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G. Pe-Piper, D.J.W. Piper, K.M. Gould, J. Shannon

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Preface

This Open File is a compilation of data on sedimentology and sedimentary petrography from Lower Cretaceous conventional core from the Peskowesk A-99 well in the Scotian basin. A preliminary interpretation is also provided.

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Abstract

Seven conventional cores are available from the Peskowesk A-99 well: four from the Cree Member of the Logan Canyon Formation, one each from the Upper and Middle members of the Missisauga Formation, and one from the top of the Mic Mac formation. These cores were described and lithofacies interpreted. Sandstone samples were analysed in polished thin sections to identify detrital petrology, using petrographic microscope and electron microprobe analyses and backscattered electron images.

The cores predominantly contain shore-face prodeltaic facies in the Mic Mac Formation and Middle Member of the Missisauga Formation, whereas in the Upper Member of the Missisauga Formation and the Cree Member of the Logan Canyon Formation, channel and tidal flat facies predominate. In the Logan Canyon Formation, transgressive deposits with low sedimentation rates tend to be cemented by siderite and in one case include coated grains of glauconite, mantling a core of chlorite pseudomorphing feldspar or biotite, and rimmed by siderite.

The detrital petrology of sandstones show only minor variations from the Mic Mac Formation to the Logan Canyon Formation. Lithic clasts are abundant, with mildly alkaline rhyolite - microgranite - syenite predominating. Clasts of metamorphic rocks, arenites and mylonitized polycrystalline quartz become more abundant in the Cree Member. Detrital feldspars are predominantly perthites. Detrital ilmenite and its alteration deposits are the dominant heavy mineral, with almandine garnet, chromite, rutile, tourmaline and zircon present in minor amounts.

This detrital petrology differs from that in the southwest Scotian basin in many ways: the character of lithic clasts, feldspar composition, abundance of mica, rarity of tourmaline. Chemical composition of garnet and chromite are also different. These data suggests that the Peskowesk area was persistently fed by a different river compared to the southwest Sable sub-basin. That river drained central Newfoundland, including widespread granitoid rocks of the alkaline Topsails complex.

1. INTRODUCTION

1.1 Introduction

Much of the current natural gas production in the Scotian Basin (Fig. 1) is from Lower Cretaceous deltaic sands of the Missisauga and Logan Canyon formations. Detrital petrology provides a means of assessing provenance and dispersal patterns of such sediments, both as an exploration tool and through the influence of sedimentary petrography on reservoir quality. The detrital petrology of selected offshore wells in the southwest Sable sub-basin and of the correlative fluvial sediments onshore was investigated in a previous project funded by ExxonMobil, PR-AC and NSERC (Pe-Piper and Piper, 2004). Detrital petrology of the Lower Cretaceous section in the Orpheus graben was investigated by Weir-Murphy (2004). The Peskowesk A-99 well (Fig. 2) lies geographically between the wells previously studied. The well is positioned approximately 100 km northeast of Sable Island (Fig. 1) at 44º28`13.8`` north latitude and 58º58`41.0`` west longitude (MacLean and Wade, 1993). It was drilled in April of 1985 by Shell PCI et al. to a depth of 4003 m, and subsequently was plugged and abandoned. Seven conventional cores were taken, sampling the Logan Canyon, Missisauga and Mic Mac Formations, with 127.6 m total recovery (Shell PCI et al., 1985).

1.2 Purpose of this study

The purpose of this study was: 1. To describe and interpret lithofacies in conventional core in Peskowesk A-99, in order to provide a context for studies of sedimentary petrography. 2. To describe the sedimentary petrography of representative sandstones in cored sections. 3. To use the chemistry of detrital minerals and lithic clasts to interpret the provenance of the sandstones. 4. To make comparisons of sedimentary petrography both stratigraphically within the Peskowesk A-99 well and to the southwestern Sable sub-basin, where similar techniques have been applied to conventional core (Pe-Piper et al. 2004b).

1.3 Regional Setting

The Scotian margin is a passive continental margin that rifted in late Triassic (McIver, 1972; Given, 1977; Wade and MacLean, 1990). Early rift sediments comprise clastic red beds and salt. Through the Jurassic there was mixed clastic and carbonate sedimentation, but in the early Cretaceous widespread deltaic sediments of the Missisauga, Logan Canyon and Verrill Canyon formations prograded across the continental margin. The Upper Cretaceous and Tertiary consists principally of transgressive shales with minor chalks and marls.

The Mic Mac Formation is a sandstone-shale clastic wedge in the inner part of the basin of Callovian to Tithonian age. The sand prone deltaic Missisauga Formation is of Berriasian to

Barremian age (Williams et al., 1990) and passes seaward into the shales of the Verrill Canyon Formation. The Upper Member of the Missisauga Formation lies above the Hauterivian-Barremian informal "O-marker", a transgressive oolitic to bioclastic limestone unit. The overlying Aptian to Cenomanian Logan Canyon Formation is also deltaic, comprising two transgressive shale units (Naskapi and Sable members), separated by two sandier units (Cree and Marmora members).

During rifting, several sub-basins developed on the Scotian margin, notably the Laurentian sub-basin including the Orpheus graben, the Abenaki sub-basin, and the Sable sub-basin (Fig. 1). Jurassic and Cretaceous sediments prograded southwards across these original basins, but with reduced sedimentation on intervening horsts. The Peskowesk A-99 well is located on the southern margin of the Abenaki sub-basin.

2. METHODS

2.1 Core logging and sampling

Conventional cores were logged and sampled at the Canada-Nova Scotia Offshore Petroleum Board. Representative core intervals were photographed. Samples were taken primarily from sandstone intervals, as well as intervals that showed moderate to intense siderite cementation of sandstone and mudstone. All samples were carefully brushed and washed to remove any remnant drilling mud and other contaminants such as precipitated seawater.

Lithofacies descriptions (Table 1) are modified from the scheme of MacRae and Jauer (2001) and Piper et al. (2004) and are illustrated in Figure 3. Lithofacies A is characterized by medium to coarse-grained cross-bedded sandstones. These may include minor interbedded siltstones or fine sandstones and are in places accompanied by "tidal bundles" of rhythmic alternations of very fine sandstone and mudstone. These sandstones are rarely bioturbated and represent tidally influenced fluvial channels (MacRae and Jauer 2001). Lithofacies B consists of bioturbated interbedded fine sandstone and mudstone beds. Lithofacies C is principally mudstone with siltstone laminations. Following MacRae and Jauer (2001) these lithofacies are interpreted as tidal sandflat and mudflat deposits respectively. Lithofacies D is similar to lithofacies C except that the mudstones are moderate to highly bioturbated, which may indicate a prodeltaic setting (MacRae and Jauer, 2001). Lithofacies E consists of highly bioturbated sandstone (up to medium sand grade), lesser mudstone alternations, patchy siderite cementation and shell fragments. It resembles transgressive lag deposits described by Drummond (1992) and Reimer (2002) and shows some similarities to lithofacies 8 of MacRae and Jauer (2001), which they interpreted as slow deposition in an interdistributary bay or lagoonal setting. Lithofacies F is characterized by abundant wood/coal partings in very fine grained sandstone or siltstone, in some cases with siderite nodules, and is interpreted to represent either a peat swamp (lithofacies 7 of MacRae and Jauer, 2001), or a wood-rich mouth bar deposit, depending on the context of the adjacent facies. Lithofacies G comprises fine-grained sandstone with slight bioturbation and low angle laminated or irregular scour and fill horizons. Such sandstones were argued to be shoreface deposits by MacRae and Jauer (2001). Lithofacies H is similar to G, but more highly bioturbated.

2.2 Laboratory analyses

Thirty-six polished thin sections were made: 34 from sandstones, one from a siderite intraclast (2272.31B m) and one sample was made from two granules identified as being granite and a pyroclastic rock (2247.41 m).

Identification of lithic clasts of medium to fine sand grain size required integration of many analytical techniques, including transmitted and reflected-light microscopy, digital microphotography, back-scattered electron imaging, electron microprobe mineral chemical analysis with a BSE image of the studied clast or mineral grain, and scanning electrom microscopy combined with EDS spectra analysis. Chemical compositions and backscattered electon (BSE) images of detrital minerals and lithic clasts were made using a JEOL-8200 electron microprobe having five wavelength spectrometers and a Noran 133 eV energy dispersion detector. The beam was operated at 15 kV and 20 nA, with a beam diameter of 1-10 µm.

3. LITHOFACIES IN CONVENTIONAL CORE AND THEIR INTERPRETATION

3.1 Lithological description of conventional cores

3.1.1 Introduction

The first four conventional core intervals of Peskowesk A-99 well all sample the Cree Member. Core 5 was taken near the top of the Upper Member of the Missisauga Formation. Core 6 sampled the Middle Member of the Missisauga Formation and Core 7 was taken within the Mic Mac Formation (MacLean and Wade, 1993). Core logs are illustrated in Figure 4.

3.1.2 Cree Member

Cores 1-4 are from the Cree Member of the Logan Canyon Formation. The uppermost interval in core 1 is a mix of mudstone, siltstone and fine-grained sandstone. The lithofacies present mostly correspond with a proximal deltaic facies, using the criteria of MacRae and Jauer

(2001). From 2208.0 m to 2209.5 m is a series of medium to fine grained sandstones interbedded with siltstone and mudstone. The unit is moderately bioturbated, with an increase in the amount of bioturbation towards the base of the succession. This interval corresponds to lithofacies B, or possibly D. Siderite nodules occur in the basal mudstone unit and wood and shell fragments are found within mudstone higher in the unit. This interval has a bioturbated contact with the underlying sequence comprised of medium to coarse-grained sandstone at 2209.5 m to 2212.8 m. This interval is rich in wood fragments, contains large-scale cross bedding (Fig. 3a), and is unbioturbated, corresponding to lithofacies A. Siderite intraclasts are a minor constituent (Fig. 3d).

From 2212.8 m to 2220.7 m there is a fining-upward upper sequence and a coarsening upward lower sequence, separated by a thin bed of intensely bioturbated coarse-grained sandstone with shell fragments, assigned to lithofacies E. Otherwise, this interval, is generally a mix of fine-grained sandstone and siltstone, which occurs in laminae in muddy intervals, with common bioturbation. Locally, fine-grained sandstone beds contain abundant siderite cementation and are well laminated. This is interpreted as a tidal flat succession of lithofacies B and C.

Lithofacies E dominates the interval between 2220.7 m to 2223.50 m. This unit consists of highly bioturbated sandstone and mudstone. Shells, wood fragments and patchy siderite cement are visible within the sandstone. This interval is interpreted as a transgressive lag.

From 2223.5 m to the base of the core at 2224.7 m is an interval dominated by silty sandstone with slight bioturbation and cross lamination. This is tentatively identified as lithofacies B. A basal sandstone bed has coaly partings and overlies a poorly sorted medium cross-bedded sandstone of facies A.

Except for the first 2 metres of core 2, which contains one metre of interbedded fine-grained sandstone and mudstone and a distinct coal bed at 2226.0 m, of facies F, the interval between 2225.0 m to 2239.23 m is sand-dominated, with variable grain size. Large-scale cross bedding in places is picked out by concentrated detrital plant fragments (Fig. 3f) and is diagnostic of lithofacies A. The sandstones included within this interval generally follow a cyclic variation of coarse and fine-grained sandstone with typical mudstone partings of a tidal regime (Photo 3e). Low angle cross-beds are visible and show coarse grained sand concentrated in the troughs of fine-grained cross-beds.

As in core 2, principally medium and coarse-grained sandstones with cross bedding dominate core 3. This core is therefore interpreted as lithofacies A. From 2243.0 m to 2249.0 m there is a fining upward sequence from very coarse-grained sandstone to medium-grained sandstone. The interval has sparse woody fragments, which tend to highlight cross bedding, and in places contains granules (Fig. 3c). At 2249.0 m to the base of the core at 2250.14 m, the sandstone beds again vary in grain size. These are cross-bedded and coarse fractions of the interval locally contain gravel up to 5 mm in size. The interval between 2250.0 m to 2250.14 is fine-grained sandstone with finely laminated silty beds.

Sandstones of lithofacies A also dominate the uppermost section of core 4. The top of the sandstone interval consists of fine-grained sandstone at 2263.0 m. Within the fine-grained sandstone are minor siltstone laminae and abundant wood fragments. At 2264.0 m there is a change in grain size to a medium to coarse-grained sandstone. This sequence is interpreted as a possible channel lag with a granule conglomerate at the base displaying an irregular scour and fill structure (Fig. 3b). At 2267.1m there is a 7 cm bed of mudstone of lithofacies C. From 2267.2 m to 2272.2 m lithofacies A is dominant and again contains variable size cross-bedded sandstones and detrital siderite intraclasts (Fig. 3g). The lowest part of the cored interval is interpreted to be lithofacies B, with an increase in the amount of mudstone and siltstone within the sandstones and the presence of lenticular (flaser) bedding (Fig. 3m). This passes down in to fine grained and bioturbated. sandstones of lithofacies H, resting on dark shales of lithofacies D.

The last metre in core 4 has an abrupt lithology change to lithofacies E. The section contains primarily black mudstone with small silty sand laminae and common sideritic cement in the top half and large scattered shells in the lower half. This is interpreted as the upper part of a transgressive lag similar to that at 2221 m.

3.1.3 Upper Member

Core 5 is from the Upper Member of the Missisauga Formation. The top five metres of the core, 2470.0 m to 2475.0 m, are dominated by lithofacies B, with a minor interbed of lithofacies C. In the interval, the ratio of fine-grained sandstone to mudstone varies and clear tidal bundles are present. There is a prominent oyster bed of facies E at 2475.10 m in this succession, which resembles facies 8 of MacRae and Jauer (2001). This bed is moderately bioturbated, however, locally there is either rare or intense bioturbation. From 2476.5 m to 2478.20 m, lithofacies B dominates and in the sandy intervals, small siltstone laminations are visible as well as some small-scale tidal bundles. From 2478.20 m to 2480.1 m, there is a thick mudstone bed with interbeds of silty sand, suggesting perhaps a deepening of a lagoonal or interdistributary bay environment. At 2480.1 m there is another oyster bed (Fig. 3h) as well as an increase in siderite cement. This interval is again interpreted to be lithofacies E, or facies 8 of MacRae and Jauer (2001). Directly underlying is a small bed of silty sandstone, which is highly bioturbated fine-grained sandstone with mudstone alternations, characterizing lithofacies B. From 2481.5 m to 2484.5 m, there is a decrease in grain size to very fine-grained sandstone and no bioturbation. Within the unit, low angle cross laminations of brown very fine-grained sandstone may be due to the presence of siderite (Fig. 3i) and at 2484.5 m the base of the sandstone bed that overlies a series of siltstone and mudstone laminae (Fig. 3k) alternating with 30% fine-grained laminated sandstone beds that contain small clay clasts. The succession is intercalated with a series of brown fine-grained sandstone beds that are cross-laminated and have a few siderite nodules. This entire succession below 2481.5 m is interpreted as a fine-grained development of lithofacies A, overlying lithofacies B. This overlies a sequence of laminated mudstone with very fine-grained sandstone laminae (lithofacies C) between 2488.3 m and 2490.0 m. The bottom five metres of core are dominated by lithofacies B. The ratio of sandstone to mudstone is approximately 50:50, and is typically bioturbated. There are several oyster beds as well as a scattering of shell fragments throughout, which characterize lithofacies E. The sandstone intervals have a prominent siderite cement and siderite nodules are present.

3.1.4 Middle Member

Core 6 from the Middle Member of the Missisauga Formation consists principally of fine-grained shore-face sandstones of lithofacies H, with disseminated calcareous shelly detritus. The interval between 2927.0 m to 2931.8 m is muddier and interpreted as lithofacies D and G. The section is predominantly mudstone with approximately 20% silty sandstone, and is moderate to highly bioturbated. Sandstone beds are 5-15 cm thick, whereas mudstone beds range in thickness from 20-75 cm. Throughout the entire section, calcareous shell fragments are visible along with minor siltstone laminae. At 2931.8 m there is a distinct facies change, which continues to a depth of 2941.0 m with the development of lithofacies H very fine to fine grained sandstone. Locally, burrows and shell fragments are visible. Siderite intraclasts are present in places and organic material along with dark siltstone makes laminations within the interval visible. From 2941.0 m to the base of the core at 2952.0 m, there are alternating beds of fine-grained sandstone and mudstone. This interval is comprised of sideritic mudstone, interbedded fine bioturbated sandstone and mudstone, and very fine-grained calcareous sandstone. Within the succession there are siderite intraclasts, shell fragments and organic matter. The lithofacies interpretation of the unit is dominantly lithofacies G overlying lithofacies D. The basal contact is highly bioturbated, below which is 3 m of fine-grained sandstone with large-scale cross bedding picked out by woody fragments (Fig. 3j) and a lack of bioturbation, interpreted as lithofacies A.

3.1.5 Mic Mac Formation

The deepest core interval, core 7, which samples the Mic Mac Formation, begins at a depth of 3793.0 m in which the first two metres are predominantly of lithofacies G. Sandstone varies from very fine to medium-grained sandstone and 5-10% of the interval contains mudstone interbeds. Some of the section is slightly bioturbated and siderite or calcareous cement is observed. Towards the lower part of the section there are abundant muddy laminations between siltstone laminae. At 3795.7 m there is a change to lithofacies D, which continues to a depth of 3796.45 m. In this interval there is a high concentration of siderite and there are several intervals with siltstone laminations. This overlies, with abrupt contact, a succession of very fine to fine grained sandstone with siltstone laminae and unidirectional ripple marks, which extends from 3796.2 m to 3797.0 m, and is interpreted as lithofacies H shoreface sandstones. Bioturbation throughout the unit is moderate. At 3797.0 m there is a 40 cm thick bed of laminated mudstone that is moderately bioturbated and interpreted as lithofacies D. From 3797.4 m to 3801.0 m the lithology consists of highly bioturbated fine-grained sandstone and interbedded mudstone, with widespread siderite sedimentation, interpreted as lithofacies E. The presence of rare coaly partings suggests deposition near a distributary mouth. The next two metres of core include laminated mudstone with moderate bioturbation, interpreted as lithofacies D, overlying a small interval of fine-grained sandstone with coal partings that grades upwards into siltstone and mudstone, probably representing the depositional effect of another distributary mouth. From 3803.5 m to the base of the core at 3813.9 m, black mudstone of lithofacies D predominates, with shell fragments and siderite nodules at 3812.0 m.

3.2 Interpretation of sedimentary environment

3.2.1 Facies associations and paleoenvironment

The lithofacies interpretations from the Peskowesk A-99 well enable an interpretation of the depositional paleoenvironment for these Lower Cretaceous sediments. Four facies associations are present. The first association, tidally-influenced fluvial channels, consists of lithofacies A. The occurrence of thick beds of coarse-grained sandstone, woody clasts, siderite intraclasts and large scale cross bedding is evidence of channelled flow and the sparse bioturbation suggests fluctuating salinity. The presence of mudstone drapes and tidal bundles of fine-grained sandstones and mudstone within this lithofacies is evidence of tidal influence. Secondly, lithofacies B, C, E and F are a tidal flat facies association, protected from the open sea, with variable bioturbation and tidal mudstone drapes. Lithofacies D, G and H are a prodeltaic facies association representing deposition in wave-dominated shoreface to offshore environments (MacRae and Jauer, 2001), confirmed by the presence of hummocky cross-stratification, ripple marks, sandstone and mudstone containing marine fossils, and abundant bioturbation. Lithofacies E represents the fourth facies association of slowly accumulating, highly bioturbated sediments associated with marine transgression. In more proximal settings, coarse-grained sandstone, granules and wood fragments may be present, together with patchy sideritic cementation. In more distal settings, oyster shells or other shelly fragments are common. Bioturbated black mudstone is a common component of this facies association.

3.2.2 Stratigraphic variation in depositional environments

Core 7 from the Mic Mac Formation consists of the prodeltaic facies association, with a prominent 5 m interval dominated by the transgressive facies association. Core 6 from the Middle Member of the Missisauga Formation also consists principally of the prodeltaic facies association, overlying fluvial channel facies. The Upper Member of the Missisauga Formation and the Cree Member of the Logan Canyon Formation are of proximal deltaic facies, consisting principally of fluvial channels and tidal flat deposits. The fluvial channels are filled with very fine to fine-grained sandstone in the Upper Member, but with medium-grained sandstone to granule conglomerate in the Cree Member.

4. SEDIMENTARY PETROLOGY

4.1 Nomenclature and framework petrology

General classification of the sandstones was based on grain sizes estimated from thin sections and petrological analysis of framework grains (Fig. 5; Table 2). In the mineralogical classification of Pettijohn et al. (1987), the sandstones range from subarkose to quartz arenites. There are also bioclastic sections that are comprised dominantly of calcareous fossil fragments. Lithic granules and sand-sized clasts occur throughout the sandstones studied, but are most abundant in the Logan Canyon Formation. They are described and interpreted in detail below. On a traditional QFL diagram (Fig. 6) all the studied rocks plot very close to the quartz apex and mostly within the continental block of Dickinson et al. (1983).

Feldspar abundance varies with stratigraphic level, but shows no systematic variation with grain size. In the Cree Member, feldspars ranges from 3% to 10% of the total grains. The dominant feldspar is K-feldspar and a few show exsolution lamellae of albite. In the Missisauga Formation, the percentage of feldspars decreases, as only 2% to 4% is present. K-feldspar is also the dominant feldspar in this interval and albite exsolution lamellae in the K-feldspar crystals are less common. In the Mic Mac Formation, feldspars are present in small amounts, 0% to 3%. Albite lamellae in the K-feldspar crystals are rare.

Quartz consists mainly of monocrystalline quartz, generally 70% to 88% of all grains, except where diluted by high fossil content. Polycrystalline quartz from 2% to 10% and does not show systematic variation with stratigraphic level. There is a weak correlation with mean grain size. Inclusions of biotite, tourmaline and zircon occur within some monocrystalline quartz grains.

Bioclastic carbonate fragments include shell fragments thought to resemble bivalves, crinoid stems and/or echinoderms (Fig. 7a) and bryozoans (Table 2). They are recognised from about half of the thin sections of sandstones from cores 6 and 7, from the prodeltaic facies of the Missisauga and Mic Mac Formations. Macroscopic shells and shell fragments are seen in many developments of Lithofacies E in the Logan Canyon formation. Ooids or coated grains of glauconite and siderite were found in the lowest development of Lithofacies E in the Cree Member (Fig. 7a).

Resistant detrital heavy minerals were point counted from heavy mineral separates from selected sandstones (Table 3). As noted elsewhere in the Lower Cretaceous of the Scotian basin, the dominant heavy minerals are opaque iron-titanium oxides, making up 60-90% of the heavy minerals. Other common heavy minerals are zircon, chromite(spinel), and rutile, with lesser monazite and apatite identified from electron microprobe analysis (Table 4). Other detrital minerals commonly found include muscovite and biotite, which may show evidence of chloritization. The amount of micas, both muscovite and biotite, is lower in the Missisauga and Mic Mac Formations than in the Logan Canyon Formation. Rarely, crystals that resemble altered amphibole or pyroxene have also been observed, although their preserved optical properties were not enough to definitely identify them. Data is insufficient to recognise any systematic stratigraphic variation in these less common minerals.

4.2 Diagenetic cements

4.2.1 General observations

Cement generally ranges from 8% to 45% of the total rock. Carbonate cements include ferroan calcite and siderite. Ferroan calcite was analysed from the Mic Mac Formation and calcite cement was identified optically in many sandstones in the Missisauga Formation. Siderite cements are more abundant in the Logan Canyon Formation.

Later cements in sandstones include, in approximate order of formation, pyrite, chlorite, silica (and quartz overgrowths), hydromuscovite (illite), and kaolinite. The common habit of hydromuscovite is fibrous or bladed and it is associated with albite. Minor kaolinite booklets are found in most sandstones. Chlorite is found as rims as well as infilling pores. Chlorite rims have been identified on quartz grains as well as on K-feldspar, and often within the rim biotite is present. Additionally, clay intraclasts in samples from the Missisauga Formation have been identified and appear to be partially chloritized. Pyrite is generally found as framboids and is often associated with silica overgrowths, chlorite rims and wood/coal fragments.

K-feldspar has been seen partially replaced by various minerals including barite (Appendix V, Fig. 1). A quartz crystal was noted with pseudomorphed inclusions of apatite now altered to Al-phosphate minerals (Appendix V, Fig. 12) (cf. Pe-Piper and Dolansky, 2005). K-feldspar overgrowths on plagioclase, possibly authigenic rather than of detrital igneous origin, have been seen (Appendix IV, Fig. 2).

4.2.2 Early diagenetic minerals in Lithofacies E, Cree Member

Coated grains with a variable mineralogy are present in Lithofacies E at the bottom of core 4 in the Cree Member (Fig. 7a; Appendix VII). The core of the grains consists of quartz, partially altered K-feldspar, or Fe-rich chlorite that appears to be pseudomorphing either biotite or K-feldspar. This is irregularly but concentrically coated with glauconite. Optical observations and electron microprobe analyses suggest that the glauconite in places is intergrown with Fe-rich chlorite. Interspersed with the glauconite are some layers that appear from their chemical composition to consist predominantly of kaolinite. The outer surface of the glauconite is corroded and rimmed by Mg-rich siderite.

4.3 Lithic clasts

4.3.1 Procedures and samples studied

Microphotographs were obtained for a representative set of lithic clasts seen in the Peskowesk A-99 well (Appendix III). These microphotographs were very useful for recognising textures and identifying larger mineral grains (Fig. 8a-d). However, in most clasts, identification of component minerals required electron microprobe analysis, with minerals spatially located on a backscattered electron (BSE) image of the clast (Appendix V). The BSE images commonly show textures less well than the photomicrographs (Fig. 8e). Using all these methods, the lithologic type of over 230 lithic clasts were identified (Appendix VI), based on criteria tabulated in Appendix I. Representative BSE images of the different lithologic types are Figs. 9 and 10. Comparison was made using the petrographic microscope with igneous rocks sampled in situ in other offshore wells, notably the Mallard (M-45) well for textures seen in the lower Cretaceous granitoid rocks and the Ojibwa (E-07) and Jaeger (A- 49) wells for the Devonian granitoid rocks (Appendix II).

4.3.2 Petrographic types of lithic clasts

Lithic clasts were then divided into the following classes, detailed in Appendix I:

A: polycrystalline quartz

a) polycrystalline quartz, with a plutonic protolith.

b) polycrystalline quartz with a metamorphic protolith, divided into schist and gneiss.

c) polycrystalline quartz showing strong mylonitic fabric (e.g. Fig. 7b)

d) vein quartz (e.g. Fig. 7e, 7f, 9d)

e) pegmatitic quartz

B: chert (e.g. Fig. 7d, 10h) or fine-grained matrix, or matrix-rich quartz arenite with a strongly siliceous matrix.

C: Siliciclastic sedimentary clasts (some of which may by intraformational)
a) shales or claystones
b) siltstones
c) sandstones
D: Carbonate clasts (some of which may be intraformational)
E. Igneous clasts (polymineralic) (see notes to Appendix VI)
a) granite (e.g., Fig. 7c, 9b)
b) quartz diorite (e.g. Fig. 10a) and granodiorite
c) microgranite (e.g., Fig. 9c, 9e, 9f)
d) intrusive rhyolite (e.g. Fig. 9g, 9i)
e) syenite (fine grained) (Fig. 10f, 10g, 10j)
f) rhyolite (e.g. Fig. 9a)
g) trachyte
h) diabase (Fig. 10c)
i) altered basalt (Fig. 10d)
j) glassy felsic pyroclastics (associated with exhalative chert) (Fig. 10h)
F. Metamorphic clasts (polymineralic)
a) quartz schist
b) mica schist
c) slate
d) gneiss (e.g. Fig. 8)

The most common polymineralic igneous rock lithologies among the clasts were porphyritic rhyolite, syenite and microgranite (Fig. 9, Appendix V). Such clasts consist mainly of K-feldspar and albite crystals, with or without quartz (Appendix V, Tables 5 and 6, Fig. 12). Granite with granophyric texture (7c) is also indicative of high-level intrusions. One granitic clast contain biotite (Table 5), the composition of which suggests a metaluminous host using the criteria of Abdel-Rahmen (1994).

4.3.3 Stratigraphic variation in lithic clasts

Thin sections were point counted for lithic clasts, which were divided into these eight classes (Tables 2 and 7).
a) plutonic polycrystalline quartz
b) metamorphic polycrystalline quartz
c) mylonitic polycrystalline quartz

d) polymineralic igneous rocks
e) vein quartz
f) polymineralic metamorphic rocks
g) sandstones (probably extrabasinal)
h) claystone and siltstone, probably mostly intraclasts.

At all stratigraphic levels, igneous rocks make up the most common group of lithic clasts, followed by the groups of polycrystalline quartz (plutonic, metamorphic, mylonitic) (Fig. 11). There are no strong differences between the Logan Canyon, Missisauga and Mic Mac formations. Mylonitic polycrystalline quartz was not found in the Mic Mac Formation. Igneous rocks are more abundant in the Mic Mac and Missisauga formations, but decrease a little in abundance in the Cree Member, where polymineralic metamorphic clasts and arenite become more abundant.

Common glassy pyroclastics and siliceous rocks interpreted as exhalative chert are found only in core 3 of the Cree Member. The only diabase and altered basalt clasts are found a little higher in core 2 of the Cree Member. The glassy pyroclastics are interpreted to be derived from the Aptian bimodal volcanism of the Orpheus graben (Jansa and Pe-Piper, 1985), which occurs stratigraphically in the lower Cree Member (Weir-Murphy, 2004). It seems likely that the diabase and altered basalt are also derived from fluvial reworking of Orpheus graben volcanics.

4.4 Chemistry of detrital minerals

4.4.1 Feldspar

The most common detrital feldspar is perthite (e.g. Appendix IV, figs. 15, 18), with very minor plagioclase. Framework plagioclase crystals in the Logan Canyon Formation are principally oligoclase, whereas plagioclase analysed from microgranite or syenite clasts is principally albite (Fig. 12). Framework analysed K-feldspars from the Logan Canyon Formation are entirely Or > 90, reflecting the dominance of perthite, but a small proportion of K-feldspars in clasts have Or of 60-90. These feldspar compositions are strikingly different from those analysed from the Alma, Glenelg and North Triumph fields (Fig. 12).

4.4.2 Chrome spinel

Chromite (chrome spinel) was found in both the Logan Canyon and Missisauga formations at Peskowesk. Compositions of chromite grains (Fig. 13) correspond to those characteristic of island-arc tholeiite source peridotite in ophiolite complexes. Although the number of analyses is small, the compositional range is different from that of chromite from the southwest Sable sub-basin.

4.4.3 Garnet

Garnet of almandine composition is a common detrital mineral from the Logan Canyon Formation. Analysed samples fall in two fields previously recognised from the southwestern Sable sub-basin: one with only trace amounts of Mn and one with small amounts of Mn (Fig. 14). Almandine garnet is a common metamorphic mineral and its presence is consistent with the abundance of metamorphic clasts in the Logan Canyon Formation at Peskowesk.

4.4.4 Micas

Some of the detrital muscovite grains are strained (e.g. Fig. 8b) which may suggest origin from a metamorphic rock (schist). All analysed muscovite grains (4) have low Na content. The three analysed biotite grains include one with igneous chemistry and two with metamorphic chemistry (Table 5).

4.4.5 Monazite

Pe-Piper and MacKay (2006) reported electron microprobe U-Pb ages on two monazite grains. A grain from the Mic Mac Formation yielded an age of 1201±3.6 Ma and a grain from the Missisauga Formation gave an age of 628 ± 45 Ma.

4.4.6 Tourmaline

Tourmaline is rare in the Peskowesk well. The single good microprobe analysis has a chemical composition indicating derivation from granite rather than metasediments, using the criteria of Kassoli-Fournaraki and Michaelidis (1994) and Henry and Guidotti (1985).

4.4.7 Ilmenite and rutile

Undivided iron-titanium oxides are the predominant detrital heavy mineral (Table 3) and, where analysed by microprobe, all appear to be of ilmenite composition. The few analysed ilmenites all have MnO < 0.4%, which Piper et al. (submitted) suggest is indicative of an igneous source. All analysed rutile grains have <0.07 % MnO, again indicative of an igneous rather than a sedimentary source. Ilmenite is also a common component of lithic clasts.

4.5 Provenance of the Peskowesk sandstones

4.5.1 Regional comparisons with other parts of the Scotian basin

The Chaswood Formation in Nova Scotia and New Brunswick (Fig. 1) has evidence of local supply of lithic clasts from bedrock of the southern Appalachians (Pe-Piper et al. 2004a,c, 2005; Gobeil et al. 2006; Piper et al. submitted), with some diagnostic minerals reworked from Carboniferous sediments. U-Pb monazite dating shows that source rocks were principally of

Taconic age, likely from northern New Brunswick (Pe-Piper and MacKay, submitted). The region developed a horst and graben topography in response to strike-slip motion along the Cobequid-Chedabucto fault zone and NE-trending splays (Pe-Piper and Piper, 2004). In contrast, the Lower Cretaceous of the southwestern Sable sub-basin includes marker minerals such as chromite and paragonite not known from the Chaswood Formation, together with Proterozoic detrital monazite. These data point to a source farther east than the most easterly Chaswood Formation (Diogenes Brook in Cape Breton Island) (Fig. 1), likely from uplifted Grenville basement and ophiolites of western Newfoundland.

The Peskowesk sandstones are quite different from those of the southwestern Sable sub-basin. This is seen most clearly in feldspar compositions (Fig. 12), with subequal abundances of K-feldspar and plagioclase in the southwestern Sable sub-basin (Pe-Piper et al. 2004b), but dominance of K-feldspar (perthite) at Peskowesk. The predominant rhyolite - syenite - microgranite lithic clasts at Peskowesk are absent in the southwestern Sable sub-basin, where foliated (metamorphic) rock fragments are present only in a few sandstones in the Missisauga Formation. Spessartine garnet is common in the southwestern Sable sub-basin, but was not detected at Peskowesk (Fig. 14). Tourmaline is much less common at Peskowesk and the single analysed grain was derived from granite, compared with a metasedimentary source for tourmaline in the southwestern Sable sub-basin. Rutile from the southwest Sable sub-basin includes about 10% with high Mn content, which appears absent from Peskowesk. Ilmenite is more abundant at Peskowesk than in the Sable sub-basin. The abundance of both biotite and muscovite is greater at Peskowesk (Fig. 5) than in the southwest Sable sub-basin, where modal abundance of muscovite is < 2% and of biotite <0.2 %, even though most sandstones analysed there are finer grained than at Peskowesk (Pe-Piper et al. 2004b). Peskowesk thus appears to have been sourced by a river distinct from that which provided sediment to the southwestern Sable sub-basin. It must have lain to the southeast of the river draining western Newfoundland that supplied sediment to the southwestern Sable sub-basin.

Furthermore, these distinct rivers with distinct sediment supply to the southwestern and northeastern Sable sub-basin persisted from the Mic Mac Formation at least to the Cree Member of the Logan Canyon Formation. The variations in sediment supplied to Peskowesk through time illustrated in Figures 11 and 12 are much less than the variations between Peskowesk and the wells of the southwest Sable sub-basin.

4.5.2 Bedrock sources in Newfoundland

The regional data thus suggest a source of sediment to Peskowesk from central Newfoundland. The abundant lithic clasts suggest a major igneous source for all the Cretaceous sandstones of the Peskowesk A-99 well. The microgranite, syenite and related rocks, with predominant alkali feldspar, suggest a mildly alkaline granitoid source. This may have been associated with some more mafic rocks including quartz diorite, granodiorite, and biotite granite. In addition, there was a substantial input of medium to high grade metamorphic rocks. The sparse monazite ages suggest an input both from the Grenville and from Avalonian rocks. Chromite suggests input from ophiolites.

A source area with these characteristics is present in central Newfoundland, where there are extensive Silurian alkaline granites including the Topsails complex intruding metamorphic rocks and migmatites of the Gander zone (Currie, 1995). To the northwest, Grenville basement outcrops in the Long Range and is overthrust by Taconic ophiolites.

4.5.3 Possible sources in Cretaceous igneous rocks

The local abundance of alkali granitoid clasts at Peskowesk led us to consider whether there was a local source of Cretaceous alkali granite, similar to that intersected by the Mallard M-45 well on the southwest Grand Banks (Pe-Piper et al. 1994). Although the clasts of microgranite and porphyritic rhyolite in the Peskowesk well look similar to the same type of rocks found in the Mallard M-45 well, critical minerals like sodic amphiboles and aegirine-augite that are present at Mallard well rocks are not found at Peskowesk. The feldspar textures are similar but the compositions of these feldspars are different. The principal feldspar at Mallard is orthoclase with Na_2O about 6% and K_2O about 7%, a composition not found at Peskowesk (Fig. 12).

As discussed above, it seems probable that the felsic pyroclastic rocks and weathered basalt from the Cree Formation were derived from erosion of contemporary volcanic rocks in the Orpheus graben (Jansa and Pe-Piper, 1985).

5. CONCLUSIONS

Conventional core from the Peskowesk A-99 well shows principally shore-face prodeltaic facies in the Mic Mac Formation and Middle Member of the Missisauga Formation, whereas in the Upper Member of the Missisauga Formation and the Cree Member of the Logan Canyon Formation, channel and tidal flat facies predominate. In the Logan Canyon Formation, transgressive deposits with low sedimentation rates tend to be cemented by siderite and in one case include coated grains of glauconite, mantling a core of chlorite pseudomorphing feldspar or biotite, and rimmed by siderite.

The detrital petrology of sandstones show only minor variations from the Mic Mac Formation to the Logan Canyon Formation. Lithic clasts are abundant, with mildly alkaline rhyolite - microgranite - syenite predominating. Clasts of metamorphic rocks, arenites and mylonitized polycrystalline quartz become more abundant in the Cree Member. Detrital feldspars are predominantly perthite. Detrital ilmenite and its alteration deposits are the dominant heavy mineral, with almandine garnet, chromite, rutile, tourmaline and zircon present in minor amounts.

This detrital petrology differs from that in the southwest Scotian basin in many ways: the character of lithic clasts, feldspar composition, abundance of mica, rarity of tourmaline. It suggests that the Peskowesk area was persistently fed by a different river compared to the southwest Sable sub-basin. This river drained central Newfoundland, where there are widespread alkaline granitoid rocks including the Topsails complex.

References

Abdel-Rahmen, A.-F.M., 1994. Nature of biotites from alkaline, calc-alkaline and peraluminous magmas. Journal of Petrology, 35, 525-541.

Allan, B. D., and Clarke, D. B. 1981. Occurrence and origin of garnet in the South Mountain Batholith, Nova Scotia. Canadian Mineralogist, 19, 19-24.

Bedard, J.H. and Hebert, R., 1998: Formation of chromitites by assimilation of crustal pyroxenites and gabbros into peridotitic intrusions: North Arm Mountain massif, Bay of Islands ophiolite, Newfoundland, Canada. Journal of Geophysical Research, 103, 5165-5184.

Coish, R.A., 1989: Boninitic lavas in Appalachian ophiolites: a review. In: Boninites and related rocks, Edited by A.J. Crawford. Unwin Hyman, London, p.264-.

Currie, K.L. 1995. Plutonic Rocks. Ch. 8 in Geology of the Appalachian - Caledonian orogen in Canada and Greenland, (ed.) H. Williams, Geological Survey of Canada, Geology of Canada, no. 6, 629-680.

Dickinson, W.R. and 8 others. 1983. Provenance of North American Phanerozoic sandstones in relation to tectonic setting. Geological Society of America Bulletin, 94, 222-235.

Drummond, K. J., 1992, Geology of Venture, a geopressured gas field, offshore Nova Scotia, *in* M. T. Halbouty, ed., Giant oil and gas fields of the decade 1978-1988: AAPG Memoir 54, 55-71.

Feetham, M. 1995. Lithogeochemistry of the Goldenville-Halifax Transition Zone (GHT) at North Beaverbank, Nova Scotia. B.Sc. hons. thesis, Saint Mary’s University, 78 p.

Given, M.M., 1977, Mesozoic and Early Cenozoic geology of offshore Nova Scotia. Bulletin of Canadian Petroleum Geology, 25, 63-91.

Gobeil, J.-P., Pe-Piper, G., and Piper, D.J.W. 2006. The Early Cretaceous Chaswood Formation in the West Indian Road pit, central Nova Scotia. Canadian Journal of Earth Sciences, 43, 391-403.

Ham, L., 1988, The mineralogy, petrology, and geochemistry of the Halfway Cove-Queensport pluton, Nova Scotia, Canada [M.Sc. thesis]: Halifax, Nova Scotia, Dalhousie University.

Hebert, R., and Laurent, R., 1989. Mineral chemistry of ultramafic and mafic plutonic rocks of the Appalachian ophiolites, Quebec, Canada. Chemical Geology, 77, 265-285.

Henry, D. J., and Guidotti, C. V. 1985. Tourmaline as a petrogenetic indicator mineral: an example from the staurolite-grade metapelites of NW Maine. American Mineralogist, 70, 1-15.

Jansa, L.F. and Pe-Piper, G. 1985. Early Cretaceous volcanism on the northeastern American margin and implications for plate tectonics. Geological Society of America Bulletin, v. 96, p. 83-91.

Kassoli-Fournaraki, A. and Michailidis, K., 1994: Chemical composition of tourmaline in quartz veins from Nea Roda and Thasos areas in Macedonia, Northern Greece. Canadian Mineralogist, 32, 607-615.

Laurent, R., and Kacira, N., 1987. Chromite deposits in the Appalachian Ophiolites. In: Evolution of chromium ore fields, p.169-193. Edited by C.W. Stowe. Van Nostrand Reinhold Co., New York.

MacLean, B.C. and Wade, J.A., 1993. Seismic markers and stratigraphic picks in the Scotian Basin wells, East Coast Basin Atlas Series.

