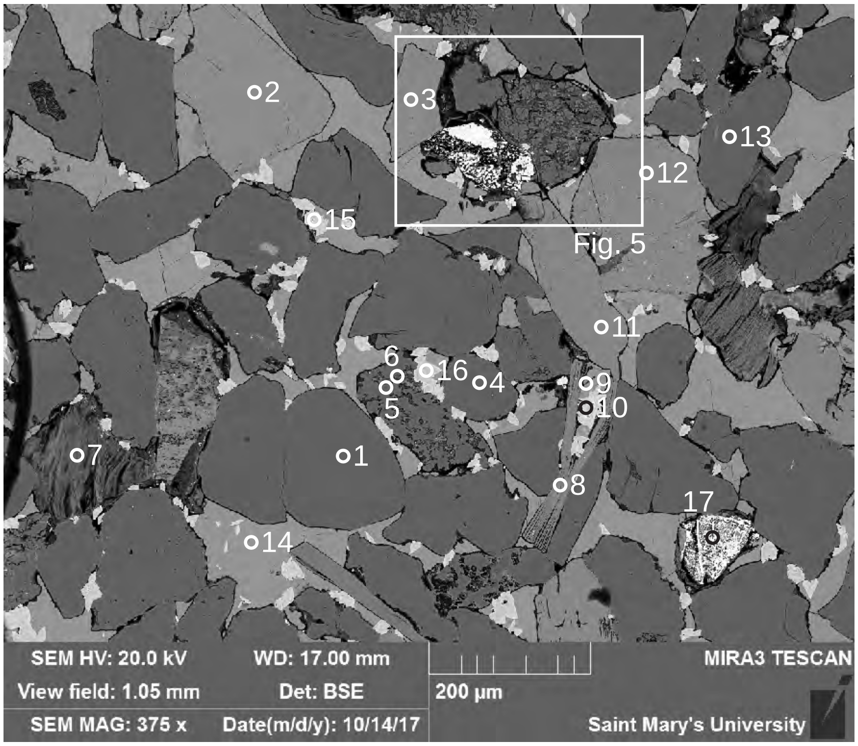
1:Quartz
2:Quartz
3:K-feldspar
4:K-feldspar
5:Quartz
6:K-feldspar
7:Quartz
8:Calcite
9:Calcite
10:K-feldspar
11:Siderite
12:Siderite
13:Muscovite

Figure 1-6.2: Sample 3H-58 2001.33 (SEM) site 1. This site consists of quartz, K-feldspar, and muscovite grains within a calcite cement. Late siderite (11-12) is seen filling secondary porosity.



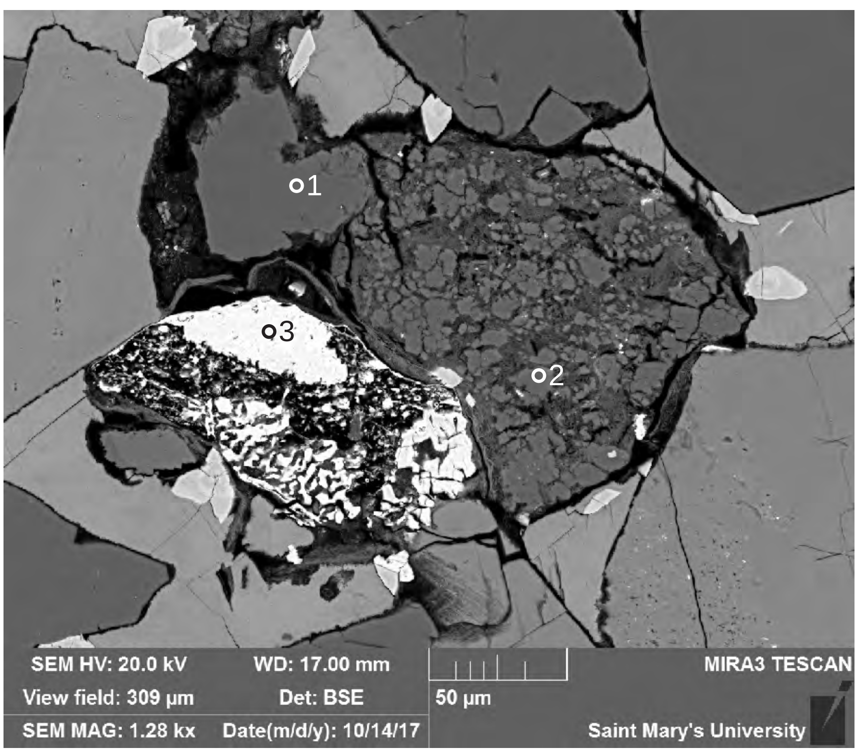
1:K-feldspar
2:Albite
3:K-feldspar
4:Chlorite + Illite
5:Muscovite + Chlorite
6:K-feldspar
7:Calcite
8:Siderite

Figure 1-6.3: Sample 3H-58 2001.33 (SEM) site 1.1. This site consists of altered K-feldspar (3), and a quartz -muscovite metasiltstone (schist) lithic clast.



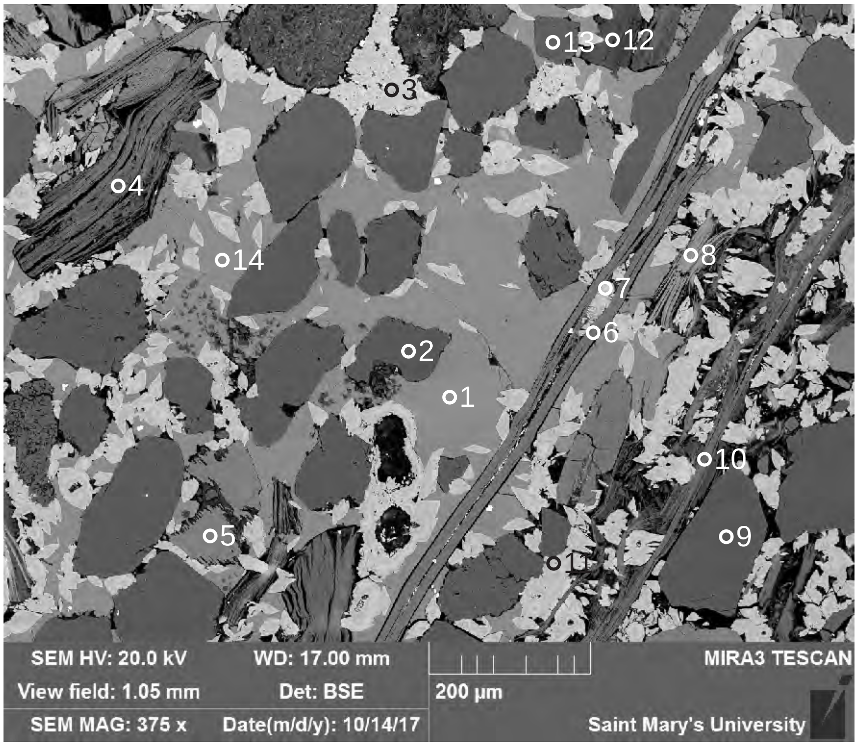
1:Quartz
2:K-feldspar
3:K-feldspar
4:Quartz
5:Quartz
6:Chlorite + Illite
7:Chlorite + Muscovite
8:Muscovite
9:Calcite
10:Siderite
11:K-feldspar
12:K-feldspar
13:Quartz
14:Calcite
15:Siderite
16:Siderite
17:"Ilmenite"

Figure 1-6.4: Sample 3H-58 2001.33 (SEM) site 2. This site consists of mostly of quartz, with some K-feldspar and muscovite grains. Muscovite (8) appears deformed and has siderite (10) forming within its cleavage. Calcite makes up the cement with siderite filling secondary porosity. There is also a clast of altered ilmenite (17).



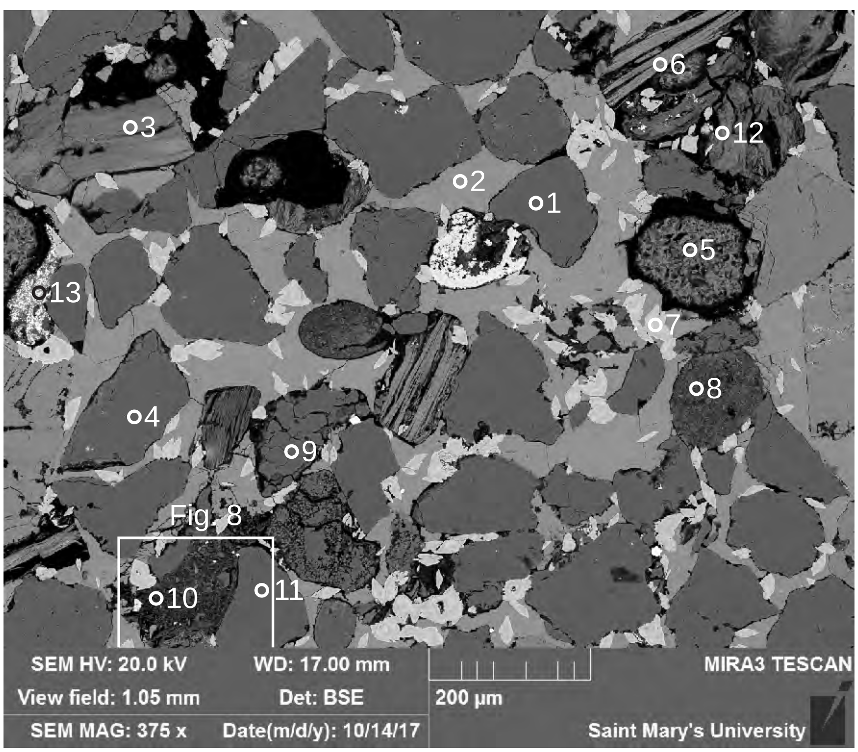
1:Quartz
2:Quartz
3:"Ilmenite"

Figure 1-6.5: Sample 3H-58 2001.33 (SEM) site 2.1. This site may be an intraclast made up of quartz (2) and probably clays. There is also an altered ilmenite (3) grain.



1:Calcite
2:Quartz
3:Siderite +
4:Chloritized
Muscovite
5:K-feldspar
6:Muscovite
7:Siderite
8:Chlorite +
Muscovite
9:Quartz
10:Kaolinite
11:Siderite
12:Kaolinite
13:Quartz
14:Calcite

Figure 1-6.6: Sample 3H-58 2001.33 (SEM) site 3. This site consists of mostly quartz grains with some K-feldspar and muscovite grains. Muscovite (6) commonly expands on cleavage and siderite (7) precipitates there. The cement consists of calcite (1,14), with siderite (3) filling secondary porosity.



1:Quartz
2:Calcite
3:Chloritized
Muscovite
4:Quartz
5:Albite + Quartz
6:Chloritized
Muscovite
7:Siderite
8:Glaucony
9:Quartz
10:Kaolinite
11:Quartz
12:Chlorite ?
13:Mix

Figure 1-6.7: Sample 3H-58 2001.33 (SEM) site 4. This site consists of quartz, chlorite, and rare glaucony grains (8). The cement is made up of calcite (2) with siderite (7) filling secondary porosity. Kaolinite (10) forms some of the ?matrix between quartz grains.

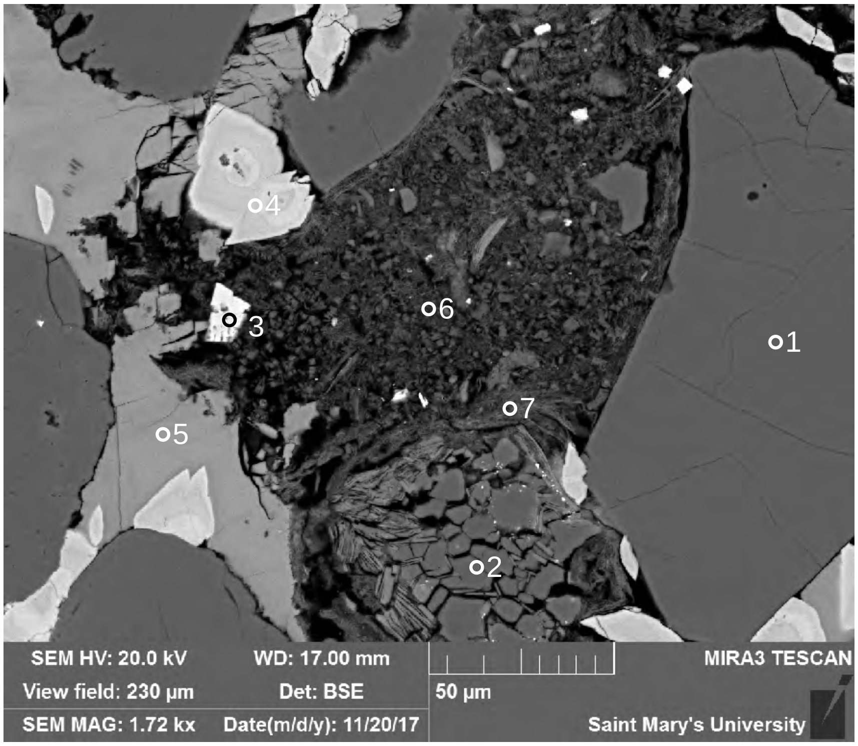


Figure 1-6.8: Sample 3H-58 2001.33 (SEM) site 4.1. This site consists of a lithic clast of quartz (2), chlorite (7), and probably muscovite. The clays between detrital quartz grains (1) seem to be made up of chloritzed muscovite. Siderite (4), titania (3) and calcite (5) appear to be filling voids within the clays.

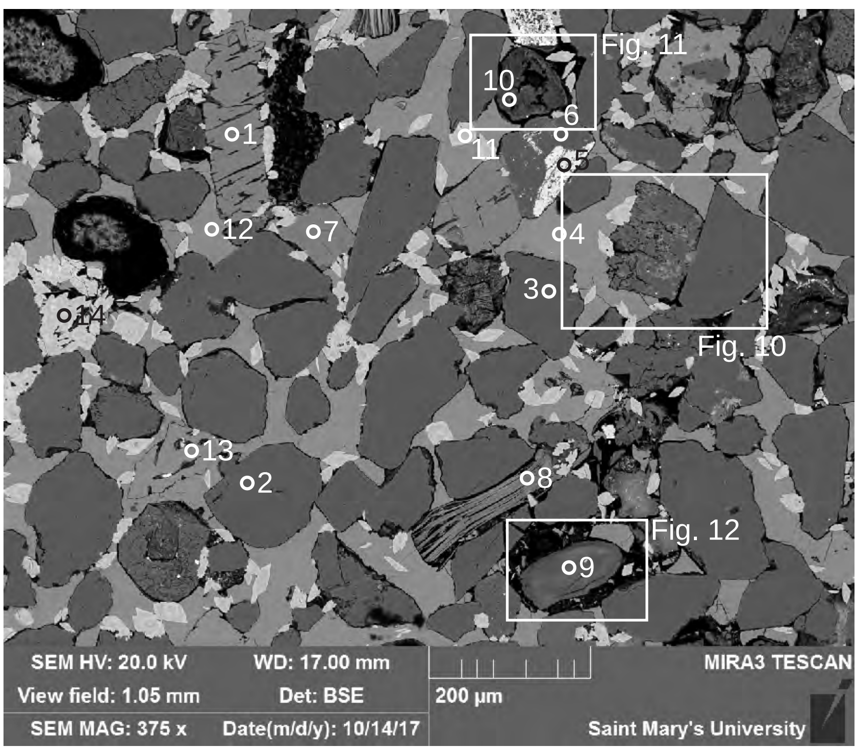
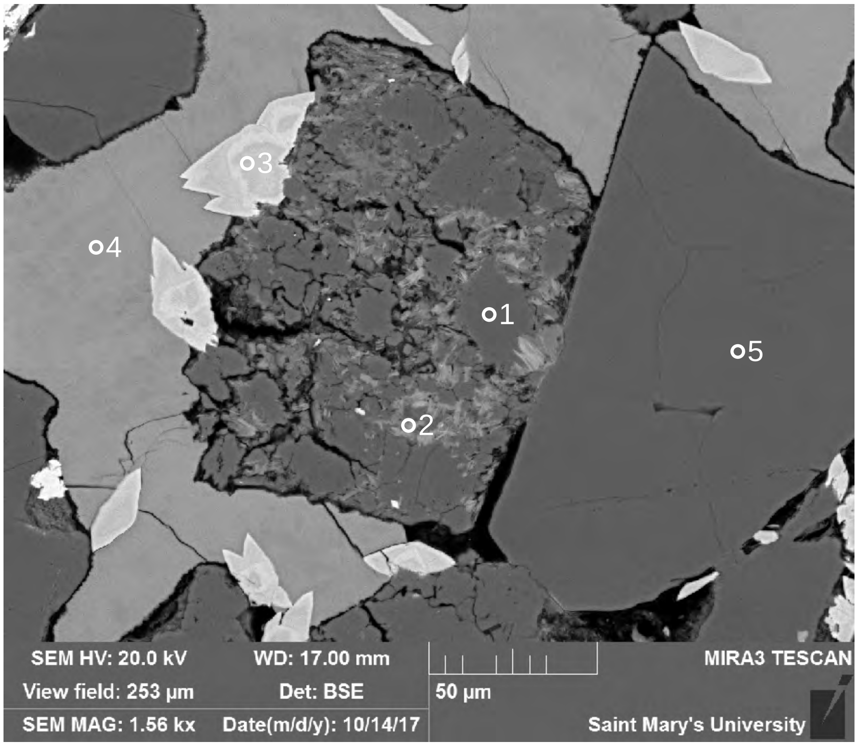
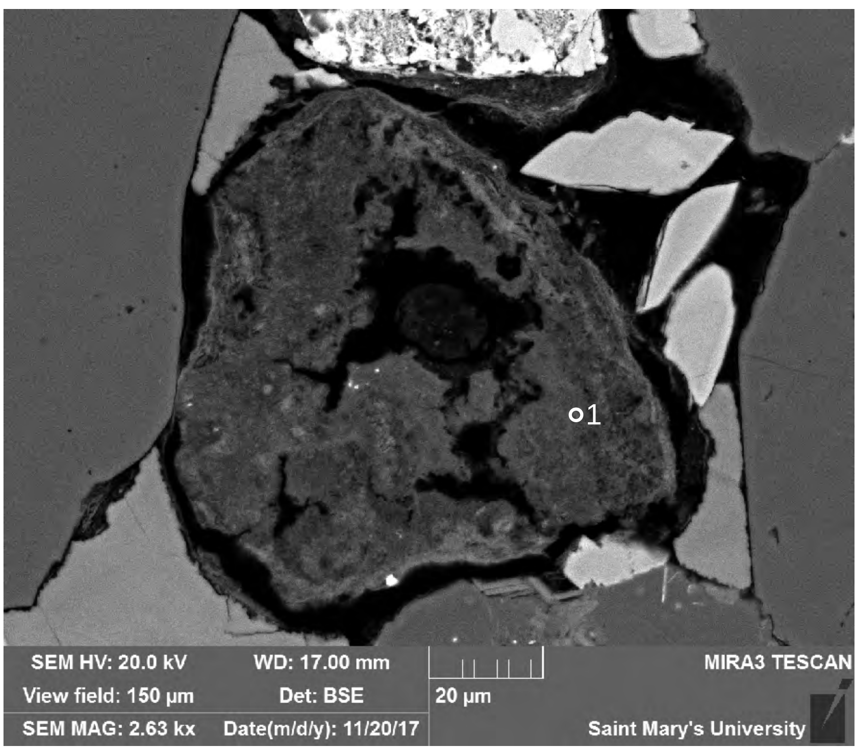


Figure 1-6.9: Sample 3H-58 2001.33 (SEM) site 5. This site consists of mostly quartz and some K-feldspar (1,7,13), chloritized muscovite (8), and glaucony (9-10). The cement is made up of calcite (4,12) and siderite (11,14) fills secondary porosity.



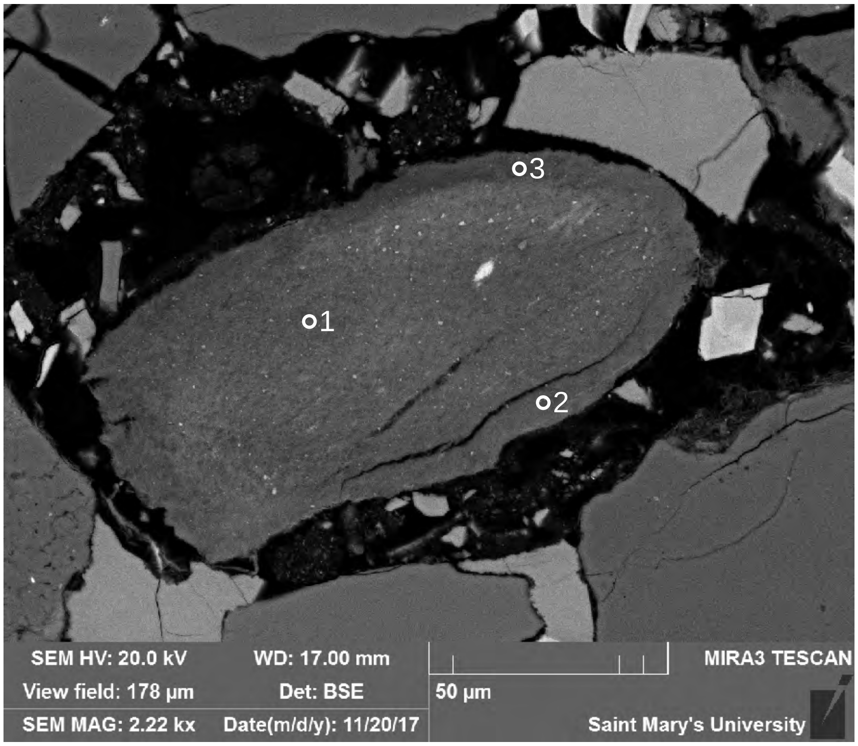
1:Quartz
2:Chloritized Muscovite
3:Siderite
4:Calcite
5:Quartz

Figure 1-6.10: Sample 3H-58 2001.33 (SEM) site 5.1. This site contains a lithic clast made up of quartz (1) and chloritized muscovite (2).



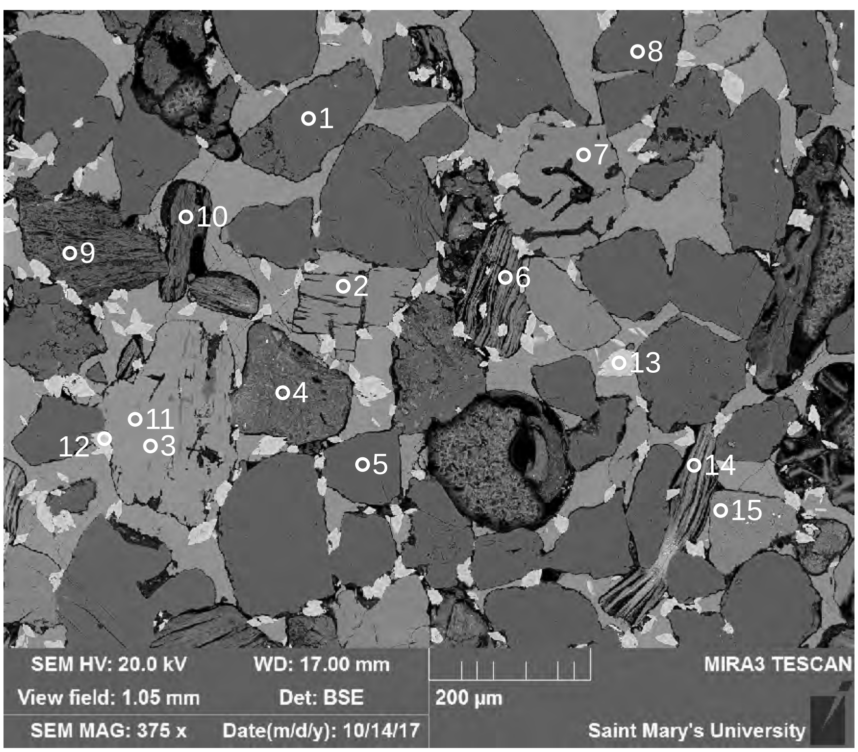
1:Glaucony

Figure 1-6.11: Sample 3H-58 2001.33 (SEM) site 5.2. This site consists of a glaucony grain that has underwent volume reduction (1).



1:Glaucony
2:Glaucony
3:Glauconite

Figure 1-6.12: Sample 3H-58 2001.33 (SEM) site 5.3. This site consists of a glaucony (1-2) grain with glauconite (3) rim.



1:Quartz
2:K-feldspar
3:K-feldspar
4:Chloritized Muscovite
5:Quartz
6:Chloritized Muscovite
7:K-feldspar
8:Quartz
9:Chloritized Muscovite
10:Chloritized Muscovite
11:K-feldspar
12:Siderite
13:Siderite
14:Chloritized Muscovite
15:K-feldspar

Figure 1-6.13: Sample 3H-58 2001.33 (SEM) site 6. This site consists of mostly quartz, with some K-feldspar (2-3,7,11,15), chloritized muscovite (4,6,9-10,14). Calcite and siderite (12-13) form the cement with siderite being the later phase.

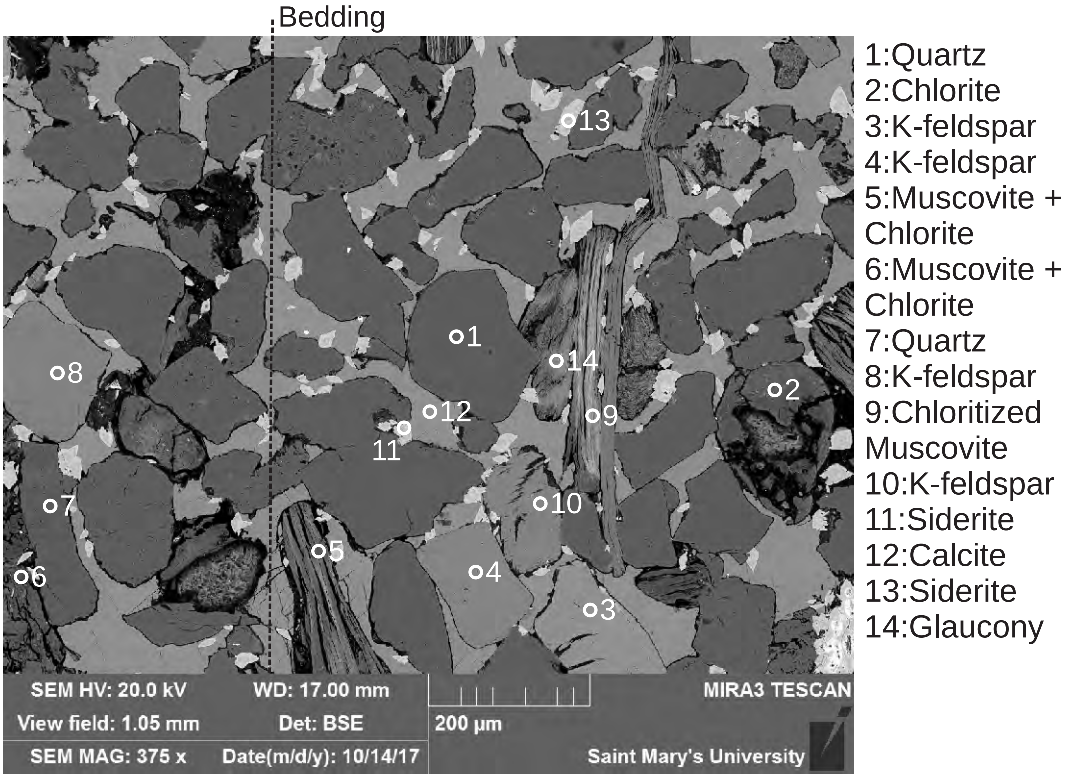


Figure 1-6.14: Sample 3H-58 2001.33 (SEM) site 7. This site consists of mainly quartz with some K-feldspar (3-4,8,10), muscovite (5-6) grains. There is also a compacted grain of glaucony (14). The cement between grains is made up of calcite (12), with siderite (11,13) filling secondary porosity.

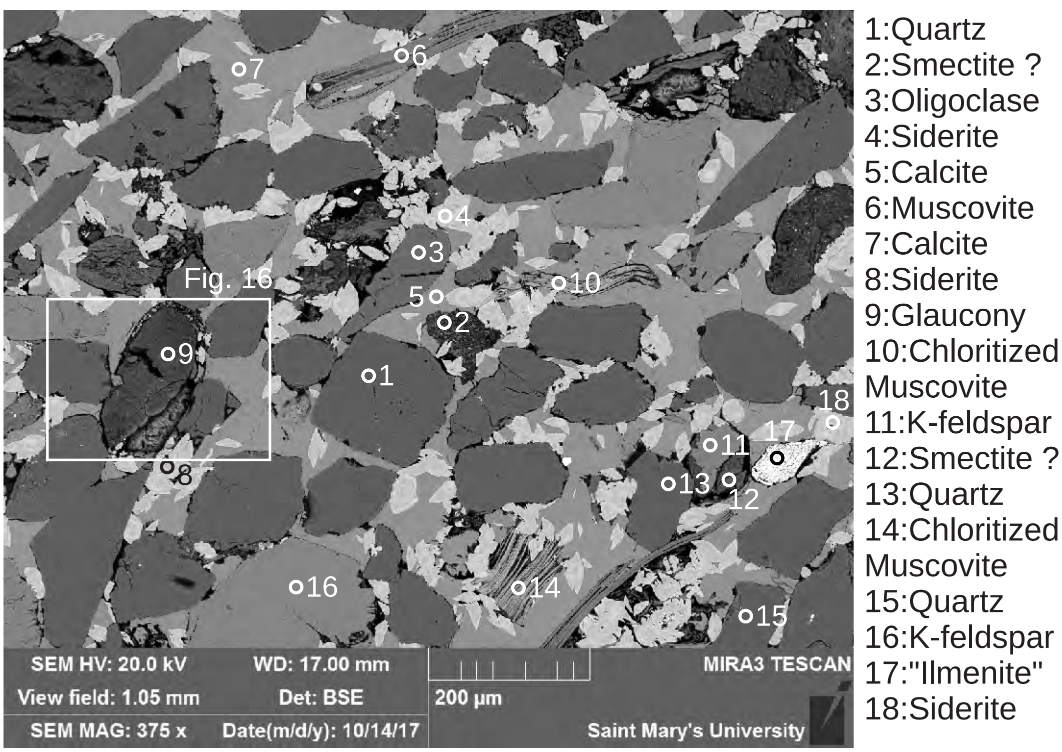
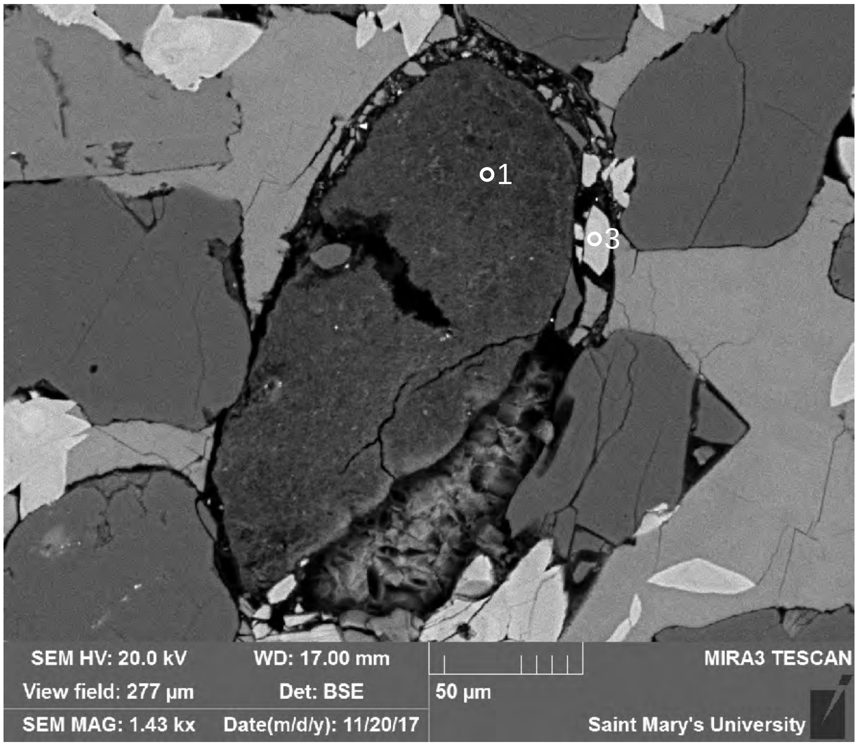
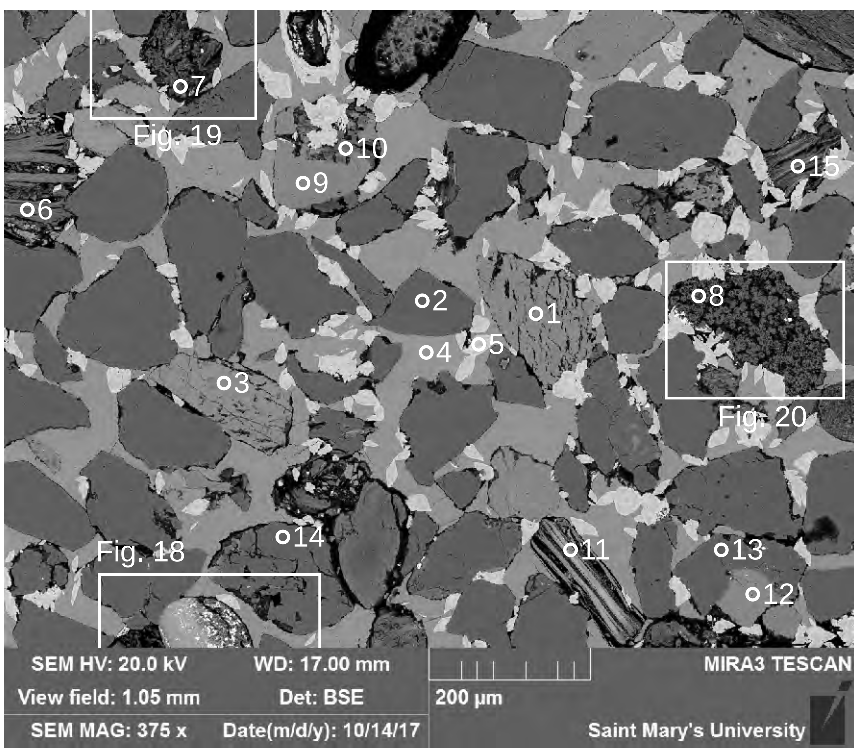


Figure 1-6.15: Sample 3H-58 2001.33 (SEM) site 8. This site consists mainly of quartz grains with some K-feldspar (11,16), oligoclase (3), muscovite (6), and chloritized muscovite (10,14). The cement is made up of calcite (5,7) with siderite (4,8,18) filling secondary porosity. There is also a glaucony grain (9).



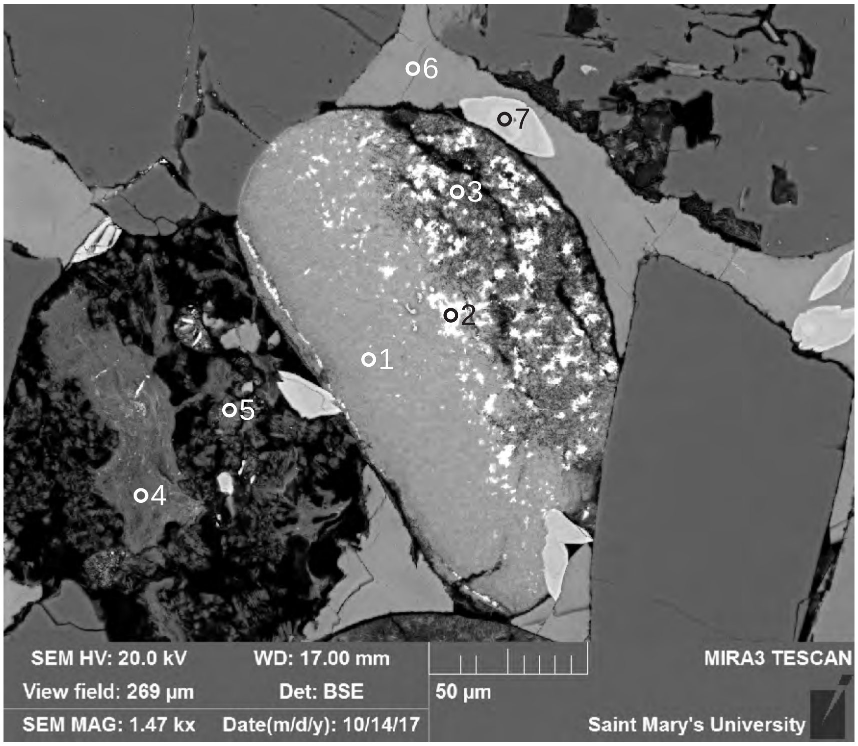
1:Glauconite
3:Siderite

Figure 1-6.16: Sample 3H-58 2001.33 (SEM) site 8.1. This site consists of a glauconite pellet (1) that has underwent volume reduction. Siderite (3) precipitates in the space around the pellet.



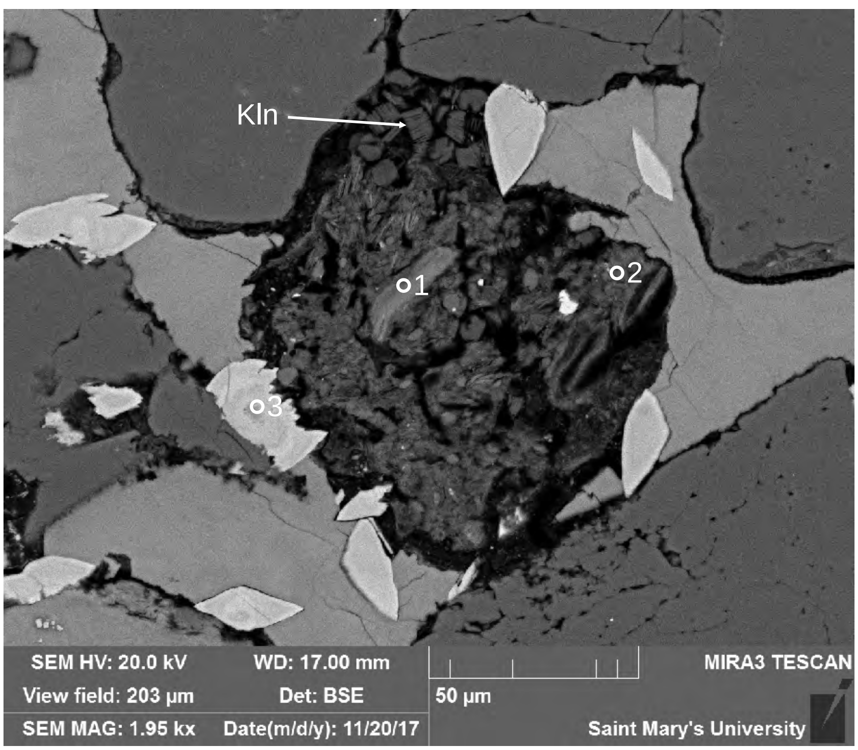
1:K-feldspar
2:Quartz
3:K-feldspar
4:Calcite
5:Siderite
6:Chloritized Muscovite
7:Muscovite + Chlorite
8:Quartz
9:K-feldspar
10:Albite + K-feldspar
11:Chloritized Muscovite
12:K-feldspar
13:Quartz
14:Albite
15:Chloritized Muscovite

Figure 1-6.17: Sample 3H-58 2001.33 (SEM) site 9. This site contains quartz, K-feldspar (1,3,9,12), and chloritized muscovite (6,11,15). The cement is made up of calcite (4) with siderite (5) filling secondary porosity.



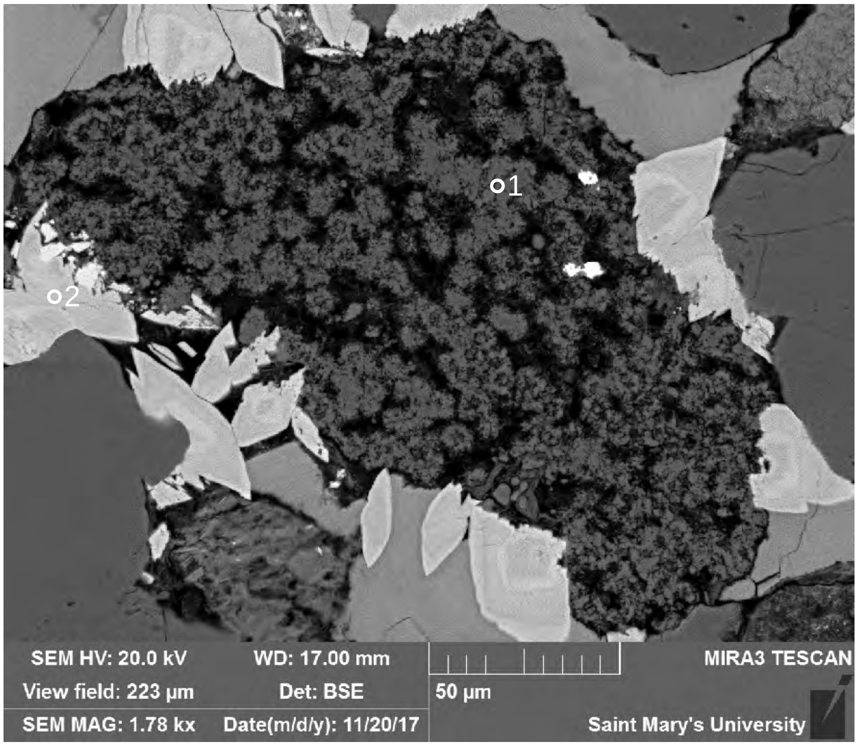
1:K-feldspar + Chlorite
2:Monazite +
3:Monazite +
4:Chlorite + Illite
5:Chlorite + Illite
6:Calcite
7:Siderite

Figure 1-6.18: Sample 3H-58 2001.33 (SEM) site 9.1. This site consists of a lithic clast made up of a ?muscovite clay with a REE rich mineral forming in the porosity of the clast.



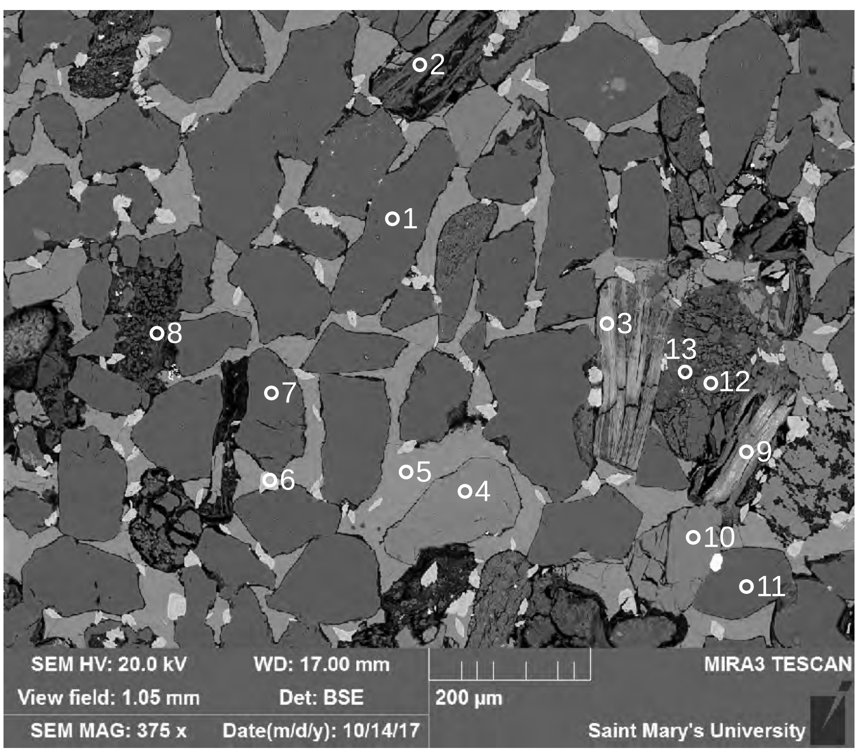
1:Chlorite
2:Fe-clay
3:Siderite

Figure 1-6.19: Sample 3H-58 2001.33 (SEM) site 9.2. This site consists of a probably altered mineral, now made up of chlorite (1), kaolinite cut by siderite, and Fe-clay (2).



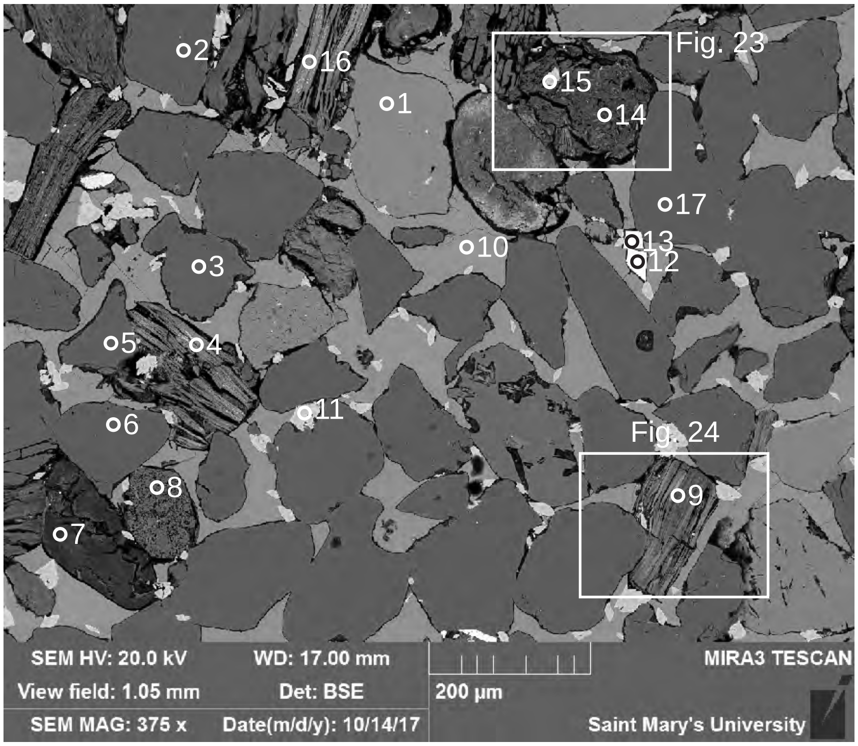
1:Quartz
2:Siderite

Figure 1-6.20: Sample 3H-58 2001.33 (SEM) site 9.3. This site consists of a very fine-grained partially dissolved rhyolite clast made up of quartz with siderite (2) precipitating in the voids around the grain.



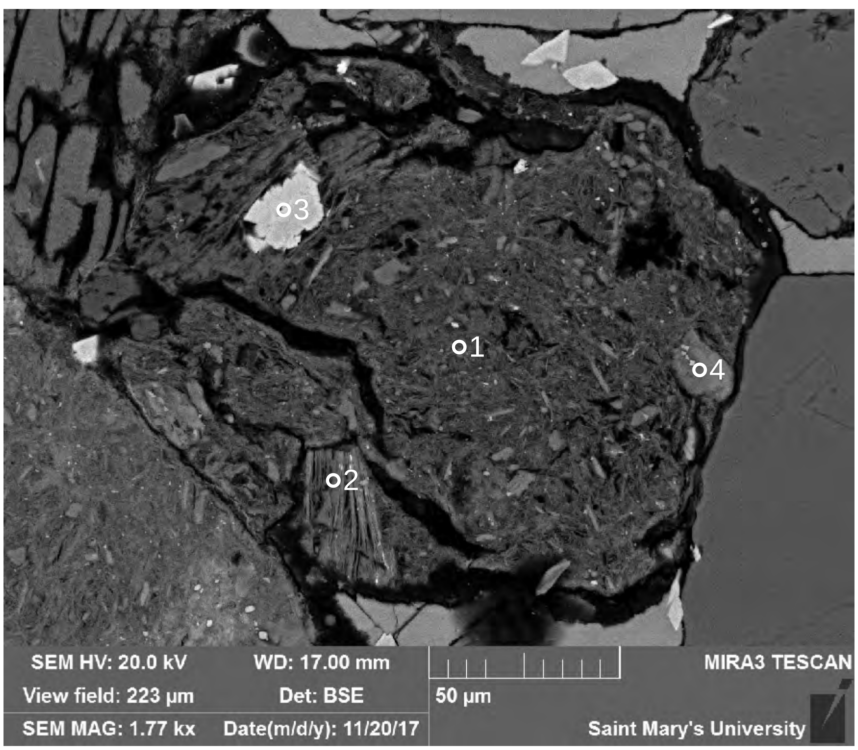
1:Quartz
2:Chloritized Muscovite
3:Chlorite +
4:K-feldspar
5:Calcite
6:Siderite
7:Quartz
8:Chlorite + ?K-feldspar + Kaolinite
9:Chloritized Muscovite
10:K-feldspar
11:Quartz
12:Quartz
13:Chlorite + K-feldspar

Figure 1-6.21: Sample 3H-58 2001.33 (SEM) site 10. This site consists of mostly of quartz and K-feldspar. Muscovite (2-3,9) has been chloritized. Smectite (8) appears to be alteration product of some grains. The cement consists of calcite (5), and siderite (6) fills secondary porosity.



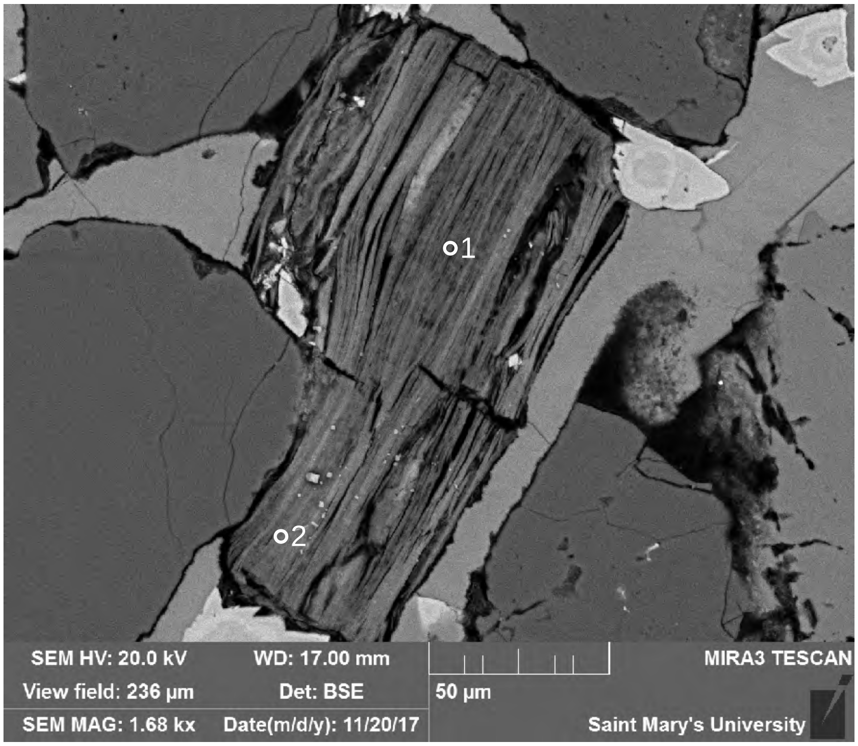
1:K-feldspar
2:Quartz
3:Quartz
4:Chloritized Muscovite
5:Quartz
6:Quartz
7:Kaolinite + Chlorite
8:Quartz +
9:Chloritized Muscovite + ?Kaolinite
10:Calcite
11:Siderite
12:Chromite
13:Chromite
14:Chlorite + K-feldspar
15:Siderite
16:Chloritized Muscovite
17:Quartz

Figure 1-6.22: Sample 3H-58 2001.33 (SEM) site 11. This site consists of quartz, K-feldspar, and some chloritized muscovite. Calcite (10) is the main cement between grains. Siderite (11,15) and chromite (12-13) appear to fill secondary porosity.



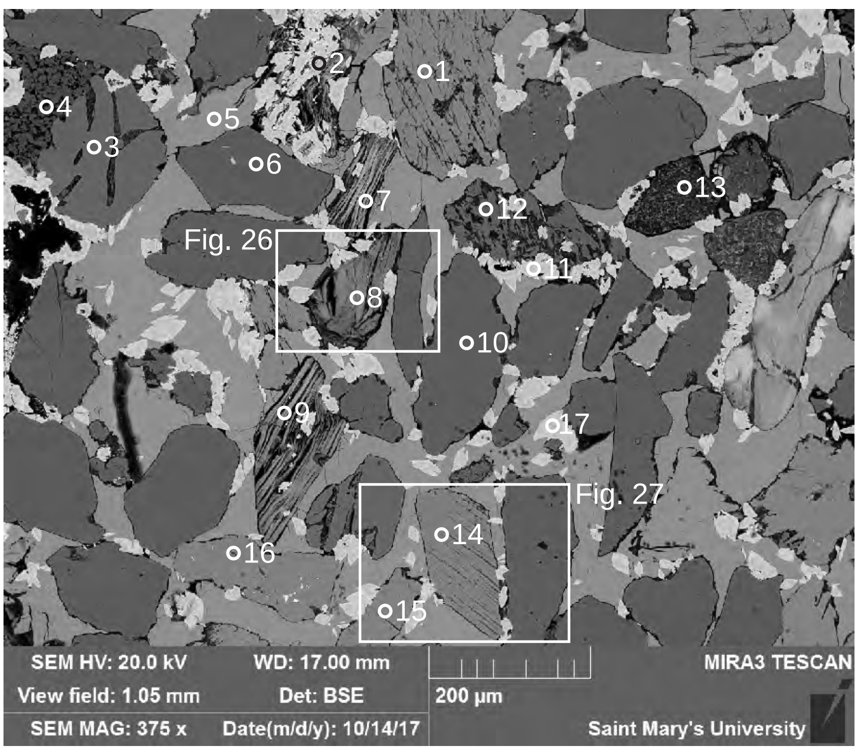
1:Glaucony
2:Chloritized Muscovite
3:Siderite
4:Glauconite

Figure 1-6.23: Sample 3H-58 2001.33 (SEM) site 11.1. This site consists of a grain of a glaucony (1) with volume reduction (voids), and a small patch of glauconite (4), a small chloritized muscovite (2) grain, and late siderite (3) precipitating in the voids.



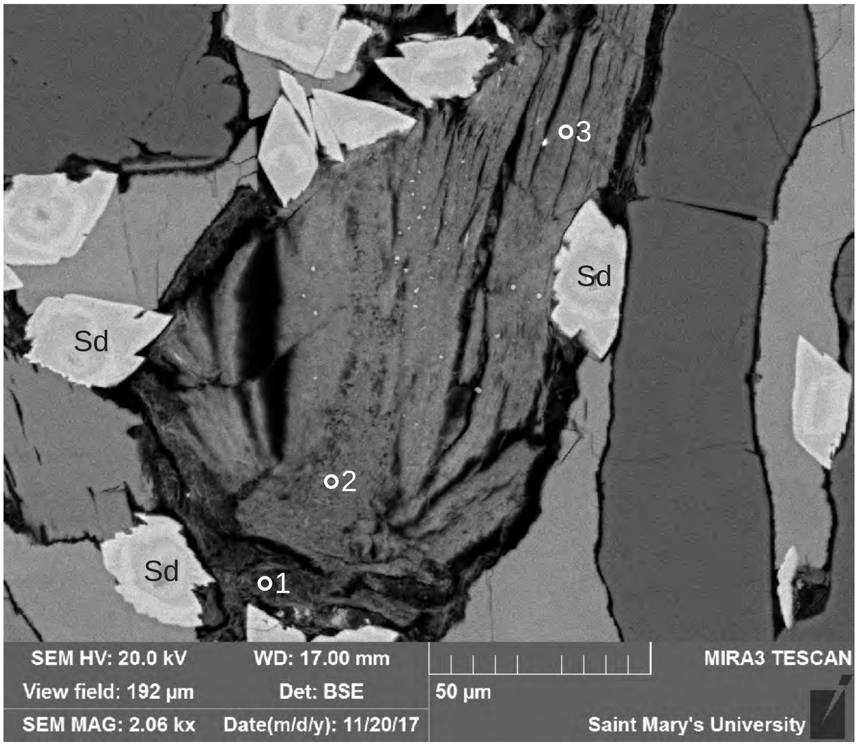
1:Chloritized Muscovite
2:Chloritized Muscovite

Figure 1-6.24: Sample 3H-58 2001.33 (SEM) site 11.2. This site consists of a chloritized muscovite lath.



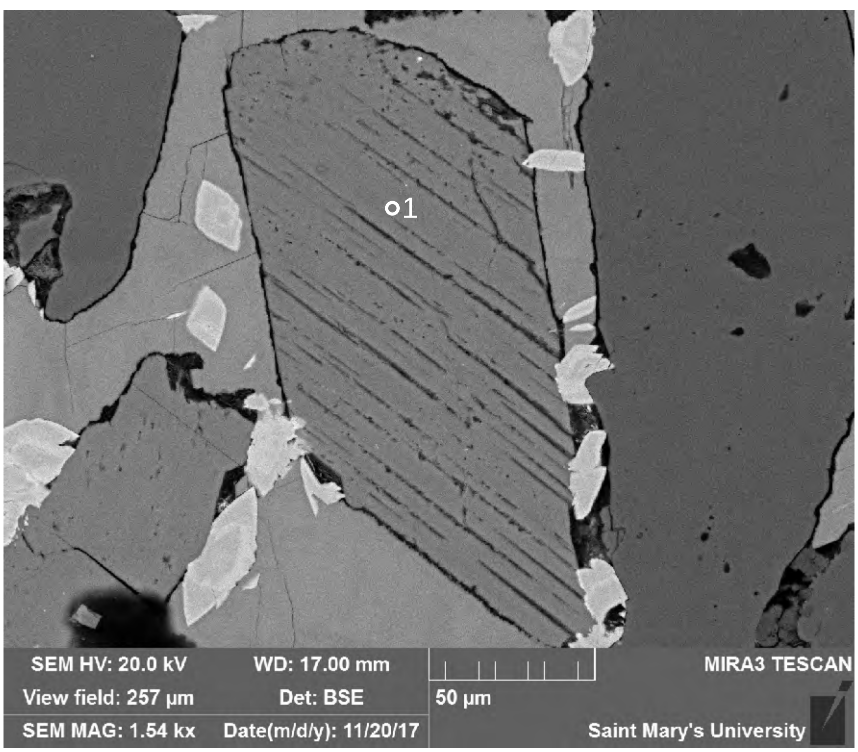
1:K-feldspar
2:Siderite
3:Oligoclase
4:Kaolinite
5:Calcite
6:Quartz
7:Chloritized Muscovite
8:Chlorite + K-feldspar?
9:Chloritized Muscovite
10:Quartz
11:Siderite
12:Albite
13:Smectite ?
14:K-feldspar
15:K-feldspar
16:K-feldspar
17:Siderite

Figure 1-6.25: Sample 3H-58 2001.33 (SEM) site 12. This site consists of quartz (6,10), K-feldspar (1,14-16), oligoclase (3), albite (12), and kaolinite (4). Muscovite (7-9) has been chloritized. Calcite (5) is the main cement between grains. Siderite (2,11,17) appears to partially fill secondary porosity.



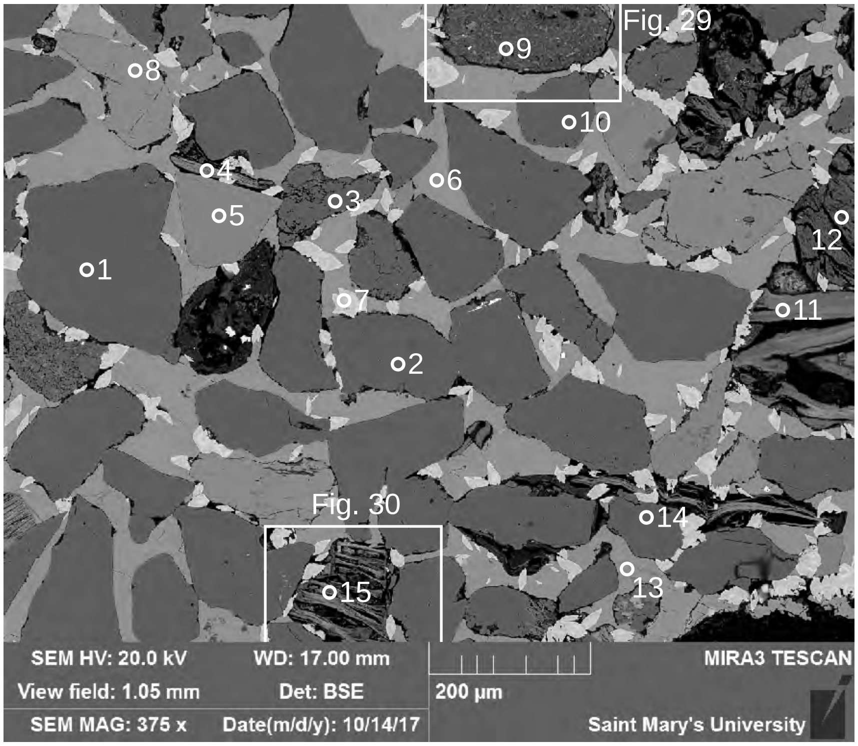
1:Chloritized Muscovite
2:Chlorite
3:Chloritized Muscovite

Figure 1-6.26: Sample 3H-58 2001.33 (SEM) site 12.1. This site consists of a chloritized muscovite grain with chlorite in the centre of the grian. Siderite precipitates in open space around the grain.



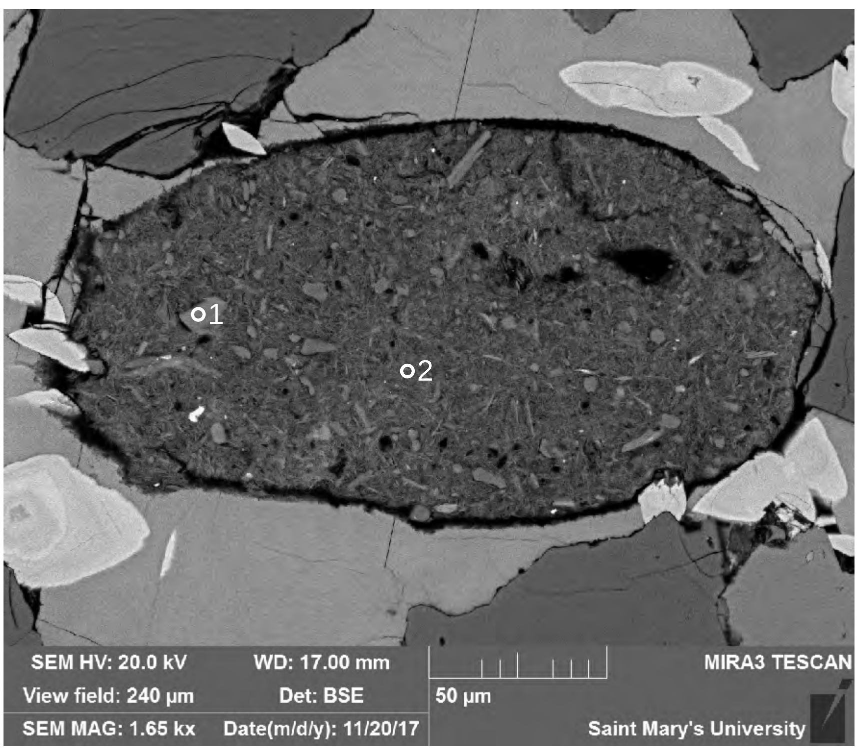
1:K-feldspar

Figure 1-6.27: Sample 3H-58 2001.33 (SEM) site 12.2. This site consists of a K-feldspar (1) grain probably with perthitic albite.



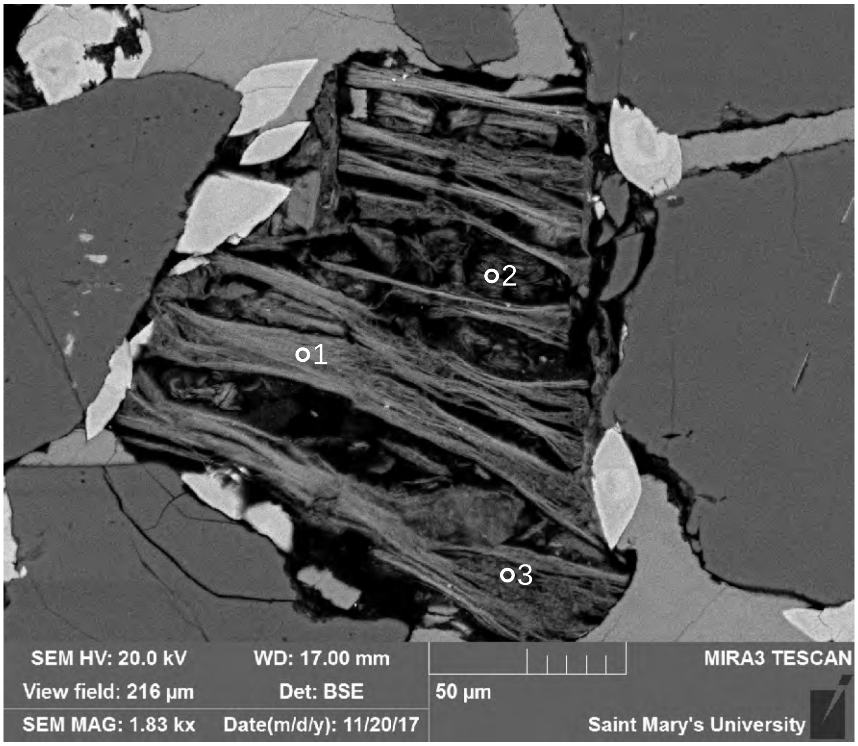
1:Quartz
2:Quartz
3:Quartz
4:Chloritized Muscovite
5:K-feldspar
6:Calcite
7:Siderite
8:K-feldspar
9:Chlorite + Illite
10:Quartz
11:Chloritized Muscovite
12:Kaolinite
13:Calcite
14:Quartz
15:Chloritized Muscovite

Figure 1-6.28: Sample 3H-58 2001.33 (SEM) site 13. This site again consists mostly of quartz, with some K-feldspar grains. Muscovite has been chloritized. Calcite forms the cement between grains and siderite partially fills secondary porosity.



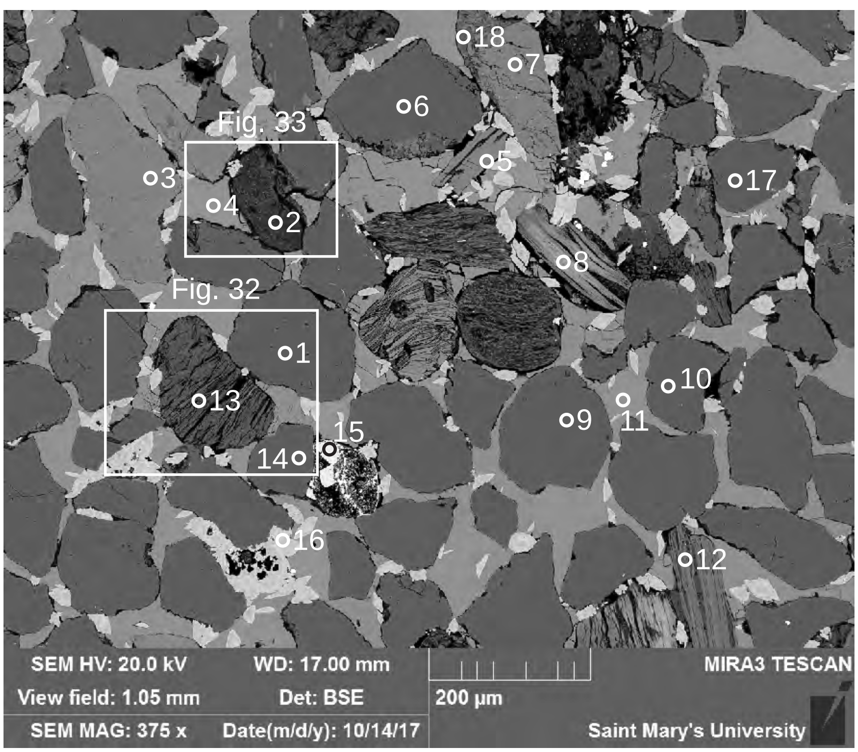
1:Muscovite
2:?Glaucony

Figure 1-6.29: Sample 3H-58 2001.33 (SEM) site 13.1. This site consists of a ?glaucony (2) pellet with a small relic muscovite (1) grain.



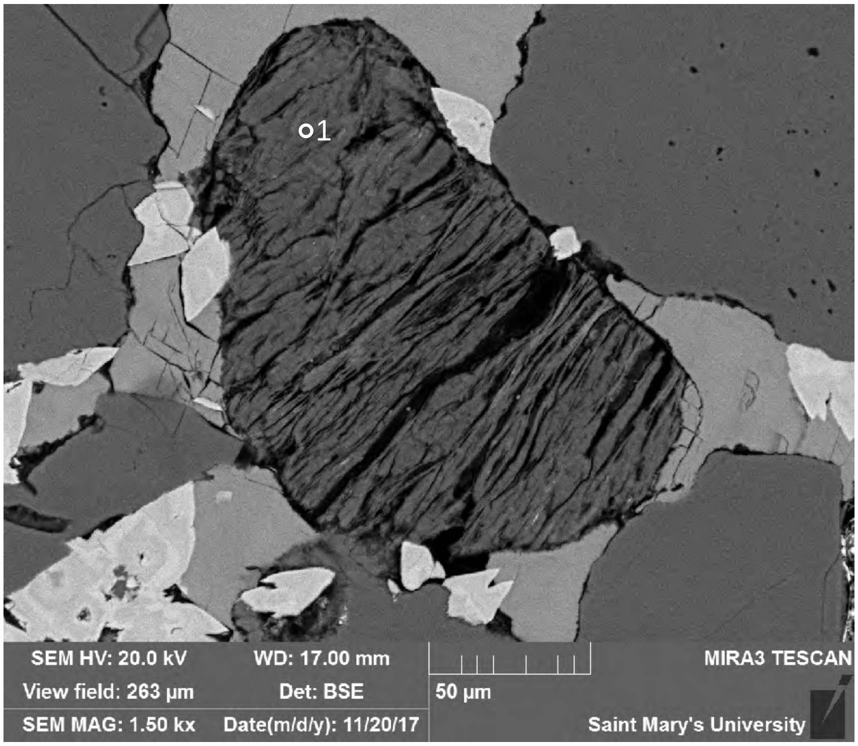
1:Chlorite
2:Chloritized Muscovite
3:Chloritized Muscovite + Kaolinite

Figure 1-6.30: Sample 3H-58 2001.33 (SEM) site 13.2. This site consists of a chloritized muscovite (1) grain that has expanded along cleavage allowing for kaolinite to form (3).



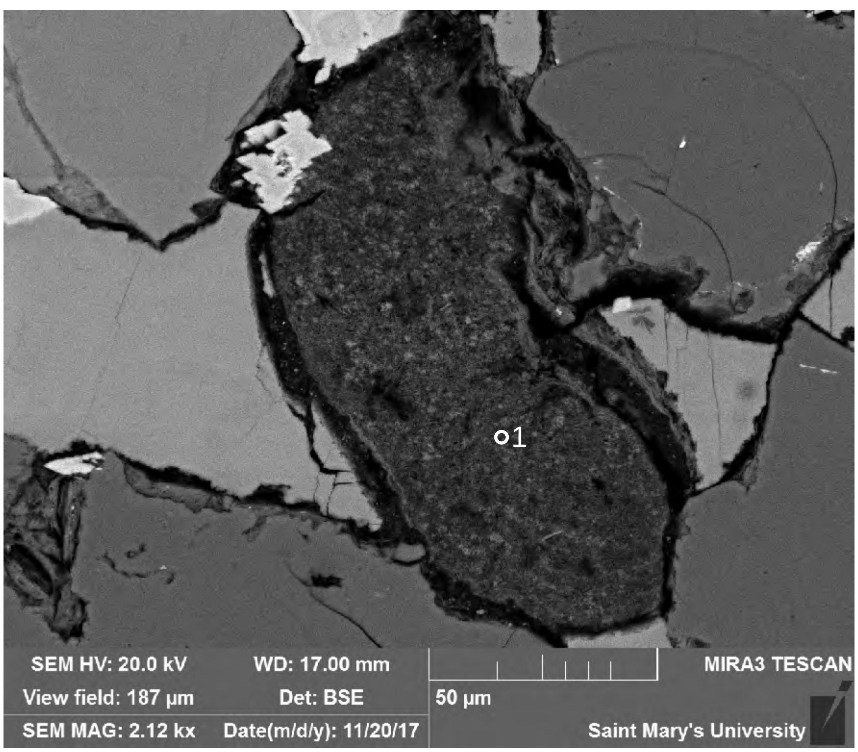
1:Quartz
2:Glauconite
3:K-feldspar
4:Calcite
5:K-feldspar
6:Quartz
7:K-feldspar
8:Chloritized Muscovite
9:Quartz
10:Quartz
11:Calcite
12:Muscovite
13:Kaolinite + Chlorite
14:Quartz
15:TiO_2
16:Siderite
17:Quartz
18:Quartz +

Figure 1-6.31: Sample 3H-58 2001.33 (SEM) site 14. This site consists of mainly quartz with some K-feldspar (3,5,7) grains. Muscovite (12) has mostly been chloritized (8). Titania (15) appears to fill a void. Calcite (4,11) is the cement between grains and siderite (16) partially fills secondary porosity. There is also a granitoid lithic clast made up of quartz (18) and K-feldspar (7), and a glauconite (2) pellet.



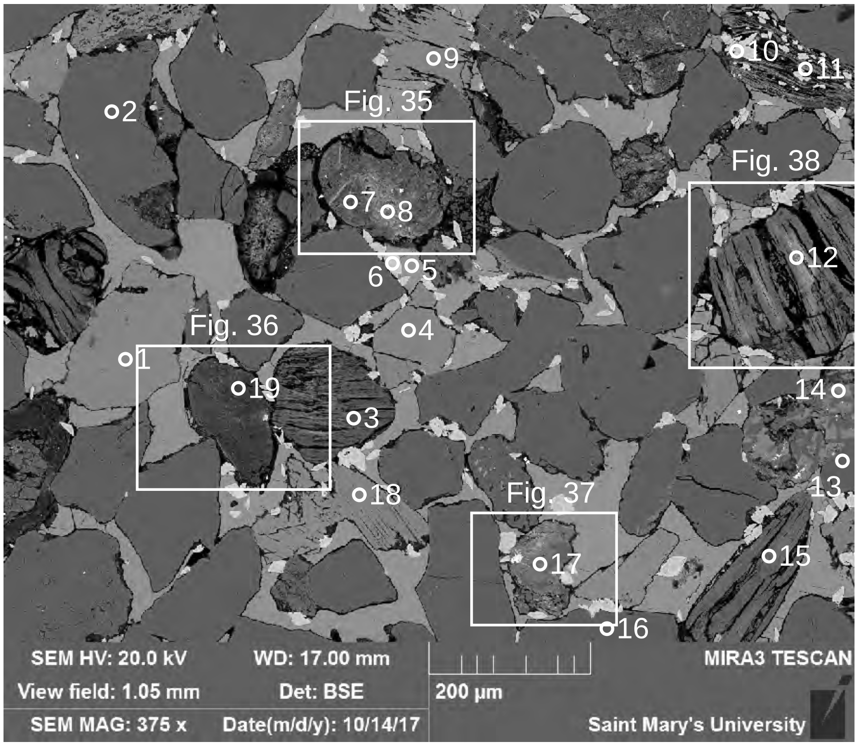
1:"Muscovite"

Figure 1-6.32: Sample 3H-58 2001.33 (SEM) site 14.1. This site consists of an altered muscovite (1) grain that is altering to kaolinite.



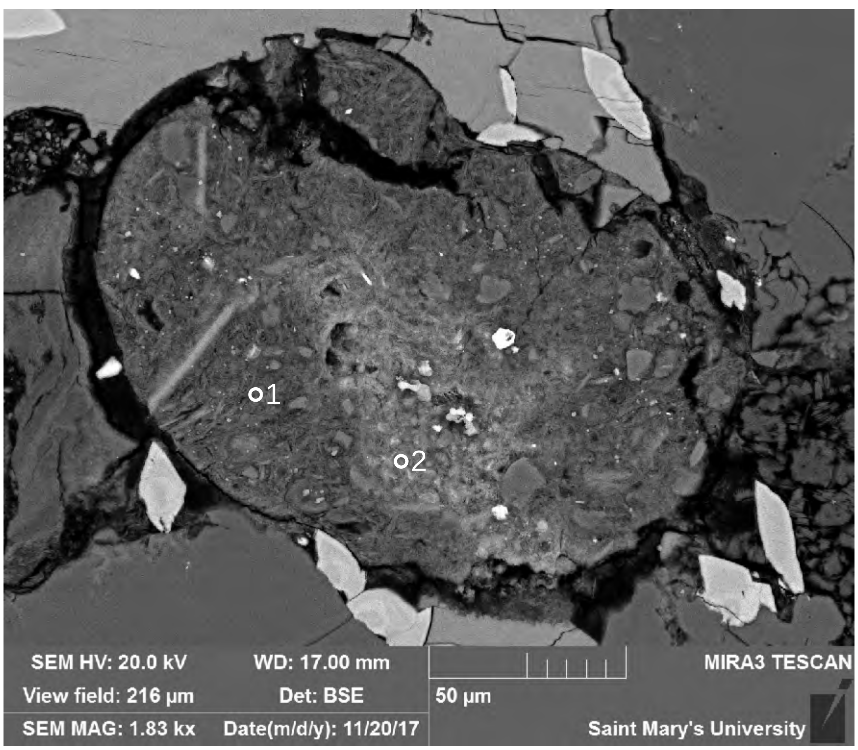
1:Glauconite

Figure 1-6.33: Sample 3H-58 2001.33 (SEM) site 14.2. This site consists of a glauconite pellet that has underwent volume reduction.



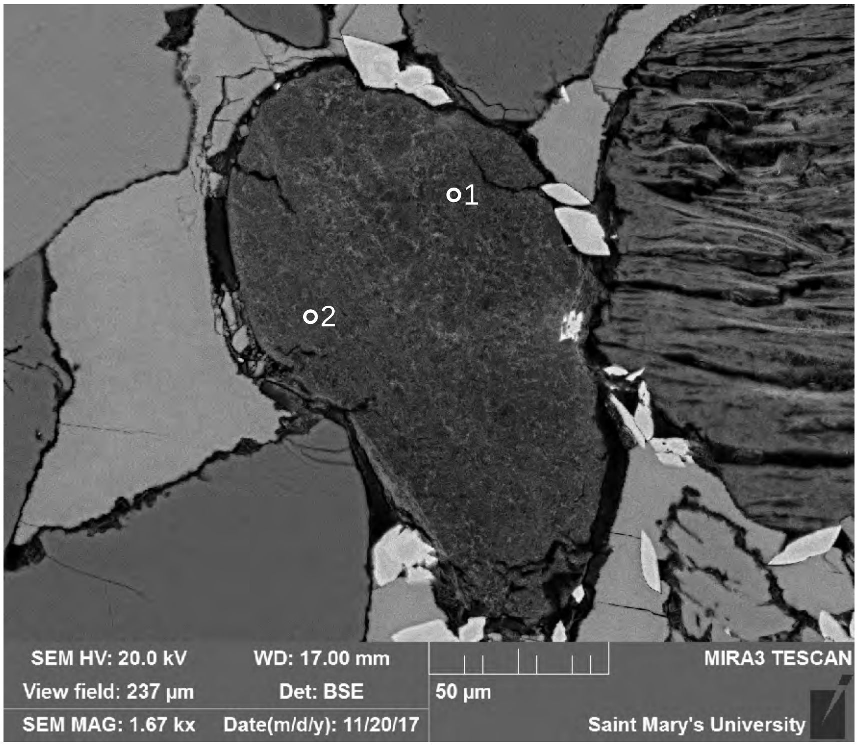
1:K-feldspar
2:Quartz
3:Kaolinite + Chlorite
4:K-feldspar
5:Calcite
6:Siderite
7:?Chlorite + K-feldspar
8:Quartz +
9:K-feldspar
10:Siderite
11:Chlorite +
12:Chlorite + ?K-feldspar
13:Quartz
14:K-feldspar +
15:Chlorite + ?K-feldspar
16:Quartz
17:K-feldspar +
18:K-feldspar
19:Glauconite

Figure 1-6.34: Sample 3H-58 2001.33 (SEM) site 15. This site is similar to previous sites. There is a lithic clast of quartz (13) and K-feldspar (14). There is also a pellet of glauconite (19).



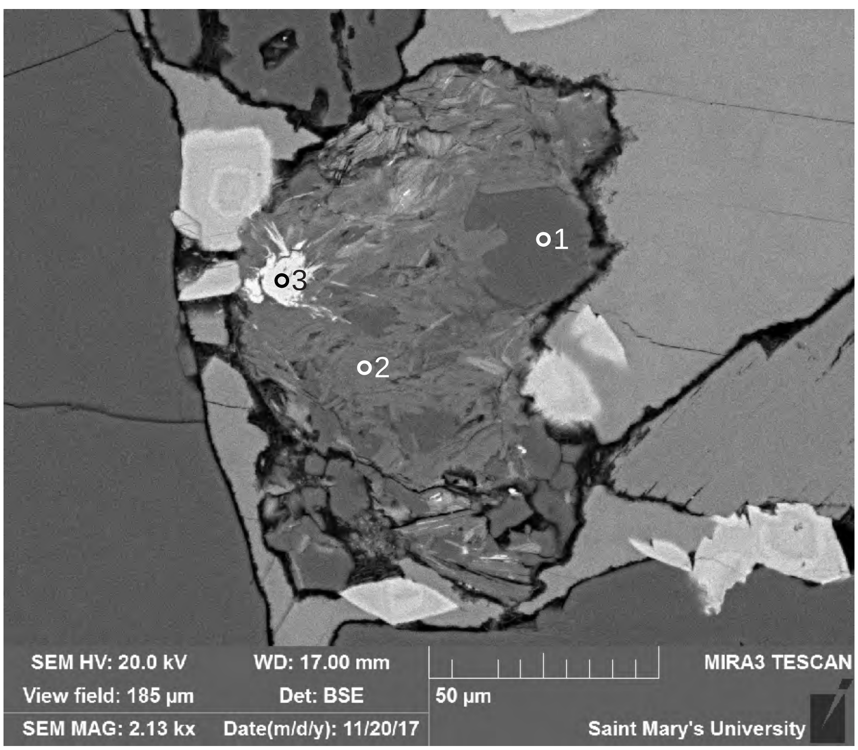
1:Glaucony
2:Glaucony

Figure 1-6.35: Sample 3H-58 2001.33 (SEM) site 15.1. This site consists of a glaucony grain.



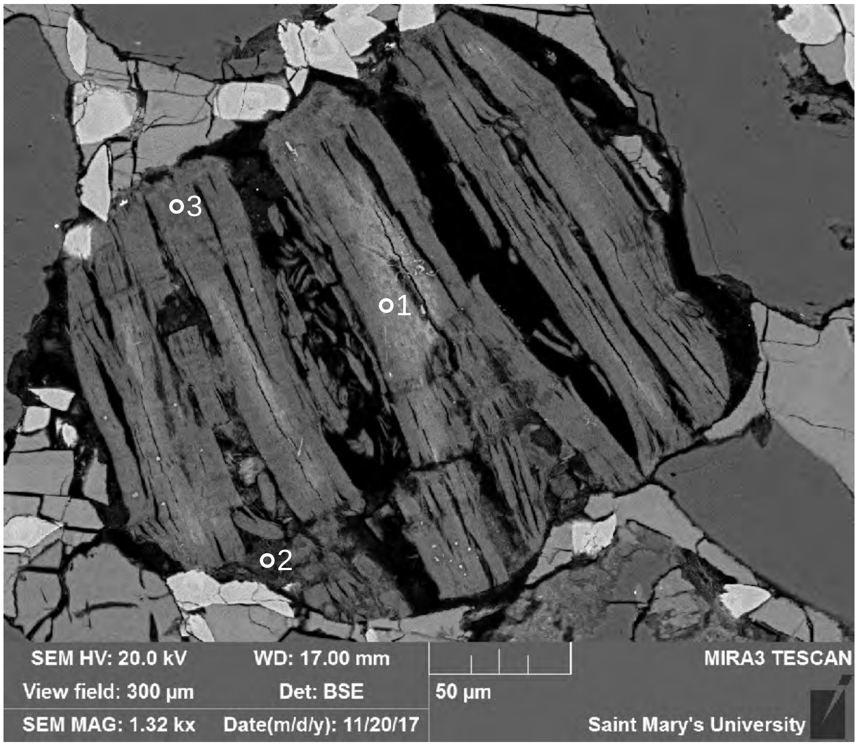
1:Gaucony
2:Glaucony

Figure 1-6.36: Sample 3H-58 2001.33 (SEM) site 15.2. This site consists of a glaucony grain.



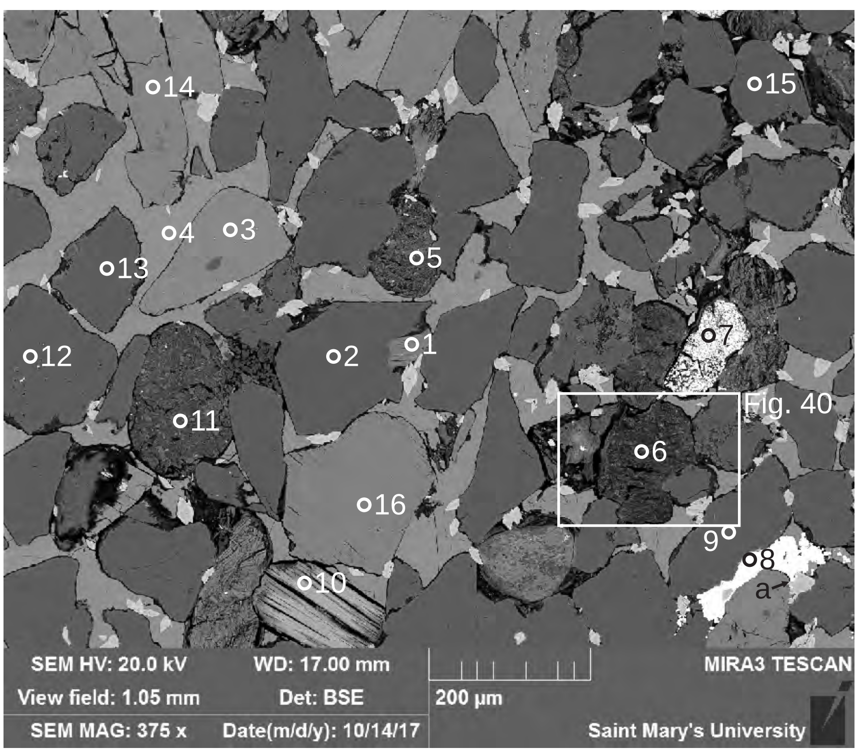
1:Quartz
2:Muscovite
3:TiO_2 +

Figure 1-6.37: Sample 3H-58 2001.33 (SEM) site 15.3. This site consists of a lithic clast made up of muscovite (2) and quartz (1). Titania (3) is later and cross-cuts the muscovite.



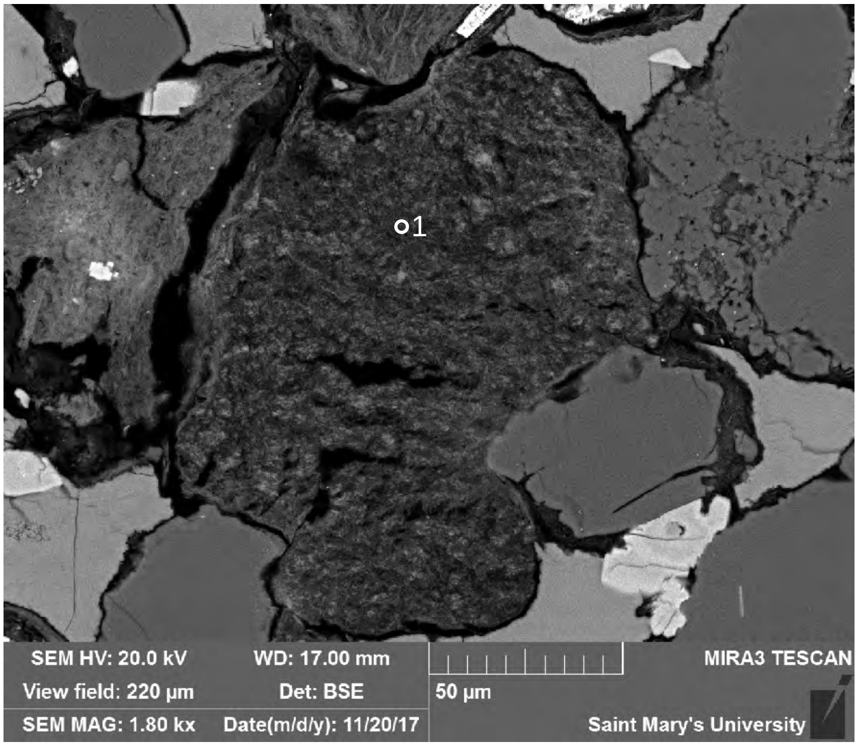
1:Chloritized Muscovite
2:Chlorite
3:Chloritized Muscovite

Figure 1-6.38: Sample 3H-58 2001.33 (SEM) site 15.4. This site consists of chloritized muscovite.



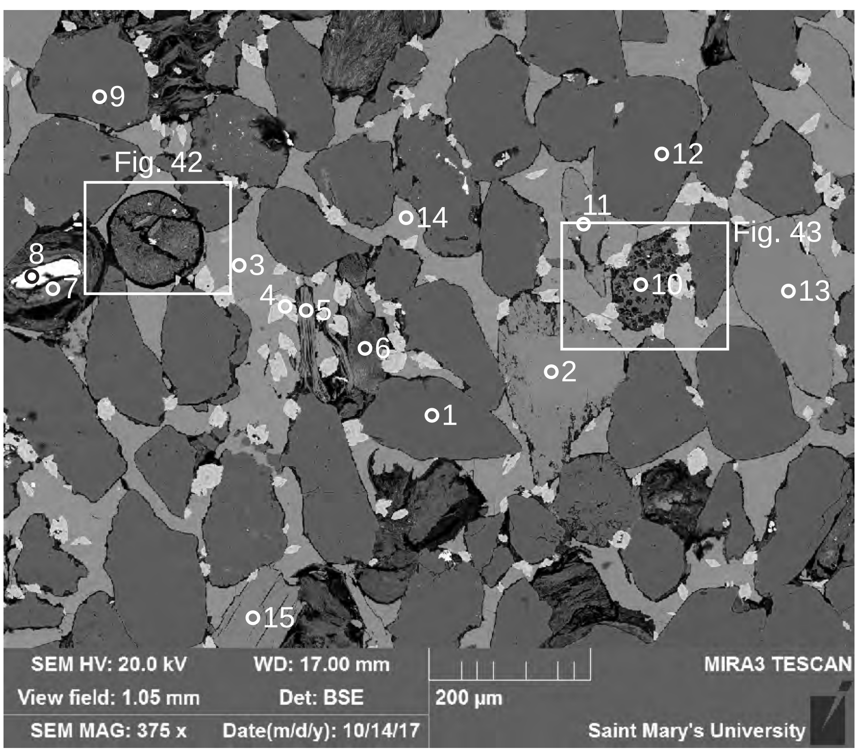
1:Muscovite
2:Quartz
3:K-feldspar
4:Calcite
5:?K-feldspar + Chlorite
6:Glaucony
7:"Ilmenite"
8:Pyrite
9:Quartz
10:Chlorite + Muscovite
11:Chlorite + ?K-feldspar
12:Quartz
13:Quartz
14:K-feldspar
15:Quartz
16:K-feldspar

Figure 1-6.39: Sample 3H-58 2001.33 (SEM) site 16. This site is similar to previous sites. There is altered ilmentie (7), and diagenetic siderite is cut by diagenetic pyrite (8) (position a).



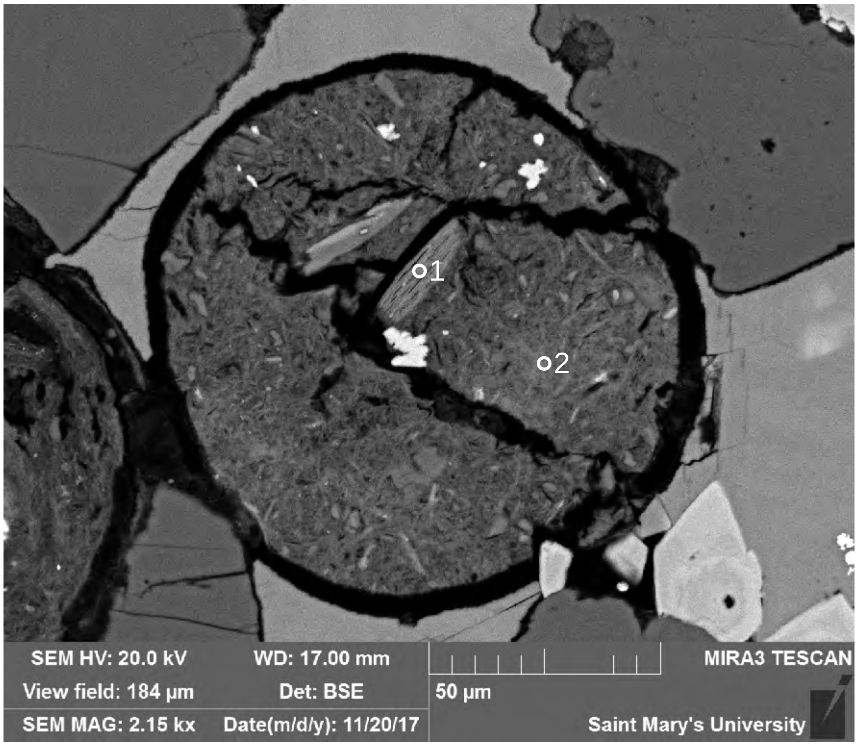
1:Glauconite

Figure 1-6.40: Sample 3H-58 2001.33 (SEM) site 16.1. This site consists of a glauconite pellet.



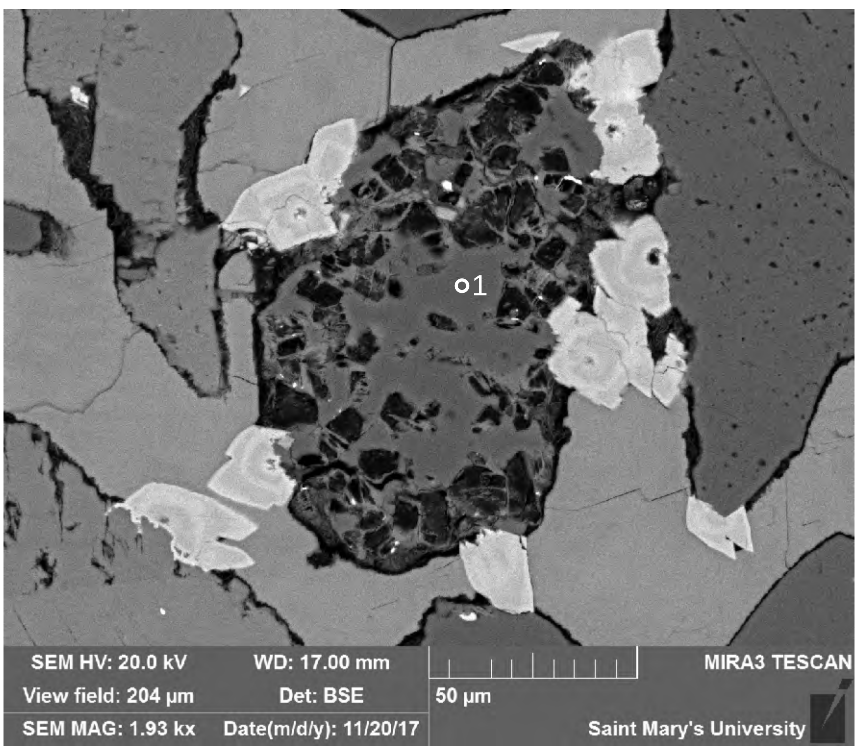
1:Quartz
2:K-feldspar
3:Calcite
4:Siderite
5:Chloritized Muscovite
6:Chloritized ?K-feldspar
7:Chlorite +
8:Monazite
9:Quartz
10:Quartz
11:K-feldspar
12:Quartz
13:K-feldspar
14:Calcite
15:K-feldspar

Figure 1-6.41: Sample 3H-58 2001.33 (SEM) site 17. This site is similar to previous sites. There is a monazite-(Ce) (8) grain which is coated by clays (chlorite?) (7).



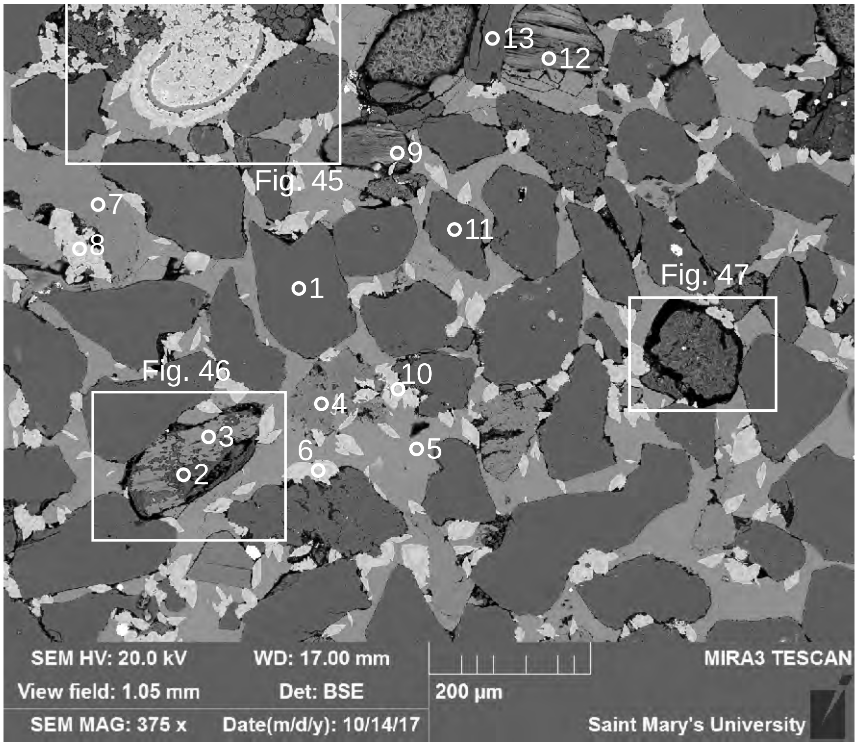
1:Glaucony
2:Glaucony

Figure 1-6.42: Sample 3H-58 2001.33 (SEM) site 17.1. This site consists of a circular glaucony (1-2) grain that has underwent volume reduction.



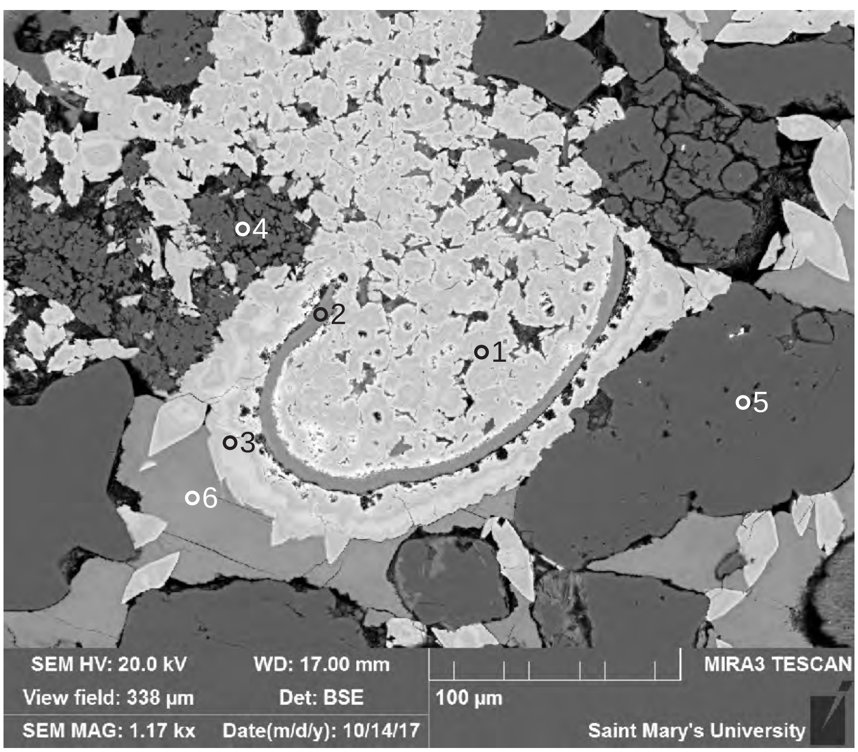
1:Quartz

Figure 1-6.43: Sample 3H-58 2001.33 (SEM) site 17.2. This site consists of a dissolved quartz grain, possibly a rhyolite lithic clast.



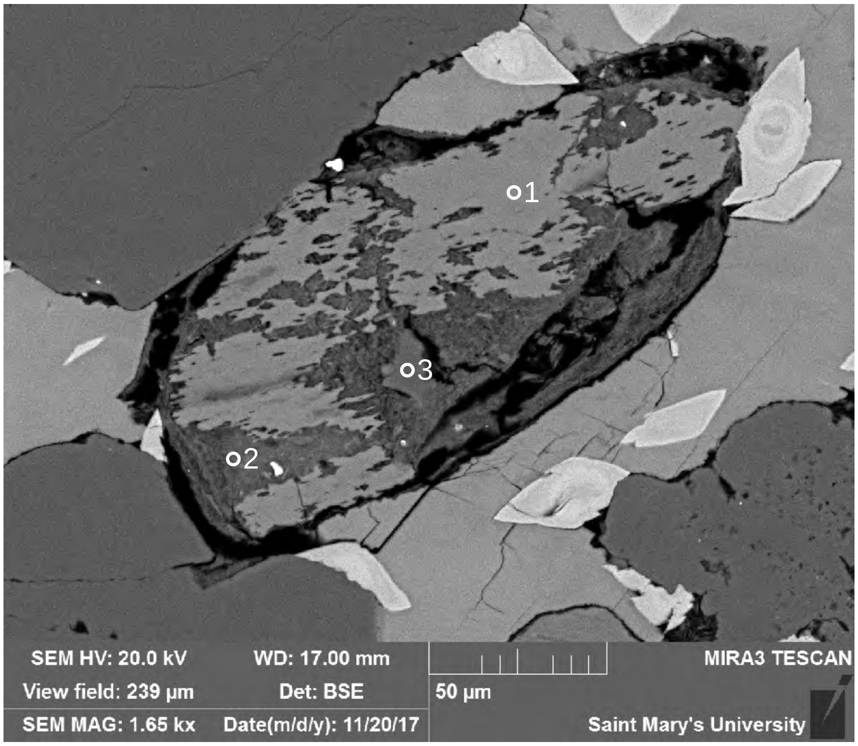
1:Quartz
2:Albite
3:K-feldspar
4:K-feldspar
5:Calcite
6:Siderite
7:K-feldspar
8:Siderite
9:Chlorite
10:Siderite
11:Quartz
12:Chloritized ?K-feldspar
13:Quartz

Figure 1-6.44: Sample 3H-58 2001.33 (SEM) site 18. This site is similar to previous sites. Muscovite is chloritized and there is an igneous lithic clast made up of albite and K-feldspar.



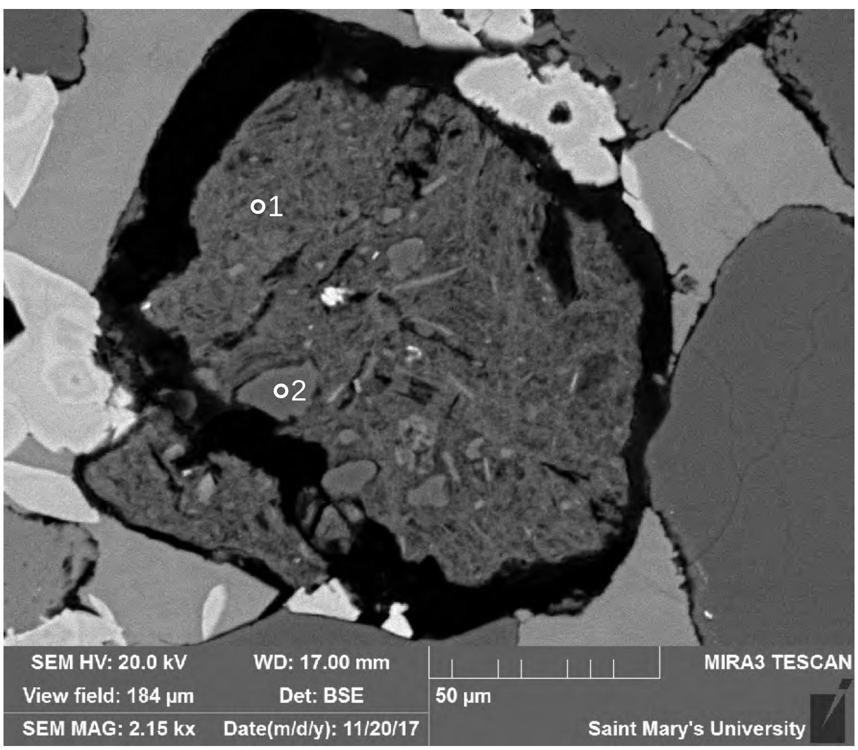
1:Siderite
2:Calcite
3:Siderite
4:Quartz
5:Quartz
6:Calcite

Figure 1-6.45: Sample 3H-58 2001.33 (SEM) site 18.1. This site consists of a coated grain (siderite [illegible] ↑ siderite) ↑ pore filling calcite [illegible]
[illegible] .