MacRae, R.A. and Jauer, C., 2001. Sequence stratigraphy and palynology, Upper Missisauga Formation. Glenelg area, offshore Nova Scotia. Poster presented at the Atlantic Geoscience Society annual colloquium.

Malpas, J., and Strong, D.F., 1975. A comparison of chrome-spinels in ophiolites and mantle diapirs of Newfoundland. Geochimica et Cosmochimica Acta, 39, 1045-1060.

McIver, N.L., 1972. Mesozoic and Cenozoic stratigraphy of the Nova Scotia Shelf. Canadian Journal of Earth Sciences, 9, 54-70.

Pearce, J.A., Barker, P.F., Edwards, S.J., Parkinson, I.J., and Leat, P.T., 2000. Geochemistry and tectonic significance of peridotites from the South Sandwich arc-basin system. Contributions to Mineralogy and Petrology, 139, 36-53.

Piper, D.J.W., Pe-Piper, G. and Ingram, S.I., 2004. Early Cretaceous sediment failure in the southwestern Sable sub-basin, offshore Nova Scotia. American Association of Petroleum Geologists Bulletin, 88, 991-1006.

Pe-Piper, G., and Dessureau, G., 2002. The West Moose River anorthosites, Avalon zone, Nova Scotia. Geological Survey of Canada Open File Report 4188

Pe-Piper, G. and Dolansky, L., 2005. Early diagenetic origin of aluminum phosphate-sulfate minerals (woodhouseite - crandallite series) in terrestrial sandstones, Nova Scotia, Canada. American Mineralogist, 90, 1434-1441.

Pe-Piper, G. and Ingram, S., 2002. The New Cornwall syenogranite, Nova Scotia: petrology and geochemistry. Atlantic Geology, 37, 133-151..

Pe-Piper, G. and Mackay, R.M. 2006. Electron microprobe geochronology and chemical variation of detrital monazite from the Lower Cretaceous sandstones of the Scotian basin and the Chaswood Formation, eastern Canada. Geological Survey of Canada Open File 5023.

Pe-Piper, G. and Mackay, R.M. submitted. Electron microprobe geochronology and chemical variation of detrital monazite from the Lower Cretaceous sandstones of the Scotian basin and the Chaswood Formation, eastern Canada. Bulletin of Canadian Petroleum Geology (submitted)

Pe-Piper, G. and Piper, D.J.W. 2004. The effects of strike-slip motion along the Cobequid-Chedabucto-SW Grand Banks fault system on the Cretaceous - Tertiary evolution of Atlantic Canada. Canadian Journal of Earth Sciences, 41, 799-808.

Pe-Piper, G., Dolansky, L., and Piper, D.J.W. 2004a. Petrography of the mid-Cretaceous Chaswood Formation in borehole RR-97-23, Elmsvale Basin, Nova Scotia: sedimentary environment, detrital mineralogy and diagenesis. Geological Survey of Canada Open File 4837, 231 p.

Pe-Piper, G., Jansa, L.F. and Palacz, Z. 1994. Geochemistry and regional significance of the Early Cretaceous bimodal basalt-felsic associations on Grand Banks, eastern Canada. Geological Society of America Bulletin, 106, 1319-1331.

Pe-Piper, G., Piper, D.J.W., Hundert, T. and Stea, R.R. 2005. Outliers of Lower Cretaceous Chaswood Formation in northern Nova Scotia: results of scientific drilling and studies of sedimentology and sedimentary petrography. Geological Survey of Canada Open File 4845, 305 p.

Pe-Piper, G., Piper, D.J.W., Vaughan, A.D., Shannon, J. and Ingram S., 2004b. Sedimentary petrology of Lower Cretaceous rocks of the southwestern Sable sub-basin (North Triumph B-52, Alma K-85 and Glenelg N-49 wells), Scotian Basin. Geological Survey of Canada, Open File 4836.

Pe-Piper, G., Stea, R.R., Ingram, S., and Piper, D.J.W. 2004c. Heavy minerals and sedimentary petrology of the Cretaceous sands from the Shubenacadie outlier, Nova Scotia. Nova Scotia Department of Natural Resources, Open File Report ME 2004-5, 78 p.

Pettijohn, F.J, Potter, P.E. and Siever, R., 1987. Detrital Minerals. In Sand and Sandstone (2nd ed.), 29-32. New York: Springer-Verlag.

Piper, D.J.W., Pe-Piper, G., Hundert, T. and Venugopal, D.K., submitted. The Lower Cretaceous Chaswood Formation in southern New Brunswick: provenance and tectonics. Canadian Journal of Earth Sciences

Reimer, C., 2002. Missisauga Formation at the Venture field proximal delta and shallow marine reservoirs. Core conference, Petroleum Society of CIM.

Shell Canada Resources Limited, 1985. Shell PCI et al. Peskowesk A-99: Well History Report; National Energy Board of Canada, Calgary, Canada.

Suhr, G., and Robinson, P.T., 1994: Origin of mineral chemical stratification in the mantle section of the Table Mountain massif (Bay of Islands Ophiolite, Newfoundland, Canada). Lithos, 31, 81-102.

Wade, J.A. and MacLean, B.C., 1990. Aspects of the geology of the Scotian Basin from recent seismic and well data. Chapter 5, in Geology of the continental margin off eastern Canada, ed. M.J.Keen and G.L.Williams. Geological Survey of Canada, Geology of Canada, no. 2, (also Geological Society of America, The Geology of North America, v. I-1), p. 190-238.

Weir Murphy, S.L., 2004. Cretaceous rocks of the Orpheus graben, offshore Nova Scotia. M.Sc. thesis, Saint Mary's University.

Williams, G.L., Ascoli, P., Barss, M.S., Bujak, J.P., Davies, E.H., Fensome, R.A., and Williamson, M.A., 1990. Biostratigraphy and related studies. Chapter 3, in Geology of the continental margin off eastern Canada, ed. M.J.Keen and G.L.Williams. Geological Survey of Canada, Geology of Canada, no. 2, (also Geological Society of America, The Geology of North America, v. I-1), p. 87-137.

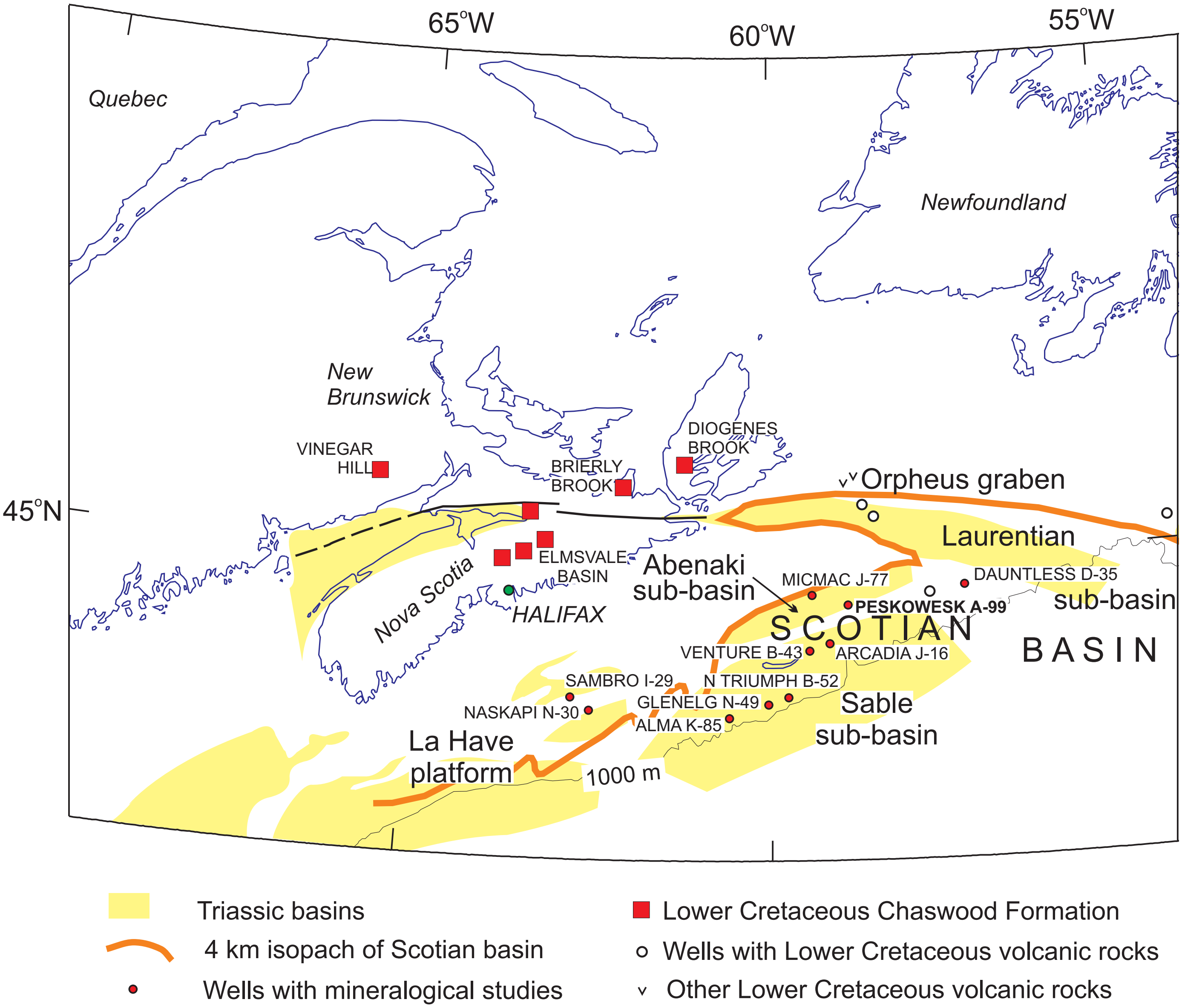


Figure 1. Map of the Scotian basin showing location of Peskowesk A-99 well

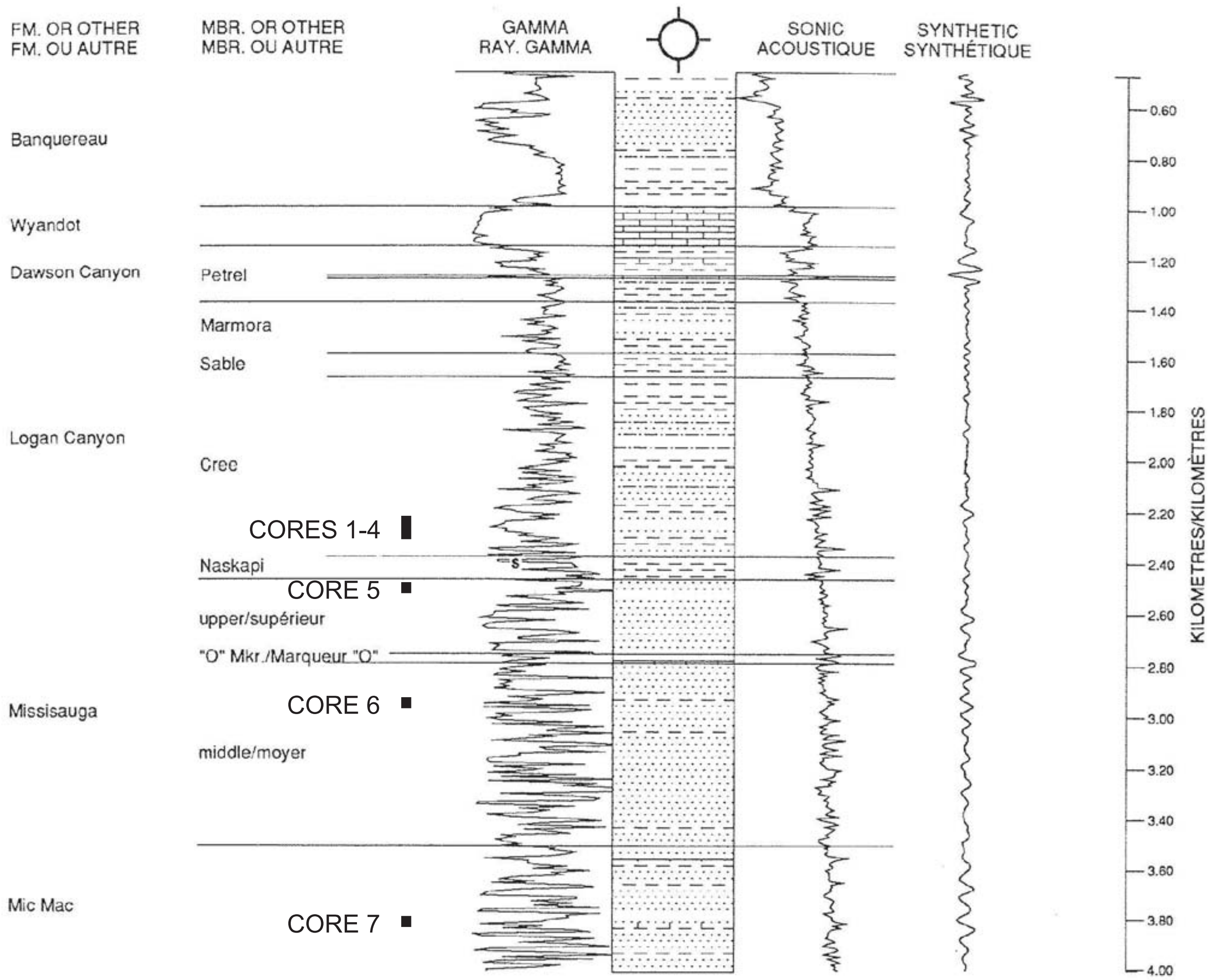


Figure 2. Stratigraphy of the Peskowesk A-99 well (from MacLean and Wade, 1993) showing the location of conventional cores.

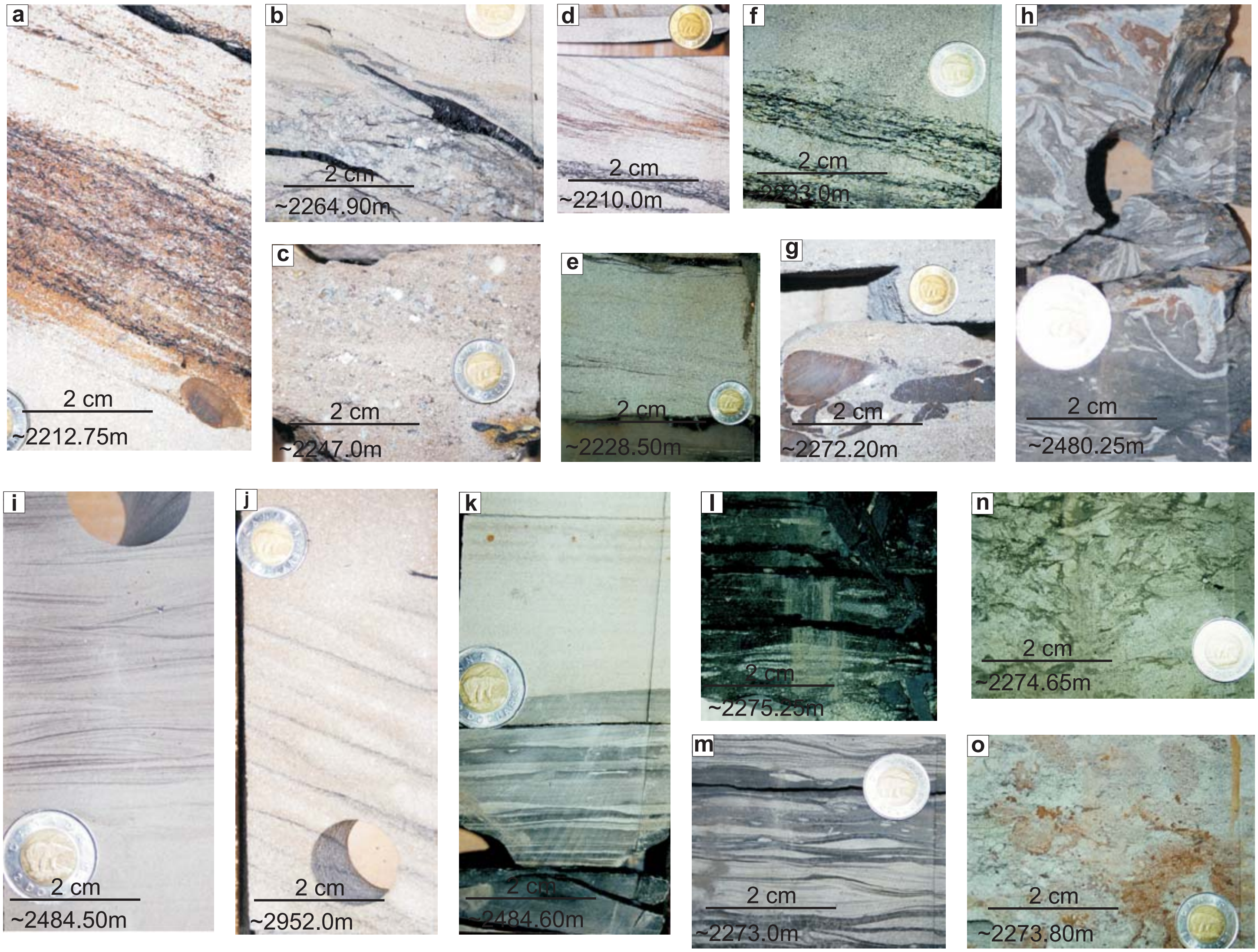


Figure 3: Core photographs illustrating lithofacies.
Photographs located in Fig. 4.
(a) 2212.75 m = large scale cross-bedding of siderite and wood fragments in fine-medium grained sandstone; detrital siderite nodule (Lithofacies A).
(b) 2264.90 m = granule conglomerate and coarse grained sandstone with coal fragments (Lithofacies A).
(c) 2247.0 m = very coarse grained sandstone grading into granule gravel sandstone (Lithofacies A).
(d) 2210.0 m = large scale cross-bedding picked out by wood fragments in medium grained sandstone (Lithofacies A).
(e) 2228.5 m = fine to medium grained sandstone with tidal mudstone drape (Lithofacies A).
(f) 2233.0 m = medium grained sandstone with wood fragments picking out cross-bedding (Lithofacies A).
(g) 2272.2 m = detrital siderite nodules and a few granules at base of medium grained sandstone bed (Lithofacies A).
(h) 2480.25 m = Oyster bed in sideritic mudstone (Lithofacies E). (i) 2484.5 m = bidirectional sets of cross-lamination in very fine sandstone (Lithofacies A).
(j) 2952.0 m = large-scale cross bedding picked out by wood fragments (Lithofacies A).
(k) 2484.6 m = contact between very fine sandstone and laminated sandy siltstone (Lithofacies A & B).
(l) 2275.25 m = black mudstone with thin silt laminae (Lithofacies D).
(m) 2273.0 m = lenticular fine grained sandstone beds with cross laminations alternating with mudstone (Lithofacies B).
(n) 2274.65 m = highly bioturbated fine grained sandstone (Lithofacies H).
(o) 2273.8 m = sideritic bioturbated sandstone (Lithofacies H).

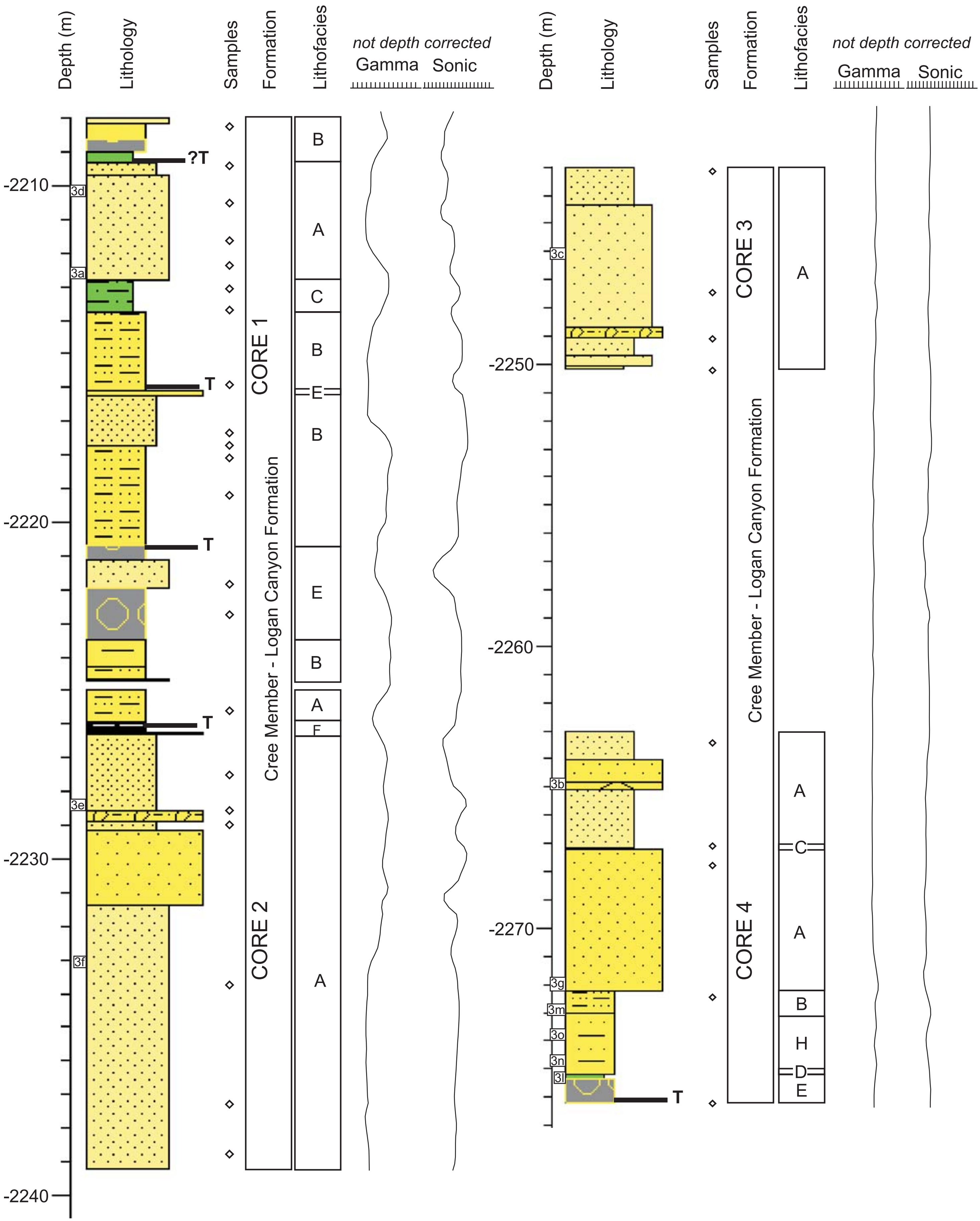


Figure 4a. Logs of conventional cores 1-4, Cree Member, Peskowesk A-99

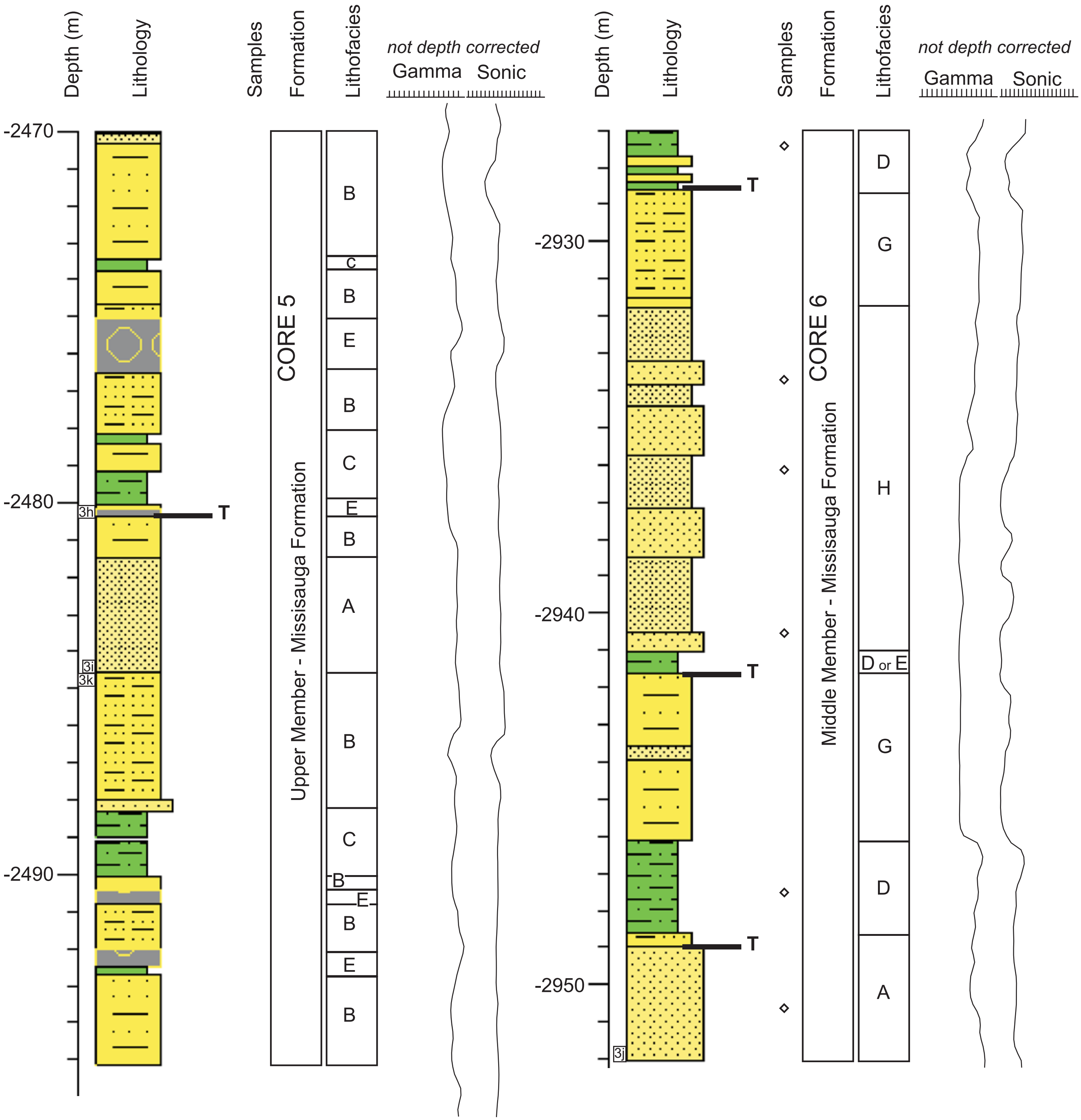


Figure 4b. Logs of conventional cores 5, Upper Member, and 6, Middle Member of Missisauga Formation, Peskowesk A-99

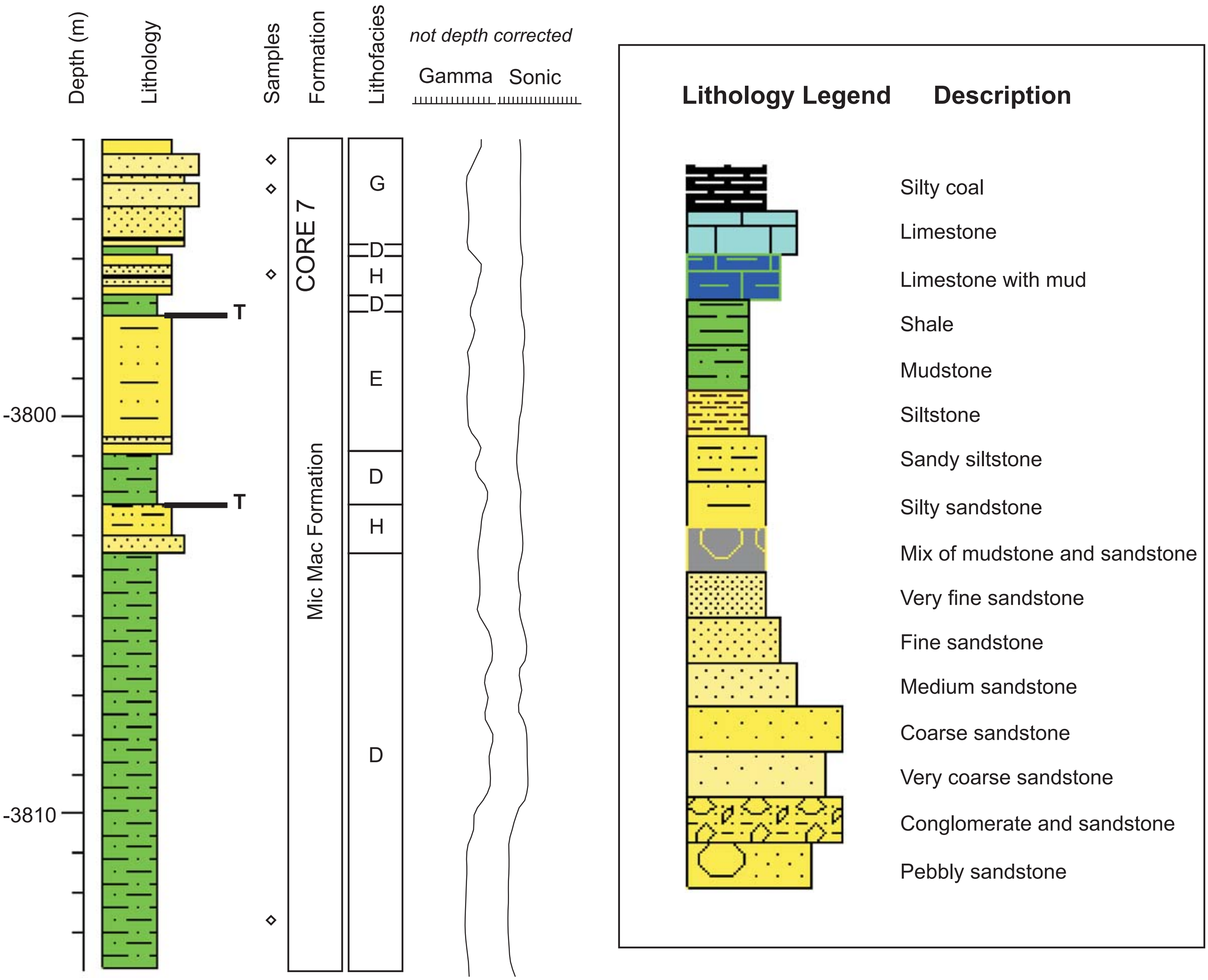


Figure 4c. Logs of conventional cores 7, Mic Mac Formation, Peskowesk A-99

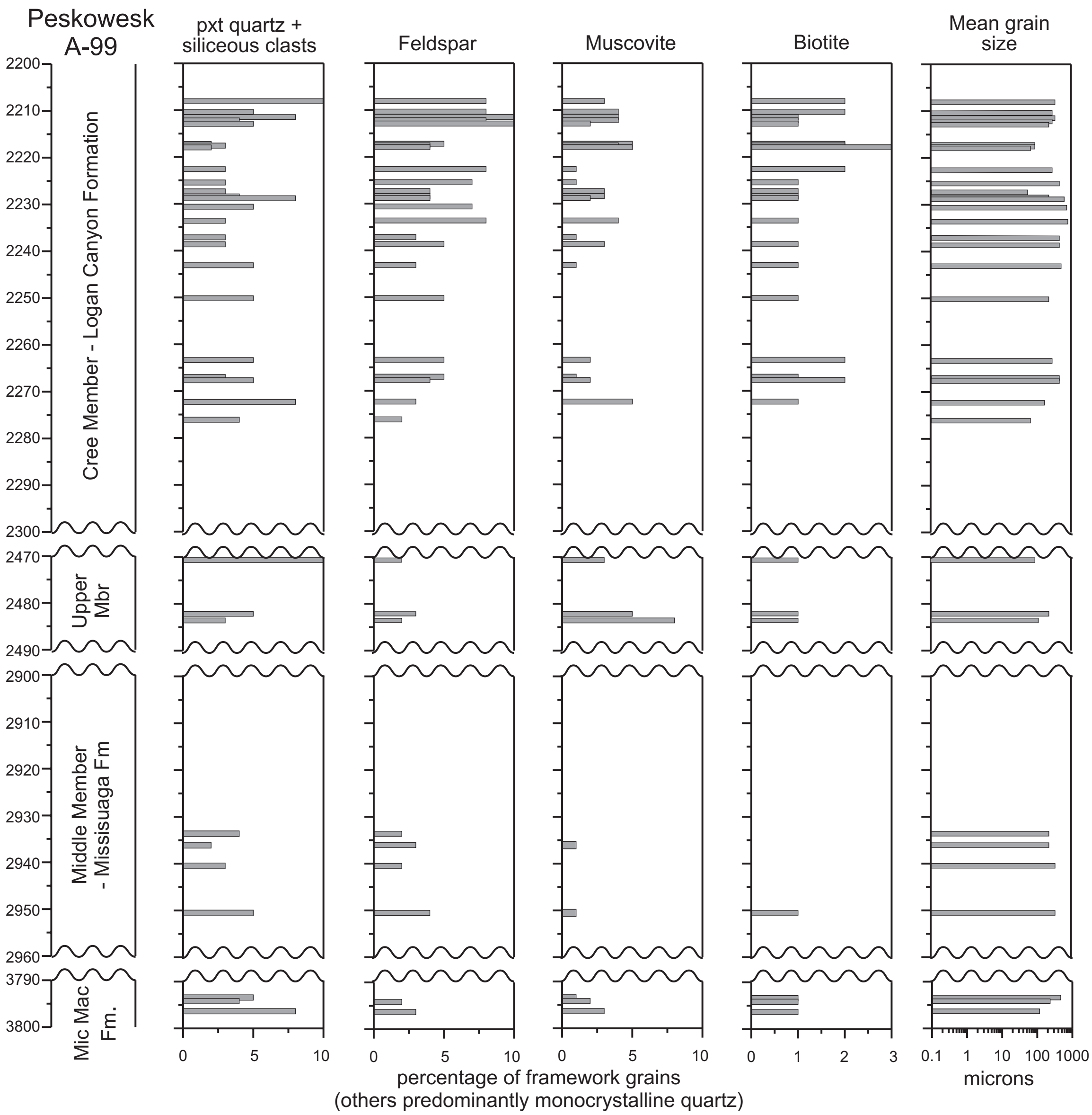


Figure 5. Downcore abundance of framework grains in sandstones, Peskowesk A-99

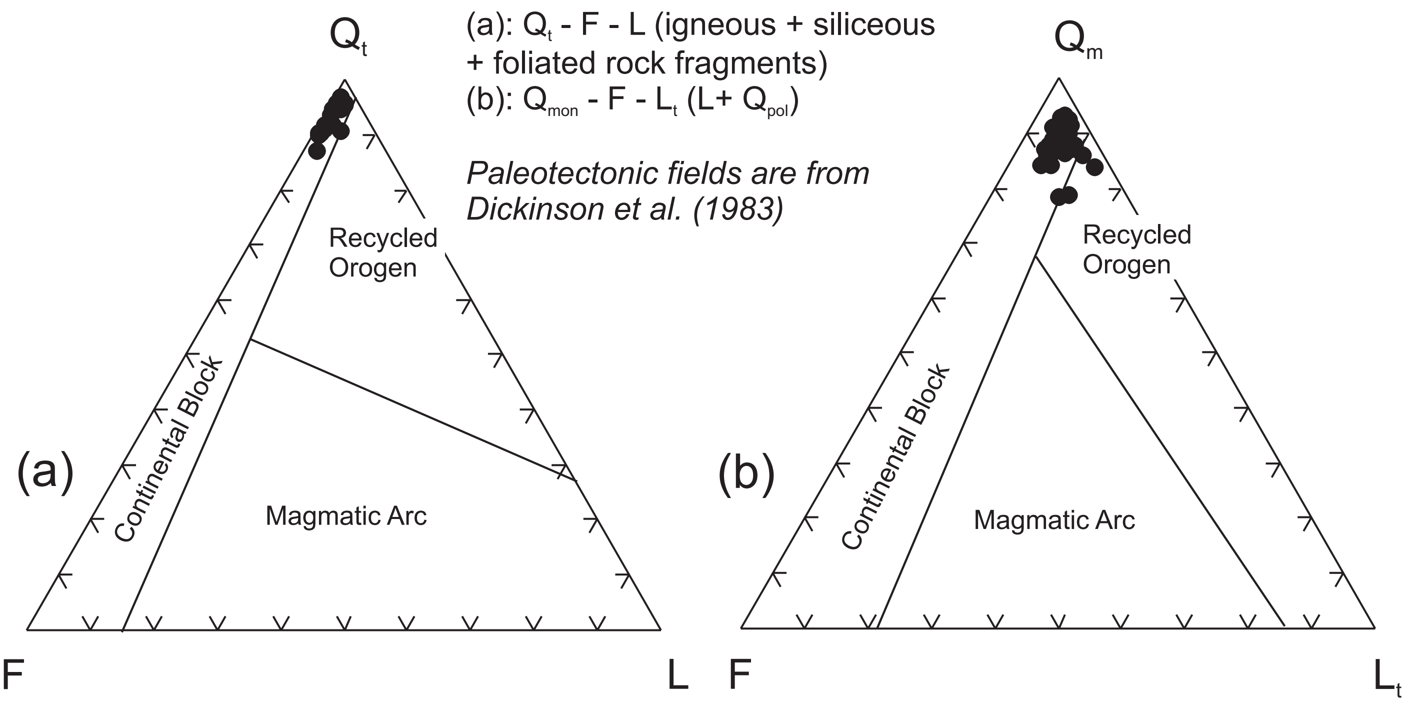


Figure 6. Light mineral detrital petrology of sandstones plotted on QFL diagrams.

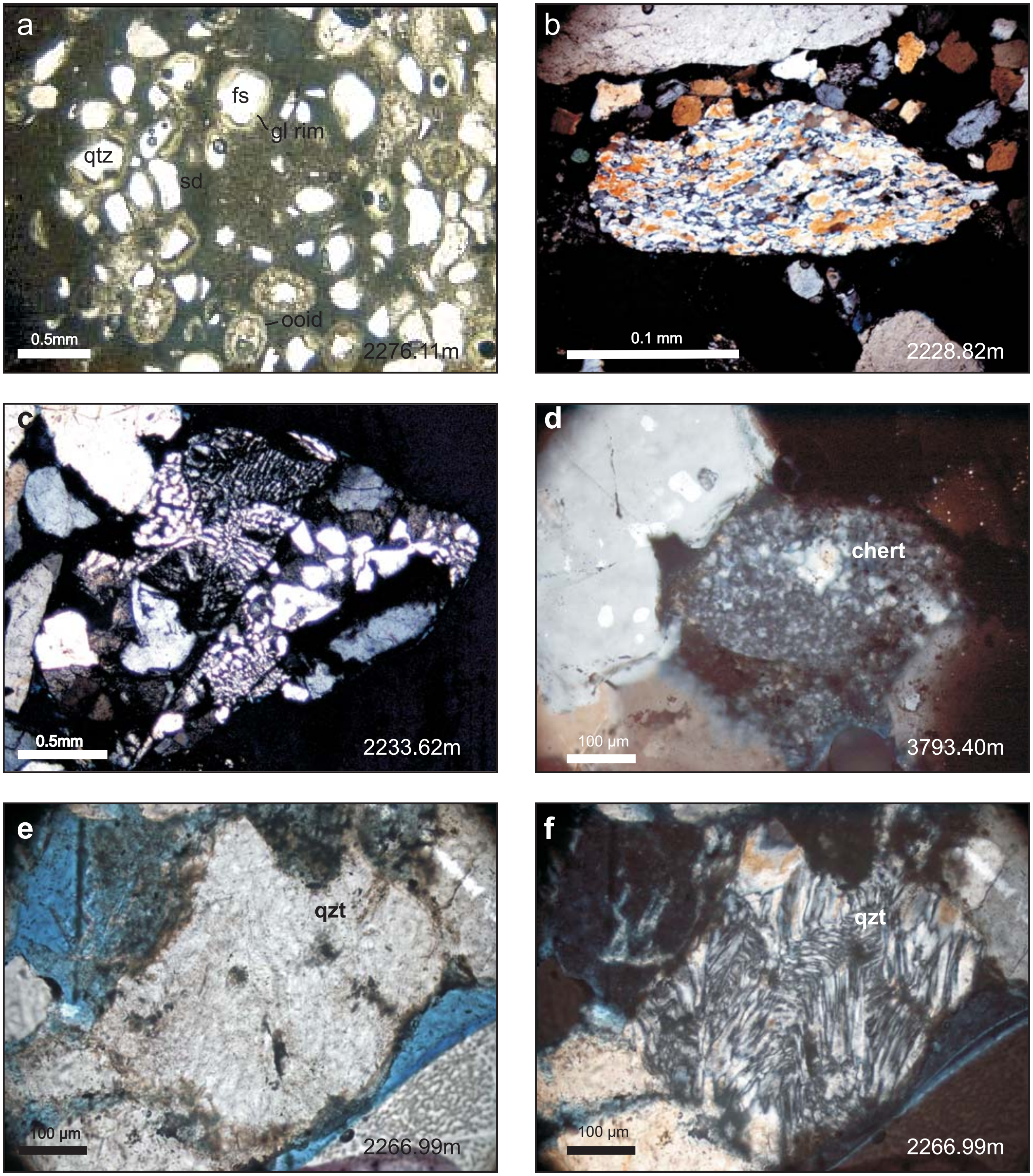


Figure 7. Microphotographs of sandstones from Peskowesk A-99.
(a) Lithofacies E transgressive sandstone with siderite cement, ooids or coated grains and detrital quartz and feldspar grains rimmed by (?) glauconite. Sample 2233.62, ppl. Cree Member.
(b) to (f) Examples of lithic class. (b) = clast of mylonitic granite. Sample 2228.82, xpl. (c) = clast of granophyric granite. Sample 2233.62, xpl. (d) = clast of chert. Sample 3793.40, xpl. (e, f) = vein quartz with bladed texture. Sample 2266.99, e in ppl, f in xpl.

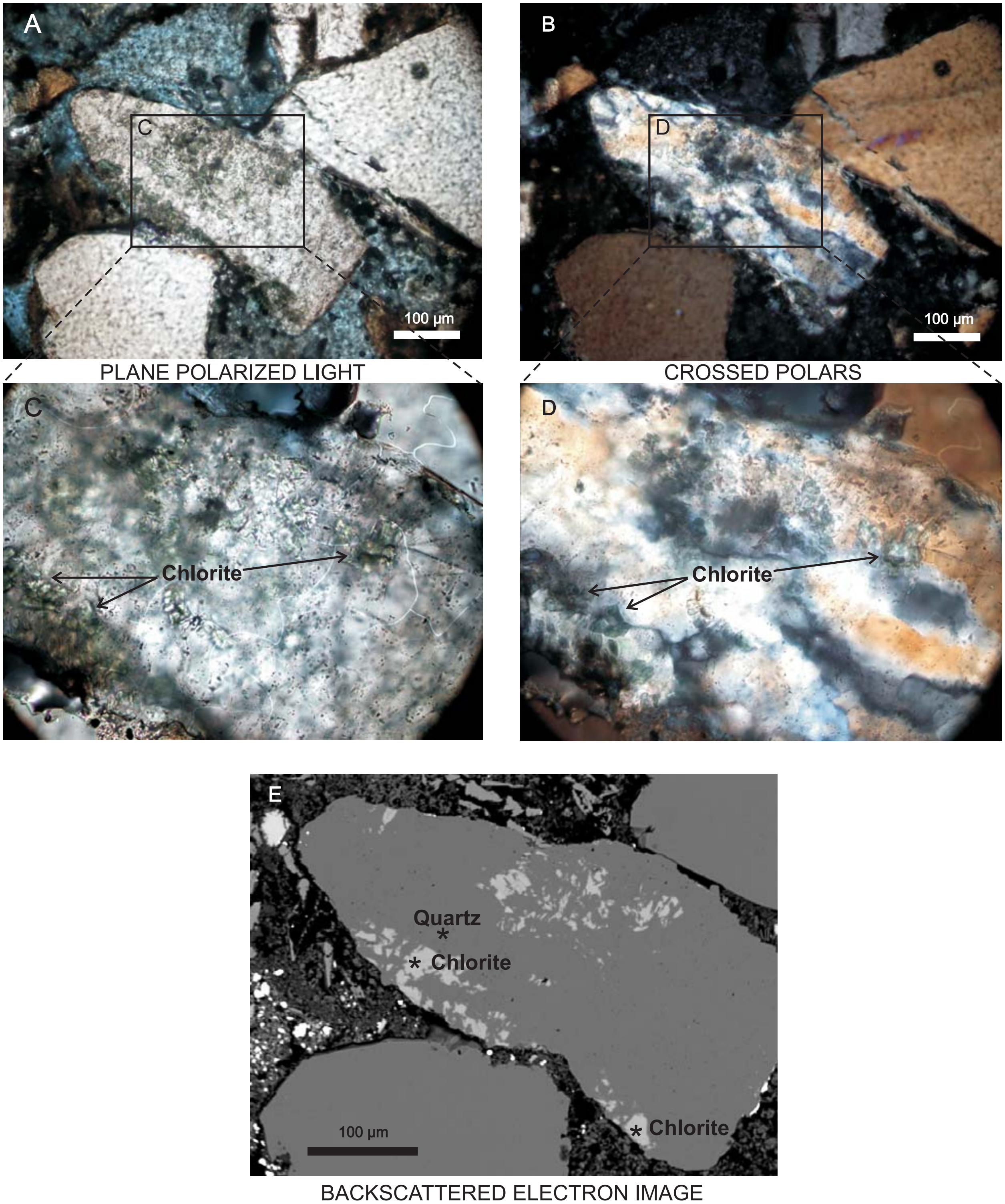


Figure 8. Comparison of microphotographs (A-D) and backscattered electron image (E) (* shows microprobe analyses) of a sample of gneiss composed of quartz and chlorite (sample 2230.62B, pos. 10).

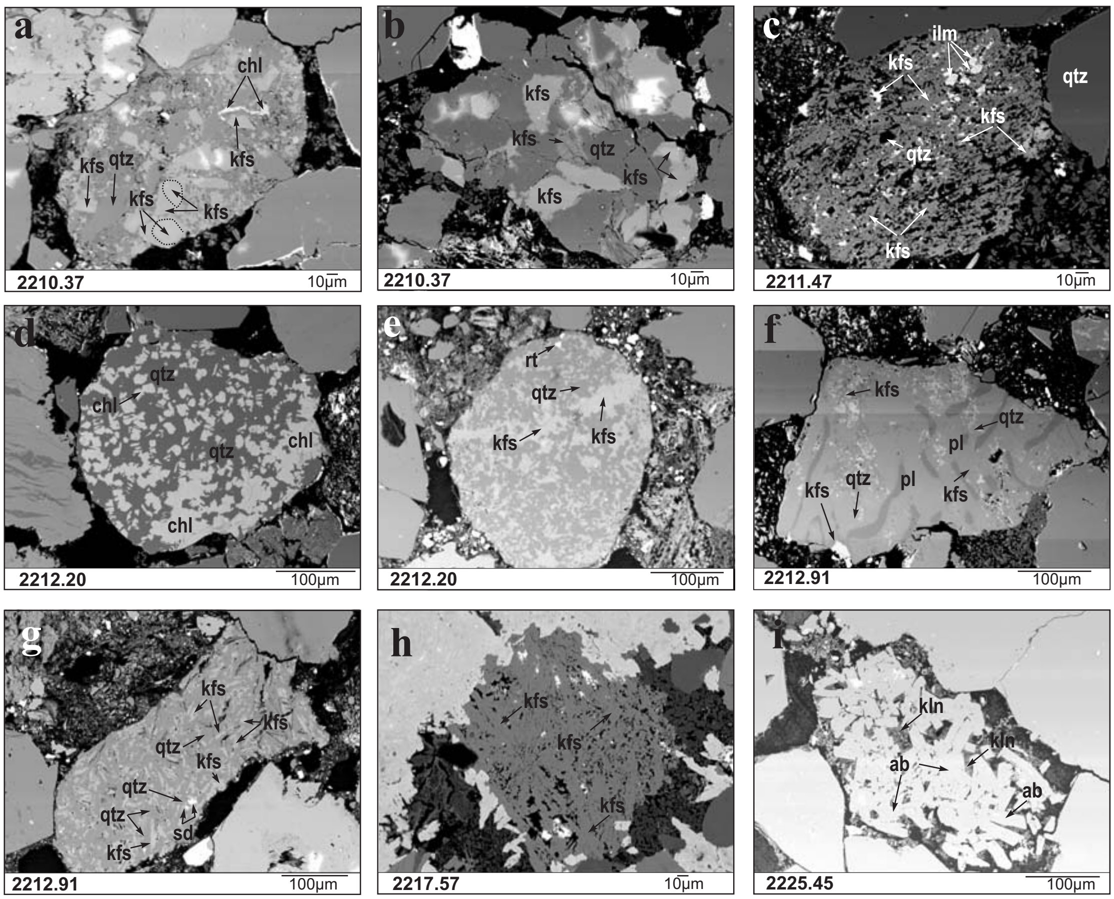


Figure 9. Backscattered electron (BSE) images of representative clast lithologies.
(a) = rhyolite or lithified felsic or pyroclastic rock with brittle deformation. Note the zoned K-feldspar crystals.
(b) = granite.
(c) = microgranite.
(d) = 50% quartz and 50% clean chlorite with vermicular texture. This clast is probably either from microgranite or a quartz vein.
(e) = microgranite (porphyry).
(f) = myrmekitic texure in microgranite.
(g) = intrusive rhyolite (porphyry).
(h) = clot of K-feldspar crystals probably from a felsic high level plutonic rock.
(i) = felty groundmass probably from an intrusive rhyolite.

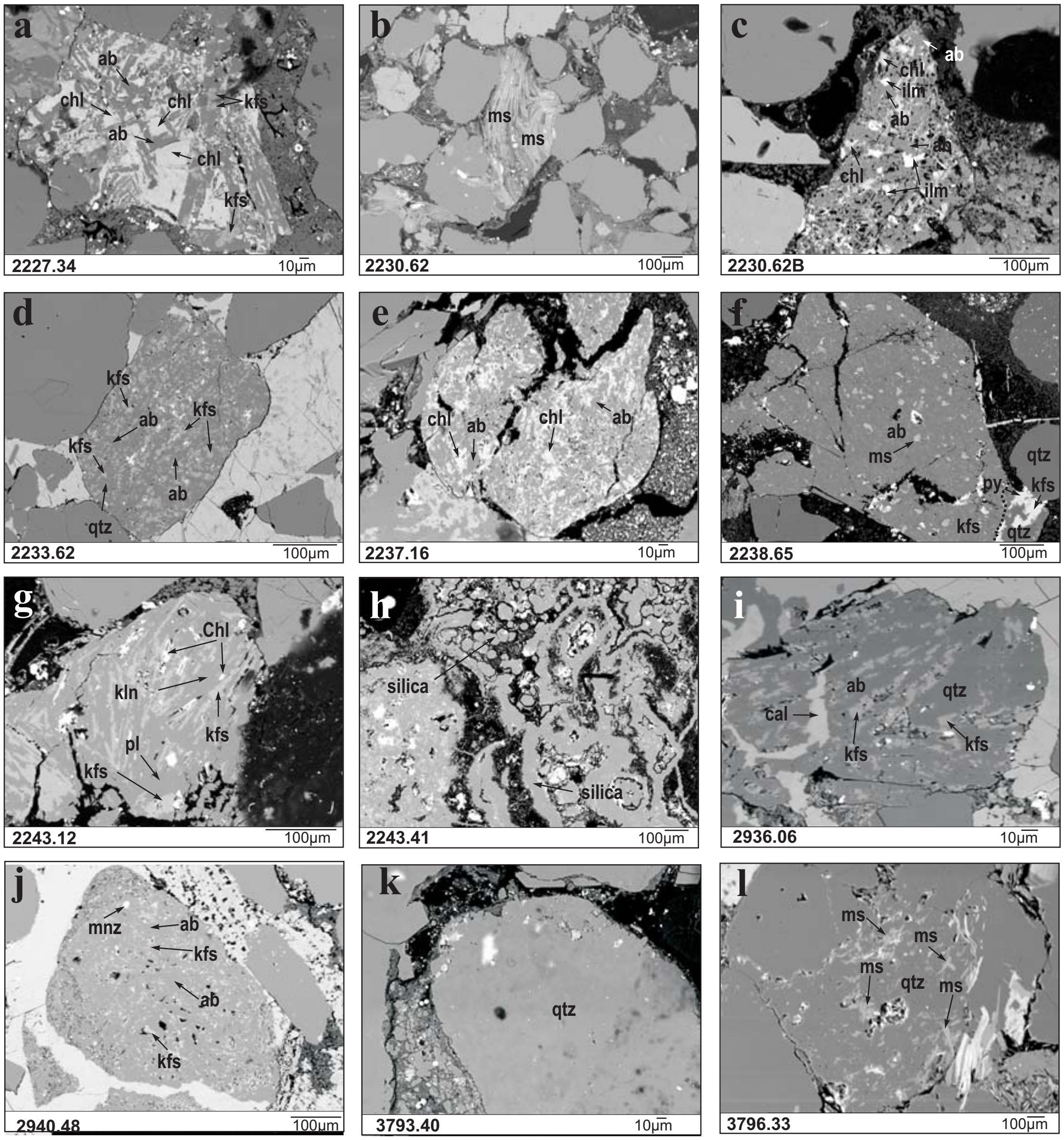


Figure 10: Backscattered electron (BSE) images of representative clast lithologies and minerals:
(a) = quartz diorite.
(b) = strained muscovite.
(c) = feldspar-rich diabase.
(d) = intrusive rhyolite (porphyry).
(e) = altered basalt.
(f) = felsic porphyry. Note at the right low corner (black dotted line) the contact between a large crystal of albite and a fine groundamass. This type of groundmass has been seen to make up a number of individual clasts through the Logan Canyon and Mississauga Formations.
(g) = syenite (porphyry).
(h) = felsic pyroclastic as a lithoclast in a small pebble. Other lithoclasts in this pebble include quartz arenite, silcrete or exhalative chert and other pyroclastic rocks.
(i) = intrusive rhyolite (porphryry).
(j) = syenite (porphyry).
(k) = chert.

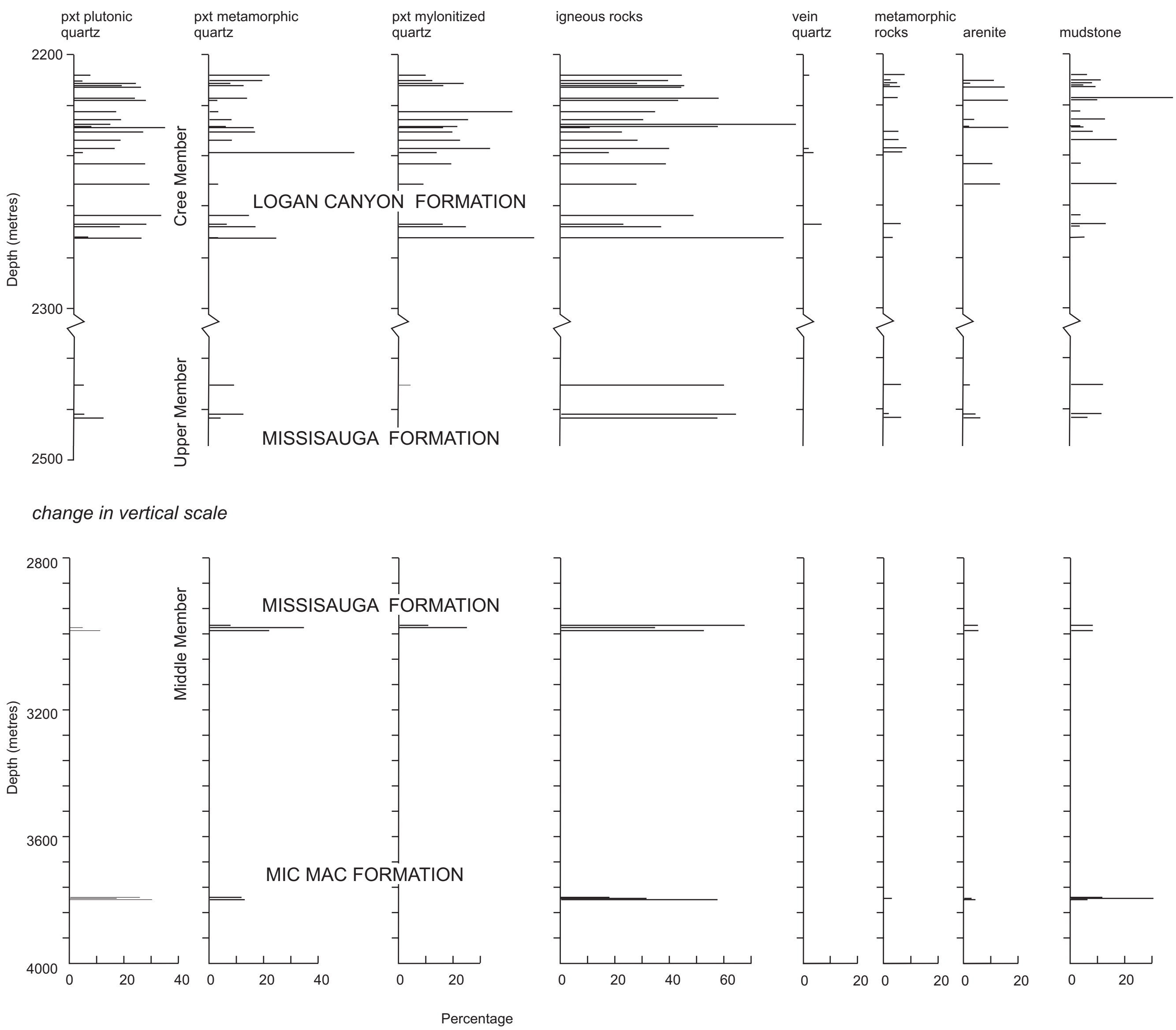


Figure 11. Distribution of various types of lithic clasts (polycrystalline [pxt] quartz, metamorphic rocks, igneous rocks and sedimentary rock clasts) with depth at Peskowesk A-99.

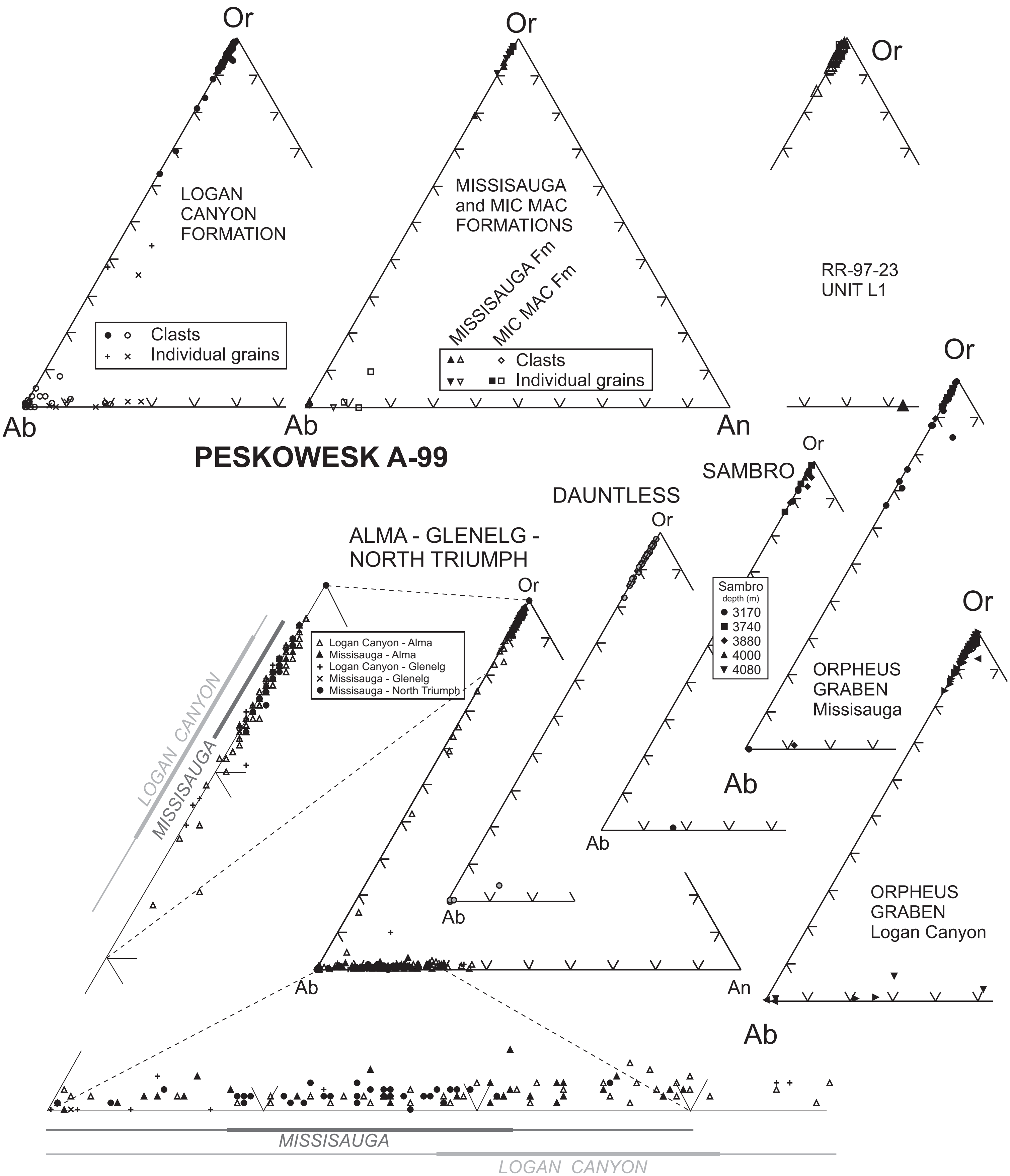


Figure 12. Feldspar compositions at Peskowesk A-99 compared with feldspar from other Lower Cretaceous rocks of the Scotian basin.

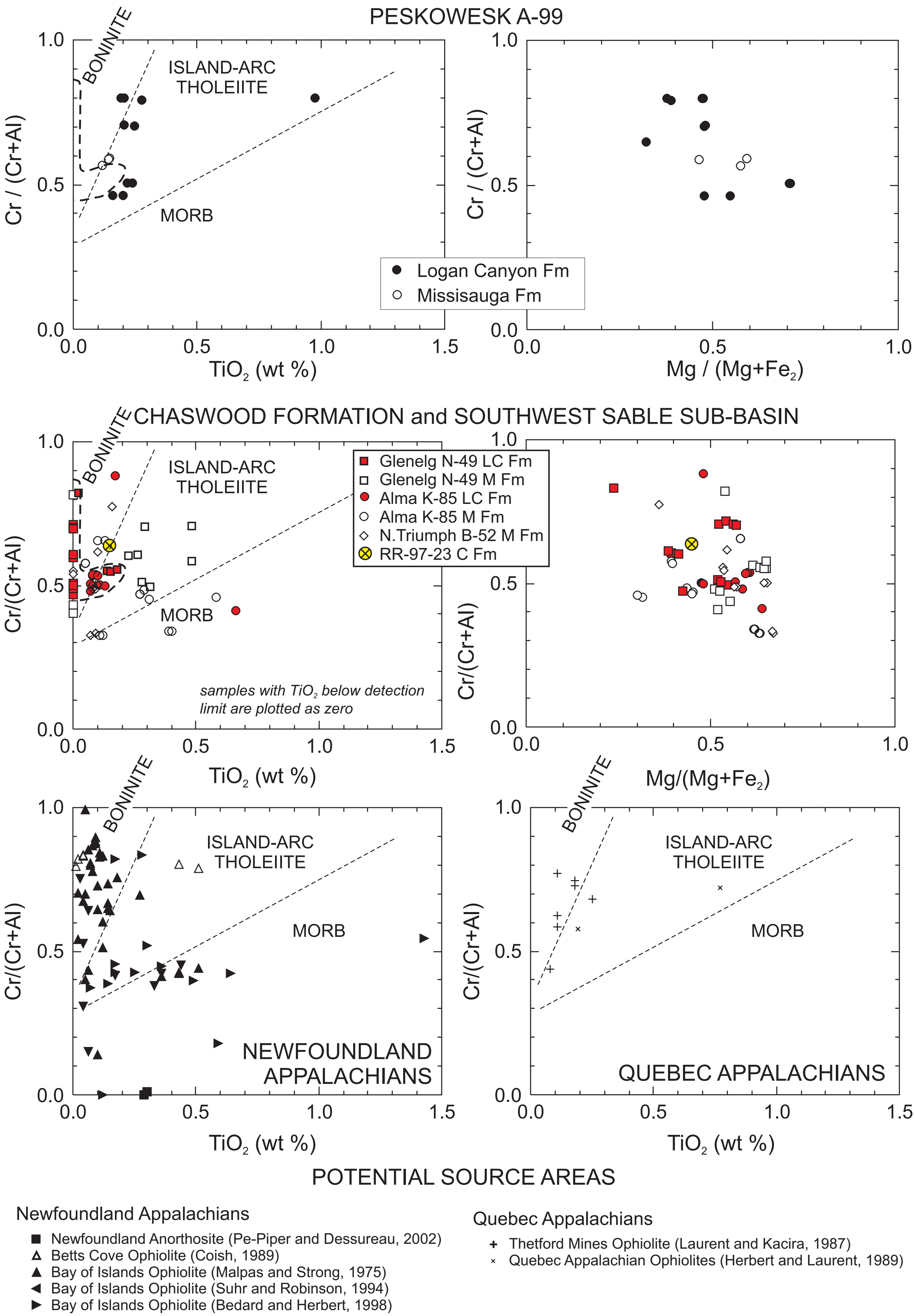


Figure 13. Composition of chromite from Peskowesk A-99 and comparison with the southwest Scotian basin and potential source areas. Ophiolite fields from Pearce et al. (2000).

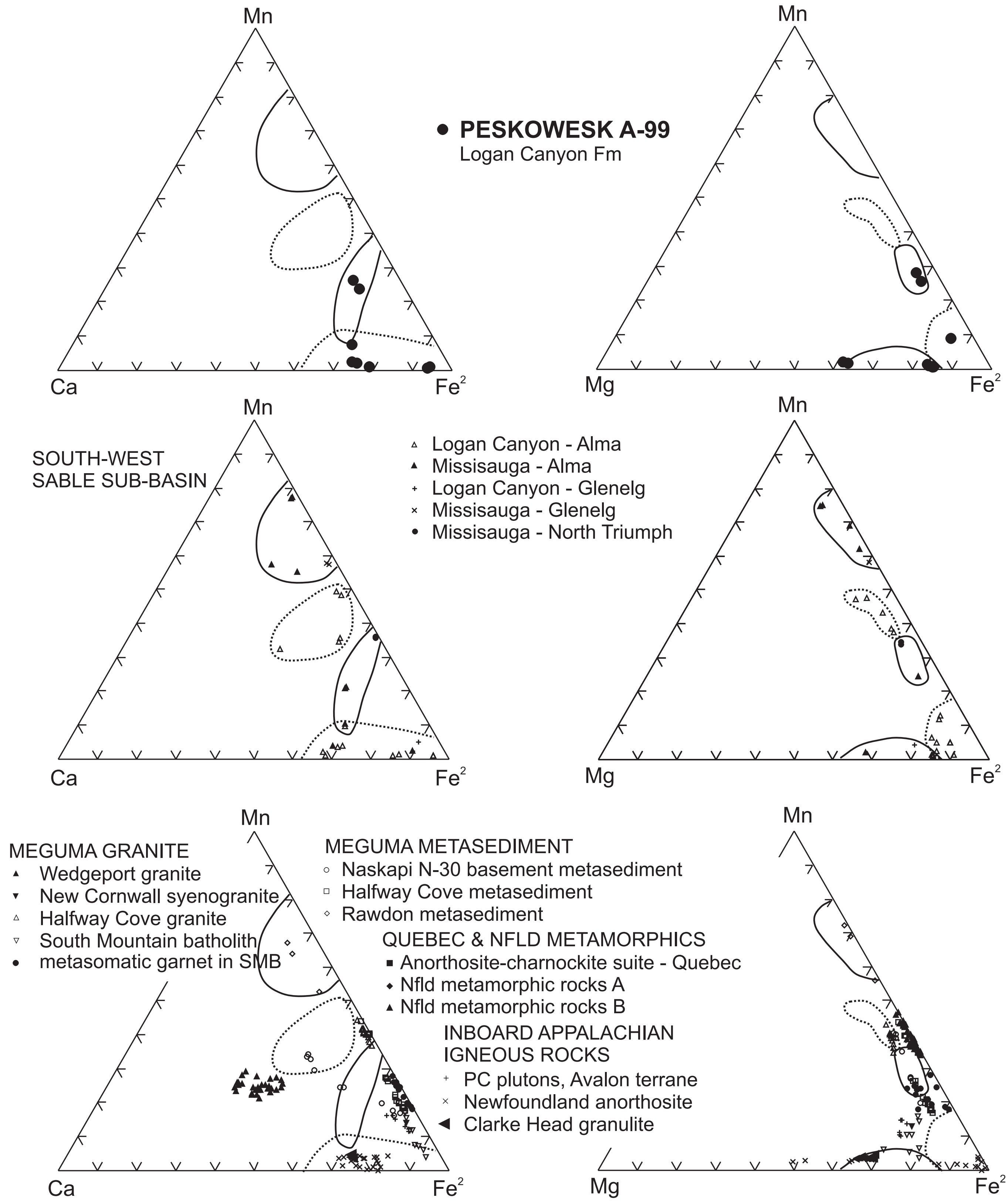


Figure 14. Composition of garnet from Peskowesk A-99 and comparison with southwest Sable sub-basin and some potential source areas. Source rock compositions from Pe-Piper and Ingram (2002), Ham (1988), Allan and Clarke (1981), Feetham (1995).

Table 1. Facies nomenclature scheme used in this study, with comparison to MacRae and Jauer (2001) and Piper et al. (2004).

facies			lithology	characteristics	major environment	sub-environment
This study	Mac Rae & Jauer	Piper et al.				
		0	mudstone with sandstone and siltstone beds	sandstone beds graded and laminated	prodelta (turbidites)	
D	1	1	bioturbated mudstone	interbedded thin fine sandstone	wave-dominated shoreface to offshore	prodelta mud
H	2	2	highly bioturbated fine sandstone	low-angle cross bedding		shore-face sand
G	2	2	slightly bioturbated fine sandstone	low-angle cross bedding		
?F			coal partings in fine sandstone or siltstone			mouth bar
E	?8	3	bioturbated shelly sandy mudstone	small mollusc shells, sideritic		transgressive lag
	3		oolitic limestone			carbonate bar
A	4	4	fine to coarse sandstone, interbedded mudstone with siltstone laminae	tidal rhythmites, sparse bioturbation, large-scale cross bedding	tidally-influenced fluvial channel	
B	5	5	fine sandstone, mudstone	bioturbation	proximal deltaic facies	sandy tidal flat
C	6	6	laminated mudstone and siltstone	roots, bioturbation		muddy tidal flat
?F	7	7	coal partings in fine sandstone or siltstone			peat swamps

Table 2: Petrology of representative sandstone samples.

Sample no	Formation	Rock name	Grains				*for each mineral or rock-type, number of grains as a percentage of total grains*														
			% of total rock	mean size mm	sorting (good, poor)	roundness of quartz	moncrystalline quartz	polycrystalline quartz	feldspar	muscovite	biotite	igneous rock fragments	siliceous rock fragments	foliated rock fragments	carbonate rock fragments	fossils	glauconite	other ferro-mag minerals	opaque minerals	resistant heavy minerals	NOTES: List noteworthy minerals and rock fragments, note alteration of minerals
Depth (m)																					
2208.09	Logan Canyon	MED SST	80%	300	MOD	SUB-R	70%	10%	8%	3%	2%		1%			3%			2%	1%	Tourmaline, Zircon, Rutile, Wood/Coal, Fe-Ti Oxides,
2210.37	Logan Canyon	MED SST	80%	250	GOOD	SUB-A to SUB-R	75%	5%	8%	4%	2%		1%			2%			1%	2%	Zircon, Rutile, Wood/Coal, Fe-Ti Oxides
2211.47	Logan Canyon	MED SST	78%	300	GOOD	SUB-A to SUB-R	73%	8%	10%	4%	1%		2%						1%	1%	Garnet, Zircon, Spinel?, Rutlie, Fe-Ti Oxides
2212.20	Logan Canyon	MED SST	82%	250	GOOD	SUB-R	80%	4%	8%	4%	1%		1%						1%	1%	Rutile/Limonite, Tourmaline, Fe-Ti Oxides
2212.91	Logan Canyon	MED SST	83%	200	GOOD	SUB-R	80%	5%	10%	2%	1%								1%	1%	Rutile, Zircon, Fe-Ti Oxides
2217.21	Logan Canyon	FN SST	75%	80	V. GOOD	SUB-A	58%	2%	5%	5%	2%		1%			25%			1%	1%	Wood/Coal, Rutile, Fe-Ti Oxides
2217.57	Logan Canyon	FN SST	55%	80	V. GOOD	SUB-A to SUB-R	57%	3%	4%	4%	2%					25%			2%	3%	Rutile/Limonite, Wood/Coal, Fe-Ti Oxides
2217.96	Logan Canyon	VF SST	65%	60	V. GOOD	SUB-A to SUB-R	70%	2%	4%	5%	3%		1%		1%	10%			2%	2%	Rutile, Wood/Coal, Tourmaline, Fe-Ti Oxides
2222.59	Logan Canyon	MED SST with GRAN	70%	250	MOD	SUB-A to SUB-R	82%	3%	8%	1%	2%		1%						2%	1%	Tourmaline, Rutile, Limonite, Fe-Ti Oxides
2225.45	Logan Canyon	MED SST	80%	400	MOD	SUB-R	73%	3%	7%	1%	1%		1%			10%			2%	2%	Wood/Coal, Rutile, Fe-Ti Oxides
2227.34	Logan Canyon	VF SST	20%	50	GOOD	SUB-R	85%	3%	4%	3%	1%		1%		1%				1%	1%	Rutile, Fe-Ti Oxides
2228.42	Logan Canyon	MED SST	78%	200	GOOD	SUB-R	84%	4%	4%	3%	1%		1%						2%	1%	Rutile, Spinel?, Fe-Ti Oxides
2228.82	Logan Canyon	MED-CRS with GRAN	80%	550	POOR	SUB-A to SUB-R	82%	8%	4%	2%	1%								2%	1%	Limonite, Fe-Ti Oxides
2230.62	Logan Canyon	CRS SST	83%	650	MOD	SUB-A to SUB-R	85%	5%	7%				1%						1%	1%	Limonite, Tourmaline?, Rutile, Fe-Ti Oxides
2233.62	Logan Canyon	CRS SST	75%	700	MOD	SUB-A to SUB-R	82%	3%	8%	4%	1%		1%						1%		Rutile, Fe-Ti Oxides
2237.16	Logan Canyon	MED SST	85%	400	MOD	SUB-R	88%	3%	3%	1%			1%						3%	1%	Zircon, Toumaline, Fe-Ti Oxides
2238.65	Logan Canyon	MED SST	87%	400	GOOD	SUB-R	86%	3%	5%	3%	1%		1%						1%		Tourmaline, Fe-Ti Oxides, Amphibole?, Titanite?
2243.12	Logan Canyon	MED SST with GRAN	82%	450	MOD	SUB-A to SUB-R	88%	5%	3%	1%	1%		1%						1%		Rutile, Spinel?, Fe-Ti Oxides
2250.17	Logan Canyon	MED SST	80%	200	GOOD	SUB-R	85%	5%	5%		1%		1%						2%	1%	Tourmaline, Zircon, Rutile, Fe-Ti Oxides, Limonite
2263.36	Logan Canyon	MED SST	80%	250	GOOD	SUB-R	75%	5%	5%	2%	2%	1%	1%			5%			1%	3%	Wood,Rutile, Fe-Ti Oxides, Tourmaline,Limonite,Hematite,Cp
2266.99	Logan Canyon	MED SST with GRAN	82%	400	POOR	SUB-A to SUB-R	84%	3%	5%	1%	1%		4%						1%	1%	Fe-Ti Oxides, Limonite, Rutile, Zircon
2267.67	Logan Canyon	MED SST	84%	400	MOD	SUB-A to SUB-R	83%	5%	4%	2%	2%		1%						1%	2%	Rutile, Hematite, Limonite, Tourmaline, Zircon
2272.31	Logan Canyon	FN SST	60%	150	GOOD	SUB-A	78%	8%	3%	5%	1%								2%	3%	Rutile, Limonite, Tourmaline, Fe-Ti Oxides
2276.11	Logan Canyon	VF SST	30%	60	GOOD	SUB-R to R	78%	4%	2%							15%			1%		Rutile, Fe-Ti Oxides, Ooids
2470.66	Logan Canyon	VF SST	90%	80	GOOD	SUB-R	73%	10%	2%	3%	1%		2%			5%			2%	2%	Wood/Coal, Rutile, Fe-Ti Oxides, Limonite
2482.14	Logan Canyon	FN SST	90%	200	GOOD	SUB-R	80%	5%	3%	5%	1%		1%			3%			1%	1%	Limonite, Tourmaline, Fe-Ti Oxides
2483.55	Logan Canyon	VF SST	30%	100	GOOD	SUB-R to R	85%	3%	2%	8%	1%		1%								Rutile, Limonite, Fe-Ti Oxides
2933.62	Missisauga	FN SST	60%	200	MOD	SUB-A to SUB-R	88%	4%	2%				1%			2%			1%	2%	Hematite, Zircon, Tourmaline, Limonite, Fe-Ti Oxides, Shell
2936.06	Missisauga	FN SST	50%	200	GOOD	SUB-A to SUB-R	89%	2%	3%	1%			2%		1%				1%	1%	Tourmaline, Zircon, Fe-Ti Oxides
2940.48	Missisauga	MED SST	63%	300	MOD	SUB-R	77%	3%	2%				1%			15%			1%	1%	Tourmaline, Zircon, Hematite, Fe-Ti Oxides, Echinoderms
2950.54	Missisauga	MED SST	83%	300	GOOD	SUB-R to R	86%	5%	4%	1%	1%		1%						1%	1%	Fe-Ti Oxides, Hematite, Rutile, Zircon, Tourmaline
3793.40	Mic Mac	MED SST	85%	400	MOD	SUB-A to SUB-R	91%	5%		1%	1%		1%							1%	Tourmaline, Rutile
3794.17	Mic Mac	FN SST	87%	200	MOD	SUB-A to SUB-R	87%	4%	2%	2%	1%		2%						1%	1%	Tourmaline, Fe-Ti Oxides, Amphibole?, Zircon
3796.33	Mic Mac	VF SST	83%	100	GOOD	SUB-R to R	80%	8%	3%	3%	1%		2%						1%	1%	Zircon, Hematite, Fe-Ti Oxides, Tourmaline

Table 2 con't: Petrology of representative sandstone samples.

Sample no	Formation	Rock name	Matrix		Cement	*list in chronological order, where apparent*					NOTES
			% of total rock	description of material	% of total rock	cement 1, mineral, % (of total cement), form, and any alteration	cement 2, mineral, % (of total cement), form and any alteration	cement 3, mineral, % (of total cement), form and any alteration	other cements	remaining porosity, % of total rock	Include information on deformation and veins; cross reference to photomicographs, BSE images etc…
Depth (m)											
2208.09	Logan Canyon	MED SST	2%	Brown mud	16%	Pyrite - 2%	Chlorite - 60%	Silica - 18%	Illite - 5% Kaolinite - 15%	2%	Trace Glauconite
2210.37	Logan Canyon	MED SST	3%	Brown mud	13%	Pyrite - 2%	Chlorite - 65%	Silica -18%	Illite - 15%	4%	Trace Glauconite
2211.47	Logan Canyon	MED SST	2%	Brown mud	15%	Pyrite - 1%	Chlorite - 35%	Silica - 19%	Illite - 45%	5%	Trace Glauconite
2212.20	Logan Canyon	MED SST	3%	Brown mud	10%	Pyrite - 3%	Chlorite - 25%	Silica - 47%	Illite - 25%	5%	Minor CaCO3 cement
2212.91	Logan Canyon	MED SST	2%	Brown mud	13%	Pyrite - 1%	Chlorite - 16%	Silica - 48%	Illite 19% Kaolinite -16%	2%	
2217.21	Logan Canyon	FN SST	0%		25%	Siderite - 30%	Calcite - 45%	Chlorite - 5%	Silica - 10% Illite -10%	0%	
2217.57	Logan Canyon	FN SST	0%		43%	Siderite -88%	Pyrite -2%	Chlorite - 10%		2%	Very large crystal of Rutile
2217.96	Logan Canyon	VF SST	0%		33%	Siderite - 35% Calcite - 10%	Pyrite - 6%	Chlorite - 24%	Illite - 25%	2%	Trace Glauconite
2222.59	Logan Canyon	MED SST with GRAN	0%		30%	Siderite - 50%	Pyrite - 5%	Chlorite - 30%	Illite - 15%	0%	Siderite covers over 1/2 of thin section.
2225.45	Logan Canyon	MED SST	2%	Light grey silt	18%	Siderite - 35%	Pyrite - 5%	Chlorite - 25%	Silica - 25% Kaolinite - 10%	0%	Trace Glauconite
2227.34	Logan Canyon	VF SST	0%		80%	Siderite - 78%	Pyrite - 2%	Calcite - 15%	Chlorite - 5%	0%	
2228.42	Logan Canyon	MED SST	2%	Brown mud	20%	Pyrite - 2%	Chlorite - 40%	Silica - 30%	Illite - 28%	0%	
2228.82	Logan Canyon	MED-CRS with GRAN	5%	Brown mud	13%	Pyrite - 2%	Chlorite -23%	Silica - 50%	Illite - 25%	2%	Trace Glauconite, PGMr
2230.62	Logan Canyon	CRS SST	2%	Brown mud	13%	Pyrite - 1%	Chlorite - 25%	Silica - 50%	Illite - 24%	2%	
2233.62	Logan Canyon	CRS SST	5%	Brown mud	18%	Siderite - 5%	Chlorite - 45%	Silica - 40%	Illite - 10%	2%	Clast shows granophyric texture, see p217 in Hatch et al.
2237.16	Logan Canyon	MED SST	2%	Brown mud	13%	Pyrite - 2%	Chlorite - 30%	Silica - 48%	Illite -20%	0%	Granophyric texture in clast
2238.65	Logan Canyon	MED SST	3%	Brown mud	10%	Chlorite - 20%	Silica - 70%	Illite -10%		0%	Granite clast, PGMr
2243.12	Logan Canyon	MED SST with GRAN	3%	Brown mud	15%	Chlorite - 30%	Silica - 60%	Illite - 10%		0%	Altered albite crystals (Hematite), trace glauconite
2250.17	Logan Canyon	MED SST	5%	Brown mud	15%	Pyrite - 5%	Chlorite - 15%	Silica - 65%	Illite - 15%	0%	Trace Glauconite, trace siderite crystals
2263.36	Logan Canyon	MED SST	2%	Brown mud	17%	Pyrite - 3%	Chlorite - 20%	Silica - 55%	Illite - 12% Kaolinite - 10%	1%	Muscovite is commonly altered
2266.99	Logan Canyon	MED SST with GRAN	3%	Brown mud	14%	Pyrite - 2%	Chlorite - 25%	Silica - 63%	Illite - 10%	1%	Trace Glauconite
2267.67	Logan Canyon	MED SST	1%	Brown mud	14%	Siderite - 5%	Chlorite - 20%	Silica - 65%	Kaolinite - 10%	1%	Trace Glauconite
2272.31	Logan Canyon	FN SST	0%		40%	Siderite - 50%	Pyrite - 2% Glauconite - 5%	Silica - 38%	Kaolinite - 5%	0%	Abundant Glauconite
2276.11	Logan Canyon	VF SST	0%		70%	Siderite - 98%	Glauconite - 2%				See Appendix 4 Figures 5&6
2470.66	Logan Canyon	VF SST	0%		10%	Pyrite - 5% Siderite - 5%	Chlorite - 20%	Silica - 45%	Illite - 15% Kaolinite - 10%	0%	Trace Glauconite
2482.14	Logan Canyon	FN SST	2%	Brown mud	8%	Pyrite - 5%	Chlorite - 25%	Silica - 50%	Illite - 10% Kaolinite - 10%	0%	
2483.55	Logan Canyon	VF SST	0%		70%	Siderite - 75%	Glauconite - 2%	Silica - 23%		0%	
2933.62	Missisauga	FN SST	2%	Brown mud	38%	Calcite - 70%	Pyrite - 5%	Chlorite - 25%		0%	Unidentifiable shells
2936.06	Missisauga	FN SST	5%	Brown mud	45%	Calcite - 70%	Pyrite - 3%	Chlorite - 12%	Kaolinite - 15%	0%	Trace Glauconite
2940.48	Missisauga	MED SST	2%	Brown mud	35%	Calcite - 90%	Pyrite - 3%	Silica - 6%	Glauconite - 1%	0%	
2950.54	Missisauga	MED SST	2%	Brown mud	13%	Siderite - 10%	Calcite - 25%	Chlorite - 40%	Kaolinite - 25%	2%	Clay clasts altering to chlorite
3793.40	Mic Mac	MED SST	3%	Brown mud	10%	Calcite - 5%	Chlorite - 30%	Silica - 20%	Illite - 20% Kaolinite - 25%	2%	
3794.17	Mic Mac	FN SST	3%	Brown mud	10%	Calcite - 5%	Chlorite - 20%	Silica - 60%	Kaolinite - 15%	0%	
3796.33	Mic Mac	VF SST	2%	Brown mud	15%	Calcite - 35%	Pyrite - 5%	Silica - 60%		0%	Trace Glauconite

Notes:
VF= Very fine
FN= Fine
MED= Medium
CRS= Coarse
GRAN= Granule
SST= Sandstone
MOD= Moderate
SUB-A= Subangular
SUB-R= Subrounded
R= Rounded
PGMr = Porphyritic microgranite

Table 3: Modal distribution of index detrital minerals based on point counting of polished thin sections of heavy mineral separates from representative sandstone samples

Depth	Fe-Ti oxides	Zrn/Mnz	Tur	Garnet	Chr/Sp	Rutile	Total	Number of grains
2212.91(LCF)*	73.1	15.4	7.7	0.0	0.0	3.8	100	26
2222.59 (LCF)	60.0	20.0	0.0	6.7	6.7	6.7	100	15
2470.66 (LCF)	71.0	11.0	5.0	0.0	11.0	2.0	100	100
2950.54 (MF)*	90.5	9.5	0.0	0.0	0.0	0.0	100	21
3794.17 (MMF)*	64.3	14.3	7.1	0.0	14.3	0.0	100	14

Zrn = zircon, Mnz = monazite, Tur = tourmaline, Chr = chromite, Sp = spinel

*: LCF = Logan Canyon Formation, MS = Mississauga Formation, MMF = Mic Mac Formation

Table 4: Estimate of modal distribution (%) of minerals based on those identified by electron microprobe mineral chemical analyses.