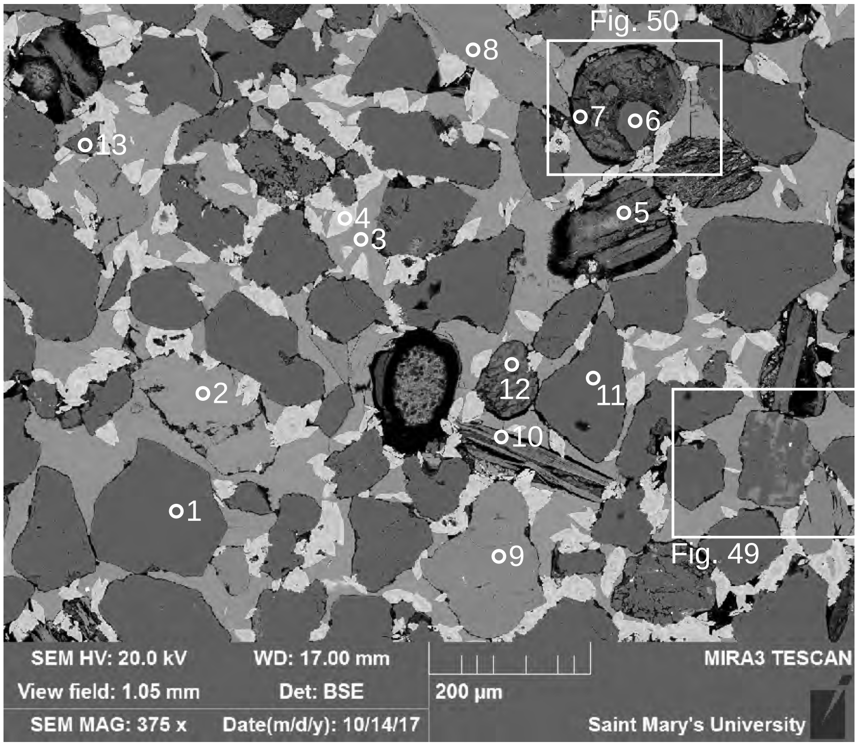
1:K-feldspar
2:Chlorite
3:Albite

Figure 1-6.46: Sample 3H-58 2001.33 (SEM) site 18.2. This site consists of an altered K-feldspar (1) grain, with a ?relic albite (3) grain.



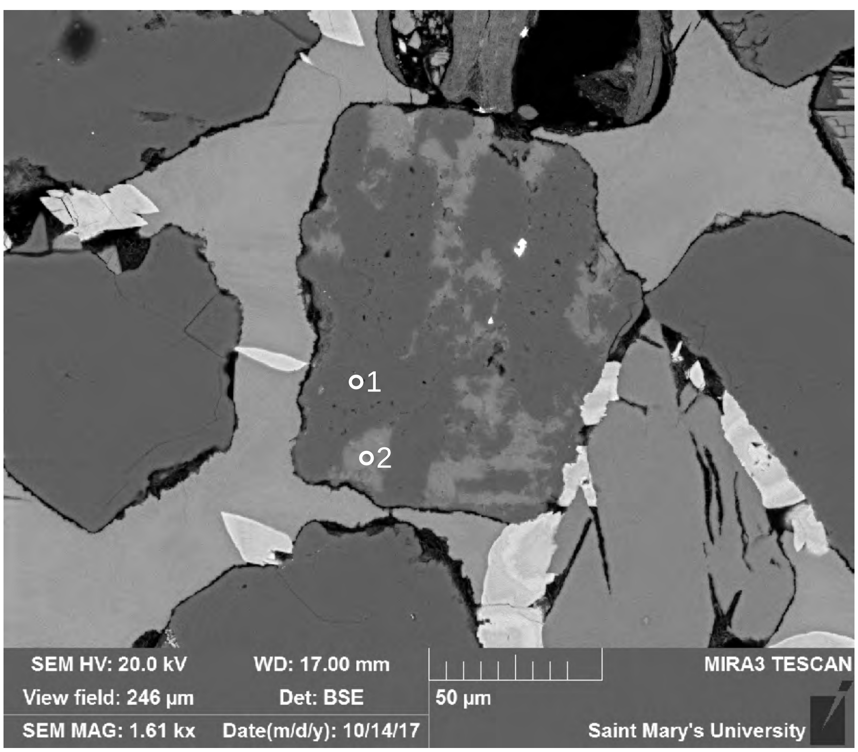
1:Glaucony
2:Quartz

Figure 1-6.47: Sample 3H-58 2001.33 (SEM) site 18.3. This site consists of a glaucony (1) grain with some small grains of quartz (2).



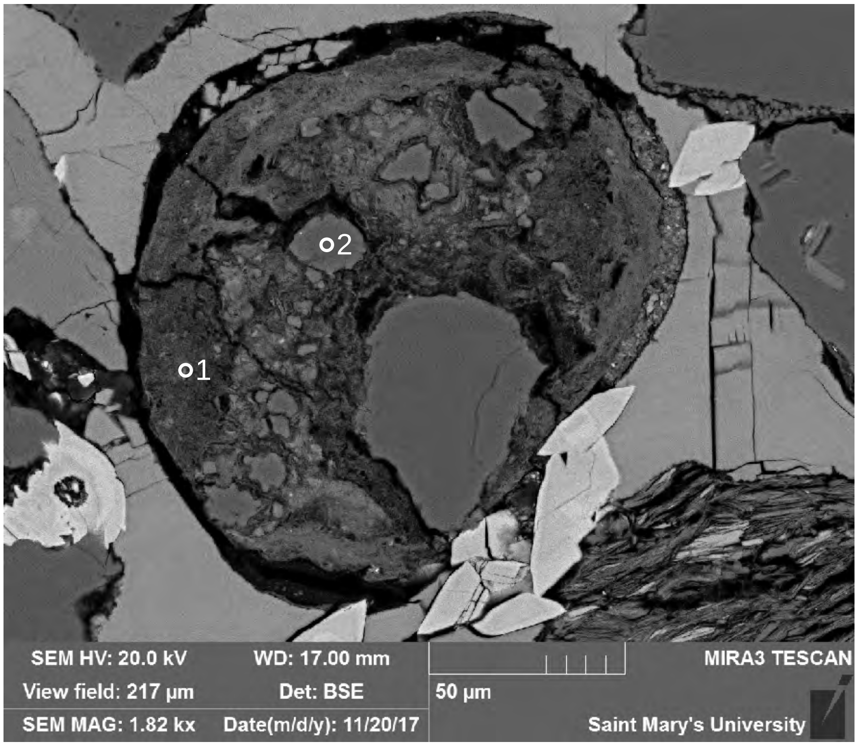
1:Quartz
2:Calcite
3:Calcite
4:Siderite
5:Chloritized Muscovite
6:Quartz
7:Glauconite
8:K-feldspar
9:K-feldspar
10:Chloritized Muscovite
11:Quartz
12:Smectite
13:Quartz +

Figure 1-6.48: Sample 3H-58 2001.33 (SEM) site 19. This site is similar to previous sites.



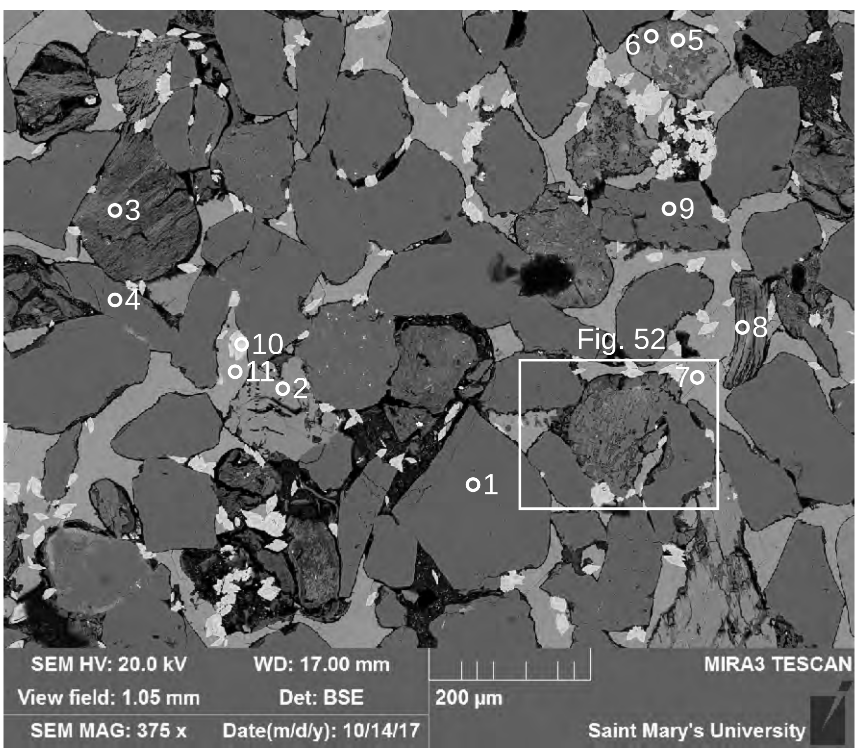
1:Quartz
2:K-feldspar

Figure 1-6.49: Sample 3H-58 2001.33 (SEM) site 19.1. This site consists of a rhyolite lithic clast made up of quartz (1) and K-feldspar (2).



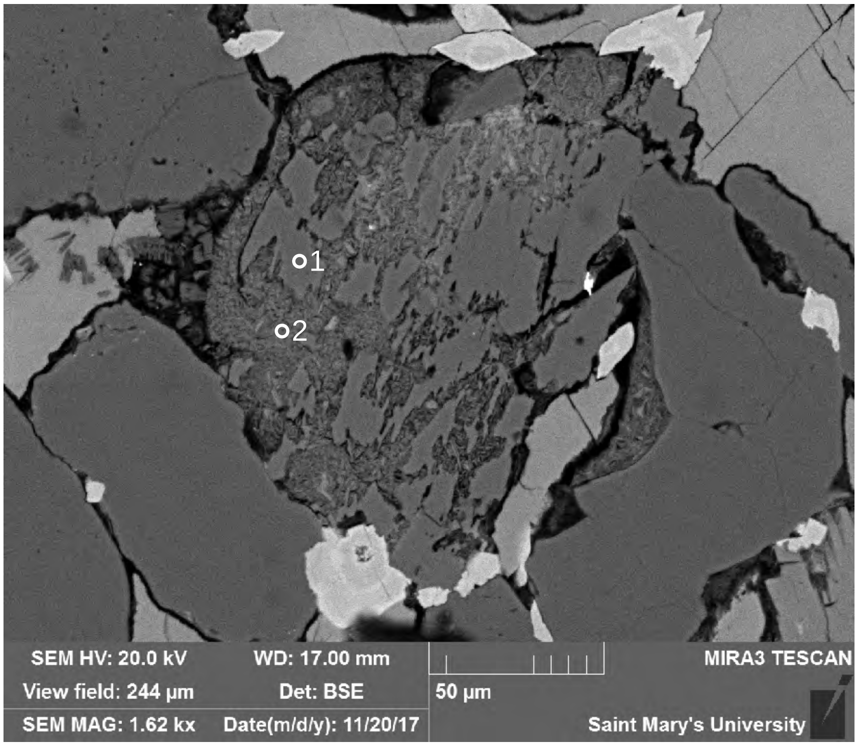
1:Glauconite
2:Quartz

Figure 1-6.50: Sample 3H-58 2001.33 (SEM) site 19.2. This site consists of a glauconite pellet (1) with large quartz (2) grains within it.



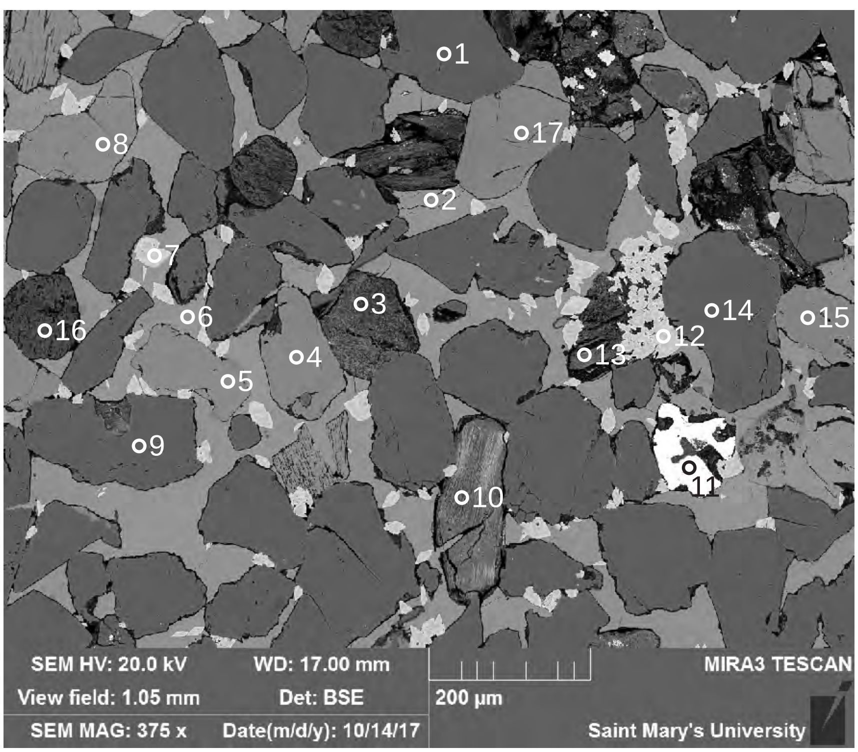
1:Quartz
2:K-feldspar
3:Chlorite + ?K-feldspar
4:Quartz
5:K-feldspar
6:Albite
7:Calcite
8:Chloritized Muscovite
9:Quartz
10:Siderite
11:Calcite

Figure 1-6.51: Sample 3H-58 2001.33 (SEM) site 20. This site consists mainly of quartz. There are some grains of K-feldspar (2), and chloritized muscovite (3,8). There is also an igneous lithic clast made up of K-feldspar (5) and albite (6).



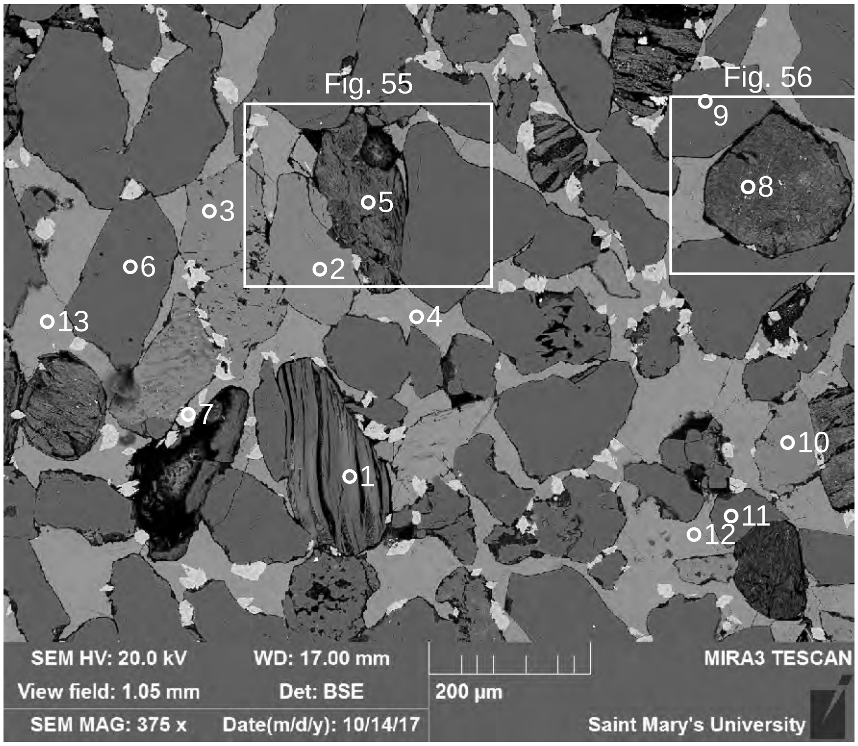
1:Oligoclase
2:Chlorite + Feldspar

Figure 1-6.52: Sample 3H-58 2001.33 (SEM) site 20.1. This site consists of a grain of oligolcase (1) altering to chlorite (2).



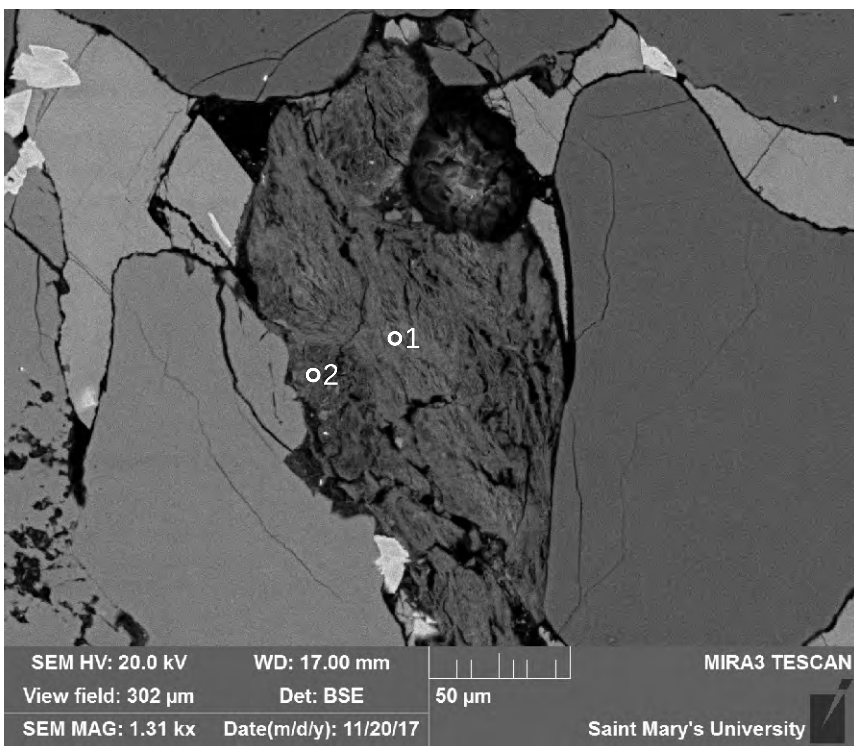
1:Quartz
2:Calcite
3:Glauconite
4:K-feldspar
5:K-feldspar
6:Calcite
7:Siderite
8:K-feldspar
9:Quartz
10:Chlorite + ?K-feldspar
11:Ilmenite
12:Siderite
13:Chloritized ?K-feldspar
14:Quartz
15:K-feldspar
16:Kaolinite + Chlorite
17:K-feldspar

Figure 1-6.53: Sample 3H-58 2001.33 (SEM) site 21. This site is similar to previous sites. Siderite (7,12) partially fills secondary porosity. There is also a detrital ilmenite (11) grain, and a glauconite (3) grain.



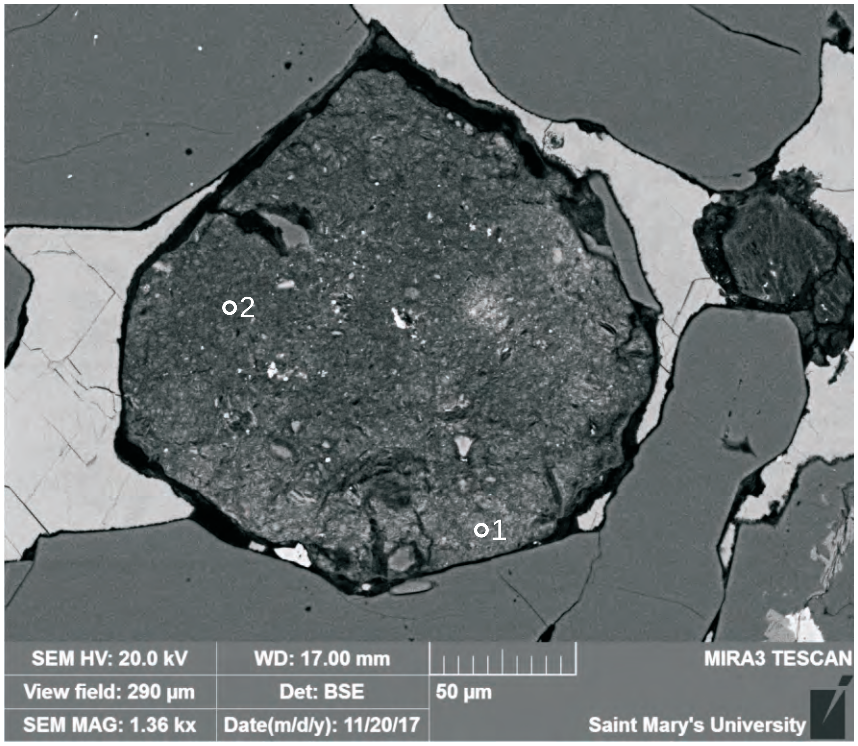
1:Chloritized Muscovite
2:K-feldspar
3:K-feldspar
4:Calcite
5:Glaucony
6:Quartz
7:Siderite
8:Glaucony
9:Quartz
10:K-feldspar
11:Quartz
12:Calcite
13:Calcite

Figure 1-6.54: Sample 3H-58 2001.33 (SEM) site 22. This site is similar to previous sites. Muscovite is commonly chloritized, calcite forms the cement, and siderite partially fills secondary porosity.



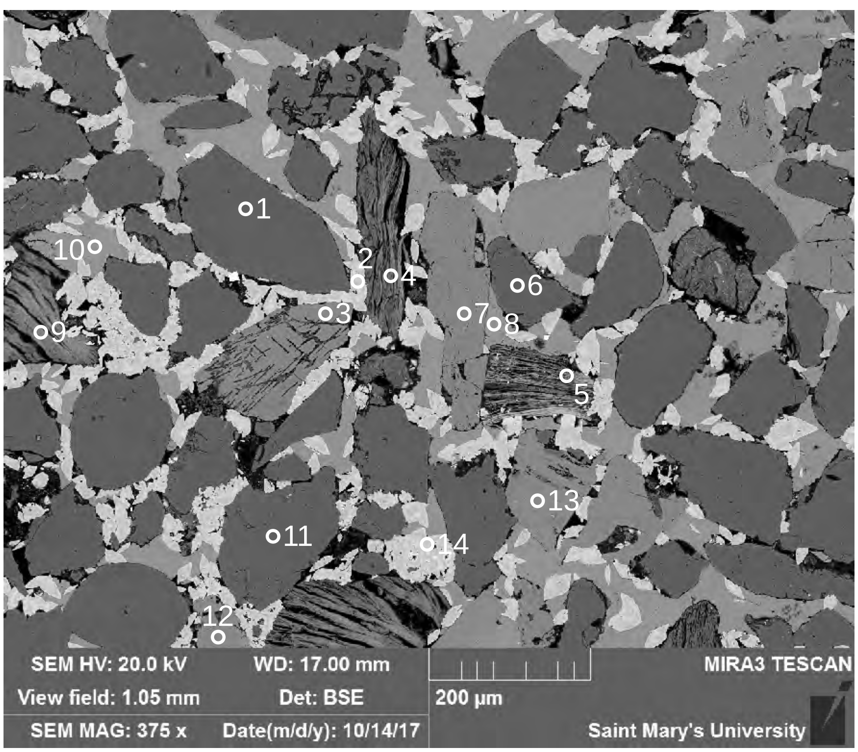
1:Glaucony
2:Glaucony

Figure 1-6.55: Sample 3H-58 2001.33 (SEM) site 22.1. This site consists of a glaucony grain (1-2).



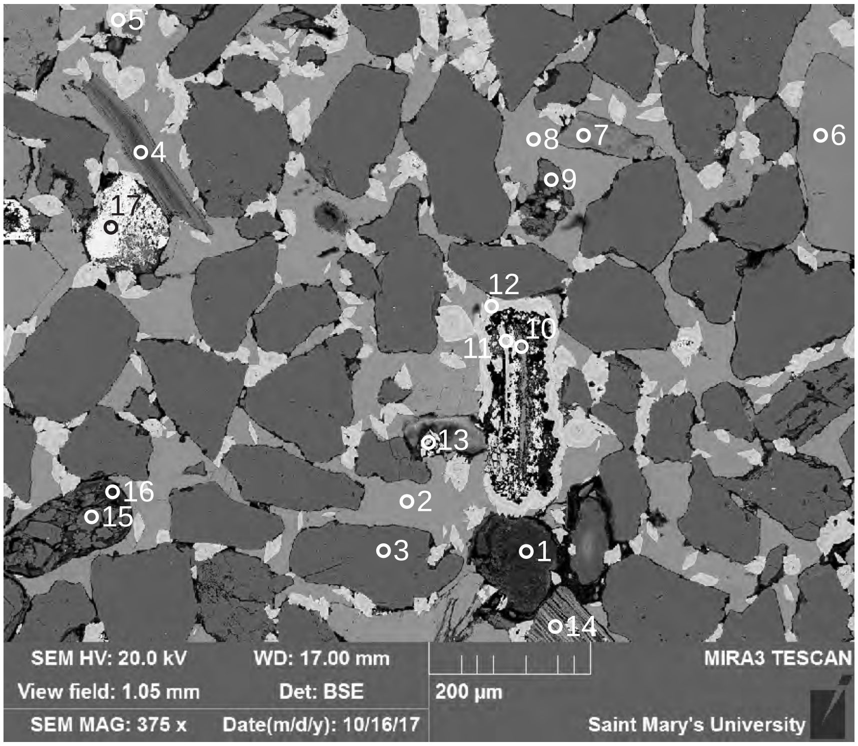
1:Glaucony
2:Glaucony

Figure 1-6.56: Sample 3H-58 2001.33 (SEM) site 22.2. This site consists of a pellet of glaucony (1-2).



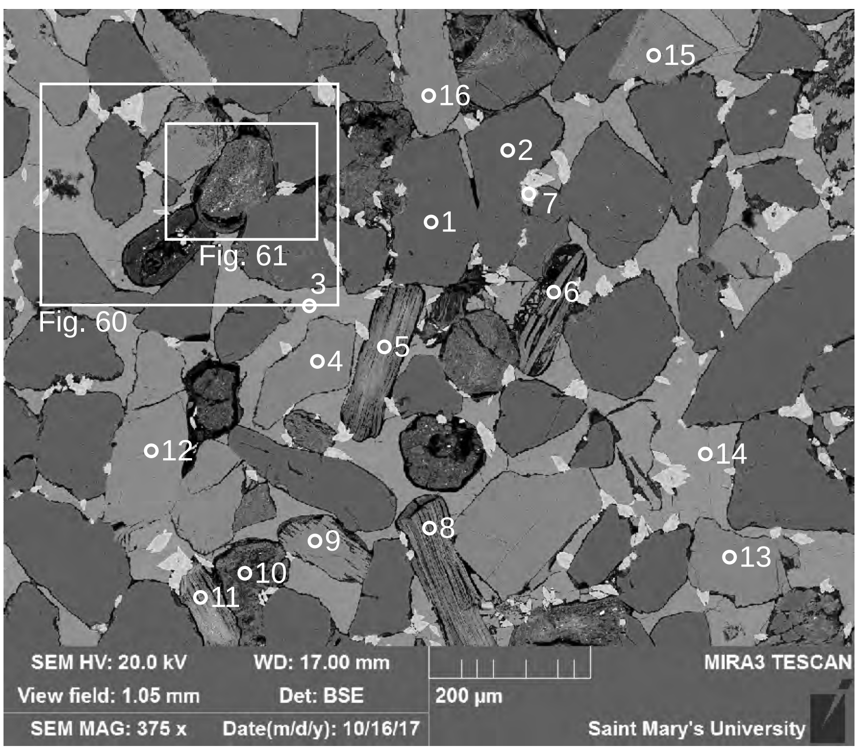
1:Quartz
2:Siderite
3:K-feldspar
4:Chloritized Muscovite
5:Chloritized Muscovite
6:Quartz
7:K-feldspar
8:Calcite
9:Chloritized Muscovite
10:Calcite
11:Quartz
12:K-feldspar
13:K-feldspar
14:Siderite

Figure 1-6.57: Sample 3H-58 2001.33 (SEM) site 23. This site is similar to previous sites.



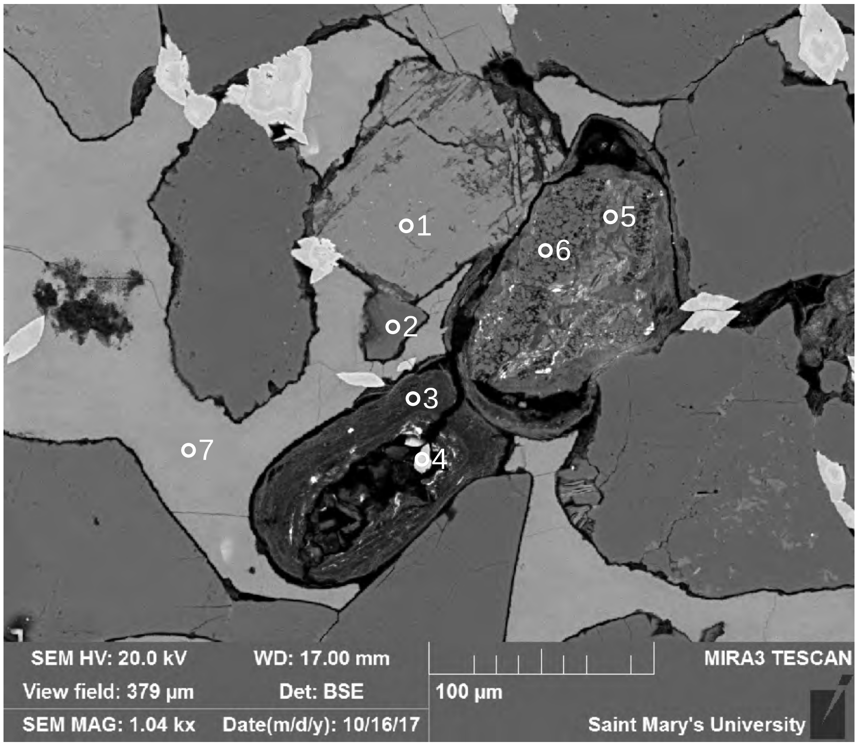
1:Kaolinite +
2:Calcite
3:Quartz
4:Kaolinite
5:Siderite
6:K-feldspar
7:K-feldspar
8:Calcite
9:Quartz
10:Calcite
11:Siderite
12:Siderite
13:Siderite
14:Chloritized Muscovite
15:Quartz
16:Chlorite + Muscovite
17:TiO_2

Figure 1-6.58: Sample 3H-58 2001.33 (SEM) site 24. This site is similar to previous sites. There is a large grain of altered ilmenite (17) and siderite (11-12) coats a calcite grain (that may have replaced a previous mineral).



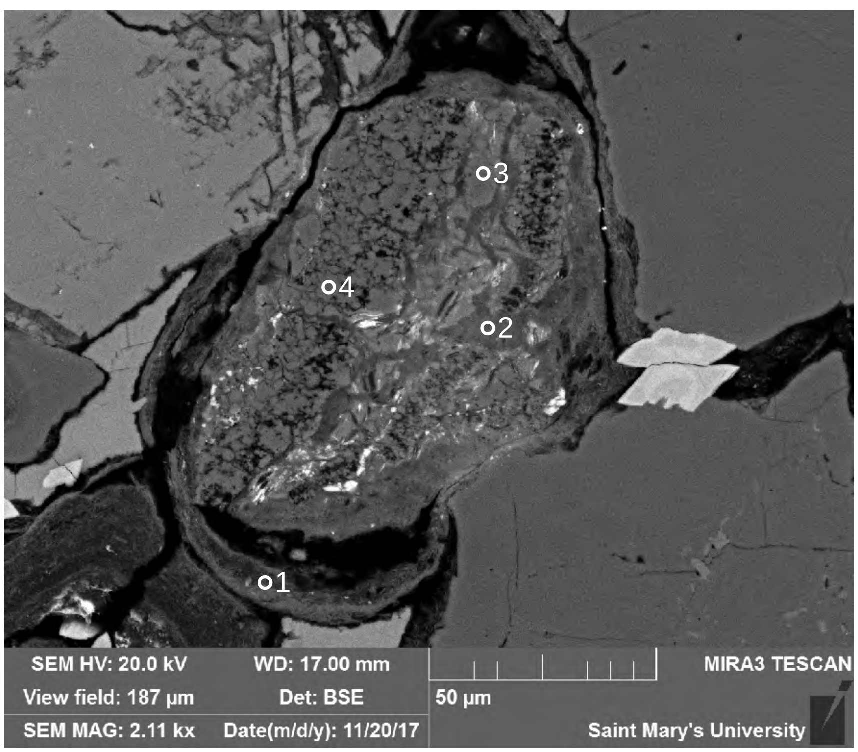
1:Quartz
2:Quartz
3:Calcite
4:K-feldspar
5:Chloritized Muscovite
6:Chloritized Muscovite
7:Siderite
8:Chloritized Muscovite
9:K-feldspar
10:Chlorite + Illite
11:Chloritized Muscovite
12:K-feldspar
13:K-feldspar
14:Calcite
15:K-feldspar
16:K-feldspar

Figure 1-6.59: Sample 3H-58 2001.33 (SEM) site 25. This site is similar to previous sites. Muscovite is commonly chloritized and siderite partially fills secondary porosity.



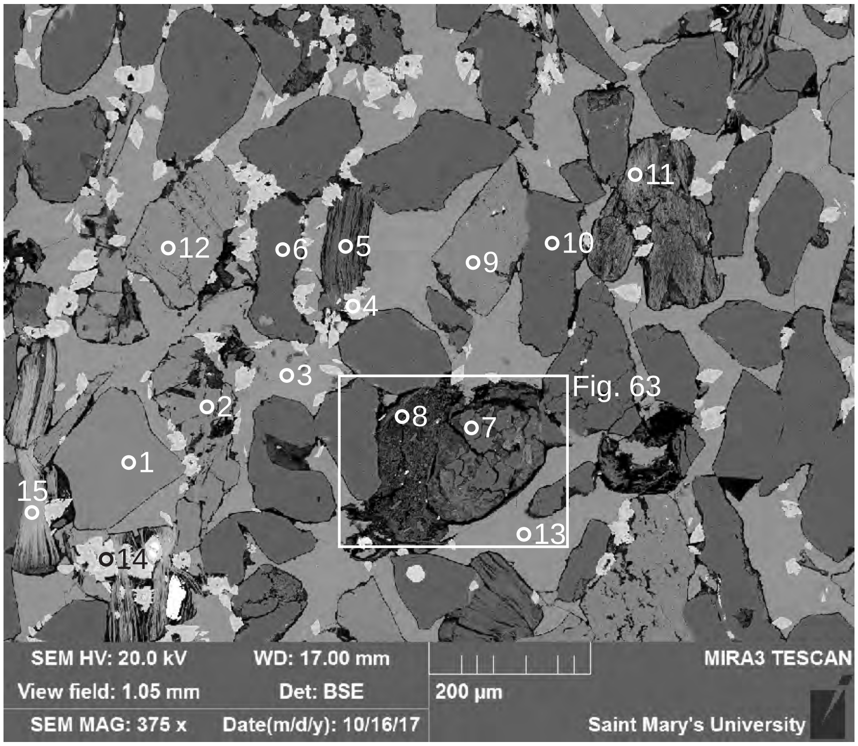
1:K-feldspar
2:Quartz
3:Chlorite
4:Siderite
5:Quartz +
6:Quartz +
7:Calcite

Figure 1-6.60: Sample 3H-58 2001.33 (SEM) site 25.1. This site consists of an altered K-feldspar (1), quartz (5-6) grains, and a coated grain (3) that had been partially dissolved.



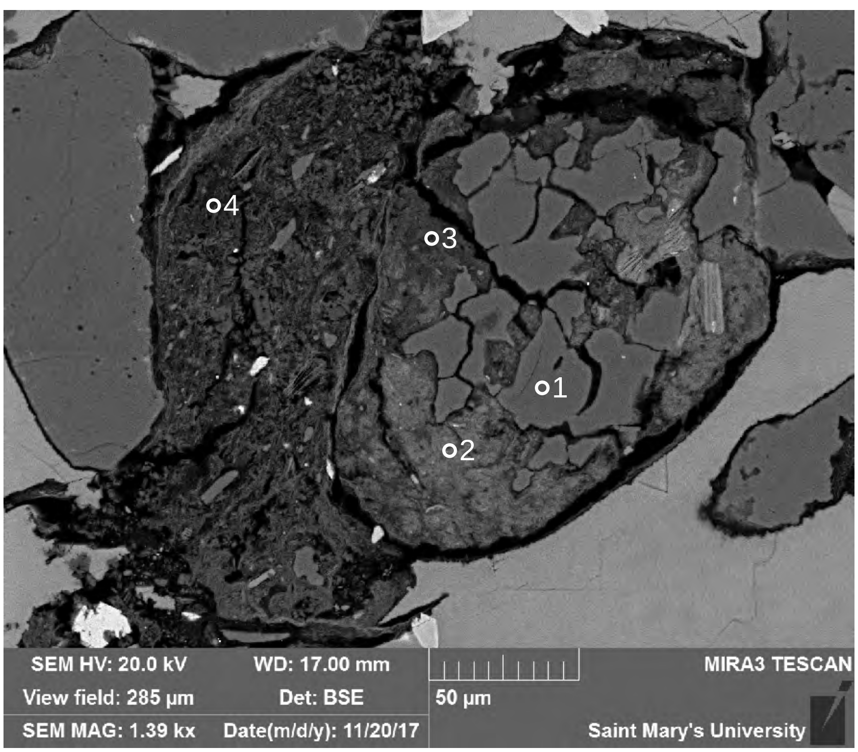
1:Fe-Chlorite
2:Fe-Chlorite
3:Quartz +
4:Quartz

Figure 1-6.61: Sample 3H-58 2001.33 (SEM) site 25.2. This site consists of a coated grain that is made up of a nucleus of layered quartz (3-4) with chlorite (2) patches and a coat of chlorite (1).



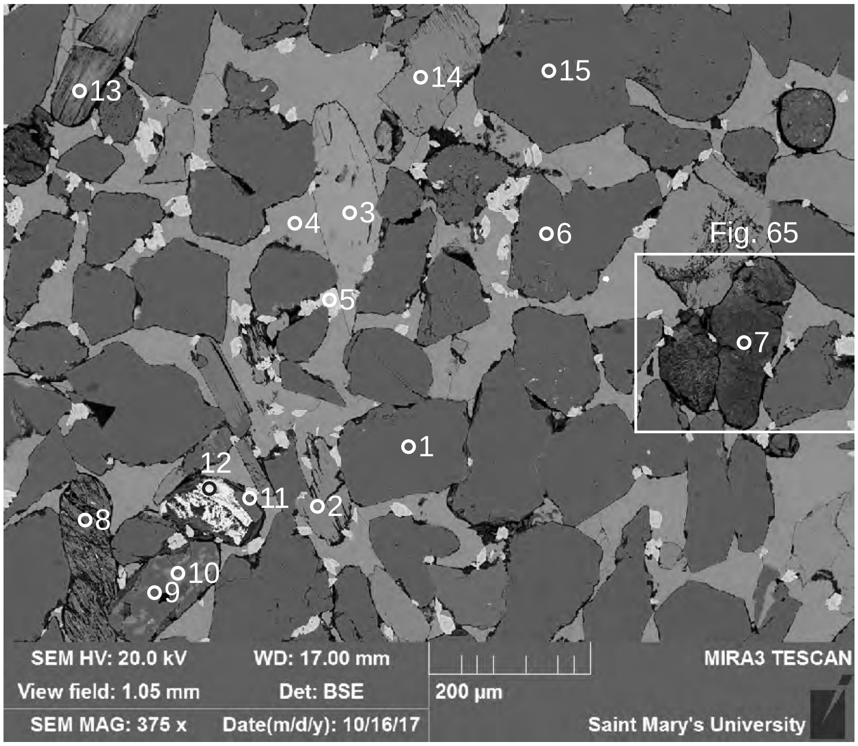
1:K-feldspar
2:K-feldspar
3:Calcite
4:Siderite
5:Chloritized Muscovite
6:Quartz
7:Quartz
8:Smectite ?
9:K-feldspar
10:Quartz
11:Glaucony
12:K-feldspar
13:Calcite
14:Siderite
15:Chloritized Muscovite

Figure 1-6.62: Sample 3H-58 2001.33 (SEM) site 26. This site consists mainly of quartz, K-feldspar, and chloritized muscovite. The cement is made up of calcite, and siderite partially fills secondary porosity.



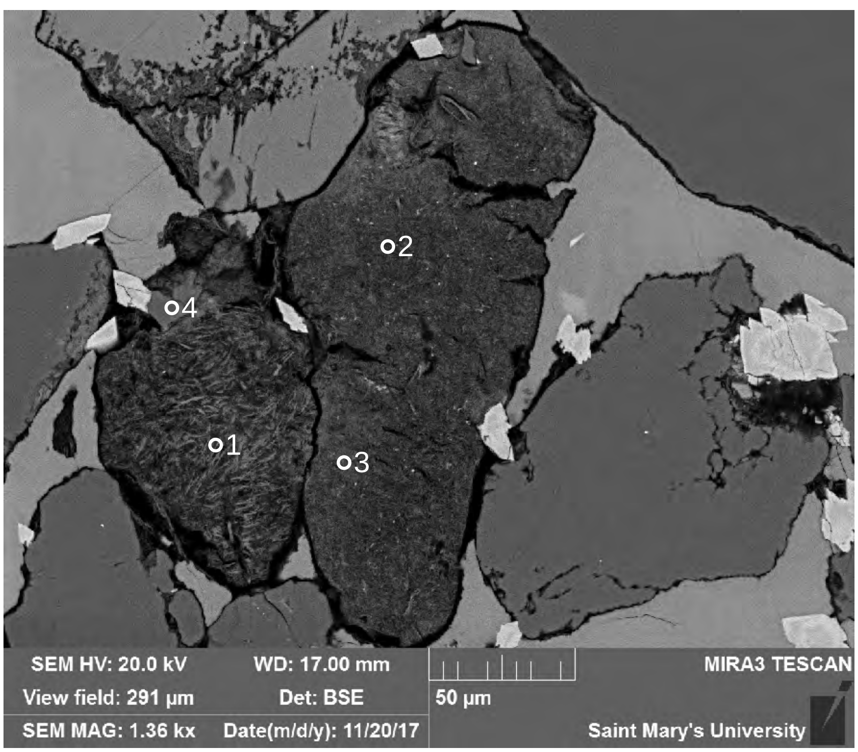
1:Quartz
2:Glaucony
3:Glaucony
4:Fe-chlorite

Figure 1-6.63: Sample 3H-58 2001.33 (SEM) site 26.1. This site consists of a crushed Fe-clay pellet (4) and a pellet of quartz (1) and glaucony (2,3). This probably was originally an Fe-clay that was converted to chamosite (Fe-rich chlorite (4)) through diagenesis.



1:Quartz
2:K-feldspar
3:K-feldspar
4:Calcite
5:Siderite
6:Quartz
7:Glaucony
8:Illite
9:Quartz
10:K-feldspar
11:Quartz
12:TiO_2
13:Chloritized Muscovite +
14:K-feldspar
15:Quartz

Figure 1-6.64: Sample 3H-58 2001.33 (SEM) site 27. This site is similar to previous sites. There is also an altered ilmenite (11-12) grain present, and a granitoid lithic clast made up of quartz (9) and K-feldspar (10).



1:Glaucony
2:Glaucony
3:Glaucony
4:Quartz

Figure 1-6.65: Sample 3H-58 2001.33 (SEM) site 27.1. This site consists of grains of glaucony (1-3).

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	1	1	Qz	100.00																									100	119
3H-58-2001.33	1	2	Qz	100.00																									100	120
3H-58-2001.33	1	3	Kfs	66.29		17.77					0.45	15.49																	100	114
3H-58-2001.33	1	4	Kfs	66.04		17.91					0.66	15.39																	100	113
3H-58-2001.33	1	5	Qz	100.00																									100	116
3H-58-2001.33	1	6	Kfs	66.28		17.80					0.77	15.15																	100	115
3H-58-2001.33	1	7	Qz	100.00																									100	118
3H-58-2001.33	1	8	Cal				1.10	0.77		54.14																			56	56
3H-58-2001.33	1	9	Cal				0.93	0.49		54.58																			56	57
3H-58-2001.33	1	10	Kfs	66.06		17.61					0.26	16.06																	100	117
3H-58-2001.33	1	11	Sd	0.40			41.37	0.88	7.20	5.63			0.52																56	62
3H-58-2001.33	1	12	Sd	0.54			39.25	1.19	7.40	7.62																			56	62
3H-58-2001.33	1	13	Ms	47.06	0.83	27.53	6.93		1.80		0.53	10.33																	95	106
3H-58-2001.33	1.1	1	Kfs	66.81		17.81					1.45	13.92																	100	118
3H-58-2001.33	1.1	2	Ab	68.82		18.86	0.20			0.50	11.54	0.08																	100	119
3H-58-2001.33	1.1	3	Kfs	66.30		17.80					0.80	15.10																	100	116
3H-58-2001.33	1.1	4	Chl + Ill	43.18		17.36	28.87		5.14	0.67	1.45	2.12				1.22													100	67
3H-58-2001.33	1.1	5	Ms + Chl	51.25	0.57	27.95	8.68		3.34		0.52	7.36				0.33													100	96
3H-58-2001.33	1.1	6	Kfs	66.26		17.66	0.29					15.80																	100	116
3H-58-2001.33	1.1	7	Cal				1.25	0.67		54.08																			56	55
3H-58-2001.33	1.1	8	Sd	0.73			44.26	1.57	6.74	2.52		0.18																	56	62
3H-58-2001.33	2	1	Qz	100.00																									100	121
3H-58-2001.33	2	2	Kfs	65.43		18.22					1.17	14.02										1.16							100	114
3H-58-2001.33	2	3	Kfs	66.07		17.78					0.67	15.48																	100	113
3H-58-2001.33	2	4	Qz	100.00																									100	121
3H-58-2001.33	2	5	Qz	100.00																									100	121
3H-58-2001.33	2	6	Chl + Ill	53.98		19.54	17.30		3.24		1.16	3.88				0.91													100	79
3H-58-2001.33	2	7	Chl + Ms	47.80	0.43	30.26	16.26		2.43		0.76	1.36				0.71													100	82
3H-58-2001.33	2	8	Ms	47.18	0.56	32.22	3.50		0.57		0.78	10.19																	95	110
3H-58-2001.33	2	9	Cal				1.48	0.60		53.92																			56	57
3H-58-2001.33	2	10	Sd				40.77	2.28	6.67	5.19	0.51					0.58													56	64
3H-58-2001.33	2	11	Kfs	66.07		17.77					0.56	15.60																	100	118
3H-58-2001.33	2	12	Kfs	66.29		17.98					1.42	14.31																	100	115
3H-58-2001.33	2	13	Qz	100.00																									100	118
3H-58-2001.33	2	14	Cal				0.99	0.60		54.40																			56	56
3H-58-2001.33	2	15	Sd	0.44			39.38	1.20	7.34	7.64																			56	60
3H-58-2001.33	2	16	Sd	0.41			37.03	1.20	8.86	8.50																			56	61
3H-58-2001.33	2	17	"Ilm"	4.94	61.78	2.48	26.87	2.03	0.90	0.39		0.24				0.37													100	92
3H-58-2001.33	2.1	1	Qz	99.31		0.67						0.02																	100	117
3H-58-2001.33	2.1	2	Qz	99.55			0.45																						100	118
3H-58-2001.33	2.1	3	"Ilm"	0.49	97.24		0.56													1.71									100	108
3H-58-2001.33	3	1	Cal				1.33	0.80		53.87																			56	54
3H-58-2001.33	3	2	Qz	100.00																									100	116
3H-58-2001.33	3	3	Sd +	6.70		3.86	69.24	2.06	9.12	8.53		0.49																	100	62
3H-58-2001.33	3	4	Chloritized Ms	48.65		26.44	17.49		3.71	0.53	0.79	1.95				0.44													100	80
3H-58-2001.33	3	5	Kfs	66.37		17.71					0.80	15.13																	100	112
3H-58-2001.33	3	6	Ms	47.36	1.08	33.05	1.75		0.84		0.62	10.31																	95	101
3H-58-2001.33	3	7	Sd				44.83	0.93	2.84	5.85			1.55																56	58
3H-58-2001.33	3	8	Chl + Ms	40.49	2.25	20.47	21.88	0.27	8.49		0.51	5.64																	100	95
3H-58-2001.33	3	9	Qz	100.00																									100	119
3H-58-2001.33	3	10	Kln	46.96		36.00	0.40				0.51	2.14																	86	97
3H-58-2001.33	3	11	Sd	0.92		0.54	37.32	1.15	8.24	7.83																			56	61
3H-58-2001.33	3	12	Kln	48.53		36.40	0.93					0.15																	86	83

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	3	13	Qz	99.80			0.20																						100	110
3H-58-2001.33	3	14	Cal				0.96	0.64		54.40																			56	53
3H-58-2001.33	4	1	Qz	100.00																									100	118
3H-58-2001.33	4	2	Cal				0.81	0.55		54.64																			56	54
3H-58-2001.33	4	3	Chloritized Ms	45.21	0.50	25.02	22.78		3.55	0.36	0.78	1.25				0.56													100	86
3H-58-2001.33	4	4	Qz	99.97								0.03																	100	116
3H-58-2001.33	4	5	Ab + Qz	74.33		1.22			4.58	7.42	11.94	0.51																	100	116
3H-58-2001.33	4	6	Chloritized Ms	37.88	1.21	20.17	29.24		7.18	0.33	1.09	2.38				0.51													100	84
3H-58-2001.33	4	7	Sd				41.80	0.44	7.22	5.69			0.85																56	61
3H-58-2001.33	4	8	Gly	44.81		12.63	19.18		3.39	0.43	0.64	5.18				0.73													87	63
3H-58-2001.33	4	9	Qz	100.00																									100	119
3H-58-2001.33	4	10	Kln	49.24		35.84	0.42									0.49													86	55
3H-58-2001.33	4	11	Qz	100.00																									100	119
3H-58-2001.33	4	12	Chl ?	43.23		24.36	26.79		3.26	0.57	0.92	0.32				0.55													100	75
3H-58-2001.33	4	13	Mix	30.52		11.82	9.19		2.40	2.77		2.26	21.60			0.76								13.99	4.70				100	79
3H-58-2001.33	4.1	1	Qz	100.00																									100	121
3H-58-2001.33	4.1	2	Qz	97.06		1.81	0.69					0.43																	100	118
3H-58-2001.33	4.1	3	TiO2 +	3.49	92.72	2.20	0.79			0.81																			100	103
3H-58-2001.33	4.1	4	Sd	0.44			42.83	0.66	7.82	4.24																			56	57
3H-58-2001.33	4.1	5	Cal				0.91	0.56		54.53																			56	53
3H-58-2001.33	4.1	6	Chl + Ill	52.35	0.77	32.19	10.17		1.61	0.25	0.64	1.31				0.70													100	69
3H-58-2001.33	4.1	7	Chl	34.52		21.03	23.59		3.27	0.27	0.81	0.89				0.62													85	66
3H-58-2001.33	5	1	Kfs	66.29		17.69					0.54	15.48																	100	109
3H-58-2001.33	5	2	Qz	100.00																									100	117
3H-58-2001.33	5	3	Qz	100.00																									100	116
3H-58-2001.33	5	4	Cal				0.88	0.65		54.47																			56	54
3H-58-2001.33	5	5	"Ilm"	8.55	87.15	2.19	0.92		0.44			0.75																	100	105
3H-58-2001.33	5	6	Qz	100.00																									100	114
3H-58-2001.33	5	7	Kfs	66.65		17.86					1.36	14.13																	100	112
3H-58-2001.33	5	8	Chloritized Ms	41.17	0.75	23.21	28.83		3.01	0.37	0.87	1.08				0.71													100	84
3H-58-2001.33	5	9	Gly	45.37		15.22	16.02		3.06	0.30	1.35	4.78				0.89													87	90
3H-58-2001.33	5	10	Ill + Chl	42.51		17.75	28.89		5.48	0.68	1.66	1.77				1.26													100	63
3H-58-2001.33	5	11	Sd				40.51	0.82	7.99	6.69																			56	58
3H-58-2001.33	5	12	Cal				12.78	0.86	1.01	41.35																			56	52
3H-58-2001.33	5	13	Kfs	64.90		18.13					0.86	14.45										1.65							100	112
3H-58-2001.33	5	14	Sd				43.02	0.96	7.25	4.54						0.23													56	58
3H-58-2001.33	5.1	1	Qz	99.78			0.22																						100	121
3H-58-2001.33	5.1	2	Chloritized Ms	50.29		18.47	21.79		7.43	0.28	0.75	0.99																	100	102
3H-58-2001.33	5.1	3	Sd				38.18	0.99	8.41	8.42																			56	60
3H-58-2001.33	5.1	4	Cal				1.13	0.59		54.28																			56	55
3H-58-2001.33	5.1	5	Qz	100.00																									100	119
3H-58-2001.33	5.2	1	Gly	37.09		14.62	25.58		4.99	0.56	1.19	1.96				1.02													87	66
3H-58-2001.33	5.3	1	Gly	45.56		14.94	16.30		2.88	0.44	0.82	5.35				0.72													87	78
3H-58-2001.33	5.3	2	Gly	46.26		15.16	14.93		3.01	0.43	1.01	5.10				1.10													87	84
3H-58-2001.33	5.3	3	Glt	42.58		12.96	20.44		2.11	0.60	0.84	6.43				1.04													87	59
3H-58-2001.33	6	1	Qz	100.00																									100	116
3H-58-2001.33	6	2	Kfs	66.38		17.86					1.02	14.74																	100	114
3H-58-2001.33	6	3	Kfs	64.83		18.29					1.06	14.03										1.79							100	115
3H-58-2001.33	6	4	Chloritized Ms	42.81	1.25	20.65	25.59		4.50	0.59	1.29	2.31				1.01													100	78
3H-58-2001.33	6	5	Qz	100.00																									100	120
3H-58-2001.33	6	6	Chloritized Ms	43.21	0.61	22.40	24.81		4.64	0.28	1.23	1.88				0.93													100	85
3H-58-2001.33	6	7	Kfs	66.24		17.70					0.39	15.68																	100	114
3H-58-2001.33	6	8	Qz	100.00																									100	115

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	6	9	Chloritized Ms	45.10		27.49	21.20		3.26	0.40	1.08	0.49				0.98													100	70
3H-58-2001.33	6	10	Chloritized Ms	40.82		20.69	30.06		4.12	0.86	1.50	1.02				0.94													100	75
3H-58-2001.33	6	11	Kfs	64.70		18.21					1.06	13.94										2.10							100	114
3H-58-2001.33	6	12	Sd				42.11	0.97	6.30	6.05			0.57																56	59
3H-58-2001.33	6	13	Sd	0.40			37.64	1.01	8.67	8.28																			56	62
3H-58-2001.33	6	14	Chloritized Ms	38.88	0.64	18.38	30.55		6.55	0.46	1.62	1.88				1.04													100	83
3H-58-2001.33	6	15	Kfs	66.51		17.62						15.86																	100	119
3H-58-2001.33	7	1	Qz	100.00																									100	119
3H-58-2001.33	7	2	Chl	30.62		13.40	33.00	0.39	4.04	0.45	1.24	0.28				1.59													85	66
3H-58-2001.33	7	3	Kfs	64.58		18.02					0.94	13.99										2.48							100	118
3H-58-2001.33	7	4	Kfs	65.59		17.92					0.68	15.11										0.70							100	117
3H-58-2001.33	7	5	Ms + Chl	50.91		27.85	13.66		2.48	0.36	0.99	2.95				0.81													100	87
3H-58-2001.33	7	6	Ms + Chl	50.73		22.30	16.49		3.36	0.57	1.11	4.51				0.93													100	80
3H-58-2001.33	7	7	Qz	100.00																									100	117
3H-58-2001.33	7	8	Kfs	66.22		17.80					0.59	15.38																	100	113
3H-58-2001.33	7	9	Chloritized Ms	41.77	0.62	19.96	26.58		5.45	0.44	1.74	2.73				0.71													100	97
3H-58-2001.33	7	10	Kfs	65.72		17.64	1.07				0.70	14.86																	100	115
3H-58-2001.33	7	11	Sd	0.46			38.75	1.04	7.90	7.86																			56	60
3H-58-2001.33	7	12	Cal				1.21	0.63		54.16																			56	56
3H-58-2001.33	7	13	Sd	0.61			38.88	1.02	7.99	7.50																			56	59
3H-58-2001.33	7	14	Gly	41.40		19.82	14.39		3.11	0.40	2.24	4.77				0.86													87	99
3H-58-2001.33	8	1	Qz	100.00																									100	119
3H-58-2001.33	8	2	Sme ?	51.98	0.45	24.81	12.97		2.65	0.41	0.53	5.55				0.65													100	71
3H-58-2001.33	8	3	Oligo	63.67		22.72				4.71	8.71	0.19																	100	115
3H-58-2001.33	8	4	Sd				40.53	0.69	7.76	7.02																			56	59
3H-58-2001.33	8	5	Cal				1.06	0.66		54.28																			56	55
3H-58-2001.33	8	6	Ms	46.99	0.79	31.81	3.70		0.79		0.46	10.47																	95	103
3H-58-2001.33	8	7	Cal				1.68	0.87		53.45																			56	53
3H-58-2001.33	8	8	Sd				39.57	0.82	8.47	7.14																			56	60
3H-58-2001.33	8	9	Gly	44.38		14.05	18.44		2.96		0.69	5.46				1.03													87	67
3H-58-2001.33	8	10	Chloritized Ms	38.66	1.40	17.46	29.03	0.28	7.09	0.72	0.89	3.94				0.52													100	92
3H-58-2001.33	8	11	Kfs	66.39		17.77					1.32	14.52																	100	117
3H-58-2001.33	8	12	Sme ?	56.36		21.83	11.80		2.71	0.84	1.13	4.41				0.92													100	90
3H-58-2001.33	8	13	Qz	100.00																									100	121
3H-58-2001.33	8	14	Chloritized Ms	37.74	1.84	19.40	27.50		6.63	0.45	0.58	5.45				0.39													100	91
3H-58-2001.33	8	15	Qz	100.00																									100	124
3H-58-2001.33	8	16	Kfs	66.24		17.87					0.98	14.92																	100	116
3H-58-2001.33	8	17	"Ilm"		70.61		28.92			0.47																			100	92
3H-58-2001.33	8	18	Sd	0.46			38.47	1.16	8.37	7.53																			56	62
3H-58-2001.33	8.1	1	Glt	46.21		14.20	16.15		3.05		0.84	5.72				0.84													87	66
3H-58-2001.33	8.1	3	Sd				43.01	0.73	5.26	5.66			1.34																56	59
3H-58-2001.33	9	1	Kfs	66.35		17.49					0.33	15.83																	100	115
3H-58-2001.33	9	2	Qz	100.00																									100	119
3H-58-2001.33	9	3	Kfs	65.94		17.75	0.45				0.44	15.42																	100	111
3H-58-2001.33	9	4	Cal				1.00	0.59		54.41																			56	56
3H-58-2001.33	9	5	Sd	1.02			38.87	2.07	7.07	6.01	0.76					0.20													56	63
3H-58-2001.33	9	6	Chloritized Ms	43.15		22.36	26.02		4.68	0.58	0.80	1.66				0.77													100	74
3H-58-2001.33	9	7	Ms + Chl	53.03		27.22	12.56		2.34	0.41	0.84	2.83				0.76													100	78
3H-58-2001.33	9	8	Qz	98.58		0.59	0.83																						100	109
3H-58-2001.33	9	9	Kfs	66.04		17.60					0.28	16.07																	100	114
3H-58-2001.33	9	10	Ab + Kfs	67.57		18.43					9.86	4.15																	100	118
3H-58-2001.33	9	11	Chloritized Ms	39.23	0.89	16.94	29.42	0.29	7.37	0.54	0.88	4.11				0.33													100	96
3H-58-2001.33	9	12	Kfs	65.72		17.72					0.48	15.55										0.53							100	119

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	9	13	Qz	100.00																									100	123
3H-58-2001.33	9	14	Ab	69.32		18.82				0.27	11.59																		100	119
3H-58-2001.33	9	15	Chloritized Ms	39.34	2.05	17.76	29.76		5.40	0.38	1.12	3.18				1.02													100	77
3H-58-2001.33	9.1	1	Kfs + Chl	53.86		11.83	20.35		3.52	0.64	1.01	8.54				0.24													100	104
3H-58-2001.33	9.1	2	Mnz +	26.60		5.85	11.05		1.85	5.28		4.53	21.77			0.29					1.01			16.32	5.45				100	83
3H-58-2001.33	9.1	3	Mnz +	48.55		11.63	18.76		2.75		0.70	7.38	3.12			0.76							1.66	3.34	1.35				100	78
3H-58-2001.33	9.1	4	Chl + Ill	48.19	1.59	19.60	20.99		3.25	0.34	1.34	3.60				1.10													100	83
3H-58-2001.33	9.1	5	Chl + Ill	46.76		21.28	22.33		3.72	0.98	1.62	2.12				1.18													100	81
3H-58-2001.33	9.1	6	Cal				1.02	0.55		54.43																			56	55
3H-58-2001.33	9.1	7	Sd				44.06	1.10	3.77	5.85			1.22																56	59
3H-58-2001.33	9.2	1	Chl	31.48		22.02	14.07	0.41	15.58	0.16	0.48	0.60				0.22													85	95
3H-58-2001.33	9.2	2	Fe-clay	64.92		21.18	8.54		1.75	0.45	0.78	1.99				0.39													100	91
3H-58-2001.33	9.2	3	Sd	0.55			24.83	8.70	4.49	17.25						0.18													56	57
3H-58-2001.33	9.3	1	Qz	99.71			0.29																						100	109
3H-58-2001.33	9.3	2	Sd	0.47			41.93	0.39	7.35	5.04			0.82																56	58
3H-58-2001.33	10	1	Qz	100.00																									100	115
3H-58-2001.33	10	2	Chloritized Ms	46.05		28.69	19.25		2.66	0.60	0.86	1.28				0.61													100	72
3H-58-2001.33	10	3	Chl +	36.43	0.40	17.33	31.54		7.63	0.61	3.87	0.43				1.76													100	93
3H-58-2001.33	10	4	Kfs	65.94		17.65					0.71	15.13										0.57							100	116
3H-58-2001.33	10	5	Cal				1.13	0.67		54.20																			56	56
3H-58-2001.33	10	6	Sd	0.52			38.51	0.95	8.48	7.54																			56	60
3H-58-2001.33	10	7	Qz	100.00																									100	118
3H-58-2001.33	10	8	Chl + ?Kfs + Kln	41.47		26.02	26.00		3.29	0.31	1.03	1.01				0.87													100	57
3H-58-2001.33	10	9	Chloritized Ms	44.44		15.22	23.91		4.45	0.64	1.89	4.05	2.90			0.71								1.79					100	92
3H-58-2001.33	10	10	Kfs	66.43		17.79					0.99	14.79																	100	118
3H-58-2001.33	10	11	Qz	100.00																									100	121
3H-58-2001.33	10	12	Qz	99.78			0.22																						100	118
3H-58-2001.33	10	13	Chl + Kfs	59.02		17.97	13.54		2.63		0.97	4.94				0.93													100	88
3H-58-2001.33	11	1	Kfs	65.40		17.98					0.61	14.97										1.05							100	113
3H-58-2001.33	11	2	Qz	100.00																									100	114
3H-58-2001.33	11	3	Qz	100.00																									100	116
3H-58-2001.33	11	4	Chloritized Ms	43.06	0.34	16.25	26.48		7.15	0.46	1.39	4.00				0.88													100	83
3H-58-2001.33	11	5	Qz	100.00																									100	116
3H-58-2001.33	11	6	Qz	100.00																									100	117
3H-58-2001.33	11	7	Kln + Chl	49.69		31.09	13.22		2.48	0.43	0.91	0.71				1.47													100	56
3H-58-2001.33	11	8	Qz +	88.93		6.41	2.20		0.40		0.42	1.47				0.16													100	99
3H-58-2001.33	11	9	Chloritized Ms + ?Kln	49.10	0.51	30.76	14.06		2.18	0.34	0.88	1.52				0.64													100	84
3H-58-2001.33	11	10	Cal				1.15	0.79		54.06																			56	55
3H-58-2001.33	11	11	Sd	1.00			41.80	1.23	6.14	5.12	0.48					0.24													56	62
3H-58-2001.33	11	12	Chr			18.81	21.12		10.97	0.63							48.47												100	106
3H-58-2001.33	11	13	Chr			19.14	21.30		11.28	0.42							47.85												100	107
3H-58-2001.33	11	14	Chl + Kfs	49.48		23.73	17.07		3.77	0.65	1.23	2.94				1.12													100	76
3H-58-2001.33	11	15	Sd	0.60			42.92	0.99	6.58	4.92																			56	58
3H-58-2001.33	11	16	Chloritized Ms	41.08		15.42	21.20		4.16	7.98	2.99	3.86		0.58		2.71													100	90
3H-58-2001.33	11	17	Qz	100.00																									100	118
3H-58-2001.33	11.1	1	Gly	44.57		19.02	14.65		3.58	0.40	0.86	3.24				0.68													87	82
3H-58-2001.33	11.1	2	Chloritized Ms	52.44		34.70	7.69		1.26	0.45	0.49	2.68				0.28													100	90
3H-58-2001.33	11.1	3	Sd				43.06	1.09	5.65	5.57			0.62																56	58
3H-58-2001.33	11.1	4	Glt	47.12		24.59	5.42		2.52	0.31	0.66	6.17				0.20													87	101
3H-58-2001.33	11.2	1	Chloritized Ms	48.48		31.10	15.48		2.05	0.32	0.75	1.18				0.65													100	79
3H-58-2001.33	11.2	2	Chloritized Ms	48.47	0.39	30.86	15.38		2.10	0.30	0.95	1.32				0.21													100	89
3H-58-2001.33	12	1	Kfs	66.21		17.67					0.55	15.57																	100	111
3H-58-2001.33	12	2	Sd	0.67			42.86	2.52	3.35	5.00	0.81					0.81													56	56

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	12	3	Oligo	66.66		20.25	0.31			2.13	10.51	0.14																	100	112
3H-58-2001.33	12	4	Kln	48.59		37.09										0.33													86	64
3H-58-2001.33	12	5	Cal				0.88	0.52		54.60																			56	53
3H-58-2001.33	12	6	Qz	100.00																									100	116
3H-58-2001.33	12	7	Chloritized Ms	37.04	0.82	17.71	31.75		6.66	0.77	1.01	3.32				0.92													100	73
3H-58-2001.33	12	8	Chl + Kfs?	41.23		19.29	30.57		4.80	0.36	1.63	1.04				1.08													100	81
3H-58-2001.33	12	9	Chloritized Ms	37.84	2.36	18.27	28.15	0.55	7.11	0.76	1.26	3.07				0.63													100	83
3H-58-2001.33	12	10	Qz	100.00																									100	119
3H-58-2001.33	12	11	Sd	0.49			43.11	0.83	4.67	5.59			1.30																56	60
3H-58-2001.33	12	12	Ab	69.09		18.68	0.54				11.69																		100	115
3H-58-2001.33	12	13	Sme ?	61.66		11.94	19.97		3.32	0.41	0.91	0.98				0.81													100	58
3H-58-2001.33	12	14	Kfs	66.28		17.86					1.03	14.82																	100	116
3H-58-2001.33	12	15	Kfs	65.64		17.71	0.23				0.36	16.06																	100	111
3H-58-2001.33	12	16	Kfs	66.24		17.76					0.92	15.08																	100	114
3H-58-2001.33	12	17	Sd				41.00	0.96	7.11	6.93																			56	60
3H-58-2001.33	12.1	1	Chloritized Ms	44.57		24.61	23.27		3.29	0.55	1.09	1.54				1.08													100	65
3H-58-2001.33	12.1	2	Chl	32.68		13.90	29.52		5.55	0.65	1.44	0.41				0.87													85	73
3H-58-2001.33	12.1	3	Chloritized Ms	46.26		22.63	23.27		3.79	0.51	0.92	1.95				0.67													100	84
3H-58-2001.33	12.2	1	Kfs	66.73		18.11					1.89	13.28																	100	112
3H-58-2001.33	13	1	Qz	100.00																									100	116
3H-58-2001.33	13	2	Qz	100.00																									100	119
3H-58-2001.33	13	3	Qz	100.00																									100	116
3H-58-2001.33	13	4	Chloritized Ms	38.04	2.47	21.75	27.61		6.99	0.64	0.93	1.00				0.59													100	88
3H-58-2001.33	13	5	Kfs	66.34		17.72					0.45	15.49																	100	113
3H-58-2001.33	13	6	Cal				0.87	0.61		54.52																			56	54
3H-58-2001.33	13	7	Sd				41.40	0.40	7.57	5.90			0.73																56	60
3H-58-2001.33	13	8	Kfs	65.53		17.85					0.65	14.97										1.00							100	112
3H-58-2001.33	13	9	Chl + Ill	44.71		22.51	23.32		5.04	0.60	1.25	1.60				0.98													100	71
3H-58-2001.33	13	10	Qz	100.00																									100	116
3H-58-2001.33	13	11	Chloritized Ms	44.94		19.71	24.64		5.14	1.08	1.33	2.48				0.68													100	87
3H-58-2001.33	13	12	Kln	46.48		32.39	4.73		1.10	0.24	0.47	0.30				0.28													86	89
3H-58-2001.33	13	13	Cal				1.08	0.59		54.34																			56	56
3H-58-2001.33	13	14	Qz	100.00																									100	122
3H-58-2001.33	13	15	Chloritized Ms	37.90		19.71	31.29		8.39	0.51	1.08	0.37				0.76													100	82
3H-58-2001.33	13.1	1	Ms	48.39	0.33	32.70	2.26		0.89		0.36	10.06																	95	101
3H-58-2001.33	13.1	2	?Gly	44.58	0.98	21.88	23.41		4.93	0.63	0.91	1.84				0.84													100	71
3H-58-2001.33	13.2	1	Chl	32.61		17.07	26.58		6.29	0.38	1.00	0.47				0.60													85	78
3H-58-2001.33	13.2	2	Chloritized Ms	43.38		25.19	23.18		5.62	0.43	0.96	0.39				0.85													100	63
3H-58-2001.33	13.2	3	Chloritized Ms + Kln	46.56		29.86	17.15		4.27	0.51	0.85	0.23				0.58													100	74
3H-58-2001.33	14	1	Qz	100.00																									100	118
3H-58-2001.33	14	2	Glt	47.51		13.61	14.96		2.98		0.93	6.10				0.90													87	65
3H-58-2001.33	14	3	Kfs	66.35		17.55					0.44	15.66																	100	113
3H-58-2001.33	14	4	Cal				1.02	0.56		54.42																			56	54
3H-58-2001.33	14	5	Kfs	65.85		17.81	0.39				0.62	15.32																	100	112
3H-58-2001.33	14	6	Qz	100.00																									100	116
3H-58-2001.33	14	7	Kfs	66.69		17.47	0.21					15.63																	100	111
3H-58-2001.33	14	8	Chloritized Ms	41.54		19.93	28.19		5.63	0.56	1.56	2.31				0.27													100	95
3H-58-2001.33	14	9	Qz	100.00																									100	121
3H-58-2001.33	14	10	Qz	99.30			0.27			0.43																			100	120
3H-58-2001.33	14	11	Cal				1.12	0.69		54.19																			56	56
3H-58-2001.33	14	12	Ms	45.08	0.43	32.45	7.48		1.08		0.88	7.44				0.16													95	104
3H-58-2001.33	14	13	Kln + Chl	51.04		35.36	10.03		1.38	0.31	0.71	0.52				0.65													100	71
3H-58-2001.33	14	14	Qz	100.00																									100	118

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	14	15	TiO2	0.84	96.95		1.65			0.55																			100	103
3H-58-2001.33	14	16	Sd				41.16	0.60	9.21	5.03																			56	60
3H-58-2001.33	14	17	Qz	100.00																									100	116
3H-58-2001.33	14	18	Qz +	84.20		7.22	2.79		0.45	0.24	0.38	4.53				0.20													100	101
3H-58-2001.33	14.1	1	"Ms"	52.87		37.83	6.97		1.17		0.61	0.20				0.34													100	89
3H-58-2001.33	14.2	1	Glt	47.92		13.30	14.51		3.02	0.37	0.87	5.98				1.03													87	67
3H-58-2001.33	15	1	Kfs	65.54		18.08					0.94	14.75										0.69							100	115
3H-58-2001.33	15	2	Qz	100.00																									100	116
3H-58-2001.33	15	3	Kln + Chl	49.45		34.58	11.64		2.11	0.31	0.73	0.85				0.33													100	89
3H-58-2001.33	15	4	Kfs	66.24		17.92					0.64	15.20																	100	116
3H-58-2001.33	15	5	Cal				1.32	0.77		53.91																			56	55
3H-58-2001.33	15	6	Sd				40.20	0.96	7.58	7.26																			56	59
3H-58-2001.33	15	7	?Chl + Kfs	54.60	0.32	19.19	16.09		3.54	0.34	1.45	3.46				1.00													100	83
3H-58-2001.33	15	8	Qz +	87.71	0.34	6.44	2.09		1.28	0.17	0.53	1.45																	100	118
3H-58-2001.33	15	9	Kfs	66.06		17.82					0.66	15.46																	100	112
3H-58-2001.33	15	10	Sd	1.00			44.82	0.93	4.63	3.91	0.49					0.22													56	57
3H-58-2001.33	15	11	Chl +	35.05		15.65	39.05	0.52	5.43	0.85	1.52	0.68				1.26													100	66
3H-58-2001.33	15	12	Chl + ?Kfs	34.14		15.06	29.65		4.62	11.62	2.39	1.42		0.61		0.49													100	77
3H-58-2001.33	15	13	Qz	100.00																									100	122
3H-58-2001.33	15	14	Kfs +	62.59		16.78	0.30				0.39	14.31	3.32											2.31					100	117
3H-58-2001.33	15	15	Chl + ?Kfs	42.60		23.91	25.59		4.14	0.49	1.25	0.82				1.19													100	84
3H-58-2001.33	15	16	Qz	100.00																									100	124
3H-58-2001.33	15	17	Kfs +	70.22	0.38	18.76	2.53		1.31		0.38	6.42																	100	114
3H-58-2001.33	15	18	Kfs	66.59		17.66					1.38	14.37																	100	118
3H-58-2001.33	15	19	Glt	46.42		14.42	15.30		2.75	0.40	0.82	6.03				0.86													87	67
3H-58-2001.33	15.1	1	Gly	42.56		16.19	14.04		3.05	0.40	2.91	2.85	0.77			4.22													87	83
3H-58-2001.33	15.1	2	Gly	42.56	0.97	17.37	16.63		3.73	0.44	1.42	3.59				0.29													87	95
3H-58-2001.33	15.2	1	Glt	46.68		14.36	15.75		2.52	0.37	0.67	5.97				0.70													87	66
3H-58-2001.33	15.2	2	Gly	46.76		14.64	15.04		2.70	0.39	0.72	5.62				1.12													87	71
3H-58-2001.33	15.3	1	Qz	99.83						0.17																			100	116
3H-58-2001.33	15.3	2	Ms	52.27	0.36	28.79	2.26		1.78		0.28	9.27																	95	106
3H-58-2001.33	15.3	3	TiO2 +	1.72	96.67	0.83	0.44			0.33																			100	105
3H-58-2001.33	15.4	1	Chloritized Ms	45.52		21.67	24.65		3.78	0.42	1.58	1.98				0.41													100	93
3H-58-2001.33	15.4	2	Chl	34.57		16.60	26.30		3.98	0.47	1.05	1.07				0.96													85	62
3H-58-2001.33	15.4	3	Chloritized Ms	44.63		21.42	25.26		4.21	0.68	1.14	1.94				0.72													100	78
3H-58-2001.33	16	1	Ms	50.66	0.40	26.48	4.22		2.47		0.30	10.47																	95	107
3H-58-2001.33	16	2	Qz	100.00																									100	118
3H-58-2001.33	16	3	Kfs	64.89		18.03	0.44				0.30	15.08										1.26							100	114
3H-58-2001.33	16	4	Cal				1.20	0.60		54.20																			56	54
3H-58-2001.33	16	5	?Kfs + Chl	53.17		20.72	14.12		2.88		0.59	7.85				0.67													100	80
3H-58-2001.33	16	6	Gly	45.17		13.34	17.72		2.92		0.91	5.49				1.44													87	55
3H-58-2001.33	16	7	"Ilm"	1.71	66.27	0.89	28.43	2.45		0.24																			100	91
3H-58-2001.33	16	8	Py	0.20			25.70							68.28				1.34	3.21							1.26			100	223
3H-58-2001.33	16	9	Qz	100.00																									100	121
3H-58-2001.33	16	10	Chl + Ms	34.32		15.38	31.90	0.29	5.00	7.13	3.35	0.76				1.86													100	93
3H-58-2001.33	16	11	Chl + ?Kfs	47.61		19.74	21.45		4.62	0.48	1.41	3.20				1.48													100	71
3H-58-2001.33	16	12	Qz	100.00																									100	115
3H-58-2001.33	16	13	Qz	100.00																									100	115
3H-58-2001.33	16	14	Kfs	65.99		18.11					0.83	15.07																	100	111
3H-58-2001.33	16	15	Qz	100.00																									100	115
3H-58-2001.33	16	16	Kfs	66.33		17.72					0.69	15.25																	100	115
3H-58-2001.33	16.1	1	Glt	46.21		12.90	17.26		2.98		0.89	5.78				0.97													87	64
3H-58-2001.33	17	1	Qz	100.00																									100	119

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	17	2	Kfs	66.47		17.69					1.04	14.79																	100	115
3H-58-2001.33	17	3	Cal				0.72	0.57		54.71																			56	55
3H-58-2001.33	17	4	Sd				41.80	1.00	7.81	5.39																			56	60
3H-58-2001.33	17	5	Chloritized Ms	45.37	1.03	32.07	10.51		1.31		0.75	8.97																	100	94
3H-58-2001.33	17	6	Chloritized ?Kfs	49.01		17.77	22.58		3.58	0.57	1.03	4.63				0.82													100	67
3H-58-2001.33	17	7	Chl +	39.06		16.80	33.94		6.57	0.81	1.32	0.90				0.60													100	77
3H-58-2001.33	17	8	Mnz	0.71						1.35			36.53		-0.05			-0.09					15.97	31.02	10.53			4.04	100	96
3H-58-2001.33	17	9	Qz	100.00																									100	114
3H-58-2001.33	17	10	Qz	98.53		0.82	0.26					0.39																	100	117
3H-58-2001.33	17	11	Kfs	65.69		17.43	1.12				0.64	15.13																	100	108
3H-58-2001.33	17	12	Qz	100.00																									100	116
3H-58-2001.33	17	13	Kfs	66.40		17.73					0.55	15.32																	100	115
3H-58-2001.33	17	14	Cal				1.28	1.14		53.58																			56	54
3H-58-2001.33	17	15	Kfs	66.29		17.71					0.81	15.18																	100	114
3H-58-2001.33	17.1	1	Gly	37.94	0.79	16.63	20.64		6.02	0.35	0.98	2.98				0.67													87	86
3H-58-2001.33	17.1	2	Gly	43.41		16.66	15.42		2.99	2.58	1.29	3.89				0.76													87	87
3H-58-2001.33	17.2	1	Qz	99.93								0.07																	100	116
3H-58-2001.33	18	1	Qz	100.00																									100	119
3H-58-2001.33	18	2	Ab	69.61		18.77					11.62																		100	115
3H-58-2001.33	18	3	Kfs	66.01	0.26	17.80					0.64	15.28																	100	114
3H-58-2001.33	18	4	Kfs	64.52		17.54	0.59			2.20	0.70	14.45																	100	111
3H-58-2001.33	18	5	Cal				0.88	0.49		54.63																			56	57
3H-58-2001.33	18	6	Sd				43.33	1.06	5.95	5.67																			56	60
3H-58-2001.33	18	7	Kfs	66.25		17.78					0.71	15.26																	100	113
3H-58-2001.33	18	8	Sd	0.81			38.70	1.27	7.73	7.49																			56	61
3H-58-2001.33	18	9	Chl	31.75	0.45	13.87	29.60	0.30	6.08	0.82	1.02	0.52				0.59													85	75
3H-58-2001.33	18	10	Sd				41.44	0.95	6.53	6.56			0.53																56	60
3H-58-2001.33	18	11	Qz	100.00																									100	119
3H-58-2001.33	18	12	Chloritized ?Kfs	44.72	0.60	18.94	24.25		5.64	0.79	0.79	3.77				0.49													100	80
3H-58-2001.33	18	13	Qz	100.00																									100	116
3H-58-2001.33	18.1	1	Sd	1.69		0.78	37.95	1.09	7.28	7.22																			56	62
3H-58-2001.33	18.1	2	Cal				1.07	0.39	0.55	53.99																			56	57
3H-58-2001.33	18.1	3	Sd				43.85	1.34	3.43	6.03			1.36																56	61
3H-58-2001.33	18.1	4	Qz	99.64			0.32					0.04																	100	117
3H-58-2001.33	18.1	5	Qz	100.00																									100	119
3H-58-2001.33	18.1	6	Cal				1.43	0.80		53.78																			56	56
3H-58-2001.33	18.2	1	Kfs	65.45		17.75	0.24				0.40	15.47										0.68							100	114
3H-58-2001.33	18.2	2	Chl	33.01		16.50	28.00		4.32	0.60	0.91	0.59				1.07													85	69
3H-58-2001.33	18.2	3	Ab	69.24		18.63	0.32				11.81																		100	113
3H-58-2001.33	18.3	1	Gly	42.37		17.06	17.72		4.74	0.39	1.00	2.91				0.81													87	76
3H-58-2001.33	18.3	2	Qz	99.68			0.32																						100	117
3H-58-2001.33	19	1	Qz	100.00																									100	120
3H-58-2001.33	19	2	Cal				0.91	0.62		54.48																			56	56
3H-58-2001.33	19	3	Cal				1.71	0.85		53.44																			56	55
3H-58-2001.33	19	4	Sd	0.58			38.41	1.69	6.69	8.64																			56	60
3H-58-2001.33	19	5	Chloritized Ms	43.52		22.97	25.32		4.33	0.58	1.46	1.36				0.46													100	87
3H-58-2001.33	19	6	Qz	99.77			0.23																						100	118
3H-58-2001.33	19	7	Glt	46.17		12.93	17.33		2.70		0.72	6.18				0.98													87	66
3H-58-2001.33	19	8	Kfs	66.25		17.54					0.41	15.80																	100	113
3H-58-2001.33	19	9	Kfs	66.19		17.78					0.33	15.70																	100	119
3H-58-2001.33	19	10	Chloritized Ms	36.36	0.72	18.10	35.87		5.01	0.81	0.96	1.17				1.00													100	77
3H-58-2001.33	19	11	Qz	99.80			0.20																						100	121
3H-58-2001.33	19	12	Sme	44.22		22.93	3.52		2.37		0.30	6.66																	80	105

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	19	13	Qz +	92.78		4.69	0.78		0.26			1.49																	100	114
3H-58-2001.33	19.1	1	Qz	99.96																							0.04		100	119
3H-58-2001.33	19.1	2	Kfs	67.96		17.21	0.48				0.30	14.05																	100	113
3H-58-2001.33	19.2	1	Glt	47.47		17.91	11.72		2.65		0.96	5.94				0.36													100	85
3H-58-2001.33	19.2	2	Qz	99.79			0.21																						100	115
3H-58-2001.33	20	1	Qz	100.00																									100	123
3H-58-2001.33	20	2	Kfs	66.19		17.69					0.34	15.78																	100	116
3H-58-2001.33	20	3	Chl + ?Kfs	47.27		18.26	23.66		3.54	0.48	1.34	3.97				1.48													100	67
3H-58-2001.33	20	4	Qz	100.00																									100	119
3H-58-2001.33	20	5	Kfs	65.60		17.80	0.24				0.34	15.42										0.60							100	115
3H-58-2001.33	20	6	Ab	66.81		19.55	1.61		0.37	1.23	10.43																		100	117
3H-58-2001.33	20	7	Cal				1.46	0.85		53.69																			56	56
3H-58-2001.33	20	8	Chloritized Ms	47.45	0.41	27.95	17.30		3.22	0.51	0.97	1.55				0.63													100	84
3H-58-2001.33	20	9	Qz	99.74			0.26																						100	120
3H-58-2001.33	20	10	Sd				43.89	1.20	4.27	5.50			1.13																56	60
3H-58-2001.33	20	11	Cal				0.85	0.51		54.64																			56	57
3H-58-2001.33	20.1	1	Oligo	66.73		20.44	0.37			2.12	10.35																		100	112
3H-58-2001.33	20.1	2	Chl + Feld	43.59		21.58	25.54		5.16	0.60	1.44	1.21				0.87													100	80
3H-58-2001.33	21	1	Qz	100.00																									100	116
3H-58-2001.33	21	2	Cal				1.50	0.88		53.62																			56	54
3H-58-2001.33	21	3	Glt	45.82		13.63	16.61		2.70	0.44	0.67	6.22				0.90													87	70
3H-58-2001.33	21	4	Kfs	66.14		17.75					0.51	15.61																	100	116
3H-58-2001.33	21	5	Kfs	66.04	0.24	17.76					0.64	15.33																	100	115
3H-58-2001.33	21	6	Cal				1.42	0.81		53.77																			56	55
3H-58-2001.33	21	7	Sd				40.72	1.16	7.60	6.52																			56	60
3H-58-2001.33	21	8	Kfs	65.80		17.80					0.89	14.77										0.74							100	113
3H-58-2001.33	21	9	Qz	100.00																									100	119
3H-58-2001.33	21	10	Chl + ?Kfs	39.99		17.07	33.43		6.21	0.66	1.10	1.03				0.50													100	74
3H-58-2001.33	21	11	Ilm		58.38		36.36	0.60	4.66																				100	105
3H-58-2001.33	21	12	Sd				38.95	1.06	8.72	7.27																			56	62
3H-58-2001.33	21	13	Chloritized ?Kfs	42.11		22.85	27.05		4.81	0.71	1.01	0.72				0.74													100	80
3H-58-2001.33	21	14	Qz	100.00																									100	120
3H-58-2001.33	21	15	Kfs	66.45		17.83					1.24	14.47																	100	116
3H-58-2001.33	21	16	Kln + Chl	53.76		39.74	4.73		0.73	0.22	0.49					0.33													100	89
3H-58-2001.33	21	17	Kfs	66.27		17.73					0.71	15.30																	100	115
3H-58-2001.33	22	1	Chloritized Ms	48.85		28.26	16.81		2.72	0.45	1.05	1.53				0.34													100	96
3H-58-2001.33	22	2	Kfs	66.24		17.39					0.33	16.04																	100	115
3H-58-2001.33	22	3	Kfs	66.16		17.92					1.22	14.70																	100	114
3H-58-2001.33	22	4	Cal				0.64	0.43		54.93																			56	56
3H-58-2001.33	22	5	Gly	44.14		27.60	11.31		1.75	0.37	0.71	0.69				0.44													87	90
3H-58-2001.33	22	6	Qz	100.00																									100	117
3H-58-2001.33	22	7	Sd				38.84	1.08	8.26	7.82																			56	59
3H-58-2001.33	22	8	Gly	43.91		13.10	16.73		3.02	0.67	0.91	5.21	1.41			0.88								1.15					87	71
3H-58-2001.33	22	9	Qz	100.00																									100	118
3H-58-2001.33	22	10	Kfs	66.29		17.89					1.27	14.55																	100	118
3H-58-2001.33	22	11	Qz	100.00																									100	123
3H-58-2001.33	22	12	Cal				1.24	0.83		53.93																			56	57
3H-58-2001.33	22	13	Cal				1.10	0.60		54.29																			56	54
3H-58-2001.33	22.1	1	Gly	41.75		24.27	15.46		2.38	0.66	0.92	1.03				0.53													87	84
3H-58-2001.33	22.1	2	Gly	45.31		16.34	15.53		3.10	0.66	0.81	4.55				0.70													87	70
3H-58-2001.33	22.2	1	Gly	47.38		13.54	15.56		3.03	0.42	0.79	5.77				0.51													87	86
3H-58-2001.33	22.2	2	Gly	45.38		13.70	17.21		3.17	0.51	0.90	5.46				0.66													87	71
3H-58-2001.33	23	1	Qz	100.00																									100	118

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	23	2	Sd	0.48			43.41	0.63	7.42	3.49			0.58																56	60
3H-58-2001.33	23	3	Kfs	65.99		17.71	0.23				0.41	15.66																	100	115
3H-58-2001.33	23	4	Chloritized Ms	43.51		24.70	25.11		3.91	0.50	1.00	0.55				0.73													100	78
3H-58-2001.33	23	5	Chloritized Ms	39.12	0.68	19.28	30.17		6.70	0.38	0.72	2.31				0.63													100	76
3H-58-2001.33	23	6	Qz	100.00																									100	119
3H-58-2001.33	23	7	Kfs	66.39		17.89					0.70	15.02																	100	116
3H-58-2001.33	23	8	Cal				0.93	0.57		54.50																			56	57
3H-58-2001.33	23	9	Chloritized Ms	45.05		25.77	22.59		3.83	0.27	0.95	1.13				0.41													100	90
3H-58-2001.33	23	10	Cal				1.55	0.95		53.50																			56	55
3H-58-2001.33	23	11	Qz	100.00																									100	120
3H-58-2001.33	23	12	Kfs	65.62		17.78					0.62	15.39										0.59							100	117
3H-58-2001.33	23	13	Kfs	66.24		17.66					0.52	15.58																	100	118
3H-58-2001.33	23	14	Sd				42.86	0.80	5.42	5.67			1.27																56	63
3H-58-2001.33	24	1	Kln +	54.80		37.20	5.45		0.76		0.51	0.55				0.73													100	79
3H-58-2001.33	24	2	Cal				0.95	0.73		54.32																			56	58
3H-58-2001.33	24	3	Qz	100.00																									100	123
3H-58-2001.33	24	4	Kln	48.68		37.32																							86	96
3H-58-2001.33	24	5	Sd	0.55			36.94	1.05	8.98	8.48																			56	59
3H-58-2001.33	24	6	Kfs	66.22		17.90					0.71	15.17																	100	116
3H-58-2001.33	24	7	Kfs	66.46		17.75					1.30	14.50																	100	117
3H-58-2001.33	24	8	Cal				1.22	0.75		54.03																			56	56
3H-58-2001.33	24	9	Qz	99.57			0.20			0.23																			100	120
3H-58-2001.33	24	10	Cal				0.88	0.48	0.73	52.95	0.37			0.59															56	57
3H-58-2001.33	24	11	Sd				40.75	1.51	6.37	7.37																			56	61
3H-58-2001.33	24	12	Sd				44.03	1.29	3.76	5.61			1.32																56	62
3H-58-2001.33	24	13	Sd	0.60			47.02	1.62	5.50	1.25																			56	63
3H-58-2001.33	24	14	Chloritized Ms	40.31	1.72	20.86	23.54		7.91	0.61	1.16	3.28				0.62													100	97
3H-58-2001.33	24	15	Qz	100.00																									100	121
3H-58-2001.33	24	16	Chl + Ms	45.26		25.14	18.88		3.73	0.56	1.08	4.42				0.95													100	70
3H-58-2001.33	24	17	TiO2	0.92	97.11	0.60	1.07			0.30																			100	104
3H-58-2001.33	25	1	Qz	100.00																									100	121
3H-58-2001.33	25	2	Qz	100.00																									100	120
3H-58-2001.33	25	3	Cal				1.15	0.77		54.08																			56	56
3H-58-2001.33	25	4	Kfs	66.14		17.94					0.91	15.01																	100	118
3H-58-2001.33	25	5	Chloritized Ms	48.12		30.47	14.81		2.49	0.32	1.60	1.07				1.11													100	99
3H-58-2001.33	25	6	Chloritized Ms	38.01	0.71	17.69	32.54		7.00	0.47	1.05	1.85				0.68													100	82
3H-58-2001.33	25	7	Sd	0.71			37.51	1.09	8.67	8.01																			56	62
3H-58-2001.33	25	8	Chloritized Ms	45.44		25.07	21.58		4.42	0.36	0.81	1.59				0.71													100	86
3H-58-2001.33	25	9	Kfs	66.00		18.42					1.80	13.19										0.59							100	120
3H-58-2001.33	25	10	Chl + Ill	47.69		16.63	24.28		4.65	0.59	1.14	3.88				1.14													100	70
3H-58-2001.33	25	11	Chloritized Ms	45.18		25.20	19.75		3.55		1.24	4.50				0.58													100	94
3H-58-2001.33	25	12	Kfs	65.61		18.10					0.83	14.53										0.93							100	118
3H-58-2001.33	25	13	Kfs	66.28		17.62					0.42	15.69																	100	123
3H-58-2001.33	25	14	Cal				0.61	0.44		54.95																			56	58
3H-58-2001.33	25	15	Kfs	66.37		17.71					0.71	15.06				0.15													100	116
3H-58-2001.33	25	16	Kfs	66.40		18.01					1.11	14.48																	100	116
3H-58-2001.33	25.1	1	Kfs	66.45		17.59						15.96																	100	119
3H-58-2001.33	25.1	2	Qz	100.00																									100	124
3H-58-2001.33	25.1	3	Chl	31.79		20.36	26.81		3.21	0.39	0.81	0.49				1.13													85	48
3H-58-2001.33	25.1	4	Sd				42.50	1.05	5.96	5.71			0.77																56	63
3H-58-2001.33	25.1	5	Qz +	90.96		4.84	2.04		0.52		0.26	1.37																	100	117
3H-58-2001.33	25.1	6	Qz +	96.03		1.53	1.97		0.28			0.06				0.14													100	115
3H-58-2001.33	25.1	7	Cal				0.39	0.42		55.19																			56	58

Table 1-6.1: EDS geochemical analyses of sample 3H-58 2001.33.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Cr2O3	NiO	As2O3	ZrO2	Cs2O	BaO	La2O3	Ce2O3	Nd2O3	Er2O3	Yb2O3	ThO2	Total	Actual Total
3H-58-2001.33	25.2	1	Fe-Chl	44.27		23.07	24.27		3.89	0.56	1.14	1.96				0.84													100	75
3H-58-2001.33	25.2	2	Fe-Chl	38.33		17.53	34.74		4.49	0.69	1.65	0.69				1.88													100	70
3H-58-2001.33	25.2	3	Qz +	91.07		4.62	2.25		0.46		0.30	1.29																	100	108
3H-58-2001.33	25.2	4	Qz	98.10		1.24	0.60					0.06																	100	113
3H-58-2001.33	26	1	Kfs	66.27		17.81					0.68	15.25																	100	118
3H-58-2001.33	26	2	Kfs	66.15		17.62					0.45	15.77																	100	118
3H-58-2001.33	26	3	Cal				0.88	0.43		54.70																			56	57
3H-58-2001.33	26	4	Sd				37.75	1.01	8.50	8.74																			56	61
3H-58-2001.33	26	5	Chloritized Ms	50.35		33.51	11.98		2.00	0.46	0.72	0.46				0.52													100	92
3H-58-2001.33	26	6	Qz	100.00																									100	120
3H-58-2001.33	26	7	Qz	100.00																									100	124
3H-58-2001.33	26	8	Sme ?	47.78		29.51	15.30		2.22	0.37	0.91	3.26				0.64													100	76
3H-58-2001.33	26	9	Kfs	66.35		17.60					0.62	15.43																	100	118
3H-58-2001.33	26	10	Qz	100.00																									100	120
3H-58-2001.33	26	11	Gly	43.68		20.33	12.40		2.92	0.36	1.68	5.03				0.60													87	101
3H-58-2001.33	26	12	Kfs	65.87		17.82					0.66	14.83										0.82							100	117
3H-58-2001.33	26	13	Cal				0.90	0.51		54.59																			56	59
3H-58-2001.33	26	14	Sd	1.24			43.65	3.98	2.12	3.96	0.72					0.33													56	70
3H-58-2001.33	26	15	Chloritized Ms	39.54	0.68	17.19	31.03		6.77	0.68	1.11	2.76				0.24													100	98
3H-58-2001.33	26.1	1	Qz	100.00																									100	116
3H-58-2001.33	26.1	2	?Gly	39.83	0.77	18.01	31.69	0.31	5.55	0.79	1.19	1.01				0.85													100	75
3H-58-2001.33	26.1	3	?Gly	41.78		19.55	29.27		5.40	0.66	1.24	1.15				0.94													100	57
3H-58-2001.33	26.1	4	Fe-Chl	42.32		27.06	25.37		2.47		0.53	1.16				1.10													100	49
3H-58-2001.33	27	1	Qz	100.00																									100	122
3H-58-2001.33	27	2	Kfs	66.38		17.85					1.24	14.53																	100	118
3H-58-2001.33	27	3	Kfs	63.68		18.70					1.59	12.44										3.59							100	115
3H-58-2001.33	27	4	Cal				0.94	0.41		54.66																			56	55
3H-58-2001.33	27	5	Sd				42.53	0.94	6.97	5.57																			56	61
3H-58-2001.33	27	6	Qz	100.00																									100	120
3H-58-2001.33	27	7	Gly	44.76		12.06	19.08		3.50	0.41	1.13	5.08				0.97													87	68
3H-58-2001.33	27	8	Ill	54.16	0.41	28.83	6.32		1.98		0.60	7.52				0.18													100	96
3H-58-2001.33	27	9	Qz	100.00																									100	121
3H-58-2001.33	27	10	Kfs	68.27		16.71						15.03																	100	116
3H-58-2001.33	27	11	Qz	99.73	0.27																								100	122
3H-58-2001.33	27	12	TiO2	1.23	90.73	4.47	1.35			0.70	0.52		1.00																100	96
3H-58-2001.33	27	13	Chloritized Ms +	40.23	14.13	20.91	17.46		3.19	0.77	1.25	1.62				0.44													100	89
3H-58-2001.33	27	14	Kfs	66.29		17.83					0.79	15.09																	100	114
3H-58-2001.33	27	15	Qz	100.00																									100	118
3H-58-2001.33	27.1	1	Gly	43.55		17.91	14.56		2.98	1.02	0.80	5.47				0.71													87	69
3H-58-2001.33	27.1	2	Gly	44.37		11.57	19.80		3.34	0.47	0.97	5.02				1.44													87	60
3H-58-2001.33	27.1	3	Gly	45.79		11.46	18.00		3.41	1.10	0.84	5.63				0.77													87	69
3H-58-2001.33	27.1	4	Qz	99.77			0.23																						100	114

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain
3. Gly refers to the mixture glaucony

Appendix 1-7: SEM-BSE images and EDS mineral analyses for sample 5H-58 1577.78.

Sample 5H-58 1577.78: Fine-grained muddy sandstone

Detrital Minerals: Chlorite, Chromite, Ilmenite, K-feldspar, Muscovite, Quartz, Titania (Figs. 8,23), Zircon

Notes:

1. This sample is a mixture of sandstone and mudstone. Identification of diagenetic minerals and their paragenetic sequence is difficult, and was not performed on this sample.

2. Quartz commonly displays overgrowths (Figs. 2,24,27).

3. There appears to be bioturbation of the sediments (Zoom out of Figure 19, page 12).

4. Suturing is uncommon between quartz and K-feldspar grains.

5. Anhydrite seems to be the latest cement (Figs. 6,18).

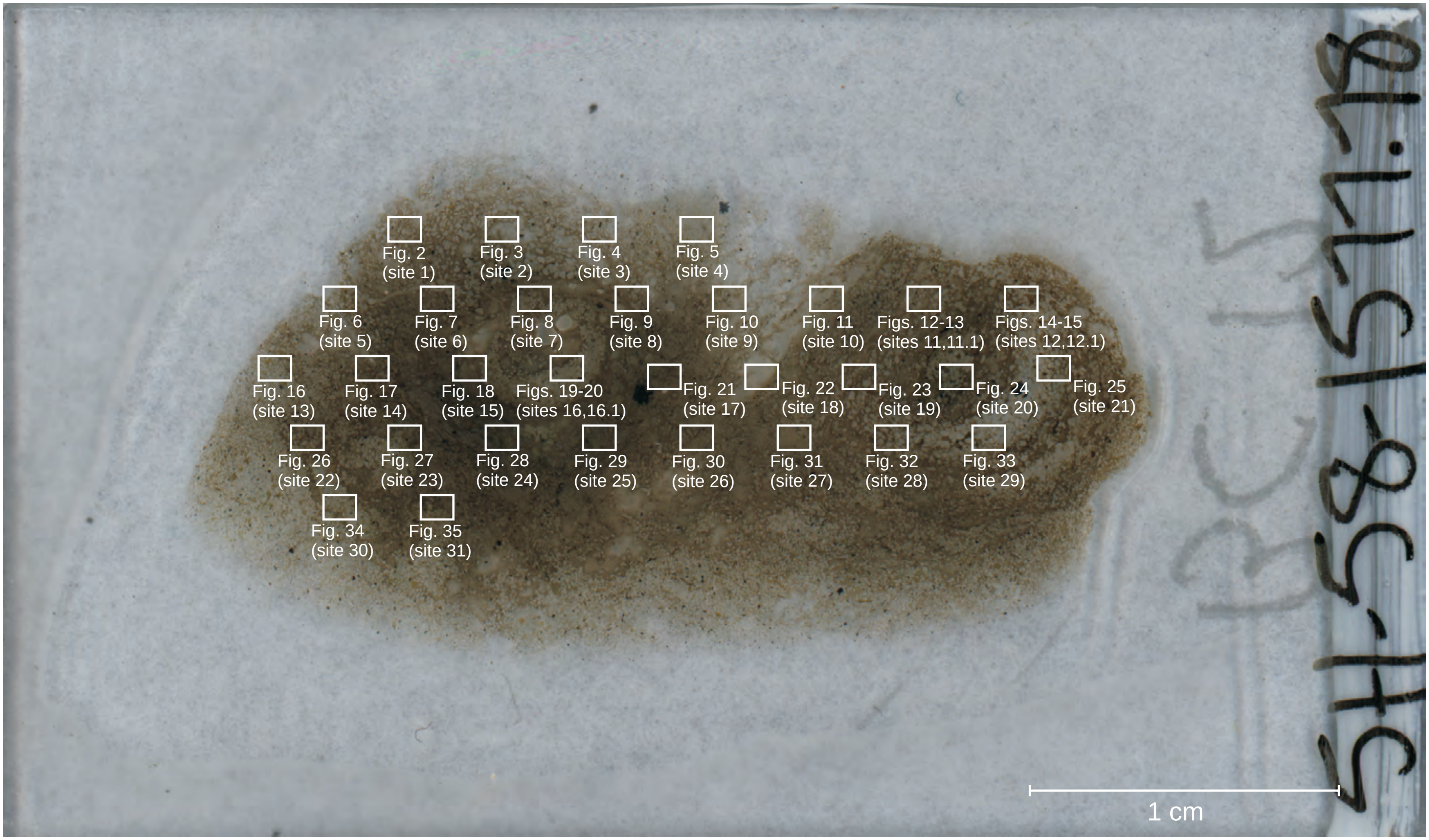
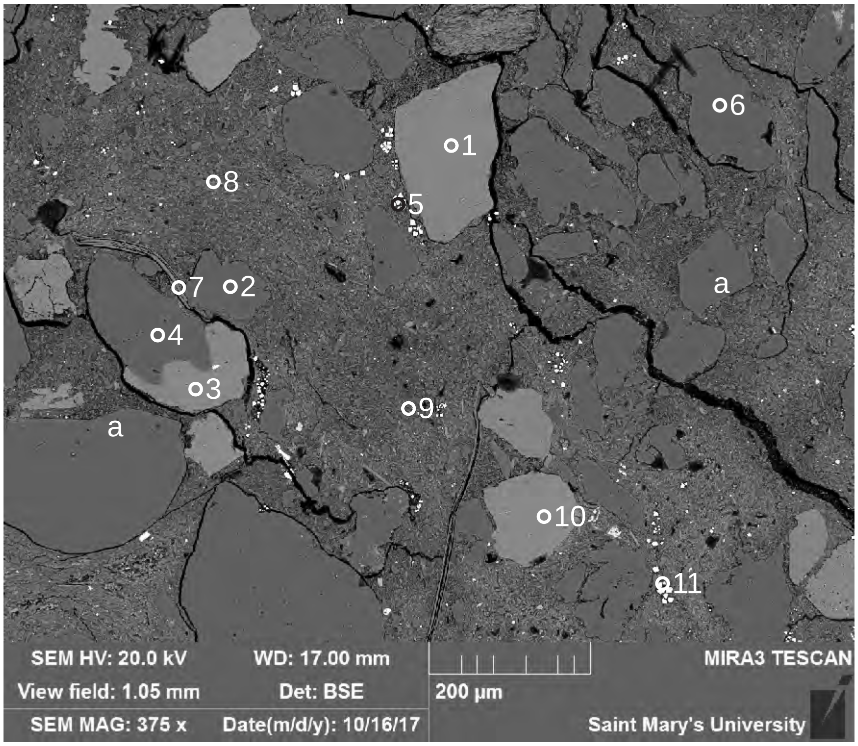
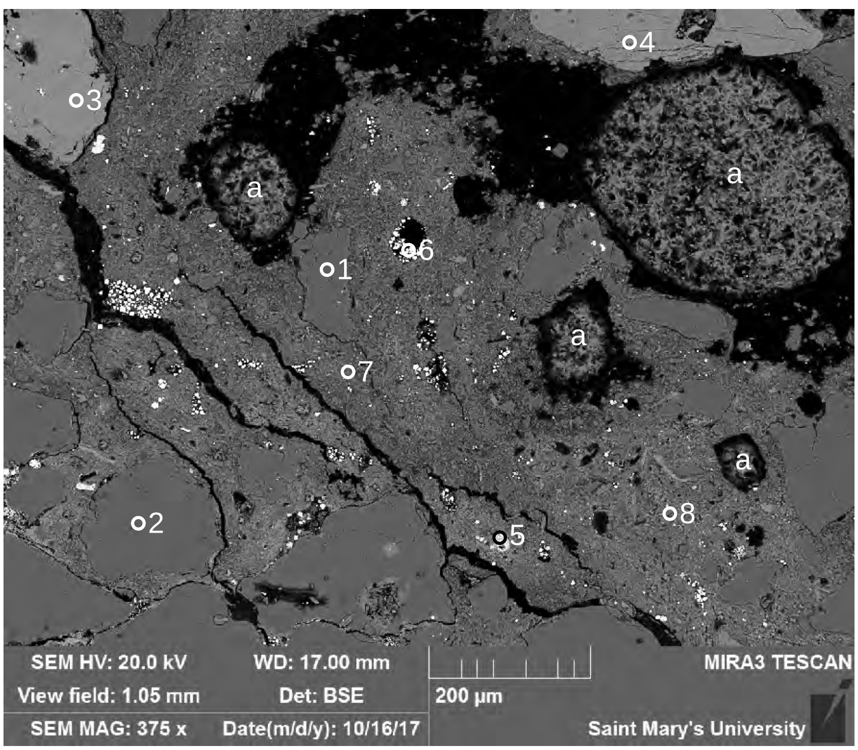


Figure 1-7.1: Scanned thin section of sample 5H-58 1577.78 showing the location of analyzed sites.



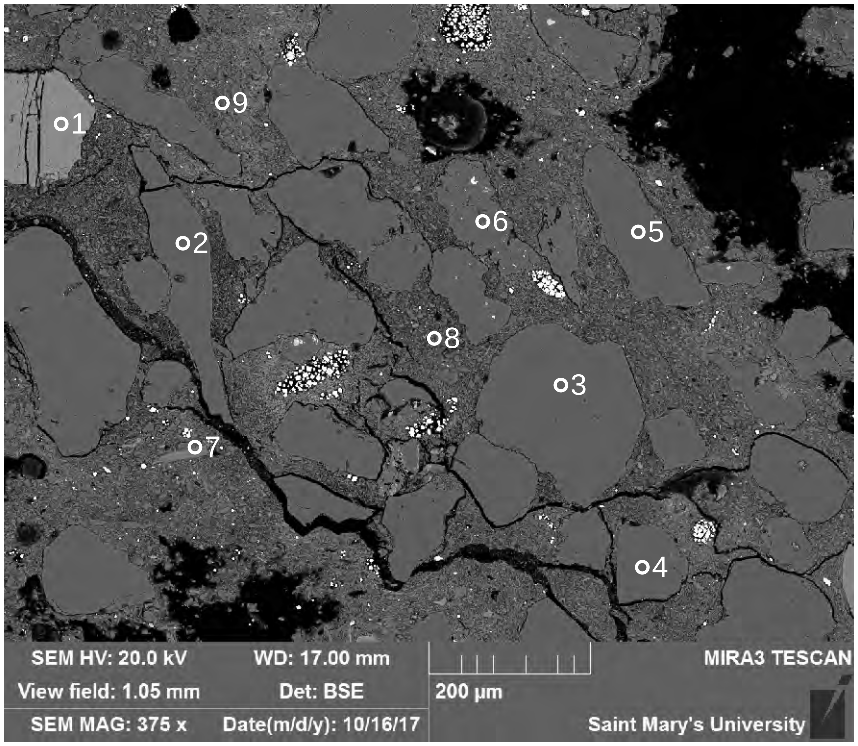
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:Pyrite
6:Quartz
7:Muscovite
8:Illite + Chlorite
9:Illite + Chlorite
10:K-feldspar
11:Pyrite

Figure 1-7.2: Sample 5H-58 1577.78 (SEM) site 1. This site consists of detrital quartz (2,4,6), K-feldspar (1,3,10), and muscovite (7) grains. The muscovite appears plastically deformed. Illite + chlorite make up the matrix between grains. Diagenetic pyrite (5,11) fills voids within the cement. Quartz may contain overgrowths (positions a).



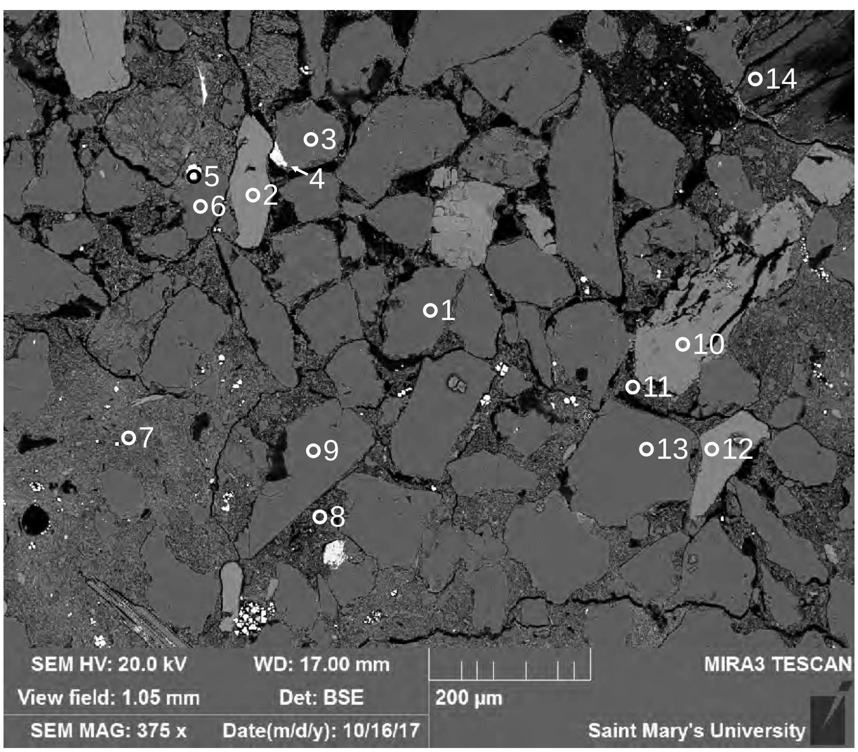
1:Quartz
2:Quartz
3:K-feldspar
4:K-feldspar
5:Pyrite
6:Pyrite
7:Illite + Chlorite + Pyrite
8:Illite + Chlorite + Pyrite

Figure 1-7.3: Sample 5H-58 1577.78 (SEM) site 2. This site consists of detrital quartz (1-2) and K-feldspar (3-4) grains. Illite + chlorite + pyrite (7-8) make up the matrix and late pyrite (5-6) partially fills voids. This site also contains contaminants (positions a).



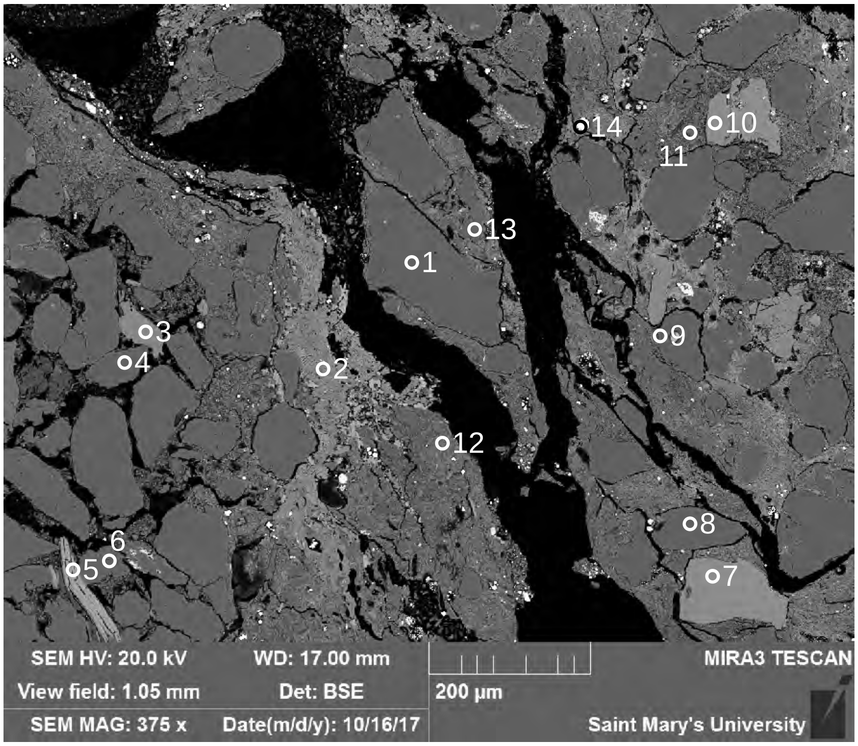
1:K-feldspar
2:Quartz
3:Quartz
4:Quartz
5:Quartz
6:Quartz
7:Muscovite
8:?Muscovite + Chlorite + Pyrite
9:Illite + Chlorite

Figure 1-7.4: Sample 5H-58 1577.78 (SEM) site 3. This site consists of detrital quartz (2-6) and K-feldspar (1) grains. Both of these detrital minerals contain overgrowths. The matrix between grains is made up of illite + chlorite + pyrite (8-9).



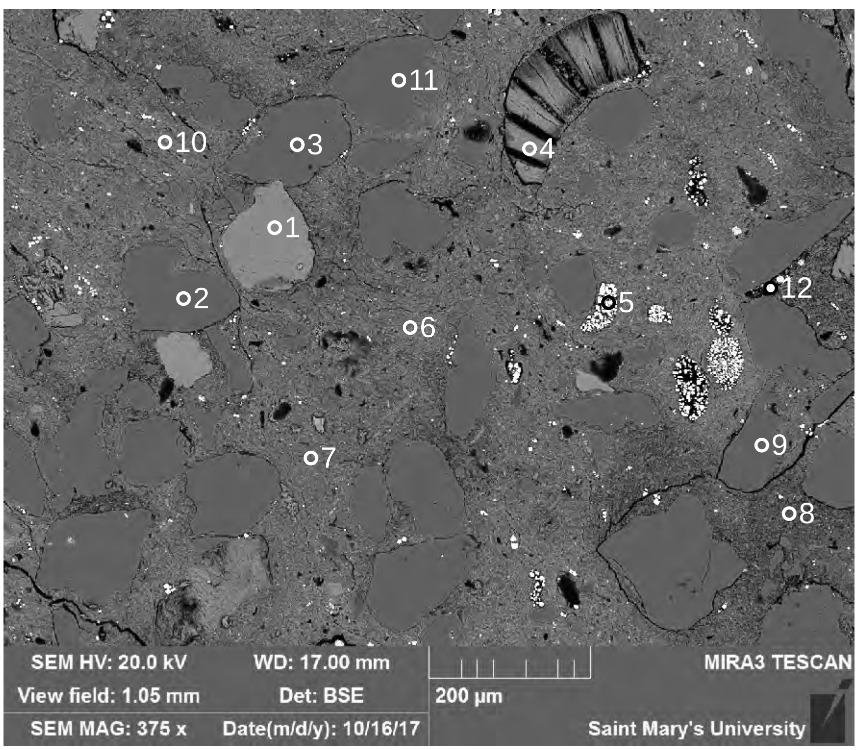
1:Quartz
2:K-feldspar
3:Quartz
4:TiO_2
5:Pyrite
6:Quartz
7:Illite + Chlorite
8:Illite
9:Quartz
10:K-feldspar
11:Illite + Chlorite
12:K-feldspar
13:Quartz
14:Illite + Chlorite

Figure 1-7.5: Sample 5H-58 1577.78 (SEM) site 4. This site consists of detrital quartz and K-feldspar grains. Illite + chlorite (7-8,11,14) make up the matrix between grains. Pyrite (5) and titania (4) appear diagenetic. K-feldspar(10) appears to be dissolving.



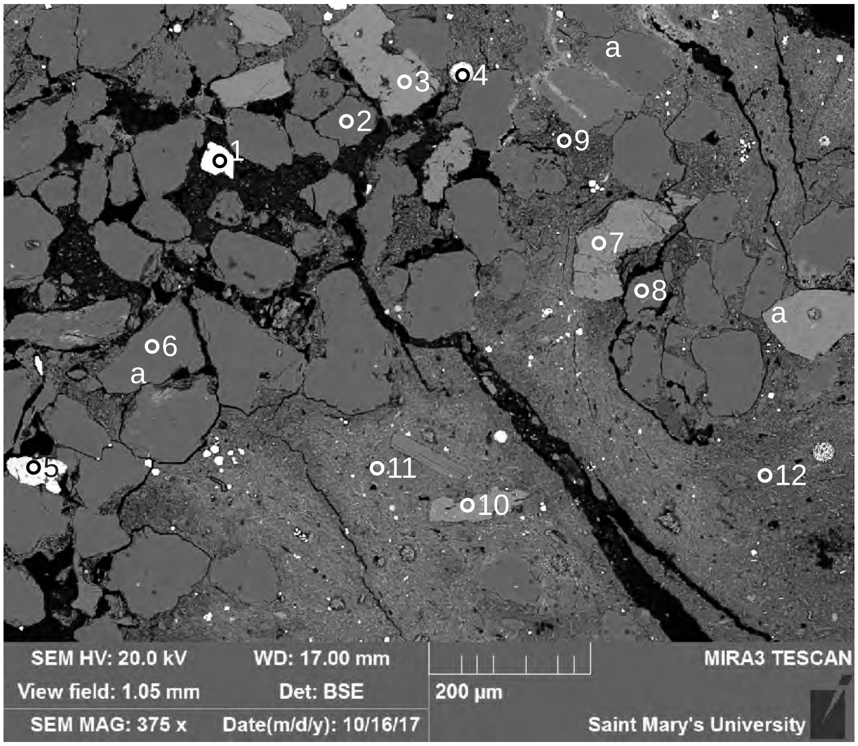
1:Quartz
2:Anhydrite
3:K-feldspar
4:Quartz
5:Chloritized Muscovite
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz
10:K-feldspar
11:Quartz
12:Quartz +
13:Quartz
14:Pyrite

Figure 1-7.6: Sample 5H-58 1577.78 (SEM) site 5. This site consists of detrital quartz (1,4,6,8-9,13), K-feldspar (3,7,10), and chloritized muscovite (5) grains. The matrix between grains a fine-grained mixture of quartz (11-12) and other minerals. Anhydrite (2) appears to be the latest cement.



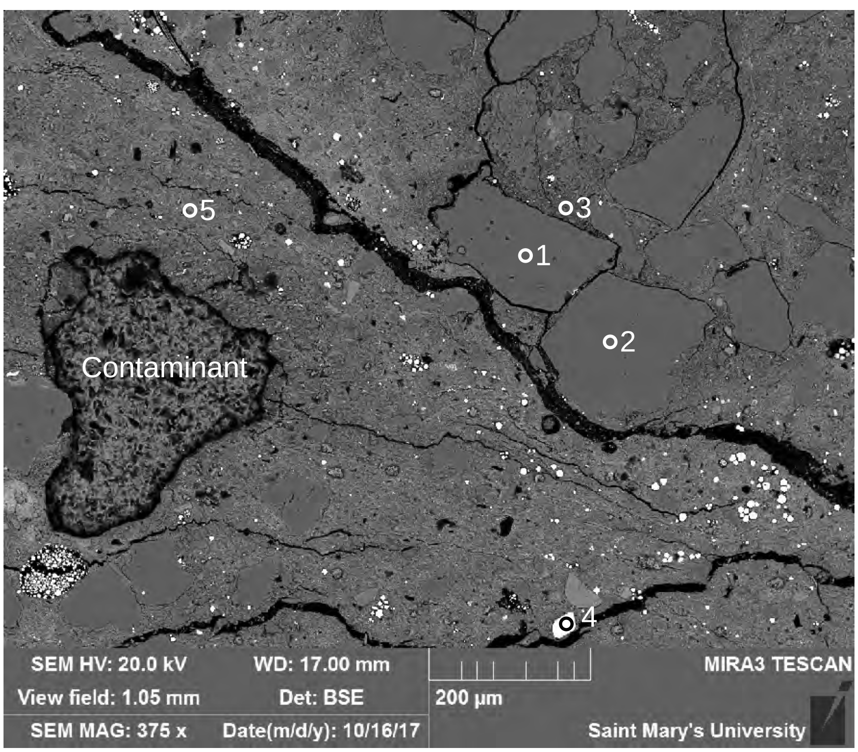
1:K-feldspar
2:Quartz
3:Quartz
4:Mixture
5:Pyrite
6:Illite + Chlorite
7:Illite + Chlorite
8:Kaolinite
9:Quartz
10:Illite + Chlorite
11:Quartz
12:Pyrite

Figure 1-7.7: Sample 5H-58 1577.78 (SEM) site 6. This site consists of detrital quartz and K-feldspar grains. Illite + chlorite (6-7,10) make up the matrix and kaolinite (8) fills porosity. There is a deformed grain that displays volume reduction (4), probably a pellet. Diagenetic pyrite (5,12) partially fills voids.



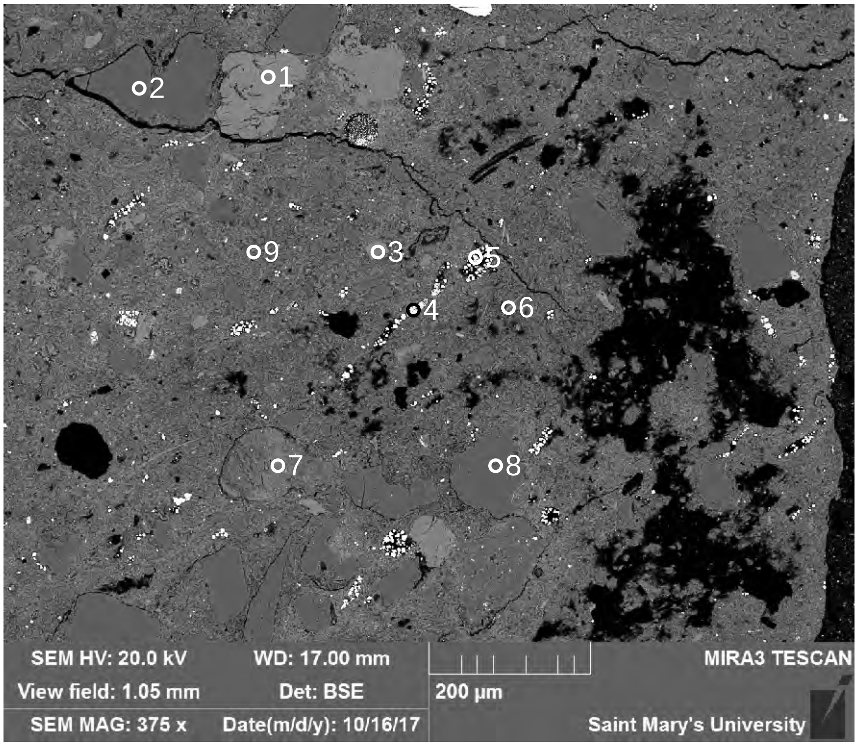
1:Zircon
2:Quartz
3:K-feldspar
4:Pyrite
5:TiO_2
6:Quartz
7:K-feldspar
8:Quartz
9:Illite + Chlorite
10:K-feldspar
11:Mixture ?
12:Mixture ?

Figure 1-7.8: Sample 5H-58 1577.78 (SEM) site 7. This site consists of detrital quartz (2,8), K-feldspar (3,7,10), zircon (1), and titania (5). The matrix is made up of illite + chlorite (9). Diagenetic pyrite (4) partially fills voids in the cement. Suturing is also common (positions a).



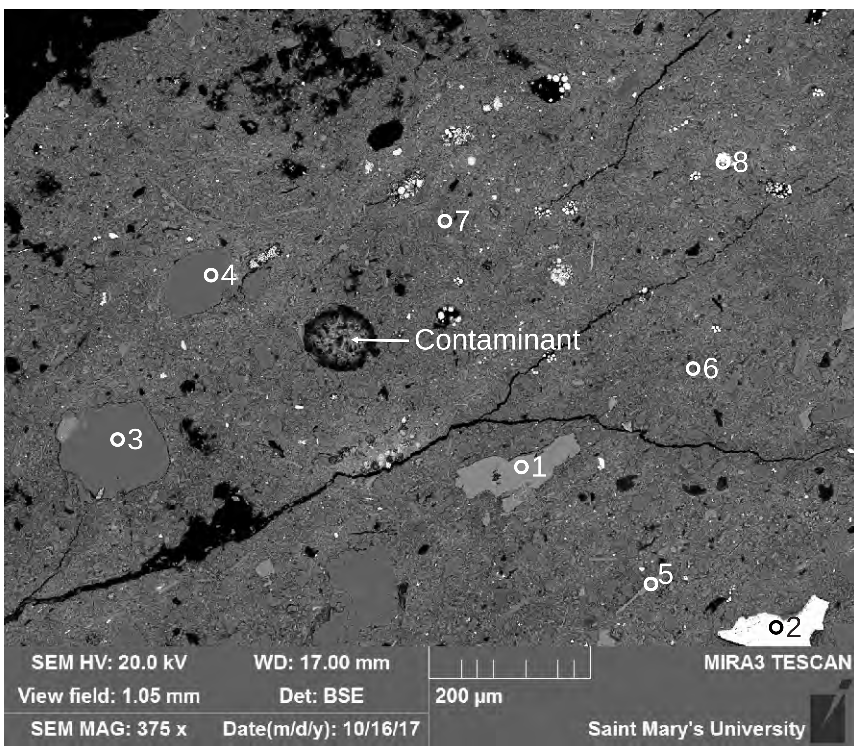
1:Quartz
2:Quartz
3:Kaolinite
4:Zircon
5:Mixture

Figure 1-7.9: Sample 5H-58 1577.78 (SEM) site 8. This site consists of mainly of detrital quartz (1-2) grains and a rare detrital grain of zircon (4). The cement appears to be made up of kaolinite (3), and the matrix is probably made up of illite + chlorite.



1:K-feldspar
2:Quartz
3:K-feldspar
4:Pyrite
5:Pyrite
6:Chlorite + Illite
7:Illite + Chlorite
8:Quartz
9:Illite + Chlorite

Figure 1-7.10: Sample 5H-58 1577.78 (SEM) site 9. This site consists of detrital quartz (2,8) and K-feldspar (1,?3) grains. Diagenetic pyrite (4-5) partially fills voids in the illite + chlorite matrix (6,9). Illite + chlorite (7) is a mudstone intraclast. K-feldspar (1) appears to be corroded and partially dissolved.



1:K-feldspar
2:"Ilmenite"
3:Quartz
4:Quartz
5:K-feldspar
6:Quartz +
7:Illite + Chlorite
8:Pyrite +

Figure 1-7.11: Sample 5H-58 1577.78 (SEM) site 10. This site consists of rare detrital quartz (3-4), K-feldspar (1,5), and altered ilmenite (2) grains. The matrix appears to be made up of illite + chlorite (7). Diagenetic pyrite (8) partially fills voids in the matrix.

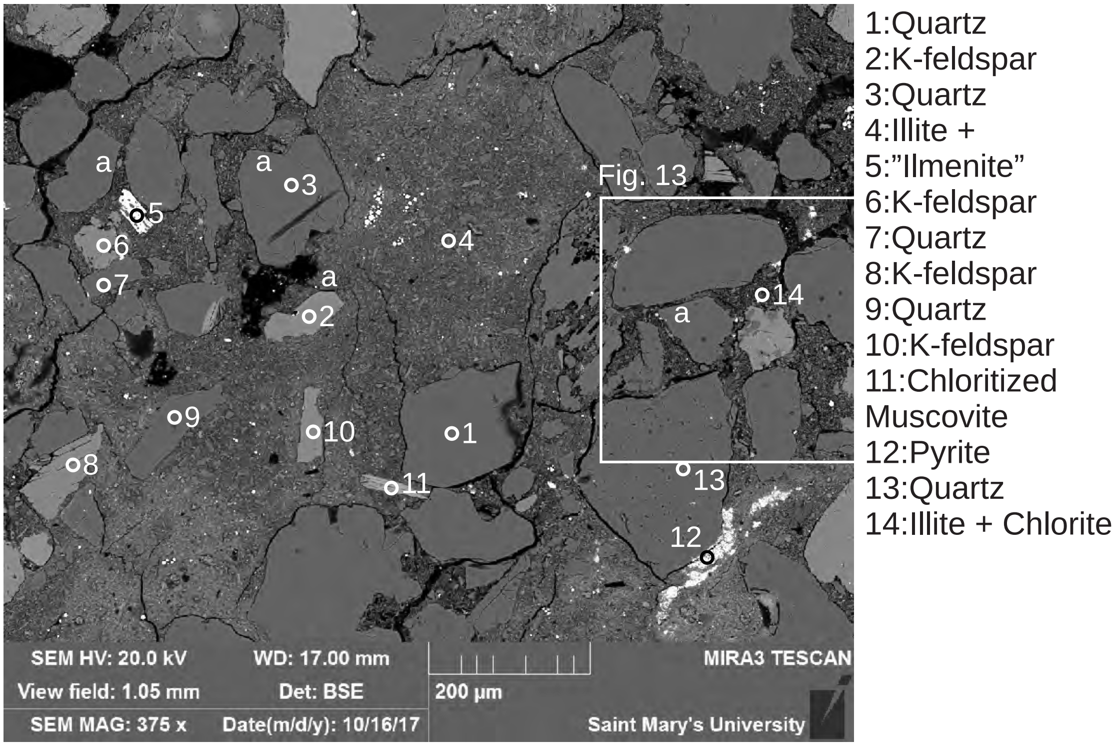


Figure 1-7.12: Sample 5H-58 1577.78 (SEM) site 11. This site consists of detrital quartz (1,3,7,9,13), K-feldspar (6,8,10), altered ilmenite (5) and chlorite (11). Diagenetic pyrite (12) partially fills voids and creates veinlets in the illite + chlorite (14) matrix. Quartz and K-feldspar contain overgrowths (positions a).

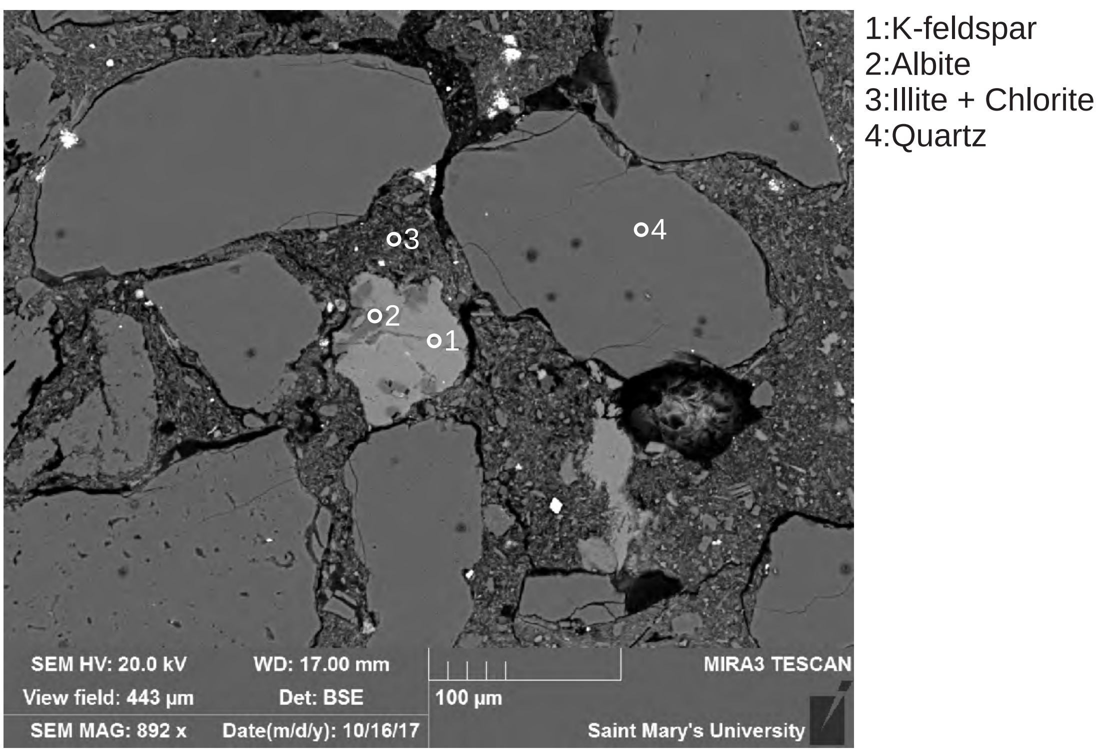
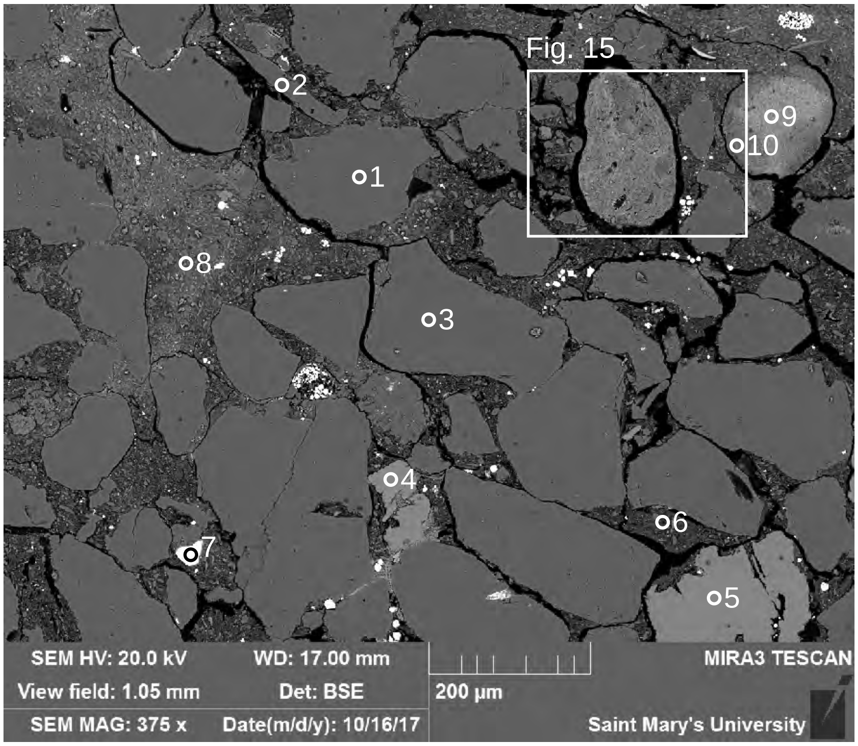
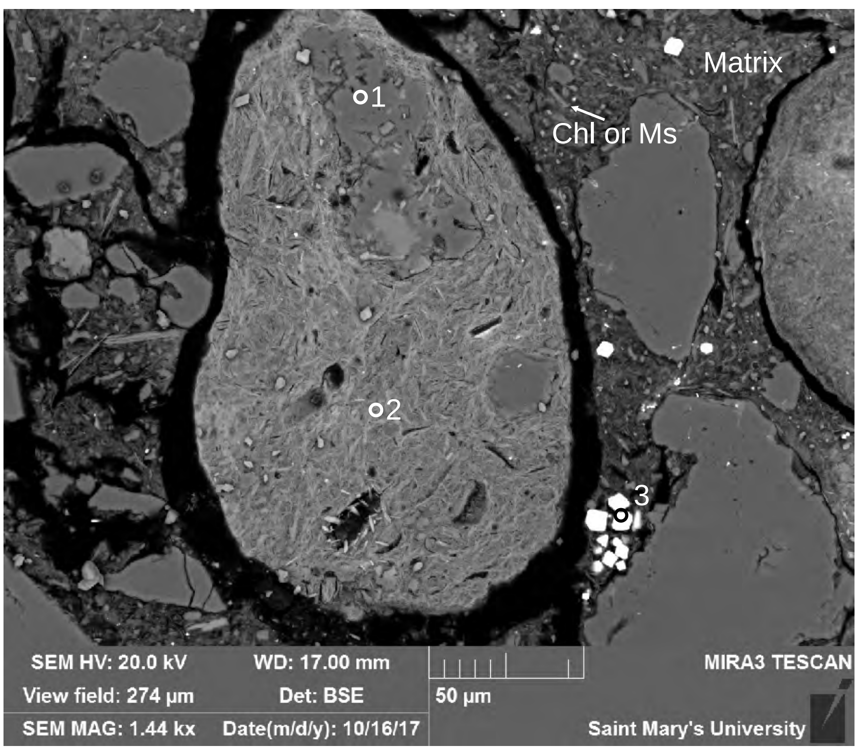


Figure 1-7.13: Sample 5H-58 1577.78 (SEM) site 11.1. This site consists of detrital quartz grains (4) and a detrital albitized K-feldspar (1-2) grain. The matrix between grains is made up of illite + chlorite (3).



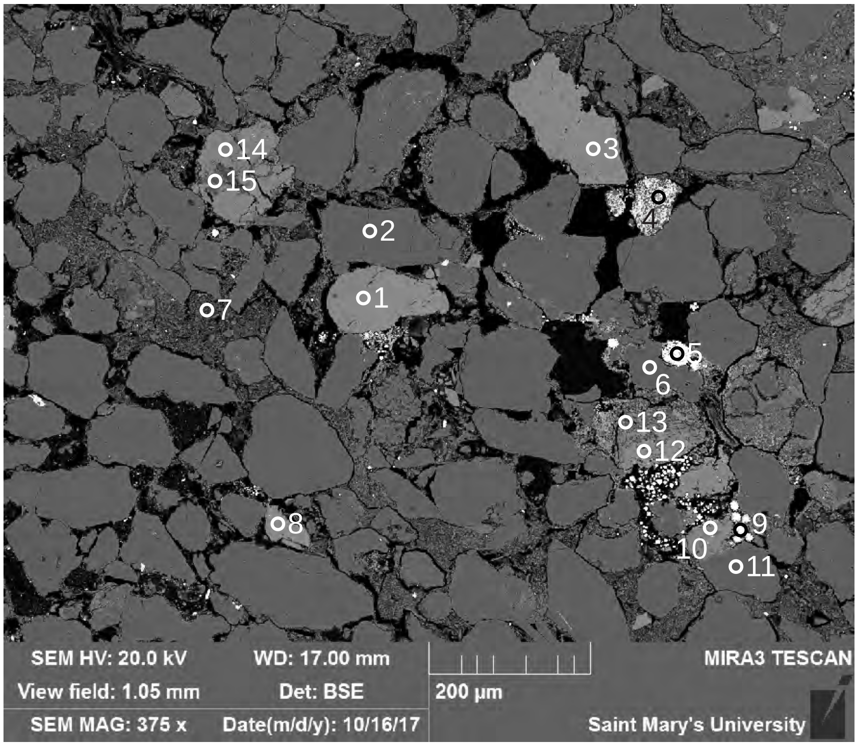
1:Quartz
2:Quartz
3:Quartz
4:K-feldspar
5:K-feldspar
6:Illite + Chlorite
7:Zircon
8:Quartz +
9:Illite + Siderite ?
10:Illite + Siderite ?

Figure 1-7.14: Sample 5H-58 1577.78 (SEM) site 12. This site consists of detrital quartz (1-3), K-feldspar (4-5), and zircon (7) grains. The matrix consists of illite + chlorite (6). There is also a pellet made up of illite + ?siderite (9-10).



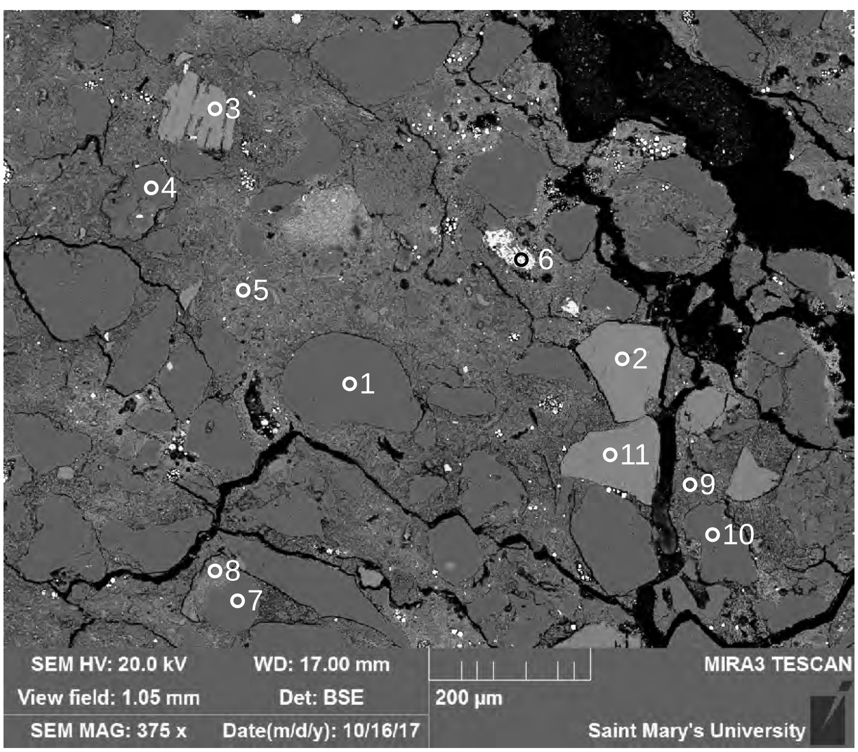
1:Albite
2:Fe-rich Chlorite + Albite
3:Pyrite

Figure 1-7.15: Sample 5H-58 1577.78 (SEM) site 12.1. This site consists probably of a lithic clast made up of albite (1) that is hosted in a muddy matrix.



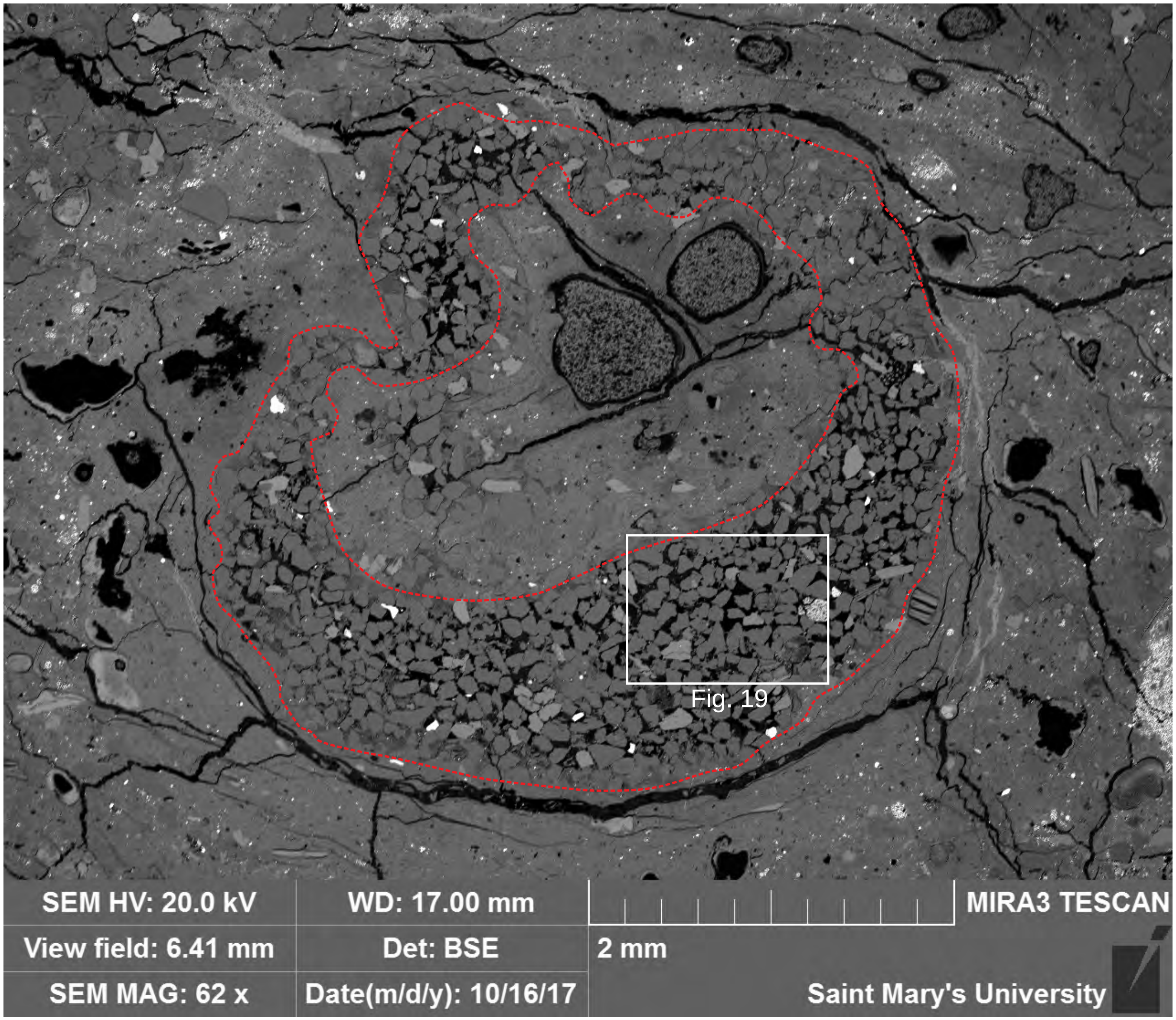
1:K-feldspar
2:Quartz
3:K-feldspar
4:TiO_2 +
5:Pyrite
6:Quartz
7:Illite + Chlorite
8:K-feldspar
9:Pyrite
10:Albite + K-feldspar
11:Quartz
12:K-feldspar
13:Illite + Chlorite
14:K-feldspar
15:Illite

Figure 1-7.16: Sample 5H-58 1577.78 (SEM) site 13. This site consists of detrital quartz (2,6,11), and K-feldspar (1,3,8) grains. The matrix is made up of illite + chlorite (7). K-feldspar (12,14) is being altered to illite + chlorite (13) and illite (15). Diagenetic pyrite (5,9) and titania (4) partially fills voids in the matrix.

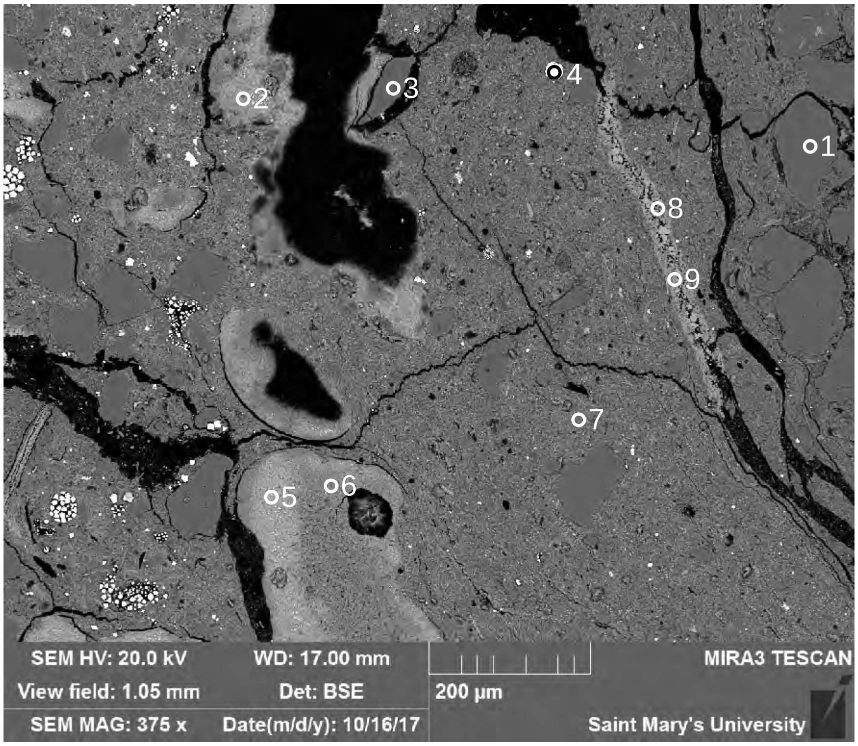


1:Quartz
2:K-feldspar
3:K-feldspar
4:Quartz
5:Illite + Chlorite
6:TiO_2 +
7:Quartz
8:Illite + Chlorite
9:Mixture
10:Quartz
11:K-feldspar

Figure 1-7.17: Sample 5H-58 1577.78 (SEM) site 14. This site consists of detrital quartz (1,4,7,10) K-feldspar (2-3,11) grains. The titania (6) appears to be diagenetic. The matrix is made up of illite + chlorite (5,8).

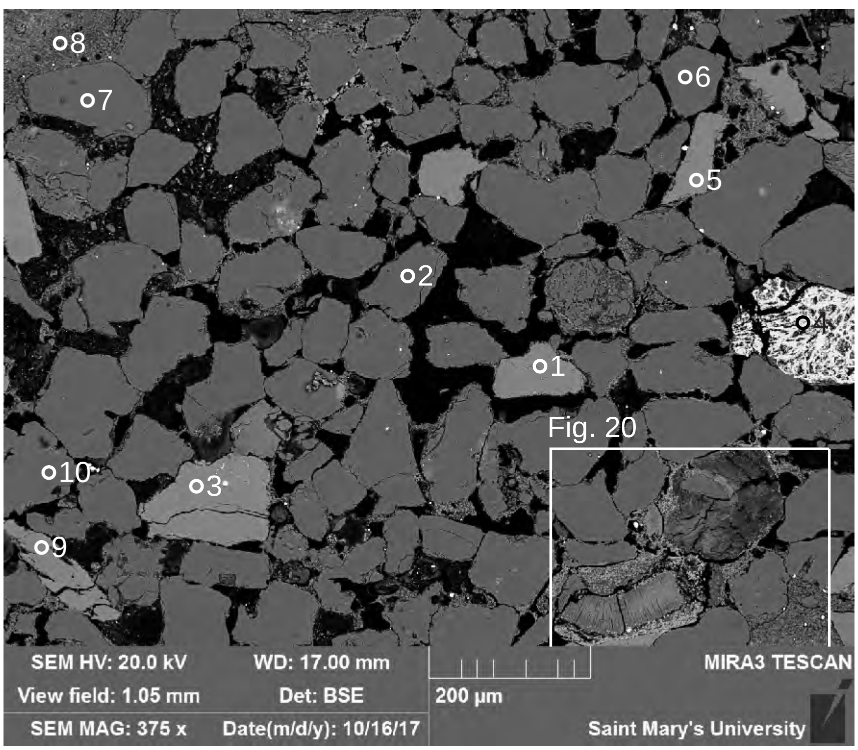


Predominately shale. The main feature in the image is a compacted lined burrow (Fig. 19)



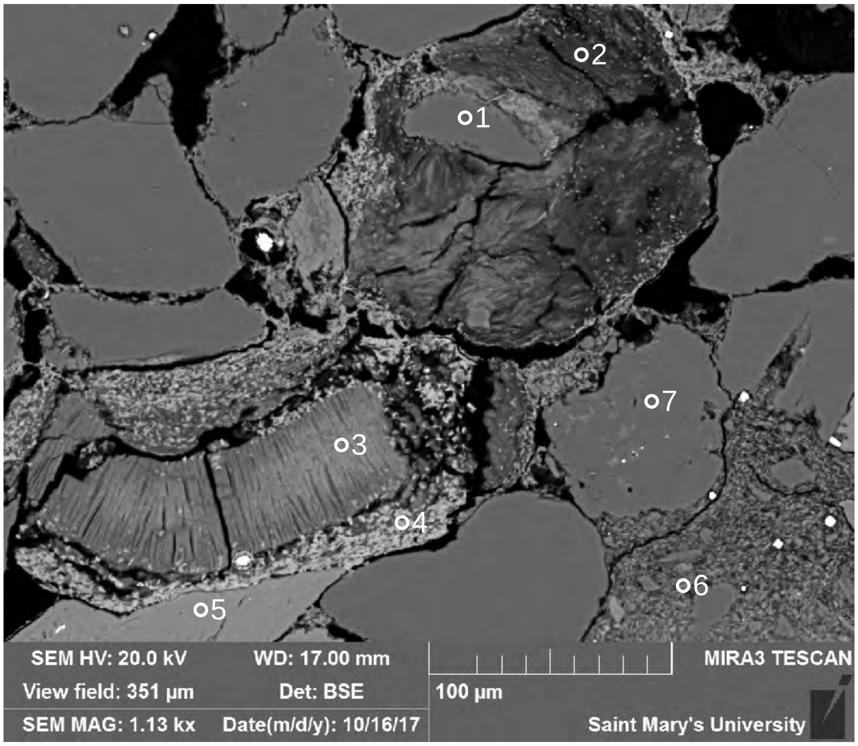
1:Quartz
2:Glaucony
3:Quartz
4:Pyrite
5:Glaucony
6:Glaucony
7:Kaolinite + Illite ?
8:Anhydrite
9:Anhydrite

Figure 1-7.18: Sample 5H-58 1577.78 (SEM) site 15. This site is a chlorite + illite mudstone with scattered pellets and rare fine sand grains and detrital quartz (1,3) grains that are surrounded by an illite + chlorite (2,5-6) matrix. Late diagenetic pyrite (4) and anhydrite (8-9) partially fills voids in the matrix.



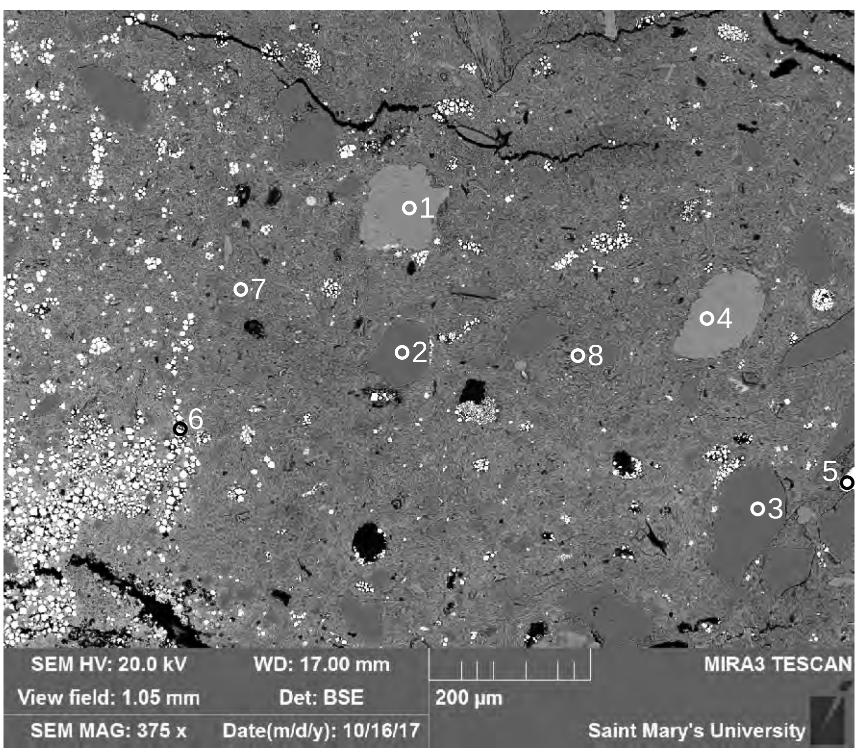
1:K-feldspar
2:Quartz
3:K-feldspar
4:TiO_2 +
5:K-feldspar
6:Quartz
7:Quartz
8:Mixture
9:K-feldspar
10:Quartz

Figure 1-7.19: Sample 5H-58 1577.78 (SEM) site 16. This site is part of a burrow lining and consists of mainly detrital quartz and K-feldspar grains, and an altered ilmenite (4) grain. The mudstone that fills the burrow (8), is probably made up of chlorite + illite.



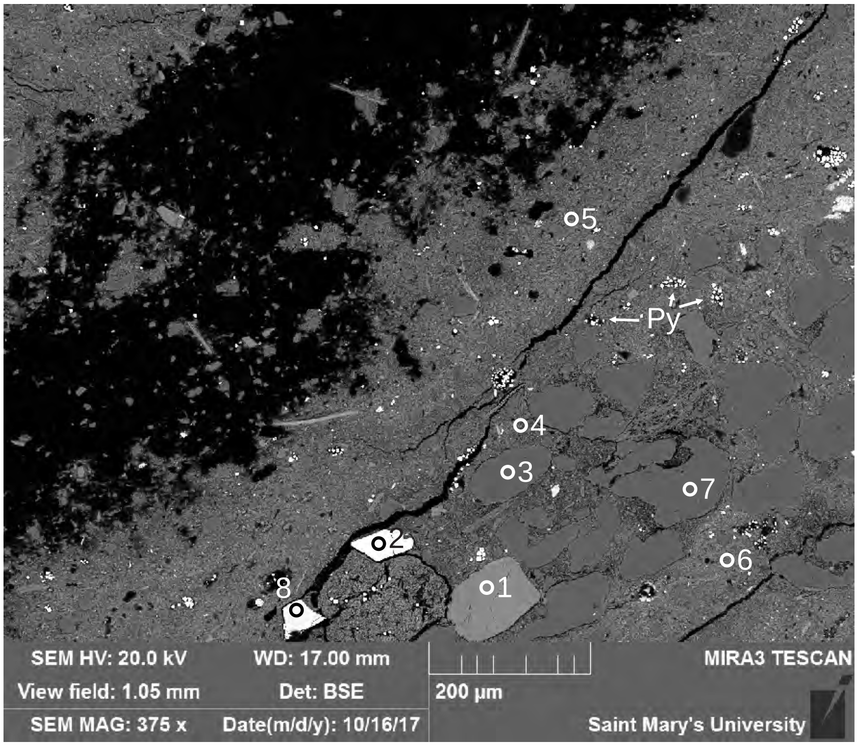
1:Quartz
2:Illite + Chlorite
3:Glaucony
4:Fe-Chlorite +
5:K-feldspar
6:Illite
7:Quartz

Figure 1-7.20: Sample 5H-58 1577.78 (SEM) site 16.1. This site consists of a grain of glaucony (3), which is coated by a fine-grained Fe-rich chlorite + (4). There is also a fine-grained ?intraclast of illite + chlorite (2) with a quartz (1) grain.



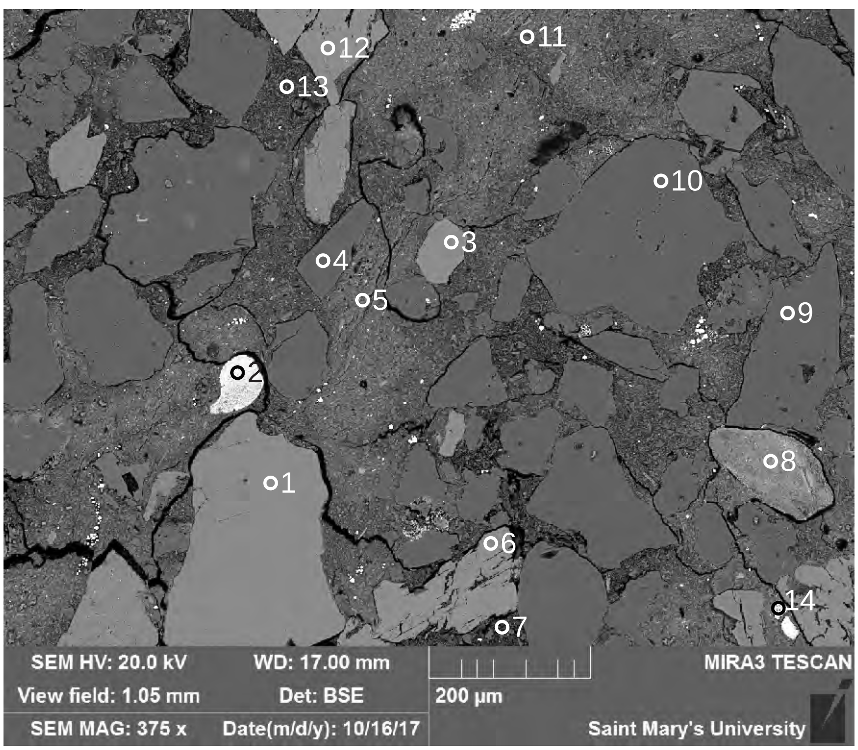
1:K-feldspar
2:Quartz
3:Quartz
4:K-feldspar
5:Zircon
6:Pyrite
7:Mixture
8:Quartz

Figure 1-7.21: Sample 5H-58 1577.78 (SEM) site 17. This site is a mudstone and consists of rare detrital quartz (2-3,8), K-feldspar (1,4), and zircon (5) grains, and probably a illite + chlorite matrix. Late diagenetic pyrite (6) partially fills voids.



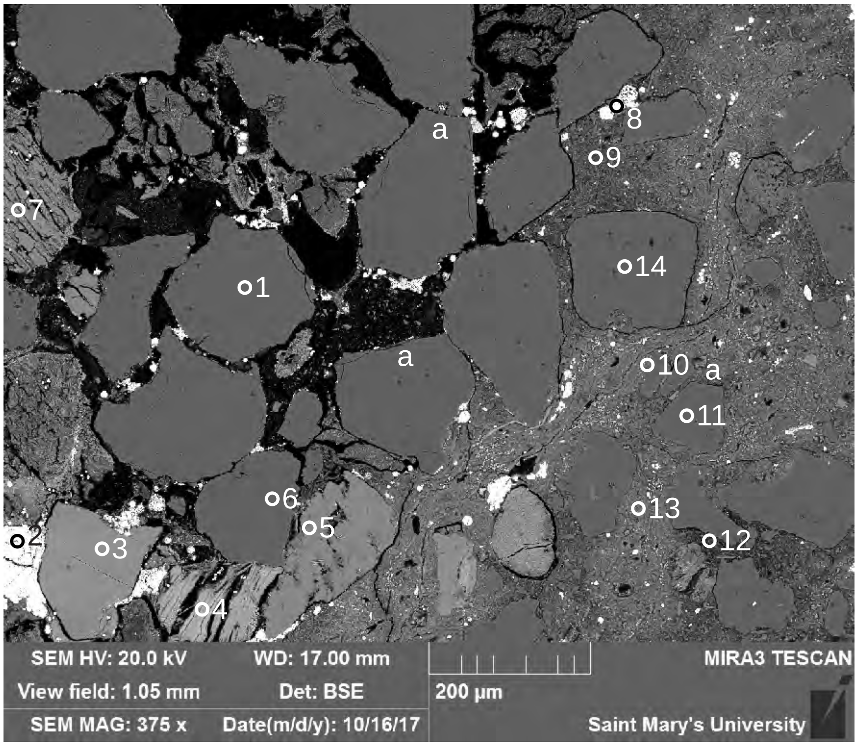
1:K-feldspar
2:Ilmenite
3:Quartz
4:Kaolinite
5:Illite +
6:Illite + Chlorite
7:Quartz
8:Chromite

Figure 1-7.22: Sample 5H-58 1577.78 (SEM) site 18. This site consists of detrital grains of quartz (3,7), K-feldspar (1), ilmenite (2), and chromite (8). The matrix is made up of illite + chlorite (5-6), probably with diagenetic pyrite partially filling voids.



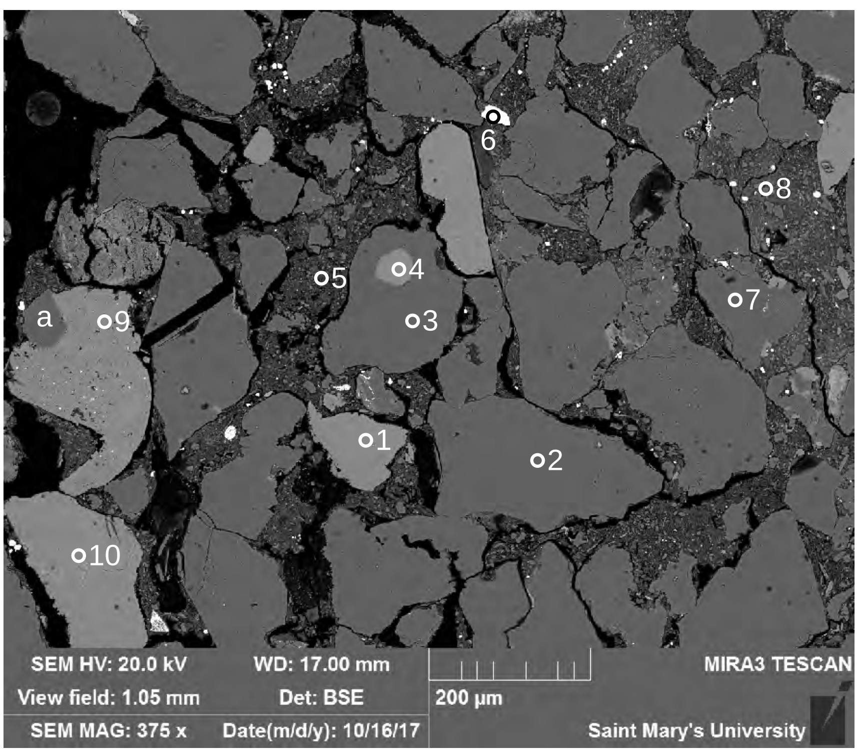
1:K-feldspar
2:TiO_2
3:K-feldspar
4:Quartz
5:Quartz +
6:K-feldspar
7:Illite + Chlorite
8:Mixture
9:Quartz
10:Quartz
11:Mixture
12:K-feldspar
13:Mixture
14:Pyrite

Figure 1-7.23: Sample 5H-58 1577.78 (SEM) site 19. This site consists of detrital quartz and K-feldspar grains. There appears to be an intraclast (8). The matrix is made up of illite + chlorite (7). Titania (2) may be detrital.



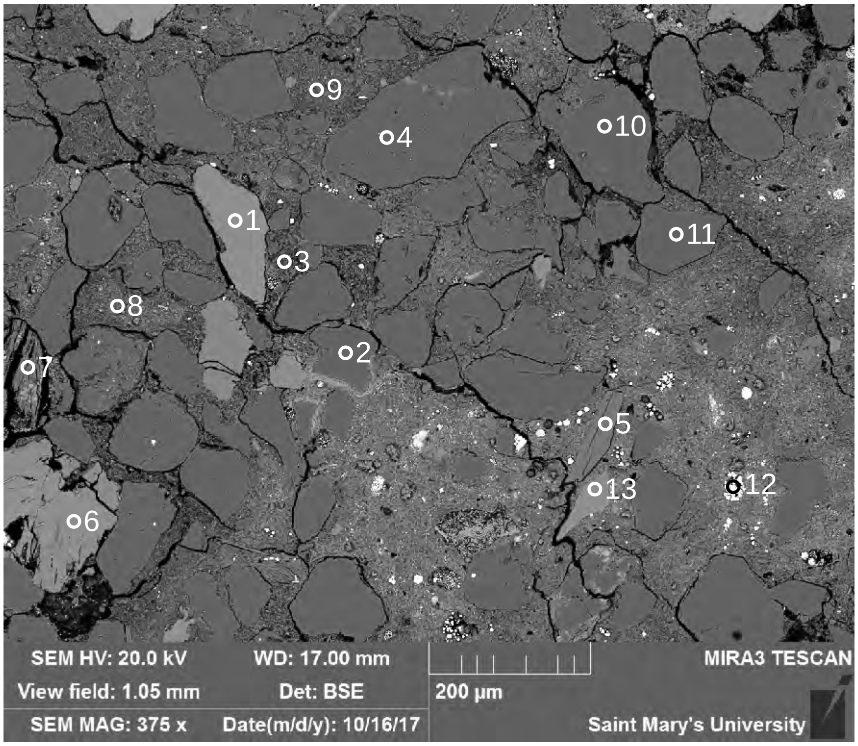
1:Quartz
2:Pyrite
3:K-feldspar
4:Chlorite +
5:K-feldspar
6:Quartz
7:Mixture
8:Pyrite
9:Mixture
10:K-feldspar
11:Quartz
12:Mixture
13:Mixture
14:Quartz

Figure 1-7.24: Sample 5H-58 1577.78 (SEM) site 20. This site is a mixture of sandstone and mudstone. The sandstone patch consists of detrital quartz (1,6,11,14), K-feldspar (3,5), and chlorite (4). The quartz grains contain overgrowths (positions a), and K-feldspar (5) appears to be altered. The mudstone patch is probably made up of illite + chlorite. Pyrite (2) fills pores.



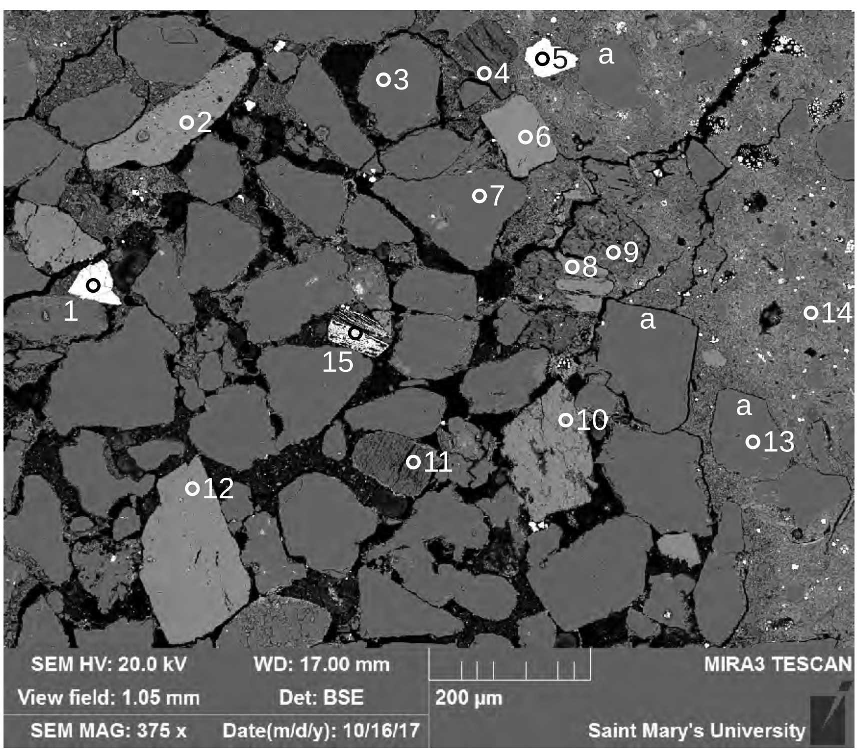
1:K-feldspar
2:Quartz
3:Quartz
4:K-feldspar
5:Illite + Chlorite
6:Xenotime-(Y)
7:Quartz
8:Quartz + Mixed Clay
9:K-feldspar
10:K-feldspar

Figure 1-7.25: Sample 5H-58 1577.78 (SEM) site 21. This site consists of detrital quartz, K-feldspar, and xenotime (6) grains. There is a granitic lithic clast made up of quartz (position a) and K-feldspar (4,9), and a quartz grain (3) with K-feldspar (4) inclusion. The matrix is made up of mixed clay minerals (5,8).



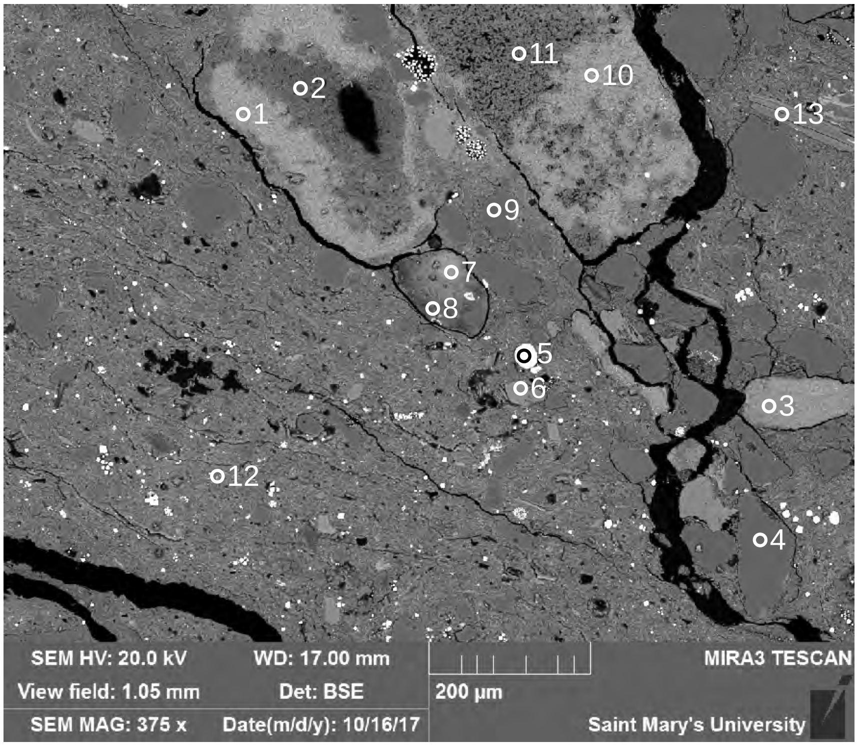
1:K-feldspar
2:Quartz
3:Chlorite + Illite
4:Quartz
5:Muscovite
6:K-feldspar
7:Mixture
8:Mixed Clay
9:Mixed Clay
10:Quartz
11:Quartz
12:Pyrite
13:K-feldspar

Figure 1-7.26: Sample 5H-58 1577.78 (SEM) site 22. This site consists of detrital quartz, K-feldspar, muscovite (5), probably altered muscovite (7) grains. The matrix is made up of illite + chlorite (3), and mixed clay minerals (8-9).



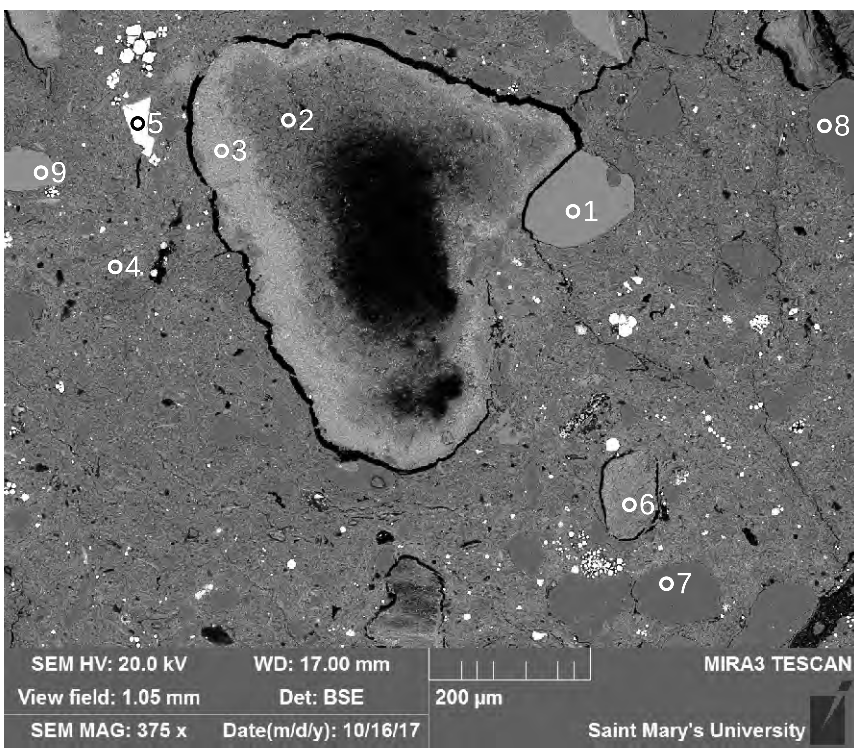
1:Ilmenite
2:K-feldspar
3:Quartz
4:Mixed Clay
5:Ilmenite
6:K-feldspar
7:Quartz
8:K-feldspar
9:Mixed Clay
10:K-feldspar
11:Mixed Clay
12:K-feldspar
13:Quartz
14:Mixed Clay
15:”Ilmenite”

Figure 1-7.27: Sample 5H-58 1577.78 (SEM) site 23. This site consists of detrital quartz, K-feldspar, ilmenite (1,5), and altered ilmenite (15) grains. The matrix is made up of mixed clay minerals (9,14). Quartz overgrowths are also seen (positions a).



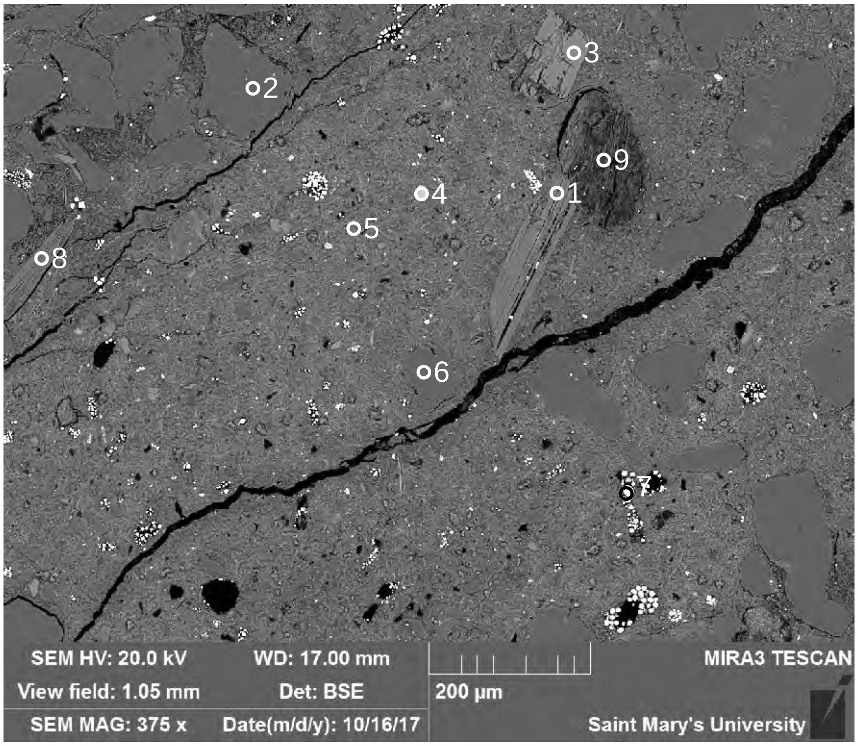
1:Glaucony
2:Glaucony
3:Glaucony
4:Quartz
5:Zircon
6:K-feldspar
7:Glaucony
8:Glaucony
9:Quartz
10:Glaucony + Pyrite
11:Glaucony ?
12:Mixture
13:Muscovite

Figure 1-7.28: Sample 5H-58 1577.78 (SEM) site 24. This site consists of rare detrital quartz, K-feldspar, muscovite (13), and zircon (5) grains. The matrix is probably made up of mixed clay minerals. There is also grains of glaucony (1-2, 7-8, 9-10).



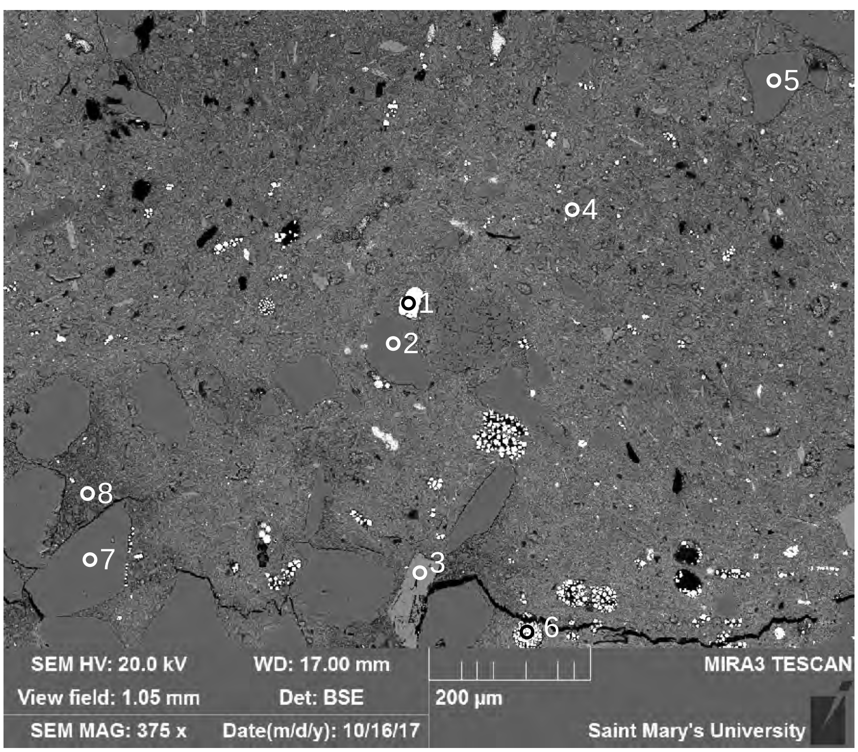
1:K-feldspar
2:Glaucony ?
3:Glaucony ?
4:Mixed Clay
5:"Ilmenite"
6:Quartz +
7:Quartz
8:Quartz
9:K-feldspar

Figure 1-7.29: Sample 5H-58 1577.78 (SEM) site 25. This site is similar to site 24.



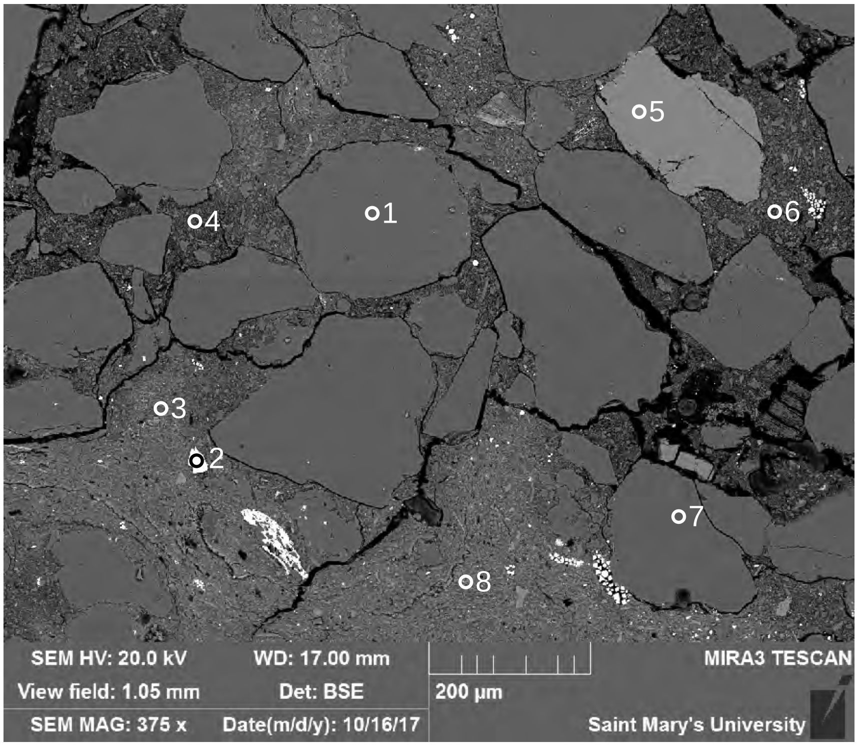
1:Muscovite
2:Quartz
3:K-feldspar
4:Apatite
5:Illite + Chlorite
6:Quartz
7:Pyrite
8:Chloritized Muscovite
9:Illite + Chlorite

Figure 1-7.30: Sample 5H-58 1577.78 (SEM) site 26. This site is a mudstone and consists of detrital quartz (2,6), K-feldspar (3), apatite (4), chloritized muscovite (8), muscovite (1) grains and mixed clay minerals. Diagenetic pyrite (7) partially fills voids.



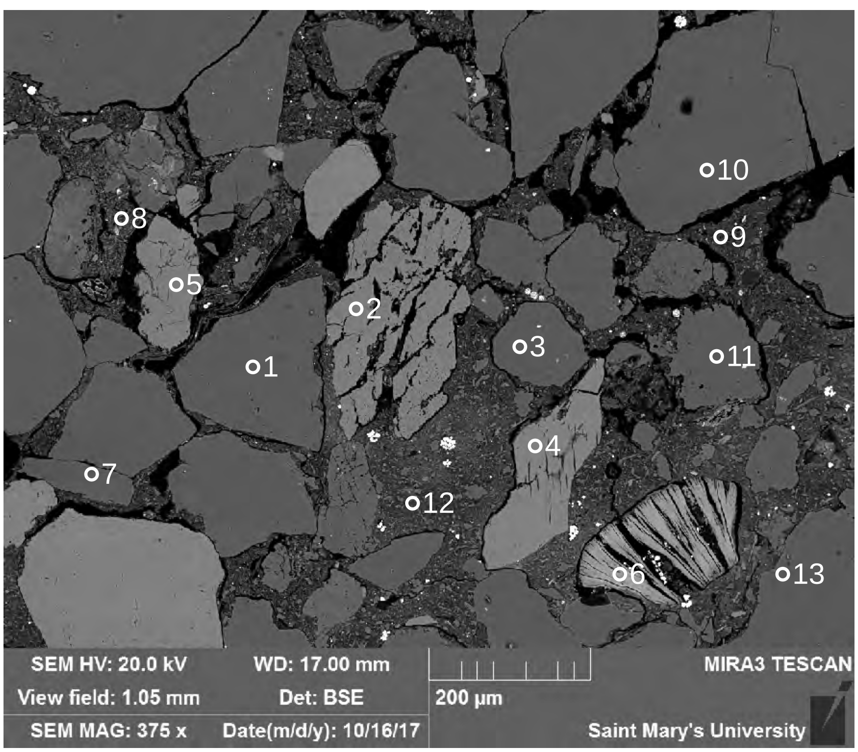
1:Zircon
2:Quartz
3:K-feldspar
4:Quartz +
5:Quartz
6:Pyrite
7:Quartz
8:Mixed Clay

Figure 1-7.31: Sample 5H-58 1577.78 (SEM) site 27. This site is similar to site 26.



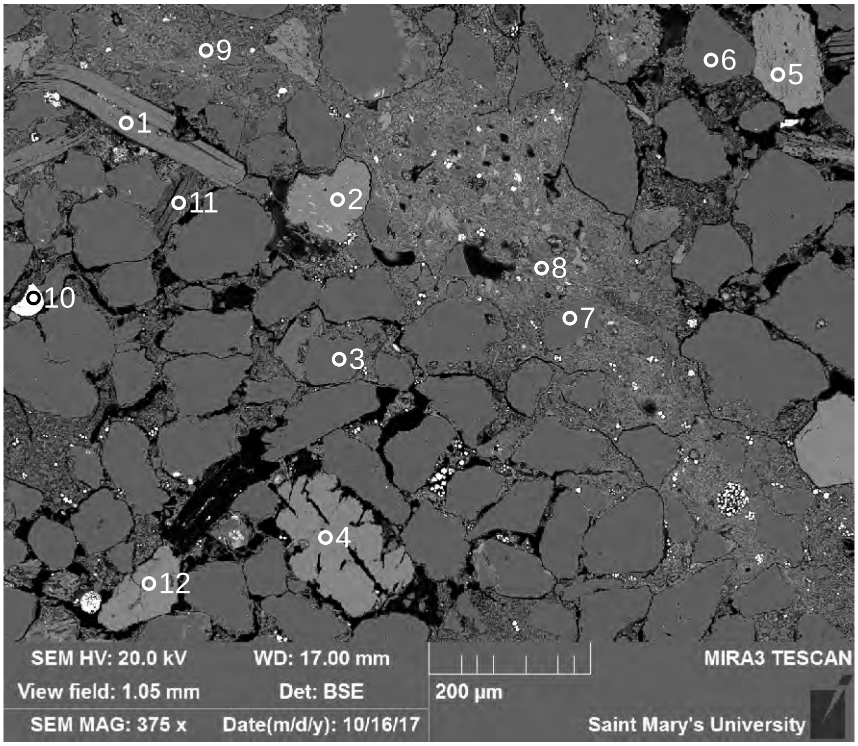
1:Quartz
2:Ilmenite
3:Mixed Clay
4:Mixed Clay
5:K-feldspar
6:Quartz +
7:Quartz
8:Mixed Clay

Figure 1-7.32: Sample 5H-58 1577.78 (SEM) site 28. This site is a mixed sandstone and mudstone.



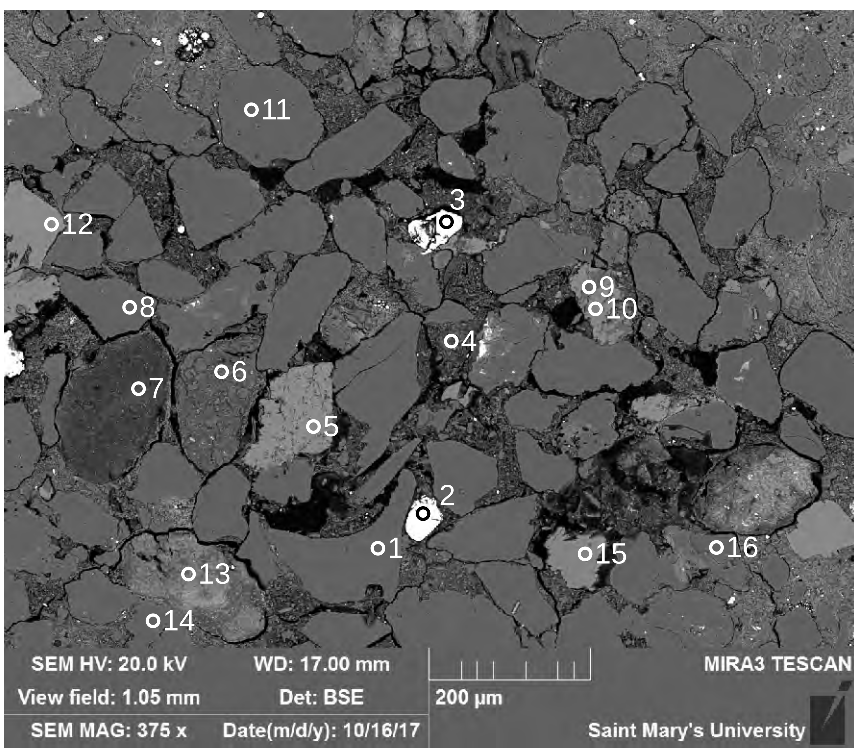
1:Quartz
2:K-feldspar
3:Quartz
4:K-feldspar
5:K-feldspar
6:Mixed Clay
7:Quartz
8:Quartz +
9:Mixture
10:Quartz
11:Quartz
12:Mixed Clay
13:Quartz

Figure 1-7.33: Sample 5H-58 1577.78 (SEM) site 29. This site consists of detrital quartz, K-feldspar grains. There is also a pellet (6). The matrix is made up of mixed clay minerals. Diagenetic pyrite probably partially fills voids.



1:Muscovite
2:K-feldspar
3:Quartz
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:Mixed Clay
10:Zircon
11:Kaolinite ?
12:K-feldspar

Figure 1-7.34: Sample 5H-58 1577.78 (SEM) site 30. This site is similar to site 28.



1:Quartz
2:Zircon
3:Ilmenite
4:Mixed Clay
5:K-feldspar
6:Quartz
7:Glaucony
8:Quartz
9:Albite
10:K-feldspar
11:Quartz
12:K-feldspar
13:"Glaucony"
14:Quartz
15:K-feldspar
16:Quartz

Figure 1-7.34: Sample 5H-58 1577.78 (SEM) site 31. This site is similar to site 28. There is also glaucony (7,13) grains, and an albitized K-feldspar grain (9-10).

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	1	1	Kfs	66.39		17.60					0.52	15.50																100	118
5H-58 1577.78	1	2	Qz	99.51		0.49																						100	122
5H-58 1577.78	1	3	Kfs	66.28		17.68					0.67	15.36																100	119
5H-58 1577.78	1	4	Qz	100.00																								100	122
5H-58 1577.78	1	5	Py	0.25			28.68							71.07														100	231
5H-58 1577.78	1	6	Qz	100.00																								100	121
5H-58 1577.78	1	7	Ms	47.27	0.84	32.69	3.08		0.58		0.62	9.93																95	106
5H-58 1577.78	1	8	Ill + Chl	54.61	1.32	28.41	6.58		1.77		1.16	2.95		3.21														100	93
5H-58 1577.78	1	9	Ill + Chl	47.76	0.35	28.70	7.71		1.37	0.34	1.52	4.30		7.68		0.27												100	99
5H-58 1577.78	1	10	Kfs	65.96		17.81					0.92	14.67									0.63							100	123
5H-58 1577.78	1	11	Py	1.45		0.89	28.39				0.26			69.01														100	222
5H-58 1577.78	2	1	Qz	100.00																								100	122
5H-58 1577.78	2	2	Qz	100.00																								100	123
5H-58 1577.78	2	3	Kfs	66.14		17.87					0.65	15.33																100	114
5H-58 1577.78	2	4	Kfs	63.59		19.65	0.70				0.38	14.86		0.50		0.33												100	85
5H-58 1577.78	2	5	Py	3.34		1.94	39.92		1.46	7.19	1.26			44.30		0.59												100	113
5H-58 1577.78	2	6	Py	0.40			29.16			0.28				70.16														100	209
5H-58 1577.78	2	7	Ill + Chl + Py	51.52	0.63	27.29	7.70		2.82		1.31	3.55		4.83		0.34												100	98
5H-58 1577.78	2	8	Ill + Chl + Py	53.49	0.47	24.58	8.35		1.14		1.86	2.55		7.28		0.28												100	106
5H-58 1577.78	3	1	Kfs	65.51		18.01					0.89	14.78									0.82							100	115
5H-58 1577.78	3	2	Qz	100.00																								100	120
5H-58 1577.78	3	3	Qz	100.00																								100	125
5H-58 1577.78	3	4	Qz	100.00																								100	126
5H-58 1577.78	3	5	Qz	100.00																								100	122
5H-58 1577.78	3	6	Qz	99.54		0.46																						100	119
5H-58 1577.78	3	7	Ms	48.78	0.58	32.28	1.27		1.31		0.38	9.64		0.75														95	111
5H-58 1577.78	3	8	?Ms + Chl + Py	52.78		33.37	4.76		1.03	0.22	1.02	2.64		3.82		0.36												100	96
5H-58 1577.78	3	9	Ill + Chl + Py	51.35	0.49	28.47	7.06		1.71		1.50	3.85		5.25		0.31												100	93
5H-58 1577.78	4	1	Qz	100.00																								100	122
5H-58 1577.78	4	2	Kfs	65.62		17.90					0.90	14.64									0.94							100	116
5H-58 1577.78	4	3	Qz	100.00																								100	119
5H-58 1577.78	4	4	TiO2	0.71	98.52		0.77																					100	106
5H-58 1577.78	4	5	Py	0.52			29.22				0.27			69.99														100	212
5H-58 1577.78	4	6	Qz	100.00																								100	119
5H-58 1577.78	4	7	Ill + Chl	51.34	0.35	26.18	9.61		0.88	0.26	1.48	1.29		8.09		0.52												100	81
5H-58 1577.78	4	8	Ill	47.43	0.27	29.25	3.52		1.34		0.86	5.51		1.83														90	106
5H-58 1577.78	4	9	Qz	100.00																								100	123
5H-58 1577.78	4	10	Kfs	68.32		17.84					3.90	9.94																100	114
5H-58 1577.78	4	11	Ill + Chl	46.93	0.91	26.26	10.61		1.21		1.68	2.02		9.79		0.59												100	79
5H-58 1577.78	4	12	Kfs	66.30		17.73					0.70	15.27																100	120
5H-58 1577.78	4	13	Qz	100.00																								100	124
5H-58 1577.78	4	14	Ill + Chl	54.52		23.56	14.06		2.65		1.82	0.87		1.81		0.69												100	66
5H-58 1577.78	5	1	Qz	100.00																								100	125
5H-58 1577.78	5	2	Anh	5.04		2.51	0.87			34.05	0.60	0.47		55.94		0.50												100	103
5H-58 1577.78	5	3	Kfs	66.69		17.88					1.27	14.16																100	119
5H-58 1577.78	5	4	Qz	100.00																								100	123
5H-58 1577.78	5	5	Chloritized Ms	41.26	4.42	20.76	19.39		7.67		0.71	5.77																100	104
5H-58 1577.78	5	6	Qz	100.00																								100	124
5H-58 1577.78	5	7	Kfs	65.58		17.94					0.94	14.48									1.06							100	125
5H-58 1577.78	5	8	Qz	100.00																								100	128
5H-58 1577.78	5	9	Qz	100.00																								100	127
5H-58 1577.78	5	10	Kfs	65.51		17.89					0.61	15.12									0.87							100	119
5H-58 1577.78	5	11	Qz	95.98		2.12	0.63				0.30	0.04		0.93														100	120

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	5	12	Qz +	90.37		6.23	1.36				0.38	0.50		1.17														100	122
5H-58 1577.78	5	13	Qz	100.00																								100	123
5H-58 1577.78	5	14	Py	0.21			28.84							70.94														100	230
5H-58 1577.78	6	1	Kfs	65.81		17.82					0.72	15.02									0.63							100	118
5H-58 1577.78	6	2	Qz	100.00																								100	122
5H-58 1577.78	6	3	Qz	100.00																								100	121
5H-58 1577.78	6	4	Mix	55.07	0.40	12.68	19.12		3.99	0.66	3.01	1.80		2.69		0.58												100	101
5H-58 1577.78	6	5	Py	0.36			29.43			0.15				70.06														100	223
5H-58 1577.78	6	6	Ill + Chl	45.02	0.29	26.97	10.88		3.74		2.43	2.21		8.11		0.34												100	109
5H-58 1577.78	6	7	Ill + Chl	52.97	0.32	32.70	5.37		0.88		1.28	1.26		4.99		0.22												100	108
5H-58 1577.78	6	8	Kln	47.52		30.52	2.80		0.61		0.75	1.19		2.27		0.34												86	99
5H-58 1577.78	6	9	Qz	100.00																								100	126
5H-58 1577.78	6	10	Ill + Chl	52.52	0.58	28.26	7.16		1.55		1.50	3.74		4.44		0.25												100	103
5H-58 1577.78	6	11	Qz	100.00																								100	120
5H-58 1577.78	6	12	Py	0.31			28.91				0.50			70.28														100	229
5H-58 1577.78	7	1	Zrn	31.16																67.50						1.34		100	124
5H-58 1577.78	7	2	Qz	100.00																								100	123
5H-58 1577.78	7	3	Kfs	66.27		17.90					0.80	15.04																100	118
5H-58 1577.78	7	4	Py	0.28			31.71				1.53			66.48														100	180
5H-58 1577.78	7	5	TiO2	0.46	99.27		0.28																					100	112
5H-58 1577.78	7	6	Qz	100.00																								100	125
5H-58 1577.78	7	7	Kfs	66.45		17.79					1.40	14.36																100	122
5H-58 1577.78	7	8	Qz	100.00																								100	126
5H-58 1577.78	7	9	Ill + Chl	48.44	0.52	29.38	6.94		1.43		1.66	4.54		6.52		0.57												100	96
5H-58 1577.78	7	10	Kfs	65.08		17.33	1.86				0.38	15.35																100	124
5H-58 1577.78	7	11	Mix ?	34.55		24.31	12.80		0.77		1.10	1.06		25.05		0.36												100	110
5H-58 1577.78	7	12	Mix ?	46.37	0.37	24.83	9.41		1.56		2.06	2.81		12.05		0.53												100	99
5H-58 1577.78	8	1	Qz	100.00																								100	122
5H-58 1577.78	8	2	Qz	100.00																								100	123
5H-58 1577.78	8	3	Kln	48.03		34.61	1.12		0.41	0.17	0.40	0.15		0.97		0.14												86	100
5H-58 1577.78	8	4	Zrn	29.23		0.52	0.46			0.88							0.71			68.20								100	110
5H-58 1577.78	8	5	Mix	44.63	0.74	25.44	11.96		1.19		2.46	2.61		10.58		0.41												100	91
5H-58 1577.78	9	1	Kfs	66.23		17.91					0.71	15.15																100	115
5H-58 1577.78	9	2	Qz	100.00																								100	118
5H-58 1577.78	9	3	Kfs	66.32		17.97					0.77	14.94																100	116
5H-58 1577.78	9	4	Py	0.29			28.52			0.44	0.41			70.34														100	217
5H-58 1577.78	9	5	Py	0.29			29.01							70.70														100	222
5H-58 1577.78	9	6	Chl + Ill	44.40	0.74	26.22	10.49		1.24	0.38	1.69	3.70		10.77		0.38												100	84
5H-58 1577.78	9	7	Ill + Chl	55.02		25.63	6.74		2.47		0.81	7.97		1.14		0.21												100	105
5H-58 1577.78	9	8	Qz	100.00																								100	124
5H-58 1577.78	9	9	Ill + Chl	50.95	0.98	23.01	11.18		1.58	0.48	1.83	1.85		7.82		0.31												100	89
5H-58 1577.78	10	1	Kfs	66.20		17.85					0.84	15.12																100	121
5H-58 1577.78	10	2	"Ilm"		60.69		37.27	2.04																				100	109
5H-58 1577.78	10	3	Qz	100.00																								100	122
5H-58 1577.78	10	4	Qz	100.00																								100	121
5H-58 1577.78	10	5	Kfs	63.03		19.13	2.30		0.40		1.18	11.64		2.31														100	127
5H-58 1577.78	10	6	Qz +	77.73	1.03	12.37	2.93		0.92	0.38	1.14	1.27		1.92		0.29												100	109
5H-58 1577.78	10	7	Ill + Chl	53.94	0.82	22.94	8.71		1.21	0.27	1.72	2.04		7.96		0.39												100	94
5H-58 1577.78	10	8	Py +	8.39	0.30	3.03	41.90		0.94	0.60	0.95	0.16		42.62		1.10												100	127
5H-58 1577.78	11	1	Qz	100.00																								100	127
5H-58 1577.78	11	2	Kfs	66.21		17.62					0.64	15.53																100	120
5H-58 1577.78	11	3	Qz	100.00																								100	123
5H-58 1577.78	11	4	Ill +	60.89	0.48	20.89	7.33		1.25		1.30	1.68		5.62		0.56												100	99

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	11	5	"Ilm"	1.10	68.45	0.45	28.90	1.10																				100	101
5H-58 1577.78	11	6	Kfs	66.29		17.64	0.42					15.64																100	117
5H-58 1577.78	11	7	Qz	100.00																								100	123
5H-58 1577.78	11	8	Kfs	66.40		17.71					1.03	14.86																100	120
5H-58 1577.78	11	9	Qz	100.00																								100	125
5H-58 1577.78	11	10	Kfs	66.42		17.68					0.61	15.29																100	121
5H-58 1577.78	11	11	Chloritized Ms	42.22	3.35	21.09	20.33		7.40		0.75	4.66				0.21												100	107
5H-58 1577.78	11	12	Py	0.80			53.06			0.20	0.80			41.52		3.63												100	121
5H-58 1577.78	11	13	Qz	100.00																								100	126
5H-58 1577.78	11	14	Ill + Chl	53.76	0.36	28.58	7.21		1.45		1.17	1.83		3.70		1.94												100	75
5H-58 1577.78	11.1	1	Kfs	66.08		17.92					0.34	15.66																100	122
5H-58 1577.78	11.1	2	Ab	67.70		18.87	1.39			0.36	11.55					0.13												100	121
5H-58 1577.78	11.1	3	Ill + Chl	50.14	1.13	28.82	8.87		1.35		1.30	1.63		4.89		1.88												100	73
5H-58 1577.78	11.1	4	Qz	100.00																								100	125
5H-58 1577.78	12	1	Qz	100.00																								100	120
5H-58 1577.78	12	2	Qz	100.00																								100	119
5H-58 1577.78	12	3	Qz	100.00																								100	123
5H-58 1577.78	12	4	Kfs	65.91	0.23	17.89					0.69	15.28																100	119
5H-58 1577.78	12	5	Kfs	66.02		17.76					0.79	14.95									0.47							100	123
5H-58 1577.78	12	6	Ill + Chl	54.84		28.54	9.59		1.69		0.94	3.26				1.14												100	75
5H-58 1577.78	12	7	Zrn	31.30																68.70								100	122
5H-58 1577.78	12	8	Qz +	88.70		8.12	1.26		0.44		0.70	0.45				0.32												100	120
5H-58 1577.78	12	9	Ill + Sd ?	45.33	0.34	18.95	25.29		3.93		1.74	2.75		1.08		0.59												100	94
5H-58 1577.78	12	10	Ill + Sd ?	43.26		17.69	29.26		3.70		1.57	1.91		0.90		1.71												100	78
5H-58 1577.78	12.1	1	Ab	67.75		19.75	0.26			1.31	10.93																	100	121
5H-58 1577.78	12.1	2	Fe-rich Chl + Ab	42.32		18.76	29.29		3.64		2.22	0.89		1.10		1.79												100	88
5H-58 1577.78	12.1	3	Py	0.32			28.93							70.75														100	231
5H-58 1577.78	13	1	Kfs	66.13		17.91					0.55	15.41																100	117
5H-58 1577.78	13	2	Qz	100.00																								100	122
5H-58 1577.78	13	3	Kfs	66.04		17.93					0.69	15.34																100	117
5H-58 1577.78	13	4	TiO2 +	2.92	95.11	1.05	0.64			0.27																		100	106
5H-58 1577.78	13	5	Py	0.45		1.13	41.77				4.62			51.39		0.63												100	117
5H-58 1577.78	13	6	Qz	100.00																								100	124
5H-58 1577.78	13	7	Ill + Chl	57.60	0.41	27.08	6.42		1.28		0.96	2.25		3.12		0.88												100	73
5H-58 1577.78	13	8	Kfs	65.94		18.03					0.95	14.41									0.67							100	119
5H-58 1577.78	13	9	Py	0.31		0.25	31.09			0.29	1.33			66.73														100	192
5H-58 1577.78	13	10	Ab + Kfs	68.73		18.51					8.10	4.67																100	126
5H-58 1577.78	13	11	Qz	100.00																								100	127
5H-58 1577.78	13	12	Kfs	60.63		20.14	4.76		0.57		0.99	11.87		0.66		0.37												100	106
5H-58 1577.78	13	13	Ill + Chl	51.44		28.62	8.06		1.10		1.22	7.51		1.44		0.61												100	101
5H-58 1577.78	13	14	Kfs	66.52		17.97	0.30				1.57	13.65																100	117
5H-58 1577.78	13	15	Ill	52.52		21.69	5.82		1.03		0.85	7.81				0.27												90	99
5H-58 1577.78	14	1	Qz	100.00																								100	123
5H-58 1577.78	14	2	Kfs	65.85		17.80					0.96	14.80									0.59							100	120
5H-58 1577.78	14	3	Kfs	65.70		17.86					0.67	15.01									0.77							100	115
5H-58 1577.78	14	4	Qz	100.00																								100	119
5H-58 1577.78	14	5	Ill + Chl	50.26	1.41	28.13	8.00		1.52		1.77	2.97		5.63		0.31												100	97
5H-58 1577.78	14	6	TiO2 +	3.24	93.09	1.92	1.48					0.28																100	108
5H-58 1577.78	14	7	Qz	100.00																								100	123
5H-58 1577.78	14	8	Ill + Chl	62.31		21.28	7.47		1.56		1.62	4.48		0.88		0.40												100	108
5H-58 1577.78	14	9	Mix	39.73	1.14	24.15	14.34		1.12		2.57	2.59		13.85		0.52												100	95
5H-58 1577.78	14	10	Qz	100.00																								100	126
5H-58 1577.78	14	11	Kfs	66.22		17.70					0.59	15.49																100	121