Formation	Pl	Kfs	Grt	Bt	Ms	Tur	Zrn	Mnz	Ap	Rt	Chr	Sp	Total %	# of analyses
Logan Canyon Fm (11)*	7.3	37.4	8.1	4.9	7.3	1.6	7.3	0.8	4.1	11.4	8.9	0.8	100	123
Missisauga Fm (2)*	14.3	57.1	0.0	7.1	0.0	0.0	4.8	0.0	2.4	7.1	7.1	0.0	100	42
Mic Mac Fm (3)*	22.2	11.1	0.0	11.1	18.5	0.0	11.1	3.7	3.7	11.1	7.4	0.0	100	27

Fe-Ti minerals are excluded
* Number of samples studied
Pl = plagioclase; Kfs = K-feldspar; Grt = garnet; Bt = biotite; Ms = muscovite; Tur = tourmaline; Zrn = zircon; Mnz = monazite; Ap = apatite; Rt = rutile; Chr = chromite; Sp = spinel

Table 5: Electron microprobe chemical analysis of selected minerals in representative sandstone samples

Well	Depth (m)	Form'n+	File (Min26)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeOt	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	ZrO_2	BaO	Total
A99	2210.37	LCF	90	K-feldspar clast	64.38	0.00	18.41	0.00	0.09	0.00	0.01	0.05	0.50	16.46				99.90
A99	2211.47	LCF	115	K-feldspar crystal	61.77	0.09	18.33	0.01	0.00	0.01	0.00	0.04	1.06	16.26				97.57
A99	2211.47	LCF	116	K-feldspar crystal	62.24	0.00	17.49	0.00	0.00	0.00	0.00	0.00	0.06	15.56				95.35
A99	2211.47	LCF	117	K-feldspar clast	62.81	0.00	17.33	0.00	0.00	0.00	0.00	0.00	0.52	18.34				99.00
A99	2212.91	LCF	91	K-feldspar crystal	63.27	0.02	17.50	0.00	0.00	0.00	0.01	0.02	1.18	16.68				98.68
A99	2212.91	LCF	92	K-feldspar crystal	67.92	0.00	18.75	0.00	0.00	0.00	0.00	0.18	6.73	6.35				99.93
A99	2212.91	LCF	93	K-feldspar crystal	63.32	0.01	17.27	0.00	0.00	0.02	0.00	0.02	0.44	18.16				99.24
A99	2212.91	LCF	94	K-feldspar crystal	62.46	0.00	17.69	0.00	0.01	0.02	0.00	0.06	0.89	17.36				98.49
A99	2212.91	LCF	95	K-feldspar crystal	62.39	0.00	17.69	0.00	0.00	0.02	0.01	0.06	0.87	17.24				98.28
A99	2222.59	LCF	96	K-feldspar crystal	63.40	0.00	17.38	0.00	0.06	0.00	0.00	0.01	1.04	17.24				99.13
A99	2222.59	LCF	97	K-feldspar crystal	63.62	0.00	17.25	0.00	0.02	0.00	0.00	0.00	0.59	18.28				99.76
A99	2222.59	LCF	98	K-feldspar crystal	64.02	0.00	17.55	0.00	0.28	0.00	0.00	0.00	0.55	18.62				101.02
A99	2222.59	LCF	99	K-feldspar crystal	63.30	0.00	17.67	0.00	0.25	0.00	0.01	0.04	0.99	17.42				99.68
A99	2222.59	LCF	100	K-feldspar crystal	64.40	0.17	18.53	0.00	0.50	0.00	0.33	0.01	0.16	15.91				100.01
A99	2222.59	LCF	101	K-feldspar crystal	64.18	0.00	17.46	0.00	0.06	0.00	0.00	0.01	0.75	17.70				100.16
A99	2222.59	LCF	102	K-feldspar crystal	63.27	0.00	17.48	0.00	0.06	0.00	0.00	0.00	0.47	18.19				99.47
A99	2222.59	LCF	103	K-feldspar crystal	63.98	0.00	17.34	0.00	0.11	0.00	0.01	0.00	1.06	17.57				100.07
A99	2230.62	LCF	104	K-feldspar crystal	63.31	0.00	17.39	0.01	0.08	0.00	0.01	0.00	0.35	18.46				99.61
A99	2238.65	LCF	89	K-feldspar clast	63.45	0.00	18.57	0.00	0.00	0.00	0.00	0.00	0.37	15.83				98.22
A99	2266.99	LCF	108	K-feldspar crystal	62.99	0.02	18.05	0.00	0.00	0.00	0.00	0.00	0.60	17.71				99.37
A99	2266.99	LCF	109	K-feldspar crystal	63.91	0.00	17.63	0.00	0.00	0.00	0.00	0.01	0.52	18.11				100.18
A99	2266.99	LCF	110	K-feldspar crystal	64.01	0.00	17.58	0.00	0.03	0.00	0.00	0.00	0.31	18.58				100.51
A99	2266.99	LCF	111	K-feldspar crystal	63.65	0.00	17.77	0.00	0.01	0.00	0.01	0.02	0.91	16.78				99.15
A99	2266.99	LCF	112	K-feldspar crystal	63.67	0.00	17.72	0.00	0.00	0.00	0.01	0.00	0.59	17.98				99.97
A99	2470.66	LCF	107	K-feldspar crystal	62.27	0.05	17.93	0.02	0.03	0.01	0.00	0.00	0.74	16.75				97.80
A99	2933.62	MSF	113	K-feldspar crystal	63.01	0.00	17.60	0.00	0.01	0.00	0.00	0.00	0.52	18.04				99.18
A99	2933.62	MSF	114	K-feldspar crystal	63.46	0.01	17.67	0.01	0.00	0.00	0.00	0.03	0.64	17.82				99.64
A99	2950.54	MSF	118	K-feldspar crystal	63.51	0.00	17.41	0.00	0.00	0.00	0.00	0.00	1.16	17.07				99.15
A99	2950.54	MSF	119	K-feldspar crystal	63.44	0.02	17.36	0.01	0.04	0.00	0.00	0.00	0.51	18.13				99.51
A99	2950.54	MSF	120	K-feldspar crystal	63.08	0.00	17.19	0.00	0.03	0.00	0.00	0.00	0.34	18.64				99.28
A99	3796.33	MMF	105	K-feldspar crystal	63.32	0.00	17.47	0.00	0.00	0.00	0.00	0.00	0.24	18.51				99.54
A99	3796.33	MMF	106	K-feldspar crystal	62.85	0.03	17.86	0.00	0.05	0.00	0.00	0.00	0.42	17.85				99.06
A99	2211.47	LCF	129	Plagioclase crystal	66.08	0.00	21.86	0.00	0.00	0.00	0.00	3.26	8.80	0.00				100.00
A99	2211.47	LCF	169	Plagioclase crystal	65.84	0.00	19.91	0.00	0.01	0.00	0.00	1.89	6.18	6.06				99.89

Table 5: Electron microprobe chemical analysis of selected minerals in representative sandstone samples

Well	Depth (m)	Form'n+	File (Min26)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeOt	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	ZrO_2	BaO	Total
A99	2222.59	LCF	122	Plagioclase crystal	62.98	0.00	23.16	0.00	0.06	0.00	0.00	5.51	8.08	0.21				100.00
A99	2238.65	LCF	121	Plagioclase clast	66.12	0.00	20.58	0.00	0.00	0.00	0.00	1.17	10.10	0.16				98.13
A99	2266.99	LCF	128	Plagioclase crystal	67.79	0.00	20.54	0.00	0.00	0.00	0.00	1.54	10.14	0.00				100.01
A99	2470.66	LCF	126	Plagioclase crystal	67.23	0.00	20.77	0.00	0.14	0.00	0.00	1.84	9.82	0.22				100.02
A99	2470.66	LCF	127	Plagioclase crystal	63.29	0.00	23.25	0.00	0.07	0.00	0.00	4.81	8.37	0.21				100.00
A99	2950.54	MSF	130	Plagioclase crystal	69.28	0.00	20.26	0.00	0.03	0.00	0.00	1.20	9.23	0.00				100.00
A99	3796.33	MMF	123	Plagioclase crystal	64.29	0.00	23.37	0.00	0.05	0.00	0.02	2.04	8.65	1.60				100.02
A99	3796.33	MMF	124	Plagioclase crystal	66.53	0.00	22.92	0.00	0.02	0.00	0.00	2.17	8.36	0.00				100.00
A99	3796.33	MMF	125	Plagioclase crystal	67.19	0.00	20.98	0.00	0.34	0.00	0.06	1.66	9.57	0.20				100.00
A99	2212.91	LCF	131	Garnet (Almandine)	36.90	0.80	19.93	0.04	25.92	10.79	1.10	3.90	0.01	0.00				99.39
A99	2212.91	LCF	132	Garnet (Almandine)	37.01	0.14	20.22	0.05	27.34	9.88	1.13	3.92	0.00	0.00				99.69
A99	2212.91	LCF	133	Garnet (Almandine)	37.40	0.04	20.48	0.02	30.76	0.42	3.26	6.33	0.03	0.00				98.74
A99	2212.91	LCF	134	Garnet (Almandine)	37.59	0.08	20.52	0.03	30.75	0.39	3.19	6.32	0.03	0.00				98.90
A99	2212.91	LCF	135	Garnet (Almandine)	37.27	0.13	19.81	0.04	30.20	3.11	1.20	7.17	0.03	0.00				98.96
A99	2222.59	LCF	136	Garnet (Almandine)	39.04	0.05	20.68	0.01	24.67	0.70	7.85	5.96	0.01	0.00				98.97
A99	2222.59	LCF	137	Garnet (Almandine)	38.83	0.06	20.67	0.01	23.94	0.73	8.02	6.17	0.01	0.00				98.44
A99	2222.59	LCF	138	Garnet (Almandine)	37.20	0.07	20.28	0.06	36.10	0.30	3.53	1.60	0.04	0.00				99.18
A99	2222.59	LCF	139	Garnet (Almandine)	37.20	0.08	20.00	0.04	36.25	0.30	3.48	1.76	0.03	0.00				99.14
A99	2222.59	LCF	140	Garnet (Almandine)	37.22	0.08	20.17	0.01	36.23	0.30	3.49	1.75	0.02	0.00				99.27
A99	2212.91	LCF	141	Kaolinite	44.92	0.00	35.03	0.00	2.03	0.00	0.56	0.14	0.05	0.00				82.73
A99	2266.99	LCF	143	Kaolinite	43.45	0.00	35.52	0.00	0.85	0.00	0.07	0.08	0.06	0.00				80.03
A99	2266.99	LCF	144	Kaolinite	44.81	0.00	32.24	0.00	0.73	0.00	0.64	0.22	0.17	2.08				80.89
A99	2212.91	LCF	146	?illite	45.44	0.64	33.65	0.00	0.91	0.00	0.58	0.00	0.65	8.77				90.64
A99	2212.91	LCF	147	?illite	45.28	0.63	33.37	0.01	0.90	0.00	0.57	0.00	0.66	9.18				90.60
A99	2230.62	LCF	148	?illite	44.37	0.43	30.39	0.00	3.98	0.03	0.85	0.00	0.28	8.85				89.18
A99	2238.65	LCF	145	Muscovite	47.50	0.00	33.35	0.00	2.61	0.00	0.93	0.00	0.13	8.42				92.94
A99	3796.33	MMF	149	Muscovite	44.42	0.56	34.45	0.00	0.82	0.00	0.59	0.00	0.85	9.79				91.48
A99	3796.33	MMF	150	Muscovite	45.88	0.06	34.52	0.00	1.03	0.02	0.60	0.02	0.22	8.31				90.66
A99	2211.47	LCF	163	Spinel (C)	0.00	0.15	21.62	46.94	18.36	0.38	12.48	0.04	0.03	0.00				100.00
A99	2211.47	LCF	164	Spinel (R)	0.00	0.14	23.12	48.90	17.83	0.32	9.62	0.05	0.01	0.00				100.00
A99	2212.91	LCF	151	Spinel	0.00	0.24	26.88	40.75	16.13	0.29	15.65	0.04	0.02	0.00				100.00
A99	2212.91	LCF	152	Spinel	0.00	0.22	26.75	40.84	16.08	0.31	15.73	0.05	0.02	0.00				100.00
A99	2212.91	LCF	153	Spinel	0.00	2.27	14.82	40.83	35.23	0.54	6.23	0.06	0.02	0.00				100.00
A99	2222.59	LCF	154	Spinel	0.00	0.21	9.92	58.60	20.76	1.44	8.99	0.05	0.03	0.00				100.00

Table 5: Electron microprobe chemical analysis of selected minerals in representative sandstone samples

Well	Depth (m)	Form'n+	File (Min26)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeOt	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	ZrO_2	BaO	Total
A99	2222.59	LCF	155	Spinel	0.00	0.19	9.99	58.72	20.65	1.40	8.97	0.04	0.03	0.00				100.00
A99	2470.66	LCF	156	Spinel (C)**	0.00	0.21	14.83	52.96	21.81	0.49	9.62	0.05	0.03	0.00				100.00
A99	2470.66	LCF	157	Spinel (R)	0.00	0.25	14.98	52.56	22.06	0.50	9.57	0.05	0.03	0.00				100.00
A99	2470.66	LCF	158	Spinel (C)	0.00	0.28	10.67	60.94	19.08	1.65	7.21	0.06	0.12	0.00				100.00
A99	2470.66	LCF	159	Spinel (R)	0.00	0.98	10.61	62.28	17.17	1.59	6.91	0.09	0.37	0.00				100.00
A99	2933.62	MSF	160	Spinel (C)	0.00	0.16	28.14	36.27	22.94	0.36	11.66	0.45	0.02	0.00				100.00
A99	2933.62	MSF	161	Spinel (R)	0.00	0.20	27.93	35.96	24.81	0.41	9.97	0.68	0.04	0.00				100.00
A99	2933.62	MSF	162	Spinel	0.00	0.12	23.84	46.50	16.78	0.47	12.14	0.13	0.03	0.00				100.00
A99	2230.62	LCF	165	Biotite	34.44	7.02	12.53	0.01	16.45	0.36	11.54	0.04	0.77	9.09				92.25
A99	2933.62	MSF	166	Biotite	35.40	3.10	17.87	0.02	21.57	0.99	5.37	0.02	0.04	11.10				95.48
A99	2933.62	MSF	167	Biotite	35.26	2.97	18.03	0.01	21.44	1.06	5.20	0.02	0.05	11.21				95.25
A99	2210.37	LCF	168	Tourmaline	37.38	0.27	37.04	0.00	9.72	0.12	3.06	0.12	1.94	0.02				89.67
A99	2211.47	LCF	8	Ilmenite*	0.21	64.06	0.41	0.13	21.55	0.12	0.12	1.18	0.03	0.00	0.06	0.14		88.01
A99	2212.91	LCF	3	Ilmenite*	0.97	85.24	1.06	0.10	1.53	0.05	0.10	0.84	0.17	0.00	0.40	0.49		90.95
A99	2212.91	LCF	4	Ilmenite*	2.09	83.88	1.54	0.19	2.57	0.07	0.07	0.60	0.11	0.12	0.26	0.45		91.95
A99	2933.62	MSF	7	Ilmenite*	0.30	74.14	0.84	0.21	14.90	0.38	0.03	0.28	0.19	0.00	0.06	0.19		91.52
A99	2210.37	LCF	9	Rutile	0.94	95.39	1.05	0.00	1.44	0.06	0.03	0.21	0.05	0.06	0.05	0.74		100.02
A99	2211.47	LCF	17	Rutile	0.32	94.97	0.68	0.09	1.73	0.07	0.07	0.15	0.04	0.00	0.03	0.30		98.45
A99	2212.91	LCF	10	Rutile	0.00	98.52	0.03	0.02	1.41	0.05	0.00	0.06	0.01	0.00	0.01	0.34		100.45
A99	2212.91	LCF	11	Rutile	0.00	101.15	0.03	0.04	0.19	0.05	0.01	0.07	0.00	0.00	0.02	0.19		101.75
A99	2230.62	LCF	12	Rutile	0.76	95.36	0.47	0.08	0.32	0.06	0.03	0.16	0.04	0.09	0.04	0.45		97.86
A99	2266.99	LCF	14	Rutile	1.29	94.50	0.35	0.02	0.60	0.07	0.01	0.47	0.04	0.00	0.04	0.43		97.82
A99	2266.99	LCF	15	Rutile	0.00	98.57	0.01	0.04	0.92	0.05	0.02	0.03	0.00	0.00	0.06	0.19		99.89
A99	2470.66	LCF	13	Rutile	0.00	98.04	0.00	0.03	0.83	0.05	0.00	0.05	0.02	0.00	0.01	0.18		99.21
A99	2933.62	MSF	16	Rutile	0.73	94.07	1.07	0.11	1.35	0.04	0.01	0.31	0.04	0.00	0.06	0.42		98.21
A99	2950.54	MSF	18	Rutile	0.00	100.21	0.04	0.03	0.17	0.03	0.00	0.04	0.00	0.00	0.02	0.14		100.68
A99	2950.54	MSF	19	Rutile	0.00	99.38	0.02	0.04	0.13	0.04	0.00	0.03	0.01	0.00	0.03	0.14		99.82
A99	3796.33	MMF	32	Rutile	0.00	97.14	0.01	0.22	1.12	0.05	0.00	0.05	0.00	0.00	0.02	0.21		98.82
A99	2211.47	LCF	30	Zircon	32.86	0.18	0.05	0.13	0.17	0.14	0.06	0.09	0.07	0.00	0.19	63.54	0.42	97.90
A99	2212.91	LCF	20	Zircon	31.06	0.20	0.11	0.14	0.16	0.14	0.06	0.15	0.06	0.00	0.22	67.32	0.40	100.02
A99	2212.91	LCF	21	Zircon	31.36	0.18	0.08	0.11	0.16	0.14	0.07	0.09	0.07	0.00	0.19	67.23	0.32	100.00
A99	2222.59	LCF	22	Zircon	31.43	0.16	0.07	0.12	0.28	0.12	0.06	0.09	0.07	0.00	0.11	67.10	0.39	100.00
A99	2222.59	LCF	23	Zircon	31.71	0.19	0.08	0.09	0.33	0.12	0.07	0.08	0.07	0.00	0.08	66.87	0.32	100.01
A99	2266.99	LCF	27	Zircon	31.13	0.16	0.06	0.11	0.31	0.11	0.06	0.06	0.07	0.00	0.19	67.34	0.42	100.02

Table 5: Electron microprobe chemical analysis of selected minerals in representative sandstone samples

Well	Depth (m)	Form'n+	File (Min26)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeOt	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	ZrO_2	BaO	Total
A99	2470.66	LCF	26	Zircon	31.27	0.22	0.08	0.09	0.24	0.16	0.05	0.08	0.08	0.00	0.13	67.17	0.46	100.03
A99	2470.66	LCF	42	Zircon	31.15	0.19	0.09	0.11	0.20	0.16	0.07	0.08	0.08	0.00	0.10	67.34	0.46	100.03
A99	2933.62	MSF	29	Zircon	32.94	0.17	0.08	0.12	0.21	0.15	0.06	0.09	0.08	0.00	0.11	64.59		98.60
A99	2950.54	MSF	31	Zircon	33.07	0.20	0.06	0.12	0.25	0.14	0.06	0.05	0.07	0.00	0.17	64.27	0.42	98.88
A99	3794.17	MMF	28	Zircon	31.11	0.21	0.07	0.11	0.37	0.15	0.06	0.09	0.06	0.00	0.26	67.13	0.40	100.02
A99	3796.33	MMF	24	Zircon	31.09	0.19	0.07	0.11	0.25	0.12	0.07	0.08	0.07	0.00	0.12	67.41	0.43	100.01
A99	3796.33	MMF	25	Zircon	31.21	0.21	0.08	0.12	0.18	0.12	0.06	0.08	0.06	0.00	0.09	67.36	0.45	100.02
A99	2933.62	MSF	34	Calcite	0.00	0.00	0.00	0.00	1.41	0.31	0.35	63.22	0.00	0.00	0.02	0.20		65.51
A99	2933.62	MSF	35	Calcite	0.00	0.00	0.00	0.00	0.01	0.01	0.23	58.67	0.06	0.00	0.01	0.06	0.08	59.13
A99	3796.33	MMF	33	Calcite	0.00	0.00	0.00	0.02	2.08	0.98	0.54	59.34	0.00	0.00	0.00	0.21		63.17
A99	3794.17	MMF	39	Ankerite	0.00	0.00	0.00	0.01	13.82	1.02	8.45	30.60	0.00	0.00	0.02	0.08	0.03	54.03
A99	3794.17	MMF	40	Ankerite	0.00	0.00	0.00	0.03	14.89	0.71	8.20	31.02	0.00	0.00	0.03	0.05		54.93
A99	3794.17	MMF	41	Ankerite	0.00	0.00	0.00	0.02	14.87	0.79	8.12	30.90	0.00	0.00	0.05	0.09		54.84
A99	3796.33	MMF	36	Ankerite	0.00	0.00	0.00	0.01	12.34	1.44	8.32	31.58	0.00	0.00	0.00	0.12	0.04	53.85
A99	3796.33	MMF	37	Ankerite	0.00	0.03	0.00	0.02	13.24	1.11	8.17	31.25	0.00	0.00	0.05	0.08	0.03	53.98
A99	3796.33	MMF	38	Ankerite	0.00	0.01	0.00	0.00	13.48	1.07	8.26	31.67	0.00	0.00	0.02	0.10	0.10	54.71
A99	2933.62	MSF	43	Apatite	0.00	0.00	0.00	0.03	0.05	0.06	0.00	58.02	0.05	0.00	43.25		0.06	101.52
A99	2230.62	LCF	44	Siderite	0.00	0.02	0.00	0.06	44.12	3.93	0.11	6.25	0.05	0.00	0.18	0.11	0.09	54.92
A99	2230.62	LCF	45	Siderite	0.00	0.02	0.01	0.02	48.64	0.93	0.11	4.95	0.04	0.00	0.15	0.15	0.10	55.12
A99	2230.62	LCF	46	Siderite	0.00	0.04	0.00	0.04	44.68	4.38	0.08	5.09	0.10	0.00	0.12	0.13	0.15	54.81
A99	2230.62	LCF	47	Siderite	0.00	0.05	0.00	0.03	48.33	0.78	0.13	5.12	0.02	0.00	0.10	0.14	0.16	54.86
A99	2230.62	LCF	48	Siderite	0.00	0.03	0.00	0.04	45.52	3.40	0.13	5.65	0.16	0.00	0.15	0.09	0.13	55.30
A99	2230.62	LCF	49	Siderite	0.00	0.06	0.00	0.04	46.81	3.66	0.12	5.70	0.16	0.00	0.15	0.14	0.15	56.99

* = Altered ilmenite

** (C) = core; (R) = rim

+ LCF = Logan Canyon Formation; MSF = Missisauga Formation; MMF = Mic Mac Formation

Table 6: Electron microprobe chemical analyses of feldspars from representative lithic clasts

Well	Depth (m)	Formation *	File (MIN27)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO_t	MnO	MgO	CaO	Na_2O	K_2O	Total
A99	2208.09	LCF	42	K-feldspar clast	65.43	0.04	18.54	0.00	0.03	0.00	0.00	0.01	0.08	16.09	100.22
A99	2208.09	LCF	43	K-feldspar clast	64.92	0.04	18.09	0.00	0.05	0.01	0.00	0.01	0.11	16.16	99.39
A99	2208.09	LCF	44	K-feldspar clast	65.03	0.05	18.23	0.00	0.07	0.01	0.00	0.00	0.11	16.00	99.50
A99	2208.09	LCF	45	K-feldspar clast	65.13	0.04	18.18	0.00	0.09	0.00	0.00	0.01	0.12	16.23	99.80
A99	2208.09	LCF	46	K-feldspar clast	64.59	0.04	18.21	0.00	0.10	0.01	0.00	0.03	0.17	15.90	99.05
A99	2210.37	LCF	47	K-feldspar clast	63.64	0.00	18.06	0.02	0.06	0.00	0.00	0.00	0.52	16.41	98.71
A99	2210.37	LCF	48	K-feldspar clast	65.99	0.00	16.54	0.00	0.06	0.00	0.00	0.00	0.10	15.97	98.66
A99	2210.37	LCF	49	K-feldspar clast	63.39	0.02	17.93	0.01	0.02	0.00	0.00	0.00	0.80	15.93	98.10
A99	2210.37	LCF	50	K-feldspar clast	64.09	0.02	17.35	0.03	0.04	0.00	0.03	0.02	0.09	16.67	98.34
A99	2210.37	LCF	51	K-feldspar clast	65.49	0.00	16.45	0.00	0.07	0.00	0.00	0.02	0.32	15.57	97.92
A99	2210.37	LCF	52	K-feldspar clast	64.20	0.04	17.95	0.03	0.04	0.00	0.00	0.05	0.86	15.62	98.79
A99	2211.47	LCF	74	K-feldspar clast	63.81	0.00	17.95	0.00	0.02	0.00	0.00	0.14	0.23	15.34	97.49
A99	2211.47	LCF	75	K-feldspar clast	64.29	0.00	18.06	0.00	0.05	0.00	0.00	0.01	0.15	15.77	98.33
A99	2211.47	LCF	76	K-feldspar clast	62.75	0.00	17.68	0.00	0.06	0.00	0.01	0.04	0.26	15.02	95.82
A99	2212.20	LCF	53	K-feldspar clast	64.60	0.02	18.16	0.01	0.00	0.00	0.01	0.00	0.33	16.56	99.69
A99	2212.20	LCF	54	K-feldspar clast	60.33	0.00	16.93	0.00	0.00	0.00	0.00	0.00	0.84	14.69	92.79
A99	2212.20	LCF	55	K-feldspar clast	64.86	0.00	18.62	0.02	0.07	0.00	0.03	0.04	0.53	15.65	99.82
A99	2212.20	LCF	56	K-feldspar clast	67.77	0.00	16.78	0.00	0.10	0.00	0.07	0.03	0.27	14.40	99.42
A99	2212.20	LCF	58	K-feldspar clast	68.04	0.00	16.63	0.00	0.11	0.00	0.03	0.05	0.37	14.67	99.90
A99	2212.91	LCF	59	K-feldspar clast	64.19	0.04	18.08	0.02	0.05	0.03	0.00	0.04	0.36	16.41	99.22
A99	2212.91	LCF	60	K-feldspar clast	61.50	0.00	20.74	0.01	0.17	0.01	0.07	0.13	0.42	14.76	97.81
A99	2212.91	LCF	61	K-feldspar clast	64.16	0.00	17.89	0.00	0.04	0.00	0.01	0.07	0.30	16.67	99.14
A99	2212.91	LCF	83	K-feldspar clast	65.54	0.05	18.02	0.01	0.09	0.01	0.02	0.01	0.19	16.38	100.32
A99	2212.91	LCF	84	K-feldspar clast	65.62	0.04	18.10	0.03	0.07	0.02	0.02	0.01	0.17	16.40	100.48
A99	2212.91	LCF	85	K-feldspar clast	64.83	0.00	17.86	0.02	0.08	0.03	0.00	0.04	0.27	16.12	99.25
A99	2212.91	LCF	86	K-feldspar clast	65.74	0.02	18.20	0.02	0.06	0.01	0.00	0.01	0.17	16.53	100.76
A99	2212.91	LCF	87	K-feldspar clast	65.29	0.02	18.03	0.01	0.05	0.01	0.00	0.02	0.17	16.49	100.09
A99	2212.91	LCF	88	K-feldspar clast	64.88	0.03	17.75	0.01	0.08	0.01	0.01	0.02	0.46	15.55	98.80
A99	2217.57	LCF	80	K-feldspar clast	65.14	0.03	18.64	0.00	0.17	0.02	0.00	0.02	0.21	15.72	99.95
A99	2217.57	LCF	81	K-feldspar clast	65.01	0.01	18.38	0.00	0.24	0.02	0.00	0.00	0.18	15.81	99.65
A99	2217.57	LCF	82	K-feldspar clast	64.96	0.05	18.21	0.01	0.19	0.01	0.01	0.00	0.27	15.75	99.46
A99	2217.96	LCF	89	K-feldspar clast	65.08	0.03	18.29	0.00	0.19	0.00	0.00	0.00	0.31	16.31	100.21
A99	2217.96	LCF	90	K-feldspar clast	65.86	0.00	17.74	0.01	0.61	0.01	0.00	0.12	1.62	13.31	99.28
A99	2227.34	LCF	62	K-feldspar clast	65.64	0.03	17.63	0.00	0.77	0.00	0.01	0.02	0.93	15.59	100.62
A99	2227.34	LCF	63	K-feldspar clast	65.09	0.01	17.87	0.00	0.27	0.00	0.00	0.02	0.72	16.00	99.98
A99	2227.34	LCF	64	K-feldspar clast	65.29	0.02	17.52	0.00	0.83	0.00	0.00	0.03	0.79	15.67	100.15
A99	2227.34	LCF	91	K-feldspar clast	65.10	0.00	18.05	0.00	0.24	0.00	0.01	0.01	0.22	15.74	99.37
A99	2227.34	LCF	93	K-feldspar clast	66.93	0.03	16.68	0.00	0.32	0.00	0.00	0.00	0.28	14.27	98.51
A99	2228.42	LCF	65	K-feldspar clast	67.39	0.00	16.89	0.01	0.03	0.03	0.00	0.00	0.35	15.83	100.53

Table 6: Electron microprobe chemical analyses of feldspars from representative lithic clasts

Well	Depth (m)	Formation *	File (MIN27)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO_t	MnO	MgO	CaO	Na_2O	K_2O	Total
A99	2228.42	LCF	66	K-feldspar clast	66.57	0.00	16.83	0.00	0.03	0.02	0.00	0.00	0.42	15.80	99.67
A99	2228.42	LCF	67	K-feldspar clast	65.10	0.02	17.78	0.01	0.11	0.01	0.02	0.00	0.38	16.01	99.44
A99	2233.62	LCF	35	K-feldspar clast	65.49	0.00	18.13	0.00	0.15	0.00	0.00	0.01	0.61	15.84	100.23
A99	2233.62	LCF	36	K-feldspar clast	65.86	0.00	18.25	0.00	0.08	0.00	0.00	0.00	1.41	14.49	100.09
A99	2233.62	LCF	37	K-feldspar clast	65.93	0.00	18.29	0.01	0.15	0.00	0.00	0.01	1.03	15.17	100.59
A99	2233.62	LCF	95	K-feldspar clast	64.72	0.04	18.02	0.03	0.16	0.01	0.02	0.09	0.52	16.00	99.61
A99	2233.62	LCF	96	K-feldspar clast	65.10	0.02	18.27	0.02	0.13	0.01	0.01	0.02	0.59	16.06	100.23
A99	2233.62	LCF	97	K-feldspar clast	64.99	0.02	18.34	0.04	0.14	0.02	0.02	0.03	0.89	15.79	100.28
A99	2233.62	LCF	98	K-feldspar clast	64.26	0.02	18.17	0.03	0.14	0.02	0.02	0.04	0.98	15.21	98.89
A99	2233.62	LCF	99	K-feldspar clast	65.33	0.03	18.22	0.02	0.21	0.00	0.01	0.03	0.38	16.13	100.36
A99	2233.62	LCF	100	K-feldspar clast	65.56	0.01	17.52	0.00	0.17	0.00	0.00	0.04	0.62	15.23	99.15
A99	2233.62	LCF	101	K-feldspar clast	64.28	0.00	17.67	0.01	0.14	0.00	0.02	0.07	0.40	15.85	98.44
A99	2237.16	LCF	69	K-feldspar clast	64.57	0.00	17.73	0.00	0.03	0.00	0.00	0.00	0.37	16.07	98.77
A99	2237.16	LCF	70	K-feldspar clast	64.13	0.00	17.73	0.00	0.00	0.00	0.00	0.00	0.48	16.00	98.34
A99	2237.16	LCF	102	K-feldspar clast	64.26	1.11	18.30	0.00	0.10	0.02	0.05	0.01	0.62	15.60	100.07
A99	2237.16	LCF	103	K-feldspar clast	65.20	0.18	18.32	0.00	0.12	0.01	0.04	0.01	0.63	15.89	100.40
A99	2238.65	LCF	104	K-feldspar clast	64.23	0.25	18.75	0.00	0.23	0.01	0.02	0.03	2.06	13.41	98.99
A99	2243.12	LCF	34	K-feldspar clast	65.34	0.06	18.34	0.01	0.11	0.03	0.10	0.01	0.83	15.88	100.71
A99	2243.12	LCF	106	K-feldspar clast	65.15	0.06	18.22	0.00	0.10	0.05	0.01	0.03	0.07	14.88	98.57
A99	2250.17	LCF	71	K-feldspar clast	65.37	0.00	18.37	0.00	0.01	0.00	0.00	0.00	0.51	16.51	100.77
A99	2250.17	LCF	72	K-feldspar clast	65.61	0.00	18.49	0.00	0.01	0.00	0.00	0.00	0.59	16.35	101.05
A99	2250.17	LCF	73	K-feldspar clast	66.80	0.00	18.81	0.00	0.00	0.00	0.00	0.25	3.33	11.97	101.16
A99	2936.06	MSF	38	K-feldspar clast	63.84	0.00	18.24	0.01	0.27	0.00	0.06	0.00	0.69	15.67	98.78
A99	2936.06	MSF	39	K-feldspar clast	65.24	0.00	18.28	0.00	0.08	0.00	0.01	0.00	0.72	16.02	100.35
A99	2212.91	LCF	26	Plagioclase clast	62.71	0.00	22.43	0.00	0.05	0.00	0.00	4.36	9.45	0.10	99.10
A99	2212.91	LCF	27	Plagioclase clast	62.94	0.00	22.27	0.02	0.05	0.00	0.00	4.08	9.72	0.18	99.26
A99	2227.34	LCF	5	Plagioclase clast	67.92	0.00	19.72	0.00	0.58	0.00	0.01	0.43	9.20	0.00	97.86
A99	2227.34	LCF	28	Plagioclase clast	68.56	0.00	19.32	0.00	0.31	0.00	0.00	0.01	10.71	0.28	99.19
A99	2230.62B	LCF	6	Plagioclase grain	69.93	0.00	20.76	0.00	0.04	0.00	0.00	0.66	5.93	0.04	97.36
A99	2230.62B	LCF	7	Plagioclase grain	63.99	0.00	22.65	0.00	0.05	0.00	0.00	3.92	9.25	0.13	99.99
A99	2230.62B	LCF	10	Plagioclase clast	68.91	0.02	19.39	0.01	0.18	0.00	0.00	0.06	9.89	0.11	98.57
A99	2233.62B	LCF	11	Plagioclase clast	67.81	0.02	19.35	0.03	0.17	0.01	0.02	0.09	10.70	0.87	99.07
A99	2233.62B	LCF	12	Plagioclase clast	84.80	0.00	9.91	0.02	0.12	0.00	0.01	0.02	5.48	0.13	100.49
A99	2233.62	LCF	19	Plagioclase clast	69.30	0.00	19.15	0.00	0.03	0.00	0.00	0.00	11.72	0.17	100.37
A99	2233.62	LCF	20	Plagioclase clast	68.83	0.00	19.44	0.00	0.14	0.00	0.00	0.15	11.33	0.16	100.05
A99	2237.16	LCF	13	Plagioclase clast	68.47	0.08	19.77	0.00	0.07	0.01	0.02	0.03	9.15	0.23	97.83
A99	2237.16	LCF	14	Plagioclase clast	68.78	0.00	19.62	0.00	0.04	0.02	0.00	0.08	11.32	0.16	100.02

Table 6: Electron microprobe chemical analyses of feldspars from representative lithic clasts

Well	Depth (m)	Formation *	File (MIN27)	Mineral	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO_t	MnO	MgO	CaO	Na_2O	K_2O	Total
A99	2237.16	LCF	15	Plagioclase clast	69.04	0.00	19.69	0.00	0.07	0.02	0.01	0.13	10.70	0.45	100.11
A99	2237.16	LCF	24	Plagioclase clast	69.32	0.00	19.66	0.00	0.32	0.00	0.03	0.14	12.14	0.00	101.61
A99	2237.16	LCF	25	Plagioclase clast	66.82	0.00	19.59	0.00	1.57	0.00	0.58	0.06	9.82	0.00	98.44
A99	2238.65	LCF	17	Plagioclase clast	68.53	0.01	19.57	0.00	0.01	0.02	0.00	0.05	9.77	0.07	98.03
A99	2243.12	LCF	18	Plagioclase clast	67.85	0.00	19.29	0.00	0.05	0.04	0.09	0.64	9.23	0.43	97.62
A99	2250.17	LCF	29	Plagioclase clast	66.36	0.00	21.11	0.00	0.02	0.00	0.00	2.08	10.20	0.39	100.16
A99	2250.17	LCF	30	Plagioclase clast	69.61	0.00	19.32	0.00	0.00	0.00	0.00	0.00	11.65	0.09	100.67
A99	2963.06	MSF	21	Plagioclase clast	68.67	0.00	19.51	0.00	0.07	0.00	0.00	0.08	10.92	0.12	99.37
A99	3793.40	MMF	31	Plagioclase clast	76.58	0.01	15.07	0.00	0.25	0.01	0.01	0.02	5.51	0.07	97.53
A99	3793.40	MMF	32	Plagioclase clast	71.99	0.00	17.74	0.01	0.03	0.00	0.00	0.13	10.57	0.10	100.57
A99	3793.40	MMF	33	Plagioclase clast	70.33	0.01	18.05	0.00	0.22	0.00	0.02	0.11	10.52	0.09	99.35

* LCF = Logan Canyon Formation; MSF = Missisauga Formation; MMF = Mic Mac Formation

Table 7a: Abundance of different lithic clasts in the sandstones.