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	15	1	Qz	100.00																								100	123
5H-58 1577.78	15	2	Gly	49.29		10.55	12.35		3.69		3.33	4.59		2.21		0.99												87	68
5H-58 1577.78	15	3	Qz	100.00																								100	121
5H-58 1577.78	15	4	Py	0.21			28.91				0.24			70.63														100	222
5H-58 1577.78	15	5	Gly	46.42		7.81	19.23		2.87		2.49	5.57		0.50		2.11												87	105
5H-58 1577.78	15	6	Gly	47.23		7.83	19.24		2.87		0.94	5.50		2.83		0.57												87	94
5H-58 1577.78	15	7	Kln + Ill ?	52.30	1.06	32.07	5.19		1.03		1.35	2.00		4.70		0.30												100	110
5H-58 1577.78	15	8	Anh	9.49		5.93	1.61			25.62	4.05	0.55		52.26		0.50												100	97
5H-58 1577.78	15	9	Anh	6.16		3.45	0.72			29.27	4.07	0.48		55.85														100	107
5H-58 1577.78	16	1	Kfs	66.24		17.75					0.54	15.47																100	121
5H-58 1577.78	16	2	Qz	100.00																								100	122
5H-58 1577.78	16	3	Kfs	66.26		18.10					1.07	14.57																100	119
5H-58 1577.78	16	4	TiO2 +	1.27	91.76	2.03	2.13			0.52	0.39		1.09	0.60		0.22												100	101
5H-58 1577.78	16	5	Kfs	65.93		17.77					0.85	14.91									0.54							100	117
5H-58 1577.78	16	6	Qz	100.00																								100	120
5H-58 1577.78	16	7	Qz	100.00																								100	119
5H-58 1577.78	16	8	Mix	42.26	0.45	25.68	12.33		1.44		2.93	2.03		12.06		0.81												100	92
5H-58 1577.78	16	9	Kfs	66.30		17.80					0.79	15.11																100	118
5H-58 1577.78	16	10	Qz	100.00																								100	121
5H-58 1577.78	16.1	1	Qz	100.00																								100	124
5H-58 1577.78	16.1	2	Ill + Chl	54.53		16.08	16.43		3.43		1.91	2.94		2.88		1.80												100	68
5H-58 1577.78	16.1	3	Gly	46.88		12.66	15.93		3.08		1.47	3.86		2.58		0.55												87	98
5H-58 1577.78	16.1	4	Fe-Chl +	31.58		10.11	27.67		2.29		5.49	0.65		21.31		0.90												100	103
5H-58 1577.78	16.1	5	Kfs	66.25		17.68					0.65	15.42																100	123
5H-58 1577.78	16.1	6	Ill	43.21	0.98	26.98	5.87		0.84		1.07	6.23		4.41		0.41												90	84
5H-58 1577.78	16.1	7	Qz	99.44		0.55						0.01																100	126
5H-58 1577.78	17	1	Kfs	66.11		17.77					1.35	14.77																100	118
5H-58 1577.78	17	2	Qz	100.00																								100	124
5H-58 1577.78	17	3	Qz	100.00																								100	127
5H-58 1577.78	17	4	Kfs	64.26		18.64	1.00		0.49			15.61																100	119
5H-58 1577.78	17	5	Zrn	29.19		0.58	0.60			0.65							0.52			66.76						1.69		100	109
5H-58 1577.78	17	6	Py				29.14							70.86														100	234
5H-58 1577.78	17	7	Mix	43.87	1.74	25.27	11.78		1.44	0.31	2.54	2.30		10.50		0.27												100	105
5H-58 1577.78	17	8	Qz	98.83		0.83	0.34																					100	121
5H-58 1577.78	18	1	Kfs	66.27		17.89					0.85	14.99																100	123
5H-58 1577.78	18	2	Ilm		52.69		44.94	0.33	2.04																			100	107
5H-58 1577.78	18	3	Qz	100.00																								100	126
5H-58 1577.78	18	4	Kln	46.85		31.49	3.09		0.39		0.68	0.43		2.81		0.26												86	101
5H-58 1577.78	18	5	Ill +	61.03	0.37	25.83	3.99		1.49		1.03	3.44		2.56		0.27												100	108
5H-58 1577.78	18	6	Ill + Chl	49.35	1.49	30.09	7.79		1.45		1.66	2.58		5.17		0.42												100	108
5H-58 1577.78	18	7	Qz	98.86		1.09						0.05																100	127
5H-58 1577.78	18	8	Chr			24.41	16.04		14.08									45.47										100	114
5H-58 1577.78	19	1	Kfs	65.91		17.97					0.60	15.52																100	122
5H-58 1577.78	19	2	TiO2	0.65	93.16	0.79	5.41																					100	105
5H-58 1577.78	19	3	Kfs	65.46		17.99					0.80	14.80									0.96							100	121
5H-58 1577.78	19	4	Qz	100.00																								100	124
5H-58 1577.78	19	5	Qz +	70.26	0.53	21.90	2.80		1.02		0.91	1.53		0.88		0.17												100	110
5H-58 1577.78	19	6	Kfs	66.33		18.00					1.26	14.41																100	123
5H-58 1577.78	19	7	Ill + Chl	48.27	0.93	28.06	11.37		1.64	0.29	1.73	2.02		4.56		1.13												100	72
5H-58 1577.78	19	8	Mix	55.77		16.32	18.88		2.80	0.25	1.86	1.93		1.81		0.38												100	108
5H-58 1577.78	19	9	Qz	100.00																								100	125
5H-58 1577.78	19	10	Qz	100.00																								100	124
5H-58 1577.78	19	11	Mix	33.19	37.98	18.39	4.31		1.20		1.29	1.26		2.18		0.21												100	111

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	19	12	Kfs	65.91		17.90					1.02	14.51									0.66							100	117
5H-58 1577.78	19	13	Mix	48.68	1.07	26.50	10.42		1.27		1.80	1.99		7.29		0.98												100	78
5H-58 1577.78	19	14	Py	1.33		0.75	51.90		0.40	0.77	0.88			41.11		2.85												100	128
5H-58 1577.78	20	1	Qz	100.00																								100	122
5H-58 1577.78	20	2	Py	2.55		2.54	66.06		0.82		1.11			23.99		2.92												100	91
5H-58 1577.78	20	3	Kfs	65.80		17.78					0.81	14.87									0.75							100	119
5H-58 1577.78	20	4	Chl +	45.27		15.75	28.31		4.69		2.84	0.95		1.18		1.00												100	103
5H-58 1577.78	20	5	Kfs	66.21		17.67					0.98	15.13																100	121
5H-58 1577.78	20	6	Qz	100.00																								100	125
5H-58 1577.78	20	7	Mix	46.42		14.71	27.48		3.05		2.40	2.45		2.05		1.45												100	87
5H-58 1577.78	20	8	Py	5.87		5.98	54.43		1.28		1.41			28.79		2.25												100	105
5H-58 1577.78	20	9	Mix	49.16	0.41	29.89	10.27		1.39		1.35	1.71		4.37		1.45												100	80
5H-58 1577.78	20	10	Kfs	68.61		22.52	1.47		0.65		0.42	6.32																100	116
5H-58 1577.78	20	11	Qz	100.00																								100	126
5H-58 1577.78	20	12	Mix	47.77	0.29	32.42	9.14		2.04		1.57	1.11		4.72		0.93												100	92
5H-58 1577.78	20	13	Mix	53.59	0.48	27.98	8.40		2.38		1.33	2.80		2.65		0.40												100	104
5H-58 1577.78	20	14	Qz	100.00																								100	124
5H-58 1577.78	21	1	Kfs	66.26		17.70					0.60	15.43																100	121
5H-58 1577.78	21	2	Qz	100.00																								100	126
5H-58 1577.78	21	3	Qz	100.00																								100	124
5H-58 1577.78	21	4	Kfs	65.95		17.76					0.73	14.94									0.62							100	120
5H-58 1577.78	21	5	Ill + Chl	54.74	1.79	30.18	6.55		1.65	0.43	0.88	1.97		0.66		1.13												100	71
5H-58 1577.78	21	6	Xenotime-(Y)																31.73			2.13	4.58	4.65	4.66			100	102
5H-58 1577.78	21	7	Qz	100.00																								100	125
5H-58 1577.78	21	8	Qz + Mixed Clay	60.42	0.80	26.57	5.72		1.76	0.65	0.91	2.70				0.47												100	98
5H-58 1577.78	21	9	Kfs	66.04		17.67	0.27					16.02																100	118
5H-58 1577.78	21	10	Kfs	65.05		17.58	2.64				0.65	14.08																100	116
5H-58 1577.78	22	1	Kfs	65.41		18.43					1.44	13.73									0.99							100	120
5H-58 1577.78	22	2	Qz	100.00																								100	125
5H-58 1577.78	22	3	Chl + Ill	41.84		25.91	13.08		1.14		2.85	1.89		12.38		0.90												100	84
5H-58 1577.78	22	4	Qz	100.00																								100	124
5H-58 1577.78	22	5	Ms	47.65	0.58	35.09	0.92		0.54		1.45	8.77																95	116
5H-58 1577.78	22	6	Kfs	66.54		18.01					1.00	14.45																100	120
5H-58 1577.78	22	7	Mix	54.40		25.63	13.29		2.62		2.22	0.17		0.56		1.11												100	97
5H-58 1577.78	22	8	Mixed Clay	54.15	0.51	24.28	8.38		1.31		2.38	2.17		6.17		0.66												100	99
5H-58 1577.78	22	9	Mixed Clay	47.09		28.15	9.68		1.57		2.04	2.64		8.12		0.72												100	91
5H-58 1577.78	22	10	Qz	100.00																								100	123
5H-58 1577.78	22	11	Qz	100.00																								100	124
5H-58 1577.78	22	12	Py	0.51			29.91							69.58														100	228
5H-58 1577.78	22	13	Kfs	65.79		17.81					0.90	14.66									0.84							100	124
5H-58 1577.78	23	1	Ilm	0.44	54.85		42.53	0.96	1.23																			100	107
5H-58 1577.78	23	2	Kfs	65.57		18.08					1.04	14.47									0.83							100	118
5H-58 1577.78	23	3	Qz	100.00																								100	122
5H-58 1577.78	23	4	Mixed Clay	57.75	0.52	25.85	8.45		1.87		1.41	0.82		2.35		0.99												100	92
5H-58 1577.78	23	5	Ilm		54.27		44.08	0.89	0.76																			100	106
5H-58 1577.78	23	6	Kfs	65.94		17.88					0.71	14.99									0.49							100	119
5H-58 1577.78	23	7	Qz	100.00																								100	123
5H-58 1577.78	23	8	Kfs	66.37		17.84					1.08	14.71																100	121
5H-58 1577.78	23	9	Mixed Clay	54.92		10.63	22.25		3.89		3.18	2.01		1.67		1.44												100	79
5H-58 1577.78	23	10	Kfs	64.75		16.84	3.03		0.46		0.93	13.66				0.34												100	115
5H-58 1577.78	23	11	Mixed Clay	53.54		34.11	6.67		1.23		1.23	0.27		1.90		1.06												100	88
5H-58 1577.78	23	12	Kfs	66.24		17.68					0.68	15.41																100	121
5H-58 1577.78	23	13	Qz	100.00																								100	127

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	23	14	Mixed Clay	44.50	0.37	27.32	11.64		1.25	0.20	2.12	2.21		10.08		0.30												100	103
5H-58 1577.78	23	15	"Ilm"	0.96	66.15		31.23	1.25	0.42																			100	96
5H-58 1577.78	24	1	Gly	48.72		9.07	19.02		2.90		2.04	3.78		0.84		0.63												87	106
5H-58 1577.78	24	2	Gly	44.55		8.47	16.26		2.44		1.94	2.70		9.83		0.82												87	82
5H-58 1577.78	24	3	Gly	46.05		10.53	17.84		2.91	0.77	2.30	3.50		2.47		0.64												87	107
5H-58 1577.78	24	4	Qz	100.00																								100	130
5H-58 1577.78	24	5	Zrn	30.20		0.54	0.59			0.75										67.92								100	115
5H-58 1577.78	24	6	Kfs	66.05		17.70	0.28				0.30	15.68																100	126
5H-58 1577.78	24	7	Gly	45.98		9.68	20.05		2.74	0.36	1.72	4.48		1.51		0.48												87	102
5H-58 1577.78	24	8	Gly	47.12		8.85	17.42		2.77		2.31	2.37		4.87		1.30												87	82
5H-58 1577.78	24	9	Qz	100.00																								100	126
5H-58 1577.78	24	10	Gly + Py	54.78		10.95	21.90		3.33		2.19	4.46		1.73		0.66												100	101
5H-58 1577.78	24	11	Gly ?	51.01		10.32	19.05		2.82		2.36	3.52		10.05		0.88												100	86
5H-58 1577.78	24	12	Mix	45.02	0.68	21.87	8.49		1.44		7.99	2.84		7.28		4.39												100	114
5H-58 1577.78	24	13	Ms	47.89	0.24	33.54	1.82		0.81		0.75	9.96																95	112
5H-58 1577.78	25	1	Kfs	65.65		17.89					1.02	14.41									1.03							100	120
5H-58 1577.78	25	2	Gly ?	52.61		9.82	19.15		3.12		2.21	3.02		9.32		0.75												100	72
5H-58 1577.78	25	3	Gly ?	53.97		10.16	22.25		3.06	0.55	1.90	5.24		2.26		0.62												100	100
5H-58 1577.78	25	4	Mixed Clay	46.71	0.55	25.26	10.90		1.44		2.21	2.44		10.15		0.33												100	104
5H-58 1577.78	25	5	"Ilm"		61.92		34.45	2.27	1.36																			100	100
5H-58 1577.78	25	6	Qz +	88.75		5.04	2.76		1.71		0.47	1.11				0.16												100	122
5H-58 1577.78	25	7	Qz	100.00																								100	128
5H-58 1577.78	25	8	Qz	100.00																								100	121
5H-58 1577.78	25	9	Kfs	65.70		17.83						15.67									0.79							100	117
5H-58 1577.78	26	1	Ms	48.45	1.43	31.76	0.60		2.12		0.59	10.06																95	119
5H-58 1577.78	26	2	Qz	100.00																								100	121
5H-58 1577.78	26	3	Kfs	66.49		17.63					0.63	15.25																100	118
5H-58 1577.78	26	4	Ap				0.50			49.92	0.63		41.61		5.71												1.62	100	119
5H-58 1577.78	26	5	Ill + Chl	56.68	0.56	22.66	8.31		1.01		1.93	1.85		6.64		0.34												100	102
5H-58 1577.78	26	6	Qz	100.00																								100	126
5H-58 1577.78	26	7	Py				29.17				0.28			70.55														100	235
5H-58 1577.78	26	8	Chloritized Ms	51.29	0.94	35.73	0.97		0.79		1.79	8.50																100	112
5H-58 1577.78	26	9	Ill + Chl	56.10		19.06	13.95		2.88		2.51	1.77		2.22		1.51												100	79
5H-58 1577.78	27	1	Zrn	30.88																67.05						2.07		100	126
5H-58 1577.78	27	2	Qz	100.00																								100	124
5H-58 1577.78	27	3	Kfs	65.74		17.80					0.37	15.35									0.74							100	124
5H-58 1577.78	27	4	Qz +	89.93	0.45	6.03	0.95		0.32		0.74	0.35		1.23														100	127
5H-58 1577.78	27	5	Qz	100.00																								100	120
5H-58 1577.78	27	6	Py	0.16			28.37							71.48														100	247
5H-58 1577.78	27	7	Qz	100.00																								100	123
5H-58 1577.78	27	8	Mixed Clay	49.99	0.47	29.34	9.45		1.45		1.40	2.01		5.16		0.74												100	85
5H-58 1577.78	28	1	Qz	100.00																								100	122
5H-58 1577.78	28	2	Ilm		51.78		46.00	0.57	1.66																			100	107
5H-58 1577.78	28	3	Mixed Clay	56.30	3.10	25.91	6.65		1.20		1.44	1.50		3.71		0.19												100	107
5H-58 1577.78	28	4	Mixed Clay	46.65	0.78	30.70	9.23		1.10	0.27	1.61	1.17		7.81		0.68												100	89
5H-58 1577.78	28	5	Kfs	66.24		17.65					0.60	15.51																100	117
5H-58 1577.78	28	6	Qz +	94.47		3.28	1.07					0.21		0.98														100	122
5H-58 1577.78	28	7	Qz	100.00																								100	126
5H-58 1577.78	28	8	Mixed Clay	55.74		33.49	4.51		0.91		0.93	1.76		2.66														100	107
5H-58 1577.78	29	1	Qz	100.00																								100	119
5H-58 1577.78	29	2	Kfs	66.02		17.55					0.28	16.16																100	109
5H-58 1577.78	29	3	Qz	100.00																								100	120
5H-58 1577.78	29	4	Kfs	66.08		17.84					0.61	15.47																100	117

Table 1-7.1: EDS geochemical analyses of sample 5H-58 1577.78.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	Y2O3	ZrO2	BaO	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	WO3	Total	Actual Total
5H-58 1577.78	29	5	Kfs	66.31		17.61					0.61	15.47																100	115
5H-58 1577.78	29	6	Mixed Clay	42.84		15.92	33.10		3.60		1.77			1.27		1.49												100	88
5H-58 1577.78	29	7	Qz	100.00																								100	118
5H-58 1577.78	29	8	Qz +	91.77		4.62	1.60		0.46			0.37		0.94		0.24												100	101
5H-58 1577.78	29	9	Mix	33.48	0.29	22.29	15.28		1.22	0.41	0.99	1.62		23.74		0.68												100	93
5H-58 1577.78	29	10	Qz	100.00																								100	117
5H-58 1577.78	29	11	Qz	100.00																								100	120
5H-58 1577.78	29	12	Mixed Clay	57.50	0.40	27.04	7.37		1.48		1.14	2.00		2.30		0.77												100	81
5H-58 1577.78	29	13	Qz	100.00																								100	124
5H-58 1577.78	30	1	Ms	47.97	1.12	33.49	0.72		1.09		0.68	9.93																95	107
5H-58 1577.78	30	2	Kfs	65.90		17.65	0.42				0.47	15.55																100	116
5H-58 1577.78	30	3	Qz	100.00																								100	123
5H-58 1577.78	30	4	Kfs	66.14		17.83					0.61	15.42																100	120
5H-58 1577.78	30	5	Kfs	63.16	0.36	17.17	1.71				0.40	14.65		2.55														100	118
5H-58 1577.78	30	6	Qz	100.00																								100	120
5H-58 1577.78	30	7	Qz	100.00																								100	124
5H-58 1577.78	30	8	Qz	95.93		2.41	0.62					0.39		0.65														100	124
5H-58 1577.78	30	9	Mixed Clay	53.87	0.47	30.62	5.73		0.80		1.34	1.81		4.95		0.42												100	92
5H-58 1577.78	30	10	Zrn	31.09			0.57													68.33								100	112
5H-58 1577.78	30	11	Kln ?	55.07		34.95	6.36		1.41		1.34	0.20				0.66												100	95
5H-58 1577.78	30	12	Kfs	66.44	0.27	17.90					0.84	14.55																100	110
5H-58 1577.78	31	1	Qz	100.00																								100	126
5H-58 1577.78	31	2	Zrn	29.92		0.51				0.94							0.46			68.17								100	111
5H-58 1577.78	31	3	Ilm		52.34		43.37	4.29																				100	106
5H-58 1577.78	31	4	Mixed Clay	50.47	0.40	25.91	8.49		1.45		1.86	2.08		8.65		0.68												100	87
5H-58 1577.78	31	5	Kfs	66.12		17.80						16.08																100	120
5H-58 1577.78	31	6	Qz	98.79		0.71	0.49																					100	119
5H-58 1577.78	31	7	Gly	47.66		12.52	16.04		2.84		1.31	3.87		1.87		0.89												87	78
5H-58 1577.78	31	8	Qz	100.00																								100	122
5H-58 1577.78	31	9	Ab	69.61		18.77				0.52	11.10																	100	122
5H-58 1577.78	31	10	Kfs	66.76		17.81	0.66				1.03	13.74																100	116
5H-58 1577.78	31	11	Qz	100.00																								100	122
5H-58 1577.78	31	12	Kfs	66.19		18.00					1.39	13.91									0.50							100	118
5H-58 1577.78	31	13	Gly	47.25		9.65	19.02		2.88		1.31	5.24		0.80		0.85												87	93
5H-58 1577.78	31	14	Qz	100.00																								100	125
5H-58 1577.78	31	15	Kfs	66.13		17.97					0.79	15.11																100	124
5H-58 1577.78	31	16	Qz	97.45	0.54	1.54	0.31					0.16																100	126

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain
3. Gly refers to the mixture glaucony

Appendix 1-8: SEM-BSE images and EDS mineral analyses for sample 5H-58 1903.66.

Sample 5H-58 1903.66: Fine-medium grained sandstone

Detrital Minerals: Albite, Illmenite, K-feldspar, Muscovite, Oligoclase, Quartz, Titania (Fig. 22), Zircon

Diagenetic Minerals: Kaolinite, Siderite, Titania, Quartz overgrowths, K-feldspar overgrowths

Notes:

1. Suturing is common between detrital minerals (K-feldspar and quartz).

2. The sample contains a lot of primary porosity.

3. K-feldspar and quartz display overgrowths (Figs. 32,33).

4. Drilling mud (clays + barite) have partially surround grains throughout this sample (Figs. 2,35).

5. Paragenetic sequence: Kaolinite →Siderite, Titania

↑ Fig. 37 ↑ Fig. 17 ↑ Figs. 6,31

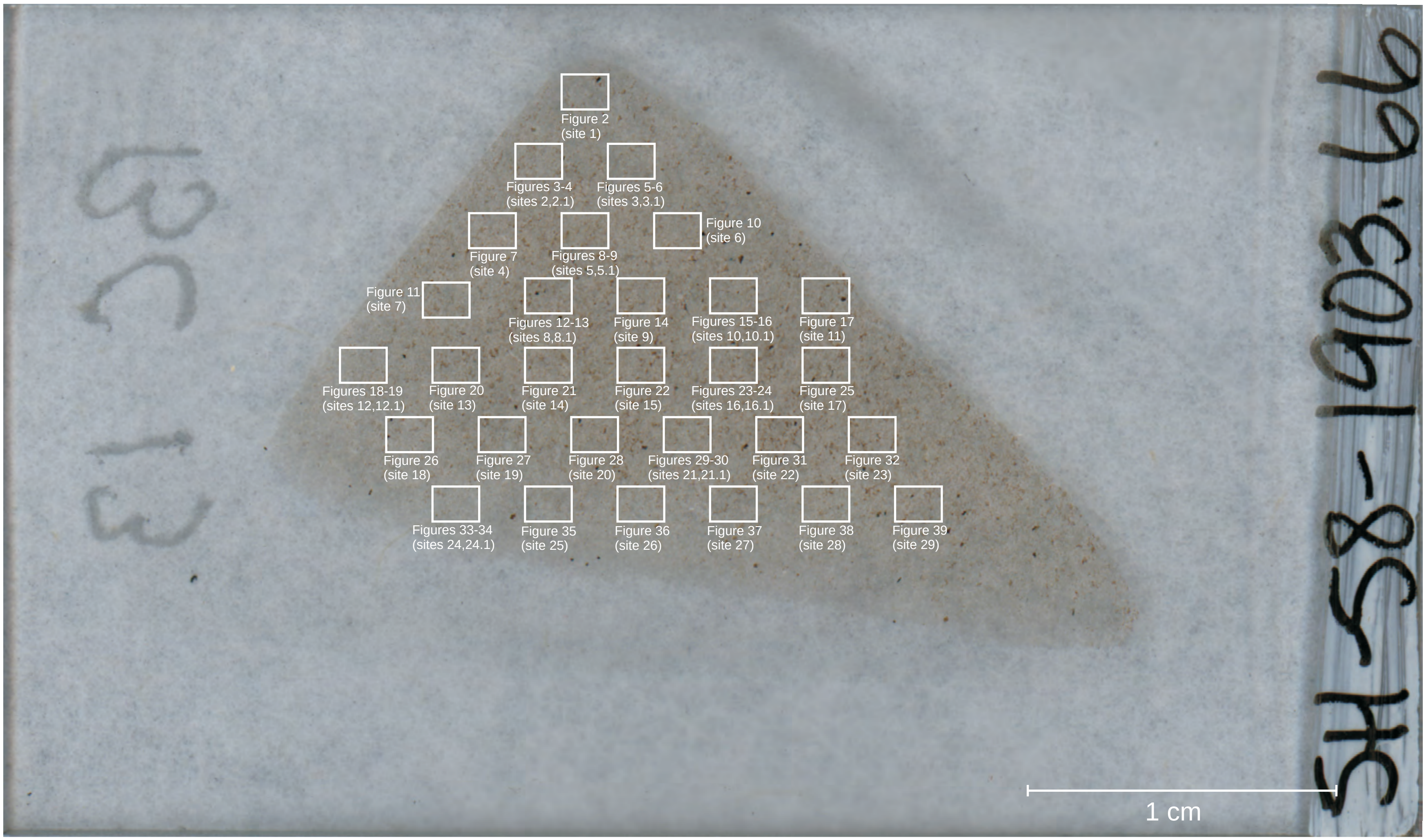
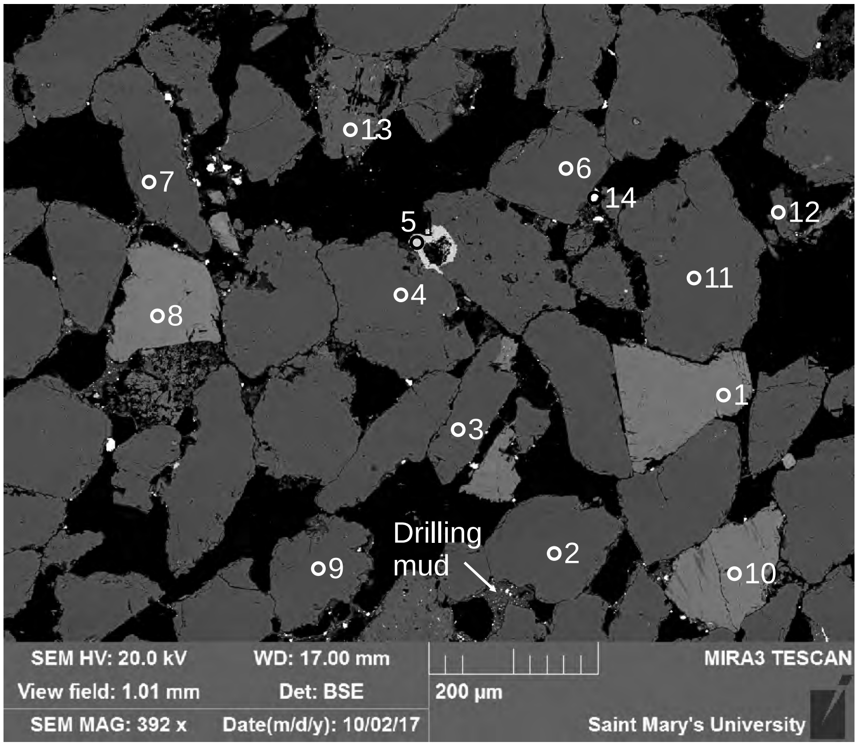
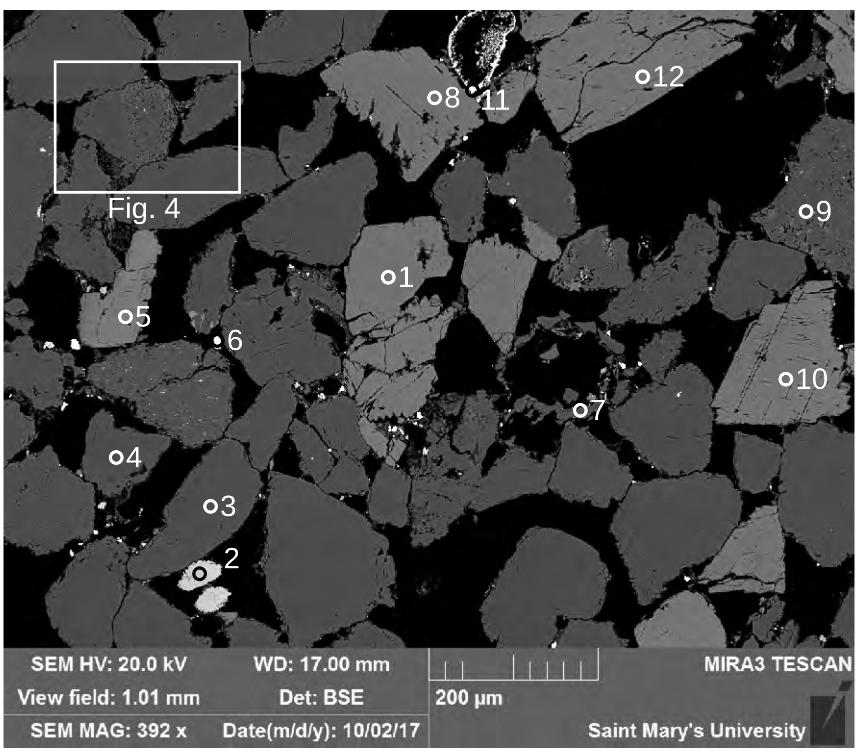


Figure 1-8.1: Scanned thin section of sample 5H-58 1903.66 showing the location of analyzed sites.



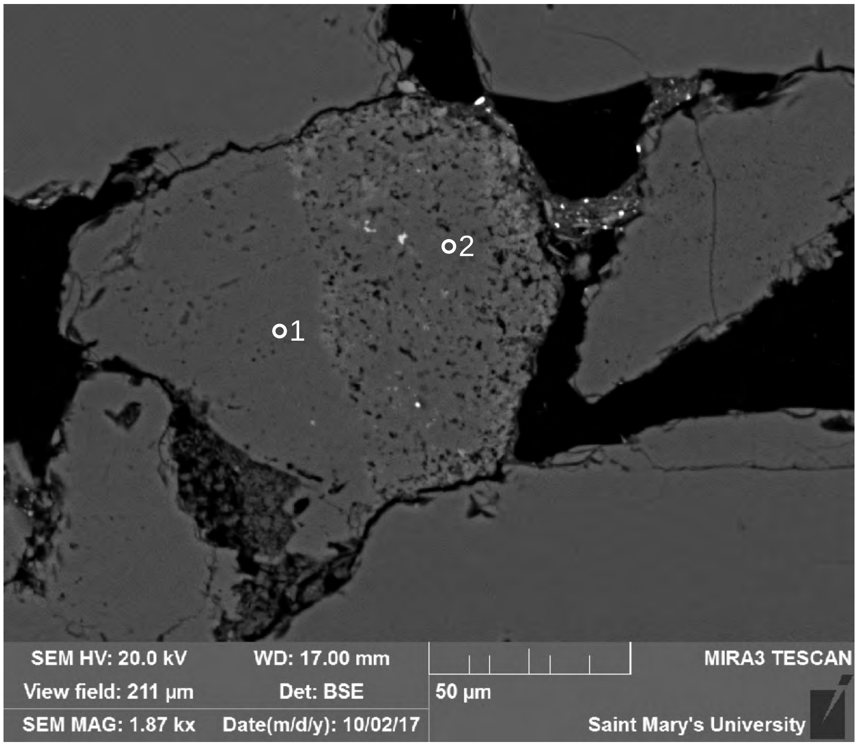
1:K-feldspar
2:Quartz
3:Quartz
4:Quartz
5:Siderite
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:K-feldspar
11:Quartz
12:Quartz
13:Oligoclase
14:Barite

Figure 1-8.2: Sample 5H-58 1903.66 (SEM) site 1. This site consists of detrital quartz (2-4,6-7,9,11-12), oligoclase (13), and K-feldspar (1,8) grains. K-feldspar (10) appears to be albitized. Siderite (5) appears to be diagenetic, partially filling voids in quartz. Barite (14) makes up part of the drilling mud.



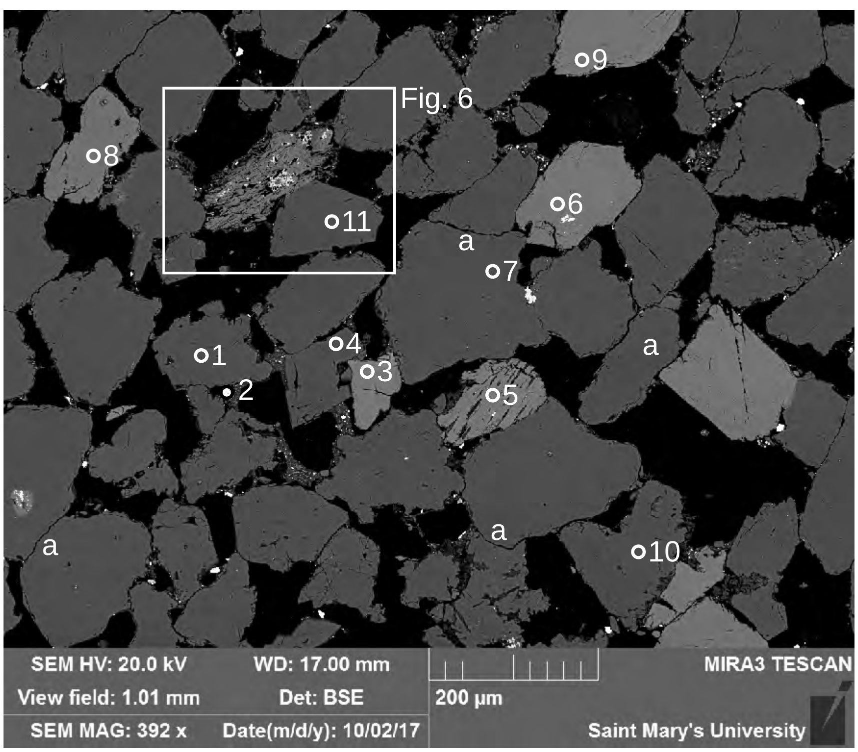
1:K-feldspar
2:Siderite
3:Quartz
4:Quartz
5:K-feldspar
6:Barite
7:Albite
8:K-feldspar
9:Quartz + K-feldspar
10:K-feldspar
11:Ilmenite
12:K-feldspar

Figure 1-8.3: Sample 5H-58 1903.66 (SEM) site 2. This site consists of detrital quartz (3-4), K-feldspar (1,5,8,10,12), and albite (7) grains. Ilmenite (11) appears to be dissolved. There appears to be a graintoid lithic clast made up of quartz and K-feldspar (9). Barite makes up part of the drilling mud (6).



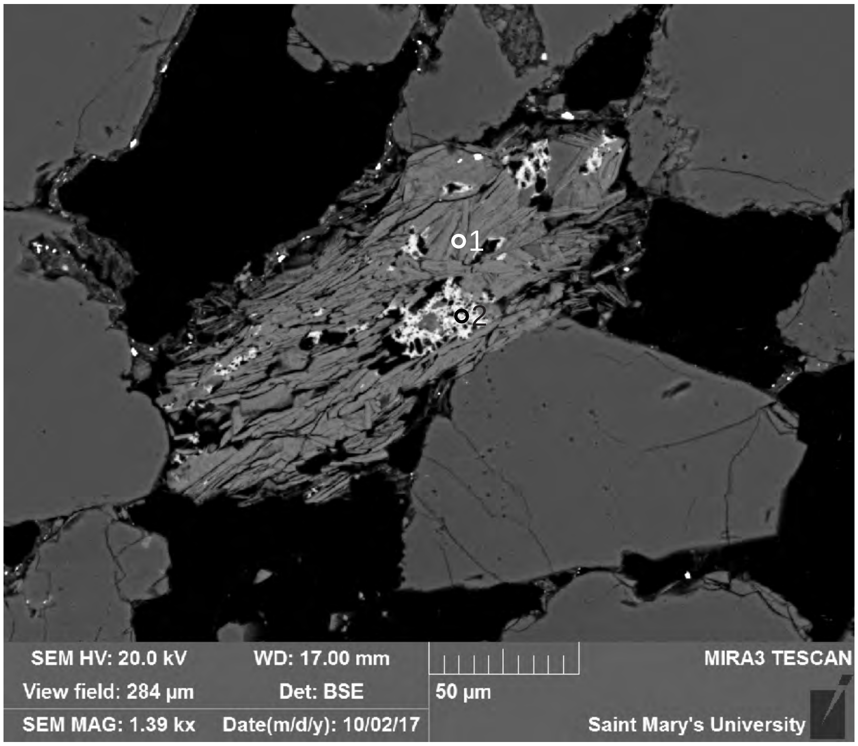
1:Quartz
2:Quartz

Figure 1-8.4: Sample 5H-58 1903.66 (SEM) site 2.1. This site consists of a partially dissolved quartz grains (2). It may be a rhyolitic lithic clast.



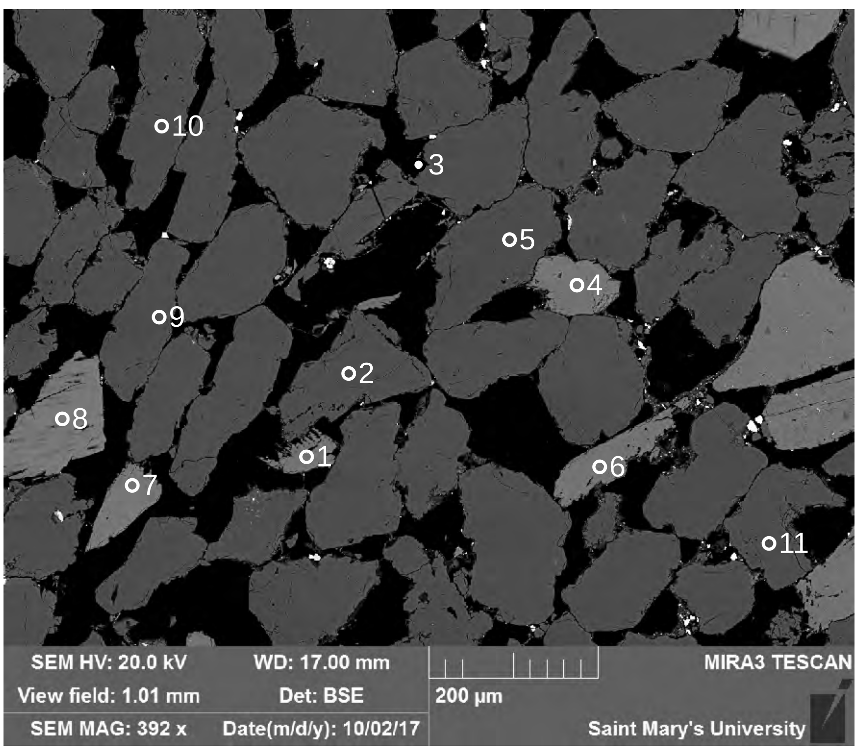
1:Quartz
2:Barite
3:K-feldspar
4:Quartz
5:K-feldspar
6:K-feldspar
7:Quartz
8:K-feldspar
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-8.5: Sample 5H-58 1903.66 (SEM) site 3. This site consists of detrital quartz (1,4,7,10-11), and K-feldspar (3,5-6,8-9) grains. These grains commonly display suturing (positions a).



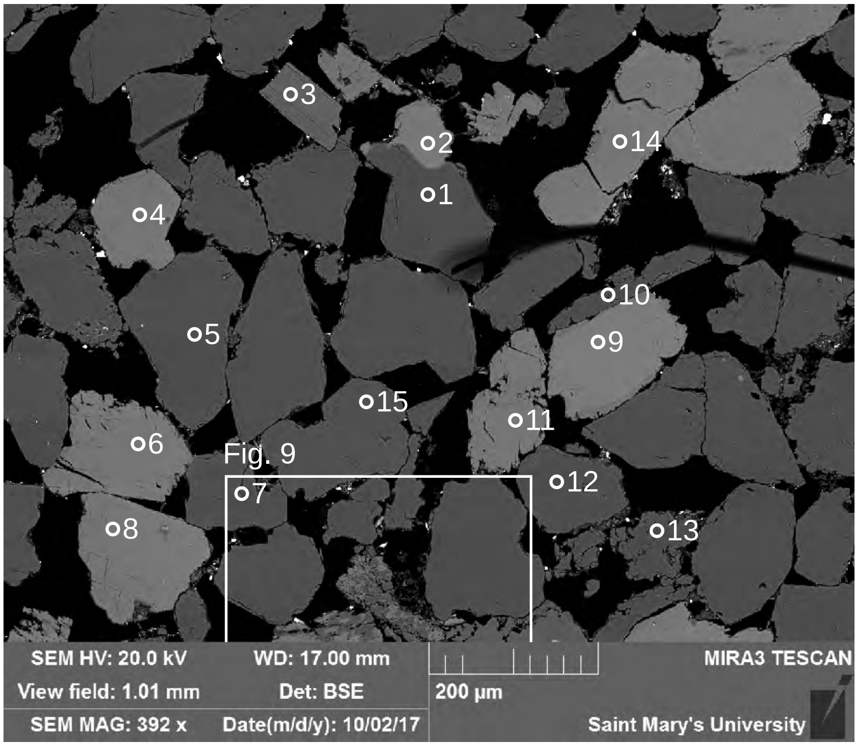
1:Muscovite
2:TiO_2 +

Figure 1-8.6: Sample 5H-58 1903.66 (SEM) site 3.1. This site consists of a metasiltstone lithic clast made up of muscovite (1) with diagenetic titania (2) precipitating within voids.



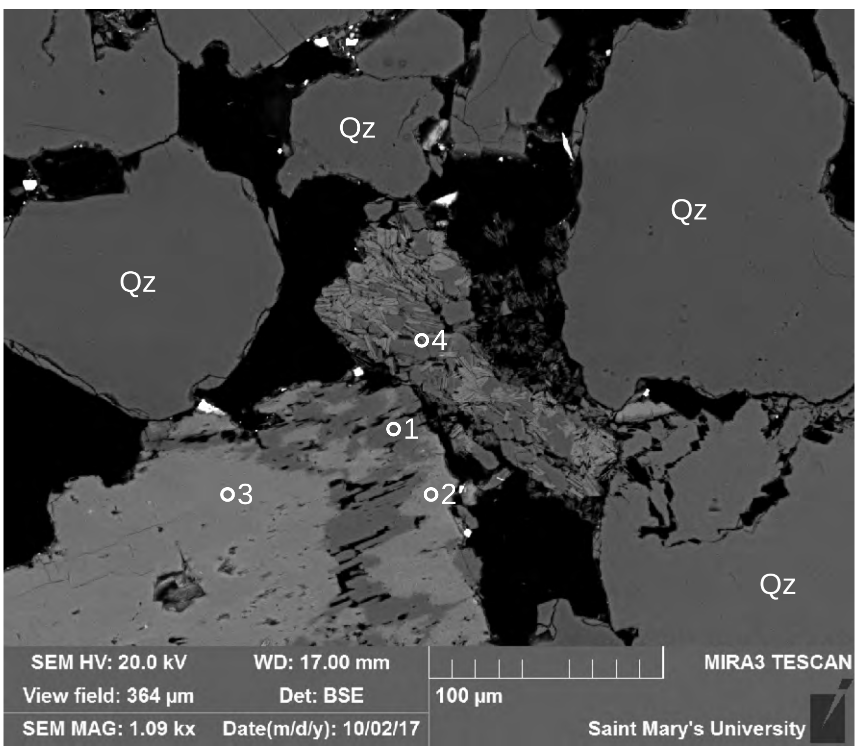
1:K-feldspar
2:Quartz
3:Barite
4:K-feldspar
5:Quartz
6:K-feldspar
7:K-feldspar
8:K-feldspar
9:Quartz
10:Quartz
11:Quartz

Figure 1-8.7: Sample 5H-58 1903.66 (SEM) site 4. This site consists of detrital quartz and K-feldspar grains. Suturing is common between these grains. Drilling (barite + clays) (3) partially fills porosity. K-feldspar (8) appears that it may be perthitic.



1:Quartz
2:K-feldspar
3:Muscovite
4:K-feldspar
5:Quartz
6:K-feldspar
7:Quartz
8:K-feldspar
9:K-feldspar
10:Quartz
11:K-feldspar
12:Quartz
13:Quartz
14:K-feldspar
15:Albite

Figure 1-8.8: Sample 5H-58 1903.66 (SEM) site 5. This site consists of mainly detrital quartz and K-feldspar grains, and a rare detrital muscovite (3), and albite (15) grain. Suturing is common.



1:Albite
2:K-feldspar
3:K-feldspar
4:Quartz + Muscovite

Figure 1-8.9: Sample 5H-58 1903.66 (SEM) site 5.1. This site consists of detrital quartz grains, a large albitized K-feldspar grain, and a small granitic lithic clast made up of quartz and probably muscovite (4).

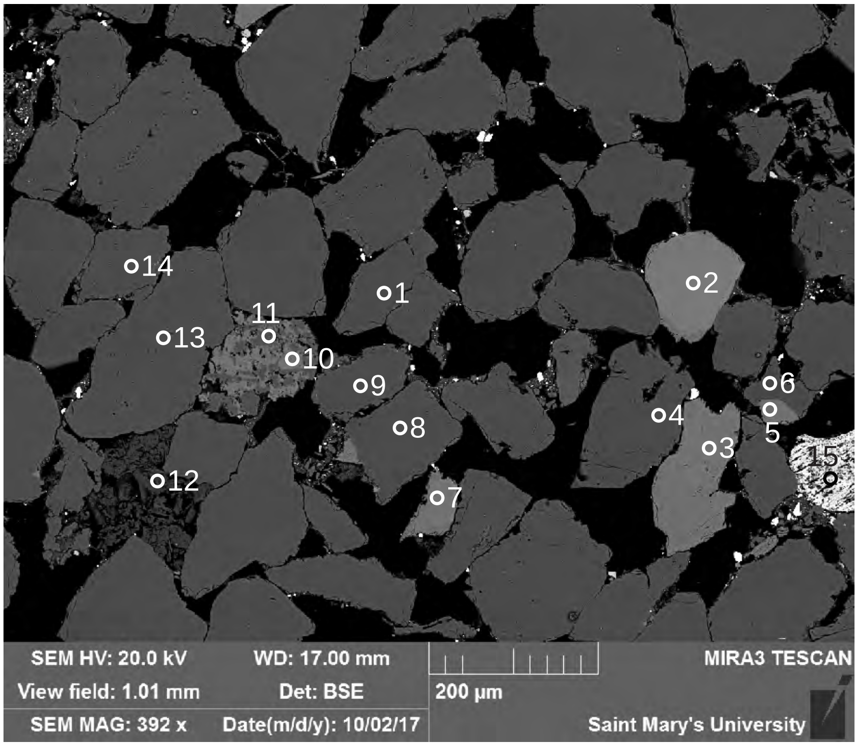


Figure 1-8.10: Sample 5H-58 1903.66 (SEM) site 6. This site consists of detrital quartz and K-feldspar grains. There is an altered ilmenite (15) grain as well as a granitic lithic clast of quartz (11) and K-feldspar (10). Kaolinite (12) partially fills primary porosity.

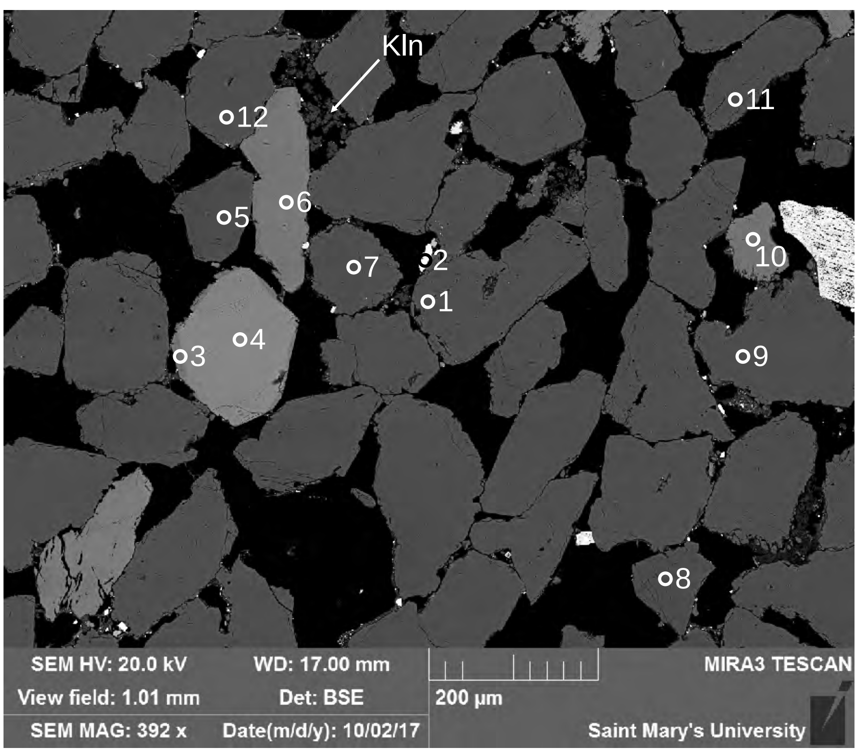
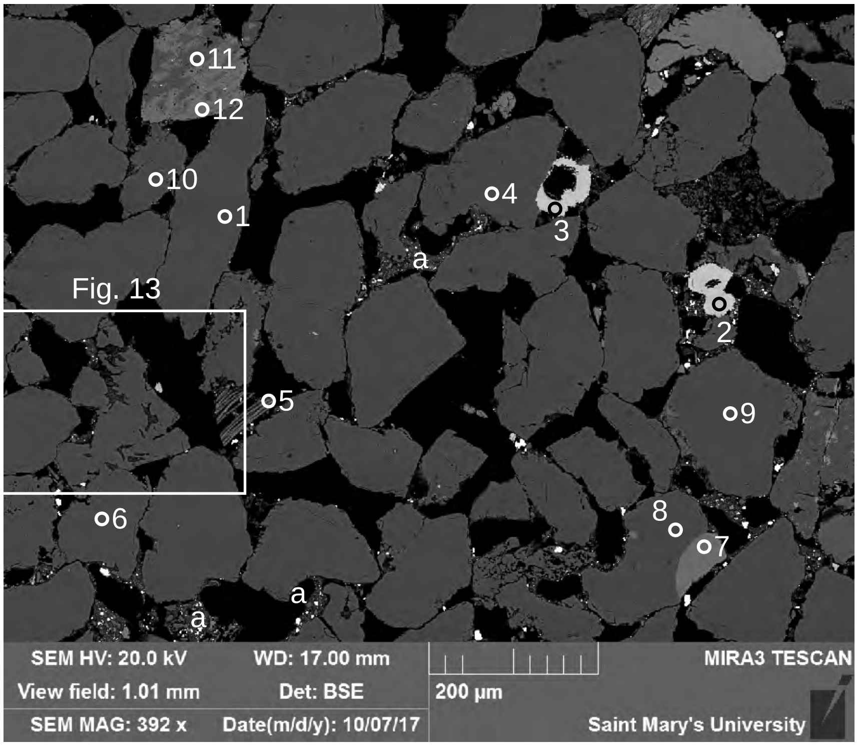
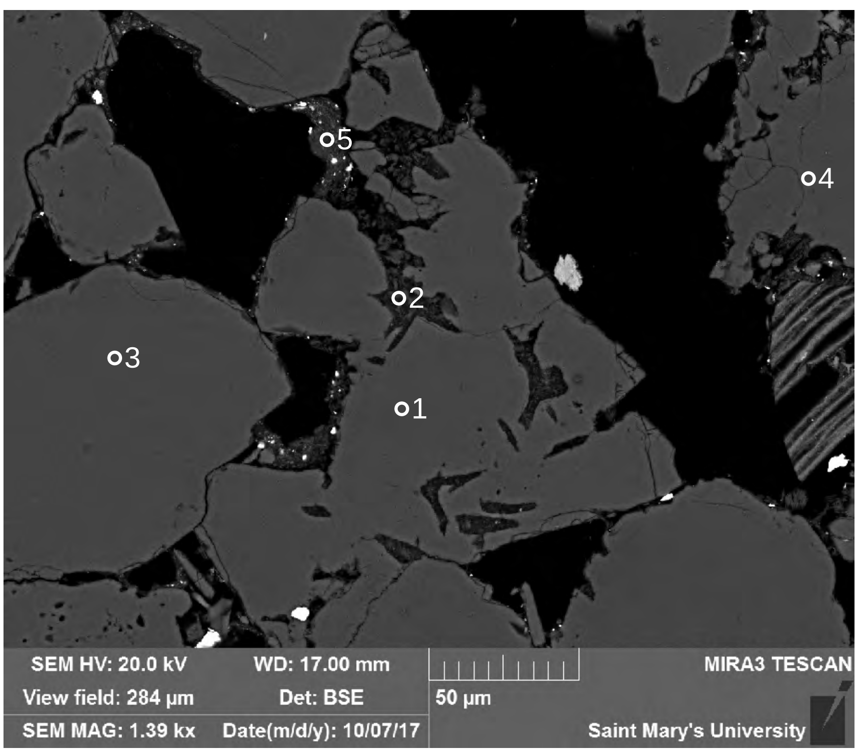


Figure 1-8.11: Sample 5H-58 1903.66 (SEM) site 7. This site consists of detrital quartz and K-feldspar grains that display suturing. Barite (2) makes up part of the drilling mud. Kaolinite partially forms between grains.



1:Quartz
2:Siderite
3:Siderite
4:Quartz
5:Chloritized Mica
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz
10:Quartz
11:Albite
12:K-feldspar

Figure 1-8.12: Sample 5H-58 1903.66 (SEM) site 8. This site consists of detrital quartz (1,4,6,9-10), and chloritized mica (5). Diagenetic siderite (2-3) partially fills primary porosity. There are two granitic lithic clasts of: 1. albite (11) and K-feldspar (12). 2: quartz (8) and K-feldspar (7). Drilling mud appears to coat most grains (positions a).



1:Quartz
2:Kaolinite
3:Quartz
4:Albite
5:Mixture

Figure 1-8.13: Sample 5H-58 1903.66 (SEM) site 8.1. This site consists of detrital quartz (3) and albite (4) grains. Kaolinite (2) grows along intergranular boundaries.

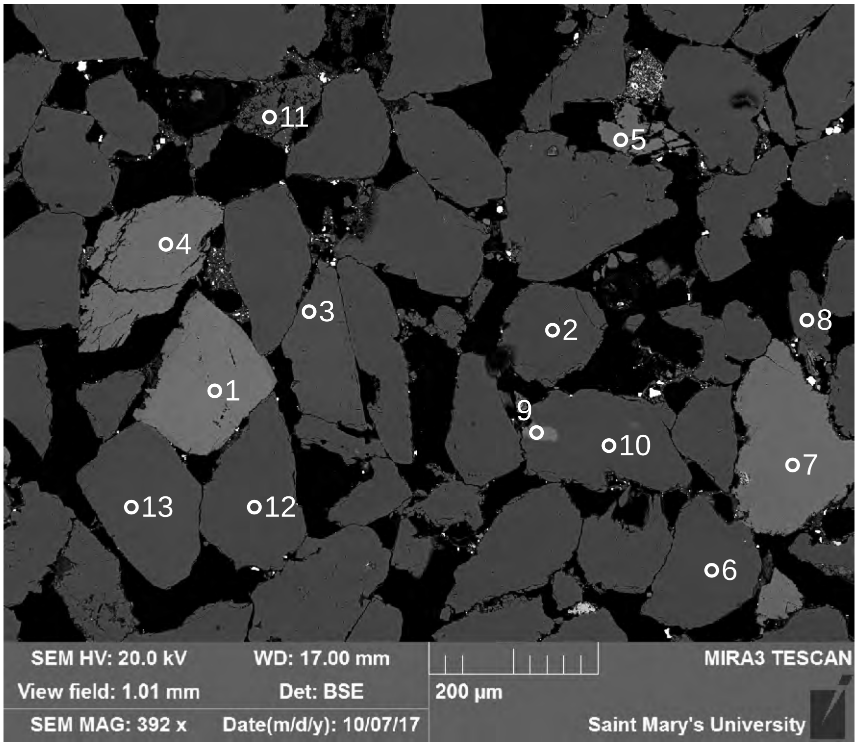


Figure 1-8.14: Sample 5H-58 1903.66 (SEM) site 9. This site consists of mainly detrital quartz (2,6,11-12), albite (3,8,13), and K-feldspar (1,4-5,7). There is also a quartz (10) grain with K-feldspar (9) inclusions.

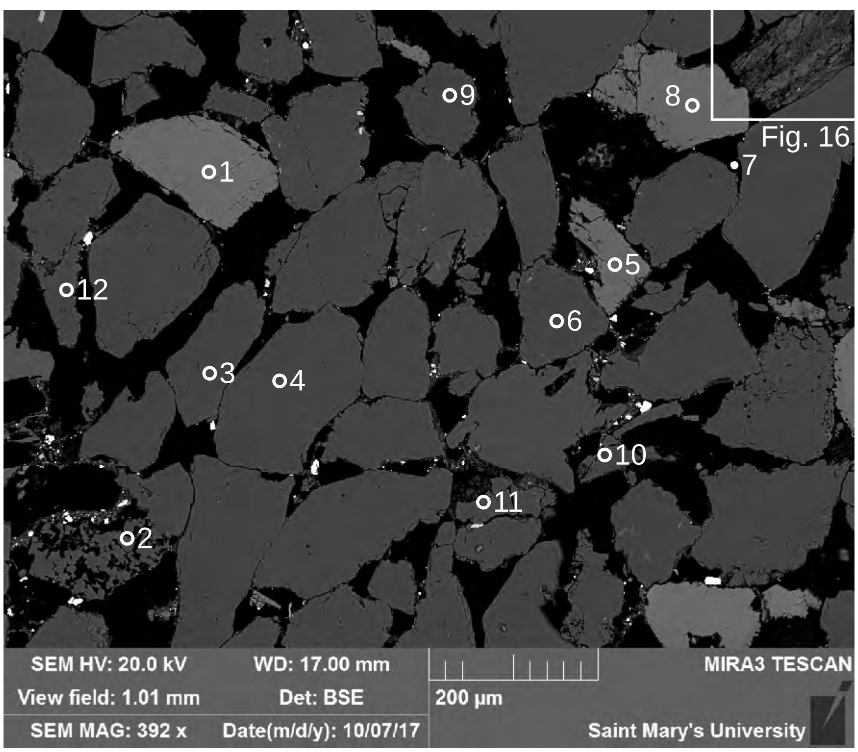
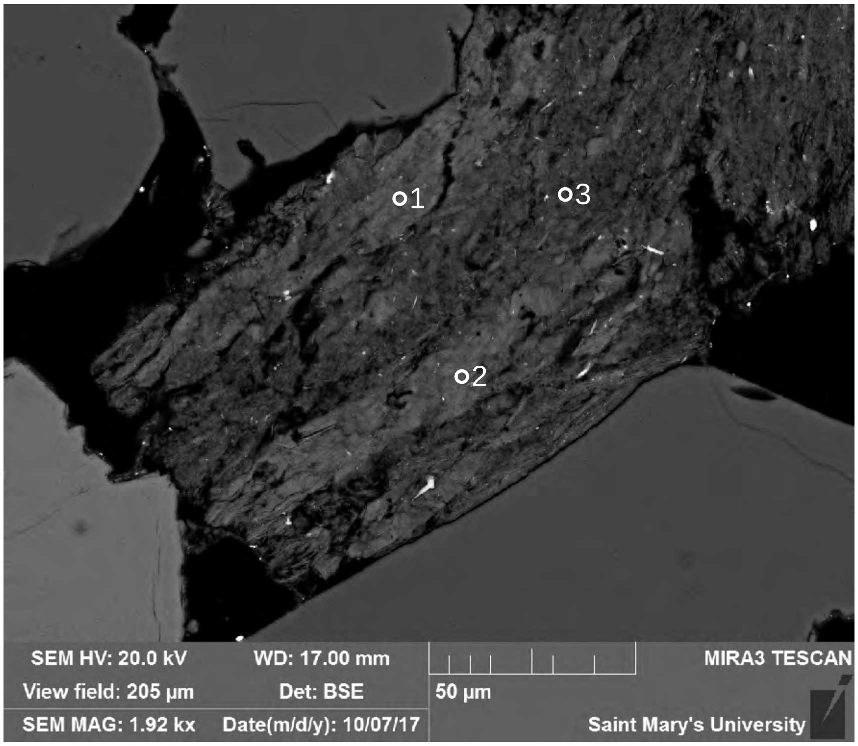
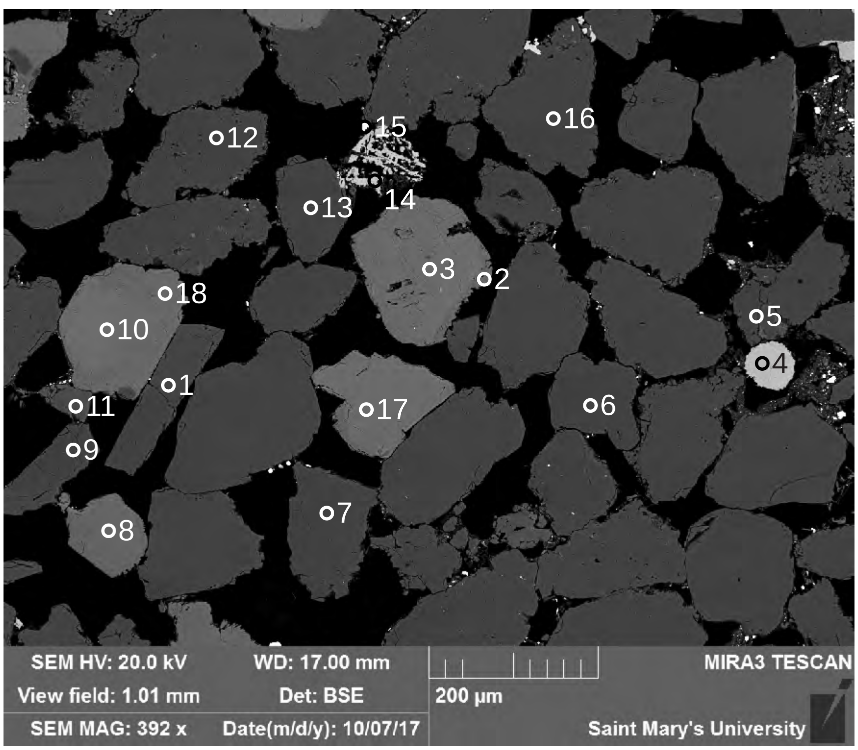


Figure 1-8.15: Sample 5H-58 1903.66 (SEM) site 10. This site consists of mainly detrital quartz and K-feldspar grains. Quartz (2) appears to be a dissolved rhyolitic lithic clast. Barite (7) makes up part of the drilling mud.



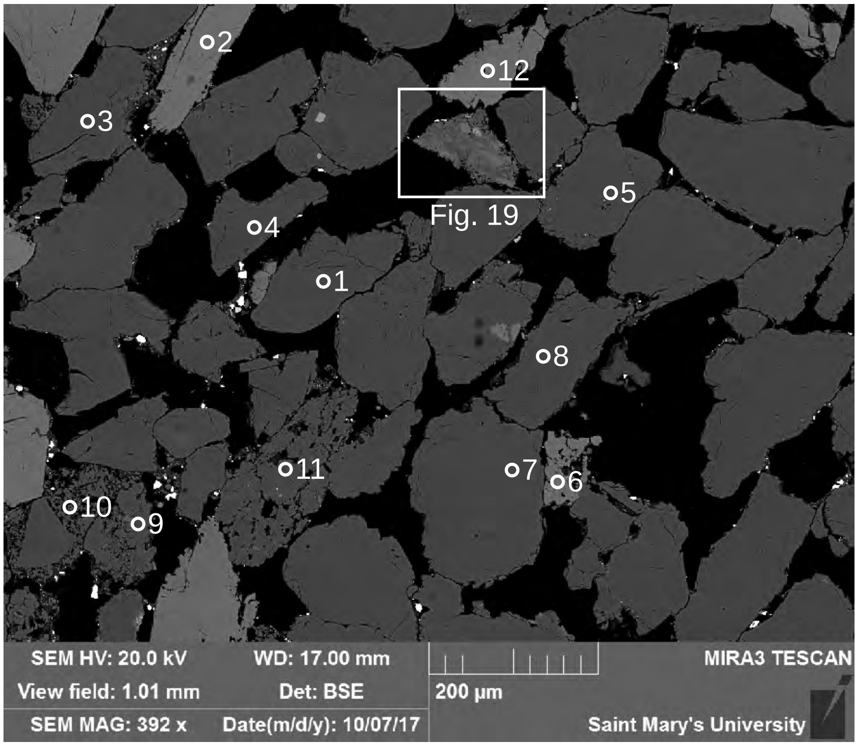
1:Muscovite
2:Muscovite
3:Muscovite +

Figure 1-8.16: Sample 5H-58 1903.66 (SEM) site 10.1. This site consists of a metasiltstone lithic clast made up of muscovite (1-3).



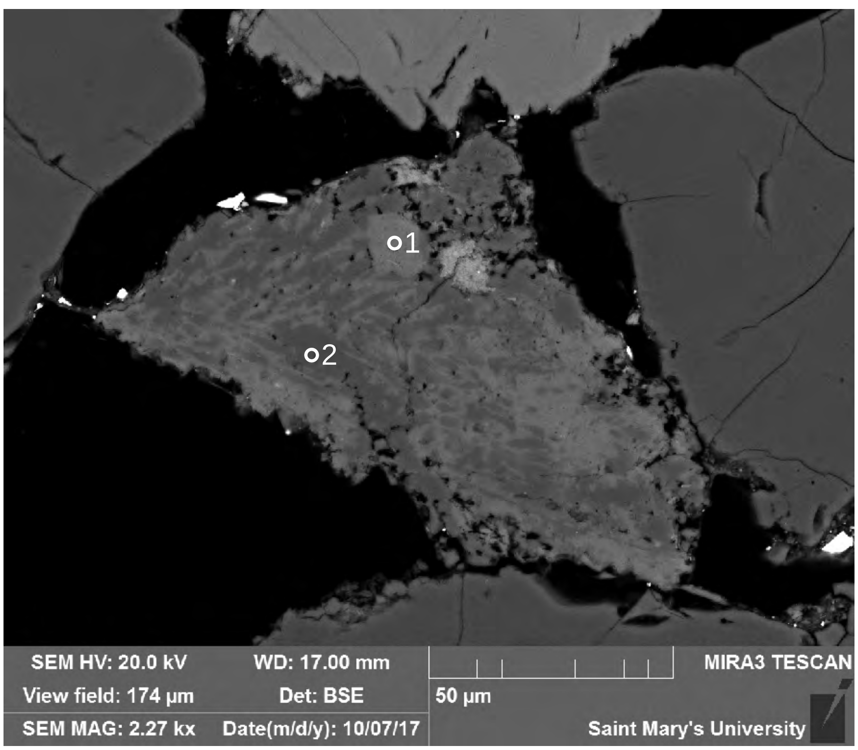
1:Quartz
2:K-feldspar
3:K-feldspar
4:Siderite
5:Muscovite +
6:Quartz
7:Quartz
8:K-feldspar
9:Quartz
10:K-feldspar
11:Oligoclase
12:Quartz
13:Quartz
14:TiO_2
15:Barite
16:Quartz
17:K-feldspar
18:K-feldspar

Figure 1-8.17: Sample 5H-58 1903.66 (SEM) site 11. This site consists mainly of detrital quartz, K-feldspar, and oligoclase (11) grains. There is also diagenetic siderite (4) and titania (14). Barite (15) makes up part of the drilling mud.



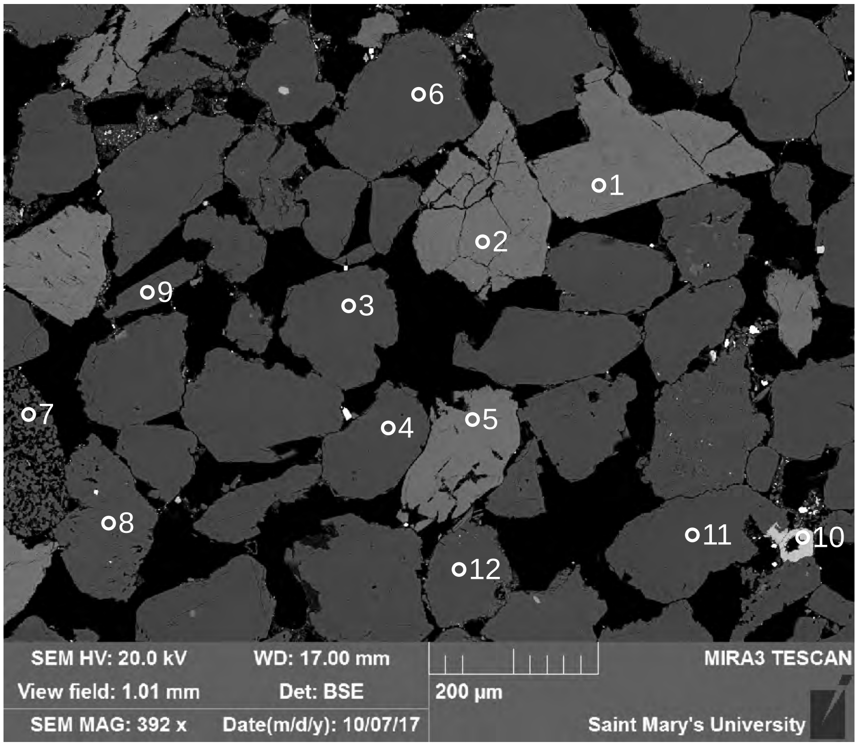
1:Quartz
2:K-feldspar
3:Quartz
4:Quartz
5:Quartz
6:K-feldspar
7:Quartz
8:Quartz
9:Quartz
10:Quartz
11:Quartz
12:K-feldspar

Figure 1-8.18: Sample 5H-58 1903.66 (SEM) site 12. This site is similar to site 7. Quartz (10) appears to be ?dissolving.



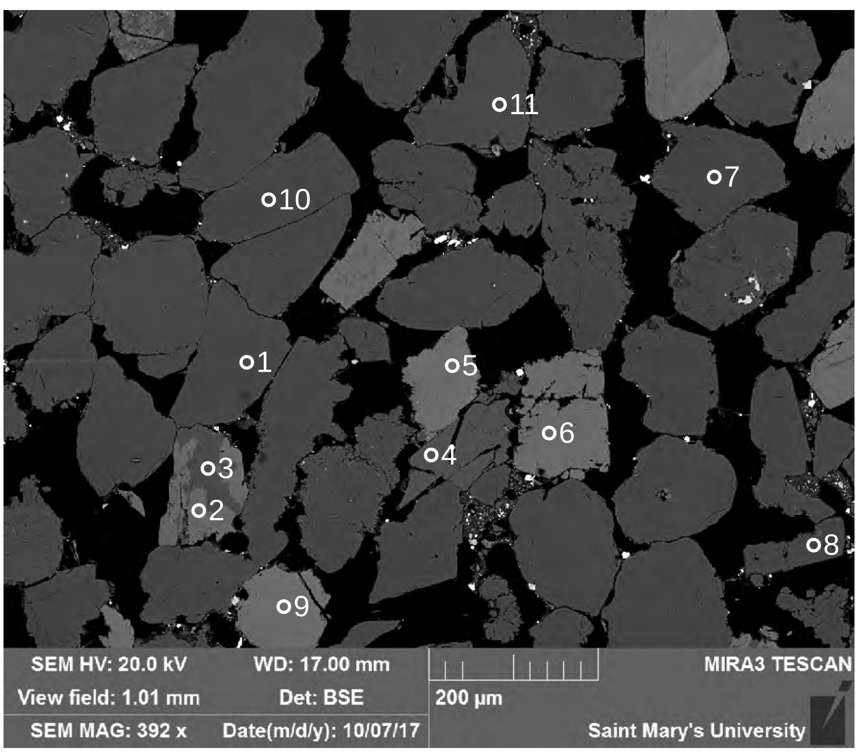
1:K-feldspar
2:Quartz

Figure 1-8.19: Sample 5H-58 1903.66 (SEM) site 12.1. This site consists of a microgranitic lithic clast made up of quartz (2) and K-feldspar (1).



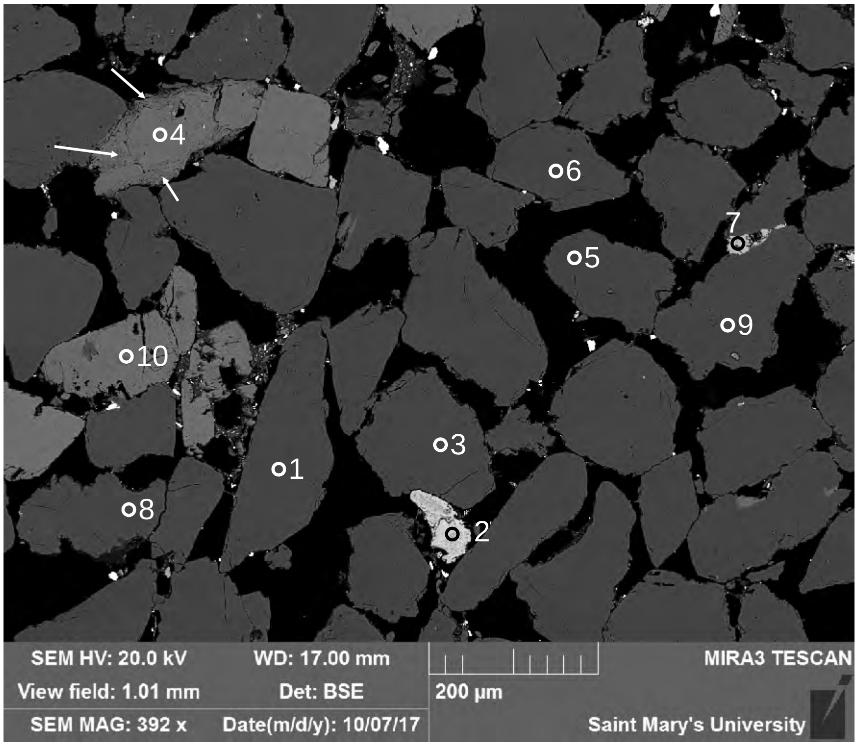
1:K-feldspar
2:K-feldspar
3:Quartz
4:Quartz
5:K-feldspar
6:Quartz
7:Quartz +
8:Albite
9:Quartz
10:Siderite
11:Quartz
12:Quartz

Figure 1-8.20: Sample 5H-58 1903.66 (SEM) site 13. This site is similar to site 8. Quartz (7) may be a rhyolitic lithic clast.



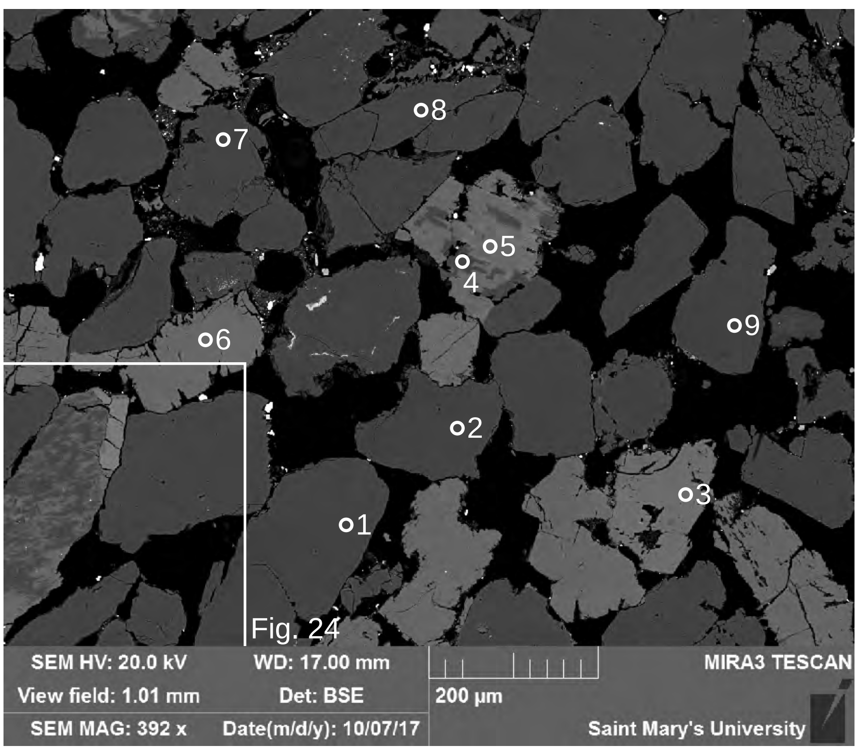
1:Quartz
2:K-feldspar
3:Albite
4:Oligoclase
5:K-feldspar
6:K-feldspar
7:Quartz
8:Quartz
9:K-feldspar
10:Quartz
11:Albite

Figure 1-8.21: Sample 5H-58 1903.66 (SEM) site 14. This site consists of detrital quartz (1,7-8,10), K-feldspar (5-6,9), and oligoclase (4). There is a granitic lithic clast made up of albite (3) and K-feldspar (2).



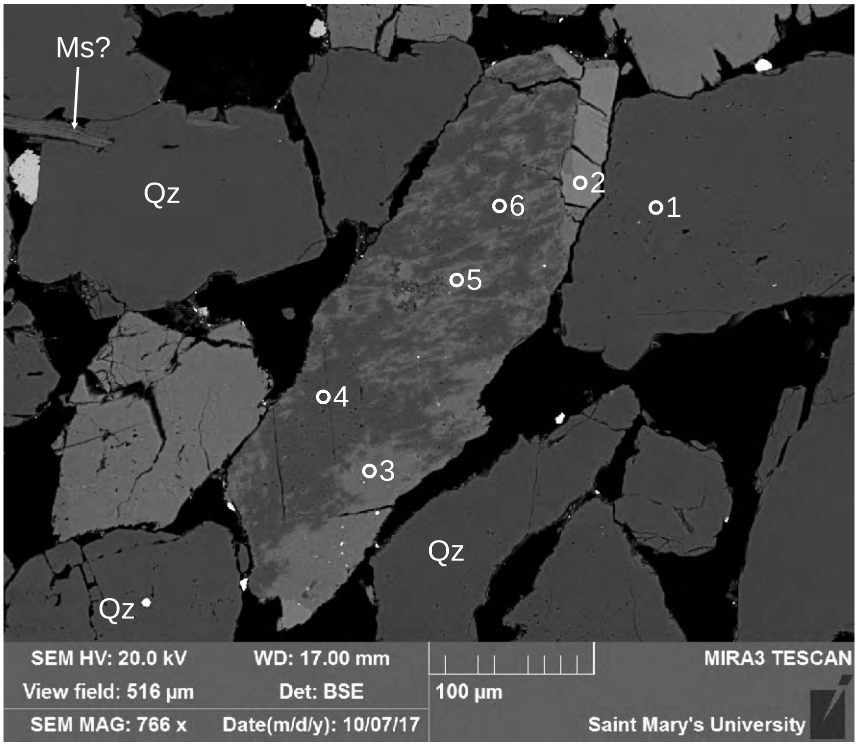
1:Quartz
2:TiO_2
3:Quartz
4:K-feldspar
5:Quartz
6:Quartz
7:Siderite
8:Quartz
9:Quartz
10:Albitized K-feldspar

Figure 1-8.22: Sample 5H-58 1903.66 (SEM) site 15. This site consists mainly of detrital quartz and K-feldspar grains. There is an albitized K-feldspar (10) grain. K-feldspar (4) appears to be surrounded by muscovite or chlorite (arrow). Titania (2) may be ?detrital.



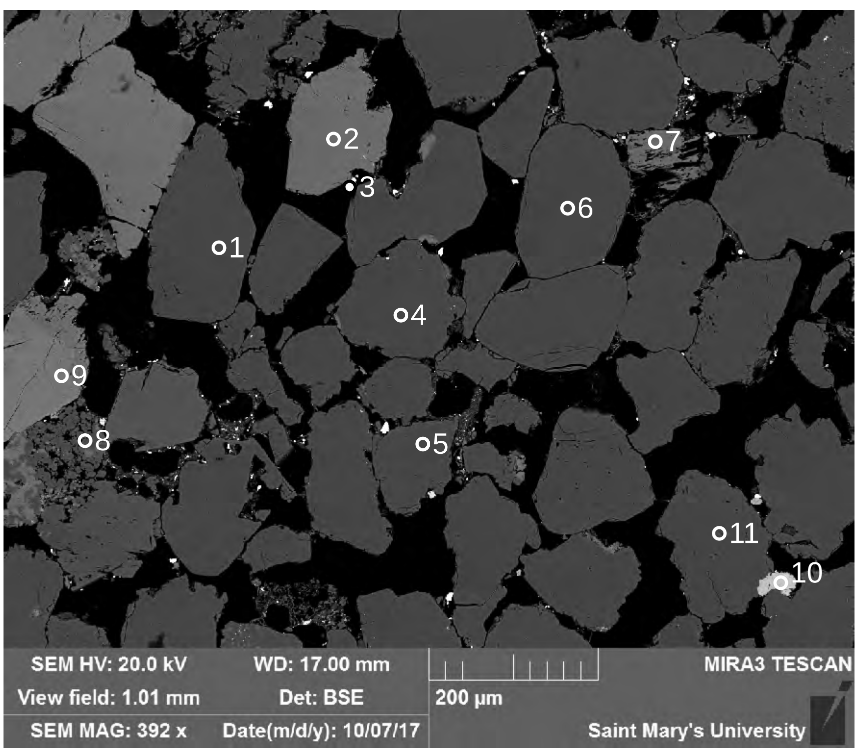
1:Quartz
2:Quartz
3:K-feldspar
4:Albite
5:K-feldspar
6:K-feldspar
7:Quartz
8:Quartz
9:Quartz

Figure 1-8.23: Sample 5H-58 1903.66 (SEM) site 16. This site is similar to previous sites, such as site 15. There is a detrital grain of albitized K-feldspar (4-5).



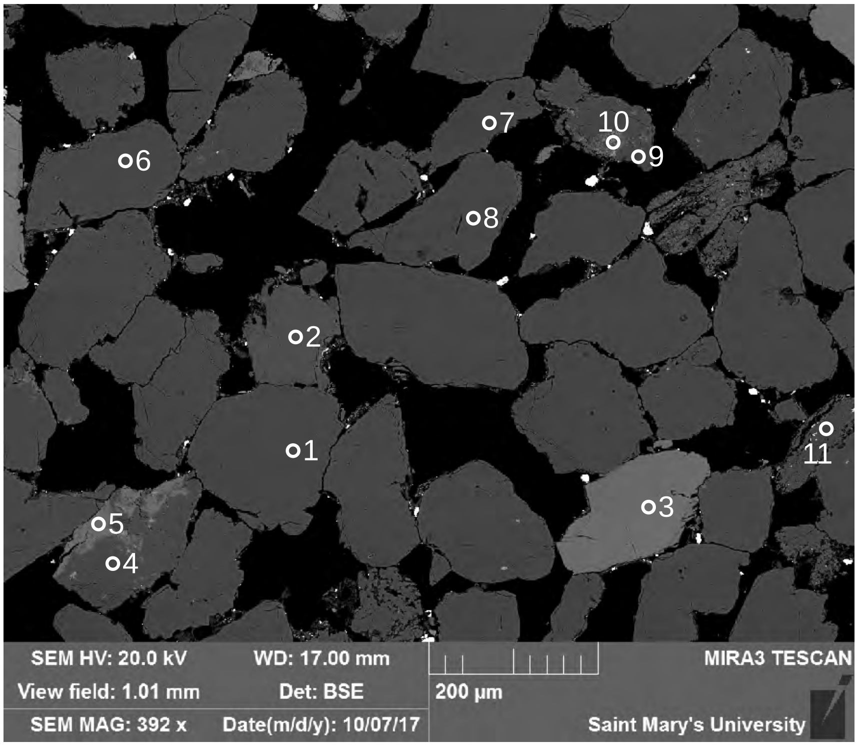
1:Quartz
2:K-feldspar
3:K-feldspar
4:Albite
5:K-feldspar
6:Albite

Figure 1-8.24: Sample 5H-58 1903.66 (SEM) site 16.1. This site consists of detrital quartz and K-feldspar grains. There is a large albitized (4,6) K-feldspar (3,5) grain.



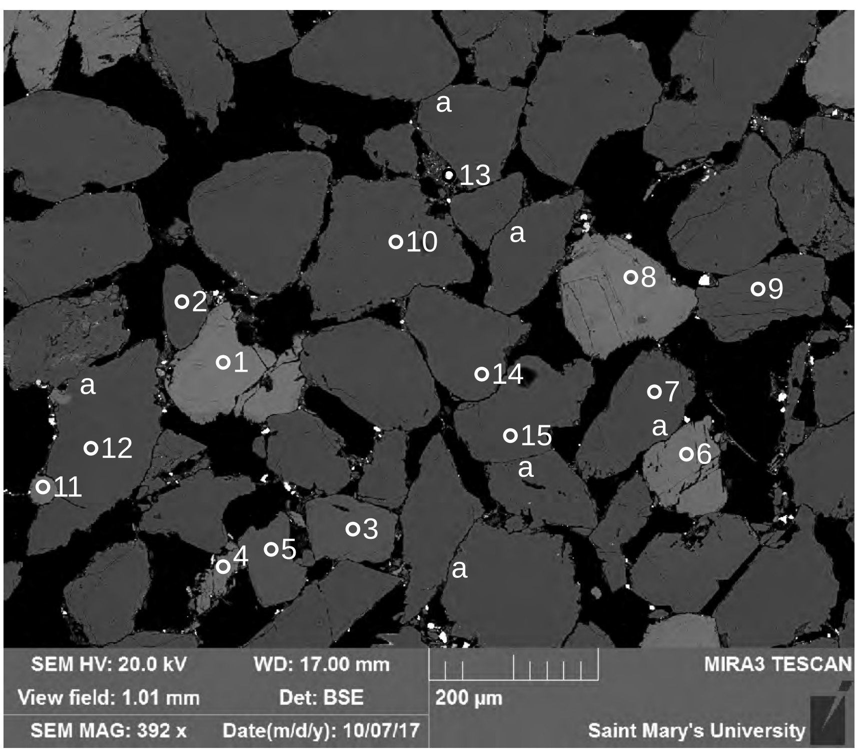
1:Quartz
2:K-feldspar
3:Barite
4:Quartz
5:Quartz
6:Quartz
7:K-feldspar
8:Albite
9:K-feldspar
10:Siderite
11:Quartz

Figure 1-8.25: Sample 5H-58 1903.66 (SEM) site 17. This site is similar to previous sites such as site 15,16. An albitized (8) K-feldspar appears to be dissolving. Barite (3) makes up part of the drilling mud.



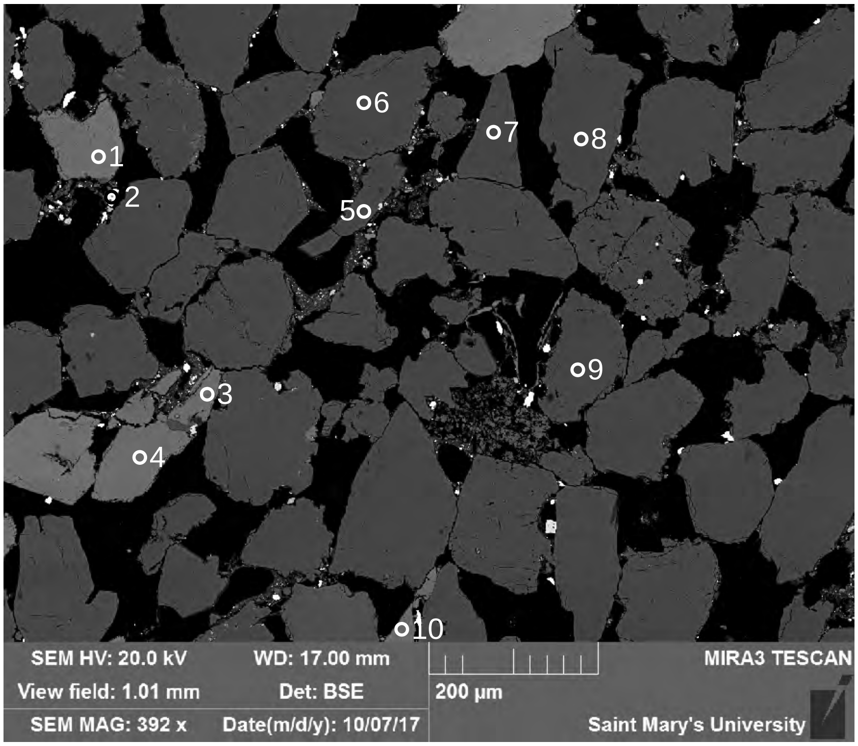
1:Quartz
2:Oligoclase
3:K-feldspar
4:Quartz
5:K-feldspar
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:Muscovite
11:Quartz

Figure 1-8.26: Sample 5H-58 1903.66 (SEM) site 18. This site consists of detrital quartz (1,6-8), K-feldspar (3), and oligoclase (2). There is a granitic lithic clast made up of quartz (4) and K-feldspar (5). Muscovite (10) appears to fill a fracture/void in quartz (9).



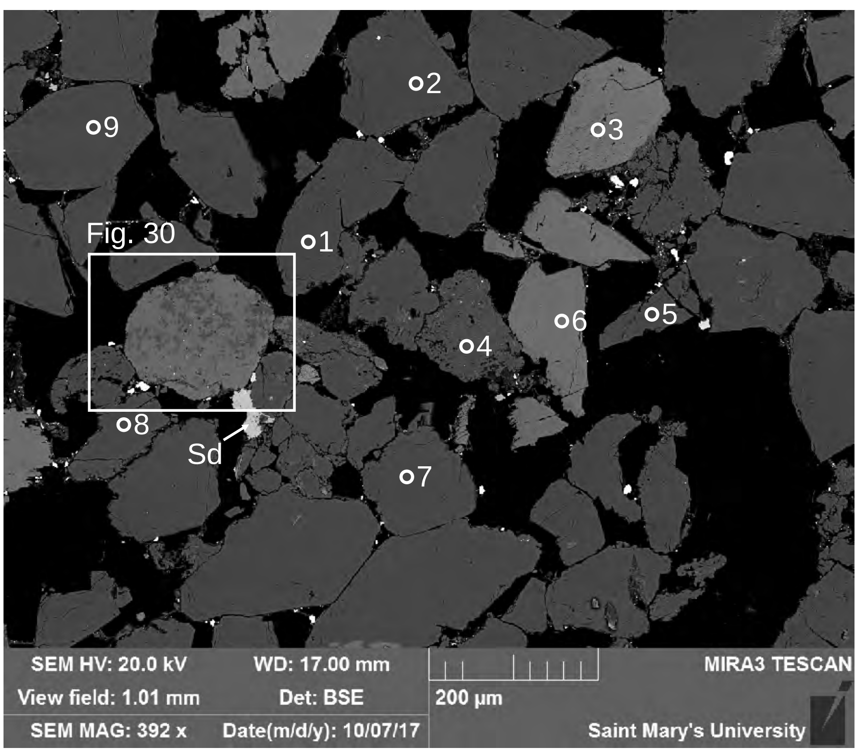
1:K-feldspar +
2:Quartz
3:Oligoclase
4:K-feldspar
5:Oligoclase
6:K-feldspar
7:Quartz
8:K-feldspar
9:Quartz
10:Quartz
11:K-feldspar
12:Quartz
13:Barite
14:Quartz
15:Quartz

Figure 1-8.27: Sample 5H-58 1903.66 (SEM) site 19. This site consists of mainly detrital quartz (2,7,9-10,12,14-15), K-feldspar (1,4,6,8,11), and oligoclase (3,5) grains. Barite (13) makes up part of the drilling mud. Suturing is common between grains (positions a).



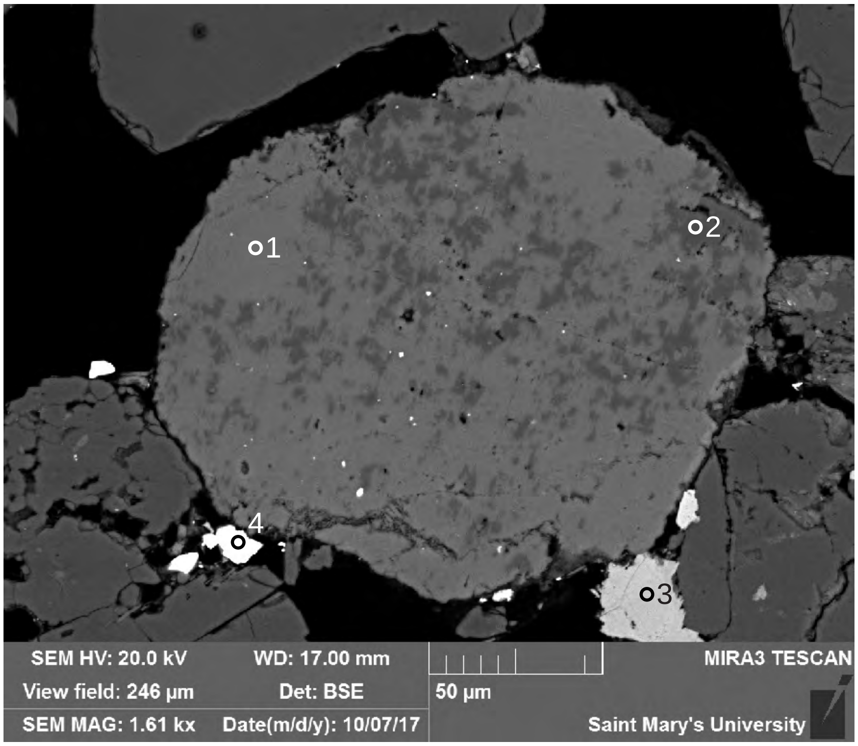
1:K-feldspar
2:Barite
3:K-feldspar
4:K-feldspar
5:Quartz
6:Quartz
7:Quartz
8:Quartz
9:Quartz
10:K-feldspar

Figure 1-8.28: Sample 5H-58 1903.66 (SEM) site 20. This site is similar to site 19.



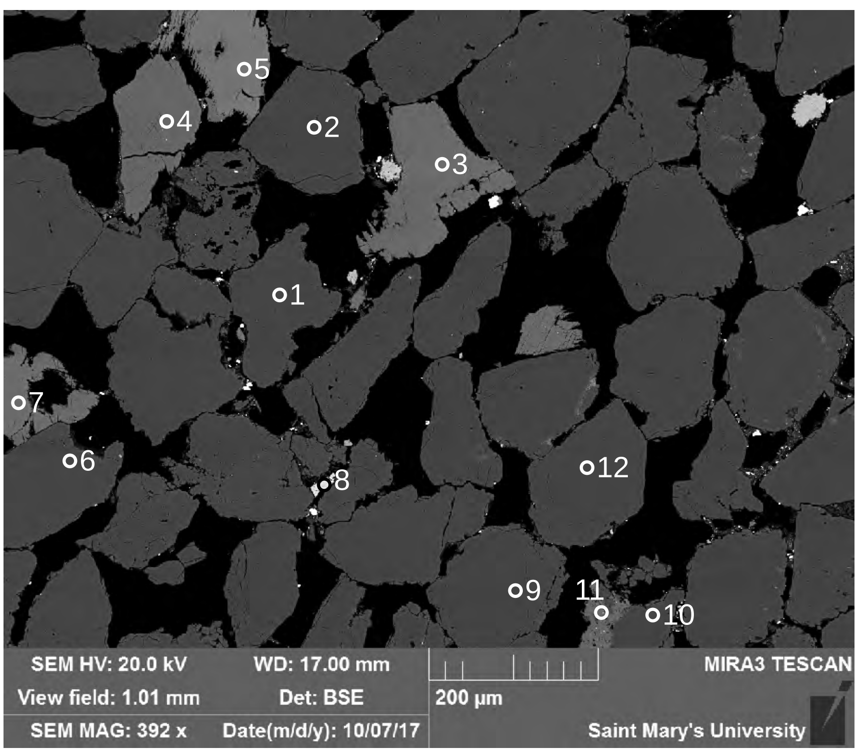
1:Quartz
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:K-feldspar
7:Quartz
8:Quartz
9:Quartz

Figure 1-8.29: Sample 5H-58 1903.66 (SEM) site 21. This site consists of detrital grains of quartz (1-2,4-5,7-9), and K-feldspar (2,6). Late diagenetic siderite appears to cross-cut detrital quartz grains.



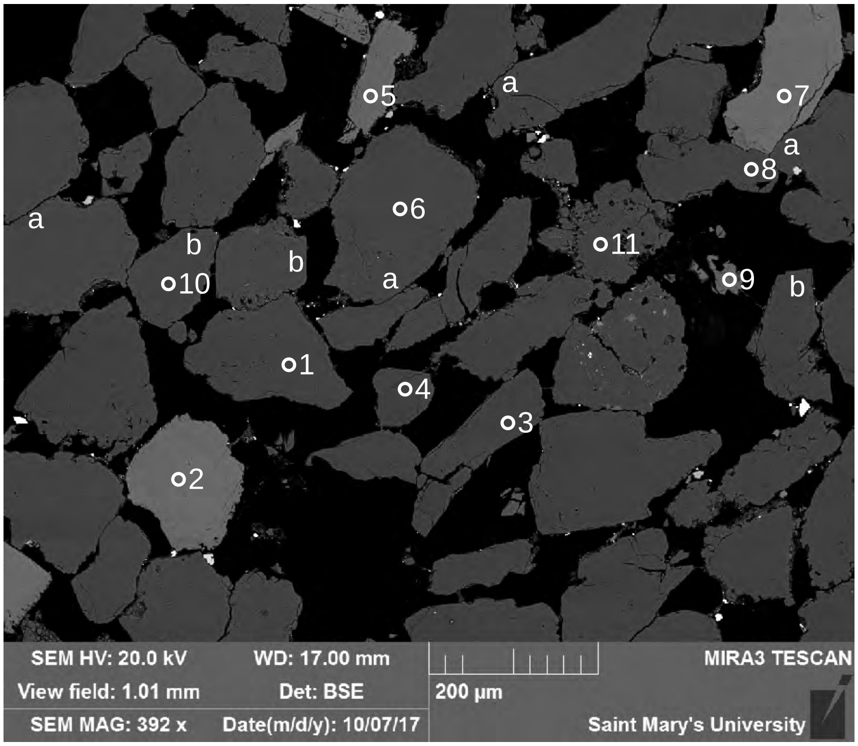
1:K-feldspar
2:Albite
3:Siderite
4:Barite

Figure 1-8.30: Sample 5H-58 1903.66 (SEM) site 21.1. This site consists of an albitized K-feldspar (1-2). Late diagenetic siderite (3) fills pores. Barite (4) makes up part of the drilling mud.



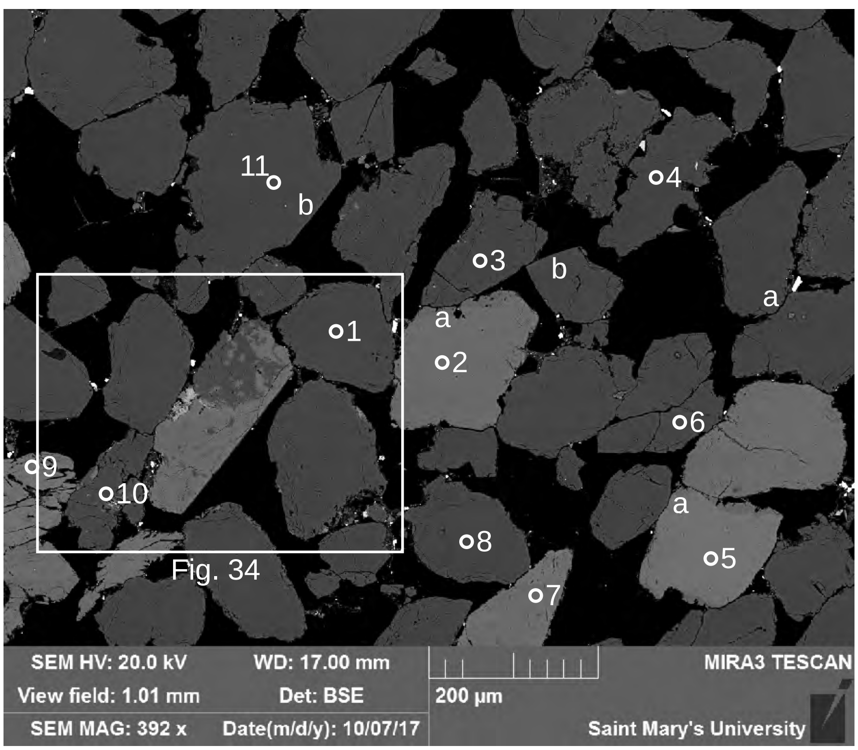
1:Quartz
2:Quartz
3:K-feldspar
4:K-feldspar
5:K-feldspar
6:Quartz
7:K-feldspar
8:TiO_2
9:Quartz
10:Quartz
11:K-feldspar
12:Quartz

Figure 1-8.31: Sample 5H-58 1903.66 (SEM) site 22. This site is similar to site 20.



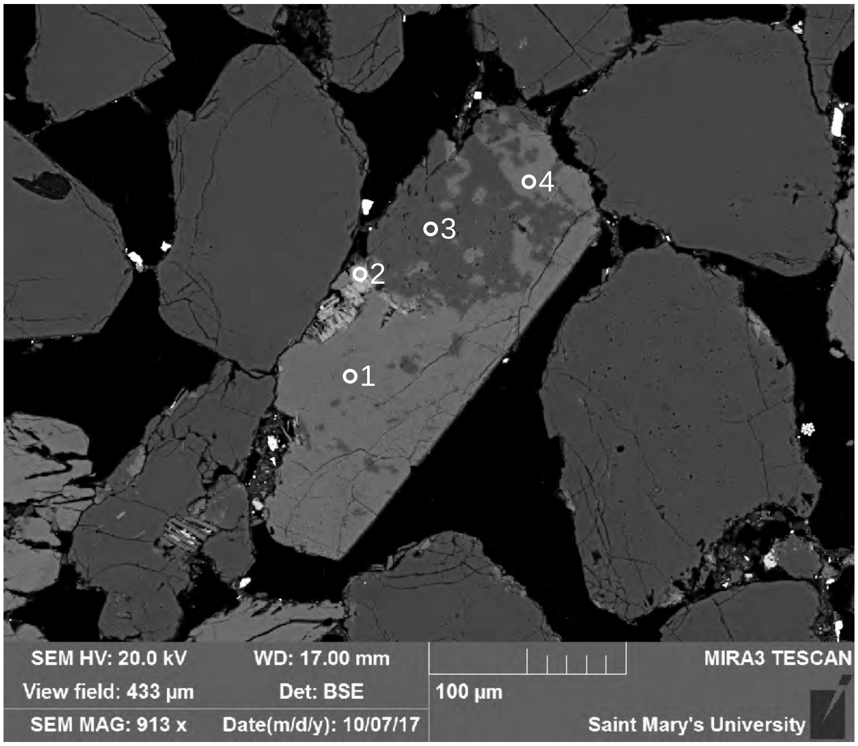
1:Quartz
2:K-feldspar
3:Quartz
4:Quartz
5:K-feldspar
6:Quartz
7:K-feldspar
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-8.32: Sample 5H-58 1903.66 (SEM) site 23. This site is similar to site 20.Quartz commonly displays suturing with other crystals (positions a) and sometimes overgrowths (positions b).



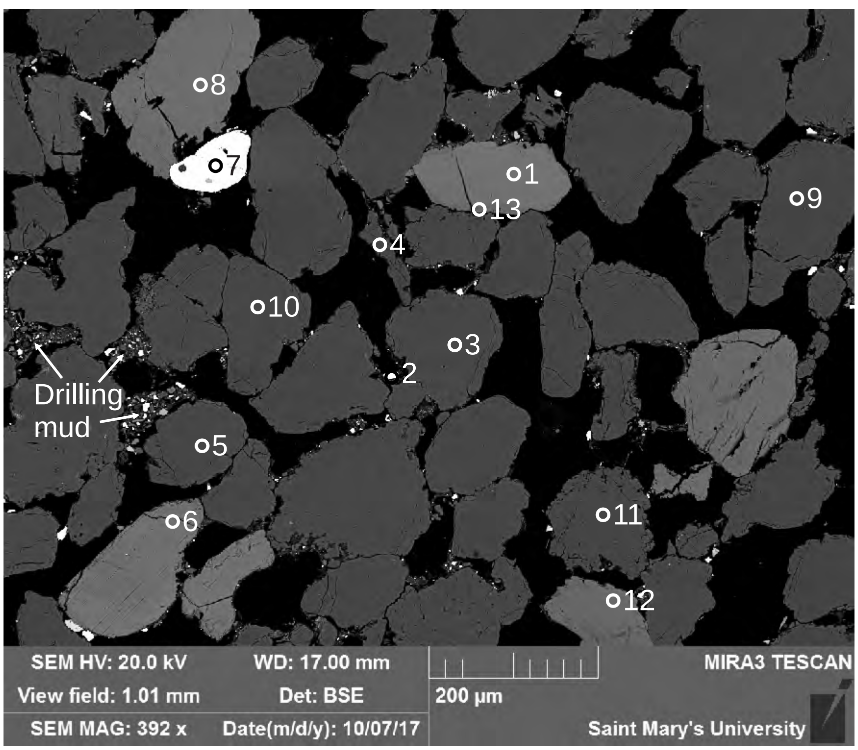
1:Quartz
2:K-feldspar
3:Quartz
4:Quartz
5:K-feldspar
6:Quartz
7:K-feldspar
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz

Figure 1-8.33: Sample 5H-58 1903.66 (SEM) site 24. This site is similar to site 20. Quartz contains some overgrowths (positions b), and quartz and K-feldspar commonly display suturing (positions a).



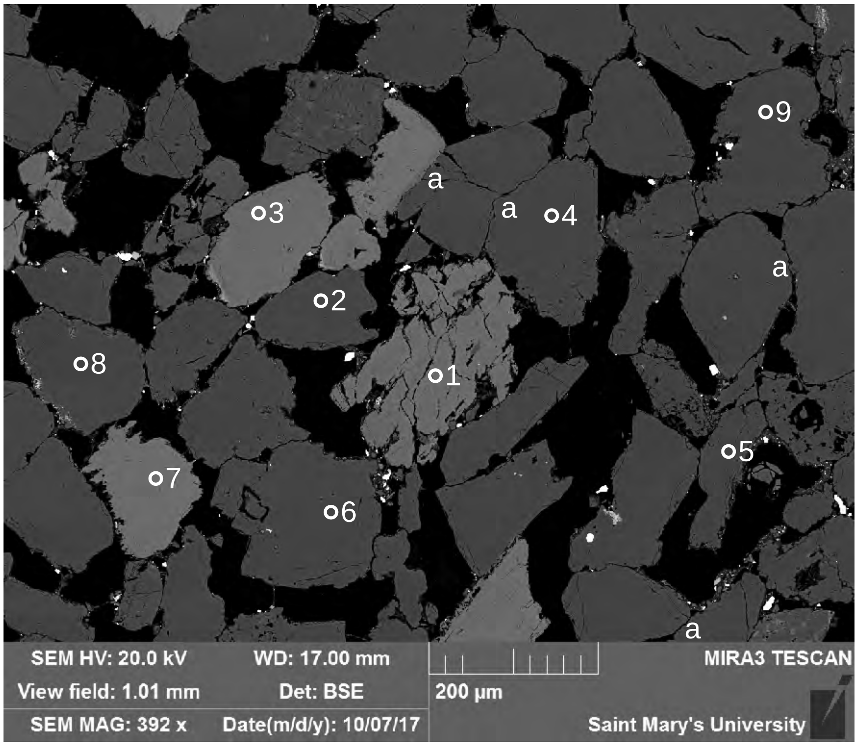
1:K-feldspar
2:Apatite + Chlorite
3:Albite
4:K-feldspar

Figure 1-8.34: Sample 5H-58 1903.66 (SEM) site 24.1. This site consists of detrital quartz grains. There is also a granitic clast of albitized K-feldspar (1,3-4), with apatite + chlorite (2) partially filling a void.



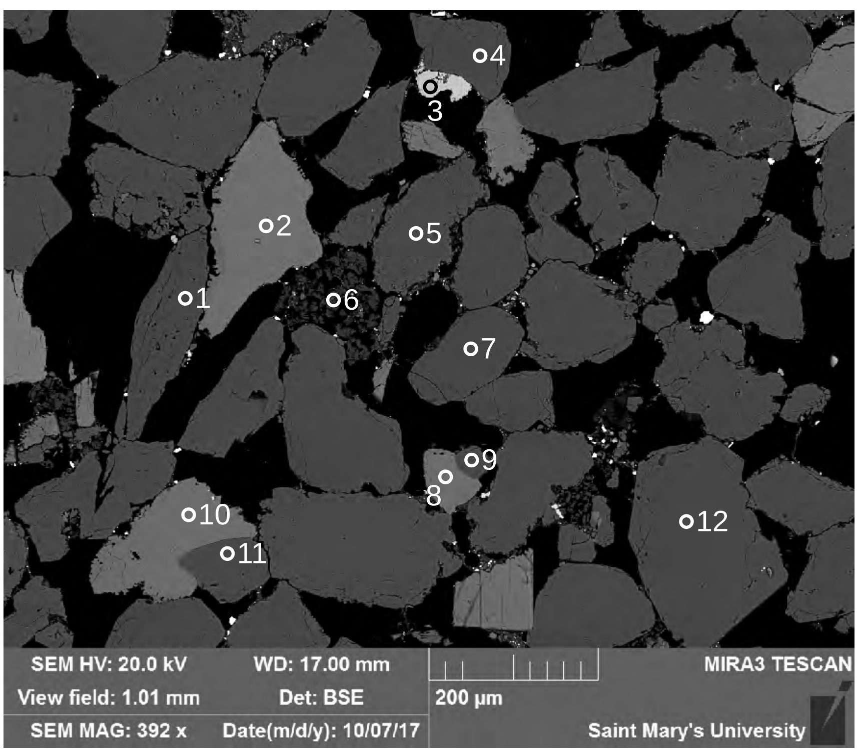
1:K-feldspar
2:Barite
3:Quartz
4:Quartz
5:Quartz
6:K-feldspar
7:Zircon
8:K-feldspar
9:Quartz
10:Quartz
11:Quartz
12:K-feldspar
13:K-feldspar

Figure 1-8.35: Sample 5H-58 1903.66 (SEM) site 25. This site is similar to site 20. There is also a detrital zircon (7) grain. Drilling mud that is made up of clays + barite (2) partially fills primary porosity.



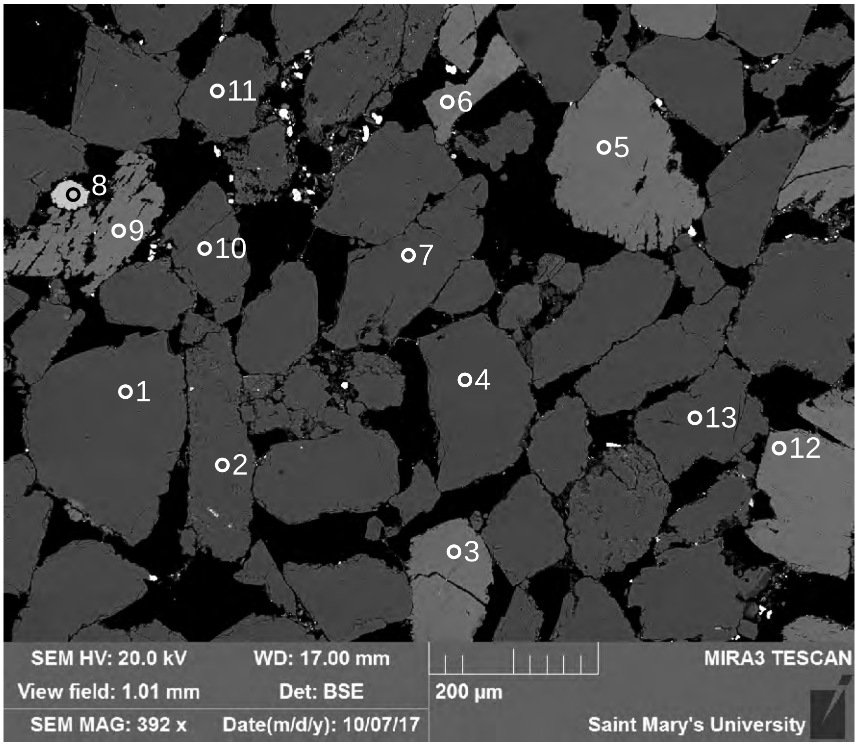
1:K-feldspar
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:Quartz
7:K-feldspar
8:Quartz
9:Quartz

Figure 1-8.36: Sample 5H-58 1903.66 (SEM) site 26. This site is similar to site 20. Suturing is common between grains (positions a).



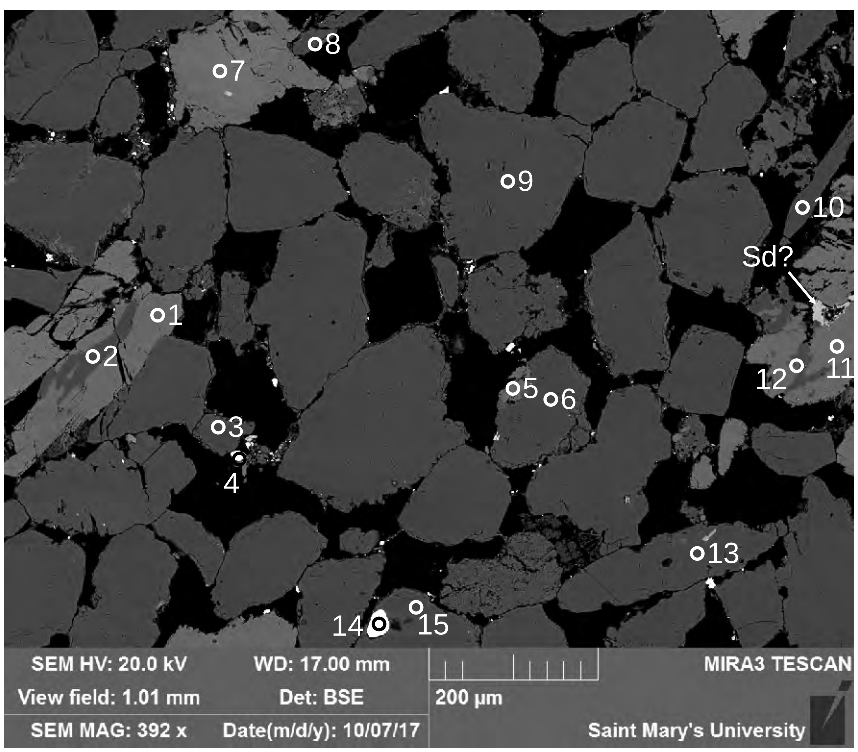
1:Quartz
2:K-feldspar
3:Siderite
4:Quartz
5:Quartz
6:Kaolinite
7:Quartz
8:K-feldspar
9:Quartz
10:K-feldspar
11:Quartz
12:Quartz

Figure 1-8.37: Sample 5H-58 1903.66 (SEM) site 27. This site consists of detrital quartz and K-feldspar grains. Siderite (3) and kaolinite (6) partially fill primary porosity.



1:Quartz
2:Quartz
3:K-feldspar
4:Quartz
5:K-feldspar
6:K-feldspar
7:Quartz
8:Siderite
9:K-feldspar
10:Quartz
11:Quartz
12:K-feldspar
13:Quartz

Figure 1-8.38: Sample 5H-58 1903.66 (SEM) site 28. This site is similar to site 27. K-feldspar (9) appears to be dissolving.



1:K-feldspar
2:Quartz
3:Quartz
4:Barite
5:K-feldspar
6:Quartz
7:K-feldspar
8:Quartz +
9:Quartz
10:Quartz
11:K-feldspar
12:Albite
13:Quartz
14:Zircon
15:Quartz

Figure 1-8.39: Sample 5H-58 1903.66 (SEM) site 29. This site is similar to site 28. There is a granitic lithic clast made up of K-feldspar (1) and quartz (2), and there is an albitized K-feldspar (11) grain with ?siderite partially filling a void in it. There is also a rare grain of detrital zircon (14). Barite (4) makes up part of the drilling mud.

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	1	1	Kfs	66.34		17.51					0.58	15.58											100	120
5H-58 1903.66	1	2	Qz	100.00																			100	125
5H-58 1903.66	1	3	Qz	100.00																			100	123
5H-58 1903.66	1	4	Qz	100.00																			100	122
5H-58 1903.66	1	5	Sd	0.60			48.06	0.32	0.41	4.83			1.76										56	61
5H-58 1903.66	1	6	Qz	100.00																			100	121
5H-58 1903.66	1	7	Qz	100.00																			100	119
5H-58 1903.66	1	8	Kfs	66.10		18.09					1.14	14.67											100	116
5H-58 1903.66	1	9	Qz	100.00																			100	124
5H-58 1903.66	1	10	Kfs	66.18		17.98					0.93	14.92											100	122
5H-58 1903.66	1	11	Qz	100.00																			100	123
5H-58 1903.66	1	12	Qz	100.00																			100	122
5H-58 1903.66	1	13	Oligo	64.53		22.07				4.27	9.13												100	117
5H-58 1903.66	1	14	Brt											36.95							63.20		100	114
5H-58 1903.66	2	1	Kfs	66.38		17.58					0.40	15.65											100	118
5H-58 1903.66	2	2	Sd				49.03		0.52	4.78			1.67										56	61
5H-58 1903.66	2	3	Qz	100.00																			100	122
5H-58 1903.66	2	4	Qz	100.00																			100	121
5H-58 1903.66	2	5	Kfs	65.04		18.06					0.93	14.44									1.52		100	117
5H-58 1903.66	2	6	Brt											36.77					0.97		62.42		100	113
5H-58 1903.66	2	7	Ab	70.00		18.41					11.59												100	123
5H-58 1903.66	2	8	Kfs	66.16		17.85					0.66	15.33											100	116
5H-58 1903.66	2	9	Qz + Kfs	94.04		3.37	0.25					2.34											100	118
5H-58 1903.66	2	10	Kfs	66.65		17.64					0.50	15.21											100	118
5H-58 1903.66	2	11	Ilm	0.87	59.86		37.59	1.17	0.51														100	98
5H-58 1903.66	2	12	Kfs	66.41		17.54					0.44	15.61											100	116
5H-58 1903.66	2.1	1	Qz	100.00																			100	118
5H-58 1903.66	2.1	2	Qz	97.65		1.95						0.40											100	117
5H-58 1903.66	3	1	Qz	100.00																			100	122
5H-58 1903.66	3	2	Brt	0.47			28.47				0.31			70.75									100	226
5H-58 1903.66	3	3	Kfs	65.76		17.67					0.72	15.03									0.82		100	119
5H-58 1903.66	3	4	Qz	100.00																			100	122
5H-58 1903.66	3	5	Kfs	66.60		18.06					1.05	14.29											100	118
5H-58 1903.66	3	6	Kfs	66.25		17.84					0.67	15.24											100	116
5H-58 1903.66	3	7	Qz	100.00																			100	121
5H-58 1903.66	3	8	Kfs	66.40		17.79					1.41	14.39											100	116
5H-58 1903.66	3	9	Kfs	65.73		17.76					1.03	14.87									0.61		100	115
5H-58 1903.66	3	10	Qz	100.00																			100	125
5H-58 1903.66	3	11	Qz	100.00																			100	121

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	3.1	1	Ms	50.49	0.33	24.76	5.22		3.19		0.47	10.55											95	107
5H-58 1903.66	3.1	2	TiO2 +	1.94	89.78	2.19	1.52			0.70	1.01	0.49	1.19		0.55	0.63							100	88
5H-58 1903.66	4	1	Kfs	66.16		17.82					0.63	15.40											100	119
5H-58 1903.66	4	2	Qz	100.00																			100	122
5H-58 1903.66	4	3	Brt											37.20							62.86		100	115
5H-58 1903.66	4	4	Kfs	65.77		17.68					0.63	15.21									0.70		100	119
5H-58 1903.66	4	5	Qz	100.00																			100	121
5H-58 1903.66	4	6	Kfs	66.27		17.57						16.16											100	119
5H-58 1903.66	4	7	Kfs	65.74		17.98					1.18	14.29									0.81		100	119
5H-58 1903.66	4	8	Kfs	66.39		17.98					2.06	13.57											100	117
5H-58 1903.66	4	9	Qz	100.00																			100	121
5H-58 1903.66	4	10	Qz	100.00																			100	119
5H-58 1903.66	4	11	Qz	100.00																			100	125
5H-58 1903.66	5	1	Qz	100.00																			100	121
5H-58 1903.66	5	2	Kfs	65.38		17.98					0.60	14.84									1.20		100	118
5H-58 1903.66	5	3	Ms	47.66	0.92	34.09	0.83		0.75		0.76	9.99											95	108
5H-58 1903.66	5	4	Kfs	66.41		17.73					0.60	15.25											100	117
5H-58 1903.66	5	5	Qz	100.00																			100	121
5H-58 1903.66	5	6	Kfs	65.95		17.87					0.86	15.32											100	118
5H-58 1903.66	5	7	Qz	99.11	0.40	0.50																	100	121
5H-58 1903.66	5	8	Kfs	66.21		17.84					0.92	15.02											100	118
5H-58 1903.66	5	9	Kfs	65.17		18.13					1.07	14.23									1.39		100	120
5H-58 1903.66	5	10	Qz	100.00																			100	125
5H-58 1903.66	5	11	Kfs	65.94		17.79					1.03	14.51									0.73		100	121
5H-58 1903.66	5	12	Qz	100.00																			100	125
5H-58 1903.66	5	13	Qz	100.00																			100	126
5H-58 1903.66	5	14	Kfs	65.71		17.78					0.77	15.02									0.73		100	117
5H-58 1903.66	5	15	Ab	69.73		18.52					11.75												100	120
5H-58 1903.66	5.1	1	Ab	69.54		18.78				0.24	11.44												100	121
5H-58 1903.66	5.1	2	Kfs	66.14		17.71					0.65	15.50											100	119
5H-58 1903.66	5.1	3	Kfs	66.16		17.88					0.86	15.11											100	119
5H-58 1903.66	5.1	4	Qz + Ms	76.20		16.99	1.98		0.90			3.94											100	115
5H-58 1903.66	6	1	Qz	100.00																			100	121
5H-58 1903.66	6	2	Kfs	65.18		18.02					0.93	14.43									1.45		100	118
5H-58 1903.66	6	3	Kfs	66.17		17.64					0.56	15.63											100	118
5H-58 1903.66	6	4	Qz	100.00																			100	123
5H-58 1903.66	6	5	Kfs	66.00		17.68					0.34	15.98											100	118
5H-58 1903.66	6	6	Qz	100.00																			100	122
5H-58 1903.66	6	7	Kfs	65.58		18.00					1.10	14.30									1.03		100	119

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	6	8	Qz	100.00																			100	122
5H-58 1903.66	6	9	Qz	100.00																			100	122
5H-58 1903.66	6	10	Kfs	66.66		17.81					0.81	14.72											100	116
5H-58 1903.66	6	11	Qz	98.55		0.91						0.54											100	119
5H-58 1903.66	6	12	Kln	48.99		36.90						0.10											86	99
5H-58 1903.66	6	13	Qz	100.00																			100	119
5H-58 1903.66	6	14	Qz	100.00																			100	119
5H-58 1903.66	6	15	"Ilm"	0.72	74.71	0.56	23.15		0.64						0.21								100	98
5H-58 1903.66	7	1	Qz	100.00																			100	122
5H-58 1903.66	7	2	Brt											38.62							58.73	2.76	100	121
5H-58 1903.66	7	3	Kfs	66.95		17.99						15.06											100	117
5H-58 1903.66	7	4	Kfs	64.36		18.31					0.94	13.97									2.43		100	118
5H-58 1903.66	7	5	Qz	100.00																			100	121
5H-58 1903.66	7	6	Kfs	66.13		17.79					0.74	15.33											100	117
5H-58 1903.66	7	7	Qz	100.00																			100	121
5H-58 1903.66	7	8	Qz	100.00																			100	126
5H-58 1903.66	7	9	Qz	100.00																			100	123
5H-58 1903.66	7	10	Kfs	65.84	0.24	17.80					0.45	15.67											100	117
5H-58 1903.66	7	11	Qz	100.00																			100	118
5H-58 1903.66	7	12	Qz	100.00																			100	119
5H-58 1903.66	8	1	Qz	100.00																			100	119
5H-58 1903.66	8	2	Sd				48.18		0.47	6.15			1.20										56	60
5H-58 1903.66	8	3	Sd	0.57			48.53			5.41			1.50										56	59
5H-58 1903.66	8	4	Qz	100.00																			100	118
5H-58 1903.66	8	5	Chloritized Mica	39.24	4.61	22.18	18.96		12.21	0.50	0.98	0.64			0.67								100	76
5H-58 1903.66	8	6	Qz	100.00																			100	119
5H-58 1903.66	8	7	Kfs	66.41		17.71					0.59	15.28											100	119
5H-58 1903.66	8	8	Qz	100.00																			100	122
5H-58 1903.66	8	9	Qz	100.00																			100	121
5H-58 1903.66	8	10	Qz	100.00																			100	117
5H-58 1903.66	8	11	Ab	69.58		18.96					11.46												100	113
5H-58 1903.66	8	12	Kfs	66.60		17.70					2.09	13.61											100	112
5H-58 1903.66	8.1	1	Qz	100.00																			100	120
5H-58 1903.66	8.1	2	Kln	48.47	0.47	35.48	0.75				0.39				0.44								86	78
5H-58 1903.66	8.1	3	Qz	100.00																			100	120
5H-58 1903.66	8.1	4	Ab	69.50		18.93				0.45	11.12												100	117
5H-58 1903.66	8.1	5	Mix	48.52	0.65	19.06	6.54		1.72	13.52	1.50	1.62		1.00	0.86								95	74
5H-58 1903.66	9	1	Kfs	65.01		18.02					0.97	14.25									1.74		100	116
5H-58 1903.66	9	2	Qz	100.00																			100	121

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	9	3	Ab	67.06		20.51				2.06	10.37												100	117
5H-58 1903.66	9	4	Kfs	66.38		17.77					0.86	15.00											100	114
5H-58 1903.66	9	5	Kfs	66.34		17.58					0.31	15.77											100	114
5H-58 1903.66	9	6	Qz	100.00																			100	124
5H-58 1903.66	9	7	Kfs	66.16		17.86					0.82	15.16											100	119
5H-58 1903.66	9	8	Ab	69.89		18.81				0.30	11.00												100	119
5H-58 1903.66	9	9	Kfs	65.16		18.04					0.84	14.52									1.45		100	119
5H-58 1903.66	9	10	Qz	100.00																			100	122
5H-58 1903.66	9	11	Qz	100.00																			100	118
5H-58 1903.66	9	12	Qz	100.00																			100	121
5H-58 1903.66	9	13	Ab	70.06		18.30	0.41				11.23												100	117
5H-58 1903.66	10	1	Kfs	65.90		17.85					0.71	15.05									0.49		100	113
5H-58 1903.66	10	2	Qz	100.00																			100	119
5H-58 1903.66	10	3	Qz	100.00																			100	119
5H-58 1903.66	10	4	Qz	100.00																			100	121
5H-58 1903.66	10	5	Kfs	66.39		17.83					1.17	14.61											100	116
5H-58 1903.66	10	6	Qz	100.00																			100	121
5H-58 1903.66	10	7	Brt	0.73										37.03							62.32		100	114
5H-58 1903.66	10	8	Kfs	66.06		17.92					0.52	15.50											100	114
5H-58 1903.66	10	9	Qz	100.00																			100	118
5H-58 1903.66	10	10	Qz	100.00																			100	122
5H-58 1903.66	10	11	Qz	100.00																			100	123
5H-58 1903.66	10	12	Qz	100.00																			100	118
5H-58 1903.66	10.1	1	Ms	51.37		31.85	1.26		1.37		0.70	8.45											95	102
5H-58 1903.66	10.1	2	Ms	52.11		31.45	1.55		1.69		0.98	7.06			0.16								95	105
5H-58 1903.66	10.1	3	Ms +	56.10	0.42	35.05	1.67		1.02		0.73	4.36			0.64								100	91
5H-58 1903.66	11	1	Qz	100.00																			100	118
5H-58 1903.66	11	2	Kfs	66.17		17.81						16.01											100	115
5H-58 1903.66	11	3	Kfs	65.64		17.94					0.69	14.84									0.89		100	115
5H-58 1903.66	11	4	Sd	0.57			46.81		0.41	6.68	0.73		0.80										56	61
5H-58 1903.66	11	5	Ms +	54.26	1.39	24.46	2.74		2.26		0.43	9.46											95	108
5H-58 1903.66	11	6	Qz	100.00																			100	121
5H-58 1903.66	11	7	Qz	100.00																			100	120
5H-58 1903.66	11	8	Kfs	66.31		17.83					0.71	15.15											100	115
5H-58 1903.66	11	9	Qz	100.00																			100	118
5H-58 1903.66	11	10	Kfs	66.17		17.93					0.88	15.02											100	113
5H-58 1903.66	11	11	Oligo	65.27		21.76				3.22	9.75												100	114
5H-58 1903.66	11	12	Qz	100.00																			100	116
5H-58 1903.66	11	13	Qz	100.00																			100	116

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	11	14	TiO2	1.20	90.31	2.19	1.89			0.97	1.51		1.12		0.37	0.44							100	94
5H-58 1903.66	11	15	Brt	1.08										35.46					2.86		60.78		100	105
5H-58 1903.66	11	16	Qz	100.00																			100	117
5H-58 1903.66	11	17	Kfs	65.63		17.84					0.63	15.08									0.83		100	116
5H-58 1903.66	11	18	Kfs	66.35		17.75						15.90											100	113
5H-58 1903.66	12	1	Qz	100.00																			100	120
5H-58 1903.66	12	2	Kfs	66.53		17.71					0.78	14.98											100	112
5H-58 1903.66	12	3	Qz	100.00																			100	116
5H-58 1903.66	12	4	Qz	100.00																			100	118
5H-58 1903.66	12	5	Qz	99.65		0.35																	100	119
5H-58 1903.66	12	6	Kfs	66.59		17.49						15.92											100	117
5H-58 1903.66	12	7	Qz	100.00																			100	122
5H-58 1903.66	12	8	Qz	100.00																			100	121
5H-58 1903.66	12	9	Qz	100.00																			100	120
5H-58 1903.66	12	10	Qz	98.84		1.02						0.15											100	117
5H-58 1903.66	12	11	Qz	96.60	0.68	2.14						0.58											100	120
5H-58 1903.66	12	12	Kfs	66.07		18.04					0.96	14.92											100	113
5H-58 1903.66	12.1	1	Kfs	66.36		17.77					0.34	15.53											100	116
5H-58 1903.66	12.1	2	Qz	99.36		0.44						0.19											100	120
5H-58 1903.66	13	1	Kfs	66.15		18.23					1.49	14.13											100	117
5H-58 1903.66	13	2	Kfs	65.65		17.71					0.43	15.64									0.56		100	118
5H-58 1903.66	13	3	Qz	100.00																			100	122
5H-58 1903.66	13	4	Qz	100.00																			100	123
5H-58 1903.66	13	5	Kfs	66.13		17.86					0.79	15.22											100	119
5H-58 1903.66	13	6	Qz	100.00																			100	120
5H-58 1903.66	13	7	Qz +	93.59	3.08	1.83						1.12			0.38								100	95
5H-58 1903.66	13	8	Ab	69.67		18.79					11.54												100	117
5H-58 1903.66	13	9	Qz	100.00																			100	119
5H-58 1903.66	13	10	Sd				48.75			5.61			1.65										56	62
5H-58 1903.66	13	11	Qz	100.00																			100	125
5H-58 1903.66	13	12	Qz	100.00																			100	124
5H-58 1903.66	14	1	Qz	100.00																			100	120
5H-58 1903.66	14	2	Kfs	66.55		17.94					1.58	13.94											100	118
5H-58 1903.66	14	3	Ab	67.87		19.94				1.46	10.60	0.14											100	118
5H-58 1903.66	14	4	Oligo	65.77		21.37				2.97	9.73	0.16											100	119
5H-58 1903.66	14	5	Kfs	65.57		18.00					0.76	14.82									0.85		100	117
5H-58 1903.66	14	6	Kfs	66.29		17.82					0.66	15.22											100	118
5H-58 1903.66	14	7	Qz	100.00																			100	120
5H-58 1903.66	14	8	Qz	98.74						0.17	0.35			0.74									100	121

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	14	9	Kfs	65.88		17.92					1.18	14.40									0.62		100	119
5H-58 1903.66	14	10	Qz	100.00																			100	119
5H-58 1903.66	14	11	Ab	69.55		18.88				0.39	11.04	0.15											100	116
5H-58 1903.66	15	1	Qz	100.00																			100	121
5H-58 1903.66	15	2	TiO2	1.10	91.81	2.44	1.71			0.65	0.67		1.39		0.22								100	97
5H-58 1903.66	15	3	Qz	100.00																			100	122
5H-58 1903.66	15	4	Kfs	66.18		17.67					0.45	15.70											100	114
5H-58 1903.66	15	5	Qz	100.00																			100	120
5H-58 1903.66	15	6	Qz	100.00																			100	119
5H-58 1903.66	15	7	Sd	0.67			47.71		0.48	6.19			0.95										56	59
5H-58 1903.66	15	8	Qz	100.00																			100	119
5H-58 1903.66	15	9	Qz	100.00																			100	120
5H-58 1903.66	15	10	Albitized Kfs	68.22		18.44					8.34	5.00											100	118
5H-58 1903.66	16	1	Qz	100.00																			100	120
5H-58 1903.66	16	2	Qz	100.00																			100	120
5H-58 1903.66	16	3	Kfs	65.15		17.94					0.75	14.82									1.34		100	117
5H-58 1903.66	16	4	Ab	68.50		19.54				0.63	11.33												100	117
5H-58 1903.66	16	5	Kfs	65.71		17.70					0.28	15.46									0.84		100	114
5H-58 1903.66	16	6	Kfs	66.49		17.73					1.12	14.66											100	114
5H-58 1903.66	16	7	Qz	100.00																			100	117
5H-58 1903.66	16	8	Qz	100.00																			100	116
5H-58 1903.66	16	9	Qz	100.00																			100	119
5H-58 1903.66	16.1	1	Qz	100.00																			100	119
5H-58 1903.66	16.1	2	Kfs	63.74		18.38					1.02	13.60									3.27		100	115
5H-58 1903.66	16.1	3	Kfs	65.98		17.55	0.38				0.26	15.84											100	116
5H-58 1903.66	16.1	4	Ab	69.79		18.66					11.55												100	116
5H-58 1903.66	16.1	5	Kfs	67.82		18.32					2.34	11.52											100	114
5H-58 1903.66	16.1	6	Ab	69.21		18.72					11.09	0.98											100	115
5H-58 1903.66	17	1	Qz	100.00																			100	120
5H-58 1903.66	17	2	Kfs	66.07		17.88					1.11	14.27									0.67		100	115
5H-58 1903.66	17	3	Brt	3.59		0.43					0.62			30.72							64.69		100	99
5H-58 1903.66	17	4	Qz	100.00																			100	122
5H-58 1903.66	17	5	Qz	100.00																			100	122
5H-58 1903.66	17	6	Qz	100.00																			100	120
5H-58 1903.66	17	7	Kfs	66.15		17.61					0.44	15.80											100	115
5H-58 1903.66	17	8	Ab	68.61		19.43				0.89	10.95	0.12											100	117
5H-58 1903.66	17	9	Kfs	65.05		18.07					0.92	14.25									1.71		100	116
5H-58 1903.66	17	10	Sd	0.55			49.18	0.32	0.50	3.68			1.76										56	63
5H-58 1903.66	17	11	Qz	100.00																			100	124

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	18	1	Qz	100.00																			100	121
5H-58 1903.66	18	2	Oligo	66.47		21.00				2.62	9.91												100	117
5H-58 1903.66	18	3	Kfs	66.05		17.82					0.50	15.62											100	118
5H-58 1903.66	18	4	Qz	100.00																			100	120
5H-58 1903.66	18	5	Kfs	66.16		17.76	0.24				0.70	15.14											100	116
5H-58 1903.66	18	6	Qz	100.00																			100	118
5H-58 1903.66	18	7	Qz	100.00																			100	118
5H-58 1903.66	18	8	Qz	100.00																			100	119
5H-58 1903.66	18	9	Qz	100.00																			100	119
5H-58 1903.66	18	10	Ms	55.66	0.29	26.91	3.04		1.23		0.44	7.44											95	107
5H-58 1903.66	18	11	Qz	100.00																			100	122
5H-58 1903.66	19	1	Kfs	65.22		18.02					0.87	14.68									1.21		100	116
5H-58 1903.66	19	2	Qz	100.00																			100	121
5H-58 1903.66	19	3	Oligo	65.63		21.51				3.14	9.53	0.20											100	120
5H-58 1903.66	19	4	Kfs	65.65		17.58	0.41				0.37	15.99											100	109
5H-58 1903.66	19	5	Oligo	65.31		21.75				3.27	9.52	0.15											100	120
5H-58 1903.66	19	6	Kfs	66.14		17.79					0.61	15.46											100	119
5H-58 1903.66	19	7	Qz	100.00																			100	123
5H-58 1903.66	19	8	Kfs +	72.14		14.63					0.45	12.79											100	119
5H-58 1903.66	19	9	Qz	100.00																			100	122
5H-58 1903.66	19	10	Qz	100.00																			100	121
5H-58 1903.66	19	11	Kfs	66.28		17.79					0.73	15.20											100	117
5H-58 1903.66	19	12	Qz	100.00																			100	121
5H-58 1903.66	19	13	Brt	0.79										36.56							62.66		100	114
5H-58 1903.66	19	14	Qz	100.00																			100	123
5H-58 1903.66	19	15	Qz	100.00																			100	123
5H-58 1903.66	20	1	Kfs	65.63		17.93					0.71	14.91									0.83		100	114
5H-58 1903.66	20	2	Brt	3.37										35.38				0.10			61.20		100	106
5H-58 1903.66	20	3	Kfs	66.44		17.70					0.39	15.47											100	119
5H-58 1903.66	20	4	Kfs	66.16		17.74					0.49	15.61											100	118
5H-58 1903.66	20	5	Qz	100.00																			100	120
5H-58 1903.66	20	6	Qz	100.00																			100	119
5H-58 1903.66	20	7	Qz	100.00																			100	120
5H-58 1903.66	20	8	Qz	100.00																			100	120
5H-58 1903.66	20	9	Qz	100.00																			100	123
5H-58 1903.66	20	10	Kfs	66.38		17.62					0.59	15.41											100	121
5H-58 1903.66	21	1	Qz	100.00																			100	121
5H-58 1903.66	21	2	Qz	100.00																			100	119
5H-58 1903.66	21	3	Kfs	65.30		17.97					0.95	14.52									1.25		100	117

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	21	4	Qz	96.21		2.47	0.22				0.29	0.81											100	121
5H-58 1903.66	21	5	Qz	100.00																			100	121
5H-58 1903.66	21	6	Kfs	65.84	0.27	17.88					0.64	15.36											100	117
5H-58 1903.66	21	7	Qz	100.00																			100	123
5H-58 1903.66	21	8	Qz	100.00																			100	121
5H-58 1903.66	21	9	Qz	100.00																			100	118
5H-58 1903.66	21.1	1	Kfs	66.25		17.63					0.30	15.81											100	118
5H-58 1903.66	21.1	2	Ab	69.76		18.57					11.41	0.26											100	118
5H-58 1903.66	21.1	3	Sd				49.24			5.24			1.52										56	60
5H-58 1903.66	21.1	4	Brt											37.32							62.72		100	116
5H-58 1903.66	22	1	Qz	100.00																			100	120
5H-58 1903.66	22	2	Qz	100.00																			100	117
5H-58 1903.66	22	3	Kfs	66.55		17.70					1.19	14.56											100	114
5H-58 1903.66	22	4	Kfs	66.36		17.86					0.96	14.81											100	113
5H-58 1903.66	22	5	Kfs	64.93		18.09					1.52	13.04									2.43		100	113
5H-58 1903.66	22	6	Qz	100.00																			100	119
5H-58 1903.66	22	7	Kfs	66.40		17.57					0.66	15.37											100	114
5H-58 1903.66	22	8	TiO2	1.05	95.94	1.35	0.78									0.87							100	107
5H-58 1903.66	22	9	Qz	100.00																			100	123
5H-58 1903.66	22	10	Qz	100.00																			100	124
5H-58 1903.66	22	11	Kfs	66.29		17.52					0.55	15.63											100	118
5H-58 1903.66	22	12	Qz	100.00																			100	123
5H-58 1903.66	23	1	Qz	100.00																			100	117
5H-58 1903.66	23	2	Kfs	66.21		17.85					0.53	15.41											100	114
5H-58 1903.66	23	3	Qz	100.00																			100	119
5H-58 1903.66	23	4	Qz	100.00																			100	119
5H-58 1903.66	23	5	Kfs	66.30		17.50					0.69	15.52											100	112
5H-58 1903.66	23	6	Qz	100.00																			100	117
5H-58 1903.66	23	7	Kfs	65.46		17.93					1.04	14.48			0.17						0.92		100	111
5H-58 1903.66	23	8	Qz	100.00																			100	117
5H-58 1903.66	23	9	Kfs	66.26		17.70					0.95	15.10											100	115
5H-58 1903.66	23	10	Qz	100.00																			100	117
5H-58 1903.66	23	11	Qz	100.00																			100	118
5H-58 1903.66	24	1	Qz	100.00																			100	120
5H-58 1903.66	24	2	Kfs	66.51		17.62						15.86											100	117
5H-58 1903.66	24	3	Qz	100.00																			100	120
5H-58 1903.66	24	4	Qz	100.00																			100	119
5H-58 1903.66	24	5	Kfs	65.03		18.18					1.11	14.14									1.54		100	120
5H-58 1903.66	24	6	Qz	100.00																			100	121

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	24	7	Kfs	65.51		17.89					0.58	15.30									0.72		100	120
5H-58 1903.66	24	8	Qz	100.00																			100	123
5H-58 1903.66	24	9	Kfs	65.37		17.80					0.60	15.18									1.05		100	115
5H-58 1903.66	24	10	Qz	100.00																			100	117
5H-58 1903.66	24	11	Qz	100.00																			100	118
5H-58 1903.66	24.1	1	Kfs	66.37		17.66					0.46	15.52											100	116
5H-58 1903.66	24.1	2	Ap + Chl	20.74		11.84	24.47		2.66	21.18	0.71	0.31	18.08										100	99
5H-58 1903.66	24.1	3	Ab	68.02		19.95				1.37	10.66												100	117
5H-58 1903.66	24.1	4	Kfs	66.64		17.72					0.54	15.09											100	115
5H-58 1903.66	25	1	Kfs	65.25		17.88					0.99	14.53									1.35		100	117
5H-58 1903.66	25	2	Brt	0.75										37.27					1.84		60.20		100	117
5H-58 1903.66	25	3	Qz	100.00																			100	122
5H-58 1903.66	25	4	Qz	100.00																			100	121
5H-58 1903.66	25	5	Qz	100.00																			100	121
5H-58 1903.66	25	6	Kfs	66.43		17.68					0.83	15.06											100	117
5H-58 1903.66	25	7	Zrn	31.19																68.81			100	119
5H-58 1903.66	25	8	Kfs	65.57		18.18					1.34	14.08									0.83		100	113
5H-58 1903.66	25	9	Qz	100.00																			100	120
5H-58 1903.66	25	10	Qz	100.00																			100	121
5H-58 1903.66	25	11	Qz	100.00																			100	124
5H-58 1903.66	25	12	Kfs	66.29		17.94					1.34	14.42											100	121
5H-58 1903.66	25	13	Kfs	67.04		17.73						15.22											100	116
5H-58 1903.66	26	1	Kfs	65.84		17.84					0.95	14.70									0.67		100	117
5H-58 1903.66	26	2	Qz	100.00																			100	120
5H-58 1903.66	26	3	Kfs	66.18		17.86					0.65	15.32											100	115
5H-58 1903.66	26	4	Qz	100.00																			100	119
5H-58 1903.66	26	5	Qz	100.00																			100	122
5H-58 1903.66	26	6	Qz	100.00																			100	121
5H-58 1903.66	26	7	Kfs	65.69		17.95					0.98	14.57									0.82		100	116
5H-58 1903.66	26	8	Qz	100.00																			100	118
5H-58 1903.66	26	9	Qz	100.00																			100	118
5H-58 1903.66	27	1	Qz	100.00																			100	117
5H-58 1903.66	27	2	Kfs	65.85		17.87					0.85	14.79									0.63		100	117
5H-58 1903.66	27	3	Sd				48.74			6.17			1.09										56	58
5H-58 1903.66	27	4	Qz	100.00																			100	119
5H-58 1903.66	27	5	Qz	98.64		1.22						0.14											100	119
5H-58 1903.66	27	6	Kln	48.55		36.72					0.37				0.36								86	83
5H-58 1903.66	27	7	Qz	100.00																			100	123
5H-58 1903.66	27	8	Kfs	65.81		17.75					0.90	14.83									0.71		100	120

Table 1-8.1: EDS geochemical analyses of sample 5H-58 1903.66.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	Cl	Cr2O3	CoO	ZnO	SrO	ZrO2	BaO	WO3	Total	Actual Total
5H-58 1903.66	27	9	Qz	100.00																			100	124
5H-58 1903.66	27	10	Kfs	66.07		17.92					0.55	15.47											100	119
5H-58 1903.66	27	11	Qz	100.00																			100	123
5H-58 1903.66	27	12	Qz	100.00																			100	126
5H-58 1903.66	28	1	Qz	100.00																			100	121
5H-58 1903.66	28	2	Qz	99.29		0.46	0.25																100	120
5H-58 1903.66	28	3	Kfs	66.85		17.91					1.87	13.36											100	120
5H-58 1903.66	28	4	Qz	100.00																			100	123
5H-58 1903.66	28	5	Kfs	66.28		17.76					0.53	15.44											100	116
5H-58 1903.66	28	6	Kfs	66.17		17.72					0.37	15.75											100	115
5H-58 1903.66	28	7	Qz	100.00																			100	120
5H-58 1903.66	28	8	Sd	0.44			48.09	0.26	0.57	5.17			1.47										56	59
5H-58 1903.66	28	9	Kfs	66.14		17.77					0.42	15.68											100	116
5H-58 1903.66	28	10	Qz	100.00																			100	120
5H-58 1903.66	28	11	Qz	100.00																			100	118
5H-58 1903.66	28	12	Kfs	65.74		17.79					0.89	14.81									0.77		100	120
5H-58 1903.66	28	13	Qz	100.00																			100	124
5H-58 1903.66	29	1	Kfs	66.06		18.02					1.11	14.80											100	116
5H-58 1903.66	29	2	Qz	100.00																			100	119
5H-58 1903.66	29	3	Qz	100.00																			100	119
5H-58 1903.66	29	4	Brt	0.56										36.51							63.05		100	114
5H-58 1903.66	29	5	Kfs	66.54		17.62					0.31	15.54											100	118
5H-58 1903.66	29	6	Qz	100.00																			100	121
5H-58 1903.66	29	7	Kfs	66.02	0.31	17.90					0.75	15.02											100	112
5H-58 1903.66	29	8	Qz +	72.09			21.93			0.71	3.72				1.54								100	115
5H-58 1903.66	29	9	Qz	100.00																			100	119
5H-58 1903.66	29	10	Qz	100.00																			100	118
5H-58 1903.66	29	11	Kfs	65.89		17.87					0.36	15.88											100	117
5H-58 1903.66	29	12	Ab	69.69		18.61					11.44	0.26											100	119
5H-58 1903.66	29	13	Qz	96.42		1.88	0.57		0.48			0.65											100	121
5H-58 1903.66	29	14	Zrn	31.30																68.70			100	122
5H-58 1903.66	29	15	Qz	100.00																			100	123

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain

Appendix 1-9: SEM-BSE images and EDS mineral analyses for sample 5H-58 1906.89.

Sample 5H-58 1906.89: Fine-medium grained glauconitic sandstone.

Detrital Minerals: Albite, Apatite, Chloritized Biotite, Chloritized Muscovite, Illite, Ilmenite, K-feldspar, Monazite-(Ce), Muscovite, Oligoclase, Quartz, Spinel, Titania (Fig. 21), Zircon

Diagenetic Minerals: Calcite, Fe-Chlorite, Glauconite, Kaolinite, Siderite, Titania

Notes:

1. Detrital quartz and K-feldspar grains commonly contain dissolution voids (Fig. 18).

2. Large fractures appear to be filled by calcite (Figs. 11,17).

3. Siderite commonly rims large calcite patches/cement (FIgs. 7-8,13,34-35).

4. Siderite also occurs as veinlets (Fig. 32)

5. Halite is a result of washing the core with salt water.

6. Paragenetic sequence:
Glauconite →Kaolinite →Calcite →Siderite, Titania

Kaolinite ↑ Figs. 3, 20,28; Calcite ↑ Figs. 7, 19,32,38; Siderite, Titania ↑ Figs. 2,15,

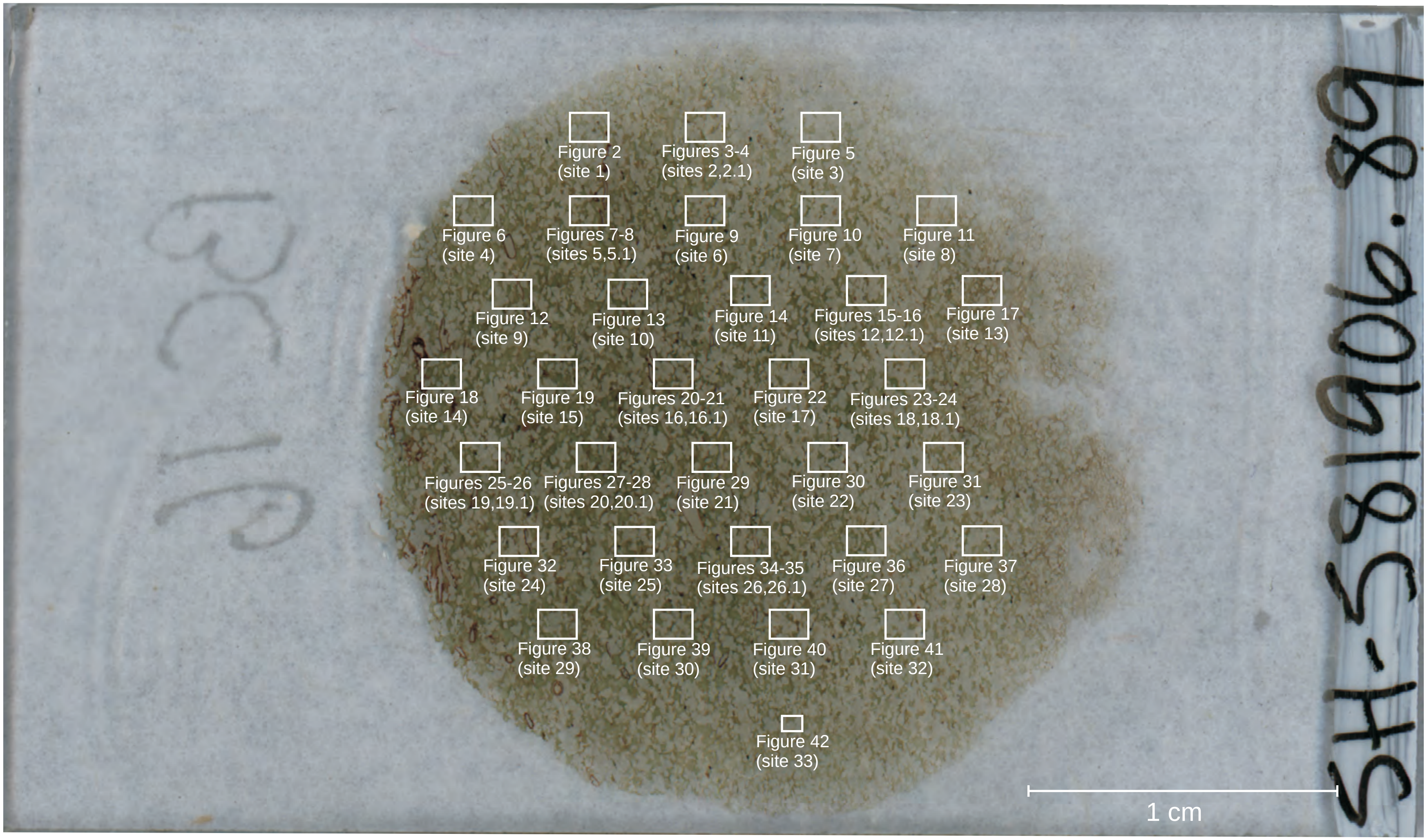
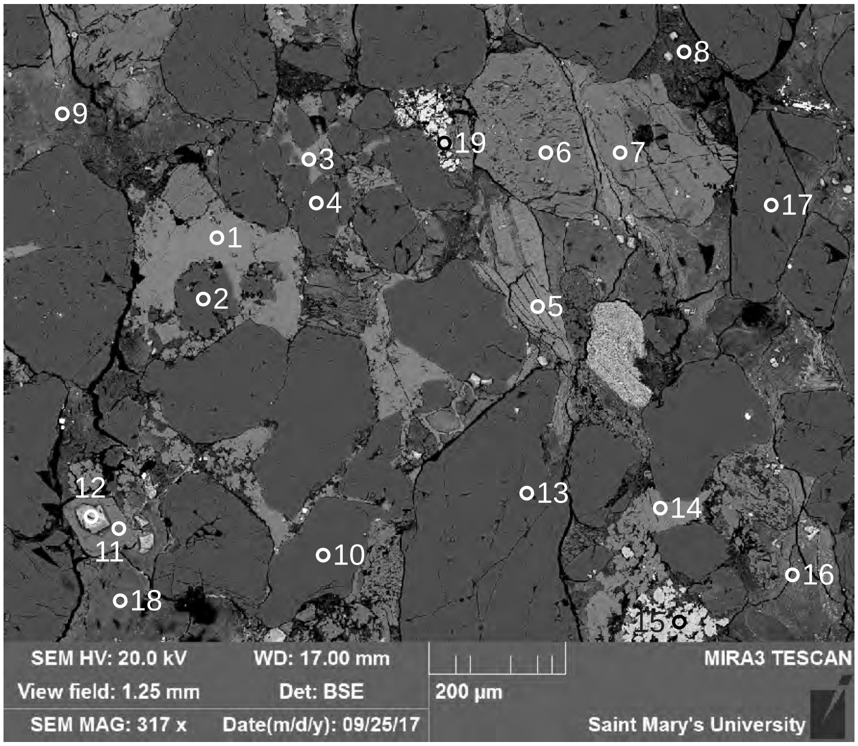
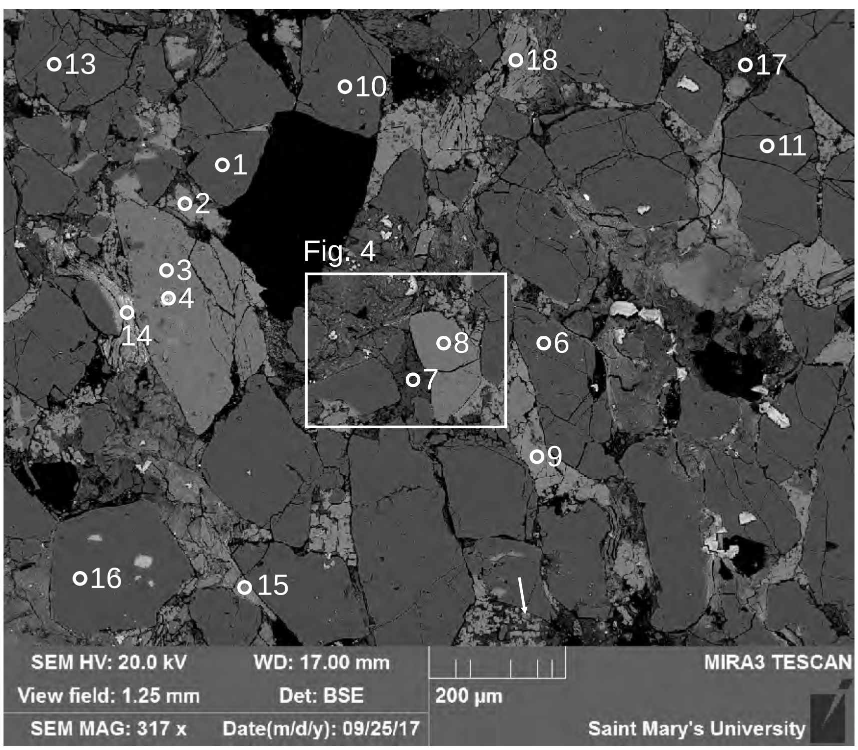


Figure 1-9.1: Scanned thin section of sample 5H-58 1906.89 the location of analyzed sites.



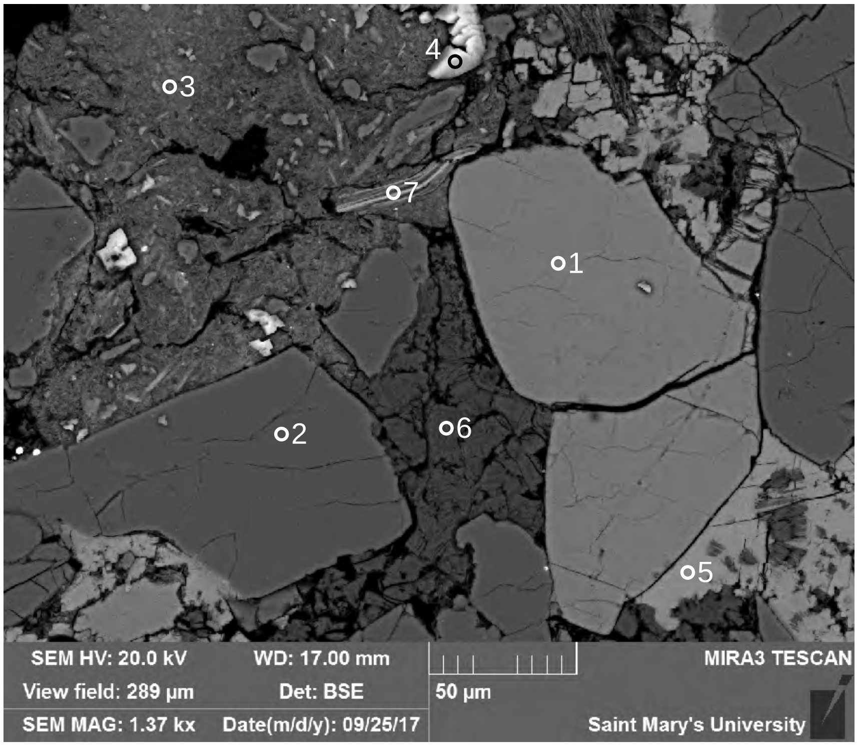
1:Calcite
2:Quartz
3:Calcite
4:Quartz
5:Chloritized Muscovite
6:K-feldspar
7:K-feldspar
8:Illite + Chlorite
9:Illite + Chlorite
10:Quartz
11:K-feldspar
12:Halite
13:Quartz
14:Calcite
15:Siderite
16:Illite + Chlorite
17:Quartz
18:Glauconite
19:TiO_2

Figure 1-9.2: Sample 5H-58 1906.89 (SEM) site 1. This site consists of detrital quartz (2,4,10,13,17), K-feldspar (6-7, 11), and chloritized muscovite (5) grains. The matrix is made up of illite + chlorite (8-9,16). The diagenetic minerals are calcite (1,3,14), siderite (15), and titania (19). There is also glauconite (18), and halite (12). The halite appears to be an artifact from washing the core with salt water.



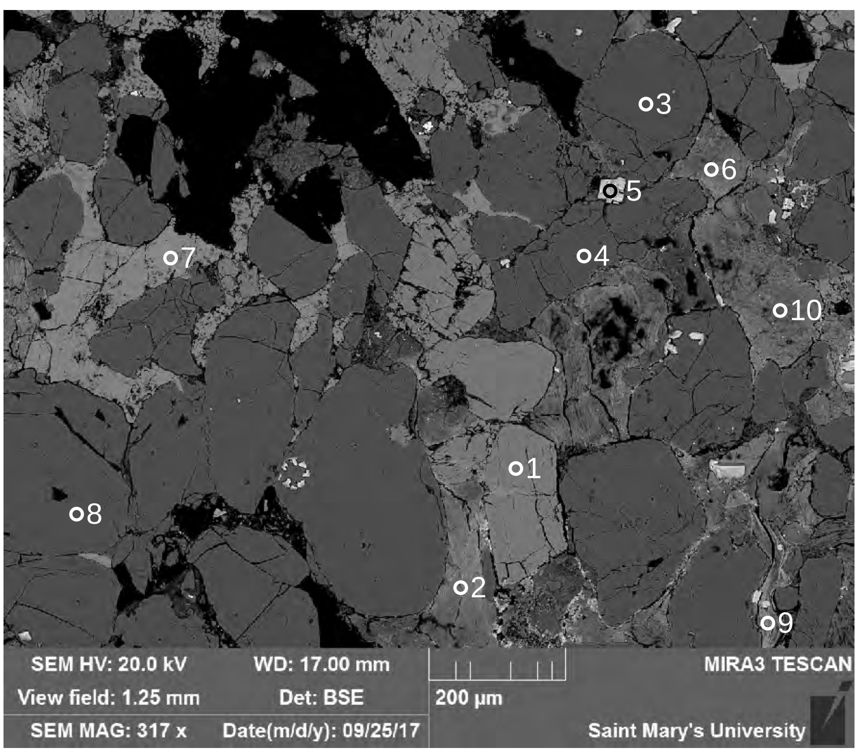
1:Quartz
2:Calcite +
3:K-feldspar
4:Halite + K-feldspar
6:Quartz
7:Kaolinite
8:K-feldspar
9:Calcite
10:Quartz
11:Quartz
13:Quartz
14:Chlorite + K-feldspar
15:Chlorite + Illite ?
16:Quartz
17:Chlorite + Illite
18:K-feldspar

Figure 1-9.3: Sample 5H-58 1906.89 (SEM) site 2. This site consists of detrital quartz and K-feldspar grains. The matrix is made up of chlorite + Illite (14-15,17). The diagenetic minerals are kaolinite (7), and calcite (2,9). Calcite appears to replace kaolinite (arrow).



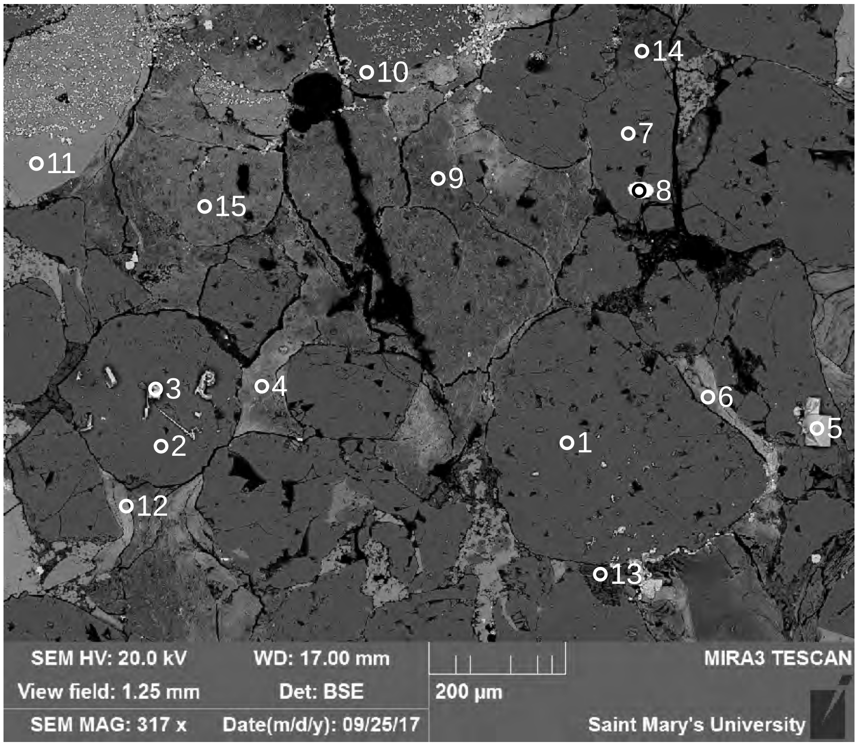
1:K-feldspar
2:Quartz
3:Chlorite + Illite
4:Halite
5:Calcite
6:Kaolinite
7:Chloritized Muscovite

Figure 1-9.4: Sample 5H-58 1906.89 (SEM) site 2.1. This site consists of detrital quartz (2), K-feldspar (1), and probably muscovite (7). The matrix is made up of chlorite + illite (3), and the diagenetic minerals are kaolinite (6), and later calcite (5). Halite is the latest mineral to form but most likely was created by washing the core with salt water.



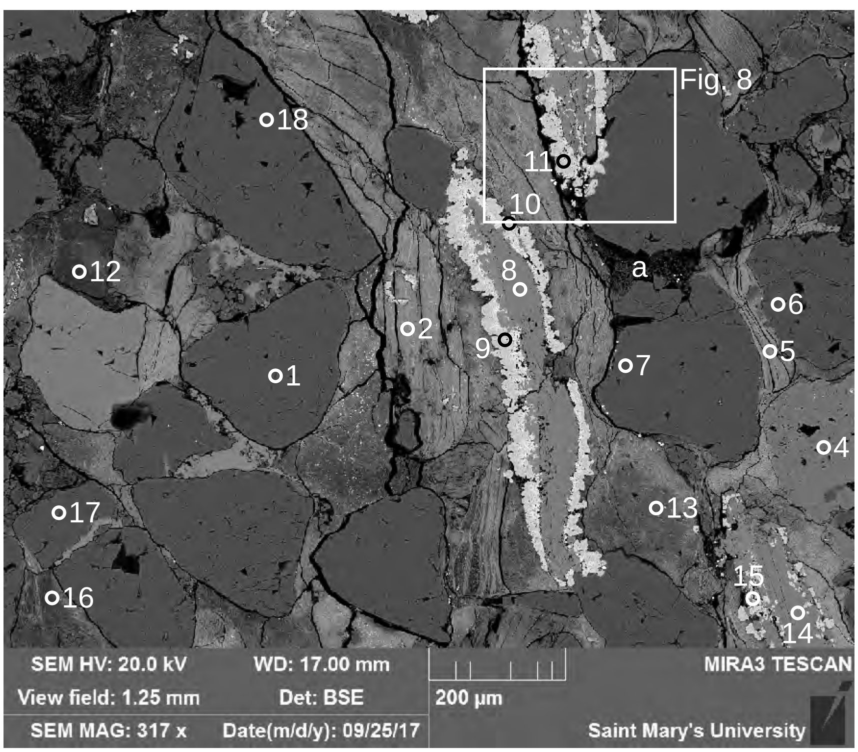
1:K-feldspar
2:Chlorite + Illite
3:Quartz
4:Quartz
5:Halite
6:Glaucony
7:Calcite
8:Quartz
9:Chlorite + ?K-feldspar
10:Glauconite

Figure 1-9.5: Sample 5H-58 1906.89 (SEM) site 3. This site consists of detrital quartz and K-feldspar grains. There is also glauconite (10), and glaucony (6). The matrix is made up of chlorite + illite (2,9), and late calcite (7) acts as the cement between grains.



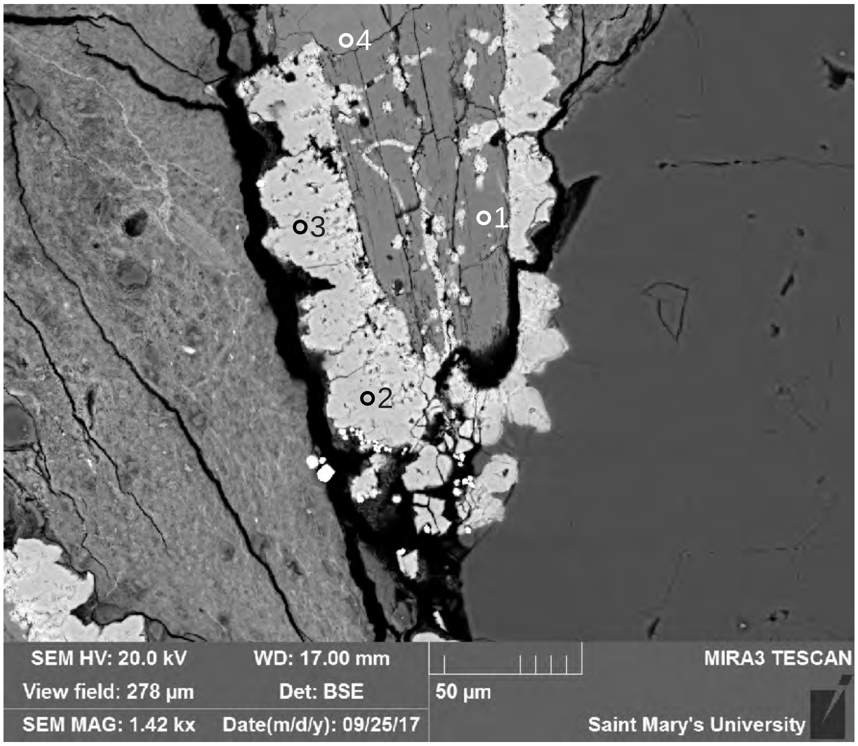
1:Quartz
2:Quartz
3:Halite
4:Chlorite + Illite
5:Halite
6:Chlorite + Illite + Halite
7:Quartz
8:Zircon
9:Glaucony
10:Quartz
11:K-feldspar + Halite
12:Kaolinite
13:Kaolinite
14:Illite + Chlorite?
15:Glauconite

Figure 1-9.6: Sample 5H-58 1906.89 (SEM) site 4. This site is similar to site 3. Zircon (8) appears to be an inclusion in quartz (7). Halite (3,5) still appears as a contaminant due to washing the core with salt water.



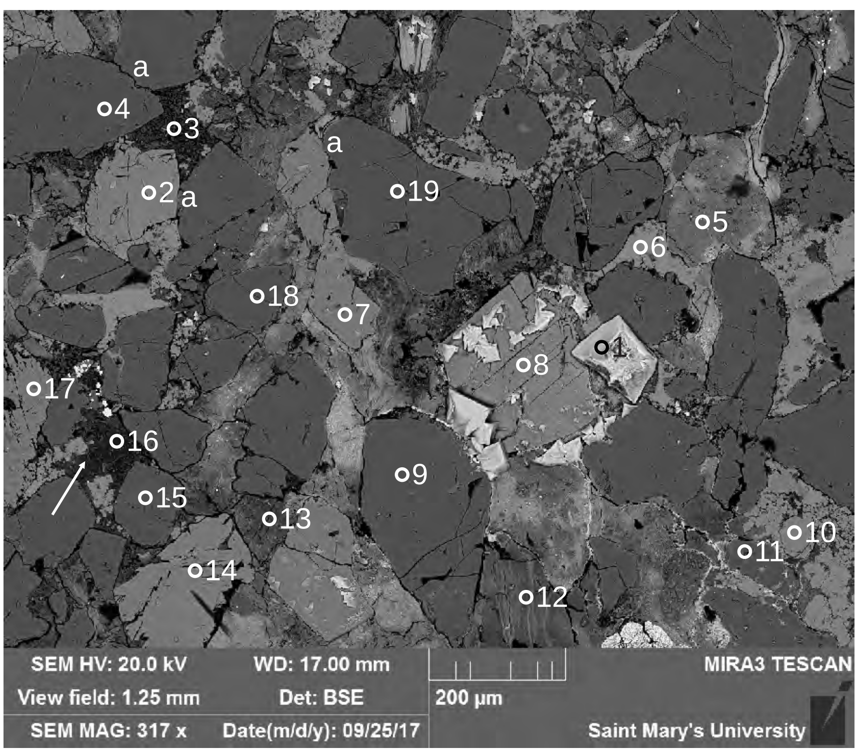
1:Quartz
2:Glauconite + Halite?
4:K-feldspar
5:Chloritized Muscovite
6:Quartz
7:Quartz
8:Calcite
9:Siderite
10:Siderite
11:Siderite +
12:Glaucony
13:Glaucony
14:Calcite
15:Siderite + Calcite
16:Chlorite + Muscovite
17:Quartz
18:Quartz

Figure 1-9.7: Sample 5H-58 1906.89 (SEM) site 5. This site consists of detrital quartz (1,6-7,17-18), K-feldspar (4), and chloritized muscovite (5) grains. The matrix consists of chlorite + muscovite (16), and the diagenetic minerals are glauconite (2), glaucony (12-13), probably kaolinite (position a), with late calcite (8,14) and siderite (9-11) making up the cement. Siderite (9) partially coats calcite (8).



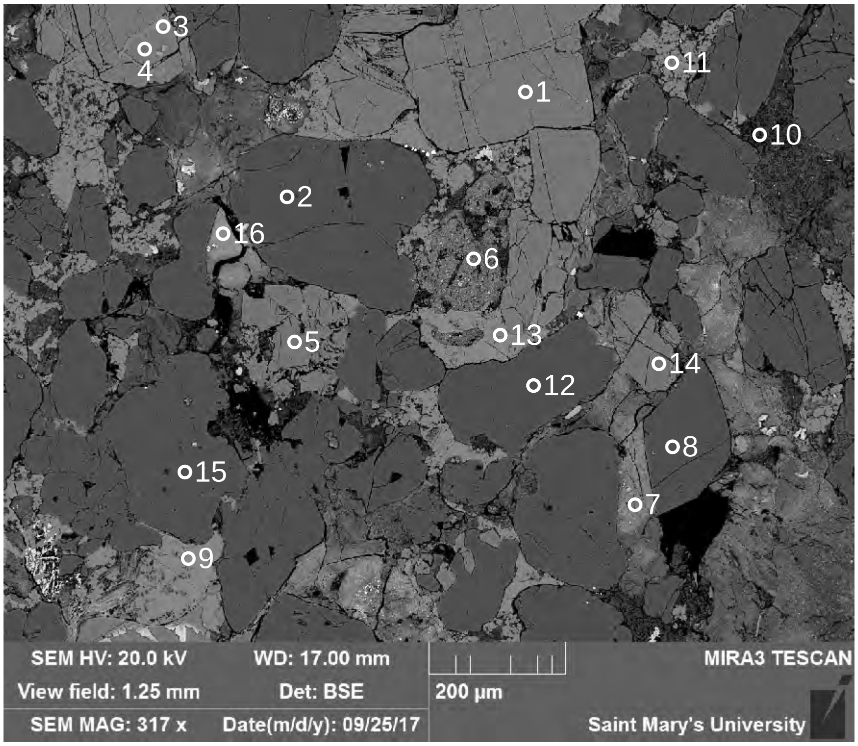
1:Calcite
2:Siderite
3:Siderite
4:Calcite

Figure 1-9.8: Sample 5H-58 1906.89 (SEM) site 5.1. This site consists of a calcite cement (1,4) that is partially coated by a late siderite (2-3) cement.



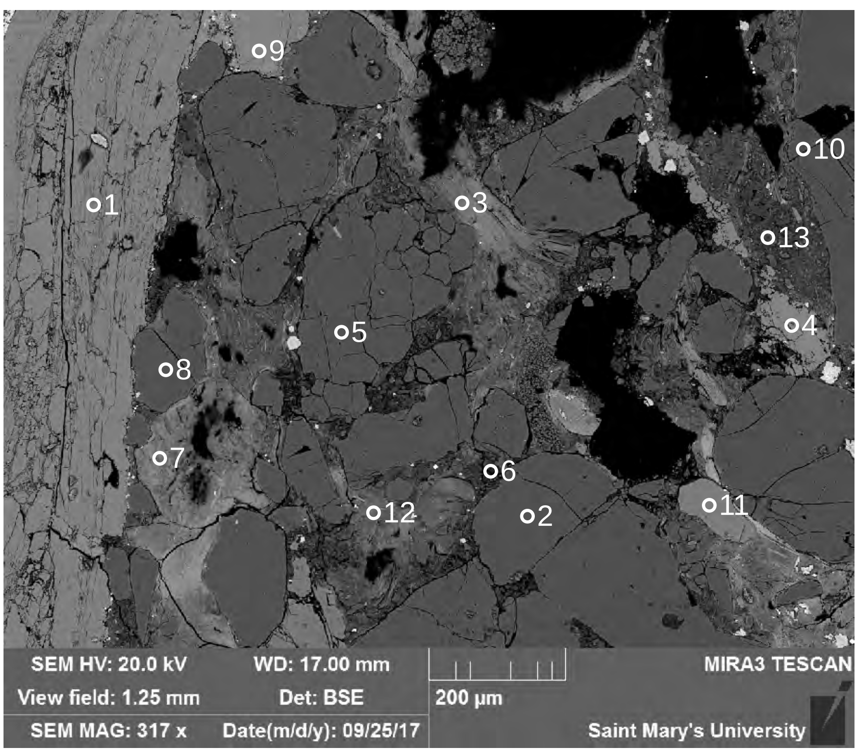
1:Halite
2:K-feldspar
3:Chlorite + Kaolinite
4:Quartz
5:Glauconite
6:Calcite
7:K-feldspar
8:K-feldspar
9:Quartz
10:K-feldspar
11:Quartz + Halite
12:Mixture
13:Chlorite + Illite ?
14:K-feldspar
15:Quartz
16:Kaolinite
17:K-feldspar
18:Quartz
19:Quartz

Figure 1-9.9: Sample 5H-58 1906.89 (SEM) site 6. This site is similar to site 2. Calcite appears to fill voids in kaolinite (16) (arrow). There also appears to be suturing between grains (positions a).



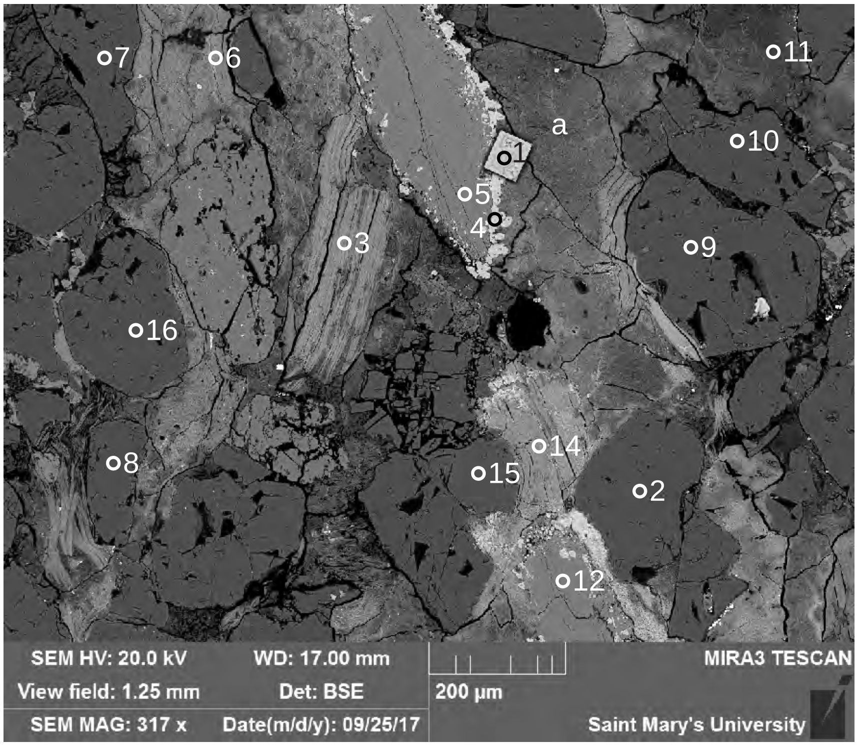
1:K-feldspar
2:Quartz
3:Calcite
4:K-feldspar
5:K-feldspar
6:Apatite +
7:Chlorite + Halite + K-feldspar
8:Quartz
9:Calcite
10:Kaolinite +
11:Calcite +
12:Quartz
13:Calcite +
14:K-feldspar
15:Quartz
16:Glauconite +

Figure 1-9.10: Sample 5H-58 1906.89 (SEM) site 7. This site consists of detrital quartz (2,8,12,16), K-feldspar (1,4-5,14), and apatite (6) grains. There is also glauconite (16). The cement between grains is made up of kaolinite (10), and calcite (3,9,11).



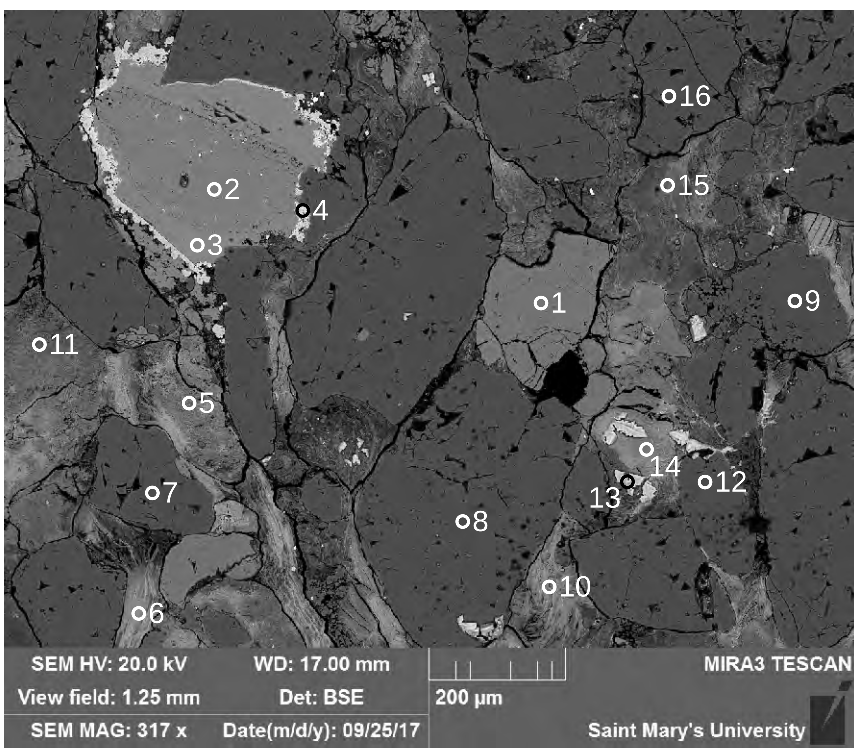
1:Calcite
2:Quartz
3:Chloritized Muscovite
4:Calcite
5:Quartz
6:Chlorite + Kaolinite +
7:Glaucony
8:Quartz
9:Calcite
10:Quartz
11:K-feldspar
12:Glauconite
13:Muscovite + Chlorite

Figure 1-9.11: Sample 5H-58 1906.89 (SEM) site 8. This site is similar to site 7. However, calcite (1) appears very large, suggesting that it is filling a fracture and is therefore late.



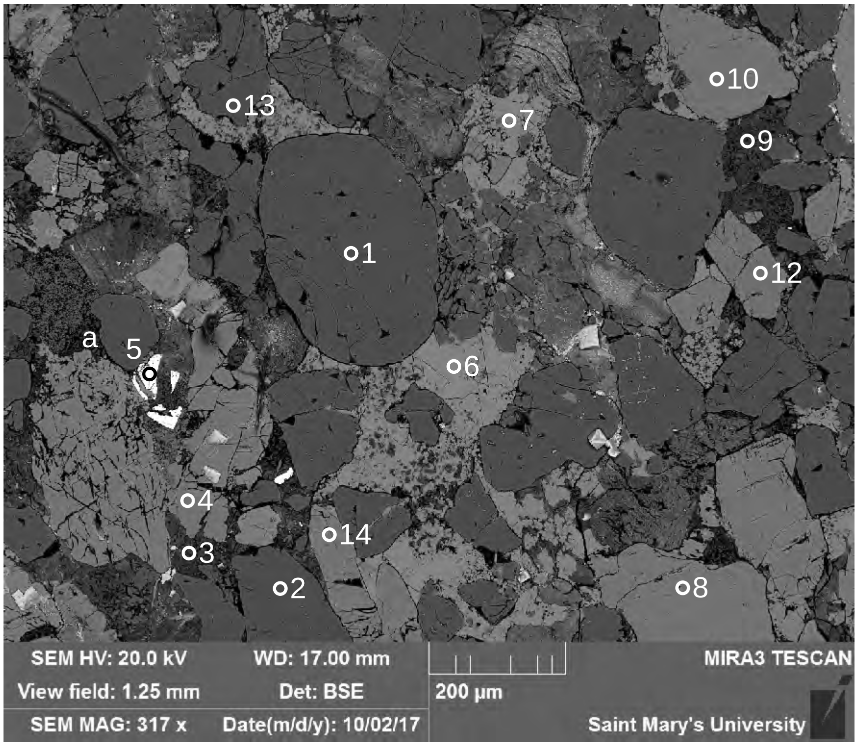
1:Halite
2:Quartz
3:Chlorite + Muscovite + Halite
4:Siderite
5:Calcite
6:Glauconite + Halite
7:Quartz
8:Quartz
9:Quartz
10:Quartz
11:Glaucony
12:Calcite
14:Chlorite + Halite + K-feldspar
15:Albite
16:Quartz

Figure 1-9.12: Sample 5H-58 1906.89 (SEM) site 9. This site consists of detrital quartz, K-feldspar, albite (15), and chloritized muscovite (3) grains. Quartz (15) appears to be partially ?brecciated. The cement is made up of calcite (5,12), and siderite (4). Siderite (4) partially coats calcite (5). There are also large grains of glaucony (11, position a).



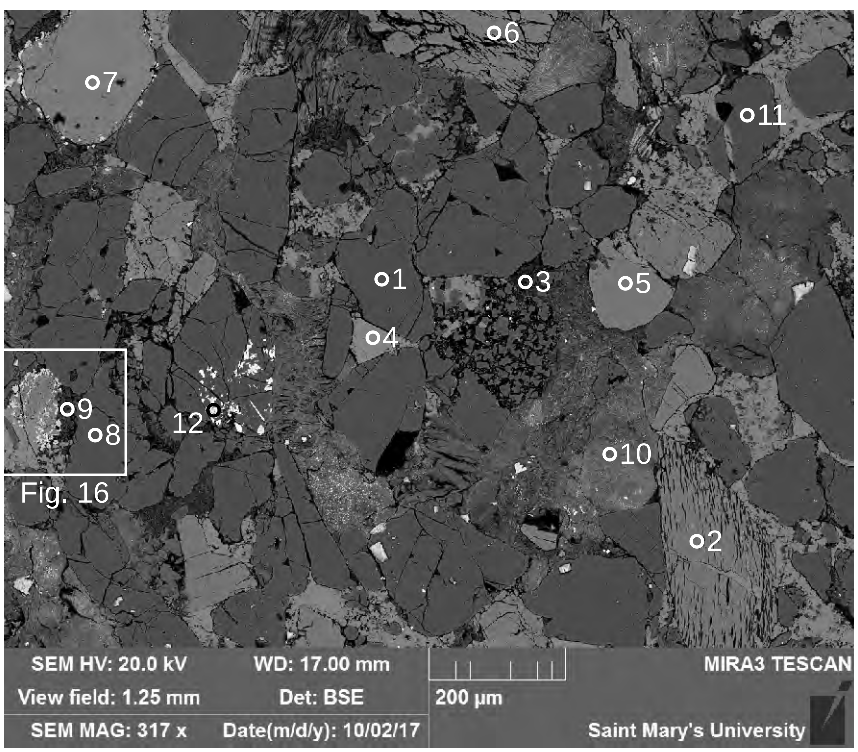
1:K-feldspar
2:Calcite
3:Calcite
4:Siderite +
5:Glauconite
6:Chloritized Biotite?
7:Quartz
8:Quartz
9:Quartz
10:Glaucony
11:Glaucony
12:Quartz
13:Halite
14:Glauconite + Halite
15:Chlorite + Glaucony + Halite
16:Quartz

Figure 1-9.13: Sample 5H-58 1906.89 (SEM) site 10. This site is similar to site 9. There is also detrital grains of chloritized biotite (6). Siderite (4) still partially coats calcite (2,3). Calcite (2) appears to pseudomorph a previous mineral.



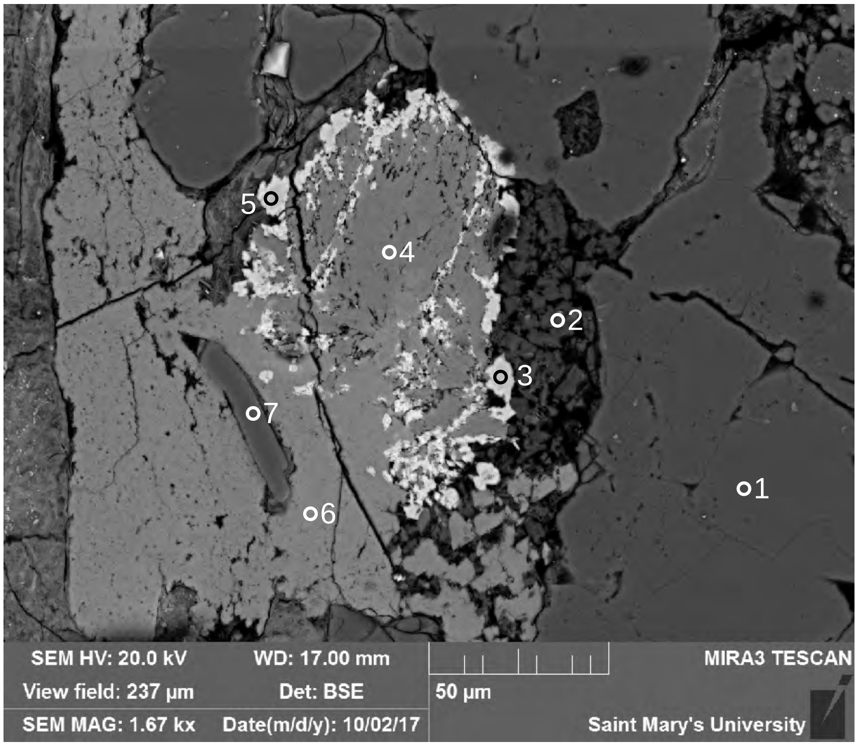
1:Quartz
2:Quartz
3:Kaolinite +
4:K-feldspar
5:"Ilmenite"
6:Calcite
7:Calcite
8:K-feldspar
9:Kaolinite
10:K-feldspar
12:K-feldspar
13:Quartz
14:K-feldspar

Figure 1-9.14: Sample 5H-58 1906.89 (SEM) site 11. This site consists of detrital quartz, K-feldspar, and altered ilmenite (5) grains. K-feldspar appears to be replaced by kaolinite (position a). The cement is made up of kaolinite (3,9) and calcite (6-7).



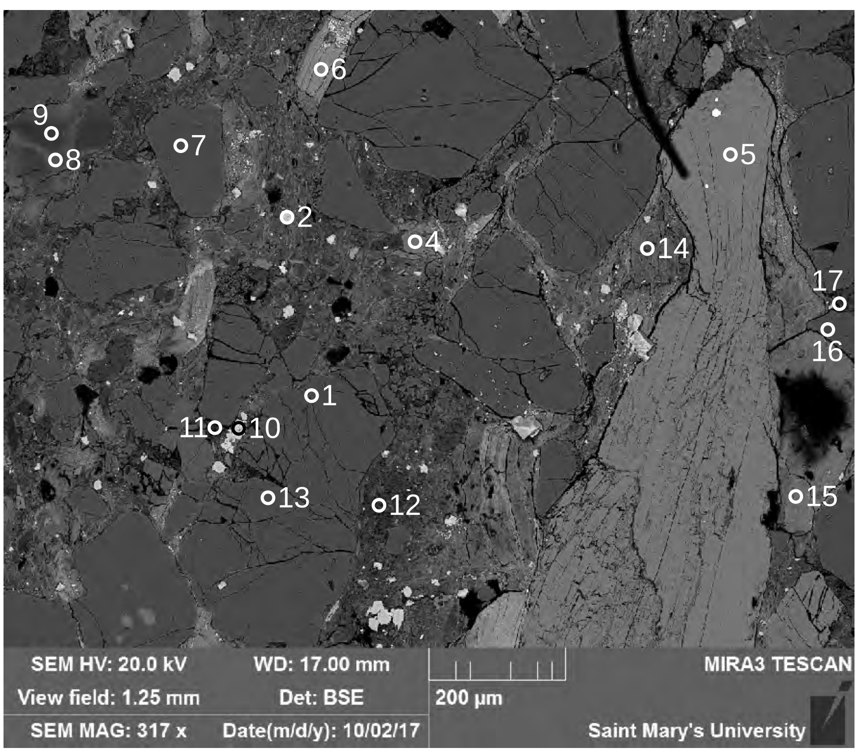
1:Quartz
2:K-feldspar
3:Kaolinite
4:Calcite
5:K-feldspar
6:K-feldspar
7:Calcite
8:Quartz
9:Kaolinite
10:Glauconite
11:Quartz
12:TiO_2

Figure 1-9.15: Sample 5H-58 1906.89 (SEM) site 12. This site consists of detrital quartz and K-feldspar grains. The cement is made up of kaolinite (3,9), and calcite (4,7). There is also glauconite (10), and late diagenetic titania (12).



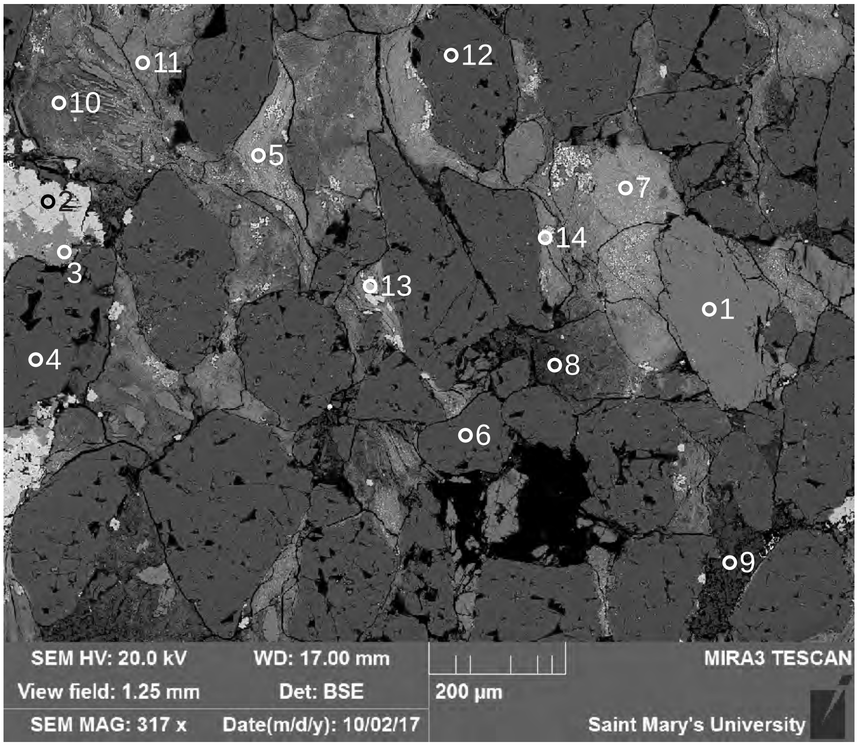
1:Quartz
2:Kaolinite
3:Siderite +
4:Calcite
5:Siderite
6:Calcite
7:Quartz

Figure 1-9.16: Sample 5H-58 1906.89 (SEM) site 12.1. This site consists of a detrital grain of quartz (1) with a cement around it made up of kaolinite (2), calcite (4,6) and siderite (3,5).



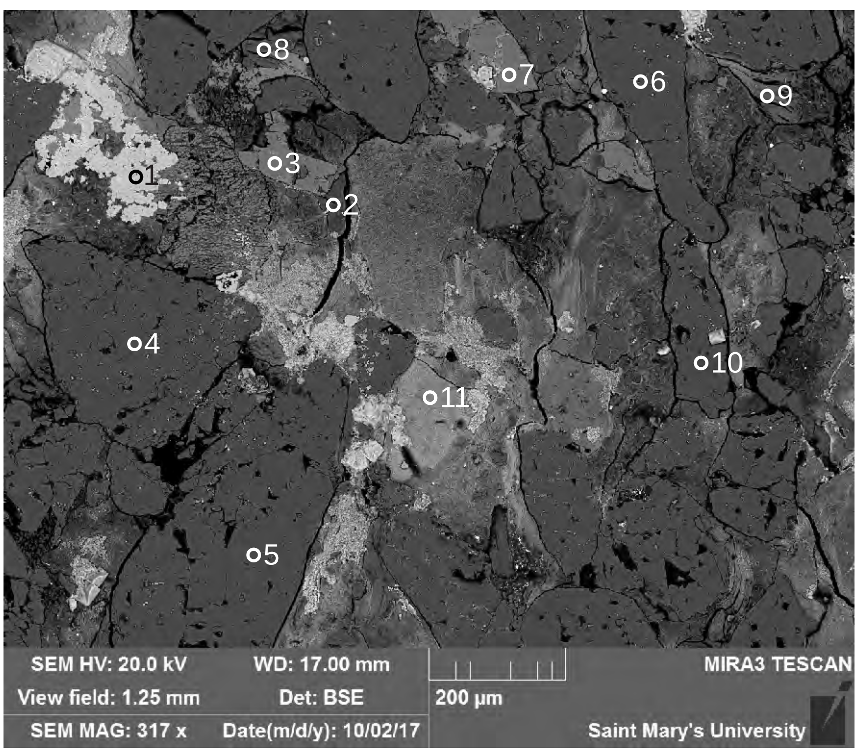
1:Quartz
2:Siderite +
4:K-feldspar
5:Calcite
6:Chlorite + Muscovite
7:Quartz
8:Glauconite + Halite
9:Glaucony
10:Siderite +
11:Kaolinite
12:Kaolinite
13:Quartz
14:Quartz
15:Glauconite
16:Quartz
17:Kaolinite

Figure 1-9.17: Sample 5H-58 1906.89 (SEM) site 13. This site consists of detrital quartz (1,7,13-14, 16), K-feldspar (4), and chlorite + muscovite (6). The cement is made up of kaolinite (11-12,17). There is also glauconite (8,15), glaucony (9), and a late calcite (5) ?vein most likely filling a fracture.



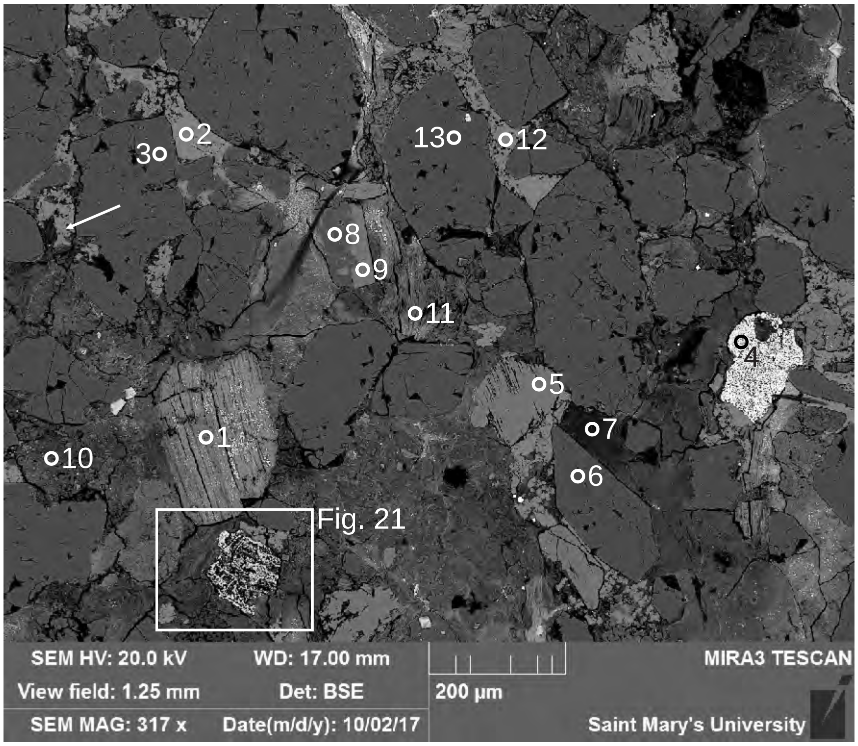
1:K-feldspar
2:Siderite + Halite
3:Calcite +
4:Quartz
5:Chlorite +
?Muscovite + Halite
6:Quartz
7:Glaucony
8:Glaucony
9:Kaolinite
10:Mixture
11:Glauconite
12:Quartz
13:Siderite +
14:Halite +

Figure 1-9.18: Sample 5H-58 1906.89 (SEM) site 14. This site is similar to site 11. The detrital quartz appears to have dissolution voids.



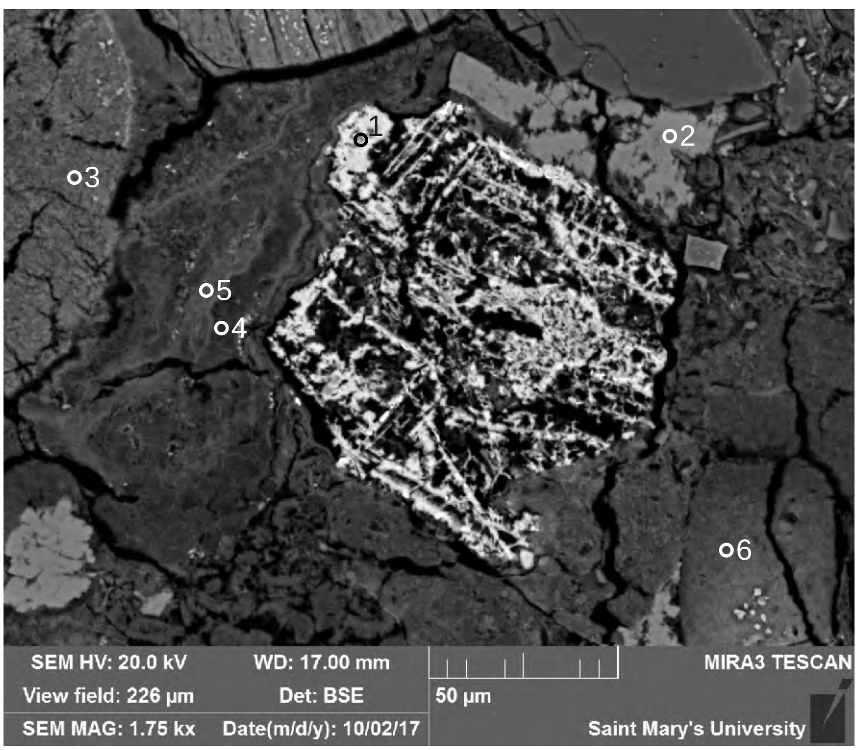
1:Siderite
2:Chlorite + Illite
3:K-feldspar
4:Quartz
5:Quartz
6:Quartz
7:K-feldspar
8:Glaucony
9:Chlorite +
Muscovite
10:Quartz
11:Glauconite

Figure 1-9.19: Sample 5H-58 1906.89 (SEM) site 15. This site consists of detrital quartz and K-feldspar grains. The matrix is made up of illite + chlorite (2,9). The cement is made up of probably kaolinite and calcite, and siderite (1). There is also small grains of glauconite (11), and glaucony (8).



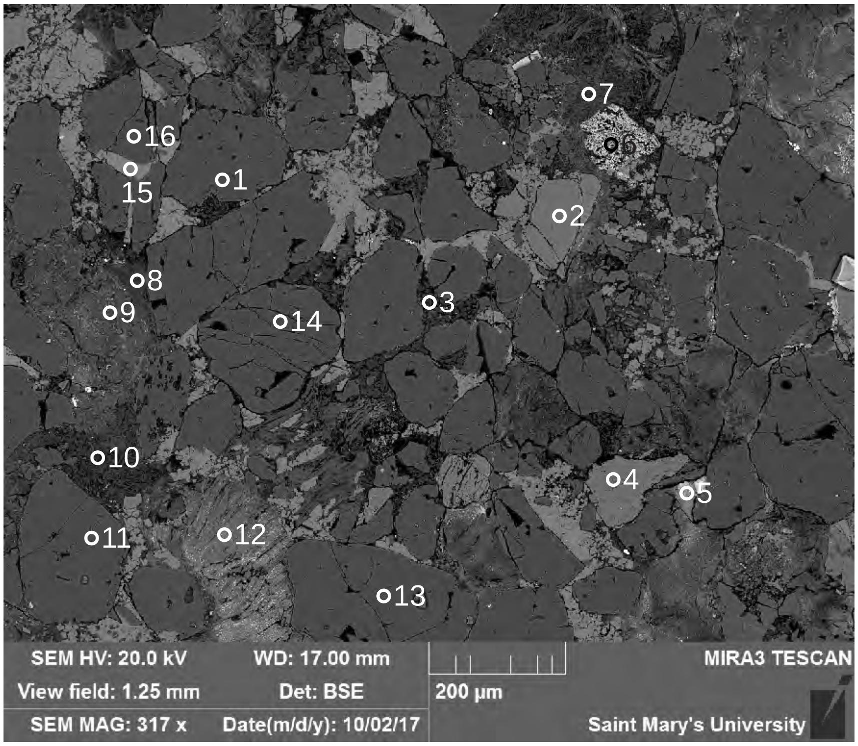
1:Chloritized Muscovite?
2:Calcite
3:Quartz
4:"Ilmenite"
5:K-feldspar
6:Quartz
7:Kaolinite +
8:Albite
9:K-feldspar
10:Glaucony
11:Glaucony
12:Calcite
13:Quartz

Figure 1-9.20: Sample 5H-58 1906.89 (SEM) site 16. This site consists of detrital quartz, K-feldspar, altered ilmenite (4), a granitic lithic clast made up of albite (8) and K-feldpsar (9), and chloritized biotite (1). There is also glauconite (10-11). The cement is made up of kaolinite (7), and calcite (2,12). Calcite appears later than the kaolinite (arrow).



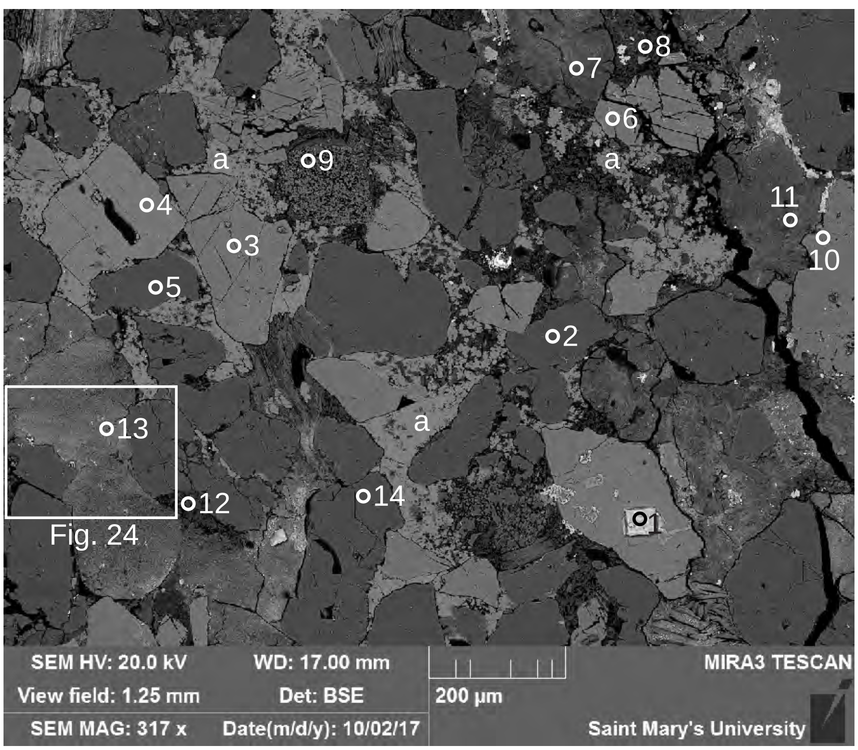
1:TiO_2 +
2:Calcite
3:Glauconite
4:Fe-chlorite
5:Glaucony
6:Glaucony

Figure 1-9.21: Sample 5H-58 1906.89 (SEM) site 16.1. This site consists of detrital titania (1) that is surrounded by glaucony (3,5-6) + Fe-chlorite (4) cement. A late calcite cement (2) is seen cross-cutting the glaucony and Fe-chlorite.



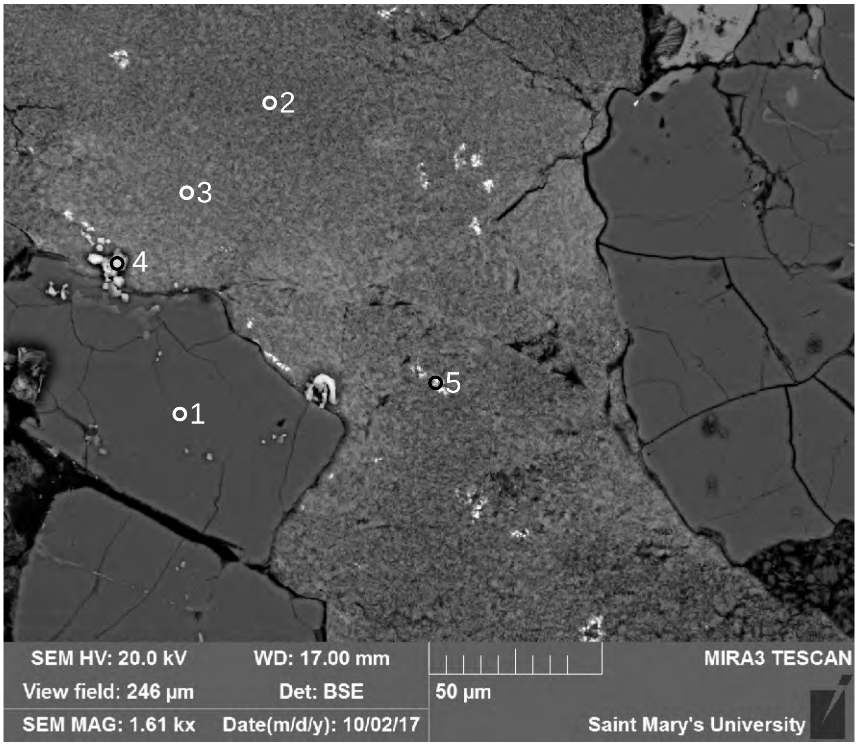
1:Quartz
2:K-feldspar
3:Kaolinite
4:K-feldspar
5:Glaucony
6:TiO_2 +
7:Glaucony
8:Chlorite + Illite
9:Glaucony
10:Kaolinite
11:Quartz
12:Glaucony
13:Quartz
14:Quartz
15:Calcite
16:Quartz

Figure 1-9.22: Sample 5H-58 1906.89 (SEM) site 17. This site is similar to site 16.



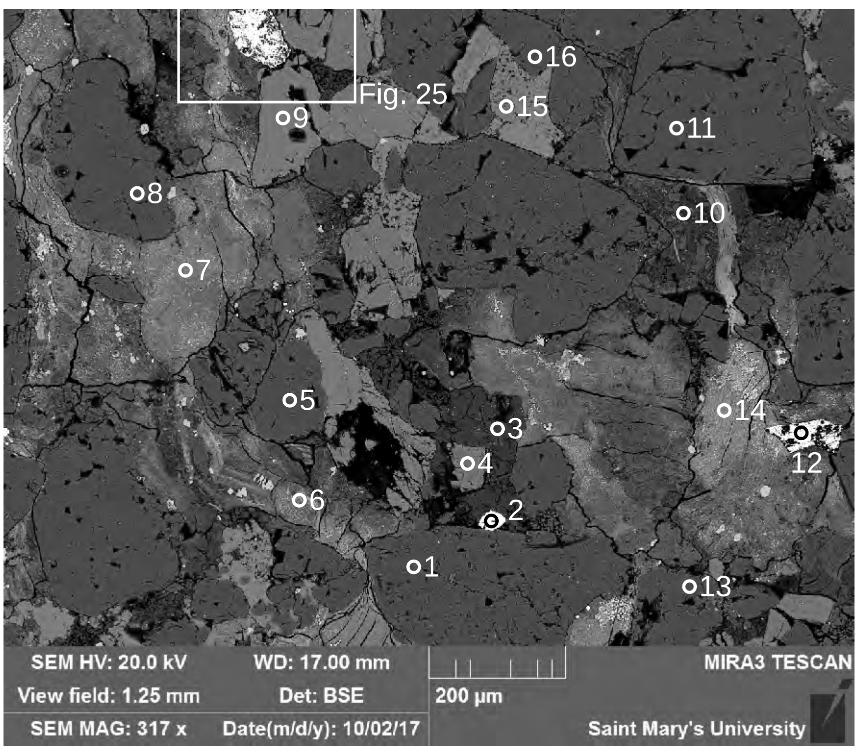
1:Halite
2:Quartz
3:K-feldspar
4:K-feldspar
5:Quartz
6:K-feldspar
7:Glaucony
8:Kaolinite
9:K-feldspar +
10:K-feldspar
11:Glauconite
12:Kaolinite
13:Glaucony
14:Quartz

Figure 1-9.23: Sample 5H-58 1906.89 (SEM) site 18. This site consists of detrital grains of quartz, and K-feldspar. Glauconite (11), glaucony (7,13), and kaolinite (8,12) make up the diagenetic minerals. The cement is made up of calcite (positions a).