depth (m)	Formation[4]	pxt quartz (from plutonic rocks)	pxt quartz (from metamorphic rocks)	pxt quartz (mylonitized)	igneous rocks	vein quartz	metamorphic rocks	quartz arenites[1]	claystone/siltstone[2]	total number of clasts
2208.09	LCF	4 [3]	11	5	22	1	4	0	3	46
2210.37	LCF	2	14	9	28	0	2	8	8	71
2211.47	LCF	17	6	18	21	0	4	2	6	74
2212.20	LCF	14	10	13	36	0	2	0	4	79
2212.91	LCF	16	0	0	29	0	4	10	6	65
2217.21	LCF	8	0	0	21	0	2	0	5	36
2217.57	LCF	5	3	0	5	0	0	0	8	21
2217.96	LCF	8	1	0	13	0	0	5	3	30
2222.59	LCF	4	1	11	9	0	0	0	1	26
2225.45	LCF	4	2	6	7	0	0	1	3	23
2227.34	LCF	2	0	0	13	0	0	0	0	15
2228.42	LCF	3	3	10	27	0	0	1	2	46
2228.82	LCF	6	3	3	2	0	0	3	1	18
2230.62B	LCF	9	6	7	8	0	2	0	3	35
2233.62	LCF	6	3	8	10	0	2	0	6	35
2237.16	LCF	7	0	16	19	1	4	0	0	47
2238.65	LCF	1	15	4	5	1	2	0	0	28
2243.12	LCF	12	0	9	18	0	0	5	2	46
2250.17	LCF	8	1	3	8	0	0	4	5	29
2263.36	LCF	17	8	0	26	0	0	0	2	53
2266.99	LCF	8	2	5	7	2	2	0	4	30
2267.67	LCF	9	9	13	19	0	0	0	2	52
2272.31A	LCF	3	2	0	47	0	2	0	3	57
2272.31B	LCF	2	2	4	0	0	0	0	0	8
2470.66	LCF	4	10	5	64	0	7	3	13	106
2482.14	LCF	4	13	0	66	0	2	5	12	102
2483.55	LCF	5	2	3	26	0	3	3	3	45
2933.62	MSF	0	3	4	25	0	0	2	3	37
2936.06	MSF	0	5	5	12	0	0	0	1	23
2940.48	MSF	1	7	5	7	0	0	0	0	20
2950.54	MSF	4	8	0	19	0	0	2	3	36
3793.40	MMF	10	4	9	6	0	0	0	4	33
3794.17	MMF	8	0	1	18	0	1	1	2	31
3796.33	MMF	4	3	0	8	0	0	1	7	23

1: This group includes sandstones, quartz arenites and greywackes.
2: Some of the clasts under this group may be clasts from groundmass of mylonites or altered feldspar.
3: These numbers represent individual identified clasts.
4: LCF= Logan Canyon Formation; MSF= Missisauga Formation; MMF= Mic Mac Formation
pxt = polycrystalline; qtz=quartz

Table 7b: Relative abundance of different lithic clasts in the sandstones.

depth (m)	% pxt quartz (from plutonic rocks)	% pxt quartz (from metamorphic rocks)	% pxt quartz (mylonitized)	% igneous rocks	% vein quartz	% metamorphic rocks	% quartz arenites[1]	% claystone/siltstone[2]	Total %	Total number of clasts
2208.09	6.12	22.45	10.20	44.90	2.04	8.16	0.00	6.12	100	46
2210.37	2.82	19.72	12.68	39.44	0.00	2.82	11.27	11.27	100	71
2211.47	22.97	8.11	24.32	28.38	0.00	5.41	2.70	8.11	100	74
2212.20	17.72	12.66	16.46	45.57	0.00	2.53	0.00	5.06	100	79
2212.91	24.62	0.00	0.00	44.62	0.00	6.15	15.38	9.23	100	65
2217.21	22.22	0.00	0.00	58.33	0.00	5.56	0.00	13.89	100	36
2217.57	23.81	14.29	0.00	23.81	0.00	0.00	0.00	38.10	100	21
2217.96	26.67	3.33	0.00	43.33	0.00	0.00	16.67	10.00	100	30
2222.59	15.38	3.85	42.31	34.62	0.00	0.00	0.00	3.85	100	26
2225.45	17.39	8.70	26.09	30.43	0.00	0.00	4.35	13.04	100	23
2227.34	13.33	0.00	0.00	86.67	0.00	0.00	0.00	0.00	100	15
2228.42	6.52	6.52	21.74	58.70	0.00	0.00	2.17	4.35	100	46
2228.82	33.33	16.67	16.67	11.11	0.00	0.00	16.67	5.56	100	18
2230.62B	25.71	17.14	20.00	22.86	0.00	5.71	0.00	8.57	100	35
2233.62	17.14	8.57	22.86	28.57	0.00	5.71	0.00	17.14	100	35
2237.16	14.89	0.00	34.04	40.43	2.13	8.51	0.00	0.00	100	47
2238.65	3.57	53.57	14.29	17.86	3.57	7.14	0.00	0.00	100	28
2243.12	26.09	0.00	19.57	39.13	0.00	0.00	10.87	4.35	100	46
2250.17	27.59	3.45	10.34	27.59	0.00	0.00	13.79	17.24	100	29
2263.36	32.08	15.09	0.00	49.06	0.00	0.00	0.00	3.77	100	53
2266.99	26.67	6.67	16.67	23.33	6.67	6.67	0.00	13.33	100	30
2267.67	17.31	17.31	25.00	36.54	0.00	0.00	0.00	3.85	100	52
2272.31A	5.26	3.51	0.00	82.46	0.00	3.51	0.00	5.26	100	57
2272.31B	25.00	25.00	50.00	0.00	0.00	0.00	0.00	0.00	100	8
2470.66	3.77	9.43	4.72	60.38	0.00	6.60	2.83	12.26	100	106
2482.14	3.92	12.75	0.00	64.71	0.00	1.96	4.90	11.76	100	102
2483.55	11.11	4.44	6.67	57.78	0.00	6.67	6.67	6.67	100	45
2933.62	0.00	8.11	10.81	67.57	0.00	0.00	5.41	8.11	100	37
2936.06	0.00	21.74	21.74	52.17	0.00	0.00	0.00	4.35	100	23
2940.48	5.00	35.00	25.00	35.00	0.00	0.00	0.00	0.00	100	20
2950.54	11.11	22.22	0.00	52.78	0.00	0.00	5.56	8.33	100	36
3793.40	30.30	12.12	27.27	18.18	0.00	0.00	0.00	12.12	100	33
3794.17	25.81	0.00	3.23	58.06	0.00	3.23	3.23	6.45	100	31
3796.33	17.39	13.04	0.00	34.78	0.00	0.00	4.35	30.43	100	23

1: This group includes sandstones, quartz arenites and greywackes.
2: Some of the clasts under this group may be clasts from groundmass of mylonite or altered feldspar.
pxt = polycrystalline; qtz = quartz

Appendix I

Petrographic criteria of classification of clasts from representative sandstone samples

<u>Detailed Notes on the Classification of Peskowesk A-99 Clasts from Representative Sandstone Samples</u>

A. Sources of Polycrystalline Quartz

<u>Igneous</u>

Plutonic

- Relatively uniformly sized grains with straight contacts
- Polycrystalline grains are larger than monocrystalline grains (average 0.25 mm up to 0.5 mm)
- Coarse grained, usually composed of 2-5 crystals, subequant to equate in size (sometimes elongated); showing no obvious crystallographic orientation
- Commonly show undulatory extinction from plastic deformation

<u>Metamorphic</u>

Gneiss

- Average size of crystals is 0.25 mm
- Usually composed of >5 crystals
- Undulatory extinction
- Strong intercrystalline suturing
- Crystals show parallel orientation, flattened/elongated in shape
- Bimodal size distribution

Schist

- Average size of crystals is 0.1 mm
- Number of crystals per grain is greater than in plutonic and gneiss clasts
- Crystals are elongated and parallel in orientation, bimodal size distribution and show a strong fabric

<u>Pegmatites and other felsic veins</u>

- Coarse-grained texture
- Milky color from water-filled vacuoles
- Vermicular chlorite inclusions with roundish, “tubular” shapes (rare)
- Intercrystalline boundaries show cockscomb texture (easily mixed up with metamorphic)

<u>Vein Quartz</u>

- Very large crystals of polycrystalline quartz, containing irregular “patches” of individual quartz crystals
- Commonly with abundant fluid inclusions or vacuoles

<u>Mylonitized</u>

- Any clasts which show deformation caused by mechanical forces applied in a particular direction.
- Clasts are placed in this category if they do not display enough features to be placed in the igneous and metamorphic sub-categories.

- Development of subgrain texture in quartz
- Strong fabric

B. Chert (or very fine-grained rhyolite or matrix from quartz-arenite)

- Composed of microcrystalline quartz in a dark, very fine-grained matrix
- Clasts are rounded to fragmental.
- Chert clasts are mostly pale brown in PPL, and the matrix is occasionally dark. In some samples, clasts contain a combination of microquartz and large quartz.
- Differ from the very fine-grained plutonic clasts in that chert does not show sharp overall boundaries.

C. Sedimentary Clasts

<u>Shales/claystones</u>

- Most of the sedimentary fragments seen in the samples are fine grained shales and claystones containing abundant platy minerals. Fragments are commonly brownish to reddish-brown in PPL

<u>Siltstones</u>

- Composed of small, randomly distributed needle-like and platy minerals set in a fine to very fine matrix. Individual crystals in some clasts are distinguishable in PPL
- Rare clasts have a carbonate cement

<u>Sandstones/Quartz Arenite</u>

- The fragments contain crystals of quartz set in a fine matrix of highly birefringent clay minerals (probably mica and chlorite)
- Clasts are sub-rounded to well-rounded

* Note: Some of these clasts may be intraformational

D. Carbonate Clasts

- Individual crystals within the clasts have very high birefringence and have a “sparkly” appearance
- Clasts have variable relief
- Clasts show a wide-range of shapes, ranging from irregular to rounded
- Rarely, bioclastic limestones and fossils are present
- Sample 2233.62 m, position 3 is possibly an epidotized basalt
- Overall their occurrence in these samples are rare

E. Igneous Clasts

<u>Volcanic Clasts</u>

- Composed of very fine to medium sized laths of feldspar set in a very fine grained groundmass of dark material
- Clasts are sub-rounded to rounded
- Sample 2243.12 m, position 4 is possibly a rhyolite fragment

<u>Microgranites (Porphyritic Rhyolites)</u>

Granophyric Texture

- Radiate intergrowths of quartz and ?feldspars
- Large clast seen in sample 2233.62 m, position 4
- Clasts are colorless and texture is nearly indistinguishable in PPL
- Clasts are rounded

Myrmekitic Texture

- Quartz with patches of feldspar
- Clast is colorless and texture is indistinguishable in PPL
- Clasts are rounded

<u>Plutonic Clasts</u>

- Feldspar crystals containing needle-like crystals of chlorite and tourmaline, and some rounded quartz grains.
- Rare granite clasts show coarse grains of K-feldspars with quartz grains
- May show fracturing of feldspars
- Clasts shapes are irregular to rounded
- The majority is very fine-grained and usually very small. They commonly appear to break down. They are less common in the Missisauga Formation.

F. Metamorphic Clasts

<u>Quartz Schist</u>

- Composed of quartz crystals with chlorite and/or muscovite crystals showing preferential alignment (schistose texture). Individual crystals are distinguishable in PPL
- Clasts are rounded

<u>Slate</u>

- Composed of platy minerals in a distinct fabric, occasionally a very fine matrix is distinguishable
- Some clasts contain fine quartz crystals

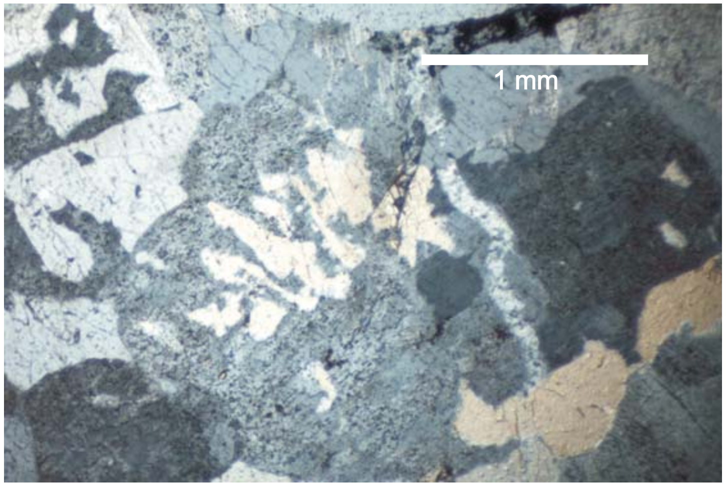
<u>Mica Schist</u>

- Composed of almost entirely muscovite crystals showing a distinct fabric
- Occurrence was very rare

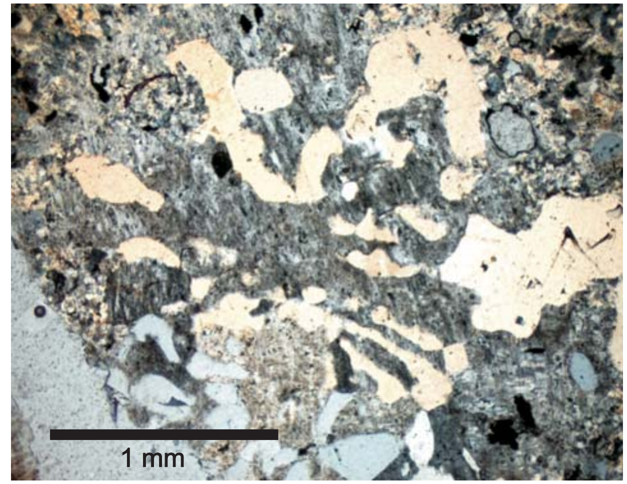
Appendix II

Textures of igneous rocks seen in other offshore wells:
Mallard (M-45):
Lower Cretaceous granitoid rocks

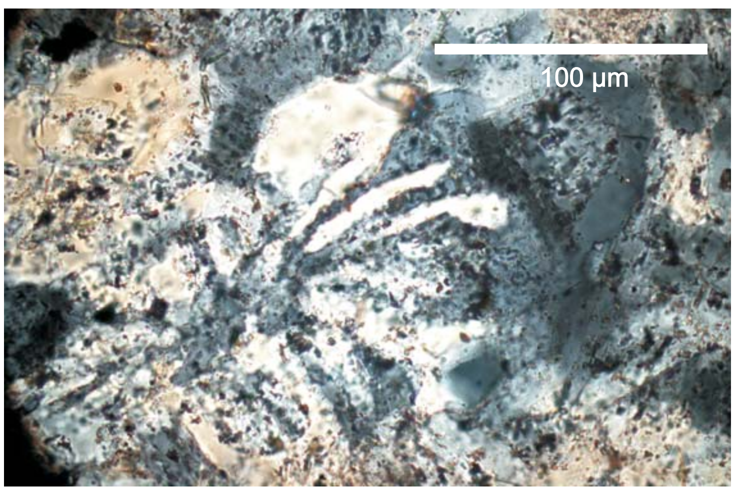
Ojibwa (E-07) and Jaeger (A-49):
Devonian granitoid rocks



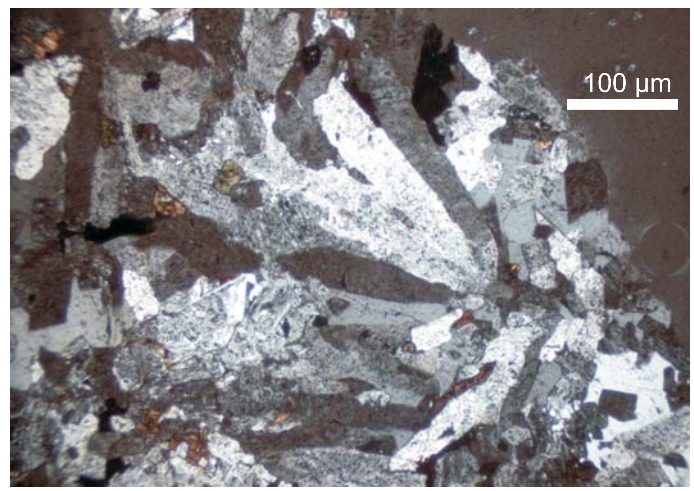
Mallard (M-45), 8310'; graphic texture (xpl)



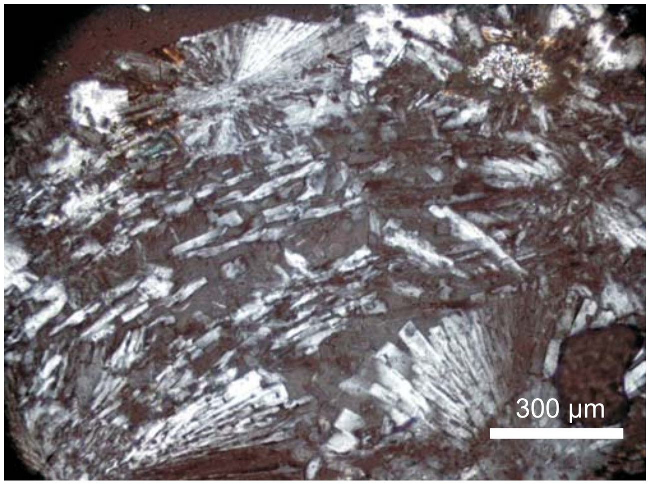
Mallard (M-45), 8550-60'; graphic texture (xpl)



Mallard (M-45), 8550-60'; micrographic texture (xpl)

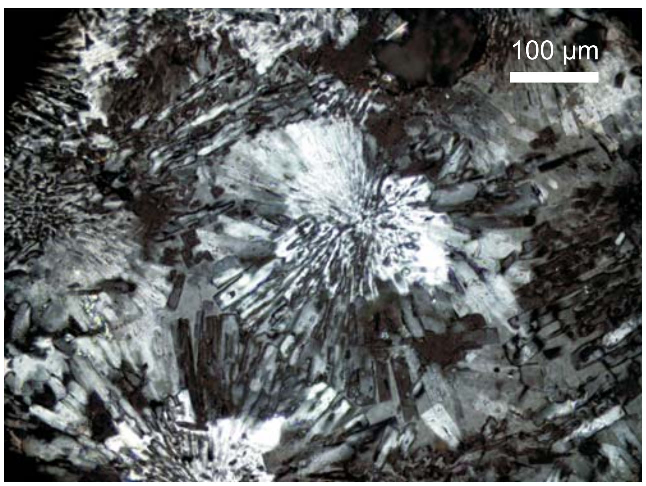


Mallard (M-45), 8550-60'; plagioclase laths (xpl)

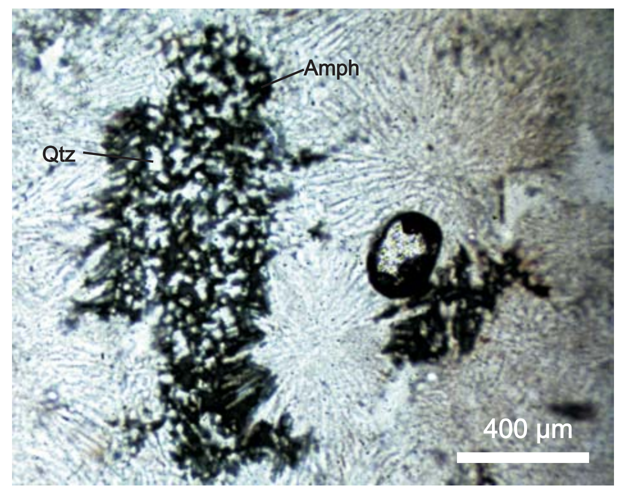


Mallard (M-45), 8660-90'; albite laths (xpl)

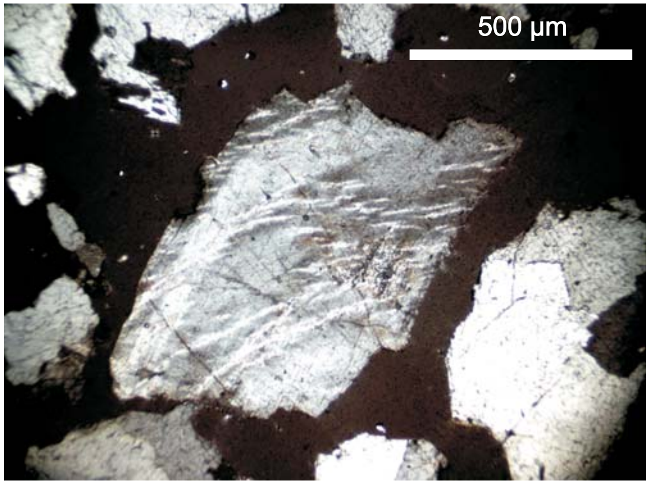
Mallard (M-45), 8660-90'; twinned albite crystal (xpl)



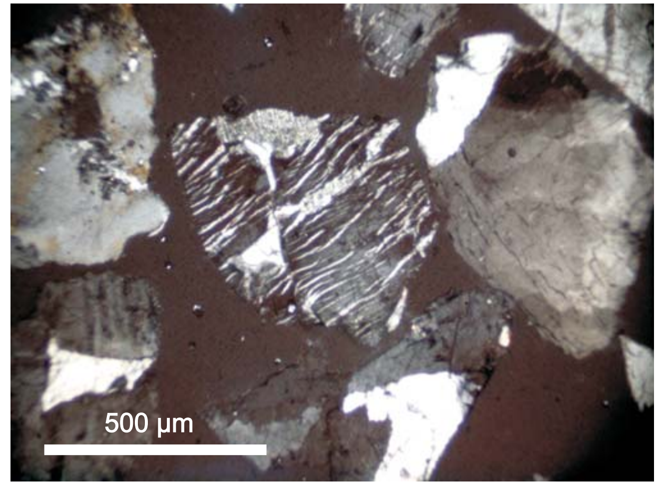
Mallard (M-45), 8660-90'; sphelurites (xpl)



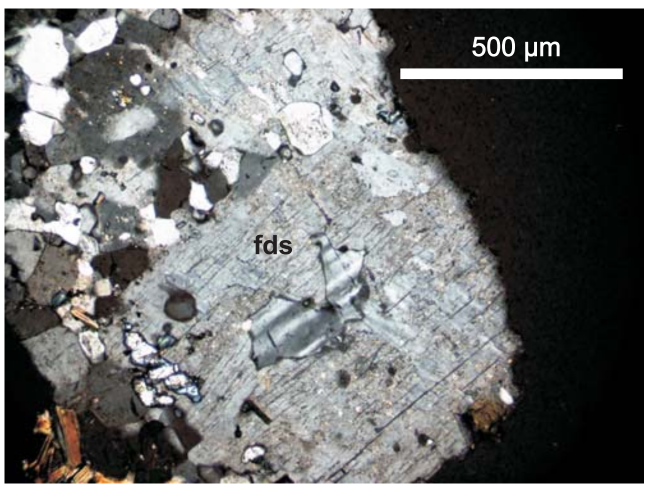
Mallard (M-45), 8660-90'; vermicular intergrowths of quartz (qzt) and sodic amphiboles (amph)(ppl).



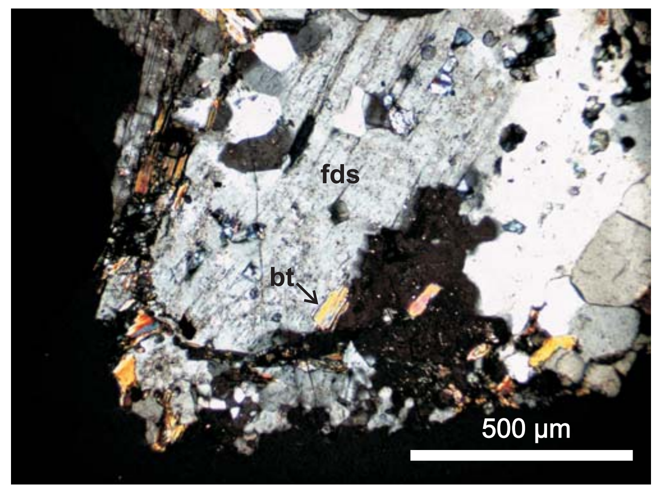
Jaeger (A-49), 3100m; strained perthite crystal (xpl)



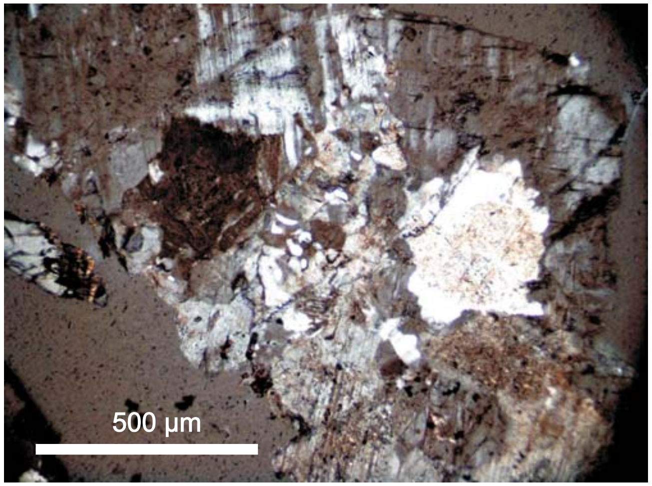
Jaeger (A-49), 3100m; strained perthite crystal (xpl)



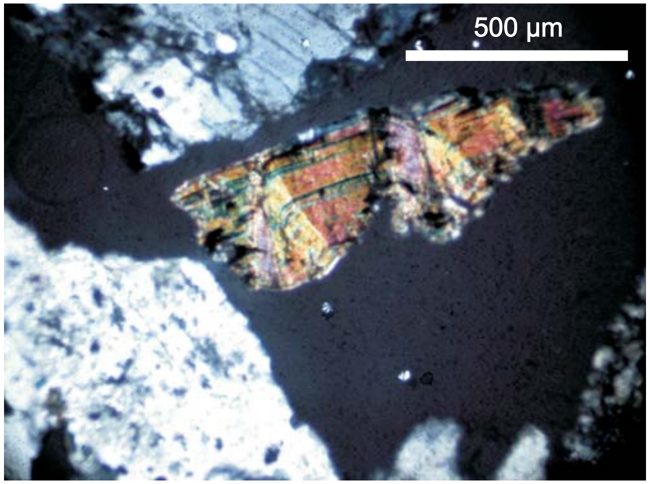
Ojibwa (E-07), 7500'; porphyritic granite (xpl)



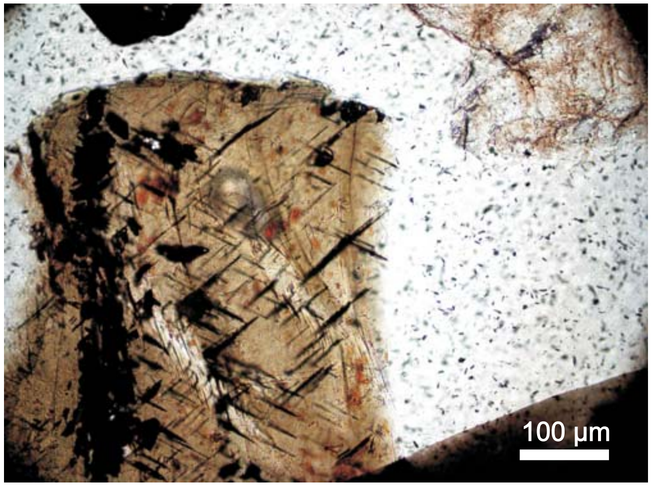
Ojibwa (E-07), 7500'; porphyritic granite (xpl)



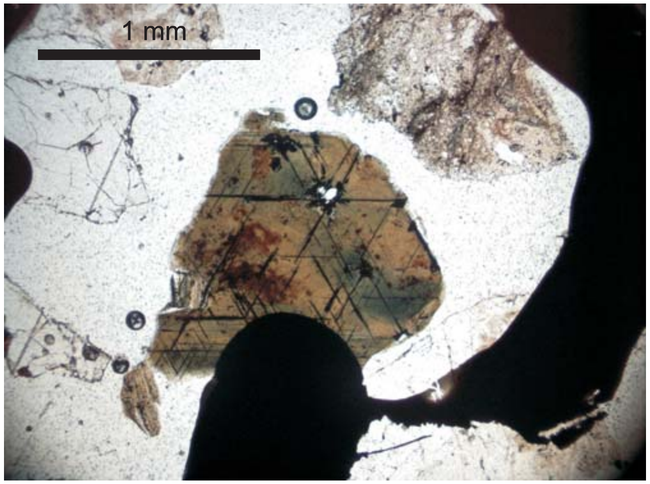
Ojibwa (E-07), 7550’; granophyric granite (xpl)



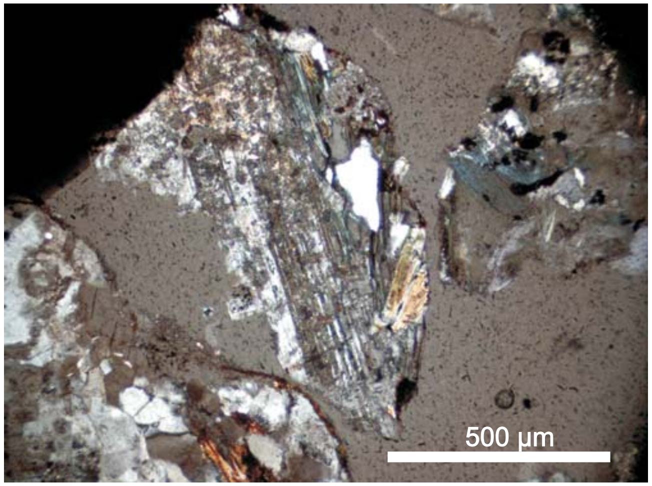
Ojibwa (E-07), 7550’; deformed biotite (xpl)



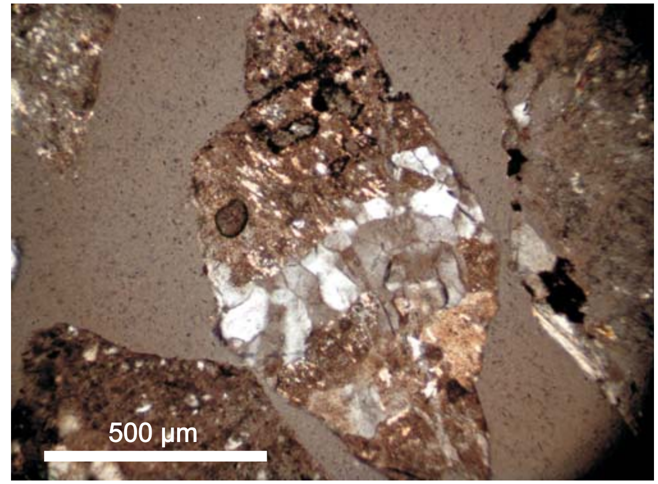
Ojibwa (E-07), 7550’; rutilized biotite (ppl)



Ojibwa (E-07), 7550’; rutilized biotite (ppl)



Ojibwa (E-07), 7550’; deformed granite (xpl)

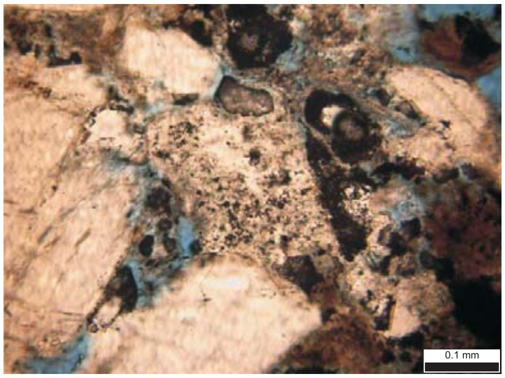


Ojibwa (E-07), 7550’; deformed granite (xpl)

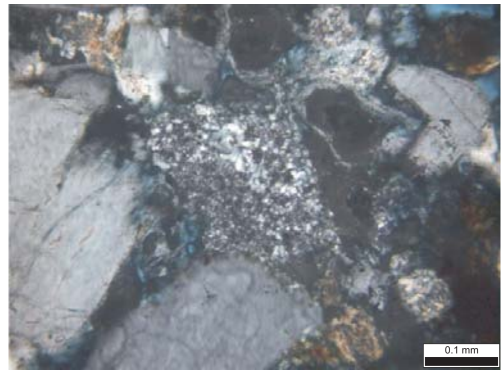
Appendix III

Microphotographs of various clast types

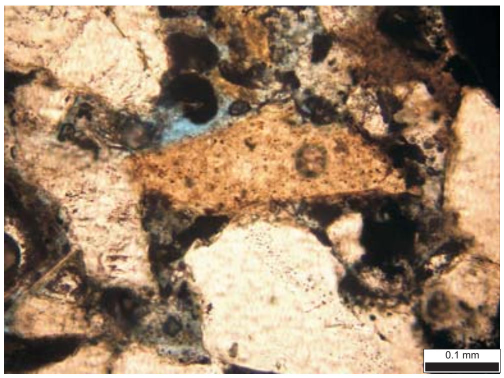
2208.09 metres



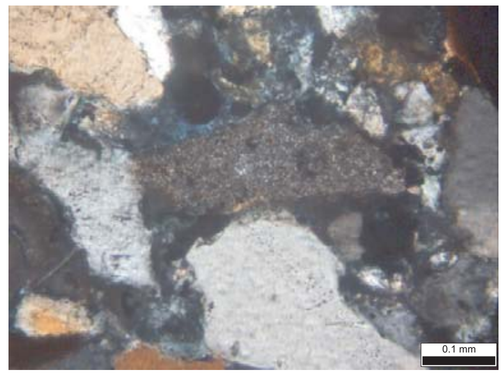
2208.09 m (pos. 8): intrusive rhyolite 200x ppl*



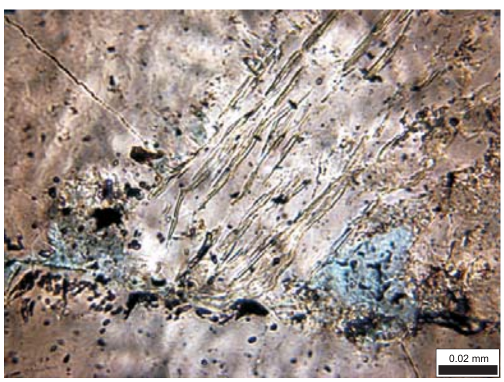
2208.09 m (pos. 8): intrusive rhyolite 200x xpl*



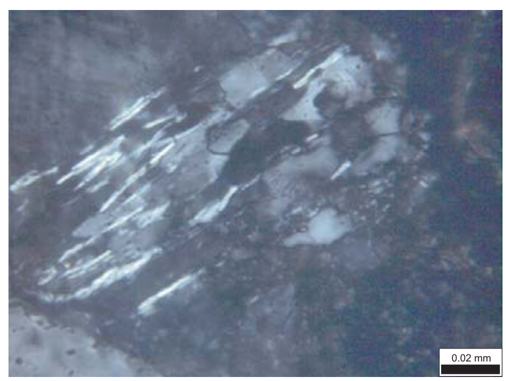
2208.09 m (pos. 16): mudstone intraclast 200x ppl



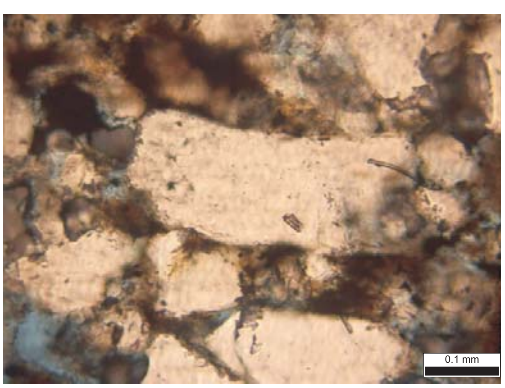
2208.09 m (pos. 16): mudstone intraclast 200x xpl



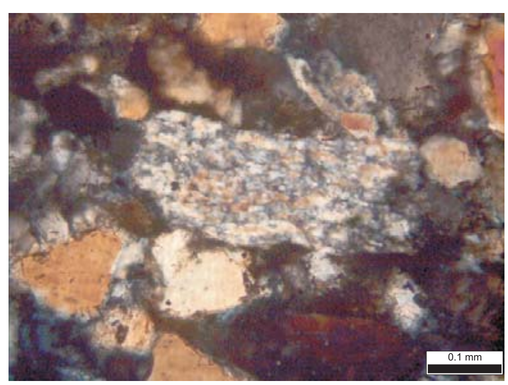
2208.09 m (pos. 19): mica-quartz schist 630x ppl



2208.09 m (pos. 19): mica-quartz schist 630x xpl

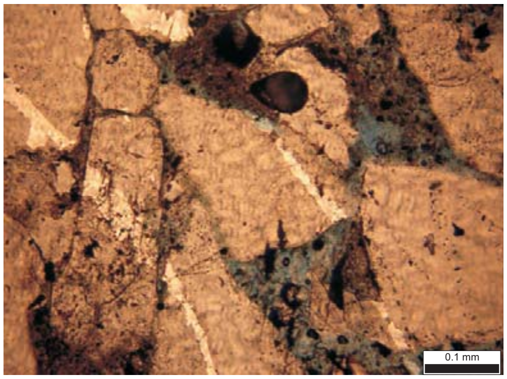


2208.09 m (pos. 20): polycrystalline quartz (weakly foliated) (EMP)* (A)*
200x ppl

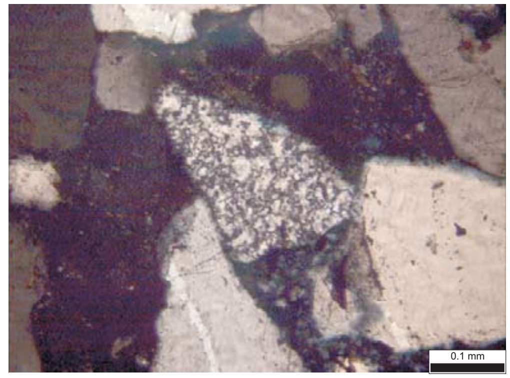


2208.09 m (pos. 20): polycrystalline quartz (weakly foliated) (EMP) (A)
200x ppl

2208.09 metres

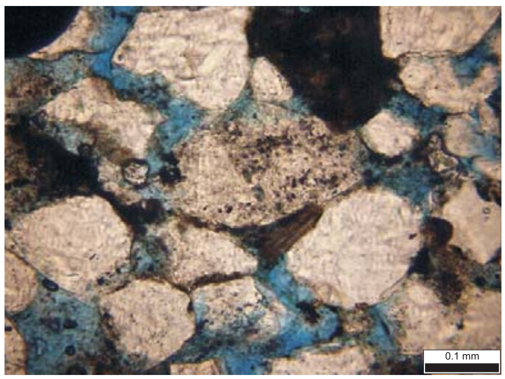


2208.09 m (pos. 22): intrusive rhyolite 200x ppl

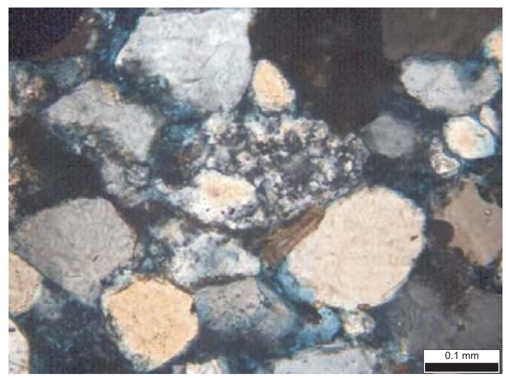


2208.09 m (pos. 22): intrusive rhyolite 200x xpl

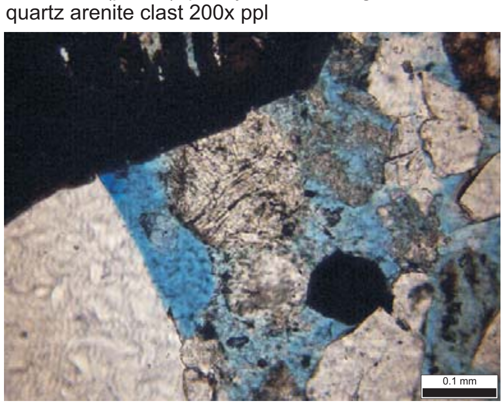
2210.37 metres



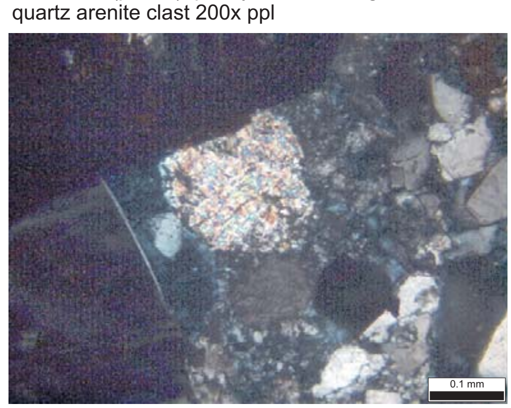
2210.37m (pos. 3): poorly sorted, fine grained quartz arenite clast 200x ppl



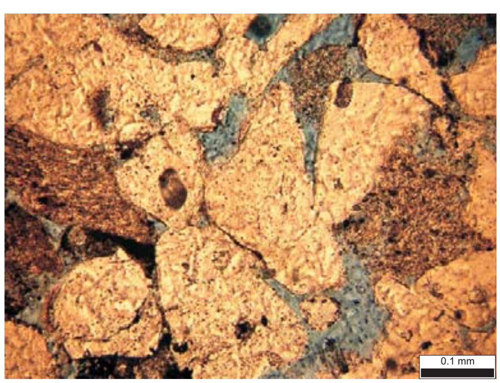
2210.37m (pos. 3): poorly sorted, fine grained quartz arenite clast 200x ppl



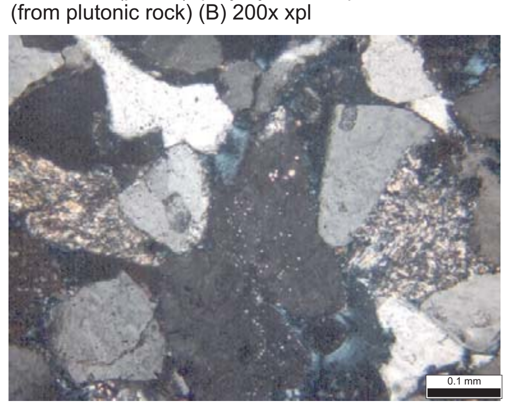
2210.37 m (pos. 4): polycrystalline quartz (from plutonic rock) (B) 200x ppl



2210.37 m (pos. 4): polycrystalline quartz (from plutonic rock) (B) 200x xpl

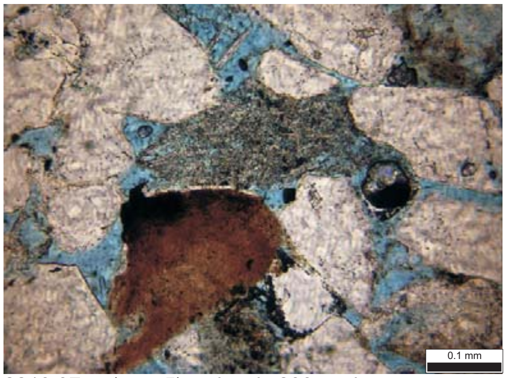


2210.37 m (pos. 5): siltstone (far right) centre (DM)*, shale (DM) far left centre (left) 200x ppl

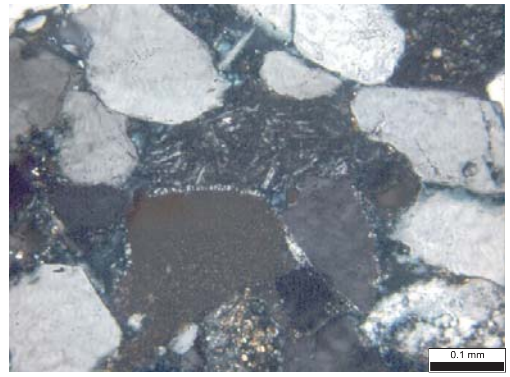


2210.37 m (pos. 5): siltstone (far right) centre (DM), shale (DM) far left centre (left) 200x ppl

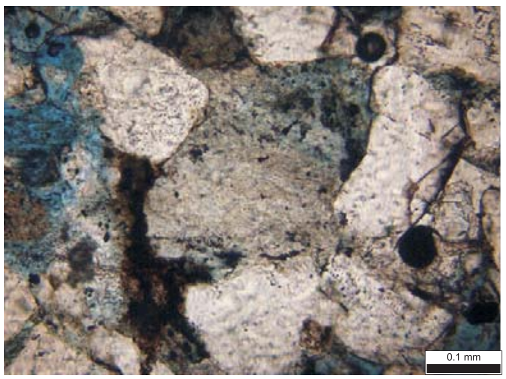
2210.37 metres



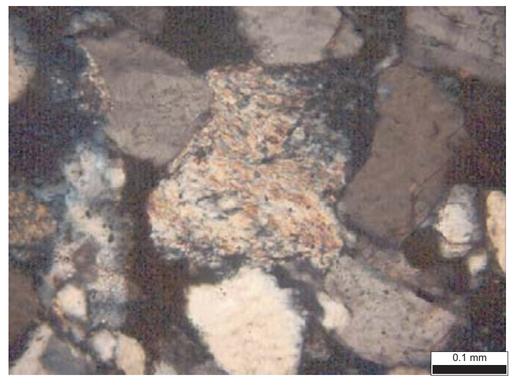
2210.37 m (pos. 5): volcanic 200x ppl



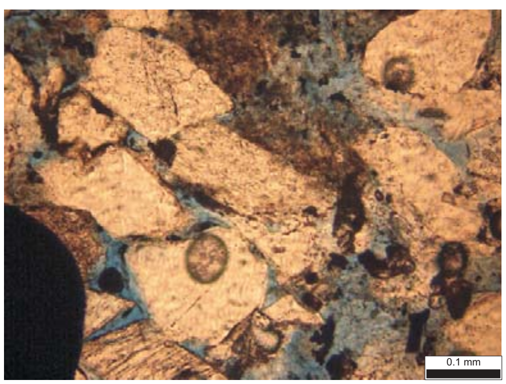
2210.37 m (pos. 5): volcanic 200x xpl



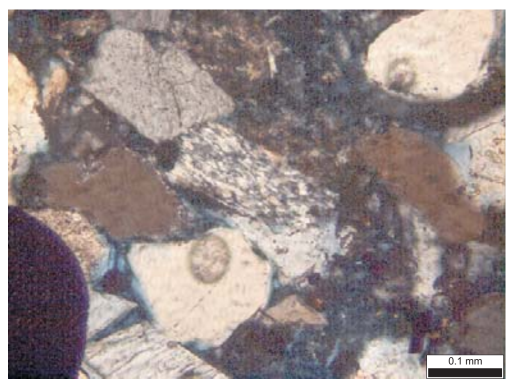
2210.37 m (pos. 7): siltstone 200x ppl



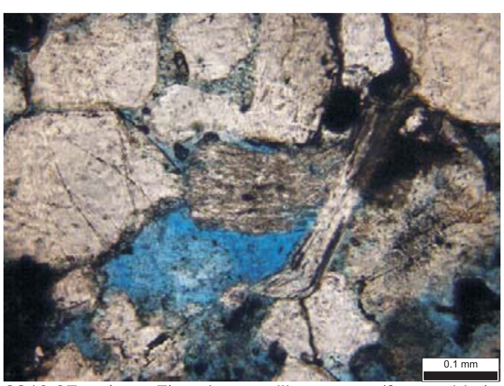
2210.37 m (pos. 7): siltstone 200x xpl



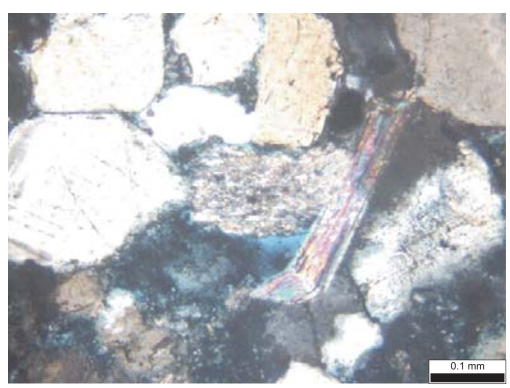
2210.37 m (pos. 6): polycrystalline quartz (from schist)



2210.37 m (pos. 6): polycrystalline quartz (from schist) 200x xpl

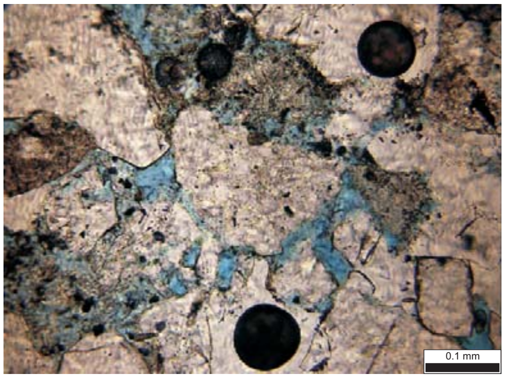


2210.37 m (pos. 7): polycrystalline quartz (from schist)

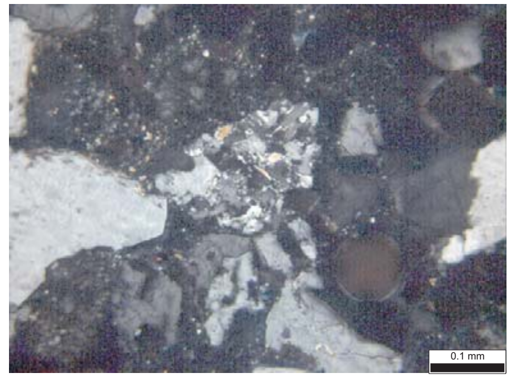


2210.37 m (pos. 7): polycrystalline quartz (from schist) 200x xpl

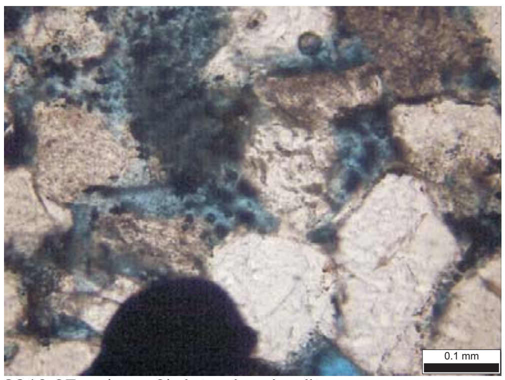
2210.37 metres



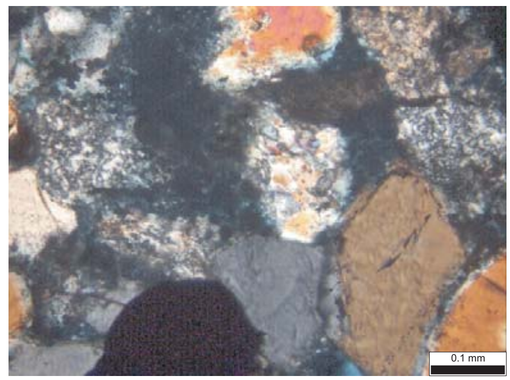
2210.37 m (pos. 8): siltstone
200x ppl



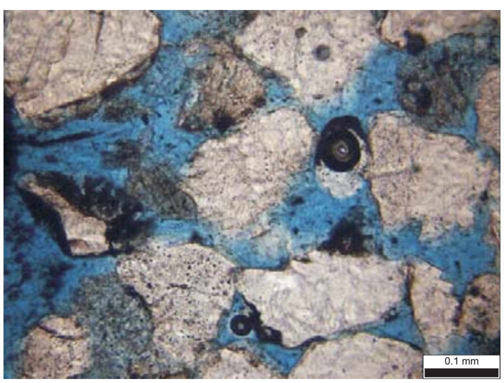
2210.37 m (pos. 8): siltstone
200x xpl



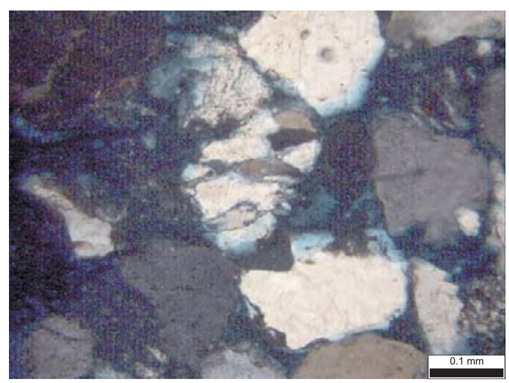
2210.37 m (pos. 9): intrusive rhyolite
200x xpl



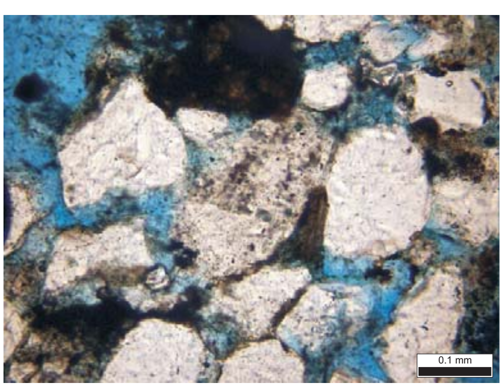
2210.37 m (pos. 9): intrusive rhyolite
200x xpl



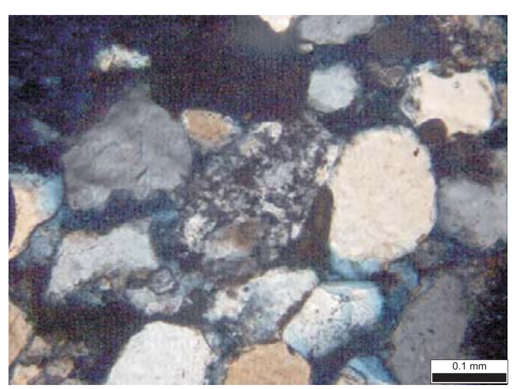
2210.37 m (pos. 12): quartz mylonite (weak) 200x ppl



2210.37 m (pos. 12): quartz mylonite (weak) 200x xpl

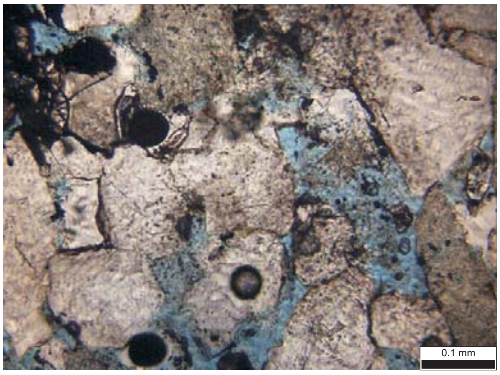


2210.37 m (pos. 13): polycrystalline quartz (from gneiss) (D)
200x ppl

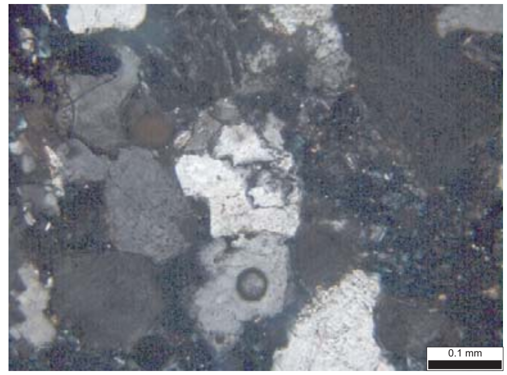


2210.37 m (pos. 12): polycrystalline quartz (from gneiss) (D)
200x xpl

2210.37 metres

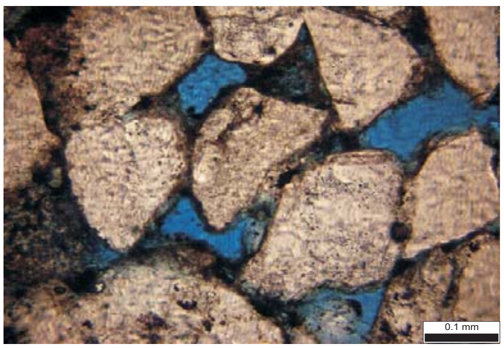


2210.37 m (pos. 14): polycrystalline quartz (from plutonic rock) (E) 200x ppl

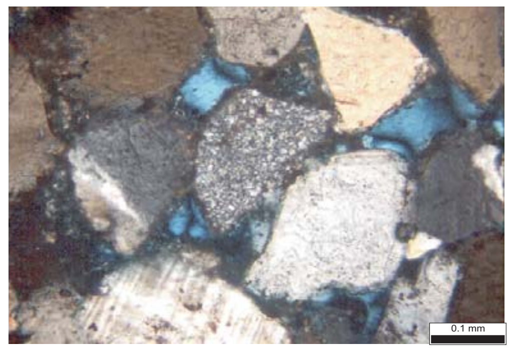


2210.37 m (pos. 14): polycrystalline quartz (from plutonic rock) (E) 200x xpl

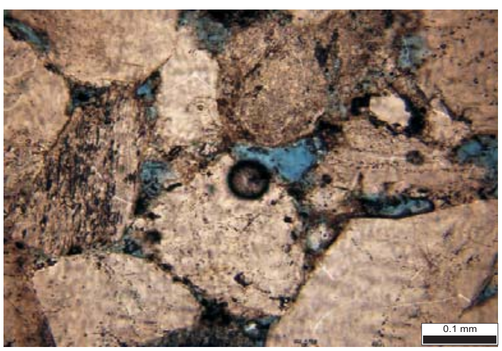
2211.47 metres



2211.47 m (pos. 3): microgranite (EMP) 200x ppl

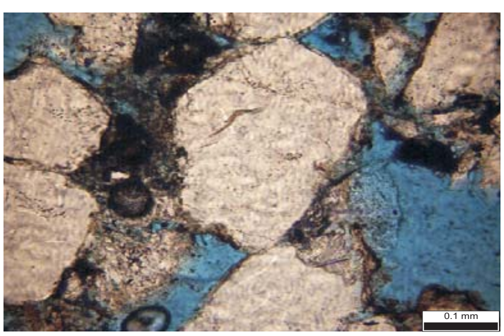


2211.47 m (pos. 3): microgranite (EMP) 200x xpl



2211.47 m (pos. 4): microgranite (upper centre), quartz mylonite (weak) (lower centre) 200x ppl

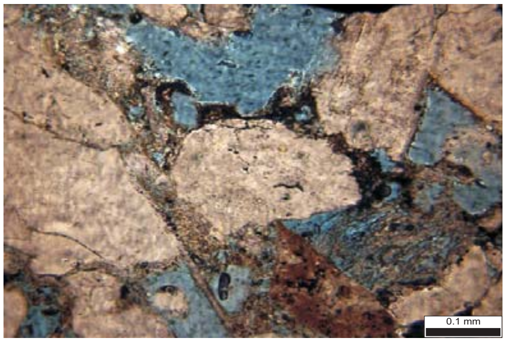
2211.47 m (pos. 4): microgranite (upper centre), quartz mylonite (weak) (lower centre) 200x xpl



2211.47 m (pos. 4): polycrystalline quartz (from plutonic rock) (E)
200x ppl

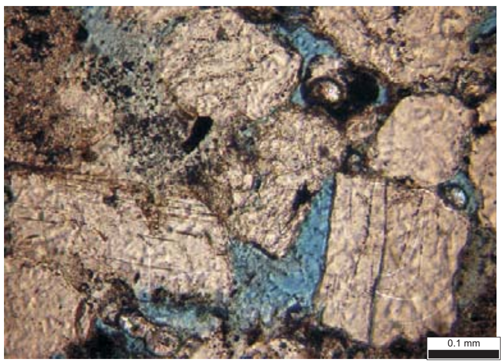
2211.47 m (pos. 4): polycrystalline quartz (from plutonic rock) (E)
200x xpl

2211.47 metres

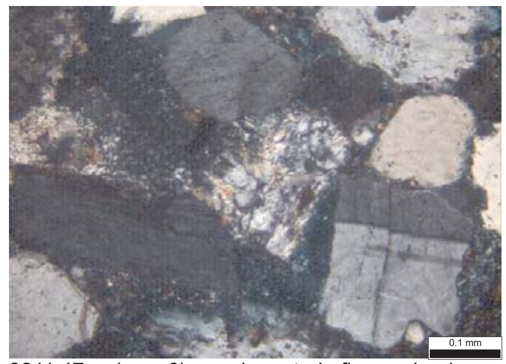


2211.47 m (pos. 5): polycrystalline quartz (from fine-grained shist) (F)
200x ppl

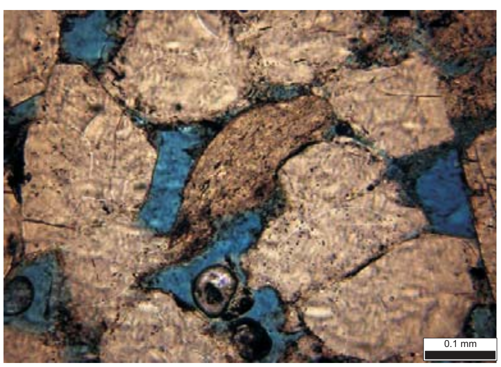
2241.17 m (pos. 5): polycrystalline quartz(from fine-grained shist)
(F)200x ppl



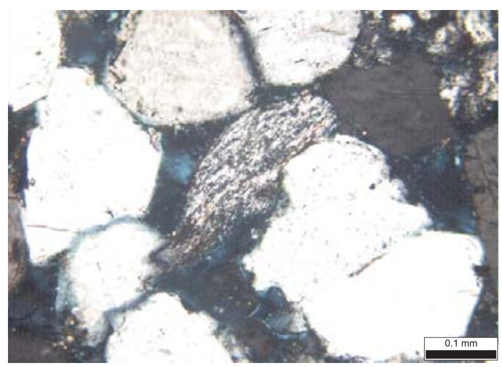
2211.47 m (pos. 6): poorly-sorted, fine-grained quartz arenite clast 200x ppl



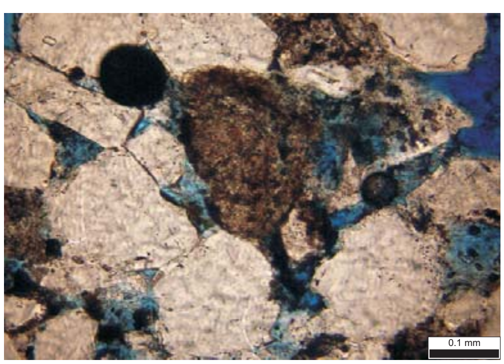
2211.47 m (pos. 6): poorly-sorted, fine-grained quartz arenite clast 200x ppl



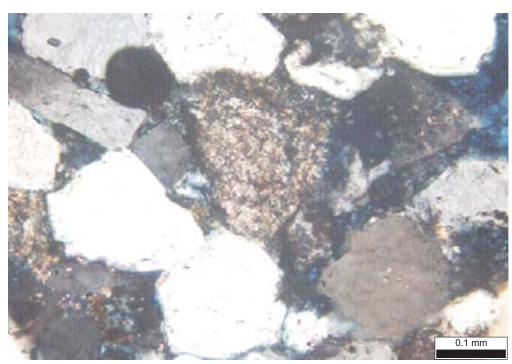
2211.47 m (pos. 7): slate
200x ppl



2211.47 m (pos. 7): slate
200x xpl

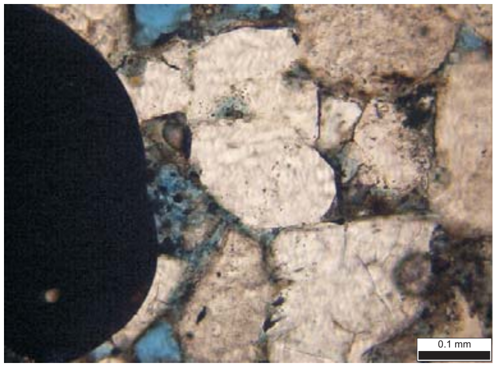


2211.47 m (pos. 8): mudstone intraclast
200x ppl

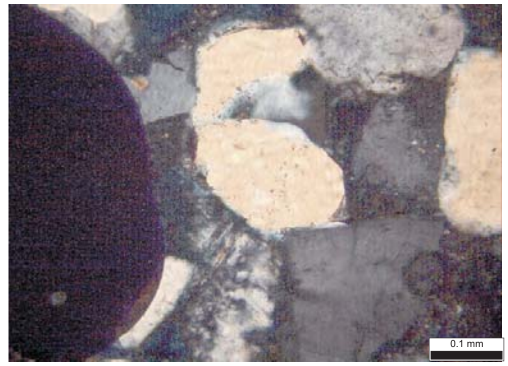


2211.47 m (pos. 8): mudstone intraclast
200x xpl

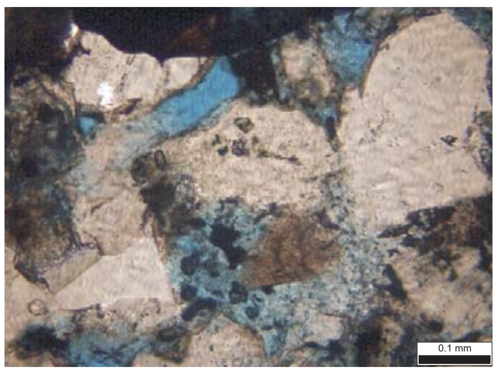
2211.47 metres



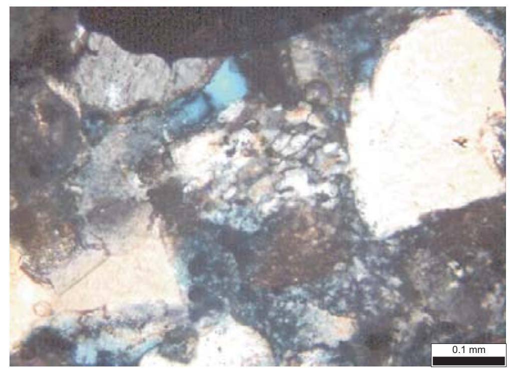
2211.47 m (pos. 9): polycrystalline quartz (from plutonic rock) (E)
200x ppl



2241.17 m (pos. 9): polycrystalline quartz (from plutonicrock) (E)
200x xpl

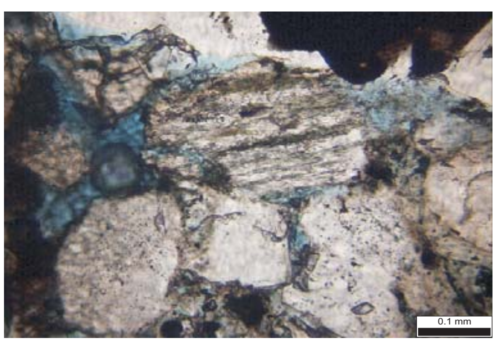


2241.17 m (pos.10): polycrystalline quartz (from gneiss) (D) 200x ppl



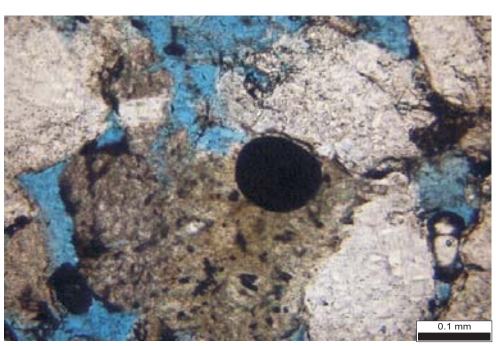
2211.47 m (pos.10): polycrystalline quartz (from gneiss) (D) 200x xpl

2212.20 metres

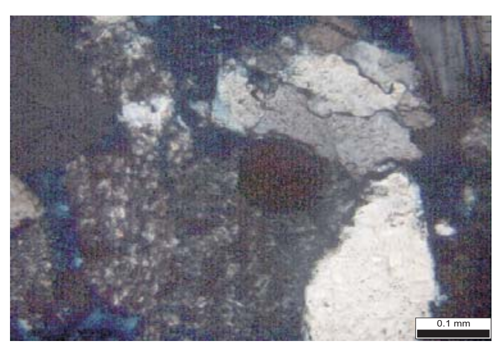


2212.20 m (pos. 1): microgranite/intrusive rhyolite (G),looks very similar to 2225.45 position 10. 200x ppl

2212.20 m (pos. 1): microgranite/intrusive rhyolite (G), looks very similar to 2225.45 position 10. 200x xpl

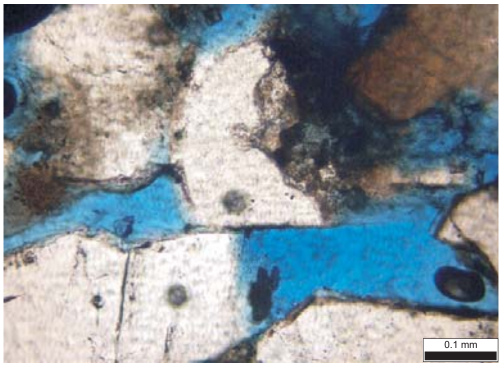


2212.20 m (pos. 2): quartz mylonite (weak) upper right mudstone intraclast (lower left)
200x ppl

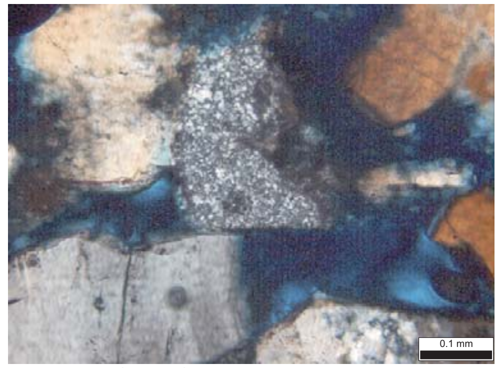


2212.20 m (pos. 2): quartz mylonite (weak) upper right mudstone intraclast (lower left)
200x xpl

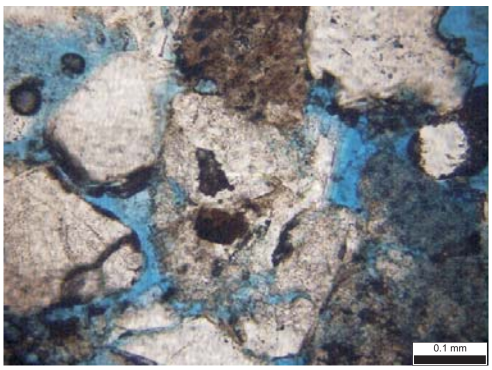
2212.20 metres



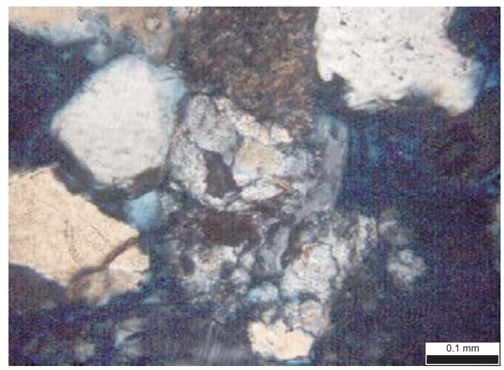
2212.20 m (pos. 3): intrusive rhyolite
200x ppl



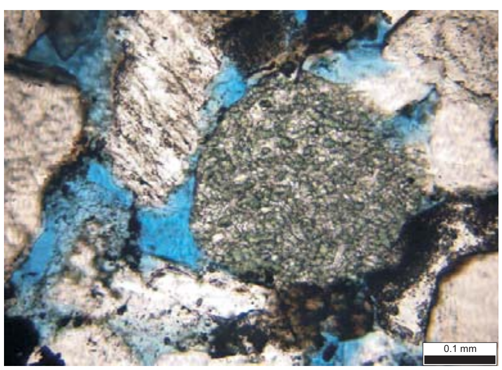
2212.20 m (pos. 3): intrusive rhyolite
200x xpl



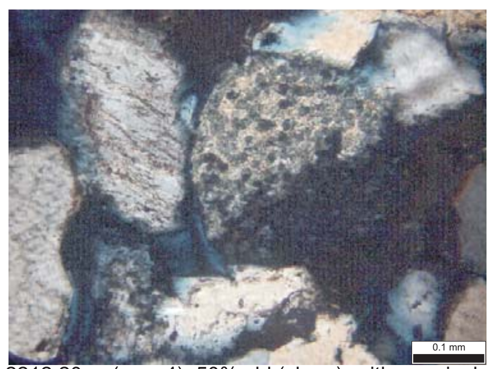
2212.20 m (pos. 4): polycrystalline quartz (from plutonic rock) (E) 200x ppl



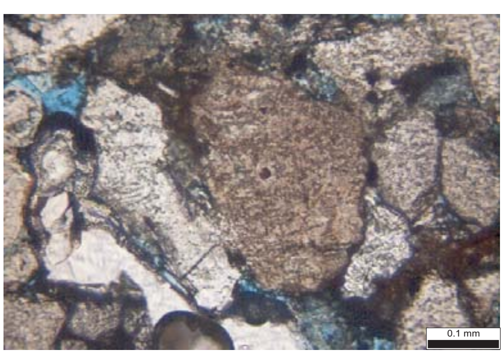
2212.20 m (pos. 4): polycrystalline quartz (from plutonic rock) (E) 200x xpl



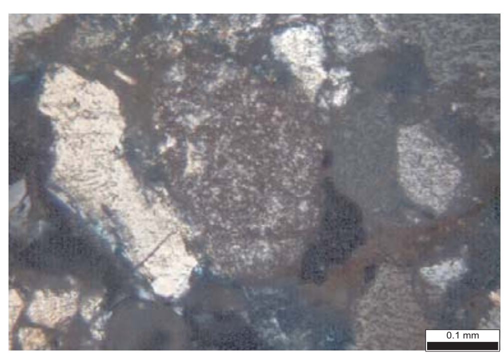
2212.20 m (pos. 4): 50% chl (clean), with vermicular textureplus 50% quartz. Clast probably comes from micrograniteor hydrothermal vein (EMP). 200x ppl



2212.20 m (pos. 4): 50% chl (clean), with vermicular textureplus 50% quartz. Clast probably comes from microgranite or hydrothermal vein (EMP). 200x ppl

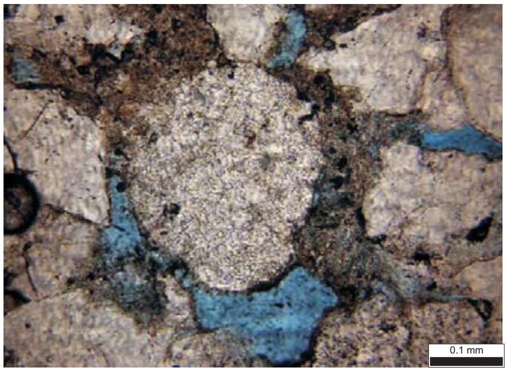


2212.20 m (pos. 5): intrusive rhyolite
200x ppl

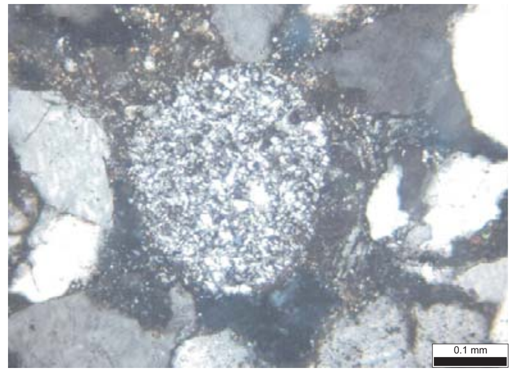


2212.20 m (pos. 5):intrusive rhyolite
200x xpl

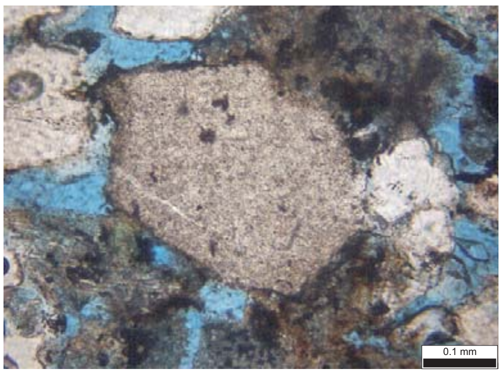
2212.20 metres



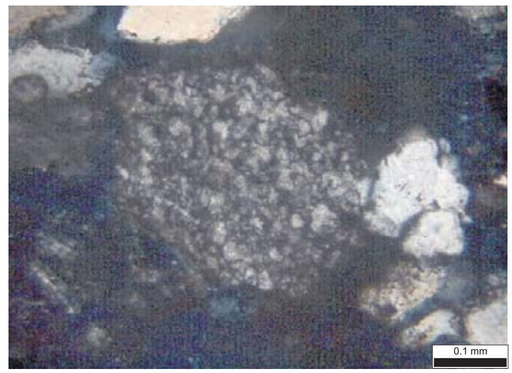
2212.20 m (pos. 6): microgranite (porphyry) (EMP)
200x ppl



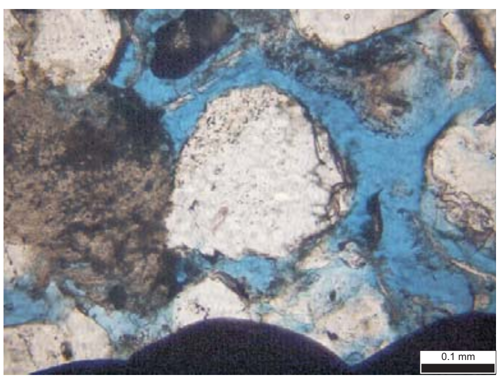
2212.20 m (pos. 6): microgranite (porphyry) (EMP)
200x xpl



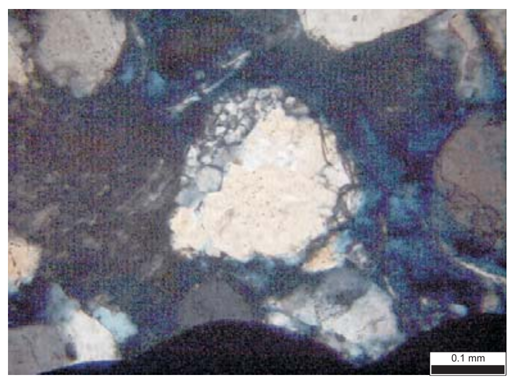
2212.20 m (pos. 7): microgranite (porphyry) (EMP)
200x ppl



2212.20 m (pos. 7): microgranite (porphyry) (EMP)
200x xpl

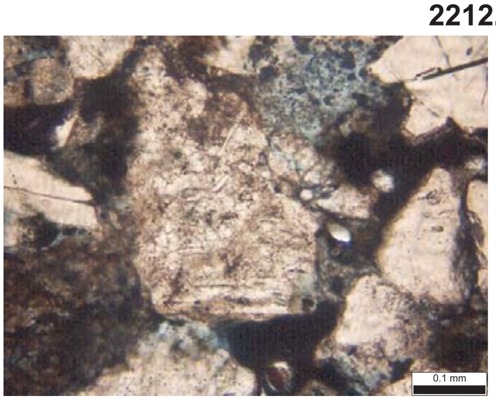


2212.20 m (pos. 8): quartz mylonite (weak)
200x ppl



2212.20 m (pos. 8): quartz mylonite (weak)
200x ppl

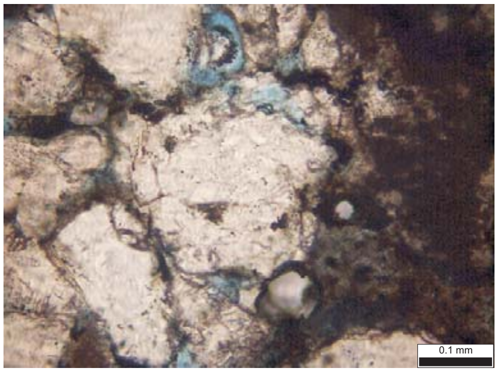
2212.91 metres



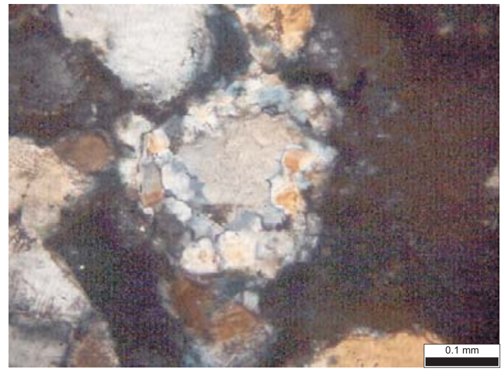
2212.91 m (pos. 1): myrmekite texture in
microgranite (EMP). 200x ppl

2212.91 m (pos. 1): myrmekite texture in
microgranite (EMP). 200x xpl

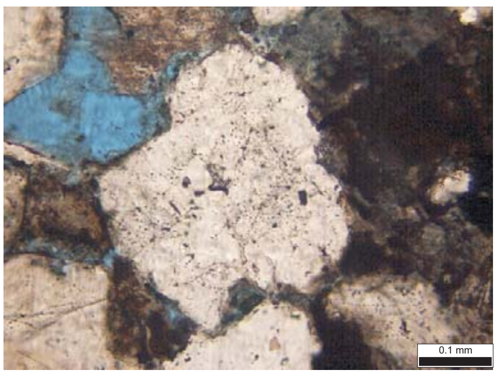
2212.91 metres



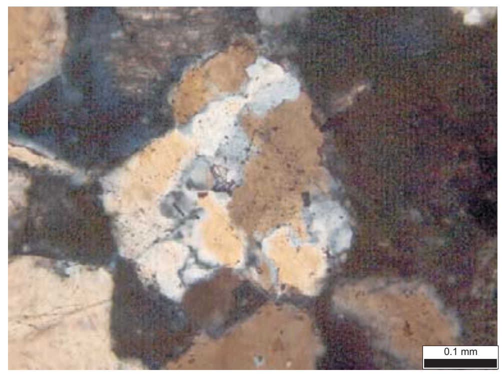
2212.91 m (pos. 2): quartz arenite (EMP)
200x ppl



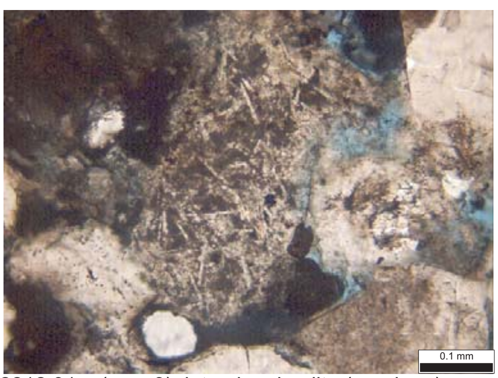
2212.91 m (pos. 2): quartz arenite (EMP)
200x xpl



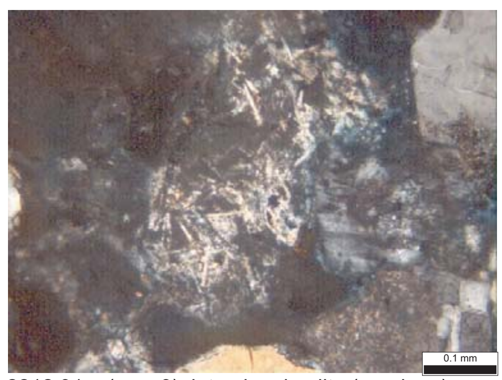
2212.91 m (pos. 3): intrusive rhyolite (porphyry) (EMP). 200x ppl



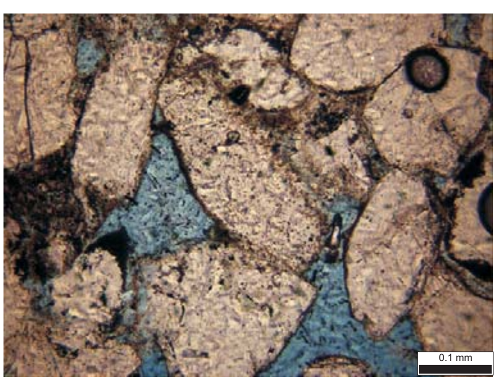
2212.91 m (pos. 3): intrusive rhyolite (porphyry) (EMP). 200x xpl



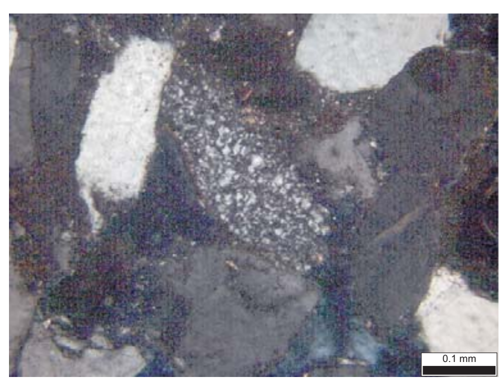
2212.91m (pos. 3): intrusive rhyolite (porphyry)
200x ppl