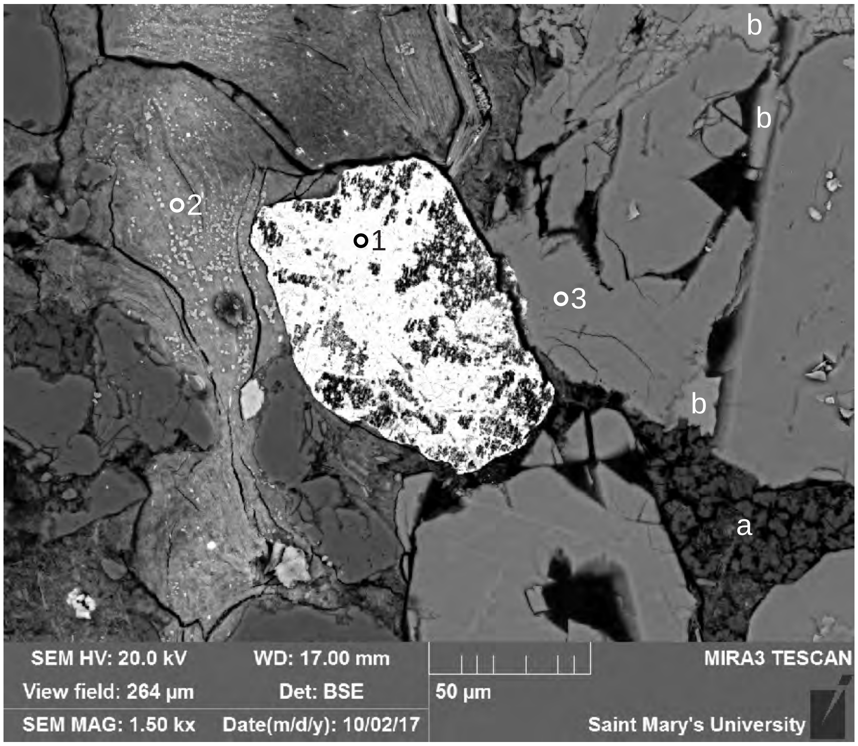
1:Quartz
2:Glauconite
3:Glauconite
4:Halite +
5:Glauconite +
Monazite

Figure 1-9.24: Sample 5H-58 1906.89 (SEM) site 18.1. This site shows a zoom in of the cement. The diagenetic minerals are made up of glauconite, with rare patches of monazite (5).



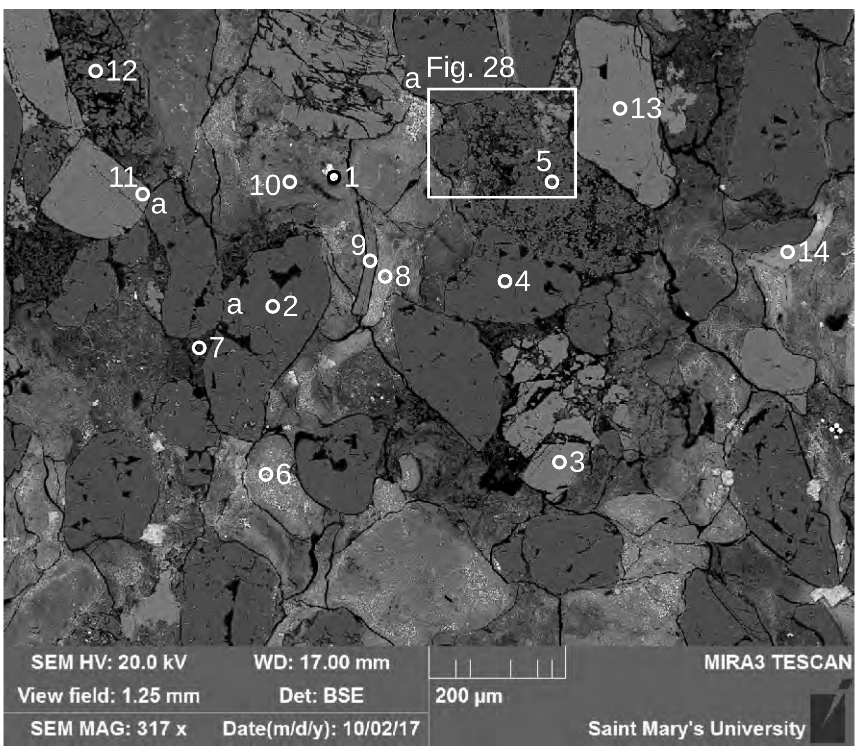
1:Quartz
2:Chalcopyrite
3:Kaolinite
4:K-feldspar
5:Quartz
6:Glaucony
7:Glauconite
8:Quartz
9:K-feldspar
10:Kaolinite
11:Quartz
12:Ilmenite
13:Quartz
14:Glauconite
15:Calcite +
16:Quartz

Figure 1-9.25: Sample 5H-58 1906.89 (SEM) site 19. This site is similar to site 16. There is also a detrital grain of chalcopyrite (2) and a partially dissolved ilmenite (12) grain.



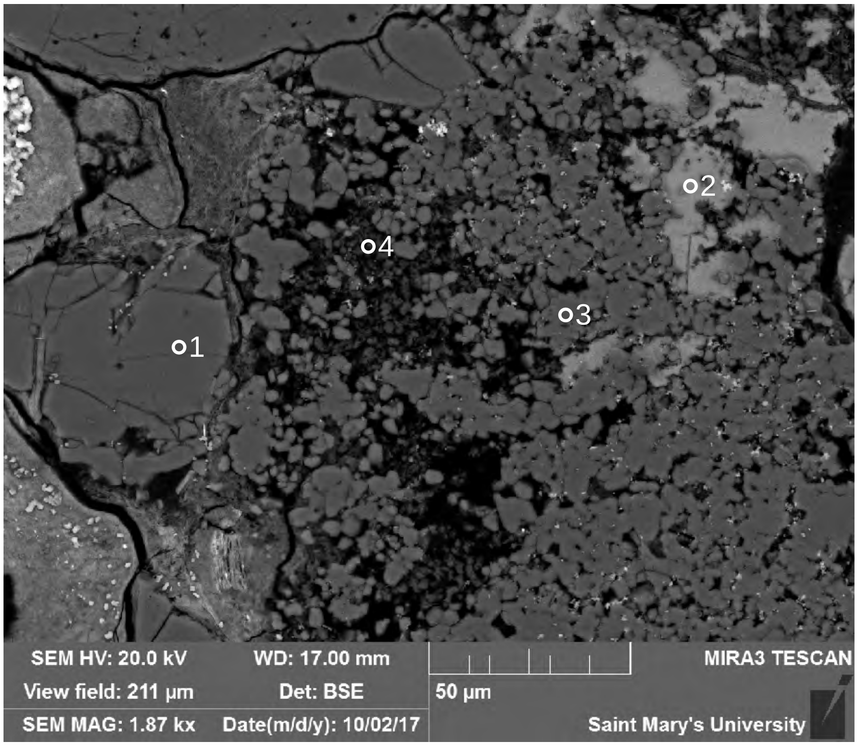
1:Ilmenite
2:Chlorite + Halite + Glaucony
3:K-feldspar

Figure 1-9.26: Sample 5H-58 1906.89 (SEM) site 19.1. This site consists of a detrital grain of ilmenite (1), and K-feldspar (3). The matrix appears to be made up of glaucony + chlorite (2) and kaolinite (position a), and calcite (positions b) makes up the cement.



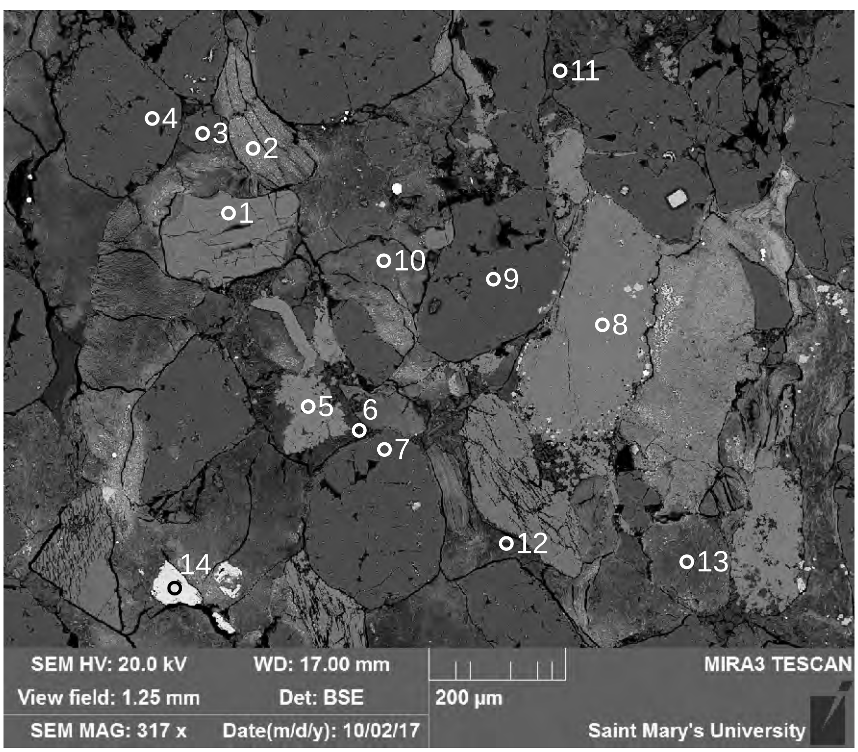
1:Ilmenite
2:Quartz
3:K-feldspar
4:Quartz
5:Quartz
6:Glauconite + Halite
7:Kaolinite
8:Fe-chlorite + Halite
9:Muscovite
10:Glauconite
11:K-feldspar
12:Albite
13:K-feldspar
14:Chloritized Biotite?

Figure 1-9.27: Sample 5H-58 1906.89 (SEM) site 20. This site is similar to site 16. Detrital quartz and K-feldspar grains appear to be partially altered. Suturing is common (positions a).



1:Quartz
2:Calcite +
3:Quartz +
4:Kaolinite

Figure 1-9.28: Sample 5H-58 1906.89 (SEM) site 20.1. This site consists of an altered grain of quartz (1,3), with kaolinite (4) and late calcite (2).



1:K-feldspar
2:Chloritized Biotite + Halite
3:Quartz
4:Quartz
5:Calcite + Mixture
6:Kaolinite
7:Quartz
8:Calcite
9:Quartz
10:Glauconite
11:Glauconite
12:Chlorite + Biotite?
13:Glaucony
14:TiO_2

Figure 1-9.29: Sample 5H-58 1906.89 (SEM) site 21. This site is similar to site 16. There is also a detrital grain of titania (14).

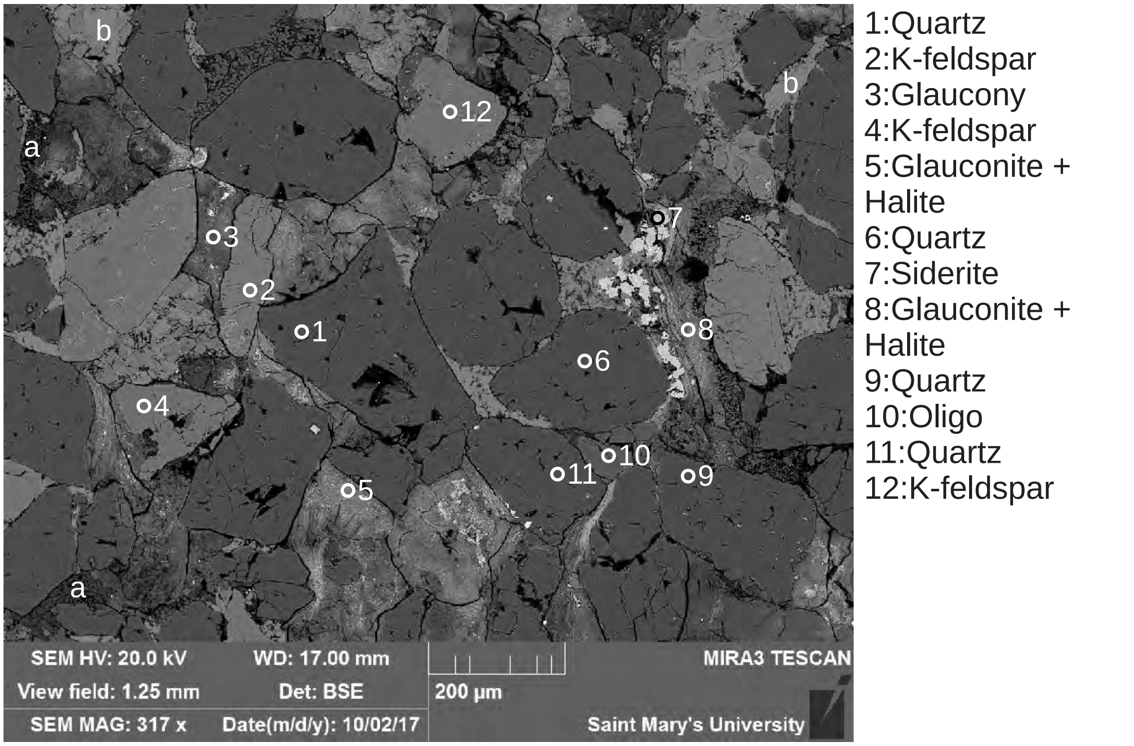


Figure 1-9.30: Sample 5H-58 1906.89 (SEM) site 22. This site consists of detrital quartz (1,6,9,11), K-feldspar (2,4,12), and oligoclase (10). The cement is made up of probably kaolinite (positions a), calcite (positions b), and siderite (7). There is also diagenetic glauconite (5,8), and glaucony (3).

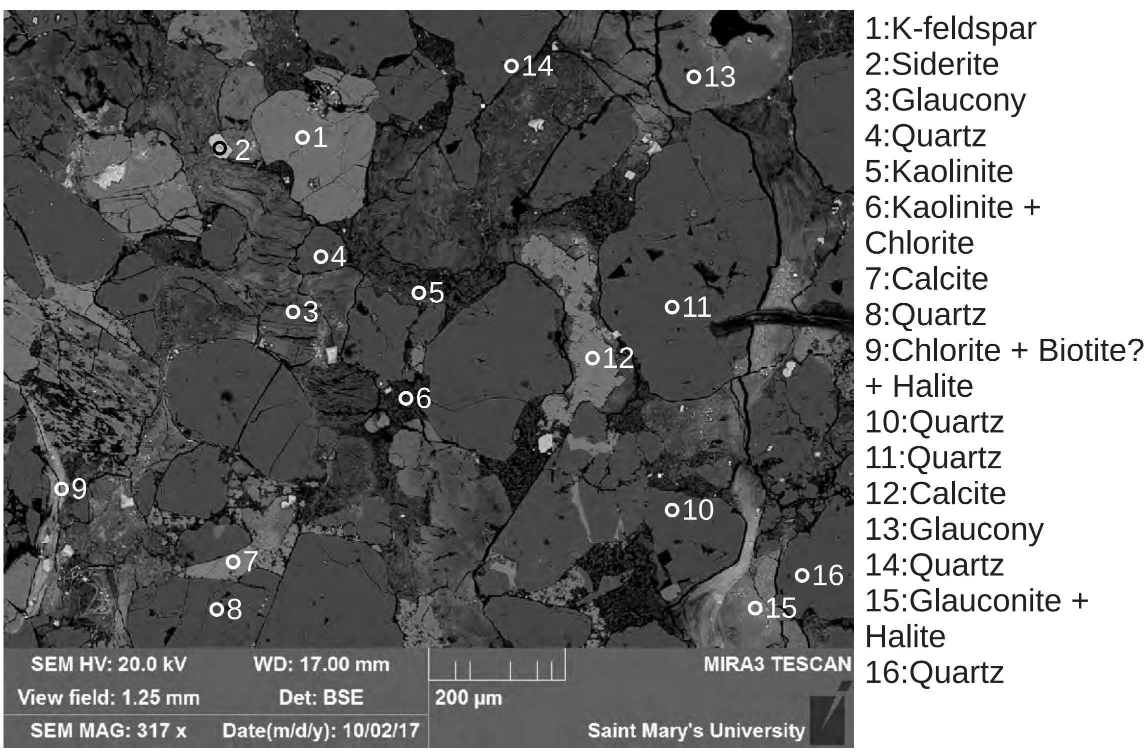
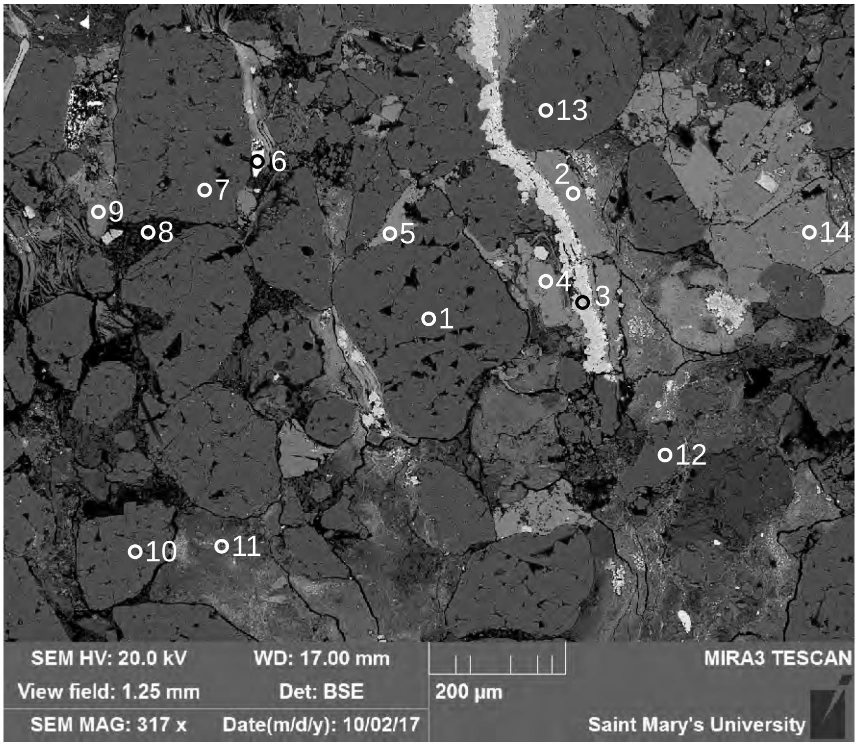
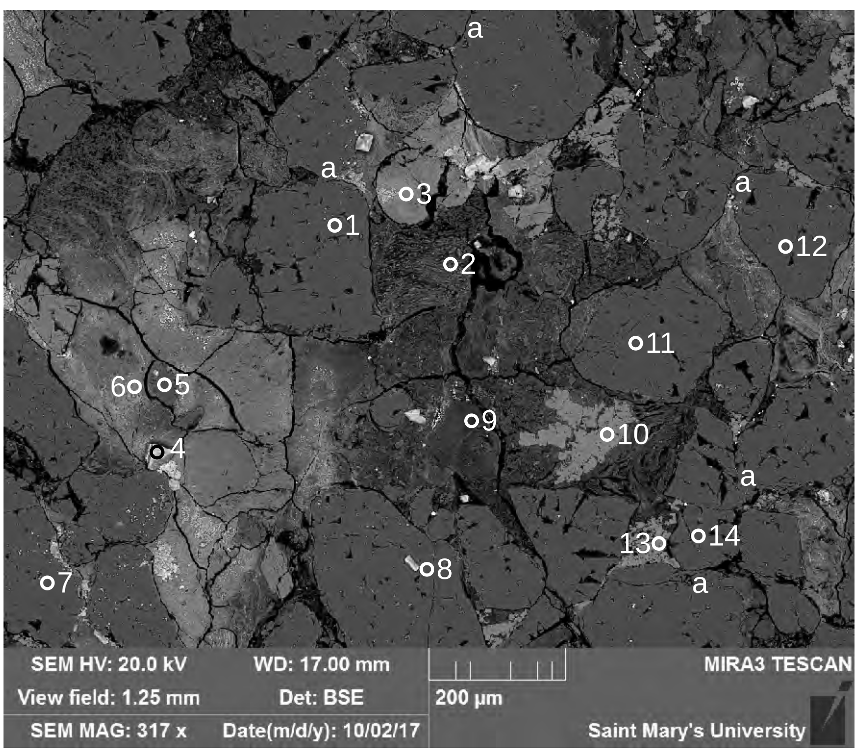


Figure 1-9.31: Sample 5H-58 1906.89 (SEM) site 23. This site is similar to site 22. The matrix in the site also consists of kaolinite + chlorite (6).



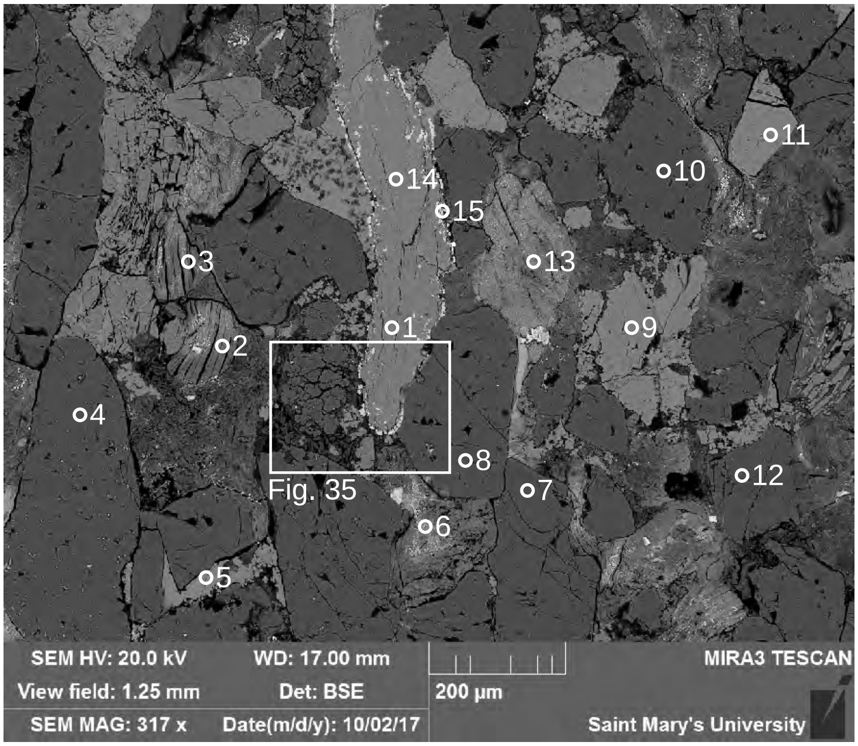
1:Quartz
2:Calcite
3:Siderite
4:Calcite +
5:Calcite
6:Ilmenite
7:Quartz +
8:Kaolinite
9:Glauconite
10:Quartz
11:Glaucony +
Halite
12:Quartz
13:Quartz
14:K-feldspar

Figure 1-9.32: Sample 5H-58 1906.89 (SEM) site 24. This site is similar to site 22. There is also a vein of late diagenetic siderite (3). Detrital quartz and K-feldspar grains contain abundant dissolution voids.



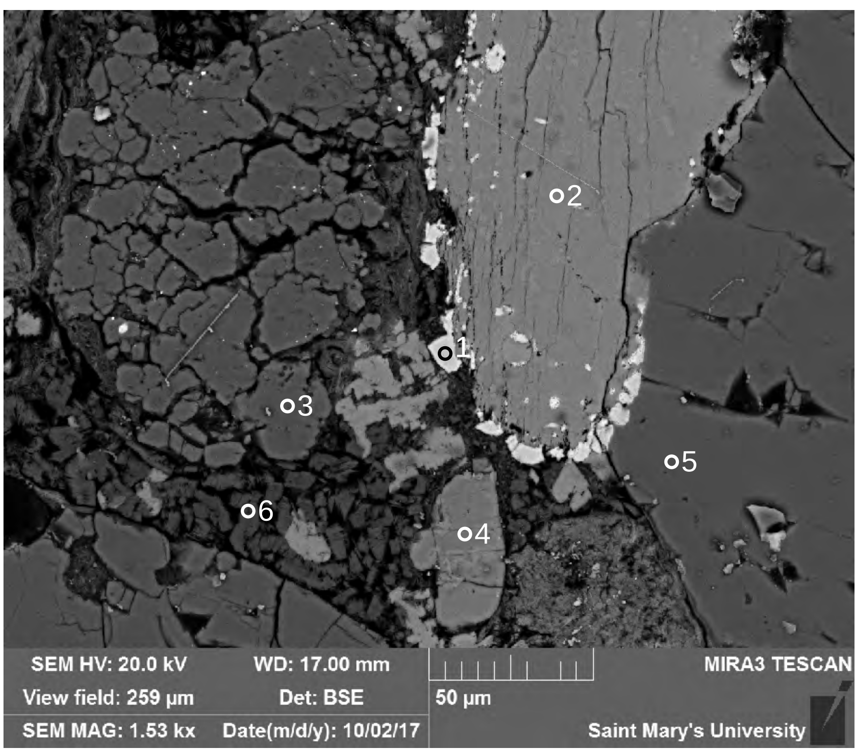
1:Quartz
2:Illite + Chlorite
3:Glauconite
4:Halite
5:Quartz
6:Glauconite
7:Quartz
8:Quartz
9:Glaucony ?
10:Calcite +
11:Quartz
12:Quartz
13:Calcite +
14:Quartz

Figure 1-9.33: Sample 5H-58 1906.89 (SEM) site 25. This site is similar to site 24. Suturing is common between quartz grains (positions a).



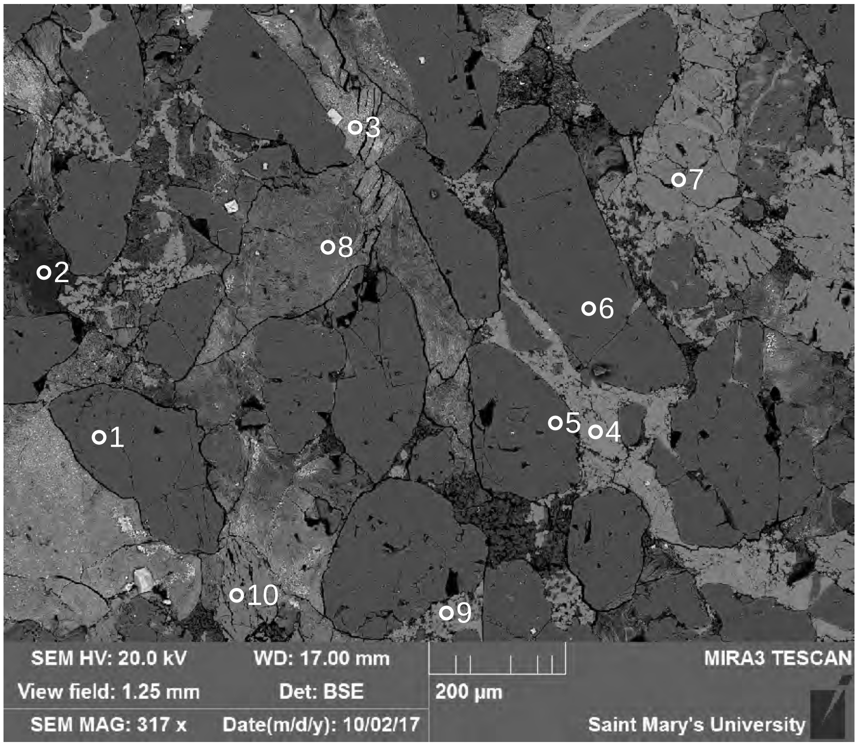
1:Calcite
2:Chloritized Muscovite
3:Chloritized Muscovite
4:Quartz
5:Calcite
6:Glauconite + Halite
7:Quartz
8:Quartz
9:K-feldspar
10:Quartz
11:K-feldspar
12:Quartz
13:Glauconite +
14:Calcite
15:Siderite

Figure 1-9.34: Sample 5H-58 1906.89 (SEM) site 26. This site is similar to site 9.



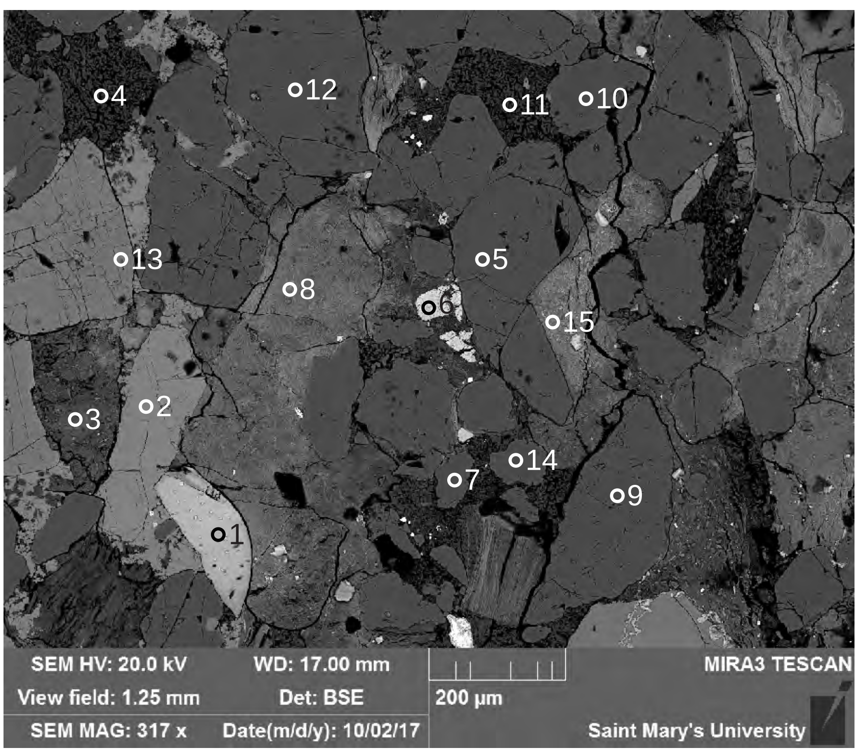
1:Siderite
2:Calcite
3:Quartz
4:K-feldspar
5:Quartz
6:Kaolinite

Figure 1-9.35: Sample 5H-58 1906.89 (SEM) site 26.1. This site consists of detrital quartz (3,5) grains with a kaolinite (6), calcite (2) and late siderite (1) cement. The calcite is partially coated by late siderite (1).



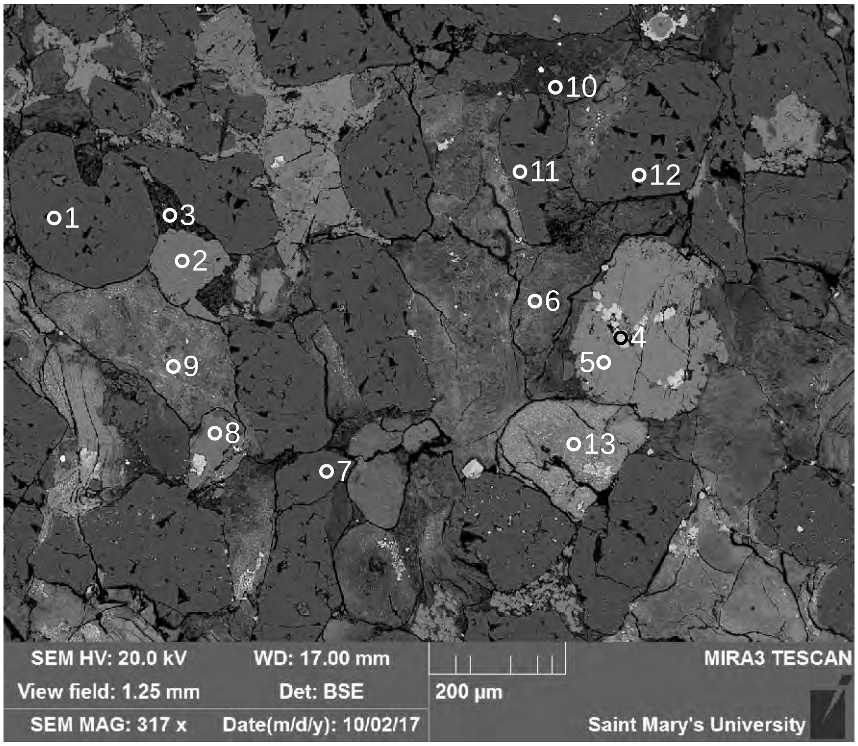
1:Quartz
2:Kaolinite +
3:Glauconite? +
Halite
4:Calcite
5:Quartz
6:Quartz
7:K-feldspar
8:Glaucony
9:Calcite +
10:K-feldspar

Figure 1-9.36: Sample 5H-58 1906.89 (SEM) site 27. This site is similar to site 22. Calcite veinlets cross-cut K-feldspar (7). This site consists of detrital quartz (1,5-6) and K-feldspar (7,10) grains. Glauconite (3), and glaucony (8) make up some of the framework grains. Kaolinite (2) and calcite (4,9) make up the cement with calcite being the latest.



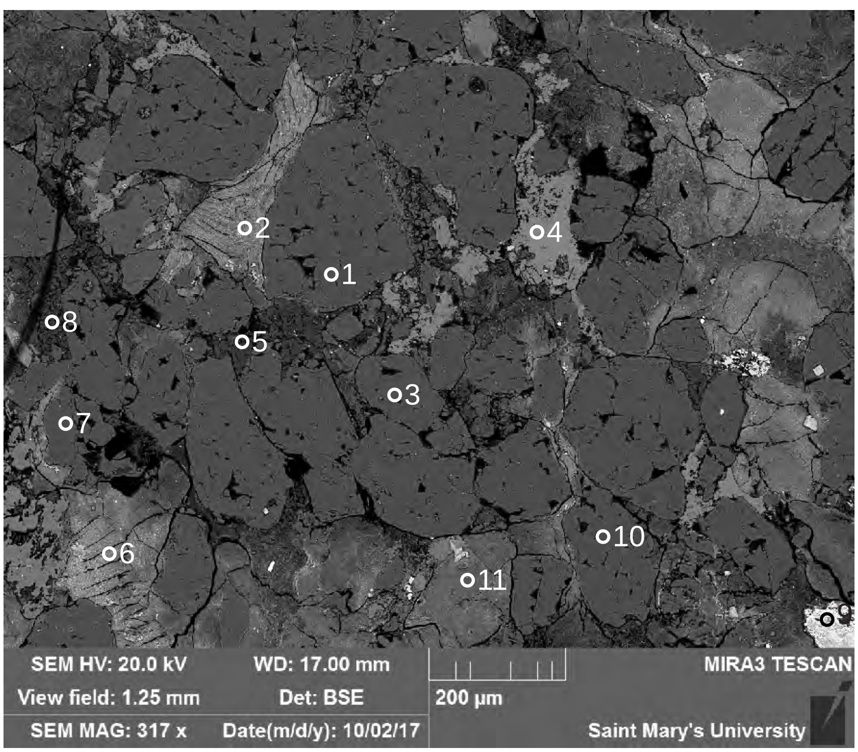
1:Halite + Apatite
2:Calcite
3:Glauconite +
Halite
4:Kaolinite
5:Quartz
6:"Ilmenite"
7:Quartz
8:Glauconite +
Halite +
9:Quartz
10:Quartz
11:Kaolinite
12:Quartz
13:K-feldspar
14:Quartz
15:Glauconite +
Halite

Figure 1-9.37: Sample 5H-58 1906.89 (SEM) site 28. This site consists of detrital quartz (5,7,9-10,12,14), K-feldspar (13), altered ilmenite (6), and apatite (1). The cement is made up of kaolinite (4,11), and calcite (2). Glauconite (3,8,15) also acts as framework grains.



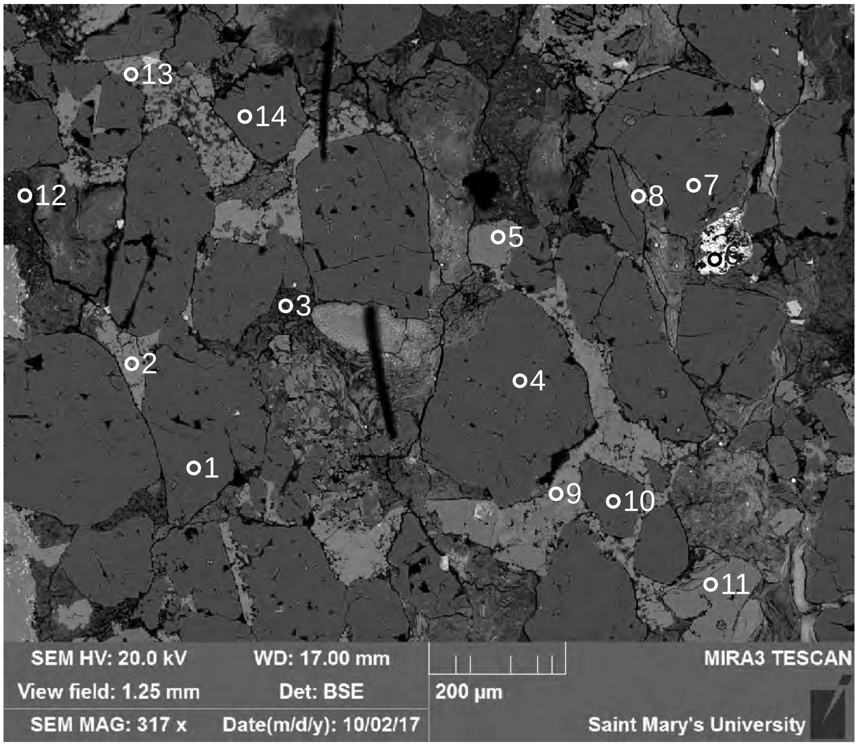
1:Quartz
2:K-feldspar
3:Kaolinite
4:Siderite
5:Calcite
6:Glauconite + Halite
7:Quartz
8:K-feldspar
9:Glauconite + Halite
10:Kaolinite
11:Quartz
12:Quartz
13:Glauconite

Figure 1-9.38: Sample 5H-58 1906.89 (SEM) site 29. This site is similar to site 28. Late diagenetic siderite partially fills voids in calcite (5).



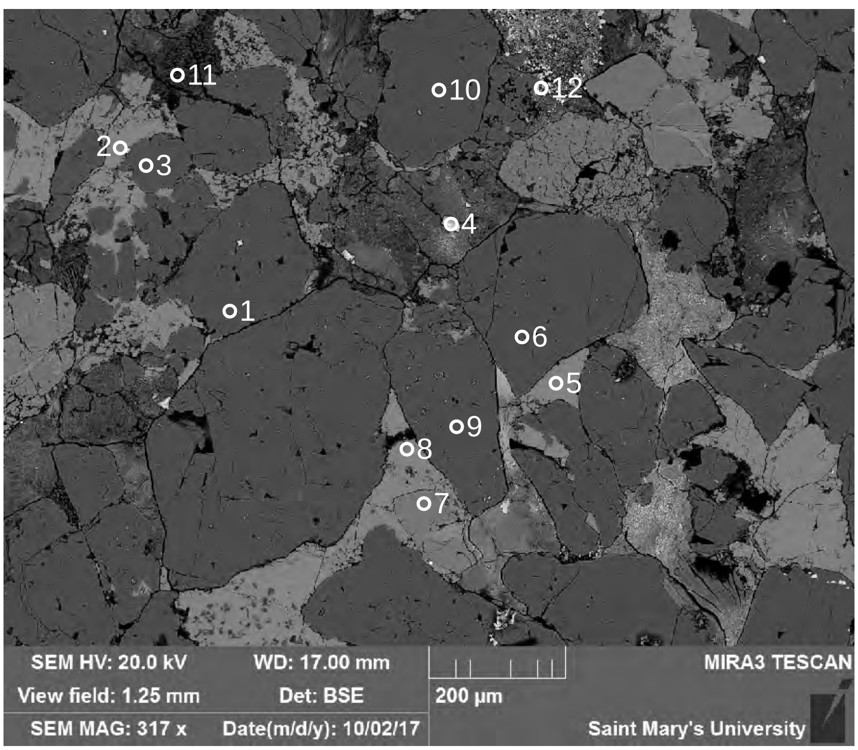
1:Quartz
2:Glauconite
3:Quartz
4:Calcite
5:Kaolinite +
6:Glauconite +
7:Quartz
8:Kaolinite
9:"Ilmenite"
10:Quartz
11:Glauconite

Figure 1-9.39: Sample 5H-58 1906.89 (SEM) site 30. This site consists of detrital quartz (1,3,7,10), and altered ilmenite (9) grains. The cement between grains consists of kaolinite (5,8), and calcite (4). Glauconite (2,6,11) acts as framework grains.



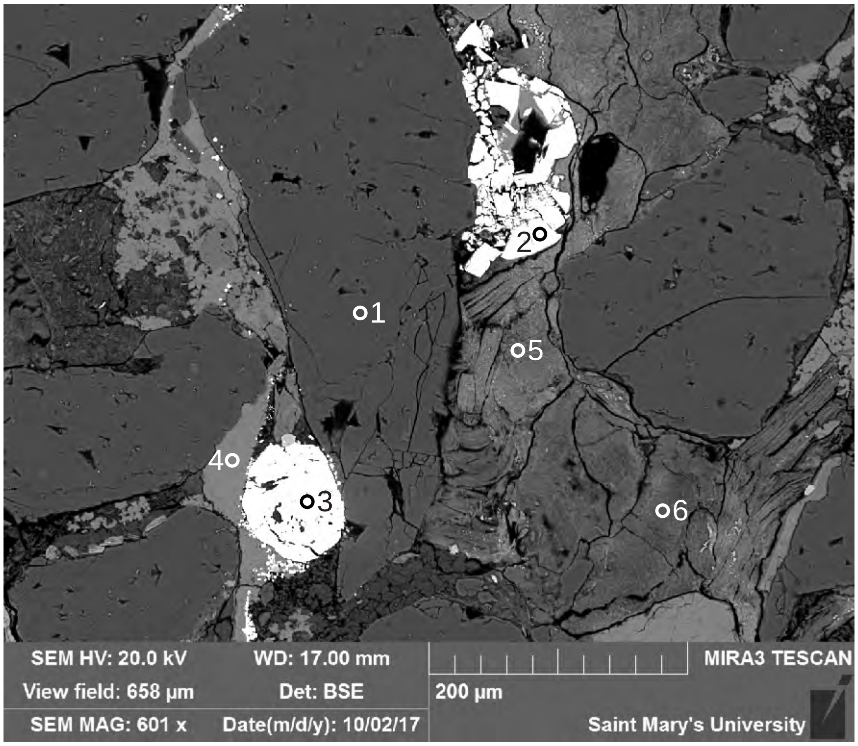
1:Quartz
2:Calcite +
3:Kaolinite
4:Quartz
5:K-feldspar
6:Ilmenite
7:Quartz
8:Glauconite
9:K-feldspar
10:Quartz +
11:K-feldspar
12:Kaolinite
13:Calcite +
Kaolinite
14:Quartz

Figure 1-9.40: Sample 5H-58 1906.89 (SEM) site 31. This site is similar to site 30. There is also detrital ilmenite (6). Calcite (13) partially fills voids in kaolinite.



1:Quartz
2:Calcite
3:Quartz
4:Halite
5:Calcite
6:Quartz
7:K-feldspar
8:Calcite
9:Quartz
10:Quartz
11:Kaolinite
12:Siderite +

Figure 1-9.41: Sample 5H-58 1906.89 (SEM) site 32. This site consists of detrital quartz (1,3,6,9-10), and K-feldspar (7) grains. The cement is made up of kaolinite (11), calcite (2,5,8), and late siderite (12).



1:Quartz
2:Zircon
3:Monazite- (Ce)
4:Calcite
5:Glauconite + Halite
6:Glauconite + Halite

Figure 1-9.42: Sample 5H-58 1906.89 (SEM) site 33. This site consists of detrital quartz (1), zircon (2) and monazite (3) grains. The cement between these grains is made up of calcite (4). Glauconite (5-6) acts as framework grains formed by early diagenesis.

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	1	1	Cal				2.25	1.10	0.44	52.21																			56	54
5H-58 1906.89	1	2	Qz	100.00																									100	117
5H-58 1906.89	1	3	Cal				2.00	1.04	0.41	52.54																			56	55
5H-58 1906.89	1	4	Qz	100.00																									100	117
5H-58 1906.89	1	5	Chloritized Ms	51.77	0.32	14.15	21.08		3.80		1.36	6.95				0.57													100	101
5H-58 1906.89	1	6	Kfs	65.45		18.29					2.72	13.23				0.31													100	111
5H-58 1906.89	1	7	Kfs	66.21		17.69					0.61	15.49																	100	113
5H-58 1906.89	1	8	Ill + Chl	47.98		19.41	13.58		2.76	0.36	0.94	4.22				0.75													90	72
5H-58 1906.89	1	9	Ill + Chl	54.21		13.53	20.03		3.56		1.17	6.57				0.94													100	82
5H-58 1906.89	1	10	Qz	100.00																									100	121
5H-58 1906.89	1	11	Kfs	65.82		17.72					1.00	15.45																	100	113
5H-58 1906.89	1	12	Hl	0.51						0.59	44.11	0.42				54.38													100	118
5H-58 1906.89	1	13	Qz	100.00																									100	122
5H-58 1906.89	1	14	Cal				1.45	0.98	0.34	53.23																			56	58
5H-58 1906.89	1	15	Sd	0.93			45.89	1.80	3.18	2.41	0.55		0.54			0.71													56	64
5H-58 1906.89	1	16	Ill + Chl	52.98		14.92	18.06		2.91		2.21	7.46				1.46													100	91
5H-58 1906.89	1	17	Qz	100.00																									100	118
5H-58 1906.89	1	18	Glt	48.25		11.67	16.43		3.20		0.59	6.12				0.74													87	72
5H-58 1906.89	1	19	TiO2	0.75	97.99		1.26																						100	103
5H-58 1906.89	2	1	Qz	100.00																									100	116
5H-58 1906.89	2	2	Cal +	3.84		2.41	4.58	1.68	0.87	86.62																			100	57
5H-58 1906.89	2	3	Kfs	66.06		17.94					0.60	15.40																	100	111
5H-58 1906.89	2	4	Hl + Kfs	33.46		8.37					27.94	8.12				22.12													100	120
5H-58 1906.89	2	6	Qz	100.00																									100	119
5H-58 1906.89	2	7	Kln	48.33		37.24					0.26					0.17													86	93
5H-58 1906.89	2	8	Kfs	66.29		17.71					0.66	15.35																	100	117
5H-58 1906.89	2	9	Cal				1.92	0.92	0.44	52.72																			56	57
5H-58 1906.89	2	10	Qz	100.00																									100	114
5H-58 1906.89	2	11	Qz	100.00																									100	116
5H-58 1906.89	2	13	Qz	100.00																									100	114
5H-58 1906.89	2	14	Chl + Kfs	41.31	0.74	16.73	20.07		8.56	5.16	1.79	3.72	1.24			0.68													100	90
5H-58 1906.89	2	15	Chl + Ill ?	54.83		13.51	18.78		3.11		1.38	7.65				0.74													100	101
5H-58 1906.89	2	16	Qz	100.00																									100	118
5H-58 1906.89	2	17	Chl + Ill	50.59		25.01	18.39		2.48		1.19	1.21				1.13													100	50
5H-58 1906.89	2	18	Kfs	65.70		17.77					0.44	15.42										0.67							100	111
5H-58 1906.89	2.1	1	Kfs	66.10		17.70					0.86	15.12				0.21													100	116
5H-58 1906.89	2.1	2	Qz	100.00																									100	120
5H-58 1906.89	2.1	3	Chl + Ill	52.76		17.22	17.80		3.44		1.54	5.53				1.71													100	85
5H-58 1906.89	2.1	4	Hl	1.29		0.33	0.26				39.38	0.51				58.24													100	105
5H-58 1906.89	2.1	5	Cal				1.13	0.50		54.38																			56	56
5H-58 1906.89	2.1	6	Kln	48.68		37.32																							86	94
5H-58 1906.89	2.1	7	Chloritized Ms	49.40	0.96	18.33	17.13		5.78		0.70	7.12				0.58													100	94
5H-58 1906.89	3	1	Kfs	65.77		17.73					0.96	14.73										0.81							100	118
5H-58 1906.89	3	2	Chl + Ill	49.70		14.44	23.14		4.25		1.14	5.86				1.12	0.34												100	85
5H-58 1906.89	3	3	Qz	98.81							0.82					0.36													100	104
5H-58 1906.89	3	4	Qz	100.00																									100	118
5H-58 1906.89	3	5	Hl	0.56							48.15	0.38				50.91													100	144
5H-58 1906.89	3	6	Gly	47.10		10.96	17.70		2.92		0.97	6.46				0.89													87	86
5H-58 1906.89	3	7	Cal				2.26	1.04	0.42	52.28																			56	54
5H-58 1906.89	3	8	Qz	100.00																									100	118

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	3	9	Chl + ?Kfs	46.09		10.60	18.16		3.22		0.82	5.61				0.50													85	87
5H-58 1906.89	3	10	Glt	47.17		10.85	18.59		3.30		0.84	5.74				0.51													87	72
5H-58 1906.89	4	1	Qz	100.00																									100	121
5H-58 1906.89	4	2	Qz	100.00																									100	117
5H-58 1906.89	4	3	Hl	1.56							46.79					51.65													100	130
5H-58 1906.89	4	4	Chl + Ill	54.66		14.13	18.77		3.48		1.16	6.92				0.55	0.33												100	88
5H-58 1906.89	4	5	Hl	1.02							41.09	0.26				57.63													100	99
5H-58 1906.89	4	6	Chl + Ill + Hl	47.97		15.34	16.90		2.52		6.67	5.13				5.46													100	100
5H-58 1906.89	4	7	Qz	99.87												0.13													100	114
5H-58 1906.89	4	8	Zrn	30.91																	67.68					1.41			100	113
5H-58 1906.89	4	9	Gly	47.54		15.17	14.26		2.78		1.25	5.39				0.60													87	81
5H-58 1906.89	4	10	Qz	100.00																									100	114
5H-58 1906.89	4	11	Kfs + Hl	46.28		13.39					16.99	10.35				12.50						0.50							100	126
5H-58 1906.89	4	12	Kln	36.78	1.16	18.15	32.85		5.92		2.14	1.38				1.62													100	88
5H-58 1906.89	4	13	Kln	48.64		36.70					0.40	0.10				0.16													86	93
5H-58 1906.89	4	14	Ill + Chl?	55.96		13.34	18.01		3.48		1.01	7.28				0.91													100	66
5H-58 1906.89	4	15	Glt	45.36		7.69	24.39		1.50		0.33	7.26				0.48													87	52
5H-58 1906.89	5	1	Qz	99.73							0.27																		100	113
5H-58 1906.89	5	2	Glt + Hl?	48.93		14.02	18.44		2.99		5.56	6.12				3.94													100	103
5H-58 1906.89	5	4	Kfs	66.95		17.55	0.53					14.98																	100	105
5H-58 1906.89	5	5	Chloritized Ms	50.05	0.39	17.56	18.92		4.18		1.41	6.16				0.96	0.35												100	102
5H-58 1906.89	5	6	Qz	100.00																									100	119
5H-58 1906.89	5	7	Qz	100.00																									100	122
5H-58 1906.89	5	8	Cal							55.33	0.49					0.18													56	56
5H-58 1906.89	5	9	Sd	0.95			46.51	1.91	2.01	3.41	0.73					0.47													56	64
5H-58 1906.89	5	10	Sd	0.52			44.64	2.14	4.47	4.22																			56	60
5H-58 1906.89	5	11	Sd +	1.36			61.38	3.55	4.13	3.87	19.71					5.99													100	80
5H-58 1906.89	5	12	Gly	44.65		14.09	17.26		3.42		1.22	5.35				1.01													87	69
5H-58 1906.89	5	13	Gly	46.90		15.13	13.64		3.05		1.22	5.76				1.31													87	92
5H-58 1906.89	5	14	Cal							55.53				0.47															56	60
5H-58 1906.89	5	15	Sd + Cal	1.92			64.25	1.65	2.98	27.99	0.67					0.53													100	62
5H-58 1906.89	5	16	Chl + Ms	52.33		20.06	17.95		3.55		0.90	4.78				0.44													100	78
5H-58 1906.89	5	17	Qz	100.00																									100	118
5H-58 1906.89	5	18	Qz	100.00																									100	115
5H-58 1906.89	5.1	1	Cal				0.32			55.68																			56	57
5H-58 1906.89	5.1	2	Sd				43.70	1.70	3.77	6.25			0.58																56	60
5H-58 1906.89	5.1	3	Sd				44.19	1.39	3.53	6.00			0.89																56	60
5H-58 1906.89	5.1	4	Cal				1.80	0.72	0.36	53.12																			56	55
5H-58 1906.89	6	1	Hl	0.33						0.67	50.90	0.52				47.59													100	162
5H-58 1906.89	6	2	Kfs	65.37		18.14					0.59	14.81										1.10							100	114
5H-58 1906.89	6	3	Chl + Kln	52.42	0.39	30.68	7.70		3.69		0.92	3.69				0.51													100	77
5H-58 1906.89	6	4	Qz	100.00																									100	117
5H-58 1906.89	6	5	Glt	47.26		10.91	18.57		3.01		0.70	6.13				0.42													87	86
5H-58 1906.89	6	6	Cal				2.23	0.96	0.35	52.46																			56	57
5H-58 1906.89	6	7	Kfs	64.33		17.87					1.72	14.45	0.66			0.96													100	115
5H-58 1906.89	6	8	Kfs	61.27		16.61					5.03	14.16				2.93													100	123
5H-58 1906.89	6	9	Qz	100.00																									100	123
5H-58 1906.89	6	10	Kfs	65.14		18.26					1.16	14.24										1.20							100	121
5H-58 1906.89	6	11	Qz + Hl	91.55							3.64					4.80													100	107
5H-58 1906.89	6	12	Mix	49.95		17.13	21.23		3.99		1.44	5.15				1.10													100	81

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	6	13	Chl + Ill ?	53.86		22.25	13.79		2.68		0.95	5.33				0.72	0.42												100	81
5H-58 1906.89	6	14	Kfs	65.72	0.33	18.09					0.88	14.98																	100	116
5H-58 1906.89	6	15	Qz	100.00																									100	120
5H-58 1906.89	6	16	Kln	48.27		33.68	2.62		0.52			0.53				0.38													86	72
5H-58 1906.89	6	17	Kfs	66.23		17.77					1.00	14.99																	100	115
5H-58 1906.89	6	18	Qz	100.00																									100	117
5H-58 1906.89	6	19	Qz	100.00																									100	119
5H-58 1906.89	7	1	Kfs	65.44		17.34					0.94	16.10				0.19													100	89
5H-58 1906.89	7	2	Qz	100.00																									100	119
5H-58 1906.89	7	3	Cal				1.54	0.85	0.41	52.95		0.25																	56	54
5H-58 1906.89	7	4	Kfs	66.21		17.84					0.63	15.32																	100	112
5H-58 1906.89	7	5	Kfs	66.25		17.66					0.39	15.70																	100	117
5H-58 1906.89	7	6	Ap +	1.13		0.61	1.28			46.84	1.69		39.74	0.72	5.02	0.45								0.97			1.56		100	80
5H-58 1906.89	7	7	Chl + Hl + Kfs	44.47		14.61	20.01		4.47	2.11	4.22	4.86				4.90	0.34												100	100
5H-58 1906.89	7	8	Qz	100.00																									100	123
5H-58 1906.89	7	9	Cal	1.15		0.99	4.21	1.92	0.92	90.81																			100	57
5H-58 1906.89	7	10	Kln +	51.30		36.81	7.24		0.88		0.79	2.56				0.42													100	69
5H-58 1906.89	7	11	Cal +	12.65		7.64	4.30	1.06	0.81	72.74		0.54				0.26													100	61
5H-58 1906.89	7	12	Qz	100.00																									100	122
5H-58 1906.89	7	13	Cal +	10.74		8.83	2.91	1.22	0.52	75.79																			100	63
5H-58 1906.89	7	14	Kfs	66.49		17.91					1.69	13.90																	100	118
5H-58 1906.89	7	15	Qz	100.00																									100	121
5H-58 1906.89	7	16	Glt +	53.24		11.73	18.92		2.90		3.19	7.82				2.22													100	101
5H-58 1906.89	8	1	Cal							55.58	0.42																		56	53
5H-58 1906.89	8	2	Qz	100.00																									100	126
5H-58 1906.89	8	3	Chloritized Ms	45.25	0.39	16.97	25.99		6.25		1.15	3.41				0.58													100	76
5H-58 1906.89	8	4	Cal				1.19	0.45		54.20						0.16													56	51
5H-58 1906.89	8	5	Qz	100.00																									100	122
5H-58 1906.89	8	6	Chl + Kln +	47.97		29.43	16.68		2.00		1.44	1.15				1.33													100	52
5H-58 1906.89	8	7	Gly	45.91		13.31	16.98		3.62	0.47	1.02	4.81				0.89													87	63
5H-58 1906.89	8	8	Qz	100.00																									100	121
5H-58 1906.89	8	9	Cal							55.68	0.32																		56	55
5H-58 1906.89	8	10	Qz	100.00																									100	119
5H-58 1906.89	8	11	Kfs	65.73		17.99					1.02	14.39										0.86							100	122
5H-58 1906.89	8	12	Glt	48.25		11.95	15.70		3.07		0.92	6.66				0.45													87	89
5H-58 1906.89	8	13	Ms + Chl	54.91		26.93	8.90		2.39		1.38	4.87				0.61													100	92
5H-58 1906.89	9	1	Hl				0.23				47.08					52.69													100	135
5H-58 1906.89	9	2	Qz	98.24							0.86					0.90													100	124
5H-58 1906.89	9	3	Chl + Ms + Hl	46.17		16.94	20.55		4.45	0.57	3.27	4.87				3.18													100	98
5H-58 1906.89	9	4	Sd	0.51			43.15	2.72	4.92	3.94	0.48					0.27													56	61
5H-58 1906.89	9	5	Cal							55.20	0.80																		56	56
5H-58 1906.89	9	6	Glt + Hl	52.06		13.40	18.38		3.09	0.88	2.76	7.50				1.93													100	94
5H-58 1906.89	9	7	Qz	100.00																									100	115
5H-58 1906.89	9	8	Qz	100.00																									100	119
5H-58 1906.89	9	9	Qz	100.00																									100	120
5H-58 1906.89	9	10	Qz	100.00																									100	118
5H-58 1906.89	9	11	Gly	46.42		12.11	18.01		3.01		0.94	5.99				0.51													87	74
5H-58 1906.89	9	12	Cal							56.00																			56	59
5H-58 1906.89	9	14	Chl + Hl + Kfs	44.50	0.31	12.94	15.51		3.00	3.39	9.69	5.33				5.33													100	112
5H-58 1906.89	9	15	Ab	68.67		19.19				0.79	11.34																		100	120

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	9	16	Qz	100.00																									100	118
5H-58 1906.89	10	1	Kfs	66.44		17.53					0.71	15.32																	100	115
5H-58 1906.89	10	2	Cal							55.61	0.39																		56	55
5H-58 1906.89	10	3	Cal				2.37	0.97	0.41	52.24																			56	54
5H-58 1906.89	10	4	Sd +	6.22		2.20	79.78	1.81	1.44	3.82	2.40					2.34													100	67
5H-58 1906.89	10	5	Glt	47.50		9.82	18.86		3.18		0.74	6.47				0.43													87	90
5H-58 1906.89	10	6	Chloritized Bt?	40.08	1.09	19.33	27.50		4.30	0.52	2.42	2.45				1.99	0.32												100	94
5H-58 1906.89	10	7	Qz	100.00																									100	119
5H-58 1906.89	10	8	Qz	100.00																									100	122
5H-58 1906.89	10	9	Qz	99.52										0.48															100	118
5H-58 1906.89	10	10	Gly	45.33		13.37	17.19		3.09	0.50	1.11	5.55				0.85													87	96
5H-58 1906.89	10	11	Gly	46.68		11.74	18.52		3.05		0.91	5.59				0.51													87	81
5H-58 1906.89	10	12	Qz	99.84												0.16													100	123
5H-58 1906.89	10	13	Hl	1.42		0.28	0.88			0.53	45.45	0.37				51.06													100	126
5H-58 1906.89	10	14	Glt + Hl	54.05		10.30	19.61		3.34		3.30	7.57				1.83													100	99
5H-58 1906.89	10	15	Chl + Gly + Hl	39.98		17.77	31.16		4.63	0.40	2.47	1.92				1.67													100	80
5H-58 1906.89	10	16	Qz	100.00																									100	116
5H-58 1906.89	11	1	Qz	100.00																									100	120
5H-58 1906.89	11	2	Qz	100.00																									100	122
5H-58 1906.89	11	3	Kln +	54.63		35.13	5.36		1.40		0.71	2.45				0.32													100	76
5H-58 1906.89	11	4	Kfs	66.20		17.69					0.79	15.32																	100	118
5H-58 1906.89	11	5	"Ilm"	0.75	62.06		31.38	5.54		0.27																			100	100
5H-58 1906.89	11	6	Cal				1.87	0.95	0.35	52.83																			56	57
5H-58 1906.89	11	7	Cal				2.12	1.08	0.53	52.27																			56	56
5H-58 1906.89	11	8	Kfs	66.50		17.93					1.38	14.19																	100	122
5H-58 1906.89	11	9	Kln	48.52		36.75	0.26				0.27					0.20													86	88
5H-58 1906.89	11	10	Kfs	66.35		17.67					0.75	15.24																	100	114
5H-58 1906.89	11	12	Kfs	63.88		17.03					2.93	15.01				1.13													100	117
5H-58 1906.89	11	13	Qz	100.00																									100	118
5H-58 1906.89	11	14	Kfs	66.28		17.65					0.35	15.71																	100	119
5H-58 1906.89	12	1	Qz	100.00																									100	121
5H-58 1906.89	12	2	Kfs	63.81		17.46	1.44			0.89	1.45	14.39				0.57													100	109
5H-58 1906.89	12	3	Kln	49.26		36.07	0.31					0.15				0.22													86	84
5H-58 1906.89	12	4	Cal				2.44	1.01	0.50	52.05																			56	57
5H-58 1906.89	12	5	Kfs	66.17		17.84					0.82	15.17																	100	118
5H-58 1906.89	12	6	Kfs	66.17		17.94					2.11	13.77																	100	114
5H-58 1906.89	12	7	Cal						0.73	54.81	0.45																		56	54
5H-58 1906.89	12	8	Qz	100.00																									100	120
5H-58 1906.89	12	9	Kln	46.61		35.11					3.08					1.20													86	104
5H-58 1906.89	12	10	Glt	47.44		11.34	17.34		3.24		0.70	6.52				0.44													87	91
5H-58 1906.89	12	11	Qz	100.00																									100	119
5H-58 1906.89	12	12	TiO2	0.68	98.64		0.68																						100	107
5H-58 1906.89	12.1	1	Qz	100.00																									100	120
5H-58 1906.89	12.1	2	Kln	48.36		36.58					0.80					0.26													86	96
5H-58 1906.89	12.1	3	Sd +	1.17			44.62	1.06	3.33	4.94			0.67			0.21													56	61
5H-58 1906.89	12.1	4	Cal						0.85	54.10	0.39			0.52		0.15													56	56
5H-58 1906.89	12.1	5	Sd	0.73			43.09	1.39	3.65	6.51			0.63																56	59
5H-58 1906.89	12.1	6	Cal				2.04	0.88	0.35	52.72																			56	56
5H-58 1906.89	12.1	7	Qz	99.74						0.26																			100	118
5H-58 1906.89	13	1	Qz	100.00																									100	119

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	13	2	Sd +	4.95		2.63	70.07	3.22	7.82	11.31																			100	62
5H-58 1906.89	13	4	Kfs	66.16		17.67						16.17																	100	116
5H-58 1906.89	13	5	Cal							55.53				0.47															56	56
5H-58 1906.89	13	6	Chl + Ms	47.76	0.73	15.39	22.27		6.19	0.70	1.37	5.32				0.27													100	99
5H-58 1906.89	13	7	Qz	100.00																									100	116
5H-58 1906.89	13	8	Glt + Hl	53.54		13.64	17.99		3.43		1.98	7.09				2.34													100	81
5H-58 1906.89	13	9	Gly	47.49		14.41	15.17		2.84		0.80	5.52				0.44	0.33												87	71
5H-58 1906.89	13	10	Sd +	4.19		1.08	79.53	2.06	4.07	6.93	1.34					0.81													100	63
5H-58 1906.89	13	11	Kln	47.58		35.25	1.55					0.60				1.02													86	33
5H-58 1906.89	13	12	Kln	48.73		36.99					0.28																		86	96
5H-58 1906.89	13	13	Qz	100.00																									100	121
5H-58 1906.89	13	14	Qz	99.78			0.22																						100	119
5H-58 1906.89	13	15	Glt	49.36		10.13	16.41		3.10		0.62	6.86				0.53													87	97
5H-58 1906.89	13	16	Qz	100.00																									100	121
5H-58 1906.89	13	17	Kln	48.57		34.55	1.70		0.34		0.31	0.52																	86	87
5H-58 1906.89	14	1	Kfs	65.84		17.67					0.75	15.53				0.20													100	118
5H-58 1906.89	14	2	Sd + Hl	0.74			43.55	2.52	3.69	2.86	1.53					1.11													56	62
5H-58 1906.89	14	3	Cal +	2.34		1.33	7.69	2.01	0.97	85.30						0.35													100	58
5H-58 1906.89	14	4	Qz	99.39							0.31					0.30													100	117
5H-58 1906.89	14	5	Chl + ?Ms + Hl	44.28	0.45	16.15	26.33		4.70	0.73	1.89	4.65				0.82													100	96
5H-58 1906.89	14	6	Qz	100.00																									100	122
5H-58 1906.89	14	7	Gly	47.86		9.16	18.71		3.24		1.00	6.78				0.26													87	102
5H-58 1906.89	14	8	Gly	48.30		15.64	13.73		2.63		0.68	5.39				0.64													87	70
5H-58 1906.89	14	9	Kln	48.68		37.32																							86	98
5H-58 1906.89	14	10	Mix	54.02		16.1	18		3.3		0.95	6.94				0.66													100	88
5H-58 1906.89	14	11	Glt	47.40		13.62	15.40		2.85		1.03	6.47				0.23													87	101
5H-58 1906.89	14	12	Qz	100.00																									100	118
5H-58 1906.89	14	13	Sd +	1.63		0.66	43.00	1.32	5.56	3.84																			56	62
5H-58 1906.89	14	14	Hl +	12.22		2.24	4.48		0.37	0.53	43.19	1.81				35.15													100	137
5H-58 1906.89	15	1	Sd	0.85			43.79	1.38	4.65	3.96	0.58		0.80																56	61
5H-58 1906.89	15	2	Chl + Ill	51.63	1.11	20.63	15.75		3.90		1.39	4.48				1.12													100	75
5H-58 1906.89	15	3	Kfs	66.17		17.94					1.42	14.47																	100	113
5H-58 1906.89	15	4	Qz	100.00																									100	118
5H-58 1906.89	15	5	Qz	100.00																									100	120
5H-58 1906.89	15	6	Qz	99.04							0.61					0.35													100	122
5H-58 1906.89	15	7	Kfs	66.04		17.85					0.44	15.67																	100	112
5H-58 1906.89	15	8	Gly	46.17		16.95	14.76		2.84		0.76	4.83				0.70													87	82
5H-58 1906.89	15	9	Chl + Ms	43.60	0.32	18.90	26.31		5.24		1.17	3.37				1.09													100	72
5H-58 1906.89	15	10	Qz	100.00																									100	118
5H-58 1906.89	15	11	Glt	48.61		8.00	19.20		3.05		0.89	6.98				0.29													87	98
5H-58 1906.89	16	1	Chloritized Ms?	51.35		16.78	20.93		3.54		1.30	5.50				0.60													100	95
5H-58 1906.89	16	2	Cal				1.64	0.85	0.32	53.19																			56	55
5H-58 1906.89	16	3	Qz	100.00																									100	118
5H-58 1906.89	16	4	"Ilm"	1.27	78.47	0.82	17.47	1.26			0.47					0.25													100	93
5H-58 1906.89	16	5	Kfs	66.33		17.89					1.01	14.77																	100	118
5H-58 1906.89	16	6	Qz	100.00																									100	124
5H-58 1906.89	16	7	Kln +	54.68		36.18	6.66		0.85		0.45	0.65				0.52													100	71
5H-58 1906.89	16	8	Ab	68.95		19.22				0.43	11.41																		100	117
5H-58 1906.89	16	9	Kfs	65.92		17.96	0.24				0.81	15.07																	100	115
5H-58 1906.89	16	10	Gly	47.05		14.00	15.56		2.81		0.82	5.71				0.75	0.31												87	76

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	16	11	Gly	43.12		14.26	19.14		3.82		1.13	4.92				0.62													87	81
5H-58 1906.89	16	12	Cal				2.33	1.27	0.40	52.00																			56	56
5H-58 1906.89	16	13	Qz	97.05							1.40					1.55													100	121
5H-58 1906.89	16.1	1	TiO2 +	5.67	81.47	3.41	3.92		0.89	0.76	1.01	0.80	0.86			0.45		0.76											100	91
5H-58 1906.89	16.1	2	Cal				2.34	1.15	0.51	52.01																			56	55
5H-58 1906.89	16.1	3	Glt	47.12		10.22	18.35		3.05	0.73	0.84	6.12				0.56													87	85
5H-58 1906.89	16.1	4	Fe-chl	44.42		14.40	15.75		2.49		1.13	5.63				1.19													85	61
5H-58 1906.89	16.1	5	Gly	45.46		14.74	16.12		2.55		1.16	5.76				1.22													87	85
5H-58 1906.89	16.1	6	Gly	42.70		13.43	20.54		4.00		1.14	4.45				0.74													87	82
5H-58 1906.89	17	1	Qz	100.00																									100	118
5H-58 1906.89	17	2	Kfs	66.30		17.78					1.03	14.88																	100	115
5H-58 1906.89	17	3	Kln	49.24		36.76																							86	91
5H-58 1906.89	17	4	Kfs	66.42		17.50					0.43	15.65																	100	119
5H-58 1906.89	17	5	Gly	44.59		10.08	15.87		2.56		5.43	6.51				1.97													87	104
5H-58 1906.89	17	6	TiO2 +	3.28	88.76	3.10	1.67			0.72	0.89		0.93			0.65													100	66
5H-58 1906.89	17	7	Gly	45.66		18.73	14.29		2.34		0.77	4.59				0.62													87	69
5H-58 1906.89	17	8	Chl + Ill	54.12		30.87	9.10		1.64		0.73	3.03				0.52													100	81
5H-58 1906.89	17	9	Gly	48.02		18.80	10.59		2.47		0.99	5.27				0.63	0.23												87	92
5H-58 1906.89	17	10	Kln	48.20		36.11	1.17				0.31					0.21													86	83
5H-58 1906.89	17	11	Qz	99.65							0.35																		100	101
5H-58 1906.89	17	12	Gly	46.12		11.92	17.48		3.06		0.99	5.96	0.68			0.79													87	88
5H-58 1906.89	17	13	Qz	100.00																									100	123
5H-58 1906.89	17	14	Qz	100.00																									100	119
5H-58 1906.89	17	15	Cal				1.54	0.78	0.32	51.23	0.85					1.27													56	57
5H-58 1906.89	17	16	Qz	100.00																									100	116
5H-58 1906.89	18	1	Hl	0.76							42.93	0.33				55.98													100	123
5H-58 1906.89	18	2	Qz	100.00																									100	121
5H-58 1906.89	18	3	Kfs	64.98		17.39					2.21	14.92				0.50													100	115
5H-58 1906.89	18	4	Kfs	65.49		17.89					1.05	14.46										1.11							100	114
5H-58 1906.89	18	5	Qz	100.00																									100	118
5H-58 1906.89	18	6	Kfs	64.24		17.56					2.04	14.79				0.68						0.68							100	115
5H-58 1906.89	18	7	Gly	46.05		13.44	16.78		3.06		1.06	5.26				1.04	0.32												87	82
5H-58 1906.89	18	8	Kln	48.31		36.62	0.61				0.34	0.12																	86	87
5H-58 1906.89	18	9	Kfs +	64.00		17.07	6.74		0.94		0.92	9.51				0.81													100	62
5H-58 1906.89	18	10	Kfs	66.09		17.74					0.26	15.91																	100	114
5H-58 1906.89	18	11	Glt	47.76		12.73	15.94		2.77		0.90	6.39				0.52													87	78
5H-58 1906.89	18	12	Kln	52.06		33.07	0.49									0.38													86	73
5H-58 1906.89	18	13	Gly	44.56		9.81	15.87		2.97		0.97	5.76	3.35			0.77								2.04	0.90				87	89
5H-58 1906.89	18	14	Qz	100.00																									100	122
5H-58 1906.89	18.1	1	Qz	100.00																									100	119
5H-58 1906.89	18.1	2	Glt	48.53		10.88	17.48		3.11		0.64	6.00				0.37													87	87
5H-58 1906.89	18.1	3	Glt	48.37		10.95	17.24		2.99		0.84	6.23				0.38													87	94
5H-58 1906.89	18.1	4	Hl +	3.23		0.63	0.64				50.52	0.22				44.76													100	162
5H-58 1906.89	18.1	5	Glt + Mnz	40.59		10.51	16.06		2.70	1.23	1.33	4.88	8.87			1.29							2.86	7.06	2.62				100	82
5H-58 1906.89	19	1	Qz	99.40			0.60																						100	122
5H-58 1906.89	19	2	Ccp	0.39			21.53							54.82					23.26										100	206
5H-58 1906.89	19	3	Kln	48.63		37.27						0.09																	86	101
5H-58 1906.89	19	4	Kfs	66.86		18.13					2.92	12.08																	100	122
5H-58 1906.89	19	5	Qz	100.00																									100	121
5H-58 1906.89	19	6	Gly	43.90	0.31	13.25	19.19		3.32		1.43	4.96				0.64													87	90

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	19	7	Glt	48.89		9.28	17.37		3.41		0.57	7.07				0.40													87	96
5H-58 1906.89	19	8	Qz	100.00																									100	117
5H-58 1906.89	19	9	Kfs	65.52		18.10					1.18	14.09										1.11							100	114
5H-58 1906.89	19	10	Kln	46.29		31.04	5.15		0.86		0.40	1.91				0.36													86	78
5H-58 1906.89	19	11	Qz	100.00																									100	118
5H-58 1906.89	19	12	Ilm	0.55	54.74		41.47	3.23																					100	108
5H-58 1906.89	19	13	Qz	100.00																									100	126
5H-58 1906.89	19	14	Glt	47.11		11.19	17.74		3.09		1.02	6.67				0.18													87	102
5H-58 1906.89	19	15	Cal +	8.19		6.86	2.98	1.64		80.32																			100	60
5H-58 1906.89	19	16	Qz	100.00																									100	117
5H-58 1906.89	19.1	1	Ilm		55.60		41.53	2.87																					100	104
5H-58 1906.89	19.1	2	Chl + Hl + Gly	43.46		12.97	23.75		4.16	0.84	4.90	5.22				4.69													100	99
5H-58 1906.89	19.1	3	Kfs	66.40		17.92					1.04	14.64																	100	115
5H-58 1906.89	20	1	Ilm		51.37		46.85	0.65	1.14																				100	102
5H-58 1906.89	20	2	Qz	100.00																									100	120
5H-58 1906.89	20	3	Kfs	65.30		17.94					0.75	15.10										0.91							100	120
5H-58 1906.89	20	4	Qz	100.00																									100	121
5H-58 1906.89	20	5	Qz	98.44	1.02	0.49						0.04																	100	115
5H-58 1906.89	20	6	Glt + Hl	39.66		8.36	13.23		2.05		18.60	5.64				12.47													100	108
5H-58 1906.89	20	7	Kln	45.96		30.32	6.34		1.08		0.52	1.41				0.37													86	72
5H-58 1906.89	20	8	Fe-chl + Hl	39.49	0.53	17.47	28.78		4.83	0.72	3.94	2.65				1.59													100	98
5H-58 1906.89	20	9	Ms	46.93	0.99	31.97	3.52		0.67		0.72	10.18																	95	99
5H-58 1906.89	20	10	Glt	48.98		12.49	14.85		3.62		0.59	6.06				0.40													87	95
5H-58 1906.89	20	11	Kfs	66.39		17.69					0.64	15.28																	100	115
5H-58 1906.89	20	12	Ab	69.06		19.02				0.31	11.61																		100	114
5H-58 1906.89	20	13	Kfs	66.34		17.84					0.96	14.86																	100	114
5H-58 1906.89	20	14	Chloritized Bt?	37.09	1.28	18.19	33.12		5.75	0.25	1.09	2.73				0.50													100	90
5H-58 1906.89	20.1	1	Qz	100.00																									100	121
5H-58 1906.89	20.1	2	Cal +	3.11		2.29	4.05	1.97	0.48	88.10																			100	59
5H-58 1906.89	20.1	3	Qz +	93.89	1.68	2.45	1.03		0.28			0.65																	100	117
5H-58 1906.89	20.1	4	Kln	49.48		35.08	0.84				0.33					0.28													86	82
5H-58 1906.89	21	1	Kfs	64.13		17.20					3.00	14.52				1.15													100	117
5H-58 1906.89	21	2	Chloritized Bt + Hl	49.10		13.88	18.23		3.73	1.15	4.06	6.34				3.18	0.34												100	100
5H-58 1906.89	21	3	Qz	100.00																									100	115
5H-58 1906.89	21	4	Qz	100.00																									100	116
5H-58 1906.89	21	5	Cal + Mix	24.37		10.61	5.59	0.61	2.84	53.32	0.50	1.83				0.34													100	70
5H-58 1906.89	21	6	Kln	47.36		34.78	2.61					0.34				0.90													86	47
5H-58 1906.89	21	7	Qz	100.00																									100	122
5H-58 1906.89	21	8	Cal							56.00																			56	57
5H-58 1906.89	21	9	Qz	100.00																									100	122
5H-58 1906.89	21	10	Glt	48.11	0.31	11.20	16.30		3.13		0.94	6.07				0.67	0.26												87	89
5H-58 1906.89	21	11	Glt	42.73		17.48	16.93		2.45		0.57	6.03				0.80													87	41
5H-58 1906.89	21	12	Chl + Bt?	44.97		21.12	25.08		4.60		0.91	2.31				1.00													100	69
5H-58 1906.89	21	13	Gly	45.45		13.53	18.38		3.08		0.80	5.19				0.57													87	85
5H-58 1906.89	21	14	TiO2		100.00																								100	108
5H-58 1906.89	22	1	Qz	100.00																									100	121
5H-58 1906.89	22	2	Kfs	65.86		17.64					0.84	15.46				0.20													100	117
5H-58 1906.89	22	3	Gly	39.39		14.47	23.64		4.47	0.45	1.10	2.80				0.67													87	79
5H-58 1906.89	22	4	Kfs	66.26		17.55					0.30	15.89																	100	117
5H-58 1906.89	22	5	Glt + Hl	48.55		14.28	21.91		2.91		3.07	6.51				2.38	0.38												100	94

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	22	6	Qz	100.00																									100	123
5H-58 1906.89	22	7	Sd	0.55			43.96	0.99	3.84	5.96			0.69																56	61
5H-58 1906.89	22	8	Glt + Hl	46.68		12.31	20.79		2.92		6.36	5.86				5.08													100	99
5H-58 1906.89	22	9	Qz	100.00																									100	125
5H-58 1906.89	22	10	Oligo	64.25		21.86				3.58	10.05					0.26													100	122
5H-58 1906.89	22	11	Qz	100.00																									100	124
5H-58 1906.89	22	12	Kfs	63.95		17.01					2.65	15.03				1.37													100	119
5H-58 1906.89	23	1	Kfs	62.42		17.08					4.33	13.72				1.92						0.54							100	113
5H-58 1906.89	23	2	Sd				43.80	1.34	3.87	6.30			0.68																56	57
5H-58 1906.89	23	3	Gly	45.93		17.49	15.24		2.97		0.70	4.32				0.36													87	83
5H-58 1906.89	23	4	Qz	100.00																									100	116
5H-58 1906.89	23	5	Kln	48.39		37.35					0.26																		86	94
5H-58 1906.89	23	6	Kln + Chl	47.16		30.23	17.37		2.25		1.03	1.36				0.60													100	73
5H-58 1906.89	23	7	Cal				1.62	0.77	0.35	53.26																			56	55
5H-58 1906.89	23	8	Qz	99.59							0.41																		100	111
5H-58 1906.89	23	9	Chl + Bt? + Hl	39.58	1.29	15.76	27.77		8.11		2.38	3.91				1.20													100	71
5H-58 1906.89	23	10	Qz	100.00																									100	121
5H-58 1906.89	23	11	Qz	99.74												0.26													100	117
5H-58 1906.89	23	12	Cal	0.66			0.86	0.66		53.82																			56	56
5H-58 1906.89	23	13	Gly	47.34		12.40	16.94		3.11		0.72	5.77				0.37	0.35												87	80
5H-58 1906.89	23	14	Qz	100.00																									100	109
5H-58 1906.89	23	15	Glt + Hl	37.60		8.07	11.73		2.59		21.40	5.10				13.50													100	125
5H-58 1906.89	23	16	Qz	100.00																									100	122
5H-58 1906.89	24	1	Qz	100.00																									100	121
5H-58 1906.89	24	2	Cal				0.38		0.53	53.89				1.20															56	58
5H-58 1906.89	24	3	Sd	0.68			47.14	2.34	1.90	2.74	0.52					0.69													56	67
5H-58 1906.89	24	4	Cal +	0.83			2.28	1.28		91.96	2.16					1.50													100	59
5H-58 1906.89	24	5	Cal				2.11	0.89	0.46	52.54																			56	56
5H-58 1906.89	24	6	Ilm	0.73	51.96		45.94	0.52	0.86																				100	103
5H-58 1906.89	24	7	Qz +	88.41		7.61	0.80		0.50		0.62	1.65				0.40													100	111
5H-58 1906.89	24	8	Kln	50.10		35.33	0.24									0.34													86	74
5H-58 1906.89	24	9	Glt	47.54		9.14	18.57		3.15		0.62	6.92	0.63			0.44													87	88
5H-58 1906.89	24	10	Qz	99.12							0.46					0.41													100	116
5H-58 1906.89	24	11	Gly + Hl	43.31		16.19	12.66		3.04		13.06	4.38				7.36													100	98
5H-58 1906.89	24	12	Qz	99.45							0.35					0.20													100	125
5H-58 1906.89	24	13	Qz	99.80			0.20																						100	119
5H-58 1906.89	24	14	Kfs	65.33		17.43					1.56	15.23				0.45													100	115
5H-58 1906.89	25	1	Qz	100.00																									100	120
5H-58 1906.89	25	2	Ill + Chl	46.33		26.93	17.93		2.77		0.91	4.35				0.78													100	73
5H-58 1906.89	25	3	Glt	48.29		9.38	17.51		3.08	0.68	1.07	6.80				0.20													87	103
5H-58 1906.89	25	4	Hl	0.77							41.47	0.18				57.58													100	106
5H-58 1906.89	25	5	Qz	100.00																									100	120
5H-58 1906.89	25	6	Glt	48.31		12.69	14.75		2.92		1.80	6.21				0.31													87	103
5H-58 1906.89	25	7	Qz	100.00																									100	121
5H-58 1906.89	25	8	Qz	100.00																									100	125
5H-58 1906.89	25	9	Gly ?	47.83		19.89	20.28		4.82		1.39	4.75				1.04													100	70
5H-58 1906.89	25	10	Cal +	4.83		3.10	3.19	1.35	0.75	86.78																			100	62
5H-58 1906.89	25	11	Qz	100.00																									100	123
5H-58 1906.89	25	12	Qz	100.00																									100	123
5H-58 1906.89	25	13	Cal +	5.61		3.34	4.10	1.29	0.66	85.00																			100	62

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	25	14	Qz	97.53							1.06					1.41													100	123
5H-58 1906.89	26	1	Cal						0.31	55.69																			56	57
5H-58 1906.89	26	2	Chloritized Ms	49.42		17.47	20.74		4.74		1.58	5.06				0.98													100	95
5H-58 1906.89	26	3	Chloritized Ms	49.33		16.10	22.09		4.15		1.80	5.41				1.12													100	88
5H-58 1906.89	26	4	Qz	100.00																									100	119
5H-58 1906.89	26	5	Cal				1.71	0.91	0.36	53.02																			56	55
5H-58 1906.89	26	6	Glt + Hl	43.98		11.51	19.50		2.72		10.92	5.64				5.37	0.35												100	104
5H-58 1906.89	26	7	Qz	100.00																									100	125
5H-58 1906.89	26	8	Qz	100.00																									100	125
5H-58 1906.89	26	9	Kfs	64.93		18.04					0.92	14.31										1.81							100	118
5H-58 1906.89	26	10	Qz	100.00																									100	116
5H-58 1906.89	26	11	Kfs	64.60		18.29					0.99	13.73										2.38							100	114
5H-58 1906.89	26	12	Qz	98.91		0.39	0.46				0.24																		100	115
5H-58 1906.89	26	13	Glt +	53.98		12.4	19.9		3.7		2.1	6.81				0.81	0.3												100	101
5H-58 1906.89	26	14	Cal							56.00																			56	56
5H-58 1906.89	26	15	Sd	1.55		0.58	43.24	0.59	3.82	5.53	0.49					0.20													56	62
5H-58 1906.89	26.1	1	Sd				43.09	1.62	3.87	7.42																			56	60
5H-58 1906.89	26.1	2	Cal				0.30		0.46	54.73				0.50															56	58
5H-58 1906.89	26.1	3	Qz	97.79		1.68					0.49	0.03																	100	119
5H-58 1906.89	26.1	4	Kfs	66.67		17.49					0.81	15.03																	100	118
5H-58 1906.89	26.1	5	Qz	100.00																									100	122
5H-58 1906.89	26.1	6	Kln	48.92		37.08																							86	99
5H-58 1906.89	27	1	Qz	100.00																									100	121
5H-58 1906.89	27	2	Kln +	54.28		36.07	6.82		1.19		0.71	0.45				0.49													100	78
5H-58 1906.89	27	3	Glt? + Hl	51.74		14.07	16.56		1.96		6.24	5.70				3.72													100	88
5H-58 1906.89	27	4	Cal				1.80	0.86	0.31	53.03																			56	58
5H-58 1906.89	27	5	Qz	100.00																									100	123
5H-58 1906.89	27	6	Qz	99.11							0.61					0.28													100	123
5H-58 1906.89	27	7	Kfs	66.22		17.86					0.67	15.25																	100	115
5H-58 1906.89	27	8	Gly	47.30		11.79	17.88		3.13		0.70	5.79				0.42													87	88
5H-58 1906.89	27	9	Cal +	11.70		10.06	2.55	1.21		74.07						0.42													100	67
5H-58 1906.89	27	10	Kfs	66.17		17.48	0.34				0.45	15.56																	100	118
5H-58 1906.89	28	1	Hl + Ap							27.81	24.60	0.24	24.10	0.68		20.57								0.80			1.20		100	110
5H-58 1906.89	28	2	Cal				2.04	1.28	0.41	52.27																			56	56
5H-58 1906.89	28	3	Glt + Hl	54.01		19.35	14.93		3.33		1.10	5.88				1.08	0.31												100	87
5H-58 1906.89	28	4	Kln	49.16		36.64										0.21													86	75
5H-58 1906.89	28	5	Qz	100.00																									100	119
5H-58 1906.89	28	6	"Ilm"	10.53	71.40	5.39	7.11		2.13	0.83	1.08	1.19				0.33													100	97
5H-58 1906.89	28	7	Qz	100.00																									100	121
5H-58 1906.89	28	8	Glt + Hl +	54.64		23.09	12.98		1.99		1.92	4.56				0.82													100	99
5H-58 1906.89	28	9	Qz	100.00																									100	125
5H-58 1906.89	28	10	Qz	100.00																									100	117
5H-58 1906.89	28	11	Kln	49.04		36.96																							86	74
5H-58 1906.89	28	12	Qz	100.00																									100	116
5H-58 1906.89	28	13	Kfs	66.70		17.92					1.45	13.94																	100	113
5H-58 1906.89	28	14	Qz	100.00																									100	123
5H-58 1906.89	28	15	Glt + Hl	54.67		14.49	15.92		3.15		3.26	7.14				1.09	0.29												100	102
5H-58 1906.89	29	1	Qz	100.00																									100	116
5H-58 1906.89	29	2	Kfs	66.14		18.11					2.05	12.99										0.71							100	117
5H-58 1906.89	29	3	Kln	48.81		36.74					0.46																		86	87

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	29	4	Sd	0.53			43.28	1.82	4.01	6.36																			56	61
5H-58 1906.89	29	5	Cal				1.56	0.87	0.36	53.21																			56	56
5H-58 1906.89	29	6	Glt + Hl	40.54		9.91	12.17		2.92		18.38	5.17				10.92													100	112
5H-58 1906.89	29	7	Qz	100.00																									100	120
5H-58 1906.89	29	8	Kfs	66.01		17.70					0.47	15.82																	100	116
5H-58 1906.89	29	9	Glt + Hl	51.79		14.18	17.45		3.06		3.27	7.42				2.48	0.35												100	92
5H-58 1906.89	29	10	Kln	48.53		36.92	0.35									0.20													86	73
5H-58 1906.89	29	11	Qz	100.00																									100	118
5H-58 1906.89	29	12	Qz	99.72							0.28																		100	106
5H-58 1906.89	29	13	Glt	48.75		9.09	17.95		3.23		0.81	6.82				0.36													87	99
5H-58 1906.89	30	1	Qz	98.93		1.02						0.05																	100	119
5H-58 1906.89	30	2	Glt	45.70	0.49	11.32	17.72		3.81		1.04	6.51				0.42													87	101
5H-58 1906.89	30	3	Qz	99.65												0.35													100	122
5H-58 1906.89	30	4	Cal				1.99	0.98	0.48	52.55																			56	56
5H-58 1906.89	30	5	Kln +	44.47		32.02	0.35				4.83	0.10				4.22													86	97
5H-58 1906.89	30	6	Glt +	52.19	0.29	12.48	22.16		4.24		1.25	7.03				0.35													100	97
5H-58 1906.89	30	7	Qz	100.00																									100	119
5H-58 1906.89	30	8	Kln	48.55		37.45																							86	86
5H-58 1906.89	30	9	"Ilm"	1.68	75.43	0.75	19.11		0.56	0.41	0.52		1.07			0.47													100	76
5H-58 1906.89	30	10	Qz	100.00																									100	125
5H-58 1906.89	30	11	Glt	48.52		12.48	15.18		2.92		0.78	6.40				0.42	0.30												87	95
5H-58 1906.89	31	1	Qz	100.00																									100	118
5H-58 1906.89	31	2	Cal +	12.31		7.42	5.70	0.88	0.88	71.97	0.53	0.32																	100	57
5H-58 1906.89	31	3	Kln	49.67		35.97					0.37																		86	92
5H-58 1906.89	31	4	Qz	100.00																									100	120
5H-58 1906.89	31	5	Kfs	66.29		17.51					0.40	15.80																	100	116
5H-58 1906.89	31	6	Ilm	0.59	55.23		42.76	1.42																					100	102
5H-58 1906.89	31	7	Qz	100.00																									100	117
5H-58 1906.89	31	8	Glt	48.31		12.45	15.05		3.08		0.97	6.41				0.41	0.32												87	91
5H-58 1906.89	31	9	Kfs	62.28		16.60	0.37			4.94	0.40	15.41																	100	86
5H-58 1906.89	31	10	Qz +	95.55							2.67					1.78													100	123
5H-58 1906.89	31	11	Kfs	66.48		17.69					1.69	14.14																	100	119
5H-58 1906.89	31	12	Kln	46.53	0.52	33.26	4.88		0.44							0.37													86	70
5H-58 1906.89	31	13	Cal + Kln	32.24		26.01	1.36	0.48		39.36	0.55																		100	77
5H-58 1906.89	31	14	Qz	100.00																									100	115
5H-58 1906.89	32	1	Qz	100.00																									100	120
5H-58 1906.89	32	2	Cal				2.03	1.17	0.47	52.33																			56	55
5H-58 1906.89	32	3	Qz	98.51							0.84					0.65													100	112
5H-58 1906.89	32	4	Hl	1.06			0.31				48.10	0.36				50.16													100	141
5H-58 1906.89	32	5	Cal				2.44	0.98	0.40	52.18																			56	58
5H-58 1906.89	32	6	Qz	99.19			0.19			0.12	0.50																		100	124
5H-58 1906.89	32	7	Kfs	65.87		17.91					0.66	15.56																	100	119
5H-58 1906.89	32	8	Cal				2.18	0.99	0.34	52.49																			56	57
5H-58 1906.89	32	9	Qz	98.51							0.72					0.77													100	123
5H-58 1906.89	32	10	Qz	100.00																									100	117
5H-58 1906.89	32	11	Kln	47.86		33.13	3.47		0.57		0.42					0.55													86	61
5H-58 1906.89	32	12	Sd +	3.46			78.00	2.11	4.26	8.79	1.48		1.09			0.82													100	61
5H-58 1906.89	33	1	Qz	99.74																0.26									100	119
5H-58 1906.89	33	2	Zrn	31.25																0.52	68.23								100	118
5H-58 1906.89	33	3	Monazite- (Ce)							0.59			36.71		-0.40					0.81			10.65	35.11	14.63		1.91		100	102

Table 1-9.1: EDS geochemical analyses of sample 5H-58 1906.89

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	V2O5	Cr2O3	CuO	ZnO	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	HfO2	WO3	B2O3	Total	Actual Total
5H-58 1906.89	33	4	Cal				1.70	0.76	0.40	52.76										0.39									56	56
5H-58 1906.89	33	5	Glt + Hl	54.92		11.46	21.05		3.49		1.27	7.45				0.36													100	88
5H-58 1906.89	33	6	Glt + Hl	53.88		18.11	15.91		3.22		1.43	6.08				0.96	0.40												100	90

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain
3. Gly refers to the mixture glaucony

Appendix 1-10: SEM-BSE images and EDS mineral analyses for sample O-47 1886.68.

Sample O-47 1886.68: Fine-grained sandstone with thin mudstone intervals

Detrital Minerals: Albite, Chlorite, Biotite, Chromite, ?Fe-clay, Garnet, Illite, Ilmenite, K-feldspar, Muscovite, Oligoclase, Quartz, Zircon

Diagenetic Minerals: Anhydrite, Chlorite, Kaolinite, Pyrite, Siderite, Titania

Notes:

1. Quartz commonly displays suturing and overgrowths (Figs. 27,29,32,38).

2. Chlorite and muscovite are usually plastically deformed, causing them to expanded along cleavage planes, allowing for diagenetic minerals to precipitate (Figs. 7,23,36).

3. When looking at the photograph of the thin section (Fig. 1) the sample appears to be layered with fine sands and muddy intervals.

4. Anhydrite appears to be the latest cement (Figs. 11,24).

5. Paragenetic sequence:

Kaolinite → Chlorite → Siderite, Titania, Pyrite, Anhydrite

Figs. 9,41 (Kaolinite → Chlorite) Figs. 11,23,34 (Chlorite → Siderite)

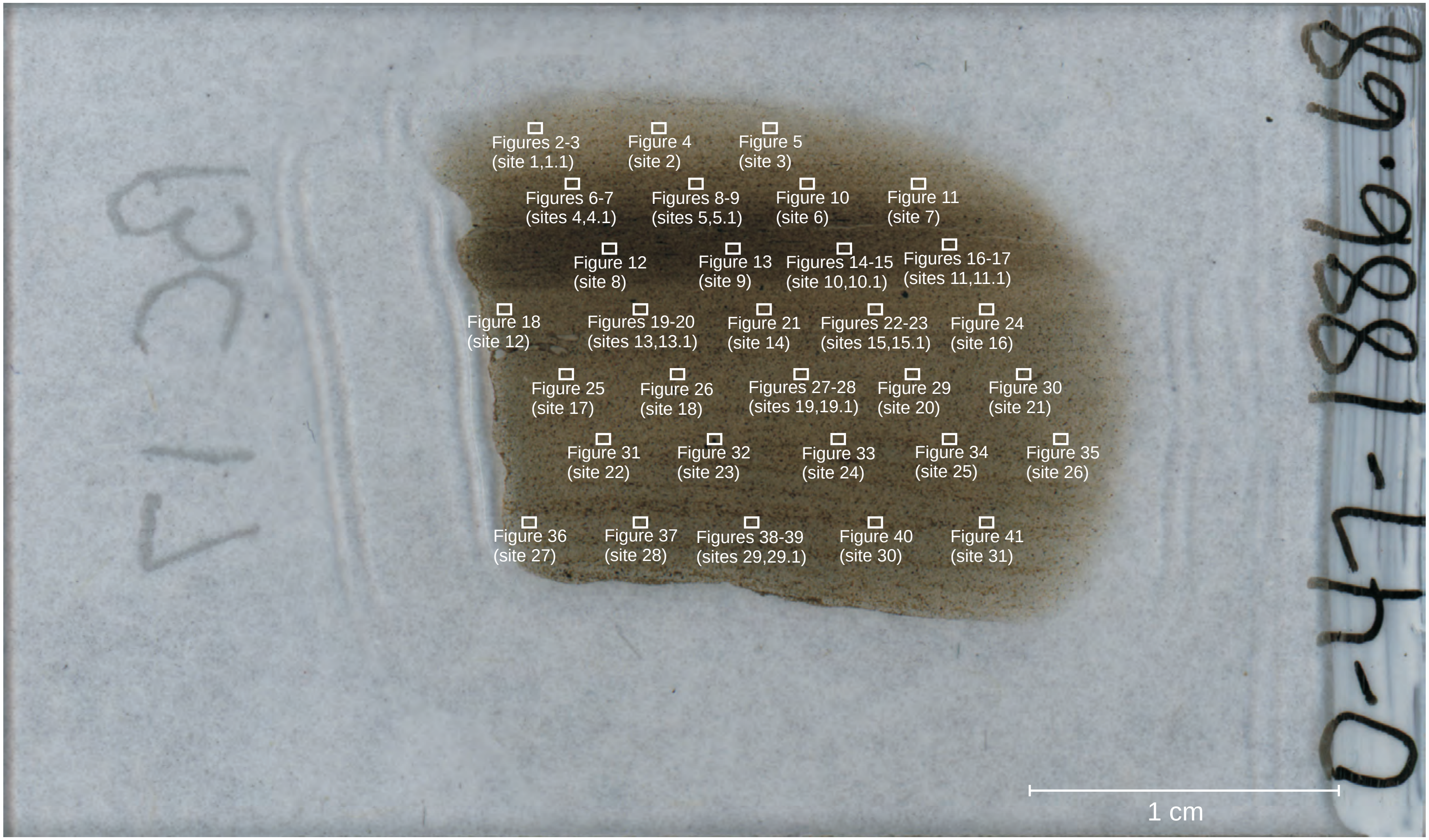
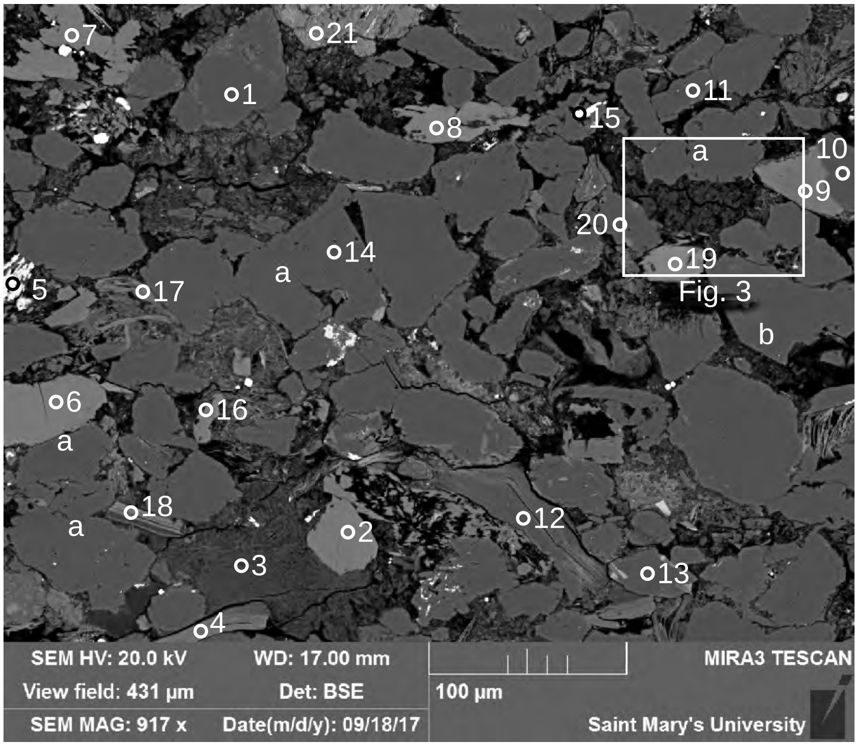
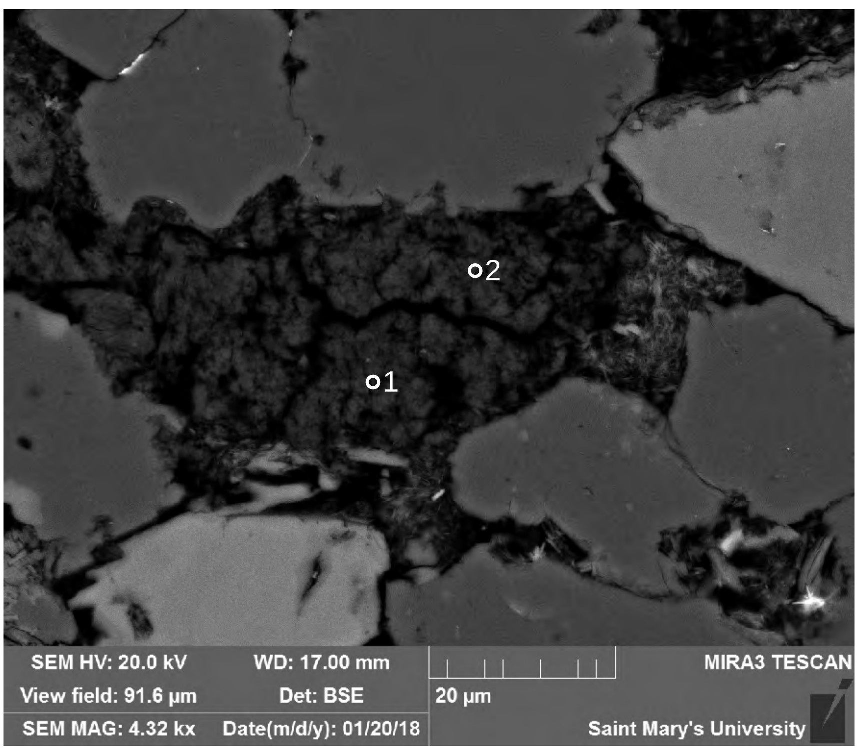


Figure 1-10.1: Scanned thin section of O-47 1886.68 showing the location of analyzed sites.



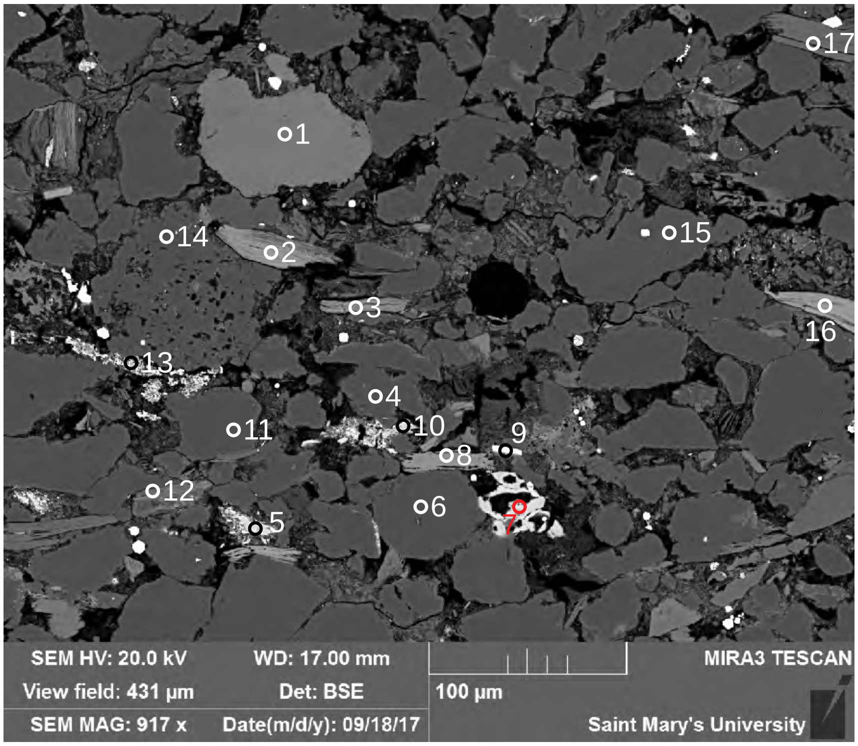
1:Quartz
2:K-feldspar
3:Kaolinite
4:Muscovite
5:TiO_2
6:K-feldspar
7:K-feldspar
8:K-feldspar
9:K-feldspar
10:Quartz
11:Quartz
12:Kaolinite
13:Quartz
14:Quartz
15:Xenotime-(Y)
16:K-feldspar
17:Muscovite + Chlorite
18:Muscovite
19:K-feldspar
20:Quartz
21:Chlorite +

Figure 1-10.2: Sample O-47 1886.68 (SEM) site 1. This site consists of detrital quartz (1,10-11,13-14,20), K-feldspar (2,6-9,19), and muscovite (4,12,17-18). The cement is made up of kaolinite (3) and chlorite (21). Suturing is common between grains (positions a). Quartz overgrowths (position b) are also present.