2212.91m (pos. 3): intrusive rhyolite (porphyry)
200x xpl

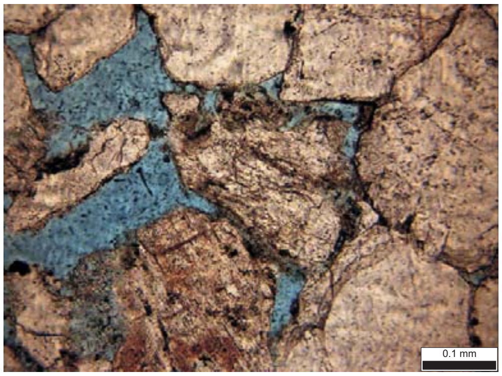


2212.91 m (pos. 4): intrusive rhyolite
200x ppl

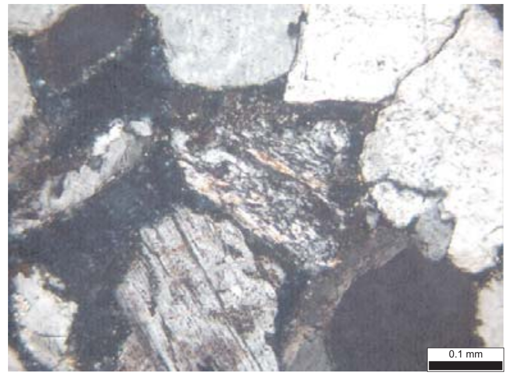


2212.91 m (pos. 4):intrusive rhyolite
200x xpl

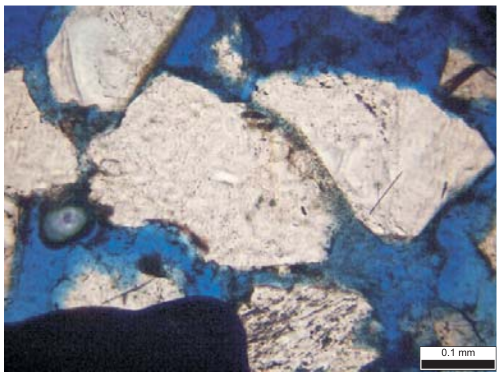
2212.91 metres



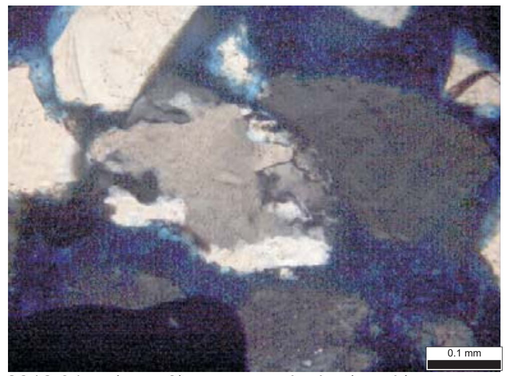
2212.91 m (pos. 5): quartz schist clast (H)
200x ppl



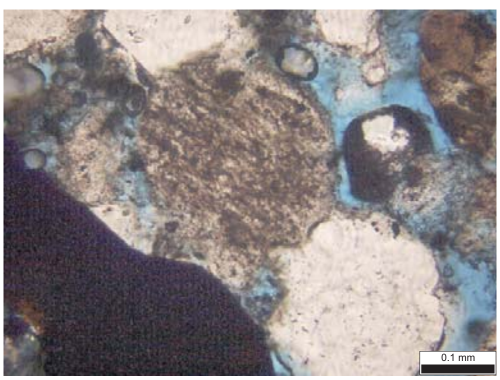
2212.91 m (pos. 5): quartz schist clast (H)
200x xpl



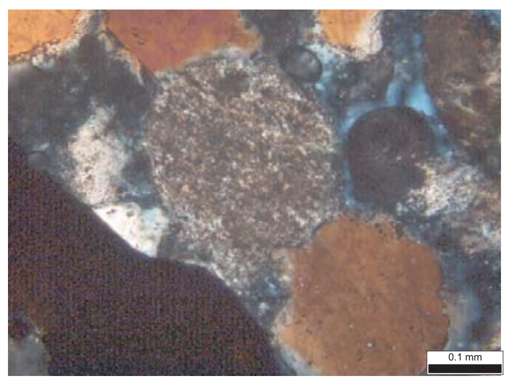
2212.91 m (pos. 6): quartz mylonite (weak)
200x ppl



2212.91 m (pos. 6): quartz mylonite (weak)
200x xpl

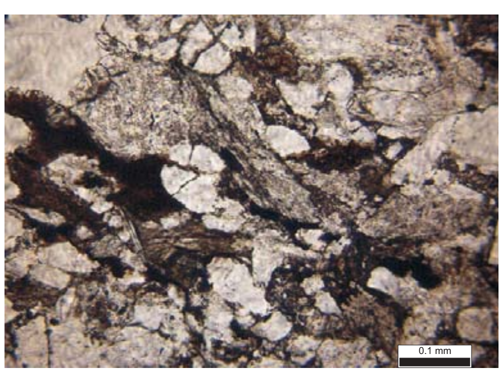


2212.91 m (pos. 7): laminated siltstone
200x ppl

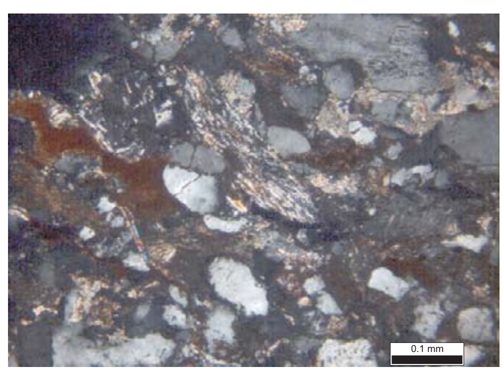


2212.91 m (pos. 7): laminated siltstone
200x xpl

2217.21 metres

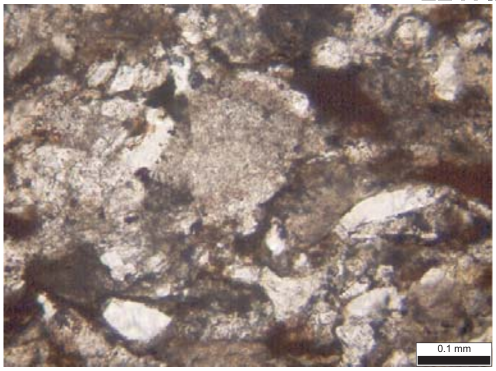


2217.21 m (pos. 1): polycrystalline quartz (weakly foliated) (A). 200x ppl

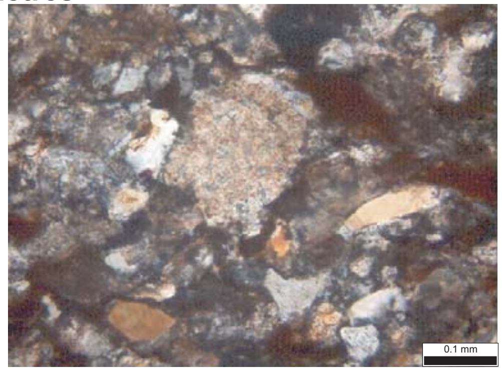


2217.21 m (pos. 1): polycrystalline quartz (weakly foliated) (A). 200x xpl

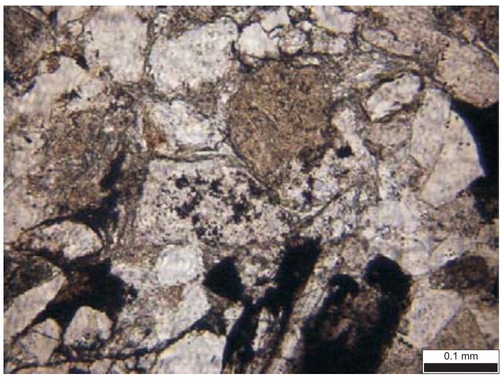
2217.21 metres



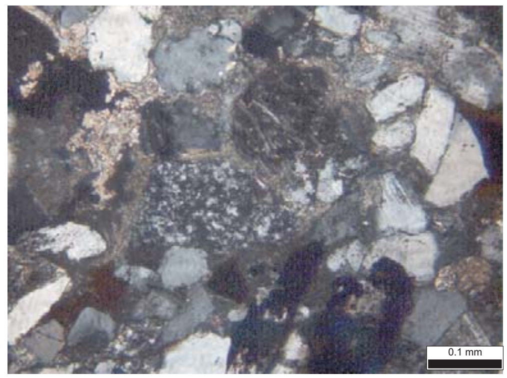
2217.21 m (pos. 3): mudstone clast
200x ppl



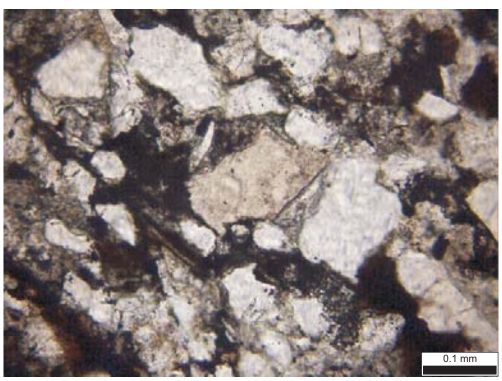
2217.21 m (pos. 3): mudstone clast
200x xpl



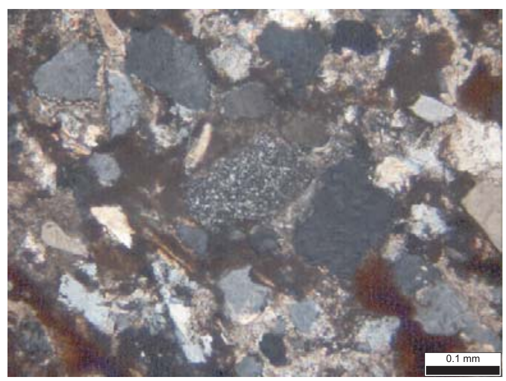
2217.21 m (pos. 4): rhyolite (upper centre)
200x ppl



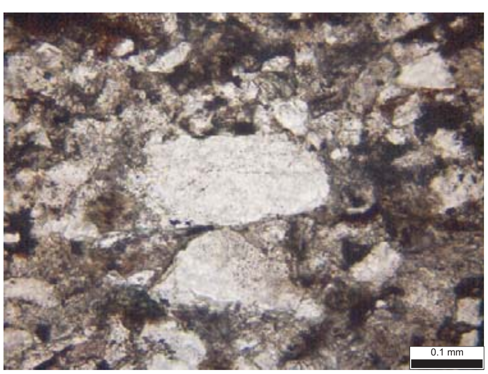
2217.21 m (pos. 4): rhyolite (upper centre)
200x xpl



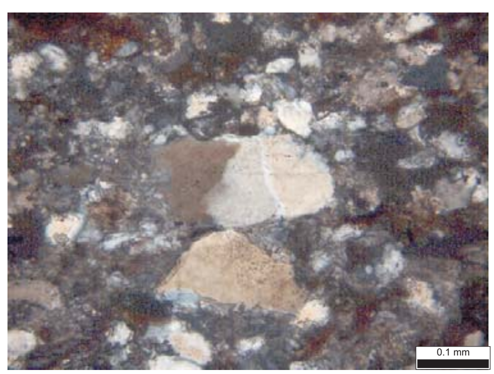
2217.21 m (pos. 5): rhyolite
200x ppl



2217.21 m (pos. 5): rhyolite
200x xpl

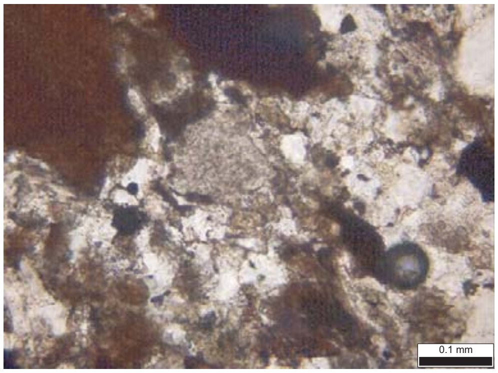


2217.21 m (pos. 6): polycrystalline quartz (from plutonic rock) (E). 200x ppl

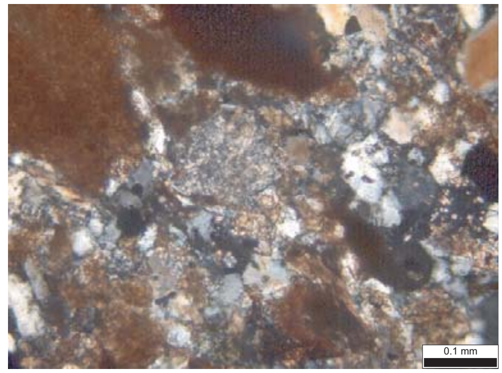


2217.21 m (pos. 6): polycrystalline quartz (from plutonicrock) (E). 200x xpl

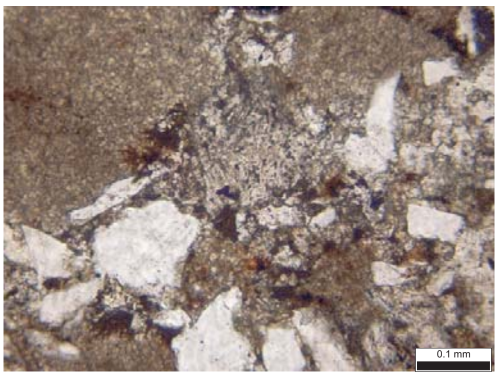
2217.57 metres



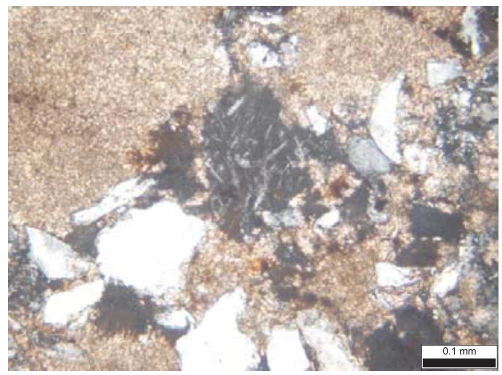
2217.57 m (pos.1): mudstone (clast)
200x ppl



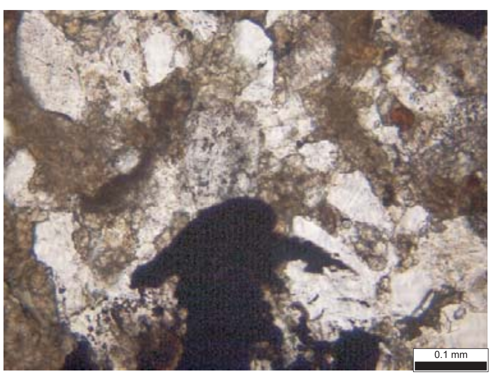
2217.57 m (pos.1): mudstone (clast)
200x xpl



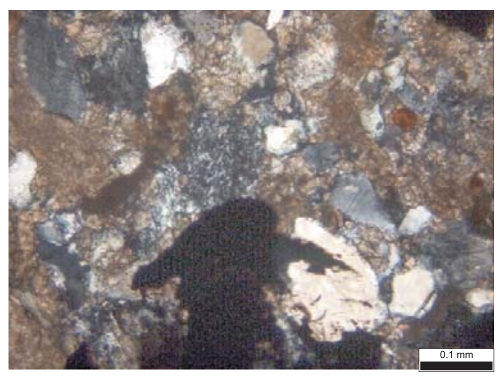
2217.57 m (pos. 2): K-feldspar clot (from felsic high level plutonic rock) (EMP)
200x ppl



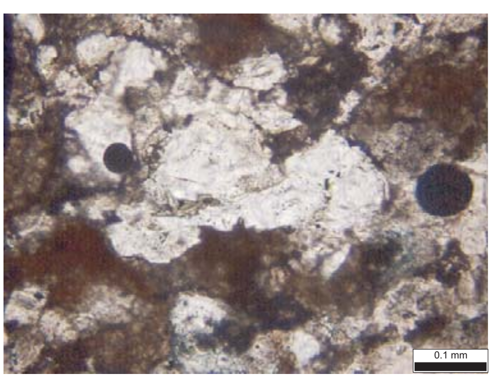
2217.57 m (pos. 2): K-feldspar clot (from felsic high level plutonic rock) (EMP)
200x xpl



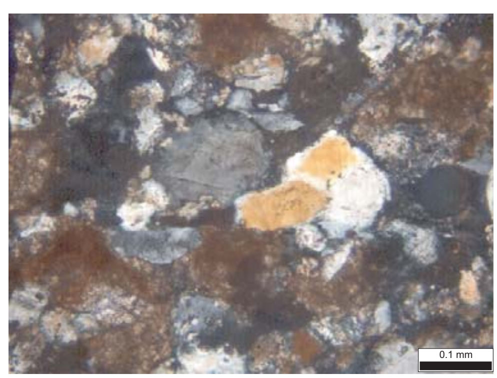
2217.57 m (pos. 3): rhyolite
200x ppl



2217.57 m (pos. 3): rhyolite
200x xpl

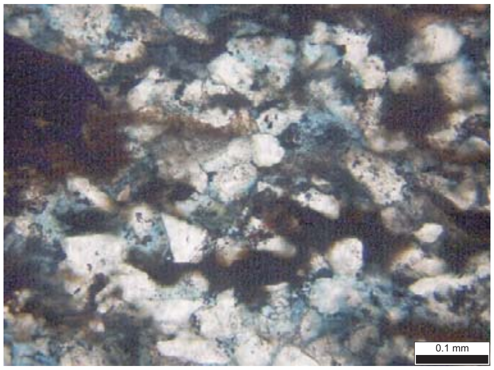


2217.57 m (pos. 4): polycrystalline quartz (from plutonic rock) (E) 200x ppl

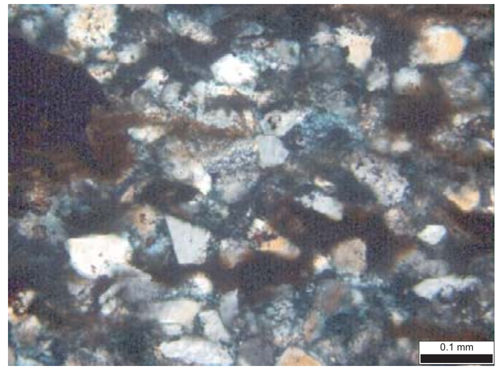


2217.57 m (pos. 4): polycrystalline quartz (from plutonic rock) (E) 200x xpl

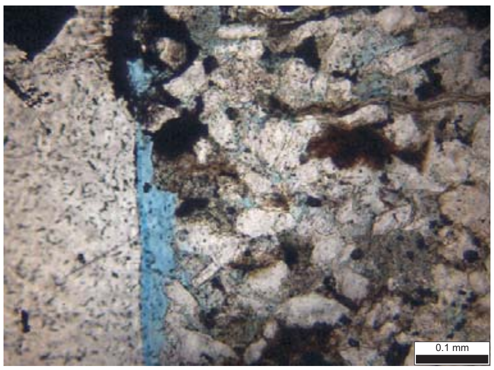
2217.96 metres



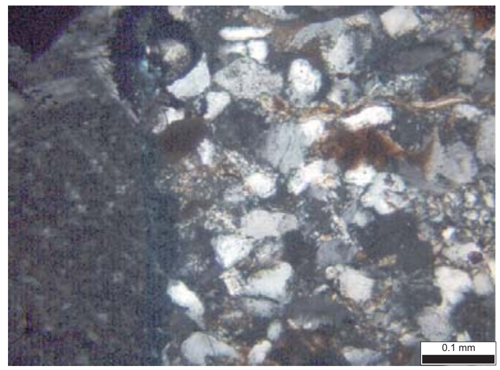
2217.96 m (pos. 1): porphyry or cement? (EMP)
200x ppl



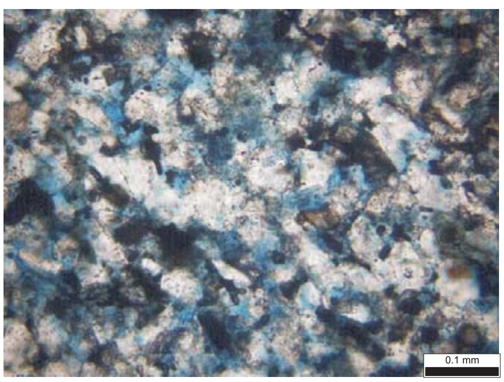
2217.96 m (pos. 1):porphyry or cement? (EMP)
200x xpl



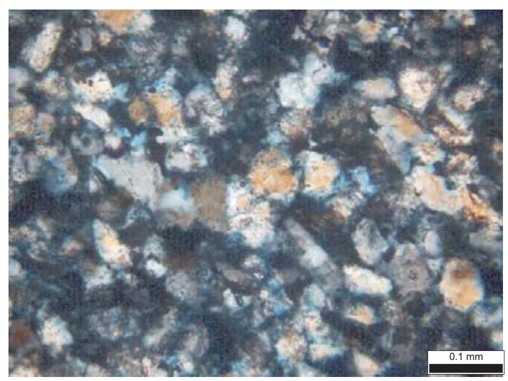
2217.96 m (pos. 2): rhyolite
200x ppl



2217.96 m (pos. 2): rhyolite
200x xpl

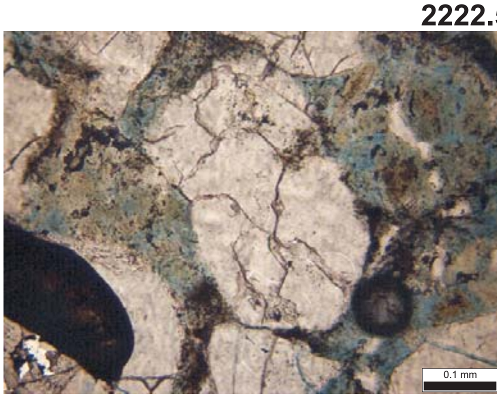


2217.96 m (pos. 3): polycrystalline quartz (from plutonic rock). 200x ppl

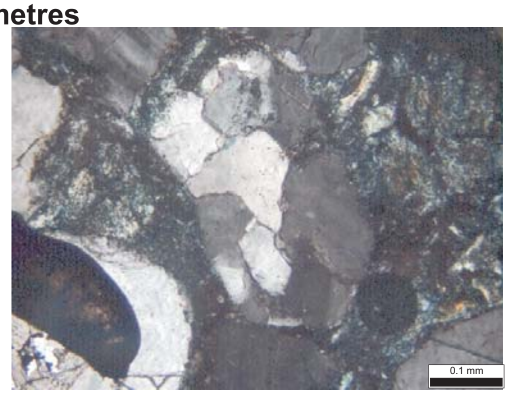


2217.96 m (pos. 3): polycrystalline quartz (from plutonic rock). 200x ppl

2222.59 metres

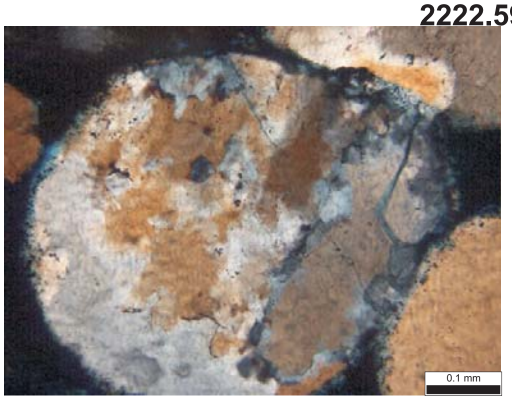


2222.59 m (pos. 1): polycrystalline quartz (from plutonic rock) (E)
200x ppl

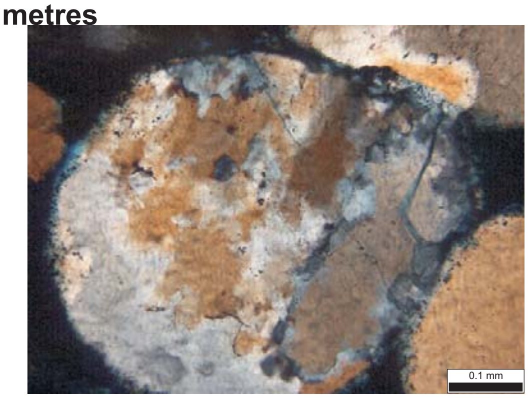


2222.59 m (pos. 1): polycrystalline quartz (from plutonic rock) (E)
200x xpl

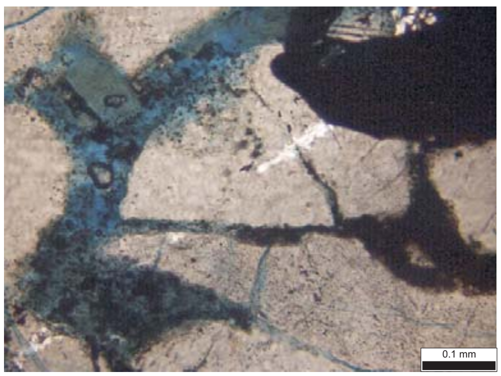
2222.59 metres



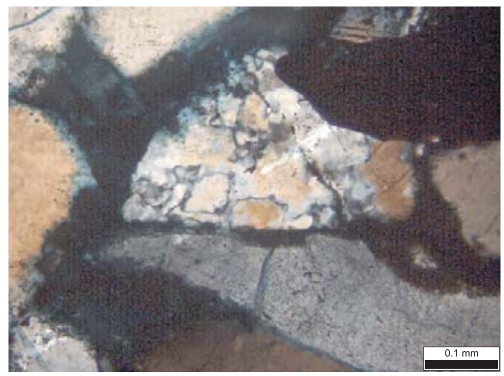
2222.59 m (pos. 2): quartz mylonite (weak)
200x xpl



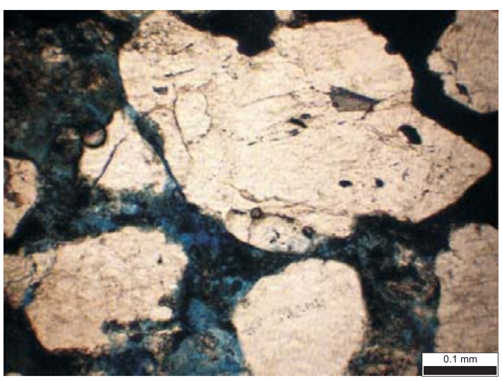
2222.59 m (pos. 2): quartz mylonite (weak)
200x xpl



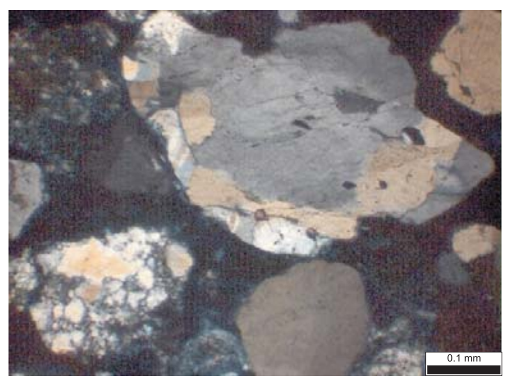
2222.59 m (pos. 2): polycrystalline quartz (from gneiss) (D). 200x ppl



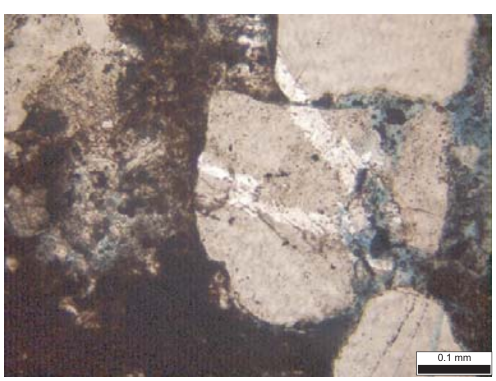
2222.59 m (pos. 2): polycrystalline quartz (from gneiss) (D). 200x xpl



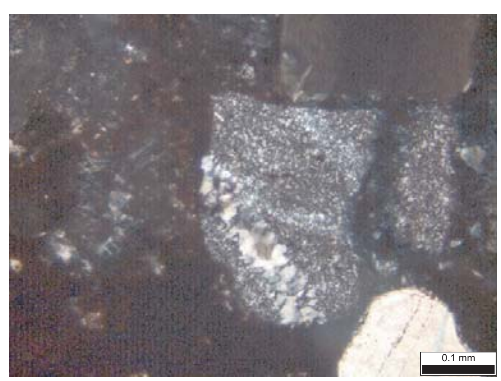
2222.59 m (pos. 2):quartz mylonite (weak)
200x ppl



2222.59 m (pos. 2): quartz mylonite (weak)
200x xpl

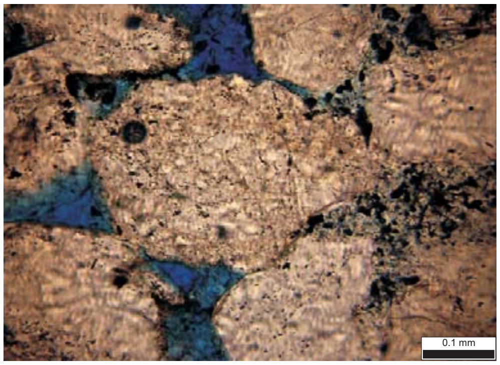


2222.59 m (pos. 3): syenite/intrusive rhyolite (O)
200x ppl

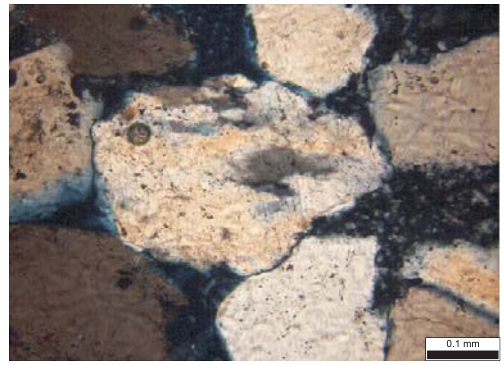


2222.59 m (pos. 3): syenite/intrusive rhyolite (O)
200x ppl

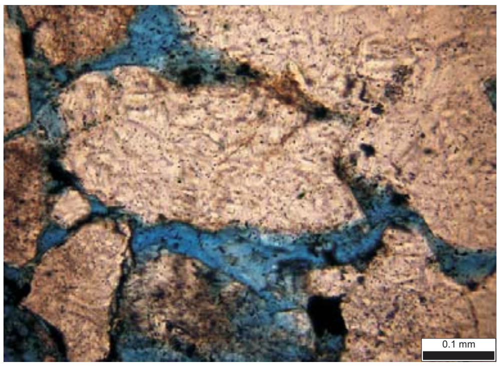
2225.45 metres



2225.45 m (pos. 5): polycrystalline quartz (from gneiss) (D). 200x ppl

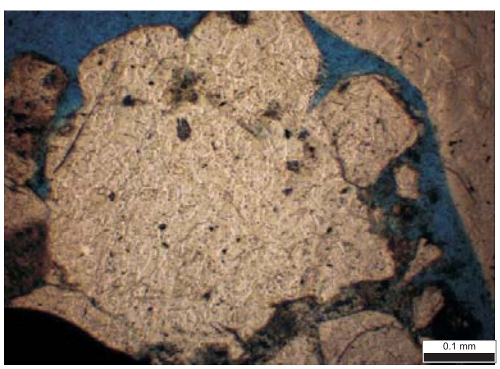


2225.45 m (pos. 5): polycrystalline quartz (from gneiss) (D). 200x xpl

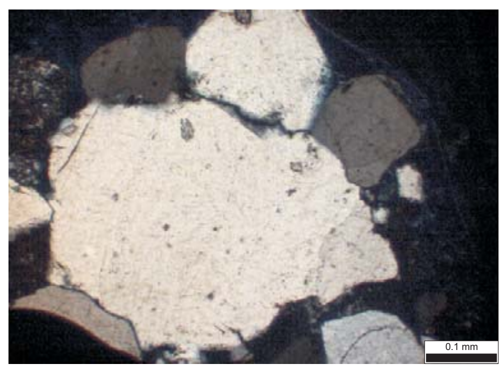


2225.45 m (pos. 7): polycrystalline quartz (from plutonic rock). 200x ppl

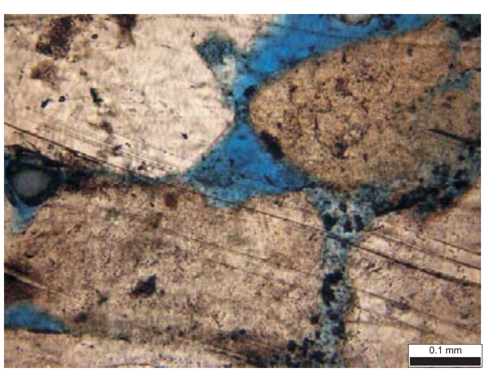
2225.45 m (pos. 7): polycrystalline quartz (from plutonic rock). 200x xpl



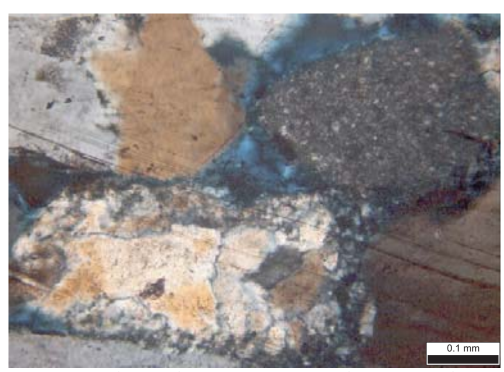
2225.45 m (pos. 7): polycrystalline (from plutonic rock). 200x ppl



2225.45 m (pos. 7): polycrystalline (from plutonic rock). 200x xpl

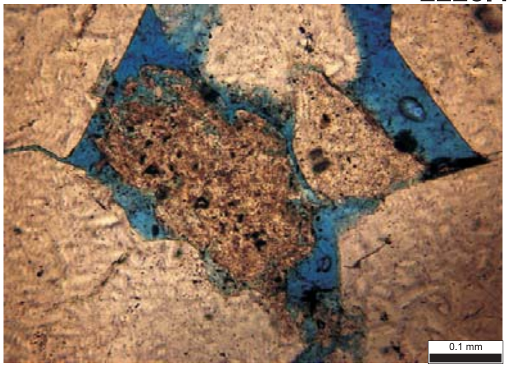


2225.45 m (pos. 8): mudstone clast (upper right)
quartz mylonite (strong) (lower left)
200x ppl

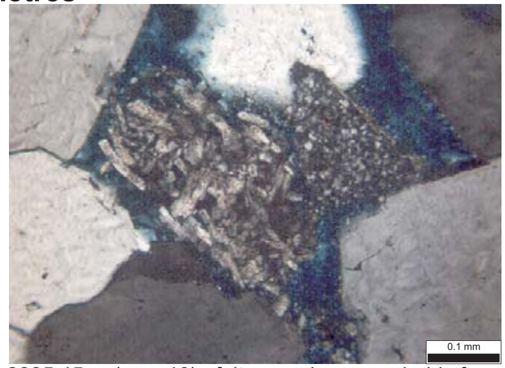


2225.45 m (pos. 8): mudstone clast (upper right)
quartz mylonite (strong) (lower left)
200x ppl

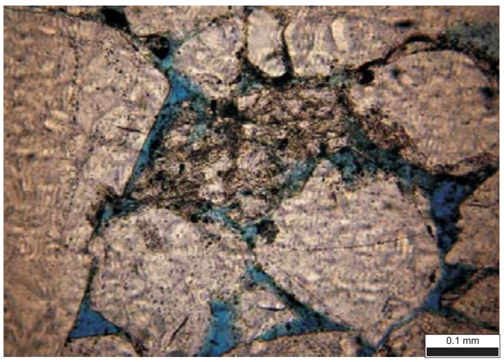
2225.45 metres



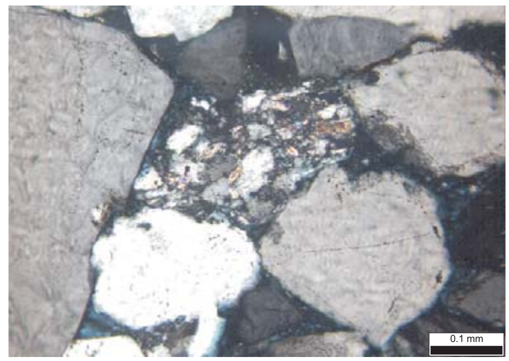
2225.45 m (pos. 10): felty groudmass probably from an intrusive rhyolite (EMP). 200x ppl



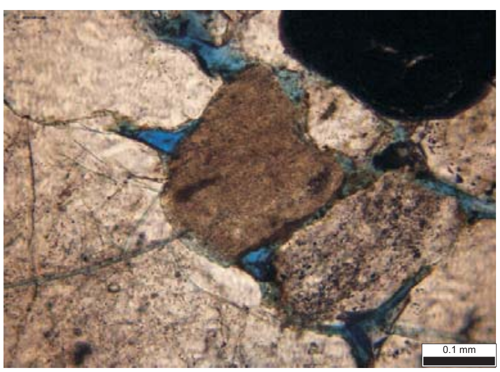
2225.45 m (pos. 10): felty groudmass probably from an intrusive rhyolite (EMP). 200x xpl



2225.45 m (pos. 12): fine-grained grey-wacke (I) (DM) 200x ppl

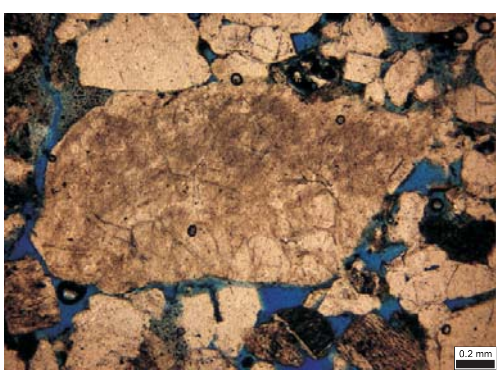


2225.45 m (pos. 12): fine-grained grey-wacke (I) (DM) 200x xpl

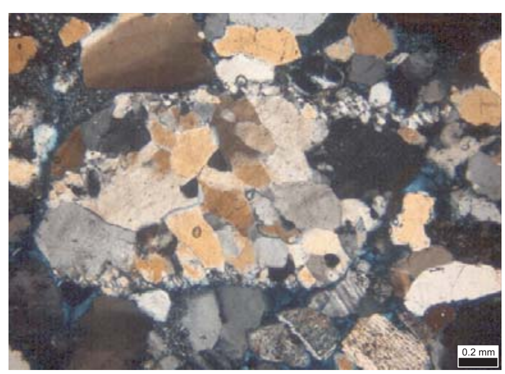


2225.45 m (pos. 14): mudstone clast 200x ppl

2225.45 m (pos. 14): mudstone clast 200x xpl

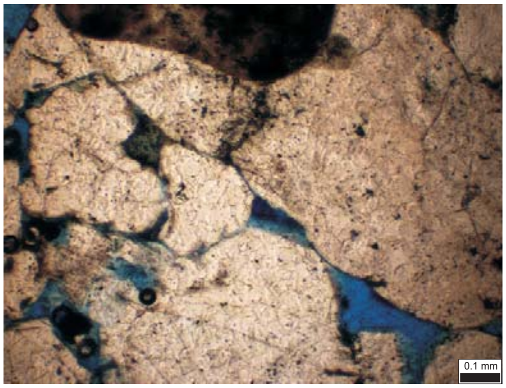


2225.45 m (pos. 15): quartz mylonite (strong) 50x ppl

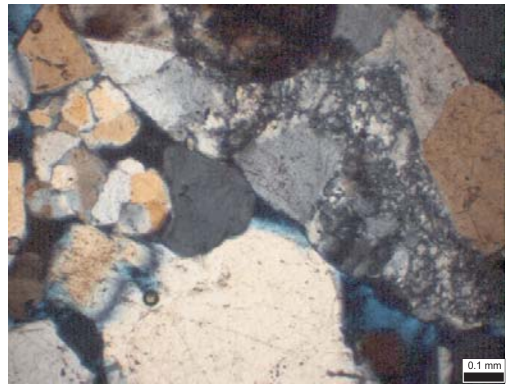


2225.45 m (pos. 15): quartz mylonite (strong) 50x ppl

2225.45 metres

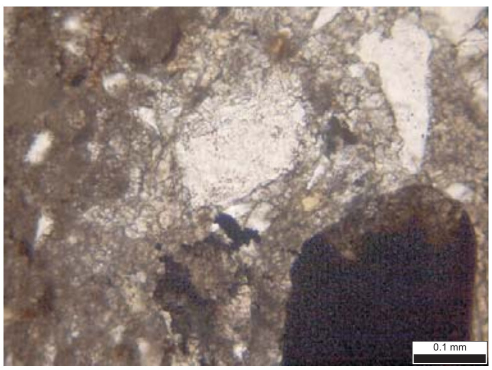


2225.45 m (pos. 16): syenite/intrusive rhyolite (K) (EMP)
100x ppl

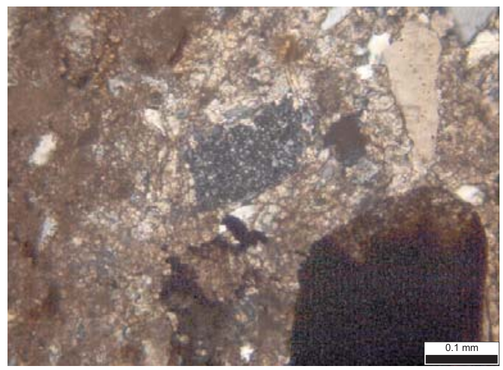


2225.45 m (pos. 16):syenite/intrusive rhyolite (K) (EMP)
100x ppl

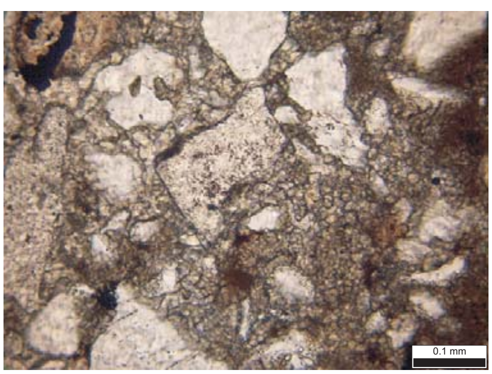
2227.34 metres



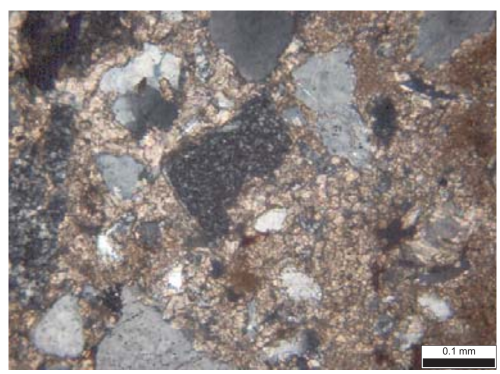
2227.34 m (pos. 1) :rhyolite
200x ppl



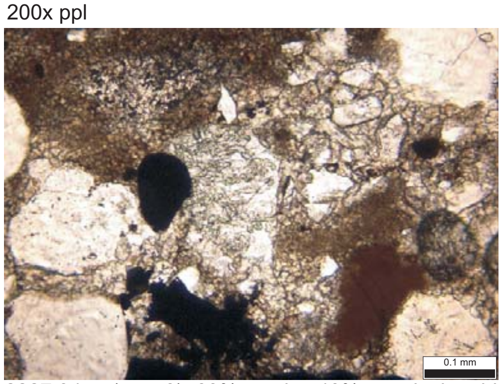
2227.34 m (pos. 1): rhyolite
200x xpl



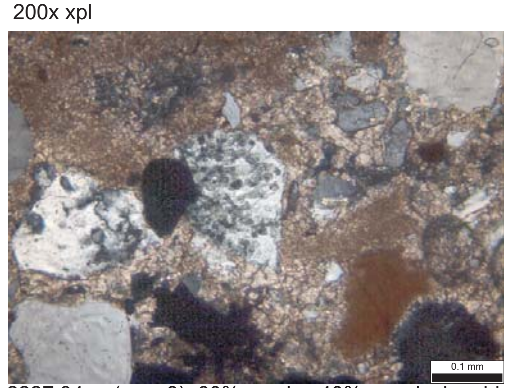
2227.34 m (pos. 2): rhyolite
200x ppl



2227.34 m (pos. 2): rhyolite
200x xpl

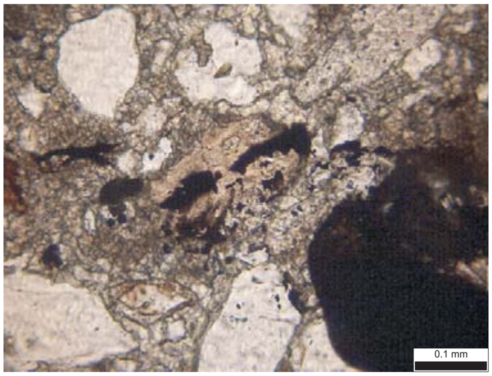


2227.34 m (pos. 3): 60% qz plus 40% vermicular chl. chl maybe altered from sodic amphibole as seen in micrograntes from the Mallard (M-45) well (vermicular intergrowths of qaurtz and sodic amphibole) or this may be a clast from a vein (EMP). 200x ppl