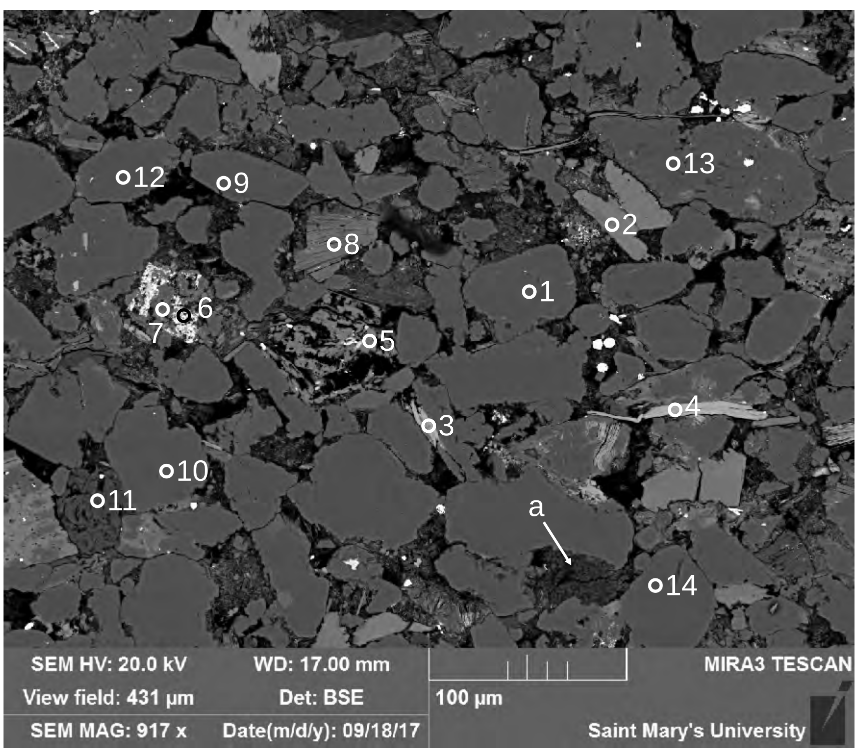
1:Kaolinite
2:Kaolinite

Figure 1-10.3: Sample O-47 1886.68 (SEM) site 1.1. This site is a zoom in of the cement in site 1. Kaolinite (1-2) booklets form between the detrital grains.



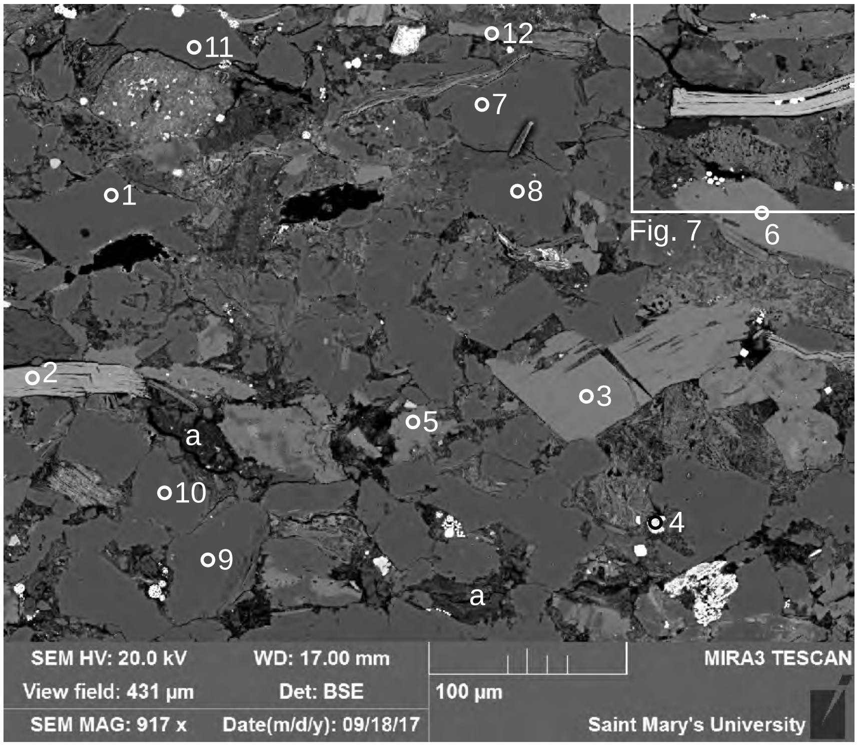
1:K-feldspar
2:Chlorite +
3:Chlorite
4:Quartz
5:Siderite
6:Quartz
7:TiO_2 +
8:Chlorite
9:Ilmenite
10:Siderite
11:Quartz
12:Muscovite
13:TiO_2 +
14:Quartz
15:Albite
16:Fe-Chlorite
17:Muscovite

Figure 1-10.4: Sample O-47 1886.68 (SEM) site 2. This site consists of detrital quartz (4,6,11,14), K-feldspar (1), muscovite (12,17), chlorite (2,16), ilmenite (9), and albite (15). There is also diagenetic siderite (5,10) which probably partially fills porosity.



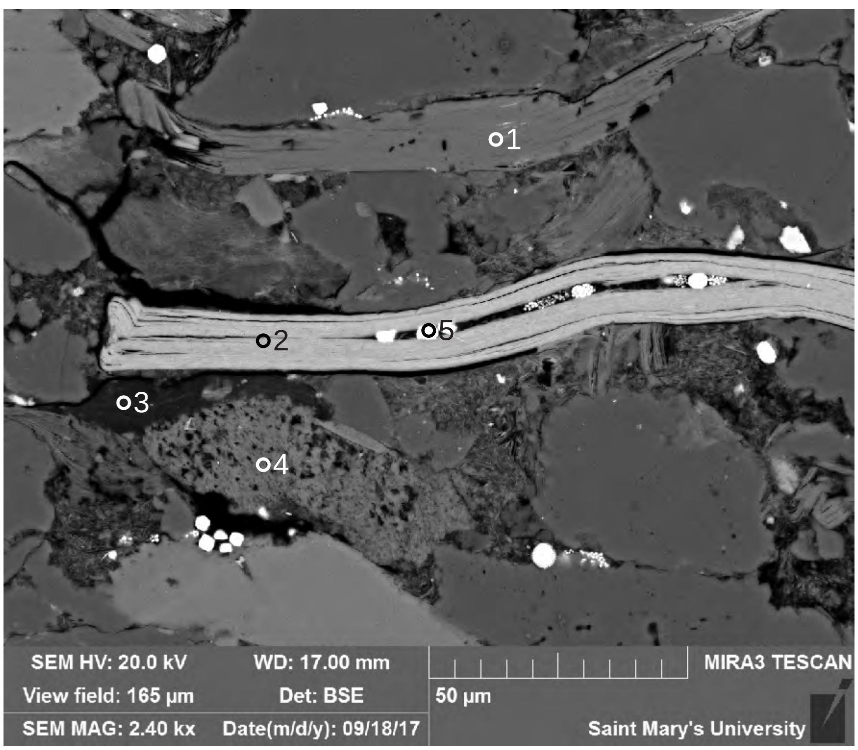
1:Quartz +
2:K-feldspar
3:Fe-Chlorite
4:Fe-Chlorite
5:K-feldspar
6:"Ilmenite"
7:Quartz + K-feldspar
8:Muscovite
9:Quartz
10:Quartz
11:Kaolinite
12:Quartz
13:Quartz
14:Quartz

Figure 1-10.5: Sample O-47 1886.68 (SEM) site 3. This site is similar to site 1. There is also detrital Fe-rich chlorite (3-4), and probably diagenetic kaolinite (position a).



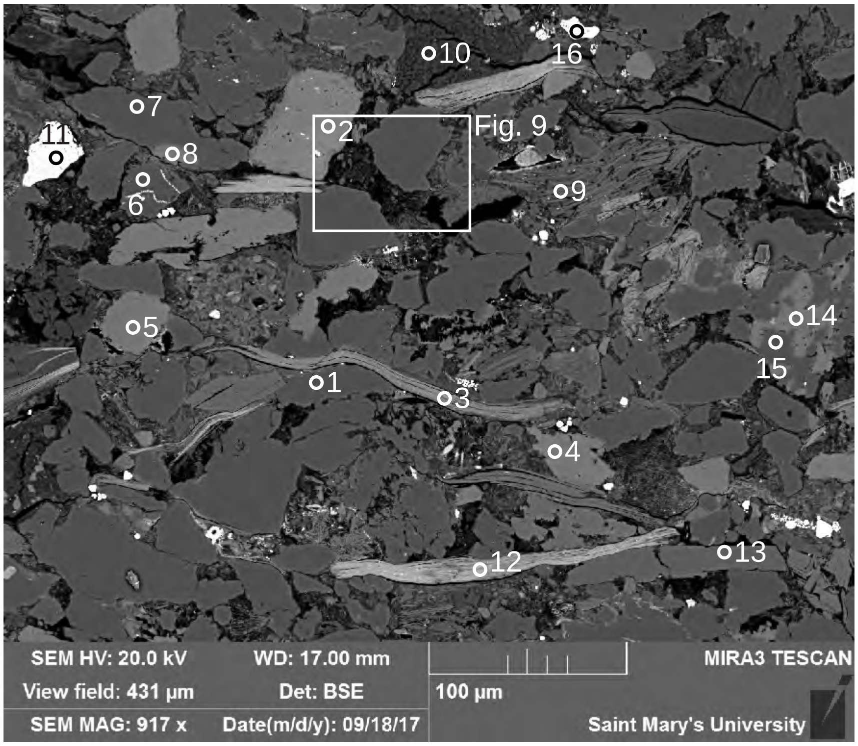
1:Quartz
2:Fe-Chlorite
3:K-feldspar
4:TiO_2 +
5:K-feldspar
6:K-feldspar
7:Quartz
8:Quartz
9:Quartz
10:Quartz
11:Quartz
12:K-feldspar + Pyrite

Figure 1-10.6: Sample O-47 1886.68 (SEM) site 4. This site consists of detrital quartz, K-feldspar, and Fe-chlorite (2). There is also probably kaolinite (positions a) cement.



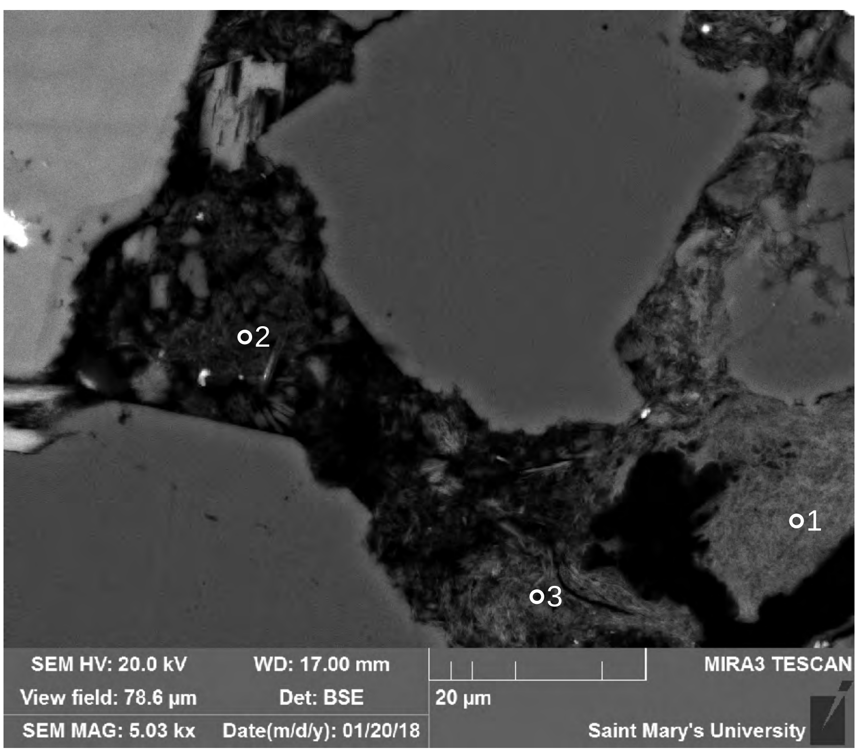
1:Muscovite
2:Fe-Chlorite +
3:Kaolinite +
4:K-feldspar
5:Pyrite

Figure 1-10.7: Sample O-47 1886.68 (SEM) site 4.1. This site consists of a detrital Fe-chlorite (2) grain that is partially deformed and has expanded along its cleavage plans allowing diagenetic pyrite to precipitate. There are also detrital grains of muscovite (1), altered K-feldspar (4) and a cement partially made up of kaolinite (3) in this site.



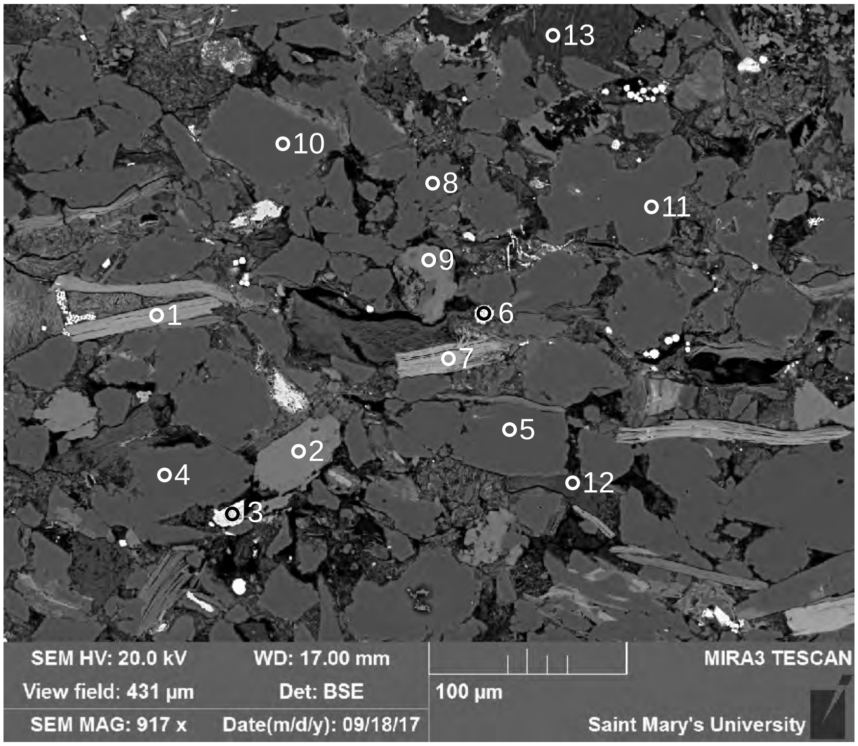
1:Quartz
2:K-feldspar
3:Chlorite +
4:K-feldspar
5:K-feldspar
6:Quartz
7:Quartz
8:K-feldspar
9:Muscovite +
10:Kaolinite
11:"Ilmenite"
12:Mixture
13:Oligoclase
14:K-feldspar
15:Quartz
16:"Ilmenite"

Figure 1-10.8: Sample O-47 1886.68 (SEM) site 5. This site is similar to site 2. Detrital muscovite (9), chlorite (3,12) appear to be plastically deformed. The cement in this site is made up of kaolinite (10). There is also a granitic lithic clast made up of K-feldspar (14) and quartz (15).



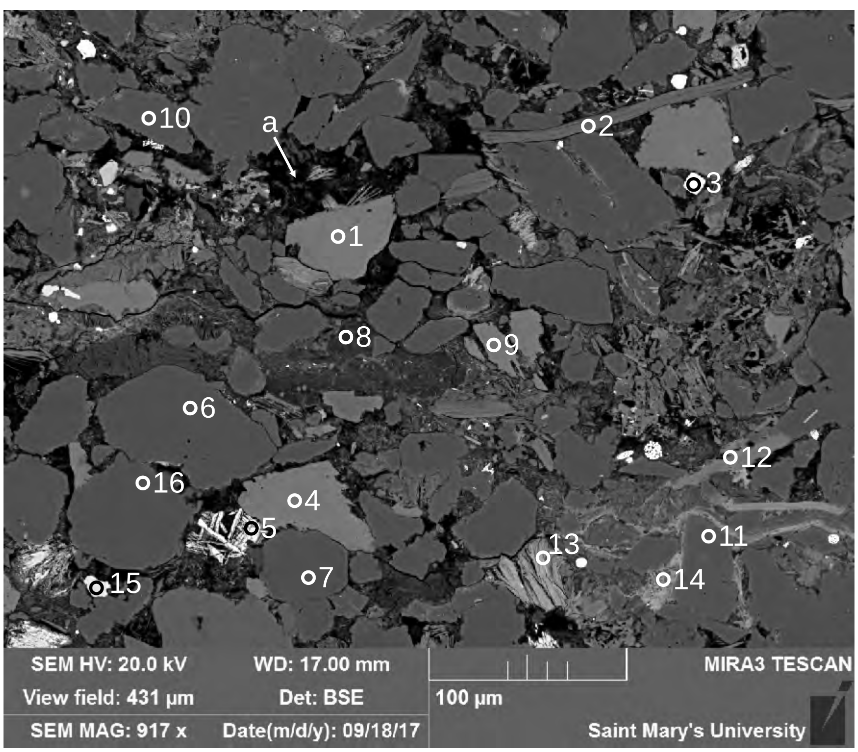
1:Fe-Chlorite
2:Kaolinite
3:Fe-clay

Figure 1-10.9: Sample O-47 1886.68 (SEM) site 5.1. This site consists of small kaolinite (2) booklets, Fe-chlorite (1), and Fe-clay (3), which make up the cement between grains filling primary porosity.



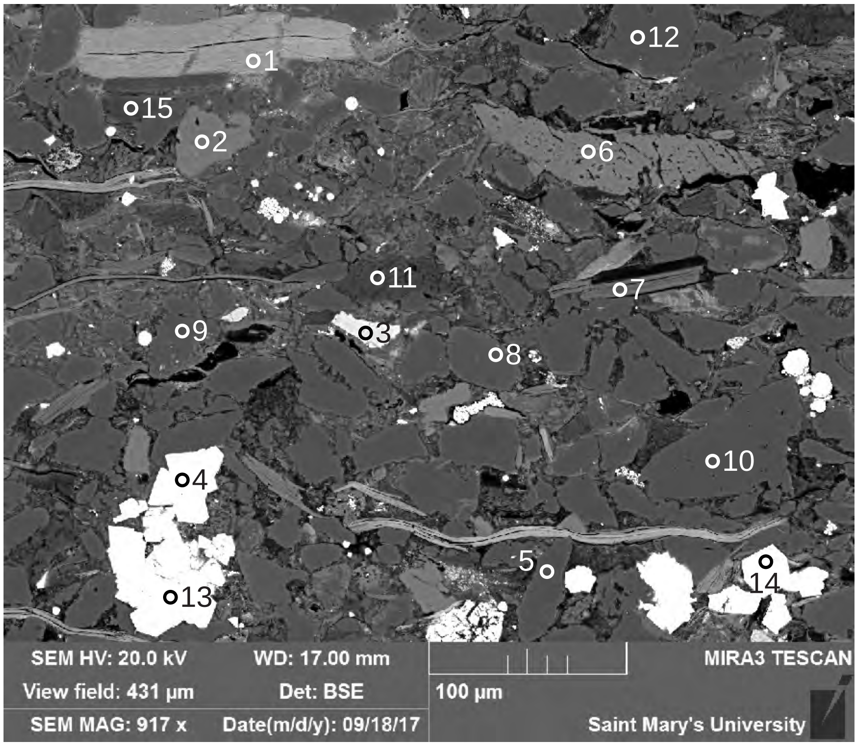
1:Chlorite + Biotite
2:K-feldspar
3:TiO_2 +
4:Quartz
5:Quartz
6:Pyrite
7:Chlorite + Biotite
8:Quartz
9:K-feldspar
10:Quartz
11:Quartz
12:Chlorite + Illite
13:Kaolinite

Figure 1-10.10: Sample O-47 1886.68 (SEM) site 6. This site is similar to site 5. Chlorite + Illite (12) make up the matrix and kaolinite (13) makes up the cement.



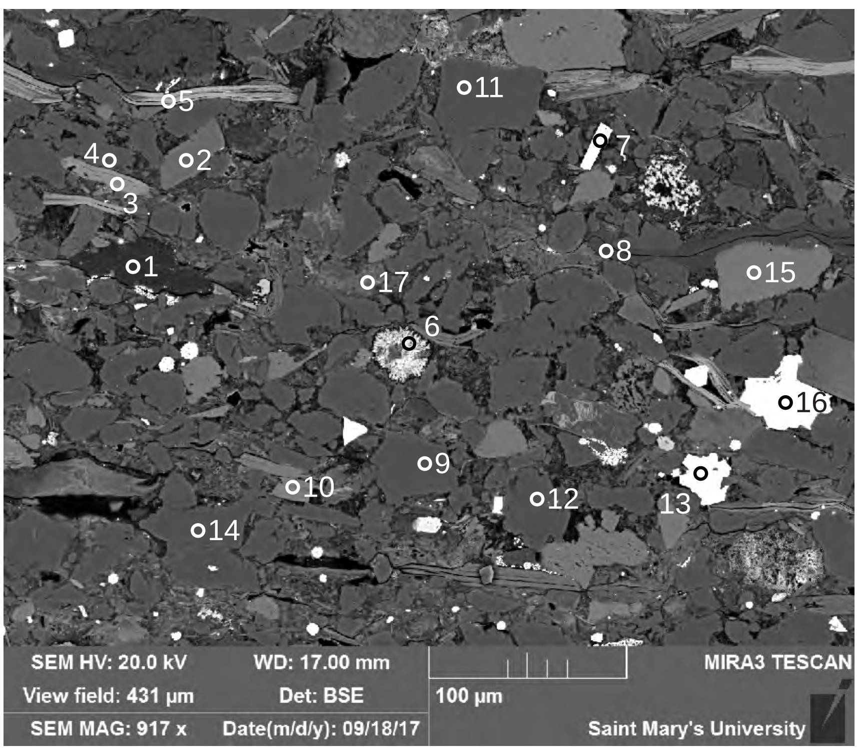
1:K-feldspar
2:Muscovite
3:Pyrite
4:K-feldspar
5:"Ilmenite"
6:Quartz
7:Quartz
8:Kaolinite +
9:K-feldspar
10:Albite
11:Albite
12:K-feldspar
13:Chlorite +
14:Anhydrite +
15:TiO_2
16:Quartz

Figure 1-10.11: Sample O-47 1886.68 (SEM) site 7. This site consists of detrital quartz (6-7), K-feldspar (1,4,9,12), muscovite (2), chlorite (13), altered ilmenite (5), and albite (10-11). The cement between grains consists of kaolinite (8,position a), and anhydrite (14). Pyrite (3) and titania (15) are the latest minerals to form.



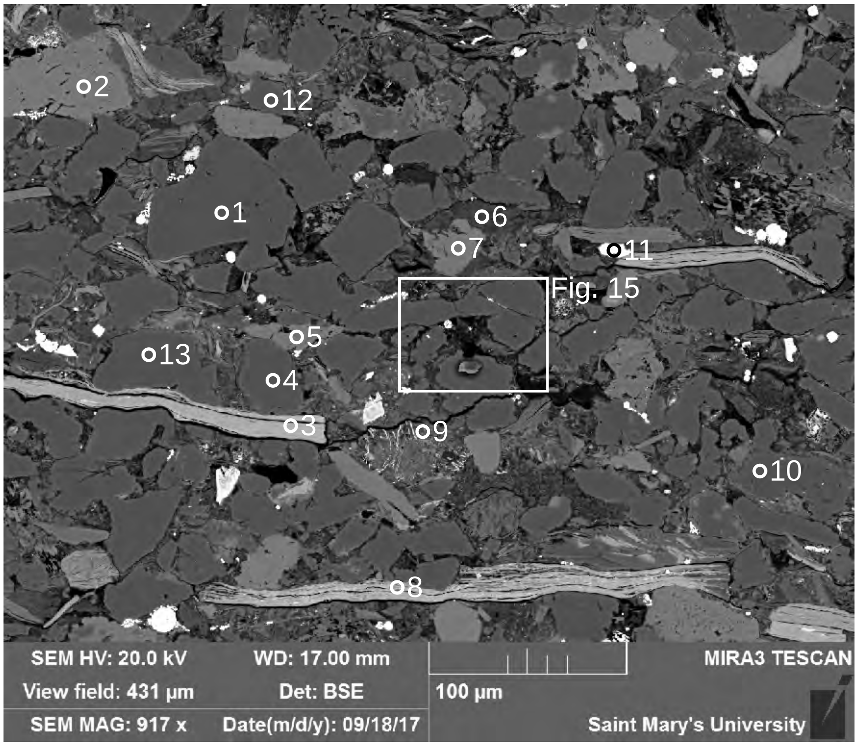
1:Mixture
2:K-feldspar
3:TiO_2 +
4:Pyrite
5:Quartz
6:K-feldspar
7:Muscovite
8:Albite
9:Quartz
10:Quartz
11:Kaolinite
12:Quartz
13:Pyrite
14:Pyrite
15:Kaolinite

Figure 1-10.12: Sample O-47 1886.68 (SEM) site 8. This site consists of detrital quartz, K-feldspar, muscovite (7), and albite (8) grains. The cement is made up of kaolinite (11,15). Late diagenetic pyrite (4,13-14) and titania (3) are the latest mineral to form.



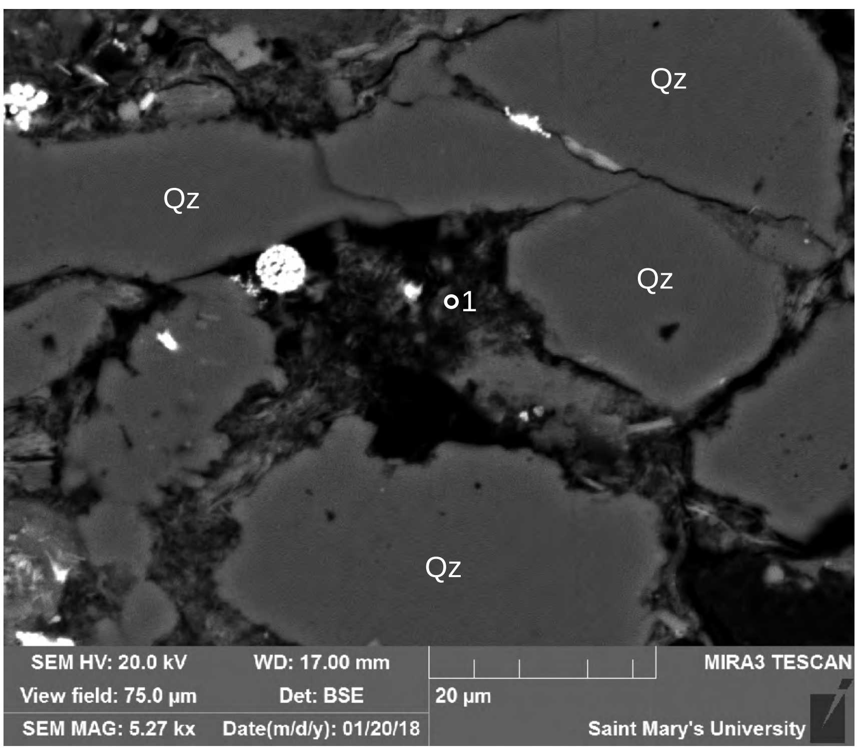
1:Kaolinite
2:K-feldspar + Albite
3:Chlorite + Biotite
4:Albite
5:Chlorite + Biotite
6:Siderite +
7:Ilmenite
8:Kaolinite
9:Quartz
10:Chloritized Muscovite
11:Quartz
12:Quartz
13:Pyrite
14:Quartz
15:K-feldspar
16:Pyrite
17:Illite + Chlorite +

Figure 1-10.13: Sample O-47 1886.68 (SEM) site 9. This site is similar to site 2. It may contain microperthite (2). Diagenetic siderite (6) and pyrite (13,16) are the latest minerals to form.



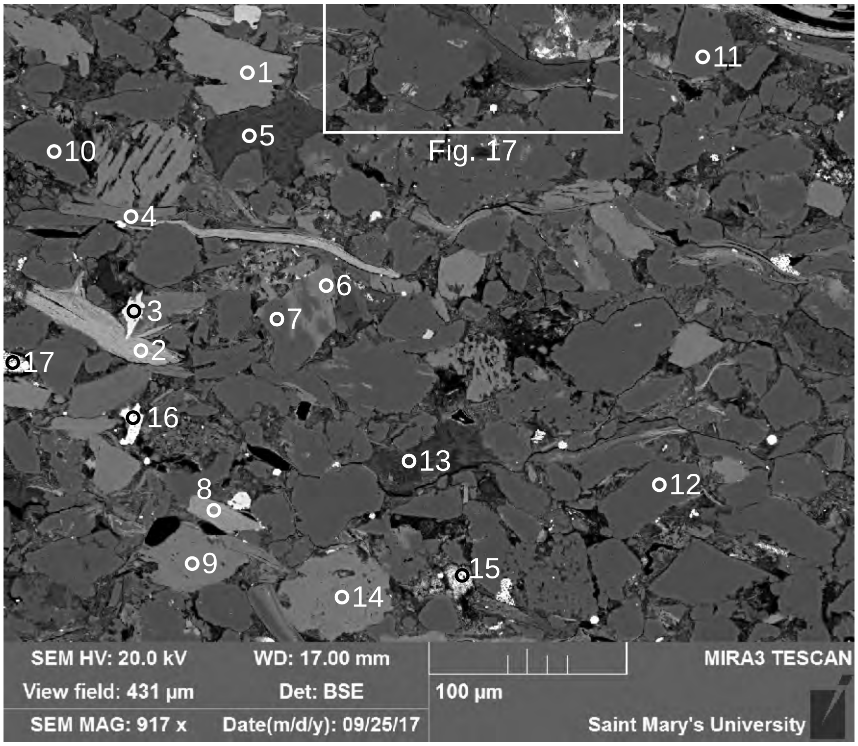
1:Quartz
2:K-feldspar
3:Fe-Chlorite
4:Quartz
5:K-feldspar
6:Kaolinite
7:K-feldspar
8:Chlorite + Biotite
9:Mixture
10:Quartz
11:Ilmenite +
12:Quartz
13:Quartz

Figure 1-10.14: Sample O-47 1886.68 (SEM) site 10. This site consists of mostly detrital quartz and K-feldspar grains. There is also detrital grains now of Fe-chlorite (3), chlorite + biotite (8), and ilmenite (11). Kaolinite (6) may be matrix or cement.



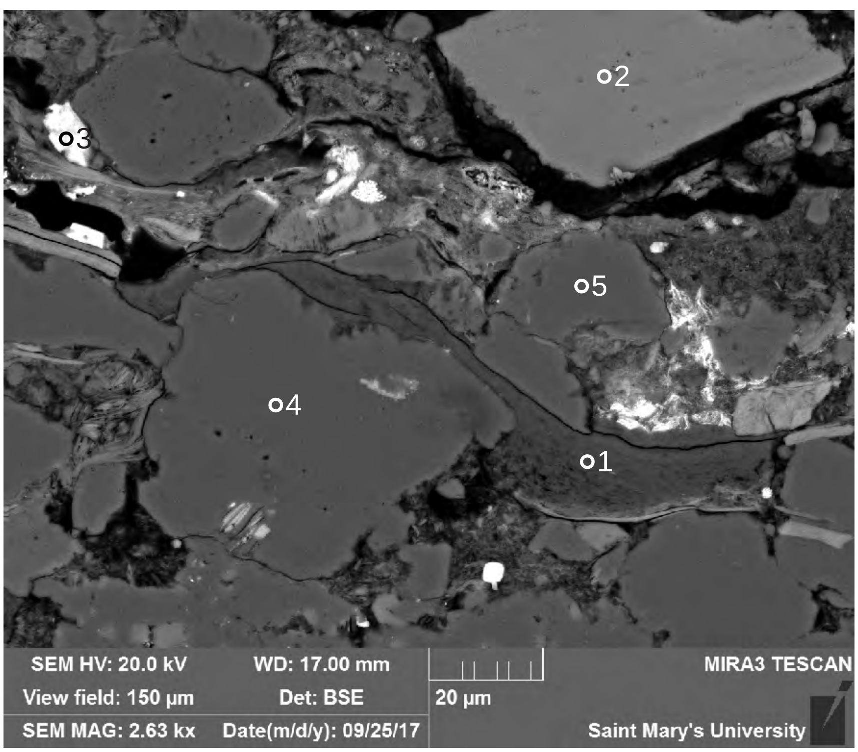
1:Fe-clay

Figure 1-10.15: Sample O-47 1886.68 (SEM) site 10.1. This site consists of an Fe-rich clay that is between detrital quartz grains. This clay may be matrix or cement.



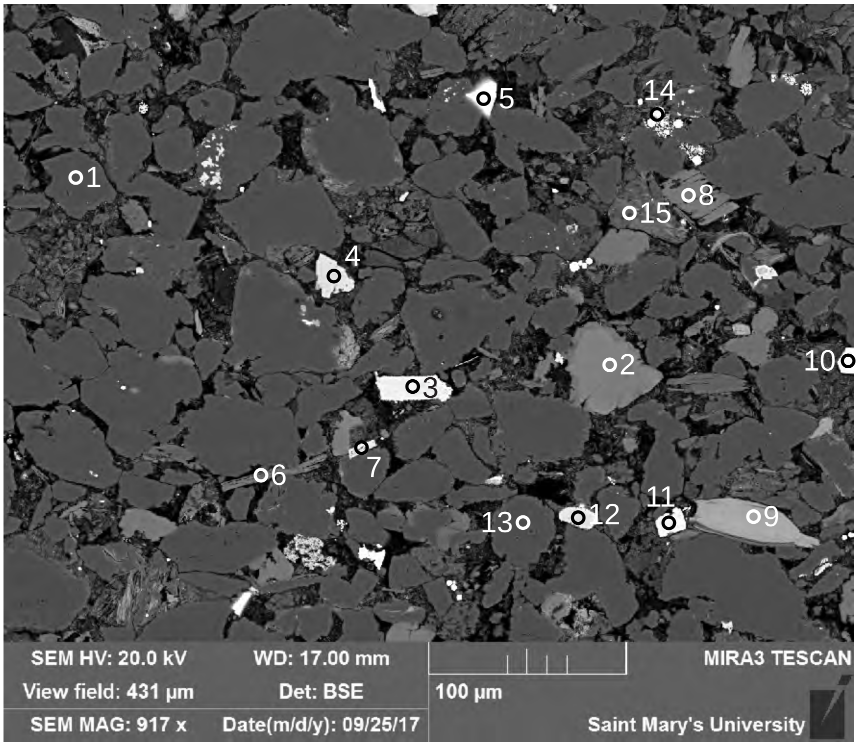
1:K-feldspar
2:Chlorite + Biotite
3:TiO_2
4:Muscovite
5:Kaolinite
6:K-feldspar
7:Albite
8:Biotite
9:K-feldspar
10:Quartz
11:Albite
12:Quartz
13:Kaolinite
14:K-feldspar
15:Siderite + Pyrite
16:"Ilmenite"
17:Pyrite

Figure 1-10.16: Sample O-47 1886.68 (SEM) site 11. This site is similar to site 10. There is diagentic titania (3), pyrite (17), and siderite (15).



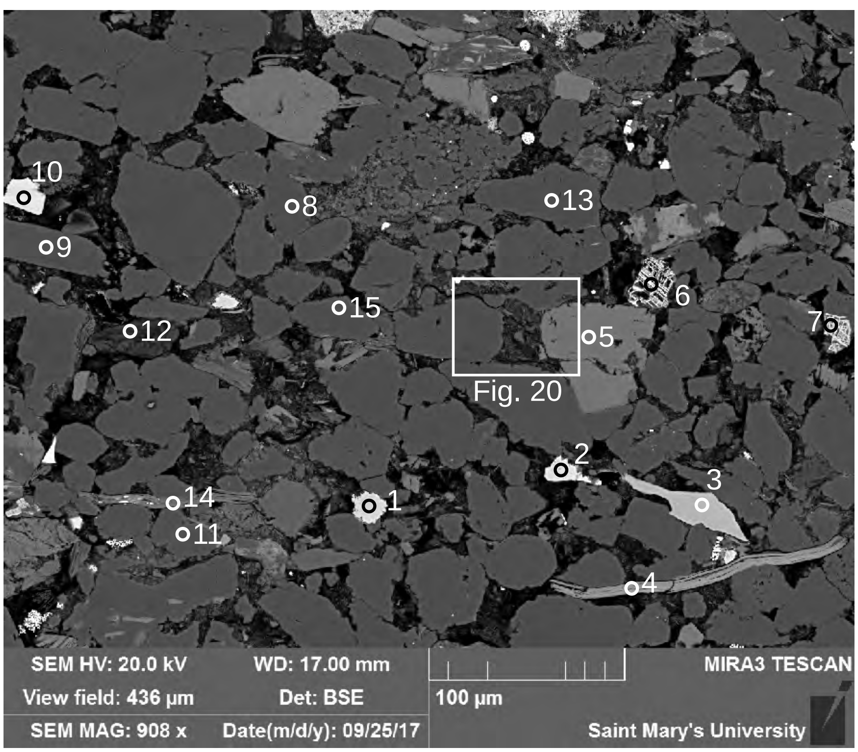
1:Kaolinite
2:K-feldspar
3:"Ilmenite"
4:Quartz
5:Quartz

Figure 1-10.17: Sample O-47 1886.68 (SEM) site 11.1. This site consists of a detrital grains of quartz (4-5), and K-feldspar (2). Kaolinite (1) appears to replace a detrital muscovite grain. There is also altered ilmenite (3).



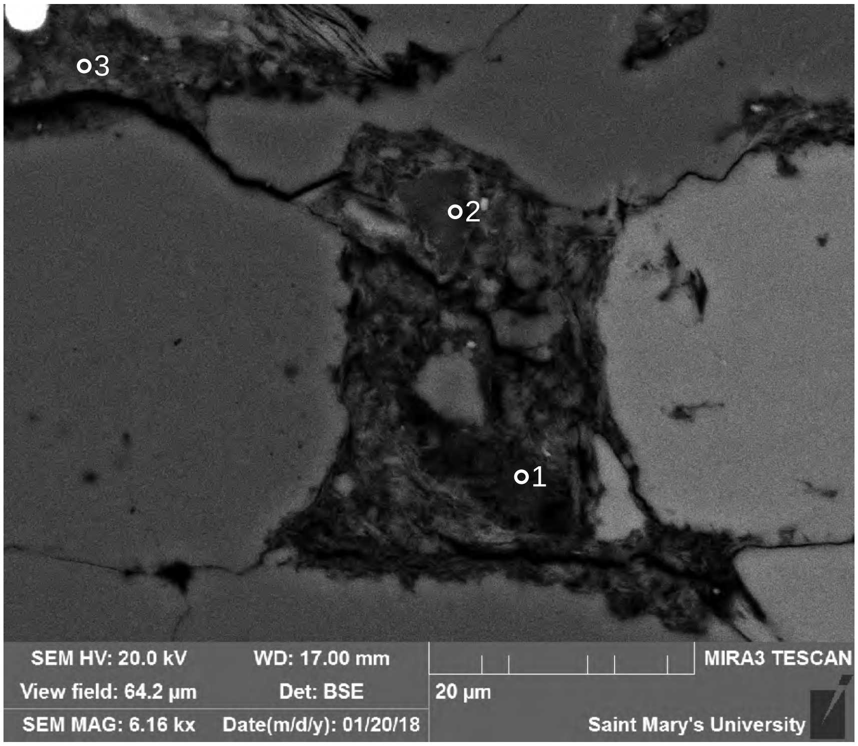
1:Quartz
2:K-feldspar
3:TiO_2
4:TiO_2 +
5:Ilmenite
6:Muscovite + Chlorite
7:TiO_2 +
8:K-feldspar
9:Fe-Chlorite
10:Ilmenite
11:TiO_2
12:TiO_2 +
13:Quartz
14:Pyrite
15:Chloritized Muscovite

Figure 1-10.18: Sample O-47 1886.68 (SEM) site 12. This site consists of detrital quartz (1,13), K-feldspar (2,8), Fe-chlorite (9), ilmenite (5,10), muscovite + chlorite (6), and titania (3-4,7,11-12). Pyrite (14) is diagenetic.



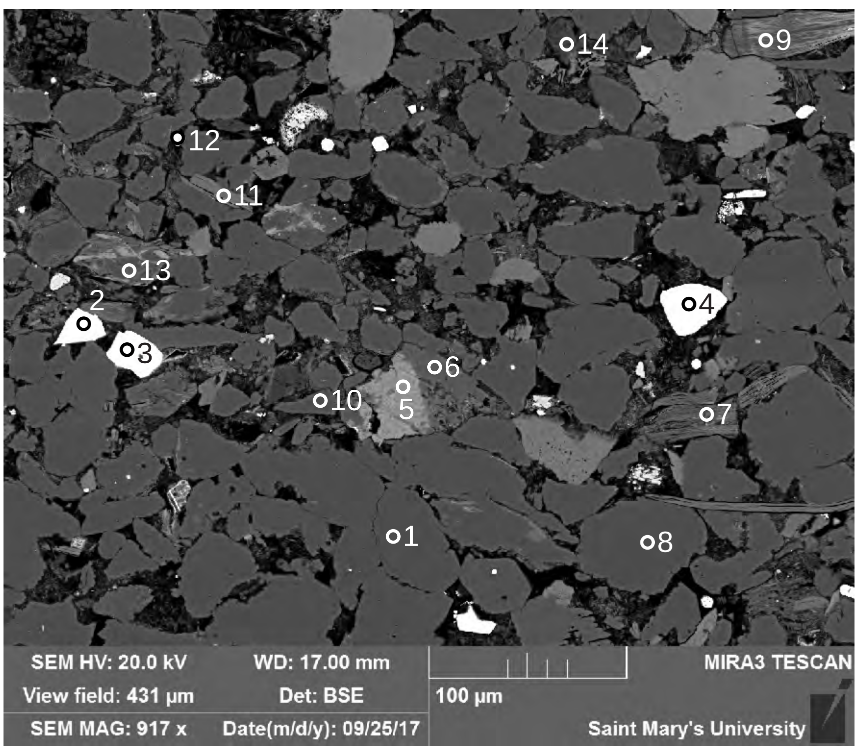
1:Siderite
2:TiO_2
3:Garnet
4:Chlorite + Biotite
5:K-feldspar
6:Ilmenite
7:"Ilmenite"
8:Quartz
9:Quartz
10:TiO_2
11:Quartz
12:Kaolinite + Chlorite
13:Quartz
14:Muscovite + Chlorite
15:Quartz

Figure 1-10.19: Sample O-47 1886.68 (SEM) site 13. This site consists of detrital quartz, K-feldspar, ilmenite (6-7), muscovite + chlorite (14), chlorite + biotite (4), and garnet (3). The cement is made up of kaolinite + chlorite (12). There is also diagenetic titania (2,10), siderite (1).



1:Kaolinite +
2:Glaucony ?
3:Kaolinite

Figure 1-10.20: Sample O-47 1886.68 (SEM) site 13.1. This site is a zoom in of the cement in site 13. The cement appears to mostly consist of kaolinite (1,3), with a small grain of ?glaucony (2).



1:Quartz
2:Ilmenite
3:Zircon
4:Zircon
5:Chlorite
6:Albite
7:Kaolinite +
8:Quartz
9:Chloritized Muscovite
10:Quartz
11:Muscovite
12:Pyrite
13:Muscovite + Quartz
14:Kaolinite

Figure 1-10.21: Sample O-47 1886.68 (SEM) site 14. This site is similar to site 13, however there is also detrital zircon (3-4), and late diagenetic pyrite (12).

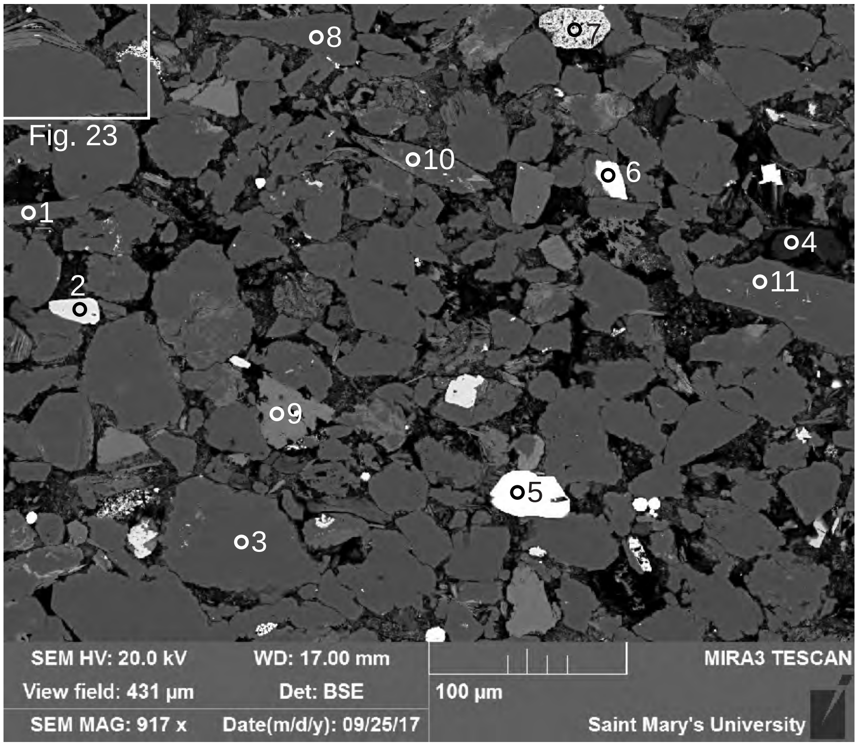


Figure 1-10.22: Sample O-47 1886.68 (SEM) site 15. This site is similar to site 14. The cement is made up of kaolinite (4). Titania (7) may be detrital. Suturing is common between quartz grains.

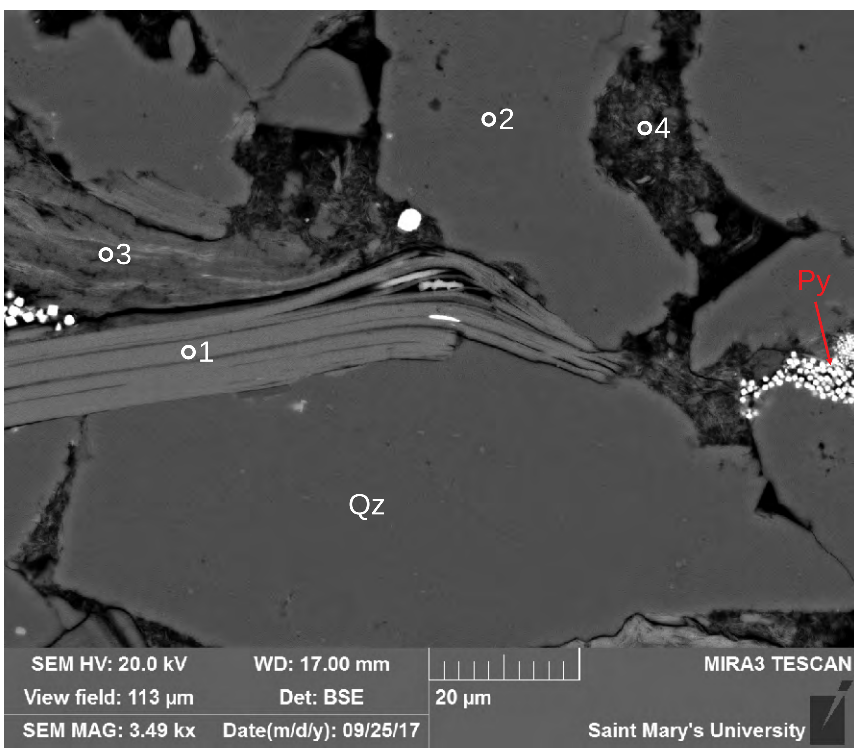
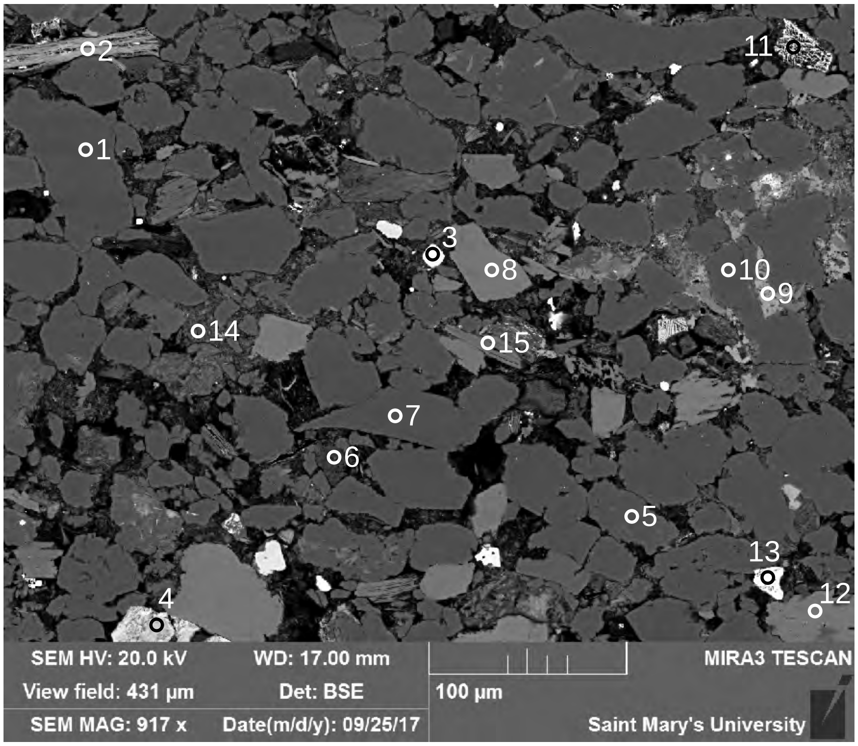
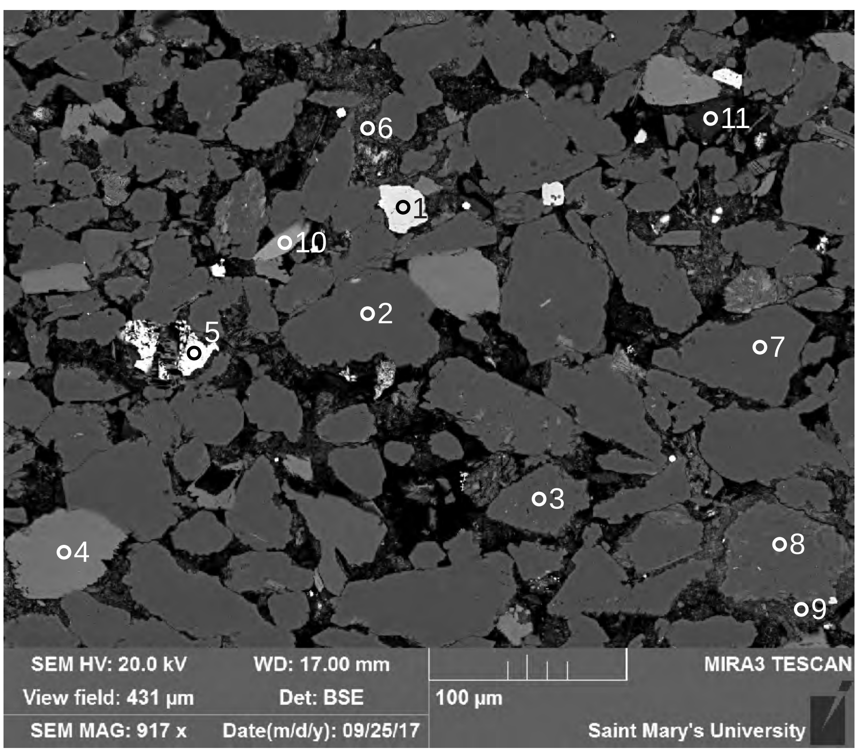


Figure 1-10.23: Sample O-47 1886.68 (SEM) site 15.1. This site consists of a detrital muscovite (1) grain that is partly deformed and expanded along cleavage planes, allowing for a diagenetic mineral to form (probably ?siderite). Quartz (2) is the other detrital mineral present in this site. Kaolinite (3) makes up part of the cement.



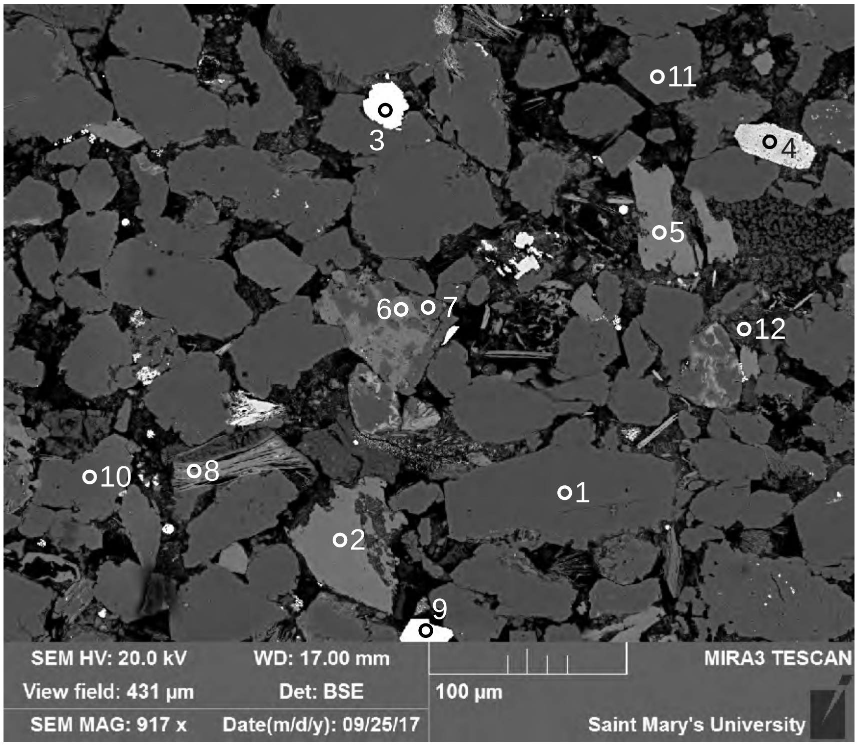
1:Quartz
2:Chlorite
3:Pyrite
4:TiO_2
5:Quartz
6:Kaolinite
7:Quartz
8:K-feldspar
9:Anhydrite +
10:Quartz
11:TiO_2 +
12:K-feldspar
13:Ilmenite
14:Illite + Chlorite
15:Muscovite

Figure 1-10.24: Sample O-47 1886.68 (SEM) site 16. This site is similar to site 12. The matrix is made up of illite + chlorite (14) and late diagenetic minerals such as pyrite (3). Anhydrite (9) appears to be cement.



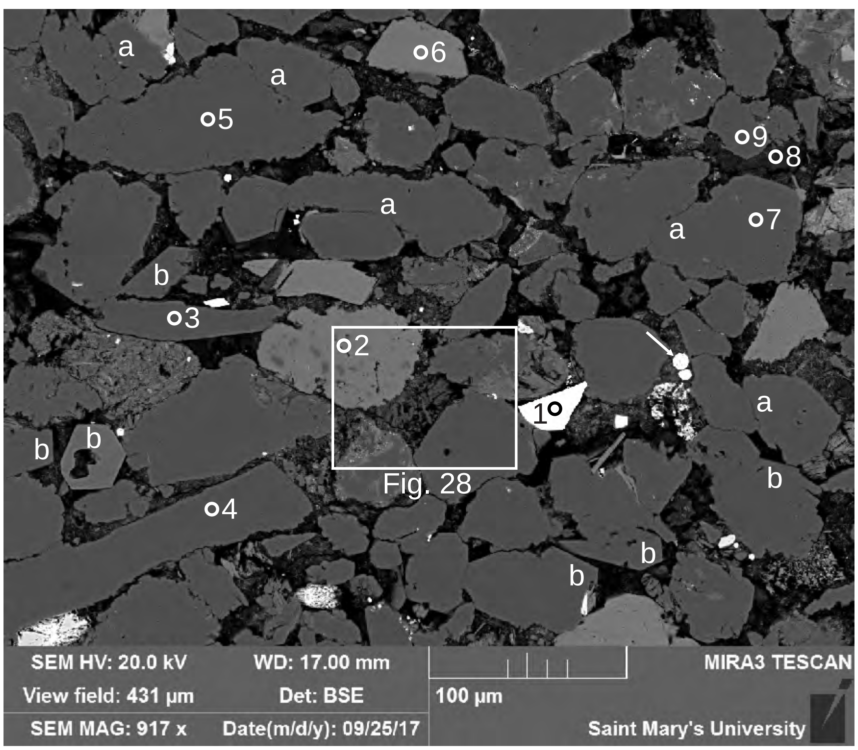
1:TiO_2
2:Quartz
3:Albite
4:K-feldspar
5:Ilmenite
6:Chlorite +
7:Quartz
8:Quartz
9:Fe-Clay ?
10:Fe-Chlorite
11:Kaolinite

Figure 1-10.25: Sample O-47 1886.68 (SEM) site 17. This site consists of detrital quartz (2,7-8), K-feldspar (4), albite (3), ilmenite (5) and Fe-chlorite (10). The cement appears to be made up of an Fe-clay (9) and kaolinite (11).



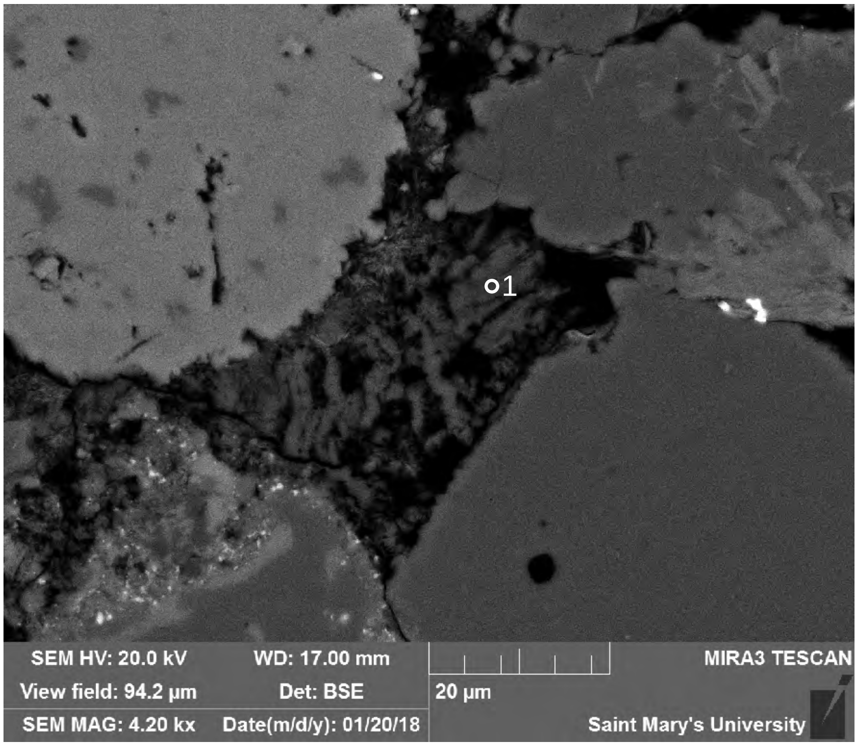
1:Quartz
2:K-feldspar
3:Pyrite
4:TiO_2 +
5:K-feldspar
6:K-feldspar
7:Albite
8:Chlorite
9:Pyrite
10:Quartz
11:Quartz
12:Quartz + Feldspar

Figure 1-10.26: Sample O-47 1886.68 (SEM) site 18. This site consists of detrital quartz (1,10-12), K-feldspar (2,5), chlorite (8), and titania (4) grains. There is a granitic lithic clast made up of albite (7) and K-feldspar (6). Pyrite (3) is the latest mineral to form.



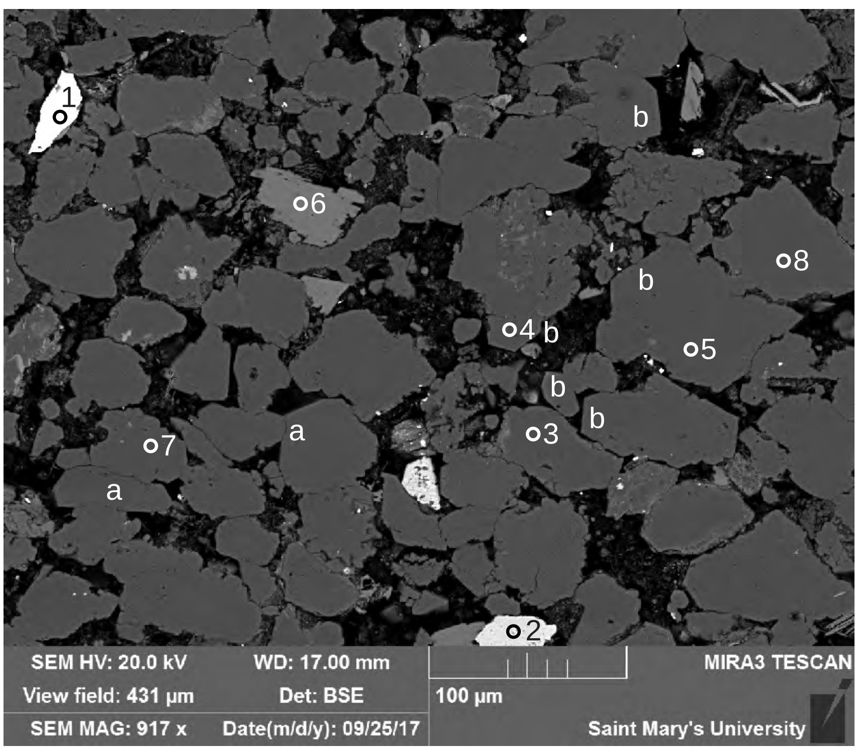
1:Zircon
2:K-feldspar
3:Quartz
4:Quartz
5:Quartz
6:K-feldspar
7:Quartz
8:Fe-Clay
9:Quartz

Figure 1-10.27: Sample O-47 1886.68 (SEM) site 19. This site is similar to site 18. There is commonly suturing (positions a) and overgrowths (positions b) that occur in quartz grains. The cement consists of a Fe-rich clay (8). There is also late diagenetic frambodial pyrite grains (arrow).



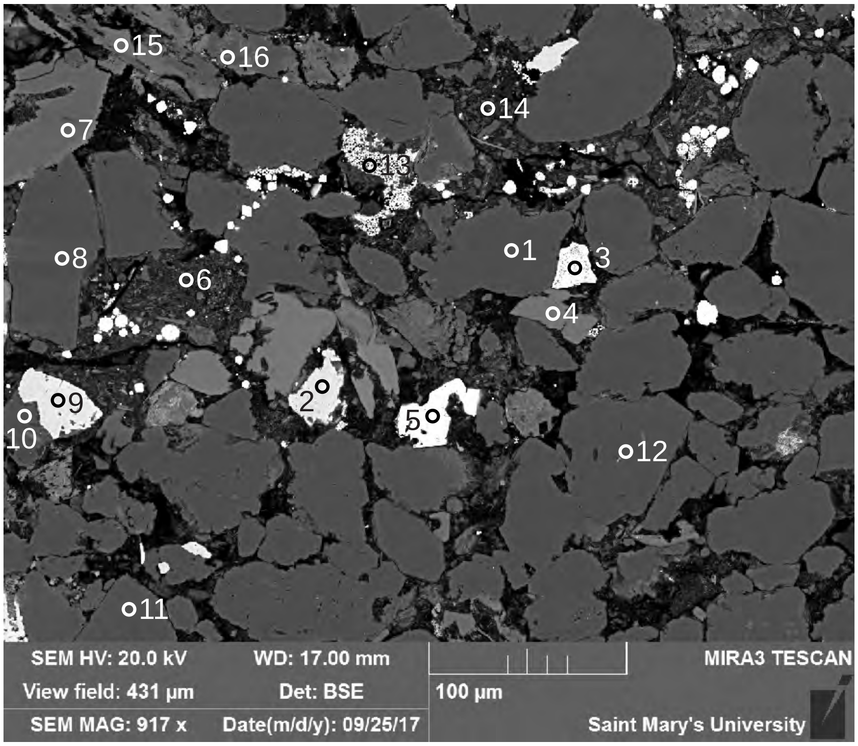
1:Kaolinite

Figure 1-10.28: Sample O-47 1886.68 (SEM) site 19.1. This site consists of detrital grains with kaolinite (1) cement.



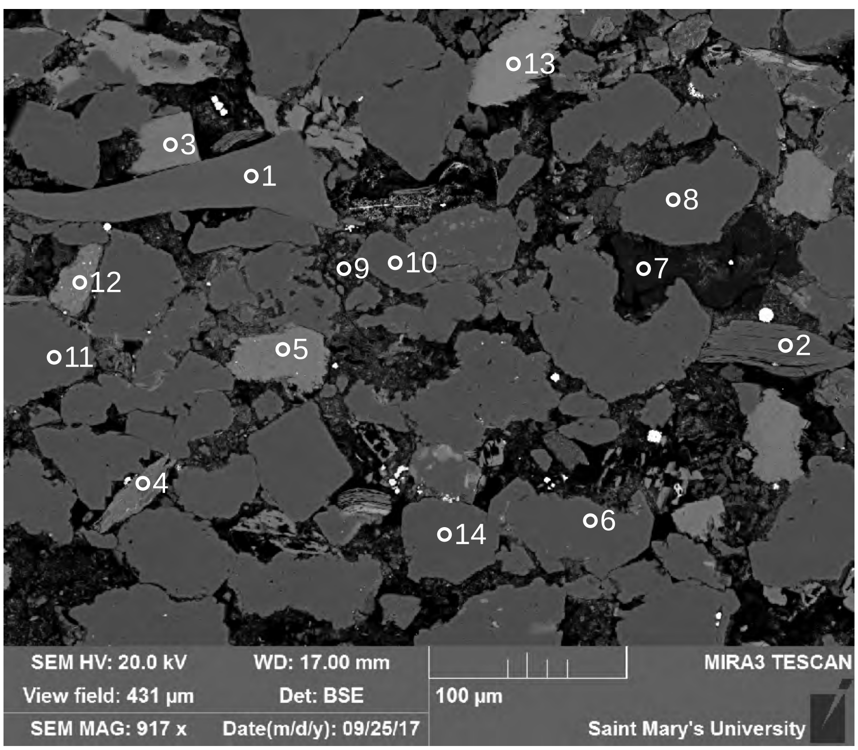
1:Monazite-(Ce)
2:TiO_2
3:Quartz
4:Quartz
5:Quartz
6:K-feldspar
7:Quartz
8:Quartz

Figure 1-10.29: Sample O-47 1886.68 (SEM) site 20. This site is similar to site 19. Quartz commonly displays suturing (positions a) and overgrowths (positions b). Titania (2) and probably monazite (1) are diagenetic.



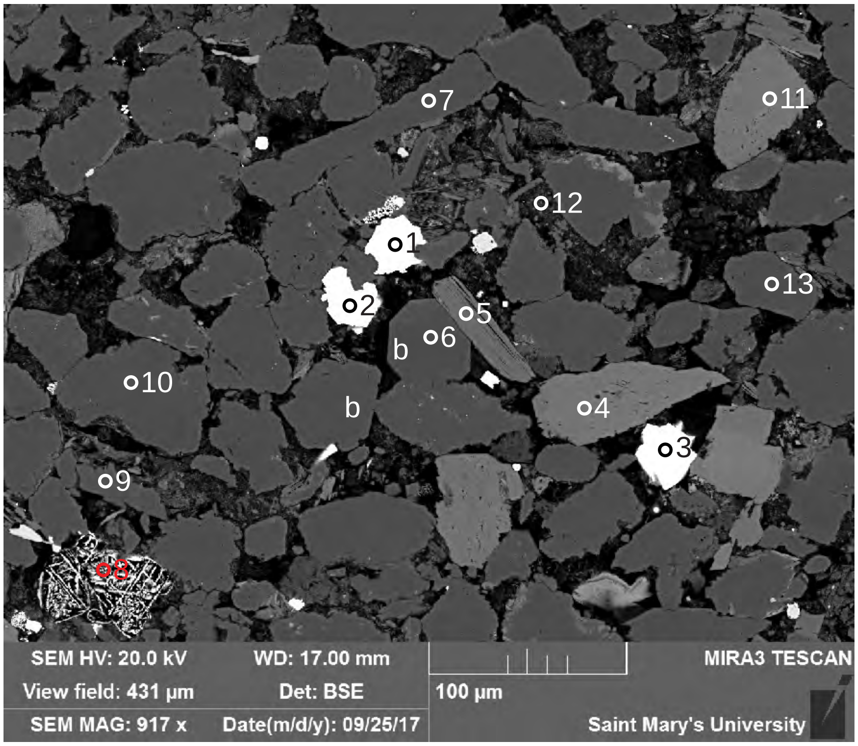
1:Quartz
2:TiO_2
3:"Ilmenite"
4:K-feldspar
5:Ilmenite
6:Illite + Chlorite
7:K-feldspar + Albite
8:Quartz
9:TiO_2
10:Quartz
11:Quartz
12:Quartz
13:Pyrite
14:Illite + Chlorite
15:K-feldspar
16:K-feldspar + Albite

Figure 1-10.30: Sample O-47 1886.68 (SEM) site 21. This site consists of detrital quartz, K-feldspar, and ilmenite (3,5) grains. There is also an albitized K-feldspar (16) grain. The matrix is made up of illite + chlorite (6,14). Diagenetic titania (2,9) and pyrite (13) are the latest minerals to form.



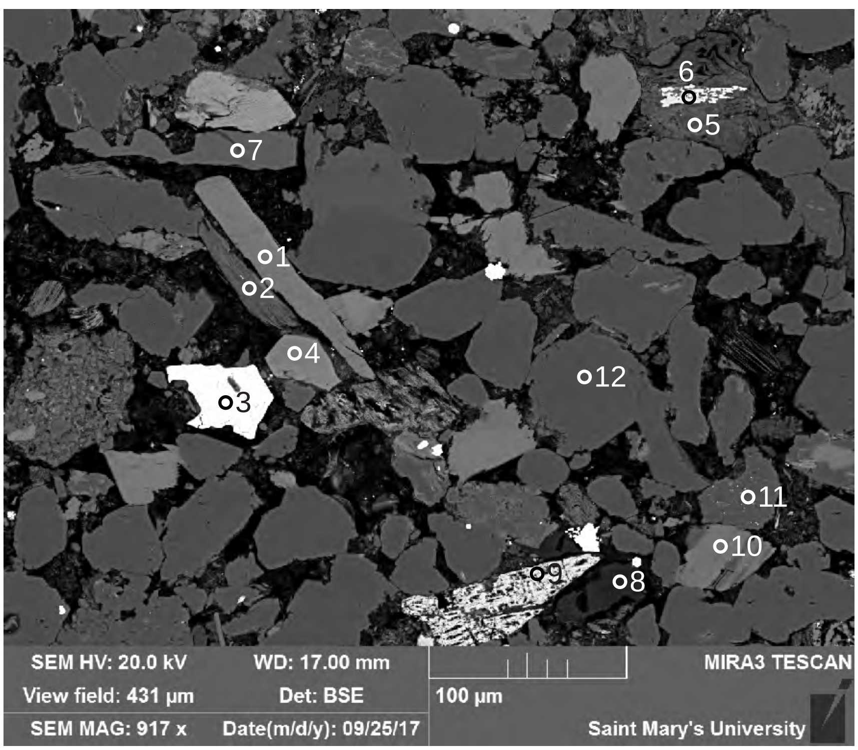
1:Oligoclase
2:Kaolinite
3:K-feldspar
4:Quartz + Muscovite
5:K-feldspar
6:Quartz
7:Illite + Chlorite
8:Quartz
9:Illite + Chlorite
10:Quartz
11:Quartz
12:K-feldspar
13:K-feldspar
14:Quartz

Figure 1-10.31: Sample O-47 1886.68 (SEM) site 22. This site is similar to site 21.



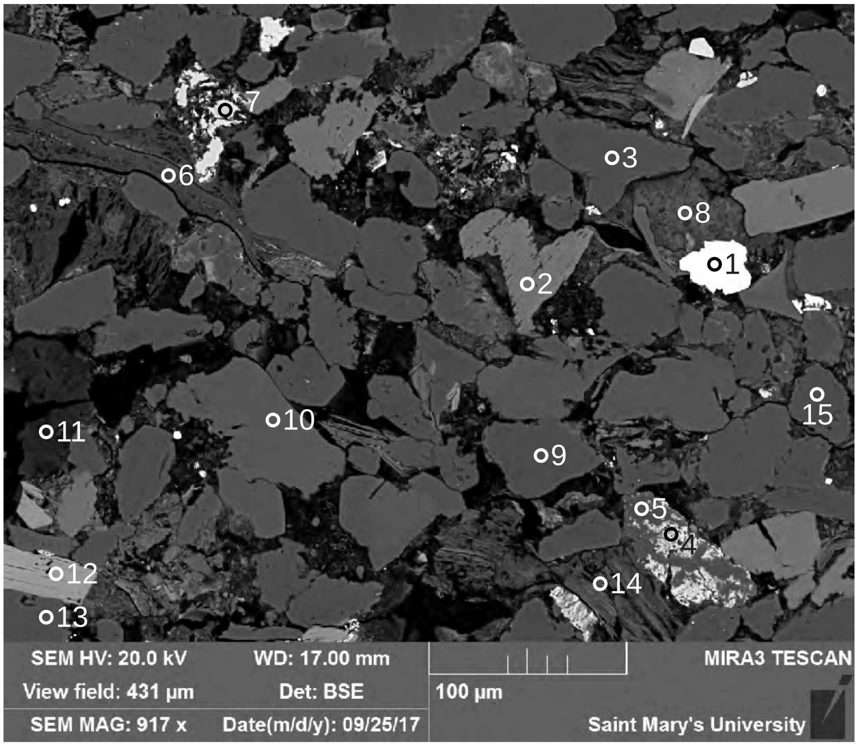
1:Pyrite
2:Pyrite
3:Pyrite
4:K-feldspar
5:Muscovite
6:Quartz
7:Quartz
8:Ilmenite?
9:Albite
10:Quartz
11:K-feldspar
12:?Kaolinite + Chlorite
13:Quartz

Figure 1-10.32: Sample O-47 1886.68 (SEM) site 23. This site consists of detrital quartz (6-7,10,13), K-feldspar (4,11), muscovite (5), albite (9), and ilmenite (8). The matrix is made up of ?kaolinite + chlorite and diagenetic pyrite (1-3). Quartz overgrowths are common (positions b).



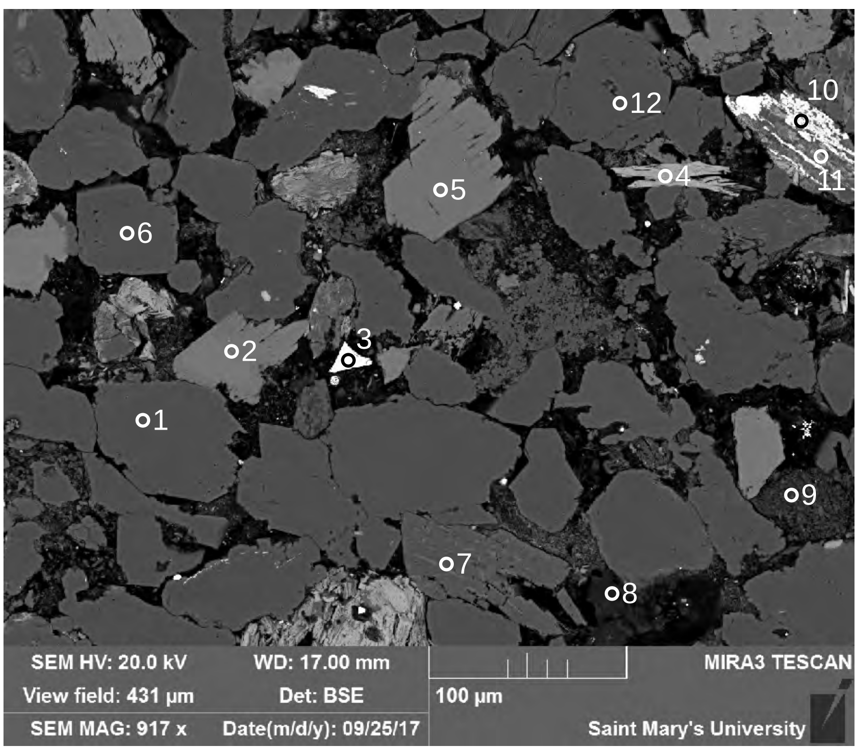
1:K-feldspar
2:Kaolinite +
3:Ilmenite
4:K-feldspar
5:Kaolinite
6:TiO_2 +
7:Oligoclase
8:Illite + Chlorite
9:TiO_2 +
10:K-feldspar
11:Quartz
12:Quartz

Figure 1-10.33: Sample O-47 1886.68 (SEM) site 24. This site consists of detrital quartz (11-12), K-feldspar (1,4,10), ilmenite (3), oligoclase (7), and titania (9). The cement is made up of kaolinite (2,5), and the matrix is made up of illite + chlorite (8). Titania (6) appears as a veinlet cross-cutting kaolinite (5).



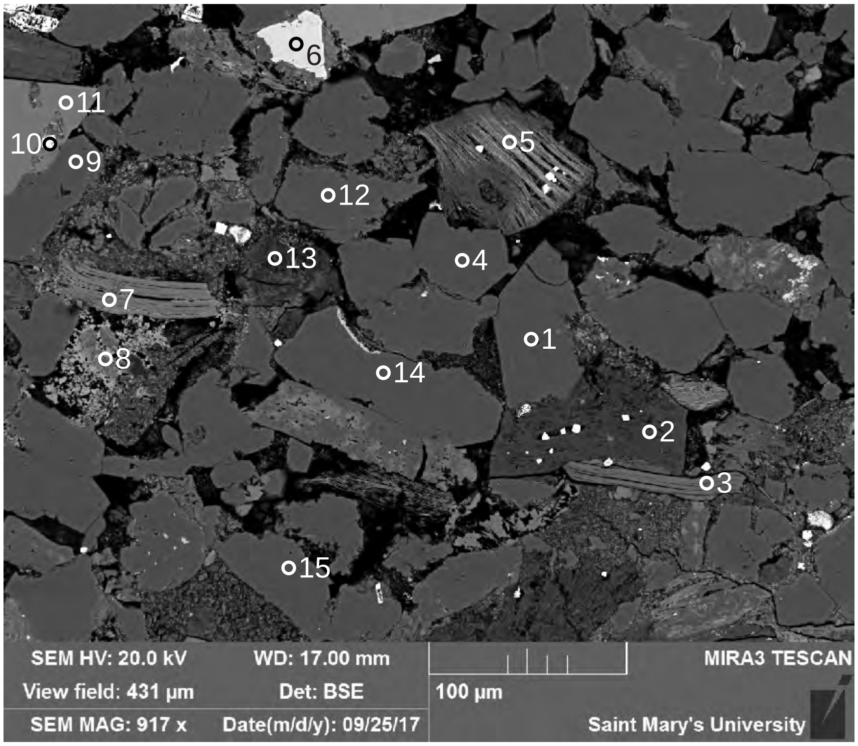
1:Pyrite
2:K-feldspar
3:Quartz
4:Ilmenite + Quartz
5:Quartz
6:Kaolinite
7:Siderite
8:Illite
9:Quartz
10:Oligoclase
11:Kaolinite + Chlorite
12:Chlorite + Biotite
13:Quartz
14:Kaolinite + Chlorite +
15:Quartz

Figure 1-10.34: Sample O-47 1886.68 (SEM) site 25. This site consists of detrital quartz (3,5,9,15), K-feldspar (2), ilmenite with quartz inclusions (4), oligoclase (10), and chlorite + biotite (12). The matrix is made up of illite (8), and the cement is made up of kaolinite + chlorite (11,14) and kaolinite (6). Pyrite (1) and siderite (7) are the latest diagenetic minerals to form.



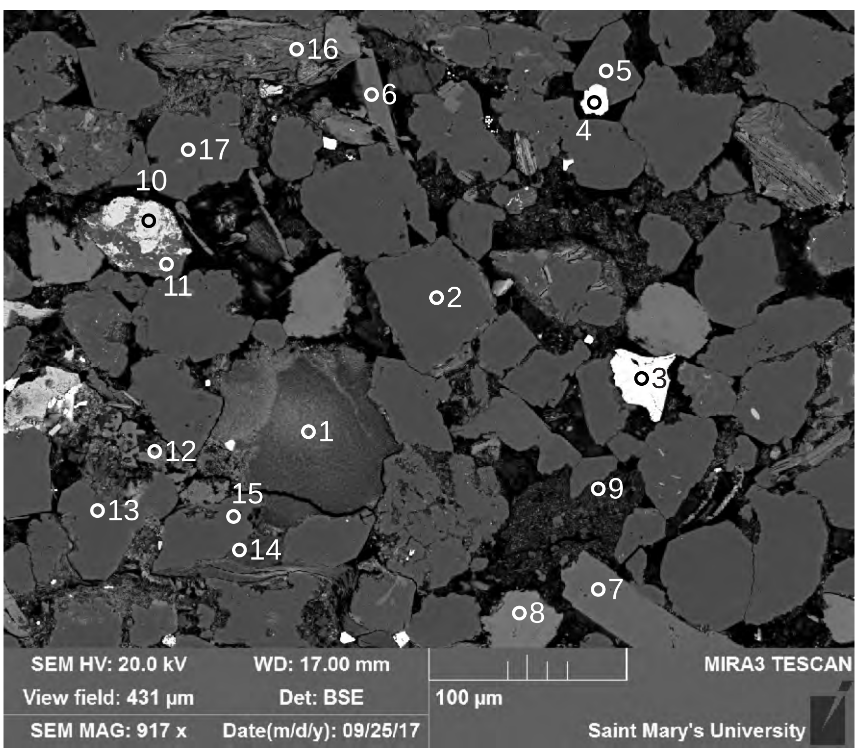
1:Quartz
2:K-feldspar
3:Ilmenite
4:Fe-Chlorite
5:K-feldspar
6:Quartz
7:Muscovite + Albite ?
8:Kaolinite + Chlorite
9:Kaolinite
10:TiO_2 +
11:Kaolinite + Chlorite
12:Quartz

Figure 1-10.35: Sample O-47 1886.68 (SEM) site 26. This site is similar to site 24 and 25. Kaolinite + chlorite (8,11) and kaolinite (9) make up the cement.



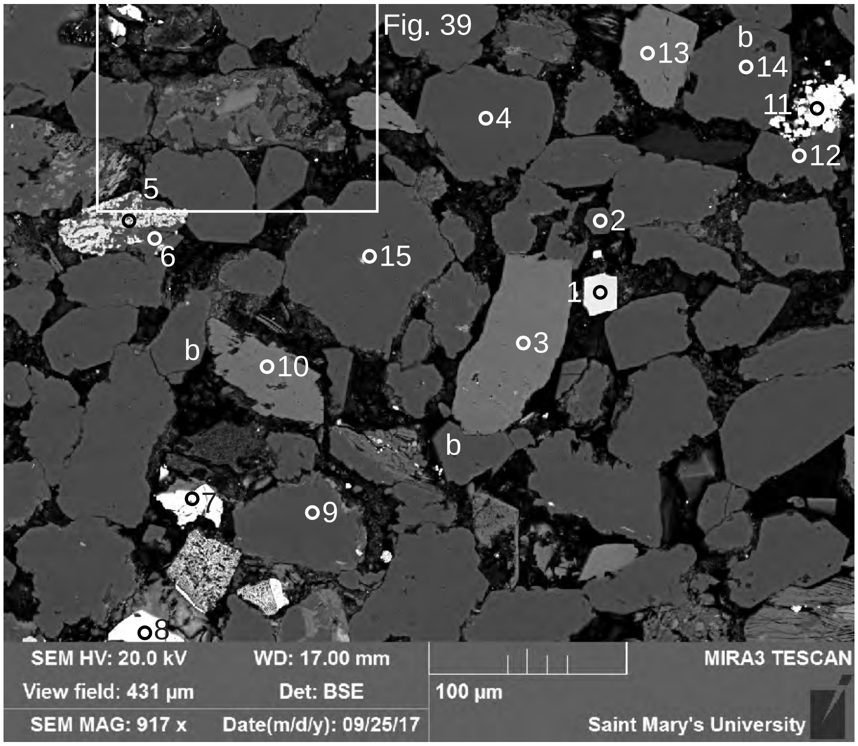
1:Quartz
2:Kaolinite
3:Muscovite
4:Quartz
5:Chlorite + Biotite
6:TiO_2
7:Muscovite
8:Chlorite +
9:Quartz
10:Pyrite
11:K-feldspar
12:Quartz
13:Chlorite +
14:Quartz
15:Quartz

Figure 1-10.36: Sample O-47 1886.68 (SEM) site 27. This site consists of detrital quartz (1,4,9,12,14-15), K-feldspar (11), muscovite (3,7), and chlorite + biotite (5). Chloritized biotite (5) appear to have expanded along cleavage planes allowing diagenetic siderite or pyrite to precipitate. Titania (6) appears to be diagenetic.



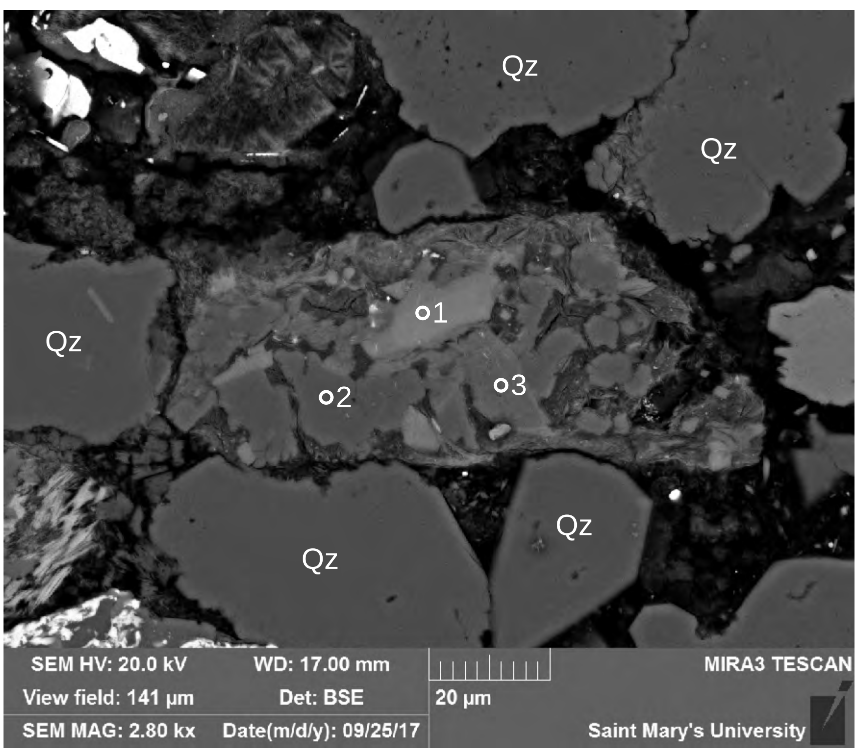
1:Fe-Chlorite
2:Quartz
3:Ilmenite
4:Pyrite
5:Quartz
6:K-feldspar + Albite
7:K-feldspar + Albite
8:K-feldspar
9:Chlorite + Illite
10:TiO_2
11:Quartz +
12:K-feldspar + Albite
13:Quartz
14:Kaolinite
15:Quartz
16:Mixture
17:Quartz

Figure 1-10.37: Sample O-47 1886.68 (SEM) site 28. This site consists of detrital quartz (2,11,13,15,17), K-feldspar (8), and ilmenite (3). The cement consists of Fe-chlorite (1), kaolinite (14).



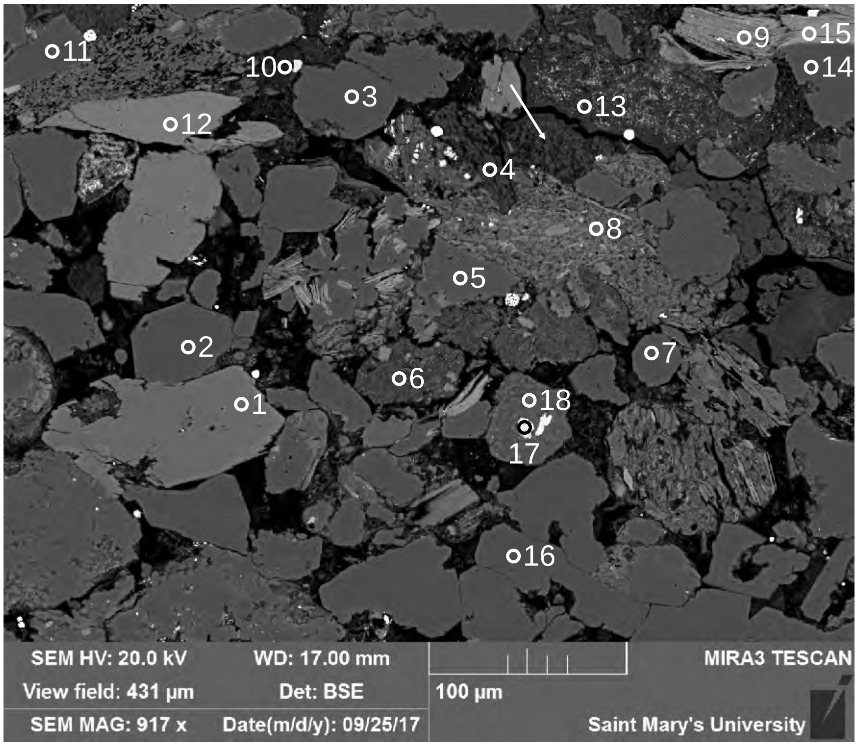
1:Chromite
2:Quartz
3:K-feldspar
4:Quartz
5:"Ilmenite"
6:Quartz
7:Ilmenite
8:Ilmenite
9:Quartz
10:K-feldspar
11:Pyrite
12:Quartz
13:K-feldspar
14:Quartz
15:Quartz

Figure 1-10.38: Sample O-47 1886.68 (SEM) site 29. This site consists of detrital quartz (2,4,6,9,12,14-15), K-feldspar (3,10,13), ilmenite (5,7-8), and chromite (1). There is also diagenetic pyrite (11), and quartz overgrowths (positions b).



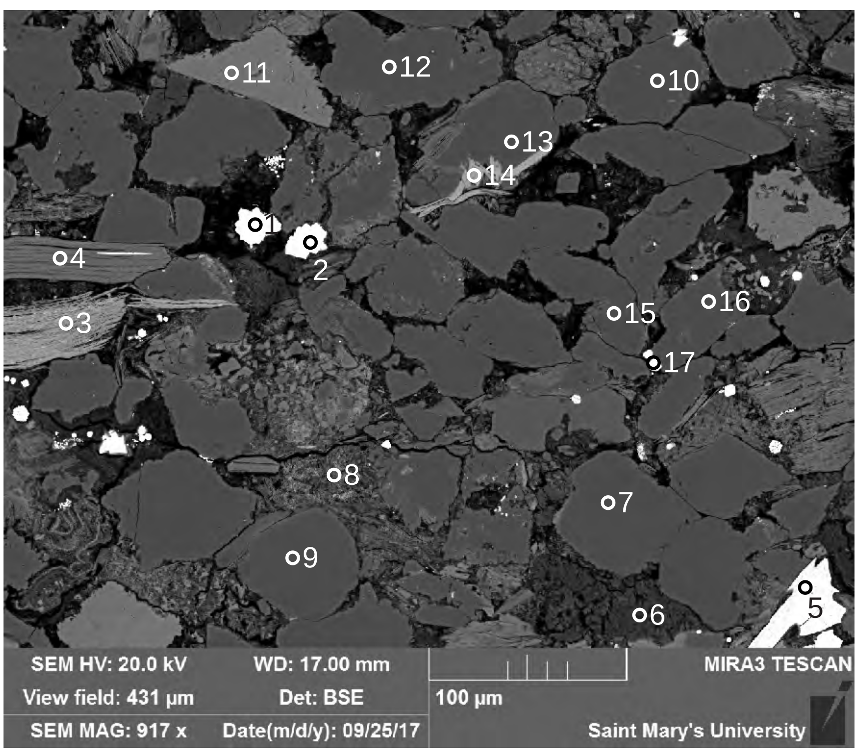
1:K-feldspar
2:Quartz
3:Chlorite

Figure 1-10.39: Sample O-47 1886.68 (SEM) site 29.1. This site consists of detrital quartz grains and a siltstone lithic clast made up of quartz (2), K-feldspar (1), and chlorite (3)



1:K-feldspar + Albite
2:Quartz
3:Quartz
4:Kaolinite
5:Albite
6:Chlorite
7:Quartz
8:Quartz +
9:Chlorite
10:Kaolinite
11:Quartz
12:K-feldspar
13:Chlorite
14:Quartz
15:Chlorite
16:Quartz
17:TiO_2 +
18:Quartz +

Figure 1-10.40: Sample O-47 1886.68 (SEM) site 30. This site consists of detrital quartz (2-3,7,11,14,16), K-feldspar (12), chlorite (9,15), and albite (7). The cement is made up of kaolinite (4,10, arrow), and chlorite (6,13).



1:Pyrite
2:Pyrite
3:Fe-Chlorite +
4:Muscovite +
5:Ilmenite
6:Kaolinite
7:Quartz
8:Chlorite +
9:Quartz
10:Quartz
11:K-feldspar
12:Quartz
13:Quartz
14:Fe-Chlorite
15:Quartz
16:Quartz + Chlorite
17:Pyrite

Figure 1-10.41: Sample O-47 1886.68 (SEM) site 31. This site consists of detrital quartz, K-feldspar, muscovite (4), Fe-chlorite (3,14), and ilmenite (5). The cement is made up of chlorite (8), kaolinite (6), and late diagenetic pyrite (1-2,17).

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	1	1	Qz	100.00																												100	119
O-47 1886.68	1	2	Kfs	66.04		17.80					0.41	15.74																				100	119
O-47 1886.68	1	3	Kln	47.39		35.71	1.81		0.40		0.40					0.29																86	94
O-47 1886.68	1	4	Ms	49.54	0.33	29.91	3.15		1.77		0.81	9.49																				95	110
O-47 1886.68	1	5	TiO2	1.43	97.13	0.59	0.85																									100	105
O-47 1886.68	1	6	Kfs	66.17		17.81					0.72	15.30																				100	117
O-47 1886.68	1	7	Kfs	66.18		17.82					0.87	15.14																				100	116
O-47 1886.68	1	8	Kfs	65.96		17.92					0.63	14.88											0.61									100	117
O-47 1886.68	1	9	Kfs	66.76		17.06	0.38		0.35		0.57	14.88																				100	117
O-47 1886.68	1	10	Qz	100.00																												100	121
O-47 1886.68	1	11	Qz	100.00																												100	119
O-47 1886.68	1	12	Kln	46.02	0.33	32.68	4.34		1.18		0.58	0.66				0.21																86	98
O-47 1886.68	1	13	Qz	100.00																												100	123
O-47 1886.68	1	14	Qz	100.00																												100	121
O-47 1886.68	1	15	Xenotime-(Y)	9.27									35.97								43.15						1.52	3.72	3.31	3.07		100	121
O-47 1886.68	1	16	Kfs	65.32		18.09	1.88		0.32		2.22	11.96				0.20																100	108
O-47 1886.68	1	17	Chloritized Ms	49.61	0.66	29.36	6.24		3.05	0.65	0.51	8.45		1.29		0.17																100	106
O-47 1886.68	1	18	Ms	50.09		32.03	3.05		1.16		0.40	8.27																				95	105
O-47 1886.68	1	19	Kfs	64.64		18.46					1.13	13.91											1.87									100	117
O-47 1886.68	1	20	Qz	100.00																												100	121
O-47 1886.68	1	21	Chl +	39.69		19.23	25.56		11.40	0.56	1.33	1.68				0.55																100	90
O-47 1886.68	1.1	1	Kln	48.54		33.14	2.18		2.02			0.11																				86	79
O-47 1886.68	1.1	2	Kln	47.81		33.55	2.24		2.36			0.05																				86	83
O-47 1886.68	2	1	Kfs	66.45		17.84					0.87	14.84																				100	114
O-47 1886.68	2	2	Chl +	37.66	1.33	22.84	27.10	0.33	7.32	0.32	0.88	2.22																				100	96
O-47 1886.68	2	3	Chl	28.99		17.13	18.21		8.71	5.30	0.85	0.37	5.44																			85	97
O-47 1886.68	2	4	Qz	99.19		0.81																										100	118
O-47 1886.68	2	5	Sd	0.83			50.93	1.51		1.52			1.20																			56	60
O-47 1886.68	2	6	Qz	100.00																												100	120
O-47 1886.68	2	7	TiO2 +	1.08	92.02	3.08	1.58			0.51	0.65		0.78			0.31																100	98
O-47 1886.68	2	8	Chl	26.51		22.33	22.86		13.30																							85	99
O-47 1886.68	2	9	Ilm	5.40	56.30	1.57	33.89		0.49	0.52	0.43			1.12		0.28																100	103
O-47 1886.68	2	10	Sd	1.19		0.43	51.26	0.92		1.06			1.14																			56	59
O-47 1886.68	2	11	Qz	100.00																												100	119
O-47 1886.68	2	12	Ms	47.55	0.51	31.15	4.50		1.42		0.32	9.55																				95	106
O-47 1886.68	2	13	TiO2 +	11.32	88.39		0.29																									100	108
O-47 1886.68	2	14	Qz	100.00																												100	118
O-47 1886.68	2	15	Ab	69.19		18.86				0.39	11.56																					100	118
O-47 1886.68	2	16	Fe-Chl	27.11		22.27	25.58		9.82			0.22																				85	95
O-47 1886.68	2	17	Ms	48.38	0.82	32.14	1.67		1.09		0.45	10.45																				95	107
O-47 1886.68	3	1	Qz +	91.66		0.84	2.26					0.10		4.37						0.77												100	124
O-47 1886.68	3	2	Kfs	66.44		17.99					0.57	15.01																				100	115
O-47 1886.68	3	3	Fe-Chl	29.26		22.17	28.29		4.44		0.48	0.37																				85	97
O-47 1886.68	3	4	Fe-Chl	26.15		22.50	29.02		7.33																							85	100
O-47 1886.68	3	5	Kfs	66.89		17.73					1.39	14.00																				100	115
O-47 1886.68	3	6	"Ilm"	32.61	64.63	1.08	1.68																									100	106
O-47 1886.68	3	7	Qz + Kfs	83.75	1.78	7.98	2.49		0.92	0.41		2.68																				100	113
O-47 1886.68	3	8	Ms	48.77		32.98	1.65		1.20			10.39																				95	108
O-47 1886.68	3	9	Qz	100.00																												100	119
O-47 1886.68	3	10	Qz	100.00																												100	120
O-47 1886.68	3	11	Kln	48.32		35.99	1.69																									86	96
O-47 1886.68	3	12	Qz	100.00																												100	119
O-47 1886.68	3	13	Qz	100.00																												100	118
O-47 1886.68	3	14	Qz	100.00																												100	122

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	4	1	Qz	100.00																												100	119
O-47 1886.68	4	2	Fe-Chl	30.63	1.87	18.00	24.42	0.38	7.77	0.81	0.77	0.36																				85	97
O-47 1886.68	4	3	Kfs	66.25		17.94					0.73	15.08																				100	117
O-47 1886.68	4	4	TiO2 +	1.35	97.00	0.63	1.02																									100	107
O-47 1886.68	4	5	Kfs	66.40		17.65						15.95																				100	118
O-47 1886.68	4	6	Kfs	65.90		17.82					0.76	14.77											0.75									100	116
O-47 1886.68	4	7	Qz	100.00																												100	120
O-47 1886.68	4	8	Qz	100.00																												100	120
O-47 1886.68	4	9	Qz	100.00																												100	120
O-47 1886.68	4	10	Qz	100.00																												100	120
O-47 1886.68	4	11	Qz	99.80			0.20																									100	118
O-47 1886.68	4	12	Kfs + Py	51.08		16.92	9.86					9.85		12.29																		100	124
O-47 1886.68	4.1	1	Ms	44.16	0.33	31.54	1.61		0.46	2.82	0.80	8.59	0.86	3.84																		95	106
O-47 1886.68	4.1	2	Fe-Chl +	38.10	3.26	19.61	35.10		3.01		0.93																					100	96
O-47 1886.68	4.1	3	Kln +	53.99		37.40	5.80		0.43		0.56	0.20		0.81		0.81																100	70
O-47 1886.68	4.1	4	Kfs	67.71		17.42	1.00				2.57	11.12				0.18																100	109
O-47 1886.68	4.1	5	Py	1.20		0.62	31.44				0.27			66.48																		100	204
O-47 1886.68	5	1	Qz	100.00																												100	121
O-47 1886.68	5	2	Kfs	65.17		17.96					0.55	15.15											1.17									100	115
O-47 1886.68	5	3	Chl +	36.95	1.47	23.00	25.93		11.48	0.27	0.91																					100	94
O-47 1886.68	5	4	Kfs	66.20		17.86					0.46	15.48																				100	117
O-47 1886.68	5	5	Kfs	66.29		17.85					0.46	15.40																				100	116
O-47 1886.68	5	6	Qz	99.58			0.42																									100	117
O-47 1886.68	5	7	Qz	100.00																												100	119
O-47 1886.68	5	8	Kfs	66.61		18.07						15.31																				100	114
O-47 1886.68	5	9	Ms +	53.23	0.31	33.99	2.20		1.64	0.93		6.34		1.19		0.17																100	102
O-47 1886.68	5	10	Kln	48.93		34.43	1.60		0.36		0.35					0.33																86	79
O-47 1886.68	5	11	"Ilm"	1.42	68.79	0.62	28.55		0.61																							100	95
O-47 1886.68	5	12	Mix	36.19	1.74	19.51	26.36		6.46	3.02	0.43	3.07	2.55	0.68																		100	103
O-47 1886.68	5	13	Oligo	63.83		22.73				4.35	8.90	0.19																				100	119
O-47 1886.68	5	14	Kfs	66.65		17.62					0.77	14.96																				100	117
O-47 1886.68	5	15	Qz	100.00																												100	120
O-47 1886.68	5	16	"Ilm"	1.20	62.60	0.52	34.65		0.70							0.33																100	94
O-47 1886.68	5.1	1	Fe-Chl	36.64		17.40	26.54		3.15			1.28																				85	78
O-47 1886.68	5.1	2	Kln	46.86		32.92	5.13		0.88			0.22																				86	67
O-47 1886.68	5.1	3	Fe-Clay	41.51		27.26	27.35		2.89			1.00																				100	63
O-47 1886.68	6	1	Chl + Bt	41.79	3.06	20.35	19.52		9.75		0.63	4.89																				100	103
O-47 1886.68	6	2	Kfs	66.08		18.07					0.64	15.21																				100	115
O-47 1886.68	6	3	TiO2 +	1.45	91.06	1.91	3.63			0.42	0.49		0.82			0.21																100	100
O-47 1886.68	6	4	Qz	100.00																												100	120
O-47 1886.68	6	5	Qz	100.00																												100	121
O-47 1886.68	6	6	Py	0.79			32.01							67.20																		100	188
O-47 1886.68	6	7	Chl + Bt	38.79	3.26	18.42	25.13		7.62	1.06	0.58	3.83	0.69	0.62																		100	100
O-47 1886.68	6	8	Qz	99.41		0.59																										100	119
O-47 1886.68	6	9	Kfs	66.44		17.75					1.18	14.63																				100	115
O-47 1886.68	6	10	Qz	100.00																												100	119
O-47 1886.68	6	11	Qz	100.00																												100	119
O-47 1886.68	6	12	Chl + Ill	54.75	1.21	29.97	9.08		1.04		0.65	2.65				0.65																100	83
O-47 1886.68	6	13	Kln	47.27		33.10	3.66		1.01		0.43	0.12				0.41																86	84
O-47 1886.68	7	1	Kfs	65.31		18.04					1.49	13.58											1.59									100	117
O-47 1886.68	7	2	Ms	47.92	0.85	34.95	0.77		0.48		1.92	8.11																				95	112
O-47 1886.68	7	3	Py	0.34			28.81							70.85																		100	221
O-47 1886.68	7	4	Kfs	66.31		17.72					0.71	15.27																				100	116
O-47 1886.68	7	5	"Ilm"	2.80	60.54	2.13	32.38	0.42	1.26		0.47																					100	92

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	7	6	Qz	100.00																												100	119
O-47 1886.68	7	7	Qz	100.00																												100	120
O-47 1886.68	7	8	Kln +	55.77		36.20	5.56		0.97		0.66	0.23				0.61																100	77
O-47 1886.68	7	9	Kfs	66.15		17.76					0.50	15.59																				100	116
O-47 1886.68	7	10	Ab	69.42		18.91				0.21	11.45																					100	114
O-47 1886.68	7	11	Ab	69.09		19.00				0.41	11.50																					100	120
O-47 1886.68	7	12	Kfs	66.44		17.72					0.43	15.41																				100	119
O-47 1886.68	7	13	Chl +	41.44		18.29	19.27		7.95	4.50	1.17	3.00	4.37																			100	99
O-47 1886.68	7	14	Anh +	19.64		13.26	6.33		1.06	19.86	2.41	0.81		36.64																		100	108
O-47 1886.68	7	15	TiO2	0.60	99.06		0.34																									100	106
O-47 1886.68	7	16	Qz	100.00																												100	119
O-47 1886.68	8	1	Mix	34.80	1.60	20.05	25.52		8.54	2.69	0.81	1.79		4.20																		100	97
O-47 1886.68	8	2	Kfs	66.63		17.47						15.90																				100	116
O-47 1886.68	8	3	TiO2 +	1.20	93.39	1.38	2.24			0.70			0.78			0.31																100	100
O-47 1886.68	8	4	Py	0.22			28.80							70.99																		100	226
O-47 1886.68	8	5	Qz	99.79			0.21																									100	123
O-47 1886.68	8	6	Kfs	66.14		18.13	0.59					15.14																				100	113
O-47 1886.68	8	7	Ms	47.89	0.48	35.25	0.92		0.58		1.45	8.42																				95	109
O-47 1886.68	8	8	Ab	69.38		19.03				0.35	11.24																					100	119
O-47 1886.68	8	9	Qz	99.74			0.25					0.01																				100	119
O-47 1886.68	8	10	Qz	100.00																												100	122
O-47 1886.68	8	11	Kln	48.13		35.83	1.50		0.54																							86	95
O-47 1886.68	8	12	Qz	100.00																												100	119
O-47 1886.68	8	13	Py	0.27			28.27	0.17						71.28																		100	230
O-47 1886.68	8	14	Py	0.20			28.63							71.17																		100	228
O-47 1886.68	8	15	Kln	45.90		34.74	4.47		0.34		0.27					0.28																86	90
O-47 1886.68	9	1	Kln	49.24		33.61	1.68		0.54		0.39					0.54																86	85
O-47 1886.68	9	2	Kfs + Ab	68.03	0.28	17.18	0.97				5.85	7.68																				100	117
O-47 1886.68	9	3	Chl + Bt	41.71	2.13	18.47	19.39		12.35	0.25	0.66	5.05																				100	99
O-47 1886.68	9	4	Ab	69.89		18.60					11.51																					100	116
O-47 1886.68	9	5	Chl + Bt	40.01	1.53	18.87	25.49	0.34	8.23		0.64	4.89																				100	103
O-47 1886.68	9	6	Sd +	5.03		3.59	75.22	0.55		0.72	1.23	0.33	3.02	4.44		5.88																100	67
O-47 1886.68	9	7	Ilm	0.65	52.54		42.91	1.12	2.77																							100	104
O-47 1886.68	9	8	Kln	47.99		36.61	1.13				0.28																					86	97
O-47 1886.68	9	9	Qz	100.00																												100	121
O-47 1886.68	9	10	Chloritized Ms	50.86	0.36	26.97	9.54		1.97		0.32	9.97																				100	105
O-47 1886.68	9	11	Qz	99.80			0.20																									100	120
O-47 1886.68	9	12	Qz	99.26			0.31			0.44																						100	121
O-47 1886.68	9	13	Py	0.26			28.65							71.09																		100	227
O-47 1886.68	9	14	Qz	100.00																												100	121
O-47 1886.68	9	15	Kfs	66.01		17.86					1.06	14.50											0.57									100	117
O-47 1886.68	9	16	Py	0.17			28.63							71.19																		100	226
O-47 1886.68	9	17	Ill + Chl +	53.92	2.54	22.62	9.47		4.09		0.61	6.56				0.18																100	100
O-47 1886.68	10	1	Qz	100.00																												100	121
O-47 1886.68	10	2	Kfs	66.47		17.80					0.38	15.35																				100	114
O-47 1886.68	10	3	Fe-Chl	30.15	1.12	15.98	26.97		6.95	0.65	0.46	1.81		0.70		0.22																85	101
O-47 1886.68	10	4	Qz	99.70			0.30																									100	121
O-47 1886.68	10	5	Kfs	66.25		17.90	0.39					15.46																				100	116
O-47 1886.68	10	6	Kln	47.68		33.37	1.61		0.52		0.40	2.07				0.34																86	93
O-47 1886.68	10	7	Kfs	66.19		17.69						16.11																				100	117
O-47 1886.68	10	8	Chl + Bt	39.97	2.54	22.48	23.45		6.30		0.50	4.04		0.52		0.19																100	99
O-47 1886.68	10	9	Mix	51.15	6.68	16.79	14.33		1.84		1.67	6.28		0.55		0.70																100	91
O-47 1886.68	10	10	Qz	100.00																												100	120
O-47 1886.68	10	11	Ilm +	1.09	50.82	0.50	44.48	1.80	1.32																							100	102

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	10	12	Qz	100.00																												100	120
O-47 1886.68	10	13	Qz	99.80			0.20																									100	121
O-47 1886.68	10.1	1	Fe-Clay +	52.81		24.81	19.40		2.40			0.58																				100	64
O-47 1886.68	11	1	Kfs	65.79		17.85					0.97	14.47											0.92									100	115
O-47 1886.68	11	2	Chl + Bt	37.18	2.08	19.04	27.51		8.21	0.39	0.63	3.84		0.85		0.26																100	99
O-47 1886.68	11	3	TiO2	0.58	99.02		0.39																									100	107
O-47 1886.68	11	4	Ms	48.41	0.67	32.07	1.58		1.59		0.57	10.11																				95	106
O-47 1886.68	11	5	Kln	47.04	0.97	35.66	1.51		0.43							0.39																86	90
O-47 1886.68	11	6	Kfs	65.74		17.78	0.88				0.64	14.97																				100	116
O-47 1886.68	11	7	Ab	68.88		19.11				0.54	11.32	0.15																				100	117
O-47 1886.68	11	8	Bt	40.19	2.56	16.69	15.62		12.20		0.44	8.30																				96	106
O-47 1886.68	11	9	Kfs	66.26		17.66					0.37	15.71																				100	116
O-47 1886.68	11	10	Qz	100.00																												100	118
O-47 1886.68	11	11	Ab	68.54		19.44				0.83	11.19																					100	115
O-47 1886.68	11	12	Qz	100.00																												100	121
O-47 1886.68	11	13	Kln	47.90		33.90	2.69		0.70		0.34					0.47																86	84
O-47 1886.68	11	14	Kfs	64.09		18.77	2.14				0.40	14.60																				100	114
O-47 1886.68	11	15	Sd + Py	1.58			80.93			2.44	2.11			7.97		4.97																100	71
O-47 1886.68	11	16	"Ilm"	2.01	61.98	0.77	34.18	1.06																								100	96
O-47 1886.68	11	17	Py	1.18		0.58	39.69				0.44			56.73		1.38																100	139
O-47 1886.68	11.1	1	Kln	47.63		36.31	1.56				0.29					0.21																86	93
O-47 1886.68	11.1	2	Kfs	66.20		17.73					0.59	15.47																				100	116
O-47 1886.68	11.1	3	"Ilm"	1.56	77.57	0.99	18.67	0.41			0.54					0.27																100	97
O-47 1886.68	11.1	4	Qz	100.00																												100	120
O-47 1886.68	11.1	5	Qz	100.00																												100	120
O-47 1886.68	12	1	Qz	100.00																												100	118
O-47 1886.68	12	2	Kfs	64.92		18.52					1.10	13.89											1.57									100	116
O-47 1886.68	12	3	TiO2	2.09	95.51	1.25	1.15																									100	105
O-47 1886.68	12	4	TiO2 +	2.14	96.19	1.07	0.61																									100	104
O-47 1886.68	12	5	Ilm		51.24		45.42	0.69	2.66																							100	103
O-47 1886.68	12	6	Ms + Chl	51.61	0.92	28.62	6.33		2.45			10.07																				100	106
O-47 1886.68	12	7	TiO2 +	2.15	90.54	1.44	2.62			0.68	0.39		1.11			0.54		0.53														100	91
O-47 1886.68	12	8	Kfs	66.30		17.91					0.70	15.08																				100	115
O-47 1886.68	12	9	Fe-Chl	24.37		23.43	29.16	0.47	7.57																							85	98
O-47 1886.68	12	10	Ilm	0.54	54.38		42.54	0.60	1.94																							100	104
O-47 1886.68	12	11	TiO2	0.66	97.12		2.22																									100	107
O-47 1886.68	12	12	TiO2 +	3.74	93.51	1.05	1.05					0.66																				100	106
O-47 1886.68	12	13	Qz	100.00																												100	121
O-47 1886.68	12	14	Py	0.95		0.66	36.09			0.40	2.42			59.03		0.44																100	171
O-47 1886.68	12	15	Chloritized Ms	42.93		29.65	17.94		4.85		0.54	4.09																				100	105
O-47 1886.68	13	1	Sd	0.47			51.21	0.89		2.64			0.79																			56	60
O-47 1886.68	13	2	TiO2	0.82	98.79		0.39																									100	107
O-47 1886.68	13	3	Grt	40.74		21.18	24.48	0.71	4.94	7.95																						100	114
O-47 1886.68	13	4	Chl + Bt	41.09	4.43	18.17	19.43	0.40	10.34		0.75	5.40																				100	101
O-47 1886.68	13	5	Kfs	66.04		18.20					1.08	14.69																				100	116
O-47 1886.68	13	6	"Ilm"	3.72	58.50	2.00	34.63	0.34	0.81																							100	92
O-47 1886.68	13	7	"Ilm"	33.17	66.18	0.39	0.26																									100	107
O-47 1886.68	13	8	Qz	100.00																												100	119
O-47 1886.68	13	9	Qz	100.00																												100	119
O-47 1886.68	13	10	TiO2	0.63	97.92		1.45																									100	105
O-47 1886.68	13	11	Qz	100.00																												100	121
O-47 1886.68	13	12	Kln + Chl	54.18	0.73	33.79	4.42		5.14		0.65	0.72				0.36																100	84
O-47 1886.68	13	13	Qz	100.00																												100	120
O-47 1886.68	13	14	Ms + Chl	56.07		25.58	5.44		2.50	0.87	0.47	7.92	0.65	0.50																		100	109

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	13	15	Qz	100.00																												100	119
O-47 1886.68	13.1	1	Kln +	54.20		35.58	8.73		1.01			0.48																				100	64
O-47 1886.68	13.1	2	Gly ?	55.09		17.67	24.58		1.09			1.57																				100	38
O-47 1886.68	13.1	3	Kln	48.73		29.30	3.90		1.17			2.91																				86	85
O-47 1886.68	14	1	Qz	100.00																												100	120
O-47 1886.68	14	2	Ilm	0.51	51.45		45.48	0.80	1.76																							100	105
O-47 1886.68	14	3	Zrn	30.03		0.86	0.80			0.93							0.91					66.46										100	101
O-47 1886.68	14	4	Zrn	31.20																		67.43									1.38	100	121
O-47 1886.68	14	5	Chl	30.95		18.60	24.28		9.64		0.61	0.93																				85	97
O-47 1886.68	14	6	Ab	67.23		20.43	0.22			1.53	10.44	0.14																				100	118
O-47 1886.68	14	7	Kln +	51.45		35.72	4.17		1.17		0.66	6.65				0.18																100	101
O-47 1886.68	14	8	Qz	100.00																												100	121
O-47 1886.68	14	9	Chloritized Ms	50.31	0.76	35.81	9.35		2.48		0.46	0.84																				100	92
O-47 1886.68	14	10	Qz	100.00																												100	121
O-47 1886.68	14	11	Ms	47.87	0.29	32.18	3.36		0.64		0.44	10.23																				95	107
O-47 1886.68	14	12	Py	0.47			28.56							70.97																		100	223
O-47 1886.68	14	13	Ms + Qz	65.49		24.69	1.45		1.01		0.81	6.55																				100	112
O-47 1886.68	14	14	Kln	47.17		33.69	3.55		1.19		0.40																					86	93
O-47 1886.68	15	1	Ab	69.02		19.08				0.45	11.35	0.10																				100	118
O-47 1886.68	15	2	TiO2	0.60	98.80		0.60																									100	107
O-47 1886.68	15	3	Qz	100.00																												100	120
O-47 1886.68	15	4	Kln	46.59		30.74	6.08		1.33		0.63	0.13				0.50																86	78
O-47 1886.68	15	5	Zrn	31.23																		68.77										100	119
O-47 1886.68	15	6	Zrn	32.67																		67.33										100	107
O-47 1886.68	15	7	TiO2	1.02	96.86	0.68	0.67			0.46						0.32																100	94
O-47 1886.68	15	8	Qz	100.00																												100	118
O-47 1886.68	15	9	Kfs	66.09		17.80					0.54	15.57																				100	116
O-47 1886.68	15	10	Qz	96.62		2.50	0.57					0.31																				100	119
O-47 1886.68	15	11	Qz	100.00																												100	120
O-47 1886.68	15.1	1	Ms	47.93	0.82	33.47	1.39		0.96		0.51	9.92																				95	108
O-47 1886.68	15.1	2	Qz	100.00																												100	119
O-47 1886.68	15.1	3	Kln	45.59		33.28	5.64		1.04			0.16				0.29																86	90
O-47 1886.68	15.1	4	Fe-Clay	42.22		28.10	25.82		3.08			0.78																				100	68
O-47 1886.68	16	1	Qz	100.00																												100	119
O-47 1886.68	16	2	Chl	31.56	2.35	18.28	24.55		5.95	0.42	0.70	0.83				0.36																85	86
O-47 1886.68	16	3	Py	0.32			28.88							70.80																		100	225
O-47 1886.68	16	4	TiO2	0.88	94.17	1.11	1.87			0.45			0.75	0.58		0.19																100	94
O-47 1886.68	16	5	Qz	99.43		0.35	0.22																									100	121
O-47 1886.68	16	6	Kln	48.63		36.60	0.58					0.20																				86	85
O-47 1886.68	16	7	Qz	100.00																												100	121
O-47 1886.68	16	8	Kfs	66.20		17.79					0.70	15.30																				100	116
O-47 1886.68	16	9	Anh +	6.01		3.66	2.01			33.31	0.46	0.22		54.33																		100	111
O-47 1886.68	16	10	Qz	100.00																												100	120
O-47 1886.68	16	11	TiO2 +	1.53	95.72	0.78	1.97																									100	82
O-47 1886.68	16	12	Kfs	66.45		17.80						15.75																				100	118
O-47 1886.68	16	13	Ilm	0.64	51.75		45.59	0.72	1.30																							100	106
O-47 1886.68	16	14	Ill + Chl	51.03	0.31	28.46	15.40		2.11		0.64	1.68				0.36																100	86
O-47 1886.68	16	15	Ms	46.98	0.46	33.71	2.30		0.62		0.95	9.23		0.75																		95	108
O-47 1886.68	17	1	TiO2	0.50	99.14		0.37																									100	107
O-47 1886.68	17	2	Qz	100.00																												100	120
O-47 1886.68	17	3	Ab	69.88		18.59					11.53																					100	118
O-47 1886.68	17	4	Kfs	66.29		17.81					0.64	15.27																				100	116
O-47 1886.68	17	5	Ilm	0.57	46.21	0.56	46.44	0.59	5.64																							100	98
O-47 1886.68	17	6	Chl +	36.42	0.44	23.71	24.72		2.36		1.74	1.84		7.95		0.82																100	76

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	17	7	Qz	100.00																												100	121
O-47 1886.68	17	8	Qz	97.89		1.46	0.48					0.17																				100	119
O-47 1886.68	17	9	Fe-Clay ?	42.29	0.33	22.41	28.93		2.53		0.81	0.64		1.30		0.76																100	71
O-47 1886.68	17	10	Fe-Chl	25.77		22.33	26.21		10.69																							85	94
O-47 1886.68	17	11	Kln	48.99		32.63	2.61		0.67		0.48	0.22				0.40																86	74
O-47 1886.68	18	1	Qz	100.00																												100	121
O-47 1886.68	18	2	Kfs	66.45		17.72					1.21	14.61																				100	117
O-47 1886.68	18	3	Py	0.28			28.55							71.17																		100	224
O-47 1886.68	18	4	TiO2 +	1.42	90.82	1.57	5.47									0.27		0.46														100	96
O-47 1886.68	18	5	Kfs	65.88		17.86					0.36	15.41											0.49									100	116
O-47 1886.68	18	6	Kfs	66.26		17.71					0.31	15.71																				100	115
O-47 1886.68	18	7	Ab	69.35		18.74	0.51				11.27	0.12																				100	115
O-47 1886.68	18	8	Chl	31.78	0.46	16.93	17.26	0.26	12.67	2.07	0.85	0.29	1.52	0.89																		85	97
O-47 1886.68	18	9	Py	0.25			28.33							71.42																		100	228
O-47 1886.68	18	10	Qz	100.00																												100	119
O-47 1886.68	18	11	Qz	100.00																												100	119
O-47 1886.68	18	12	Qz + Feld	72.86		16.03	3.14		0.62		5.86	1.28				0.21																100	97
O-47 1886.68	19	1	Zrn	31.34																		68.66										100	120
O-47 1886.68	19	2	Kfs	65.97		17.98					0.53	15.52																				100	116
O-47 1886.68	19	3	Qz	100.00																												100	120
O-47 1886.68	19	4	Qz	100.00																												100	121
O-47 1886.68	19	5	Qz	100.00																												100	119
O-47 1886.68	19	6	Kfs	66.15		17.86					0.58	15.41																				100	115
O-47 1886.68	19	7	Qz	100.00																												100	120
O-47 1886.68	19	8	Fe-Clay	46.25		32.03	18.56		1.76		0.56					0.84																100	65
O-47 1886.68	19	9	Qz	100.00																												100	120
O-47 1886.68	19.1	1	Kln	48.48		34.91	2.22		0.39			0.01																				86	95
O-47 1886.68	20	1	Monazite-(Ce)										34.87		0.91									21.78	33.28	9.27						100	107
O-47 1886.68	20	2	TiO2	0.52	99.48																											100	108
O-47 1886.68	20	3	Qz	100.00																												100	121
O-47 1886.68	20	4	Qz	100.00																												100	120
O-47 1886.68	20	5	Qz	100.00																												100	121
O-47 1886.68	20	6	Kfs	66.32		18.04					0.91	14.72																				100	115
O-47 1886.68	20	7	Qz	100.00																												100	120
O-47 1886.68	20	8	Qz	100.00																												100	120
O-47 1886.68	21	1	Qz	100.00																												100	120
O-47 1886.68	21	2	TiO2	0.97	98.57		0.46																									100	107
O-47 1886.68	21	3	"Ilm"	1.02	79.40		19.58																									100	101
O-47 1886.68	21	4	Kfs	66.26		17.66					0.63	15.45																				100	117
O-47 1886.68	21	5	Ilm		52.89		45.03	0.54	1.53																							100	105
O-47 1886.68	21	6	Ill + Chl	52.66	0.42	31.02	10.45		2.06		0.69	1.93				0.78																100	77
O-47 1886.68	21	7	Kfs + Ab	68.17		18.22	0.49				7.10	6.02																				100	116
O-47 1886.68	21	8	Qz	100.00																												100	119
O-47 1886.68	21	9	TiO2	0.46	98.84		0.71																									100	108
O-47 1886.68	21	10	Qz	100.00																												100	119
O-47 1886.68	21	11	Qz	100.00																												100	121
O-47 1886.68	21	12	Qz	100.00																												100	121
O-47 1886.68	21	13	Py	0.95		0.54	34.58							63.09		0.83																100	162
O-47 1886.68	21	14	Ill + Chl	47.59	0.50	27.23	19.06		2.62		0.66	1.21				1.12																100	76
O-47 1886.68	21	15	Kfs	66.78		17.85					2.26	13.10																				100	116
O-47 1886.68	21	16	Kfs + Ab	67.21		18.19					4.65	9.95																				100	118
O-47 1886.68	22	1	Oligo	66.67		20.73				2.22	10.28	0.09																				100	117
O-47 1886.68	22	2	Kln	43.74		34.32	0.74				6.47	0.74																				86	109
O-47 1886.68	22	3	Kfs	66.39		17.89					0.89	14.83																				100	115

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	22	4	Qz + Ms	79.50		13.76	0.82		1.37			4.56																				100	109
O-47 1886.68	22	5	Kfs	66.40		17.65						15.95																				100	116
O-47 1886.68	22	6	Qz	100.00																												100	121
O-47 1886.68	22	7	Ill + Chl	46.49		32.17	17.88		1.62		0.57					1.28																100	53
O-47 1886.68	22	8	Qz	100.00																												100	120
O-47 1886.68	22	9	Ill + Chl	53.24	0.42	26.79	12.29		2.49		0.79	2.26		0.75		0.97																100	67
O-47 1886.68	22	10	Qz	100.00																												100	120
O-47 1886.68	22	11	Qz	100.00																												100	120
O-47 1886.68	22	12	Kfs	65.79		18.14	0.55				0.64	14.88																				100	116
O-47 1886.68	22	13	Kfs	64.83		18.42					1.02	14.00											1.74									100	115
O-47 1886.68	22	14	Qz	100.00																												100	121
O-47 1886.68	23	1	Py	0.23			28.68							71.09																		100	223
O-47 1886.68	23	2	Py	0.25			29.01							70.74																		100	224
O-47 1886.68	23	3	Py				28.91							71.09																		100	226
O-47 1886.68	23	4	Kfs	65.61		18.15					1.00	14.58											0.67									100	117
O-47 1886.68	23	5	Ms	48.44	0.79	31.68	2.17		1.27		0.62	10.04																				95	109
O-47 1886.68	23	6	Qz	100.00																												100	120
O-47 1886.68	23	7	Qz	100.00																												100	119
O-47 1886.68	23	8	Ilm?	0.81	48.73	3.09	38.37	0.72	8.05							0.22																100	79
O-47 1886.68	23	9	Ab	69.46		19.00					11.55																					100	117
O-47 1886.68	23	10	Qz	100.00																												100	120
O-47 1886.68	23	11	Kfs	66.39		17.80					0.87	14.94																				100	115
O-47 1886.68	23	12	?Kln + Chl	37.79	0.64	25.83	30.25		3.29		0.64	0.53				1.04																100	66
O-47 1886.68	23	13	Qz	100.00																												100	120
O-47 1886.68	24	1	Kfs	66.32		17.77					0.71	15.20																				100	116
O-47 1886.68	24	2	Kln +	53.01		36.74	1.97		0.86		3.23	4.19																				100	103
O-47 1886.68	24	3	Ilm		51.90		44.68	0.72	2.70																							100	105
O-47 1886.68	24	4	Kfs	65.01		18.13					1.09	14.13											1.64									100	116
O-47 1886.68	24	5	Kln	46.67	0.46	33.10	1.75		0.38			3.65																				86	97
O-47 1886.68	24	6	TiO2 +	7.01	86.00	4.70	1.02					1.28																				100	105
O-47 1886.68	24	7	Oligo	64.70		22.13				3.96	8.87	0.33																				100	111
O-47 1886.68	24	8	Ill + Chl	50.99	1.76	34.44	9.50		1.28		0.44	0.95				0.64																100	73
O-47 1886.68	24	9	TiO2 +	1.29	92.14	2.47	1.71			0.74			1.01			0.64																100	80
O-47 1886.68	24	10	Kfs	66.67		17.59					1.15	14.59																				100	117
O-47 1886.68	24	11	Qz	98.02		1.60						0.38																				100	117
O-47 1886.68	24	12	Qz	100.00																												100	120
O-47 1886.68	25	1	Py				28.51				0.33			71.17																		100	224
O-47 1886.68	25	2	Kfs	65.45		18.23					1.10	14.50											0.71									100	115
O-47 1886.68	25	3	Qz	99.71		0.29																										100	117
O-47 1886.68	25	4	Ilm + Qz	18.65	65.38	10.44	2.98		0.53		1.29	0.52				0.21																100	100
O-47 1886.68	25	5	Qz	99.62	0.38																											100	118
O-47 1886.68	25	6	Kln	47.09		35.04	2.92		0.57		0.38																					86	95
O-47 1886.68	25	7	Sd	0.68			54.93	0.39																								56	59
O-47 1886.68	25	8	Ill	50.72		27.76	3.00		1.92		0.77	5.58				0.26																90	97
O-47 1886.68	25	9	Qz	100.00																												100	119
O-47 1886.68	25	10	Oligo	64.40		22.33				3.99	9.18	0.10																				100	115
O-47 1886.68	25	11	Kln + Chl	54.03		36.03	6.56		1.11		0.94	0.19				1.14																100	75
O-47 1886.68	25	12	Chl + Bt	40.36	3.20	18.29	22.82	0.31	8.75		0.83	5.43																				100	99
O-47 1886.68	25	13	Qz	100.00																												100	119
O-47 1886.68	25	14	Kln + Chl +	49.98		35.75	10.07		1.82		0.57	1.16				0.65																100	83
O-47 1886.68	25	15	Qz	100.00																												100	119
O-47 1886.68	26	1	Qz	100.00																												100	120
O-47 1886.68	26	2	Kfs	66.21		17.83					0.60	15.36																				100	114
O-47 1886.68	26	3	Ilm	0.65	54.31		41.78	0.95	2.32																							100	102

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	26	4	Fe-Chl	24.70		23.26	28.59		8.45																							85	96
O-47 1886.68	26	5	Kfs	66.42		17.83					1.37	14.37																				100	115
O-47 1886.68	26	6	Qz	100.00																												100	119
O-47 1886.68	26	7	Ms + Ab ?	58.25		29.47	0.48		0.37		4.16	7.27																				100	111
O-47 1886.68	26	8	Kln + Chl	45.17		30.55	20.34		2.00		0.51	0.29				1.14																100	55
O-47 1886.68	26	9	Kln	48.43		33.56	1.87		0.58		0.35	0.95				0.25																86	85
O-47 1886.68	26	10	TiO2 +	6.48	86.21	3.86	2.88					0.56																				100	103
O-47 1886.68	26	11	Kln + Chl	48.82	1.22	30.13	14.21		1.29		0.72	3.40				0.21																100	96
O-47 1886.68	26	12	Qz	100.00																												100	119
O-47 1886.68	27	1	Qz	100.00																												100	117
O-47 1886.68	27	2	Kln	47.47		36.37	1.10				0.37			0.48		0.21																86	92
O-47 1886.68	27	3	Ms	47.24	0.46	34.07	1.35		0.75		0.71	9.66		0.76																		95	109
O-47 1886.68	27	4	Qz	100.00																												100	120
O-47 1886.68	27	5	Chl + Bt	40.06	0.95	26.85	22.69		3.78	1.12	0.57	2.32	1.37			0.30																100	87
O-47 1886.68	27	6	TiO2	0.46	99.54																											100	106
O-47 1886.68	27	7	Ms	46.02		29.36	6.94		2.07	0.55	0.41	8.45		1.21																		95	103
O-47 1886.68	27	8	Chl +	29.19		16.81	22.13	0.31	5.01	8.65	1.27			16.20		0.43																100	89
O-47 1886.68	27	9	Qz	100.00																												100	118
O-47 1886.68	27	10	Py	0.83		0.25	29.57				0.30	0.14		68.91																		100	203
O-47 1886.68	27	11	Kfs	66.09		17.83					0.51	15.57																				100	115
O-47 1886.68	27	12	Qz	98.89		1.11																										100	117
O-47 1886.68	27	13	Chl +	44.29		15.16	13.59		22.99	0.23	1.85			1.08		0.82																100	79
O-47 1886.68	27	14	Qz	100.00																												100	120
O-47 1886.68	27	15	Qz	100.00																												100	120
O-47 1886.68	28	1	Fe-Chl	33.44		18.47	27.65		3.08		1.05	0.68				0.64																85	79
O-47 1886.68	28	2	Qz	100.00																												100	119
O-47 1886.68	28	3	Ilm		52.57		43.27	0.72	3.44																							100	105
O-47 1886.68	28	4	Py	0.49			28.35			0.15	0.60			70.41																		100	211
O-47 1886.68	28	5	Qz	100.00																												100	118
O-47 1886.68	28	6	Kfs + Ab	67.69		18.68				0.40	6.55	6.68																				100	116
O-47 1886.68	28	7	Kfs + Ab	67.92		17.97	0.46				5.89	7.76																				100	119
O-47 1886.68	28	8	Kfs	66.14		17.88					0.43	15.55																				100	116
O-47 1886.68	28	9	Chl + Ill	48.70	0.63	31.85	12.25		1.63		0.91	0.70		2.57		0.76																100	68
O-47 1886.68	28	10	TiO2	0.58	99.05		0.37																									100	106
O-47 1886.68	28	11	Qz +	76.88	1.66	14.55	1.03		1.10			4.79																				100	118
O-47 1886.68	28	12	Kfs + Ab	60.13	1.02	16.37	4.06		0.46		3.01	8.36										6.59										100	105
O-47 1886.68	28	13	Qz	99.80			0.20																									100	120
O-47 1886.68	28	14	Kln	45.33	0.32	31.98	5.27		1.62		0.34	0.93				0.21																86	87
O-47 1886.68	28	15	Qz	96.98		2.48	0.55																									100	121
O-47 1886.68	28	16	Mix	66.00	0.29	20.88	3.62		2.06		0.38	6.53				0.25																100	104
O-47 1886.68	28	17	Qz	100.00																												100	116
O-47 1886.68	29	1	Chr	0.50	0.88	20.78	25.11	0.88	16.39									35.44														100	105
O-47 1886.68	29	2	Qz	100.00																												100	117
O-47 1886.68	29	3	Kfs	66.16		17.82					0.43	15.59																				100	114
O-47 1886.68	29	4	Qz	100.00																												100	118
O-47 1886.68	29	5	"Ilm"	33.01	66.72		0.27																									100	113
O-47 1886.68	29	6	Qz	99.77	0.23																											100	117
O-47 1886.68	29	7	Ilm	1.28	51.50	0.41	37.93	1.84	7.04																							100	102
O-47 1886.68	29	8	Ilm		53.48		44.11	0.59	1.81																							100	103
O-47 1886.68	29	9	Qz	100.00																												100	119
O-47 1886.68	29	10	Kfs	66.22		17.68						16.10																				100	115
O-47 1886.68	29	11	Py	0.29		0.46	30.90				0.61			67.74																		100	208
O-47 1886.68	29	12	Qz	100.00																												100	119
O-47 1886.68	29	13	Kfs	66.38		17.68					0.40	15.53																				100	114

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	29	14	Qz	99.57		0.43																										100	118
O-47 1886.68	29	15	Qz	100.00																												100	118
O-47 1886.68	29.1	1	Kfs	65.40		18.08					0.36	14.92											1.24									100	115
O-47 1886.68	29.1	2	Qz	99.30		0.70																										100	118
O-47 1886.68	29.1	3	Chl	31.50		17.64	10.44		25.11		0.31																					85	98
O-47 1886.68	30	1	Kfs + Ab	67.99		18.04					5.17	8.80																				100	117
O-47 1886.68	30	2	Qz	100.00																												100	120
O-47 1886.68	30	3	Qz	100.00																												100	119
O-47 1886.68	30	4	Kln	47.21		34.92	2.53		0.59		0.43					0.33																86	84
O-47 1886.68	30	5	Ab	69.71		18.59	0.27				11.44																					100	117
O-47 1886.68	30	6	Chl	35.98		21.12	10.10	0.45	16.26		0.61					0.47																85	87
O-47 1886.68	30	7	Qz	99.48		0.52																										100	120
O-47 1886.68	30	8	Qz +	76.23	0.25	13.78	3.30		1.22	0.77	0.32	3.56	0.58																			100	113
O-47 1886.68	30	9	Chl	35.40		22.36	18.01		6.04	1.33	0.56	0.21	1.10																			85	92
O-47 1886.68	30	10	Kln	48.78		34.06	1.81		0.37		0.44					0.54																86	74
O-47 1886.68	30	11	Qz	100.00																												100	118
O-47 1886.68	30	12	Kfs	65.61		17.80					0.62	15.07											0.90									100	115
O-47 1886.68	30	13	Chl	37.24	6.55	25.78	12.42		1.60		0.71					0.71																85	73
O-47 1886.68	30	14	Qz	99.72			0.28																									100	120
O-47 1886.68	30	15	Chl	31.85		18.38	24.74		8.89	0.27	0.53					0.34																85	87
O-47 1886.68	30	16	Qz	100.00																												100	121
O-47 1886.68	30	17	TiO2 +	1.31	96.33	0.46	1.71					0.19																				100	106
O-47 1886.68	30	18	Qz +	88.81		6.67	2.49		0.89			1.13																				100	116
O-47 1886.68	31	1	Py	0.20			28.45							71.35																		100	223
O-47 1886.68	31	2	Py	0.26			28.63							71.11																		100	222
O-47 1886.68	31	3	Fe-Chl +	36.96	1.74	21.19	29.71	0.29	8.43	0.55	0.63	0.20				0.30																100	91
O-47 1886.68	31	4	Ms +	49.78	1.45	35.78	1.61		0.79		0.98	9.61																				100	106
O-47 1886.68	31	5	Ilm		56.10		41.38	0.74	1.78																							100	103
O-47 1886.68	31	6	Kln	48.48		34.56	1.86		0.63							0.47																86	87
O-47 1886.68	31	7	Qz	100.00																												100	121
O-47 1886.68	31	8	Chl +	38.70		23.56	12.66		8.62	7.61	0.67		7.05			1.13																100	81
O-47 1886.68	31	9	Qz	100.00																												100	120
O-47 1886.68	31	10	Qz	100.00																												100	118
O-47 1886.68	31	11	Kfs	66.31		17.59					0.30	15.81																				100	114
O-47 1886.68	31	12	Qz	100.00																												100	118
O-47 1886.68	31	13	Qz	100.00																												100	118

Table 1-10.1: EDS geochemical analyses of sample O-47 1886.68.

Sample	Site	Position	Mineral	SiO2	TiO2	Al2O3	FeO	MnO	MgO	CaO	Na2O	K2O	P2O5	SO3	F	Cl	Sc2O3	Cr2O3	NiO	CuO	Y2O3	ZrO2	BaO	La2O3	Ce2O3	Nd2O3	Gd2O3	Dy2O3	Er2O3	Yb2O3	HfO2	Total	Actual Total
O-47 1886.68	31	14	Fe-Chl	24.88		22.11	29.27	0.25	8.50																							85	97
O-47 1886.68	31	15	Qz	100.00																												100	120
O-47 1886.68	31	16	Qz + Chl	94.61		2.93	1.68		0.42			0.36																				100	120
O-47 1886.68	31	17	Py	0.43			28.64							70.92																		100	226

Notes
1. + indicates more than one mineral present
2. " " indicates altered grain
3. Gly refers to the mixture glaucony

Appendix 2-1: Whole rock analysis of selected mudstone samples.

Table 2-1.1: Whole rock analyses of mudstones from Primrose 1A-A41 and Sable Island wells.

Sample	1A-A41 1616.39a	1A-A41 1616.39b	1A-A41 1620.49	1A-A41 1623.34	3H-58 1618.73	3H-58 1804.26	3H-58 1994.66a	3H-58 1994.66b	3H-58 1996.11	3H-58 1998.03	3H-58 1999.72	3H-58 2001.33	5H-58 1469.12	5H-58 1903.66	5H-58 1905.15	E-48 2246.46	E-48 2249.39	O-47 1890.17
SiO_2	24.72	25.5	48.05	61.24	69.19	80.52	53.78	52.35	54.75	81.26	49.43	56.48	76.39	90.58	56.91	84.36	84.18	53.26
Al_2O_3	9.38	10.12	19.6	15.44	5.85	7.62	19.22	22.55	20.73	8.24	19.94	3.79	5.36	3.91	19.65	5.87	4.98	20.8
$Fe_2O_{3(T)}$	2.87	2.91	5.14	5.64	12.11	4.03	7.6	7.74	7.61	2.99	9.52	8.71	7.35	1.04	5.14	1.69	5.08	8.34
MnO	0.052	0.051	0.02	0.033	0.123	0.024	0.058	0.066	0.063	0.023	0.048	0.301	0.151	0.012	0.035	0.022	0.025	0.032
MgO	0.8	0.81	0.97	0.93	0.87	0.44	1.4	1.49	1.45	0.49	1.38	0.96	0.58	0.1	1.11	0.26	0.63	1.44
CaO	30.67	29.74	5.26	0.91	0.97	0.15	0.25	0.27	0.27	0.23	0.2	12.81	0.43	0.2	0.2	1.04	0.31	0.26
Na_2O	0.45	0.43	0.69	0.68	0.67	0.63	0.77	0.85	0.79	0.81	0.75	0.53	0.49	0.38	0.75	0.7	0.7	0.84
K_2O	1.45	1.5	1.86	2.16	1.56	2.12	2.57	2.63	2.56	1.62	2.22	1.38	1.46	1.86	2.35	1.72	1.41	2.25
TiO_2	0.413	0.41	0.935	1.003	0.477	0.887	1.054	1.163	1.119	1.063	1.107	0.424	0.744	0.326	1.35	0.465	0.431	1.315
P_2O_5	0.2	0.18	0.12	0.08	0.11	0.03	0.05	0.05	0.05	0.03	0.05	0.04	0.03		0.09	0.05	0.03	0.11
LOI	27.76	27.06	16.41	10.89	7.17	3.84	12.09	11.09	11.08	3.15	14.32	15.07	5.54	1.02	11.29	2.64	2.61	11.8
Total	98.77	98.73	99.05	99.01	99.1	100.3	98.85	100.3	100.5	99.9	98.97	100.5	98.53	99.43	98.88	98.82	100.4	100.4

Analyte Symbol	Analysis Method	1A-A41 1616.39a	1A-A41 1616.39b	1A-A41 1620.49	1A-A41 1623.34	3H-58 1618.73	3H-58 1804.26	3H-58 1994.66a	3H-58 1994.66b	3H-58 1996.11	3H-58 1998.03	3H-58 1999.72	3H-58 2001.33	5H-58 1469.12	5H-58 1903.66	5H-58 1905.15	E-48 2246.46	E-48 2249.39	O-47 1890.17
Sc	FUS-ICP	9	9	17	15	11	8	21	22	21	8	20	8	8	2	21	4	4	22
Be	FUS-ICP	2	2	3	2	1	2	3	3	3	1	3	1	1		3			4
V	FUS-ICP	72	76	131	114	173	55	157	162	150	56	165	92	44	16	157	38	43	174
Cr	FUS-MS	70	70	140	150	140	190	160	160	160	150	160	110	150	100	150	190	250	150
Co	FUS-MS	8	9	16	18	17	10	28	25	26	12	34	12	8	2	34	6	7	26
Ni	FUS-MS	40	40	60	60	30	20	90	80	80	30	90	30			100		30	80
Cu	FUS-MS	20	20	20	20	10	10	30	30	30	10	30		10	10	30	10		30
Zn	FUS-MS	50	60	90	90	50	50	90	90	90	50	90	30	40		110	50	40	90
Ga	FUS-MS	11	12	21	18	8	10	24	26	25	9	23	5	5	4	24	5	5	25
Ge	FUS-MS	0.9	1	1.7	1.2	1	1	1.1	1.3	1.1	1.2	1.3	0.7	0.8	0.8	0.7	0.7	0.8	1.2
As	FUS-MS			8		18	6	6	12	7	12	80				13		8	7
Rb	FUS-MS	75	77	90	94	52	69	137	143	133	56	127	41	47	44	117	42	37	116
Sr	FUS-ICP	760	724	371	133	116	97	135	157	142	68	115	436	72	100	123	112	65	138
Y	FUS-MS	18.6	17.9	28.2	31.4	28.9	27.2	30.6	31.7	29.9	30.3	29.5	19	26.8	6.8	41	11.6	9.1	38.2
Zr	FUS-ICP	91	89	159	302	356	736	228	212	216	508	229	129	672	127	268	177	284	240
Nb	FUS-MS	7.8	8.1	15.7	16.8	6.3	11.6	19.1	19.4	18.5	15.6	20.9	8	10.4	5.6	25.6	11.2	10	25.2
Mo	FUS-MS					4										9			
Ag	FUS-MS				0.7	0.8	2				1.3	0.5		1.7		0.6		0.8	0.6
In	FUS-MS				0.1				0.1			0.1				0.1			
Sn	FUS-MS		2	2	2	1		3	3	3	2	2				3			3
Sb	FUS-MS					0.3			0.3										
Cs	FUS-MS	4.6	4.9	5.5	5.4	1.6	2.1	8.3	8.6	8	2.1	7.8	0.8	1.4	0.6	6.8	0.7	0.5	7.3
Ba	FUS-ICP	169	178	299	326	379	536	387	398	388	358	351	341	692	2538	379	2844	551	360
La	FUS-MS	22.3	22.1	46.2	43.3	44.2	38.7	51.3	53.6	50.5	30.3	50.7	28.7	24.4	9.68	63.8	18.6	13.6	58.3
Ce	FUS-MS	52.5	51.8	102	94.3	104	86.2	105	109	103	65.2	105	71.1	52	19.6	136	37.7	32.2	122
Pr	FUS-MS	5.49	5.38	11.4	10.6	11.8	9.88	12	12.4	11.9	7.43	11.7	7.56	5.96	2.18	15.4	4.38	3.21	13.9
Nd	FUS-MS	19.9	20.2	40.4	38	43	35.5	43	44.1	42.4	26.8	42.1	27.1	21.7	7.67	56.8	15.3	11.1	51.5

Table 2-1.1: Whole rock analyses of mudstones from Primrose 1A-A41 and Sable Island wells.

Analyte Symbol	Analysis Method	1A-A41 1616.39a	1A-A41 1616.39b	1A-A41 1620.49	1A-A41 1623.34	3H-58 1618.73	3H-58 1804.26	3H-58 1994.66a	3H-58 1994.66b	3H-58 1996.11	3H-58 1998.03	3H-58 1999.72	3H-58 2001.33	5H-58 1469.12	5H-58 1903.66	5H-58 1905.15	E-48 2246.46	E-48 2249.39	O-47 1890.17
Sm	FUS-MS	4.35	3.98	7.65	7.25	8.71	6.78	8.08	8.27	8.03	5.3	7.65	5.19	4.21	1.48	10.7	3.03	1.91	9.75
Eu	FUS-MS	0.881	0.853	1.63	1.55	1.83	1.32	1.7	1.72	1.68	1.09	1.61	1.1	0.863	0.328	2.38	0.749	0.437	2.09
Gd	FUS-MS	3.61	3.41	5.95	6.15	7.22	5.34	6.45	6.57	6.17	4.74	6.08	4.14	3.88	1.24	9.01	2.35	1.43	8.08
Tb	FUS-MS	0.61	0.57	1.01	1.05	1.11	0.87	1.05	1.07	1.04	0.89	0.99	0.67	0.74	0.21	1.53	0.4	0.27	1.37
Dy	FUS-MS	3.52	3.32	5.81	6.36	6.07	5.12	6.11	6.44	6.06	5.52	5.98	4.05	4.54	1.22	8.62	2.3	1.65	7.8
Ho	FUS-MS	0.66	0.64	1.09	1.19	1.13	0.97	1.19	1.24	1.16	1.11	1.13	0.76	0.93	0.25	1.63	0.46	0.35	1.47
Er	FUS-MS	1.93	1.86	3.26	3.46	3.24	3.05	3.46	3.65	3.56	3.36	3.32	2.17	2.82	0.79	4.71	1.39	1.09	4.2
Tm	FUS-MS	0.269	0.269	0.452	0.501	0.479	0.45	0.524	0.52	0.48	0.504	0.478	0.314	0.433	0.115	0.67	0.204	0.169	0.604
Yb	FUS-MS	1.85	1.74	2.92	3.32	3.05	2.99	3.56	3.35	3.39	3.43	3.33	1.98	2.95	0.76	4.22	1.35	1.17	3.8
Lu	FUS-MS	0.282	0.267	0.449	0.533	0.48	0.489	0.524	0.548	0.505	0.554	0.507	0.294	0.471	0.122	0.64	0.219	0.189	0.581
Hf	FUS-MS	2.2	2.2	3.7	6.7	7.7	16.1	5.6	4.9	4.9	10.9	5.1	2.7	13.9	2.9	6.3	4	6.3	5.4
Ta	FUS-MS	0.63	0.62	1.25	1.32	0.57	0.98	1.46	1.48	1.41	1.35	1.45	0.55	0.96	0.5	1.96	0.98	0.78	1.83
W	FUS-MS	1.8	1.1	9.9	1.5	3.9	2.3	3.7	4.1	1.7	3.8	2.6		0.9	2.2	3.1		0.8	1.2
Tl	FUS-MS	0.17	0.18	0.26	0.32			0.42	0.46	0.4		0.36				0.41			0.38
Pb	FUS-MS	9	10	10	11	17	13	15	20	18	13	12	13	9	12	20	20	9	18
Bi	FUS-MS					0.1													
Th	FUS-MS	7.13	7.31	12.4	11.9	10.4	8.68	14.1	14.8	13.8	8.58	14.9	6.08	7.32	2.45	15.4	4.19	4.67	14.2
U	FUS-MS	2.12	2.07	2.89	2.64	1.5	2.77	2.87	2.96	2.91	2.63	2.98	0.71	2.37	0.81	3.85	1.29	1.07	3.28

Appendix 3: X-ray maps of analyzed glaucony / glauconite.

Appendix 3-1: BSE images of analyzed glaucony / glauconite sites.

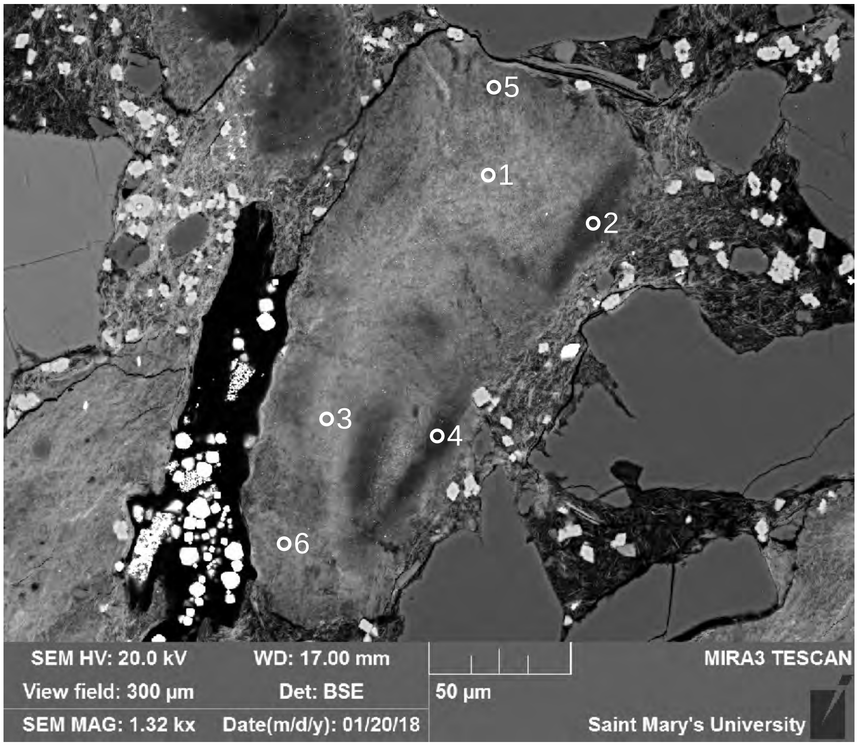


Figure 3-1.1: BSE image of analyzed glaucony / glauconite of Figure 5.1.9A.

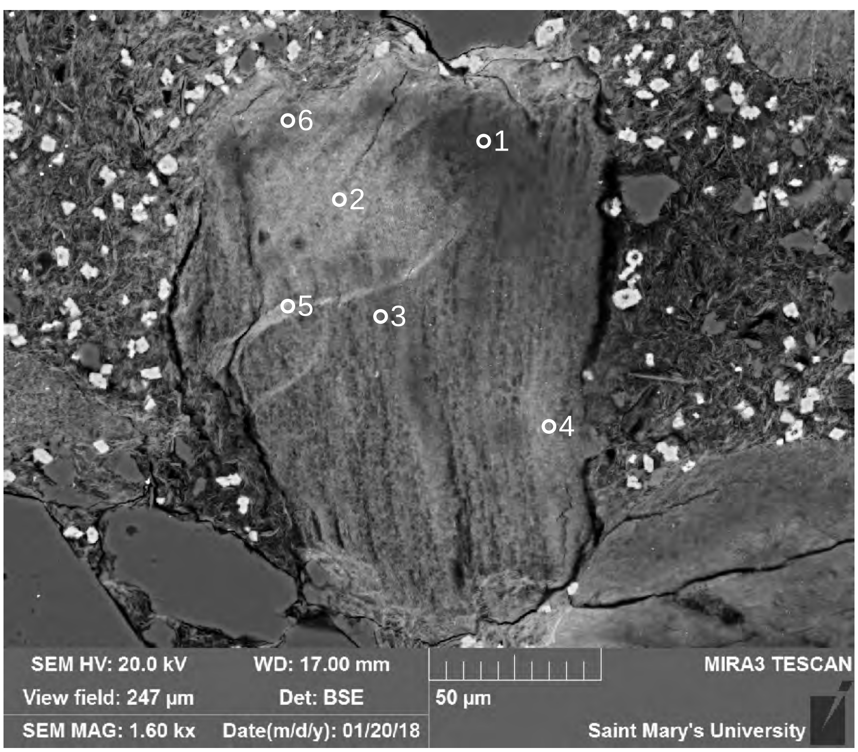


Figure 3-1.2: BSE image of analyzed glaucony / glauconite of Figure 5.1.9B.

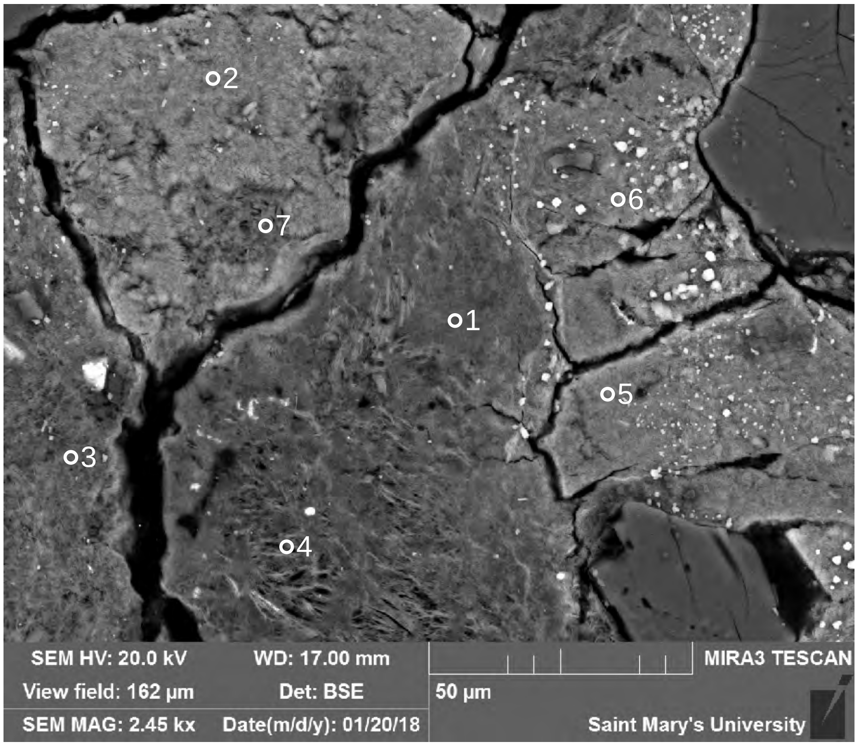


Figure 3-1.3: BSE image of analyzed glaucony / glauconite of Figure 5.1.9C.

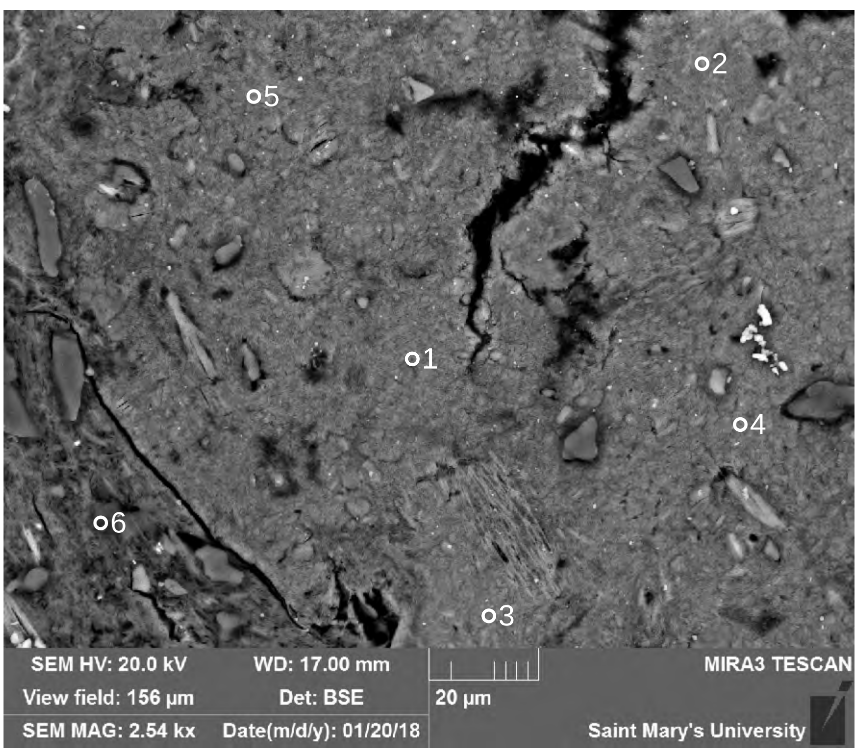


Figure 3-1.4: BSE image of analyzed glaucony / glauconite of Figure 5.1.9D.

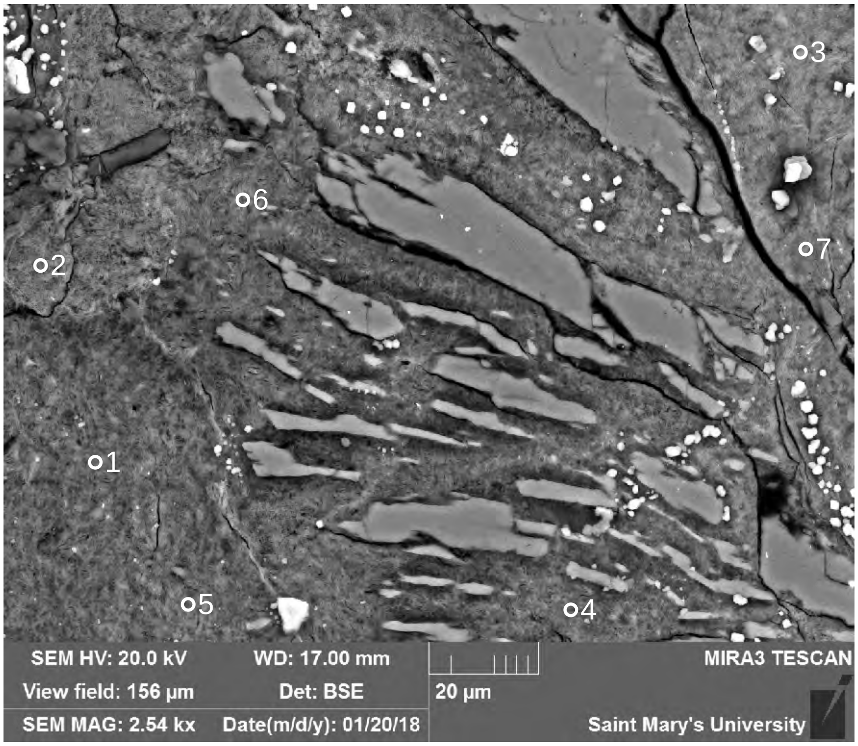


Figure 3-1.5: BSE image of analyzed glaucony / glauconite of Figure 5.1.9E.

Appendix 3-2: X-ray maps of glaucony / glauconite.

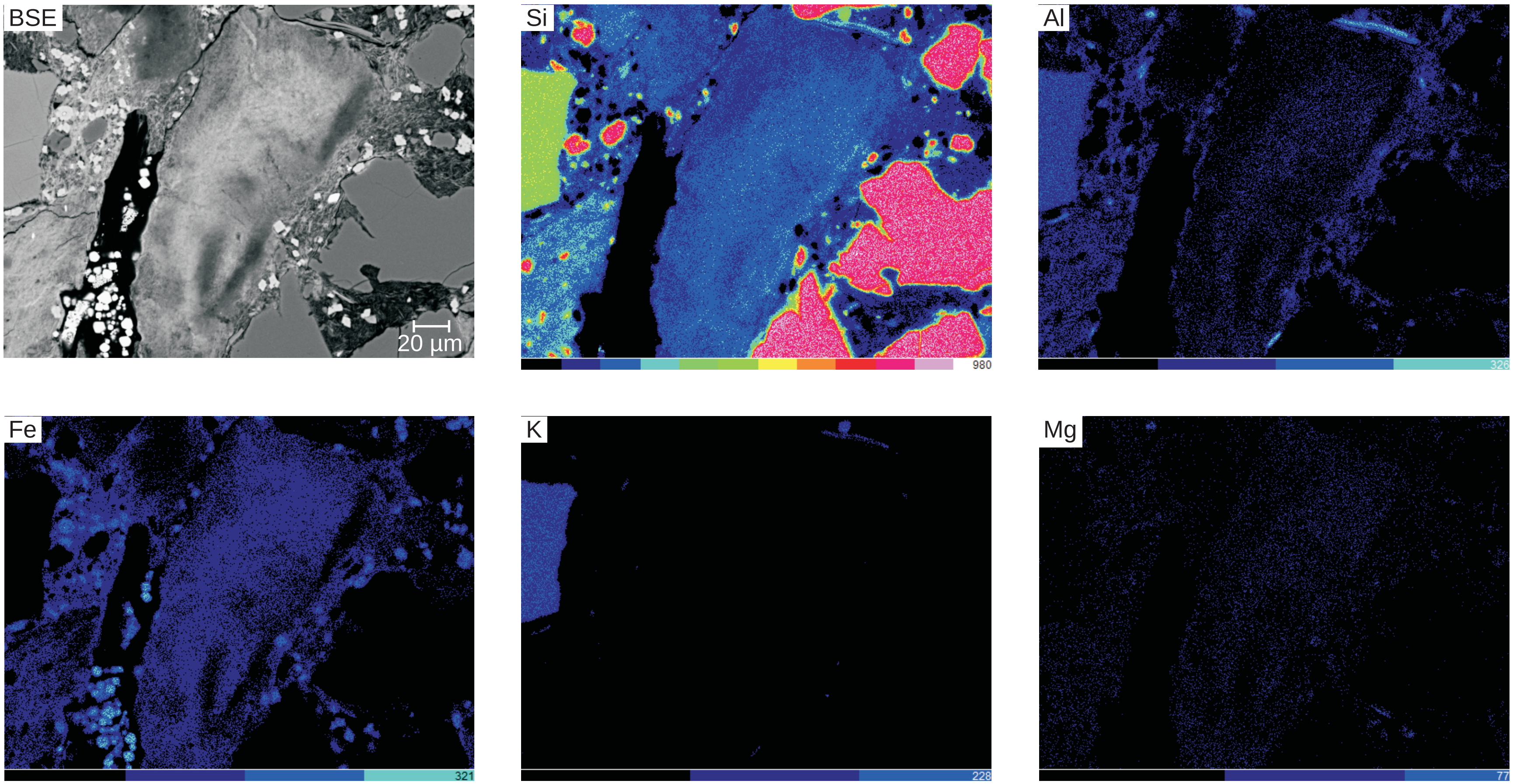


Figure 3-2.1: Peak area X-ray map for site 21.2 sample 3H-58 1613.63.

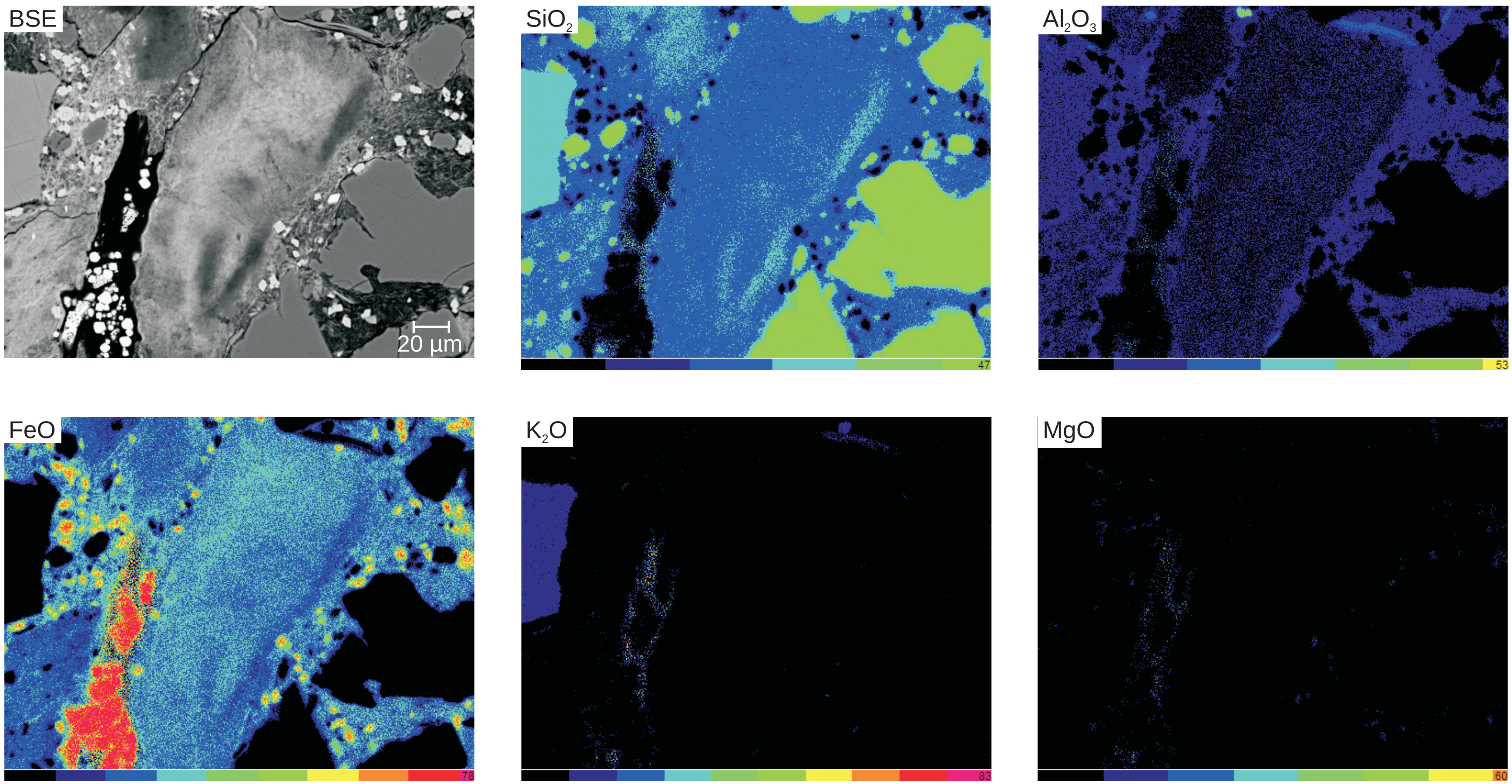


Figure 3-2.1.1: Normalized weight % oxide X-ray map for site 21.2 sample 3H-58 1613.63.

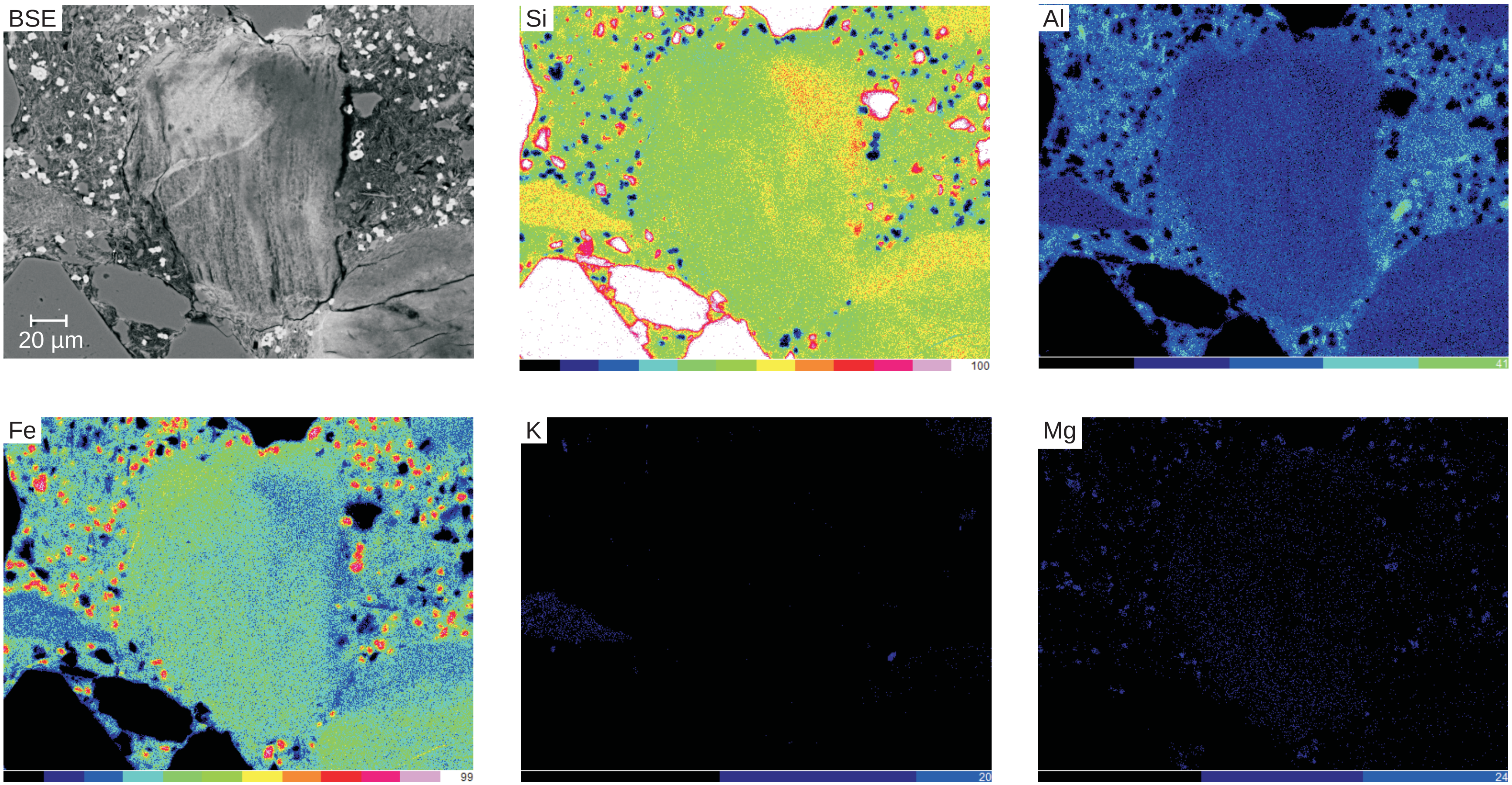


Figure 3-2.2: Compound % X-ray map for site 22.3 sample 3H-58 1613.63.

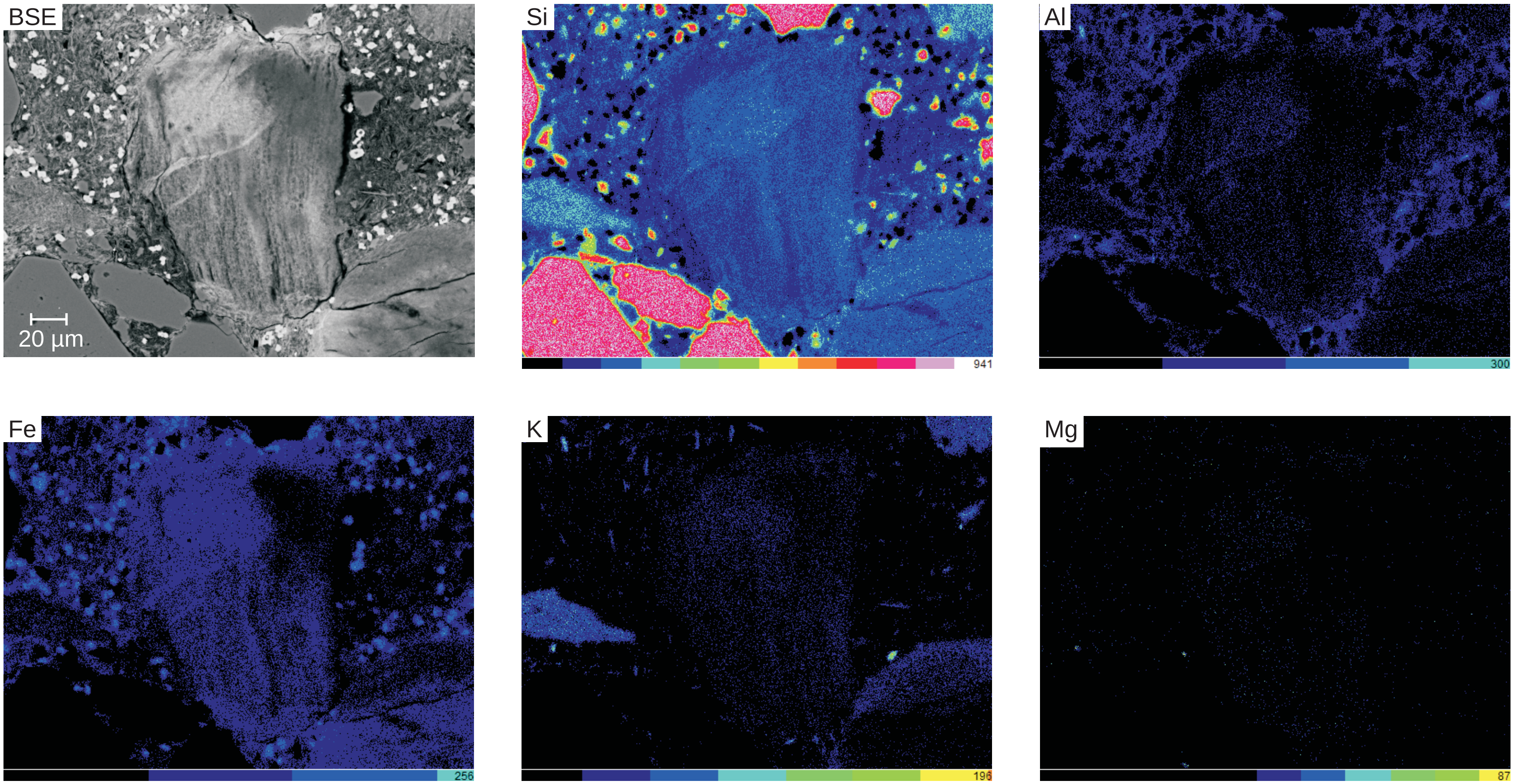


Figure 3-2.2.1: Peak area X-ray map for site 22.3 sample 3H-58 1613.63.

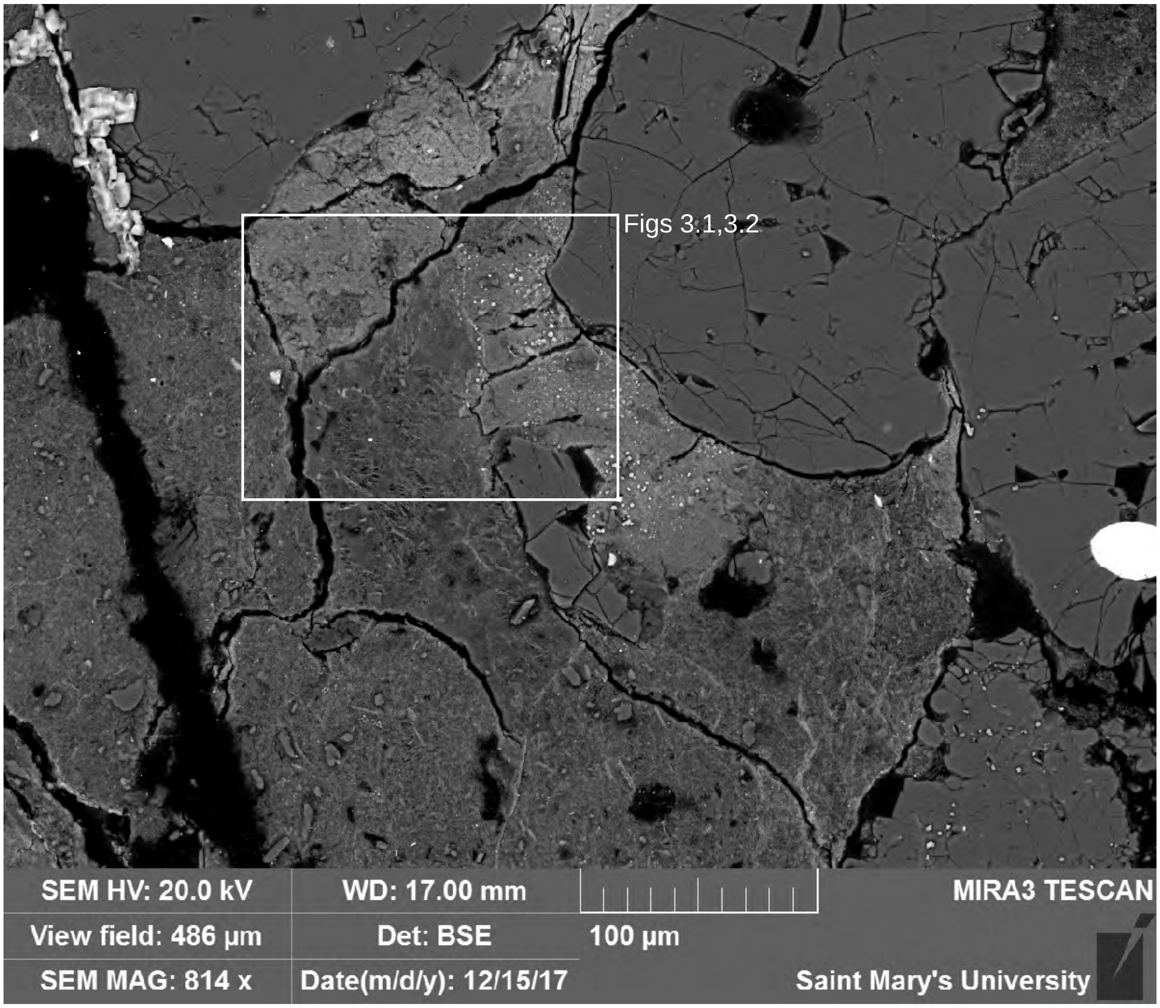


Figure 3-2.3: Zoomout of X-ray map location in site 4 sample 5H-58 1906.89.

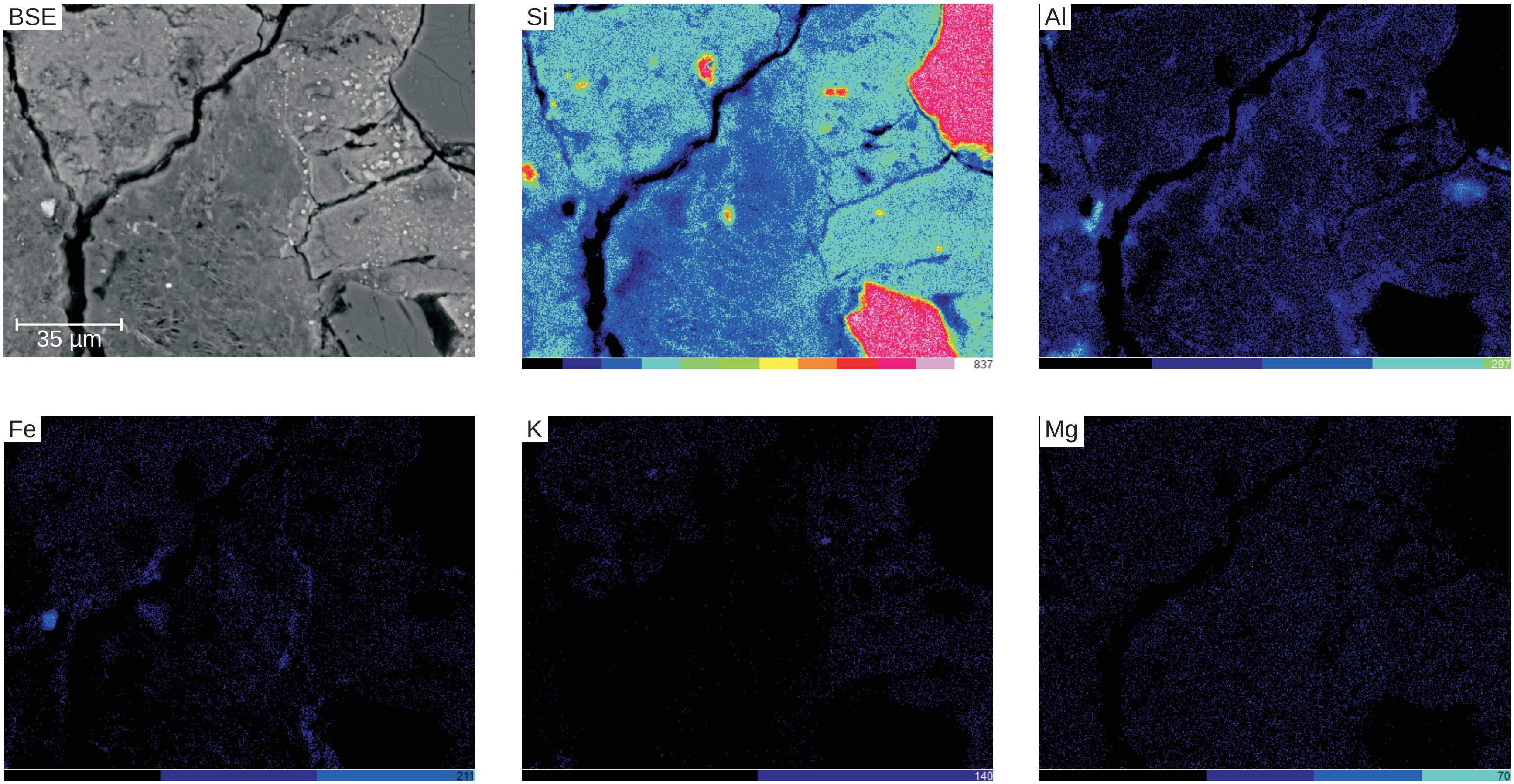


Figure 3-2.3.1: Peak area X-ray map for site 4 sample 5H-58 1903.89.

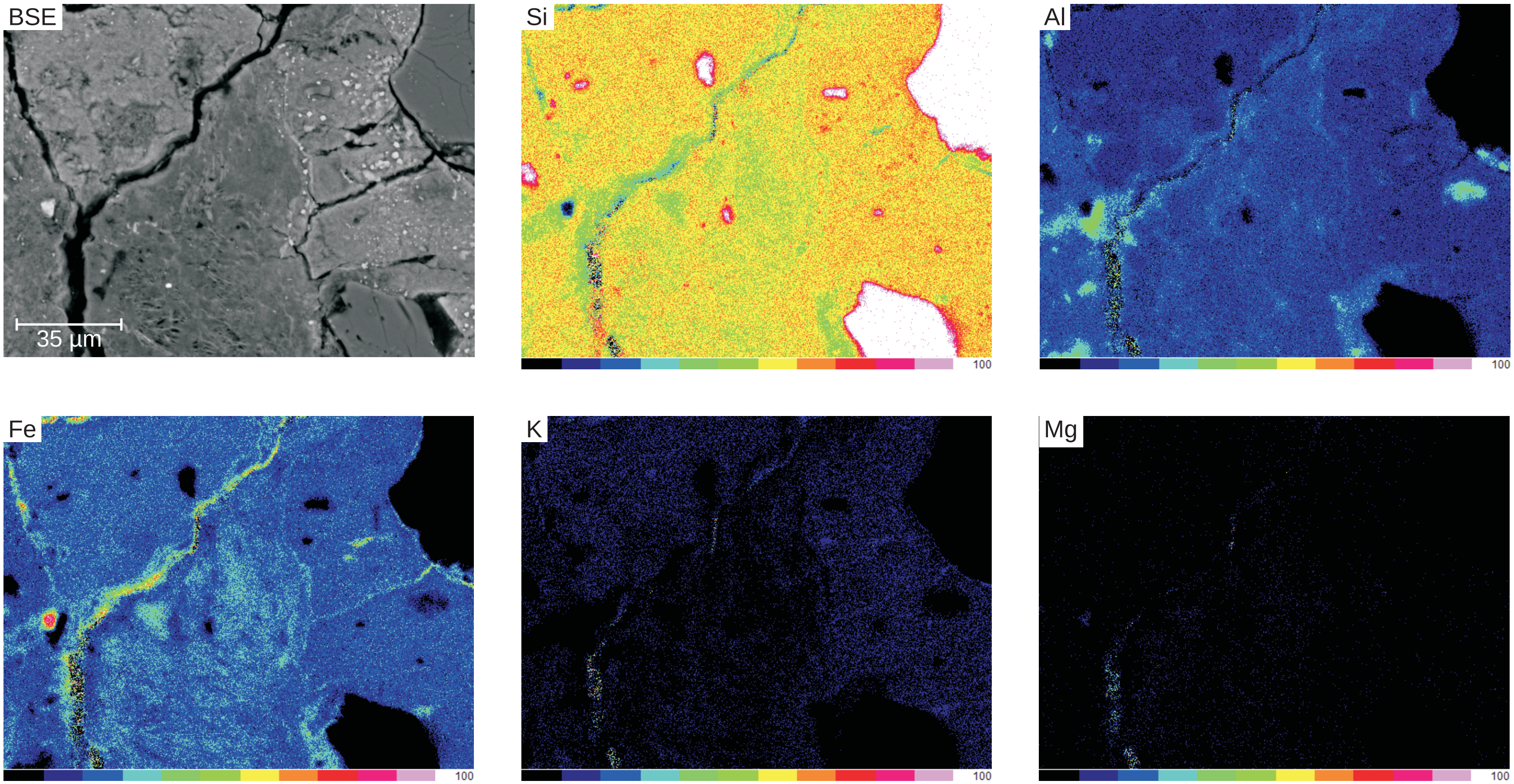


Figure 3-2.3.2: Compound % X-ray map for site 4 sample 5H-58 1903.89.

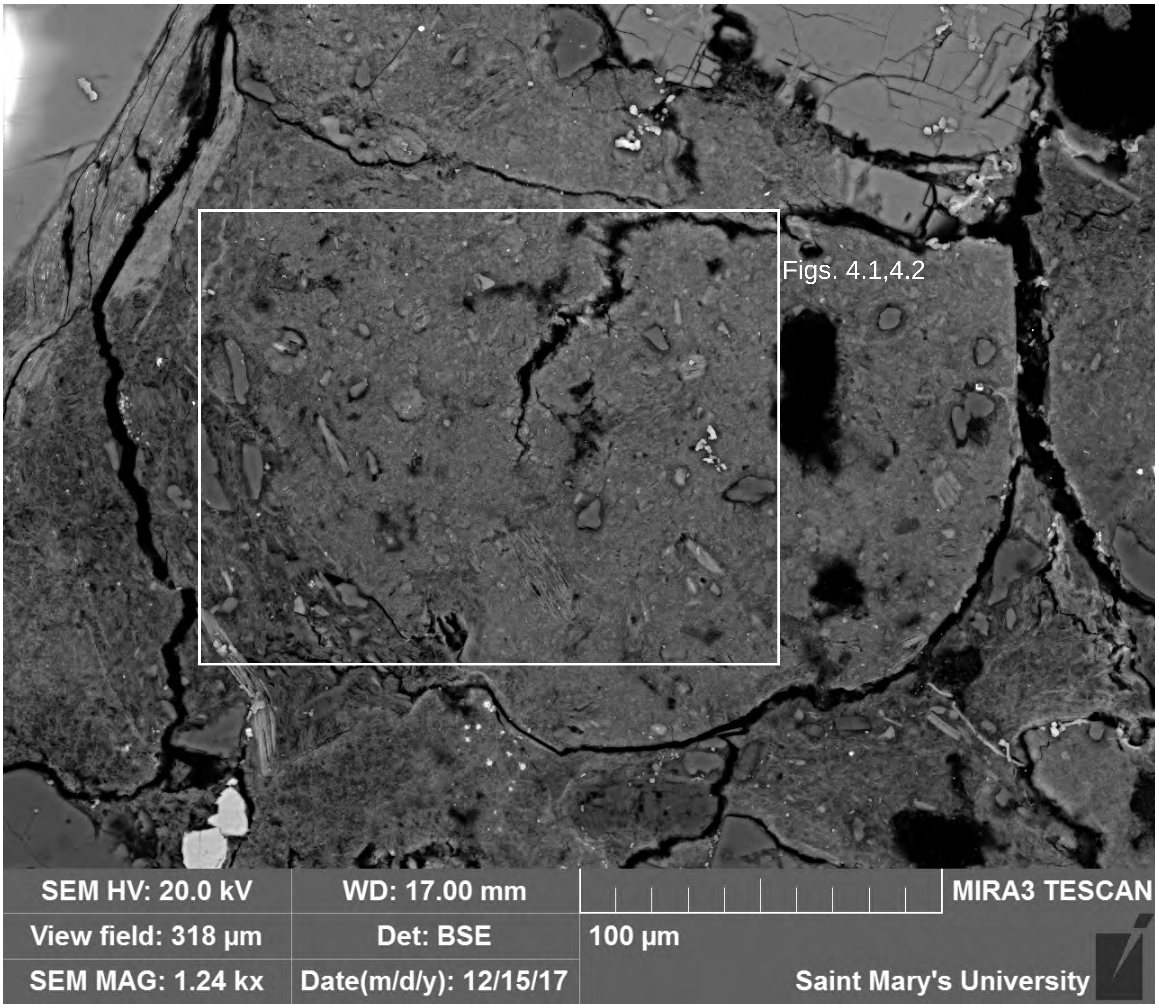


Figure 3-2.4: Zoomout of X-ray map location in site 4 sample 5H-58 1906.89.

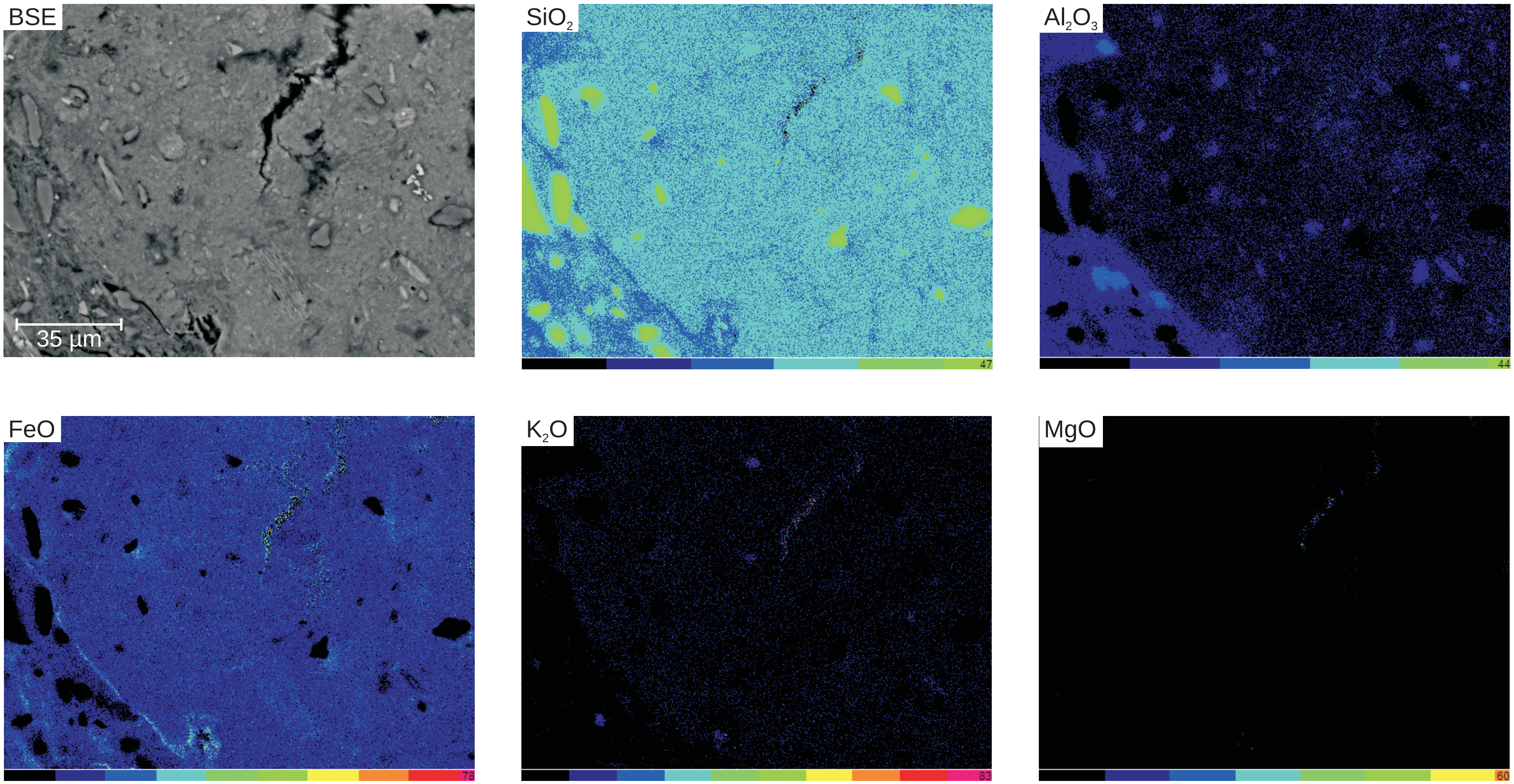


Figure 3-2.4.1: Normalized weight % oxide X-ray map for site 4 sample 5H-58 1903.89.

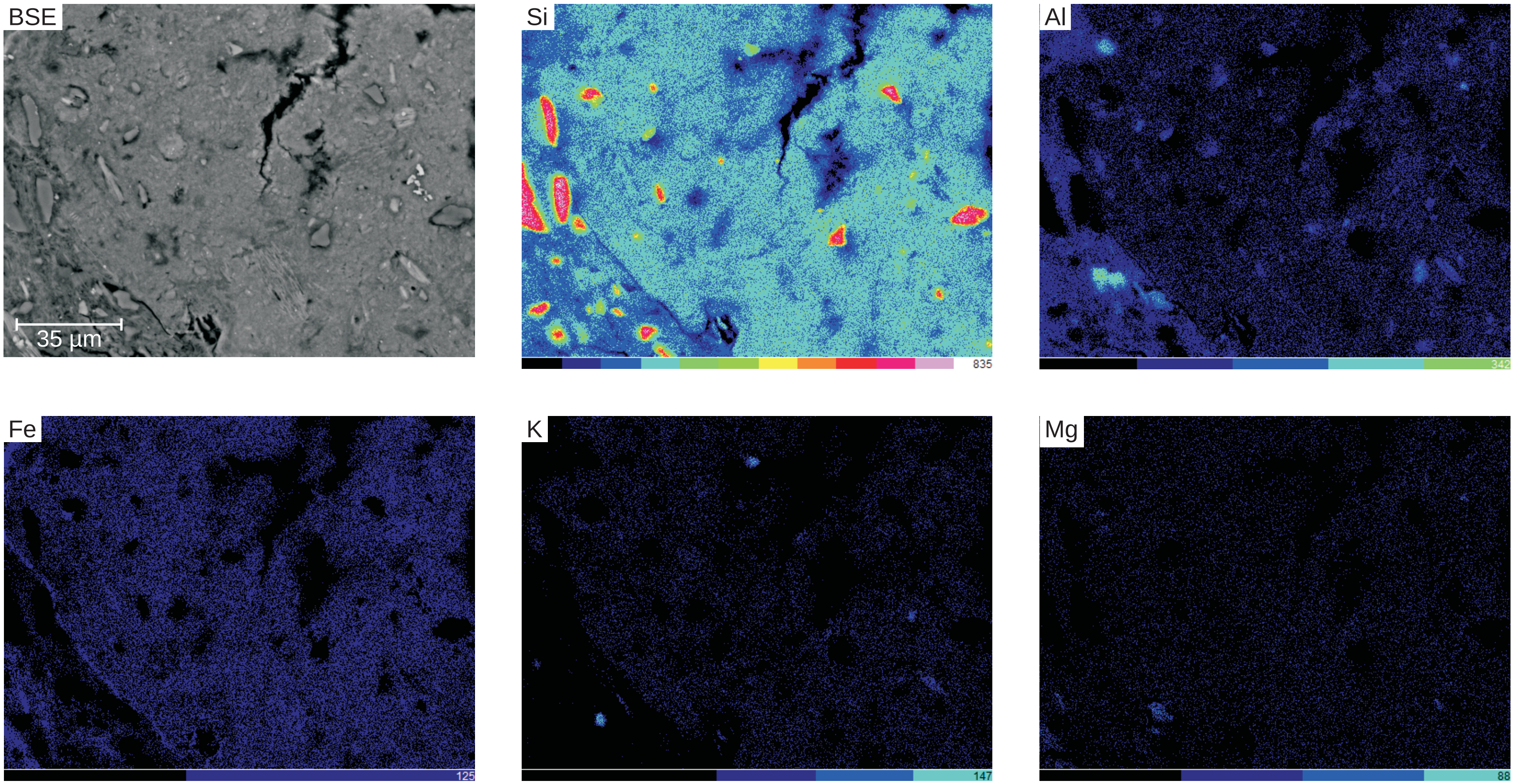


Figure 3-2.4.2: Peak area X-ray map for site 4 sample 5H-58 1903.89.

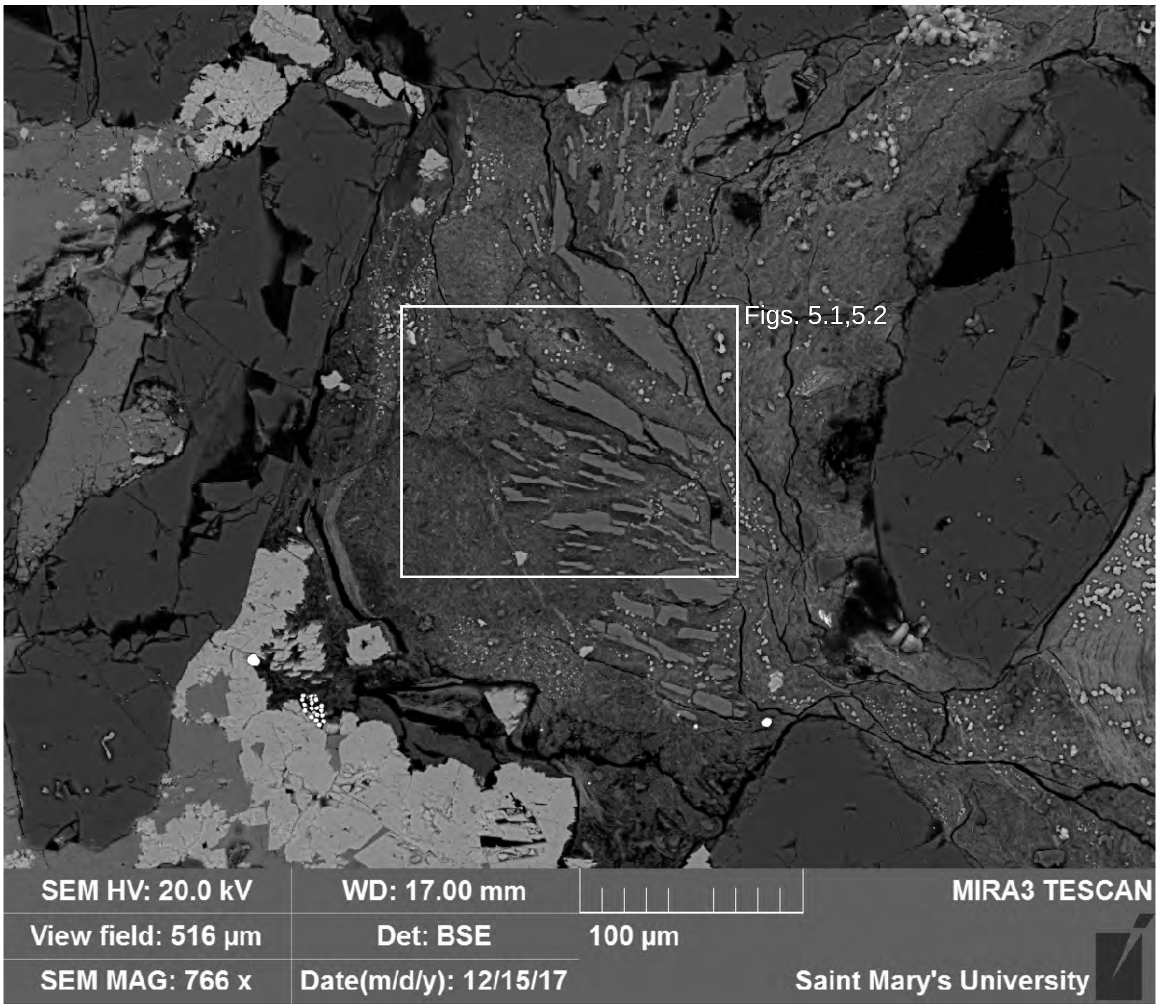


Figure 3-2.5: Zoomout of X-ray map location in site 14 sample 5H-58 1906.89.

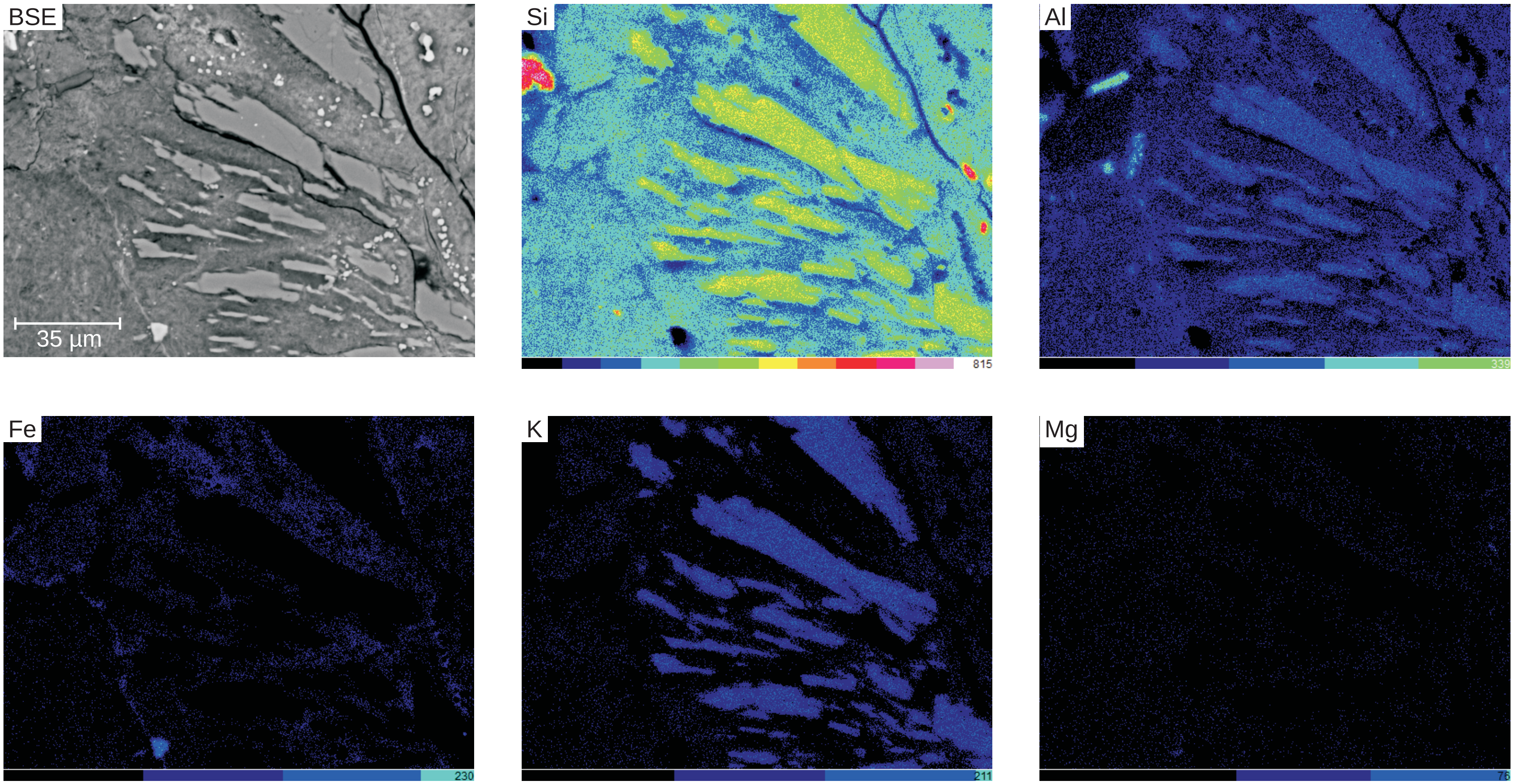


Figure 3-2.5.1: Peak area X-ray map for site 14 sample 5H-58 1906.89.

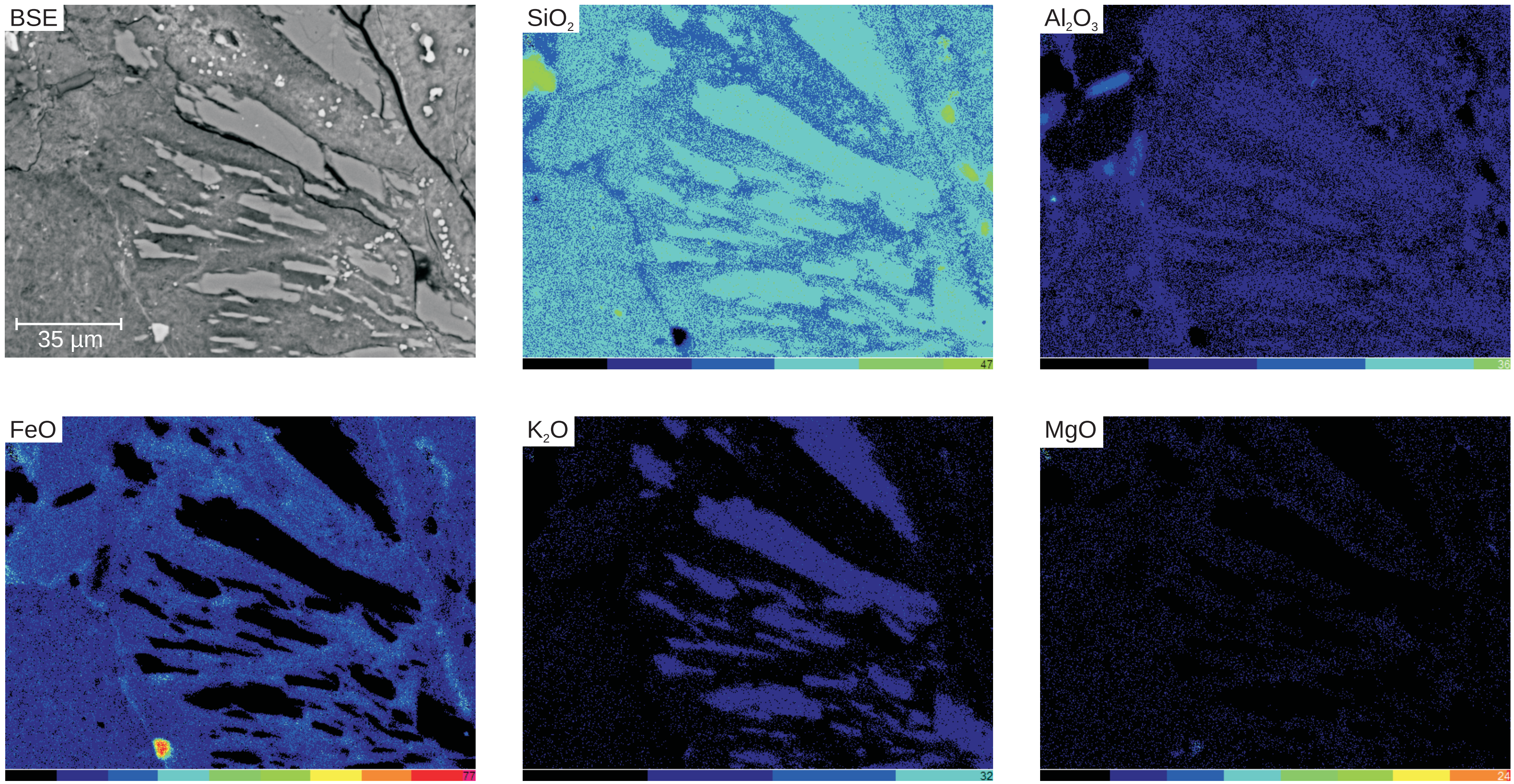


Figure 3-2.5.2: Normalized weight % oxide X-ray map for site 14 sample 5H-58 1903.89.