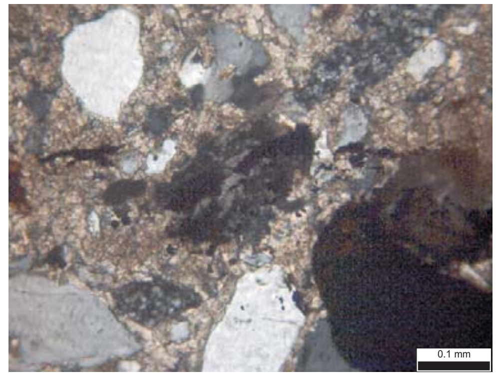


2227.34 m (pos. 3): 60% qz plus 40% vermicular chl. chl may be altered from sodic amphibole as seen in micrograntes from the Mallard (M-45) well (vermicular intergrowths of quartz and sodic amphibole) or this may be a clast from a vein (EMP). 200x ppl

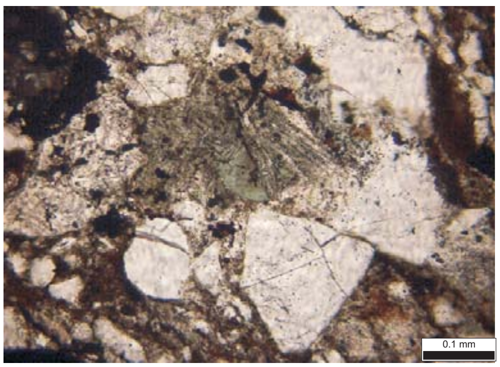
2227.34 metres



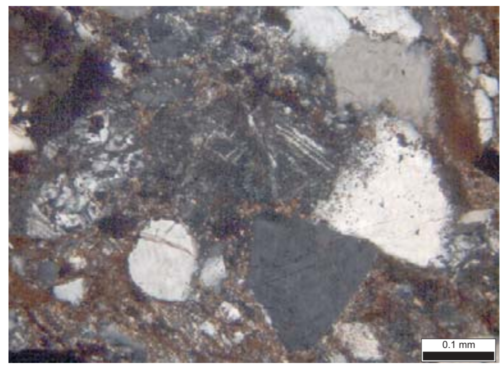
2227.34 m (pos. 4): rhyolite
200x ppl



2227.34 m (pos. 4): rhyolite
200x xpl

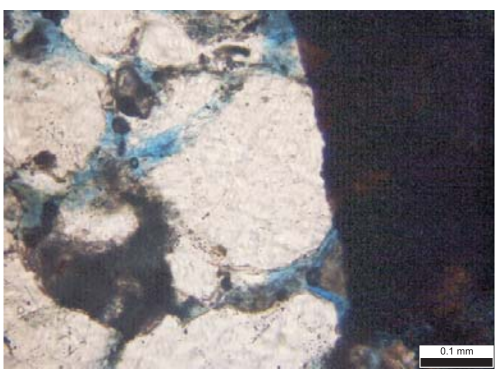


2227.34 m (pos. 5): quartz diorite (center), quartz from plutonic rock (upper right)
200x ppl

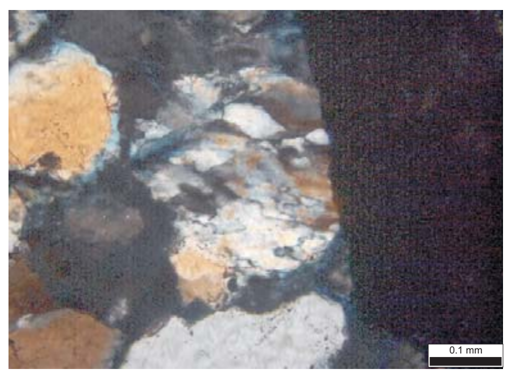


2227.34 m (pos. 5): quartz diorite (center), quartz from plutonic rock (upper right). 200x ppl

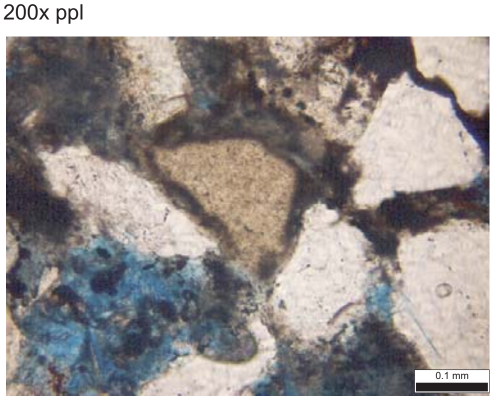
2228.42metres



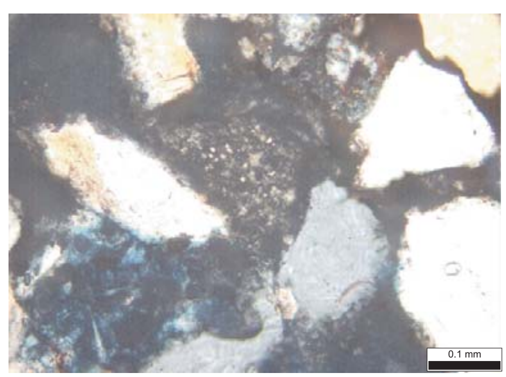
2228.42 m (pos. 1): quartz mylonite (weak)
200x ppl



2228.42 m (pos. 1): quartz mylonite (weak)
200x ppl

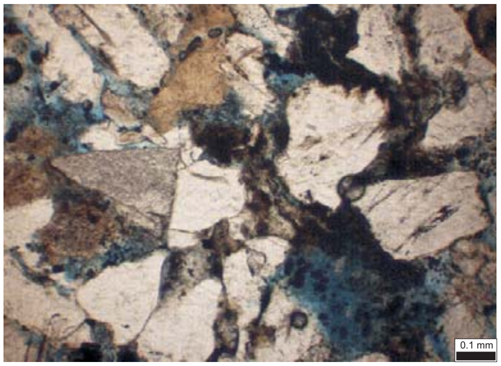


2228.42 m (pos. 1): rhyolite
200x ppl

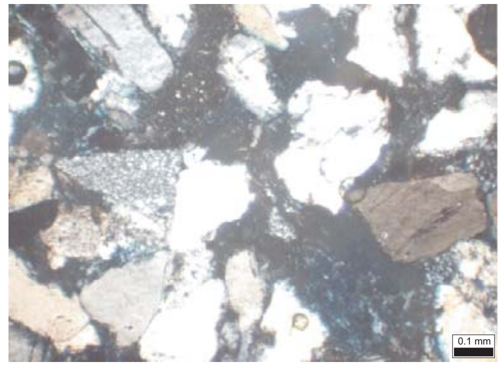


2228.42 m (pos. 1): rhyolite
200x xpl

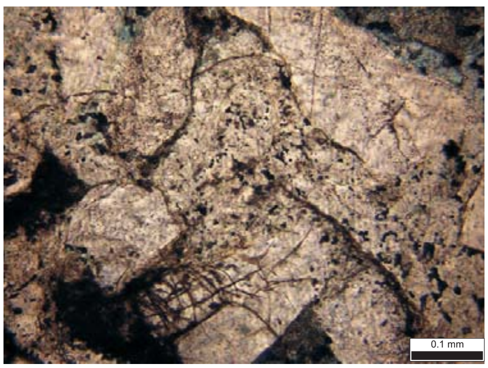
2228.42metres



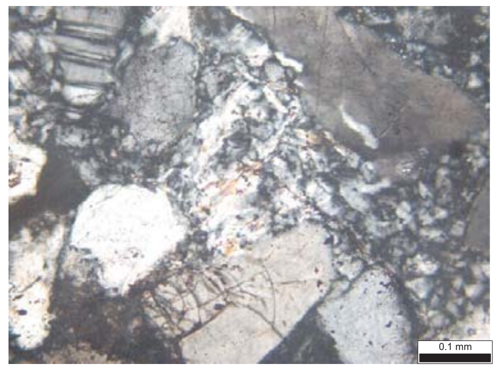
2228.42 m (pos. 2): microgranite (porphyry) (centre left). 100x ppl



2228.42 m (pos. 2): microgranite (porphyry) (centre left). 100x xpl

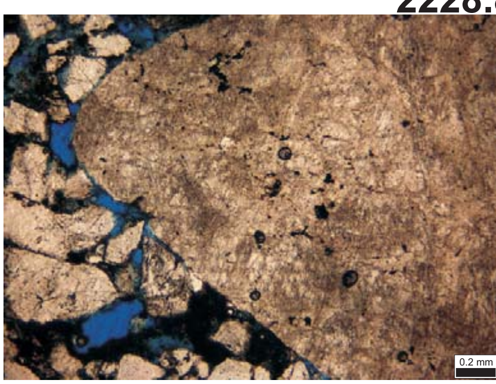


2228.42 m (pos. 3): quartz arenite (clast) 200x ppl

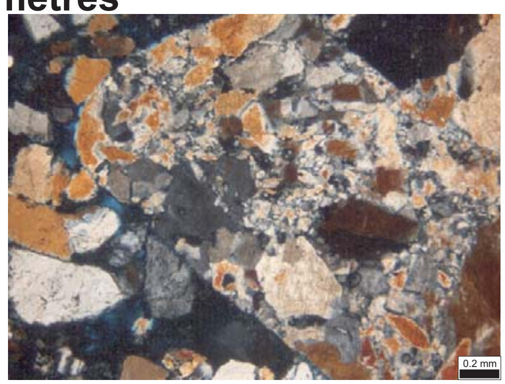


2228.42 m (pos. 3): quartz arenite (clast) 200x xpl

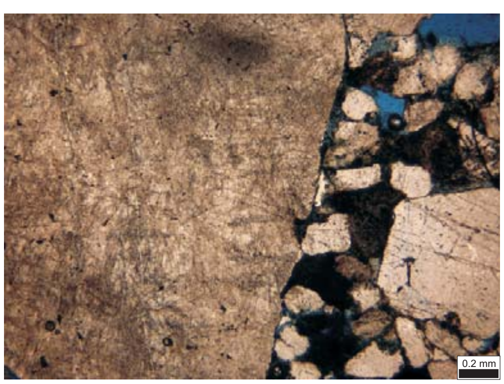
2228.82 metres



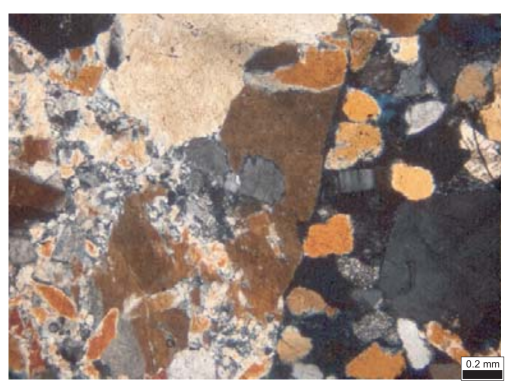
2228.82 m (pos. 1): poorly sorted quartz arenite (clast). 50x ppl



2228.82 m (pos. 1): poorly sorted quartz arenite (clast). 50x xpl

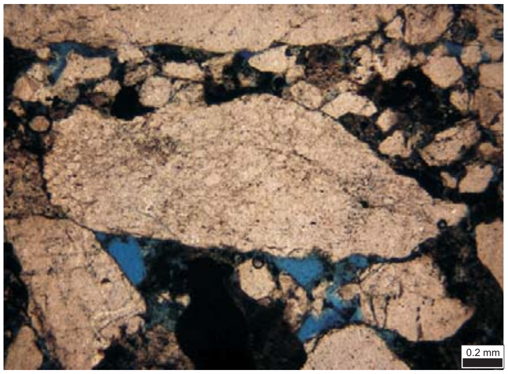


2228.82 m (pos. 1): poorly sorted quartz arenite (clast). 50x ppl

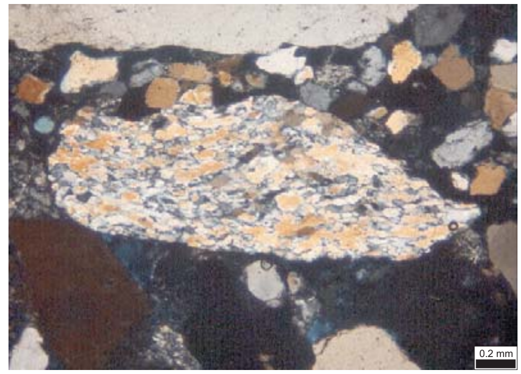


2228.82 m (pos. 1): poorly sorted quartz arenite (clast). 50x ppl

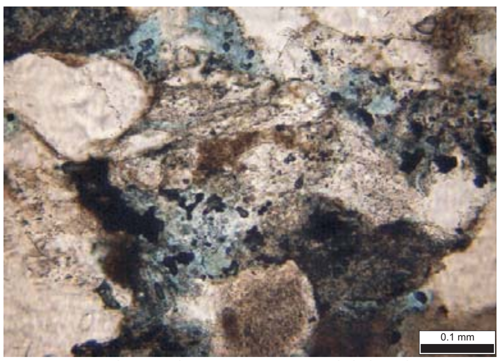
2228.82 metres



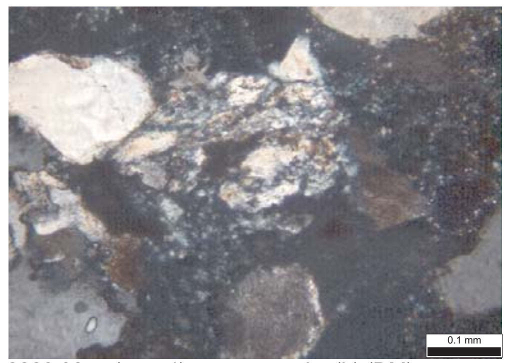
2228.82 m (pos. 3): quartz mylonite (strong)
50x ppl



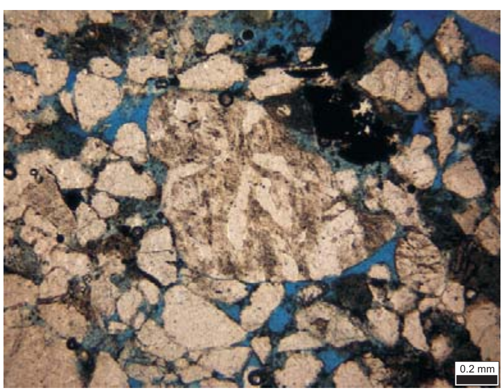
2228.82 m (pos. 3): quartz mylonite (strong)
50x xpl



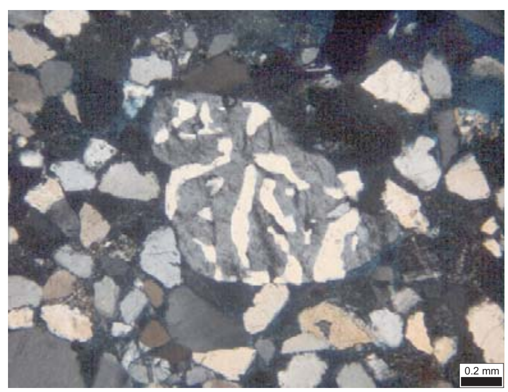
2228.82 m (pos. 4): quartz arenite (L) (DM)
200x ppl



2228.82 m (pos. 4): quartz arenite (L) (DM)
200x xpl

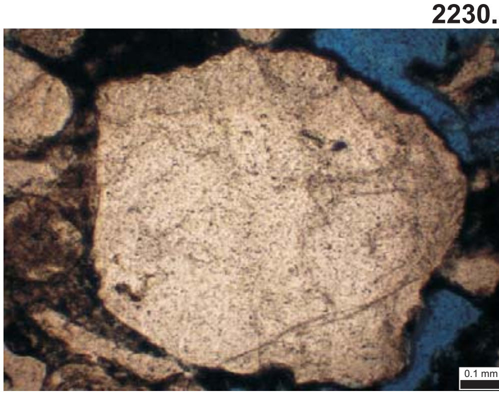


2228.82 m (pos. 6): microgranite (granophyric texture)
50x ppl

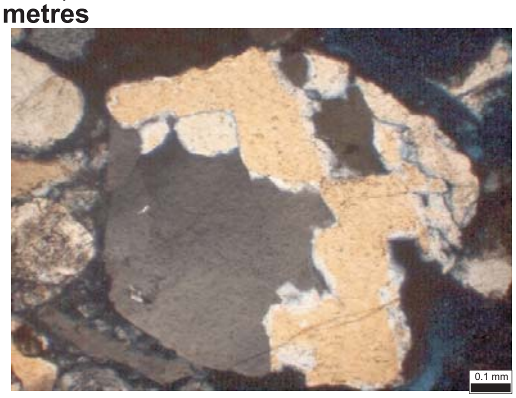


2228.82 m (pos. 6): microgranite (granophyric texture)
50x xpl

2230.62B metres

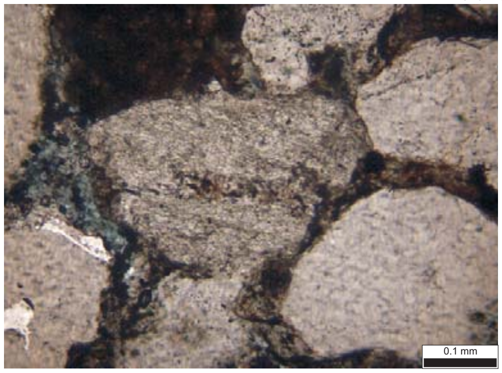


2230.62B (pos. 1): polycrystalline quartz (from plutonic rock) (E)
100x ppl

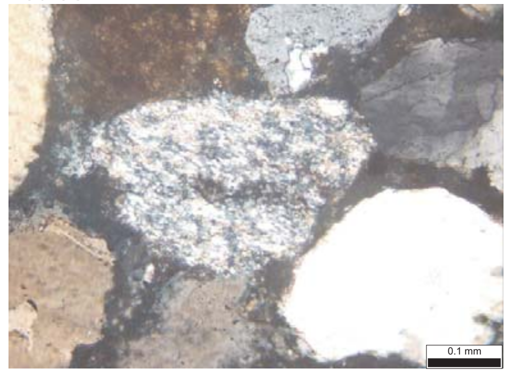


2230.62B (pos. 1): polycrystalline quartz (from plutonic rock) (E)
100x xpl

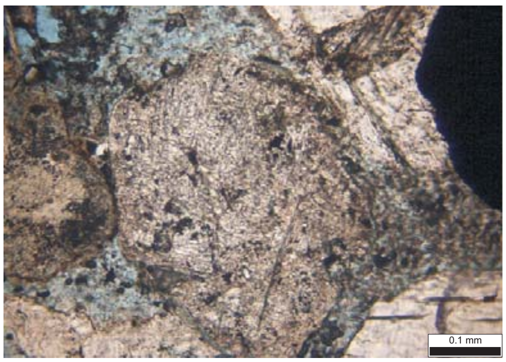
2230.62B metres



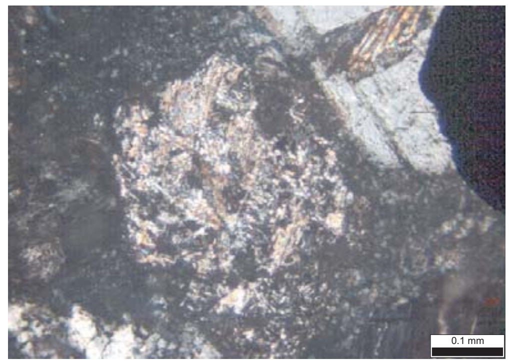
2230.62B (pos. 2): quartzite/slate (DM)
200x ppl



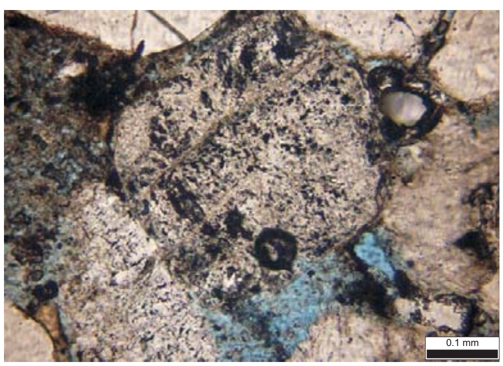
2230.62B (pos. 2): quartzite/slate (DM)
200x xpl



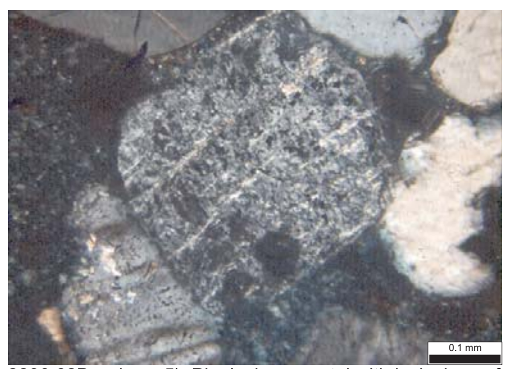
2230.62B m (pos. 4): siderite nodule (as a clast)?
200x ppl



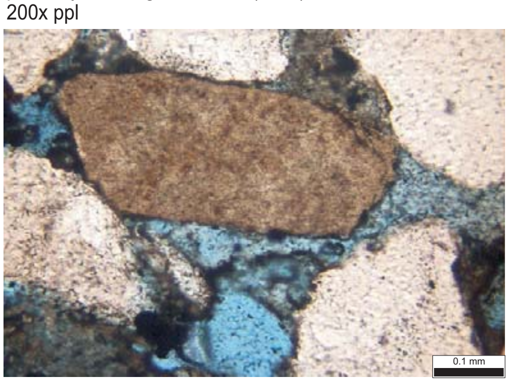
2230.62B m (pos. 4): siderite nodule (as a clast)?
200x xpl



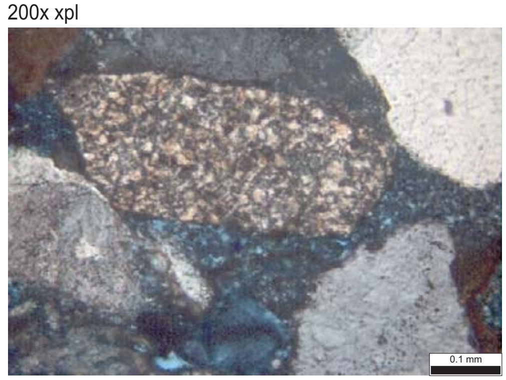
2230.62B m (pos. 5): Plagioclase crystal with inclusions of muscovite, and ferromagnesian minerals altering to siderite, probably from a granodiorite (EMP).
200x ppl



2230.62B m (pos. 5): Plagioclase crystal with inclusions of muscovite, and ferromagnesian minerals altering to siderite, probably from a granodiorite (EMP).
200x xpl

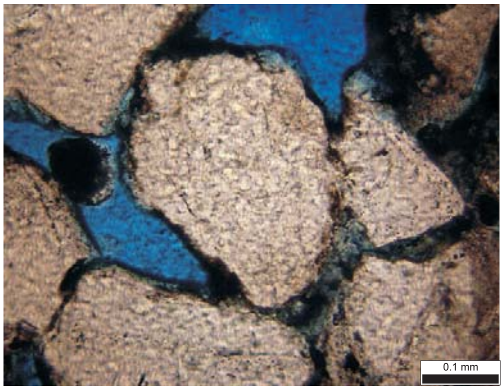


2230.62B m (pos. 6) microgranite (porphyry) with Mg-rich chl (EMP)
200x ppl

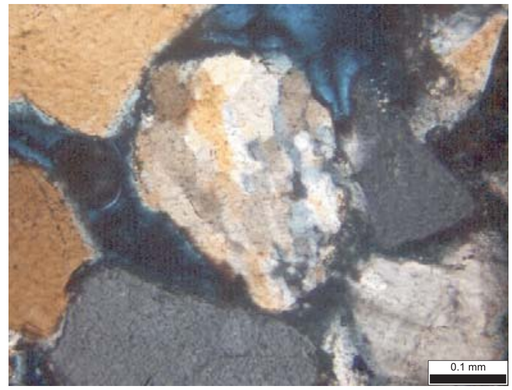


2230.62B m (pos. 6) microgranite (porphyry) with Mg-rich chl (EMP)
200x ppl

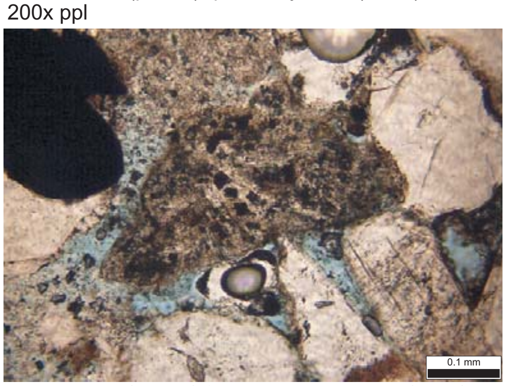
2230.62B metres



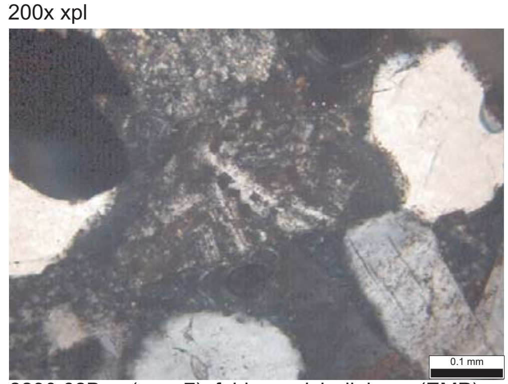
2230.62B m (pos. 6):quartz mylonite (weak)
200x ppl



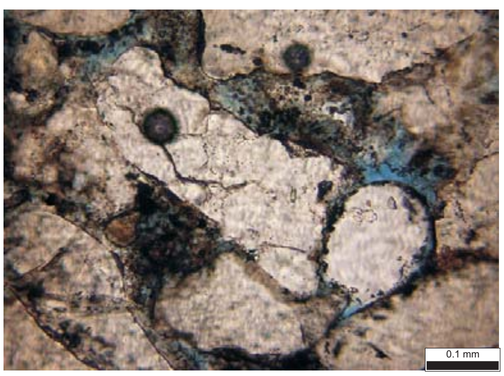
2230.62B m (pos. 6): quartz mylonite (weak)
200x xpl



2230.62B m (pos. 7):feldspar-rich disbase (EMP)
200x ppl

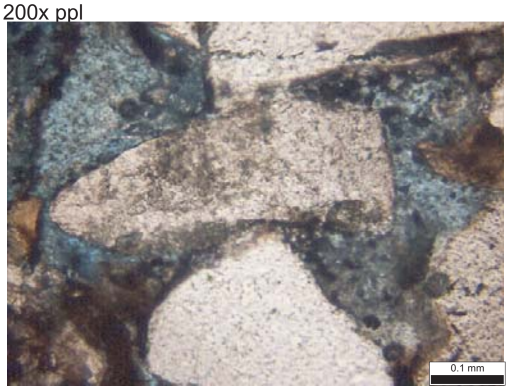


2230.62B m (pos. 7): feldspar-rich diabase (EMP)
200x xpl

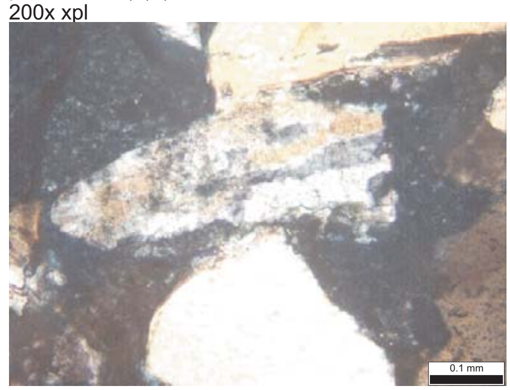


2230.62B m (pos. 9): polycrystalline quartz (from plutonic rock) (E)
200x ppl

2230.62B m (pos. 9): polycrystalline quartz (from plutonic rock) (E)
200x xpl

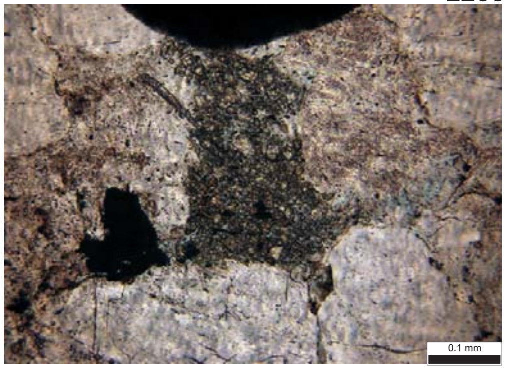


2230.62B m (pos. 10): gneiss with chlorite (D) (EMP)
200x ppl

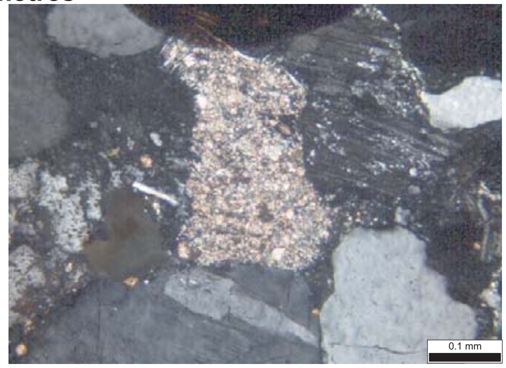


2230.62B m (pos. 10): gneiss with chlorite (D) (EMP)
200x xpl

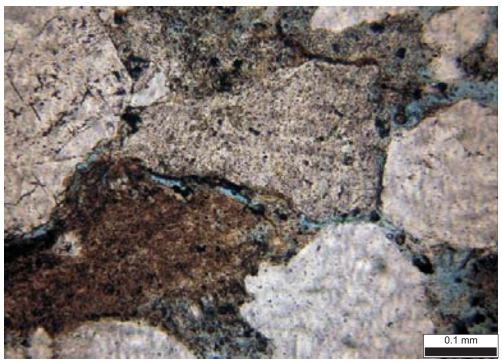
2233.62metres



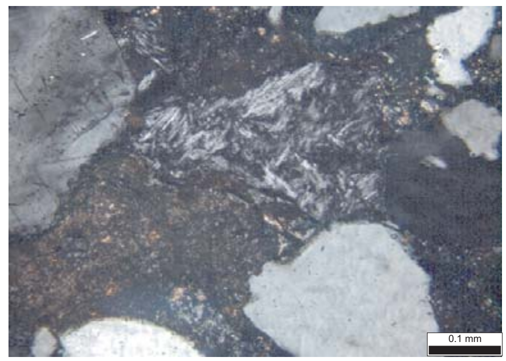
2233.62 m (pos. 3): pore filling (sd+kln+chl+ill)
200x ppl



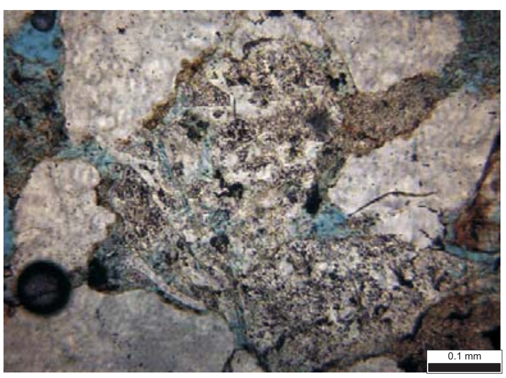
2233.62 m (pos. 3): pore filling (sd+kln+chl+ill)
200x xpl



2233.62 m (pos. 3): intrusive rhyolite
200x ppl

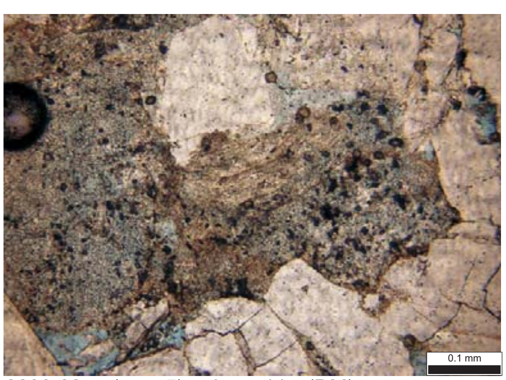


2233.62 m (pos. 3): intrusive rhyolite
200x xpl

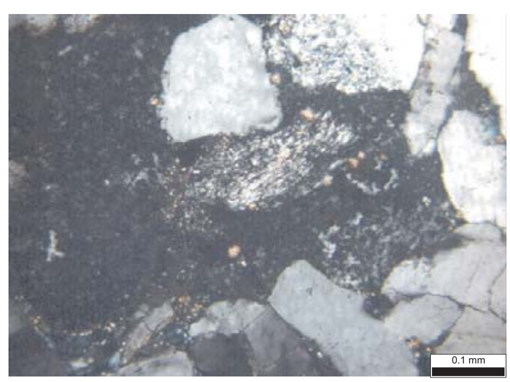


2233.62 m (pos. 4): microgranite (granophyric texture)
200x ppl

2233.62 m (pos. 4): microgranite (granophyric texture)
200x xpl

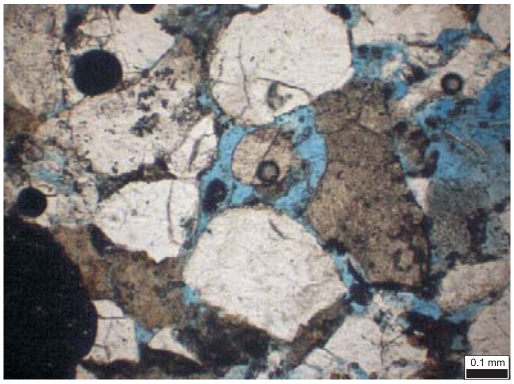


2233.62 m (pos. 5): mica schist (DM)
200x ppl

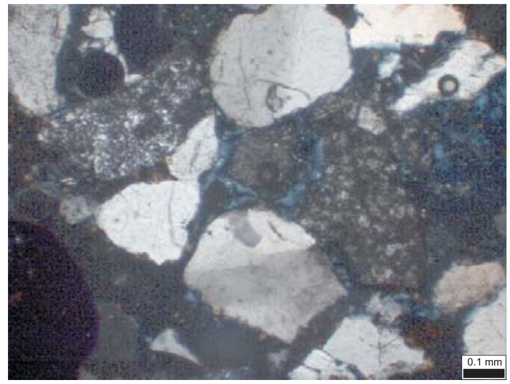


2233.62 m (pos. 5): mica schist (DM)
200x xpl

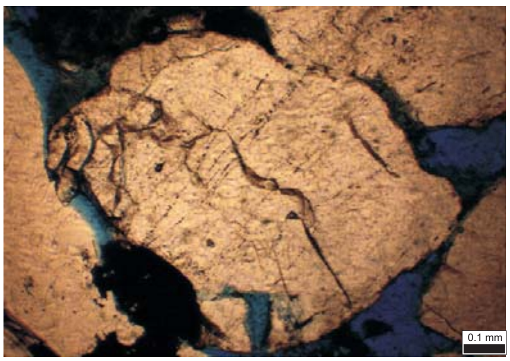
2233.62metres



2233.62 m (pos. 8): intrusive rhyolite (porphyry)
100x ppl

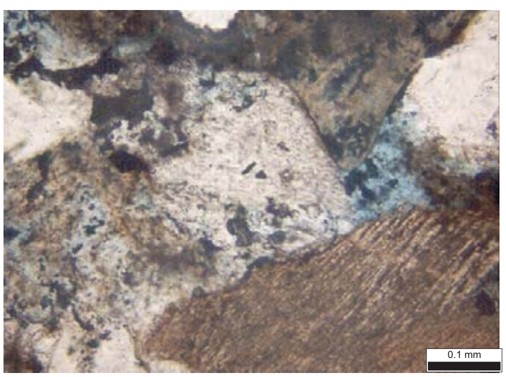


2233.62 m (pos. 8): intrusive rhyolite (porphyry)
100x xpl

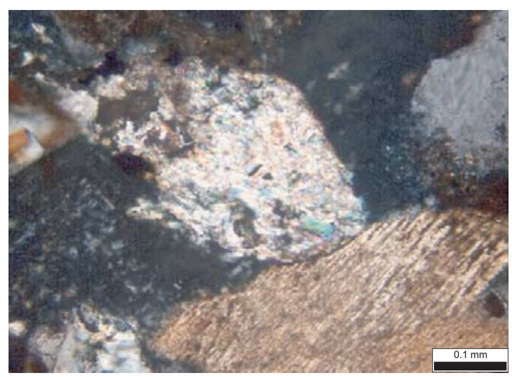


2233.62 m (pos. 9): polycrystalline quartz (from plutonic rock) (E). 100x ppl

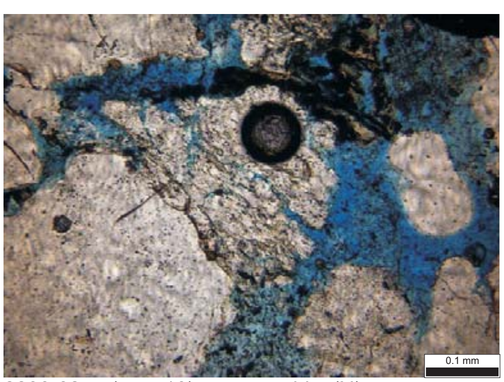
2233.62 m (pos. 9): polycrystalline quartz (from plutonic rock) (E). 100x xpl



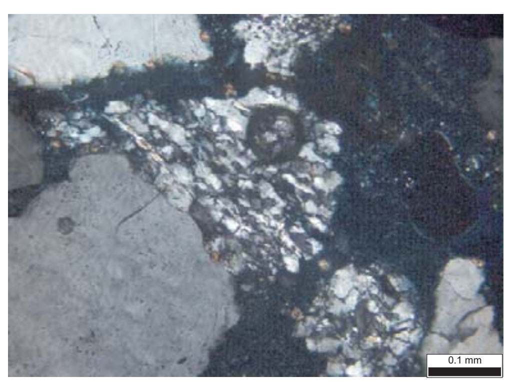
2233.62 m (pos. 9): limestone
200x ppl



2233.62 m (pos. 9): limestone
200x xpl

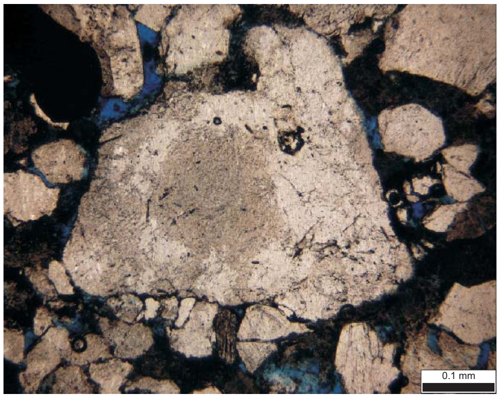


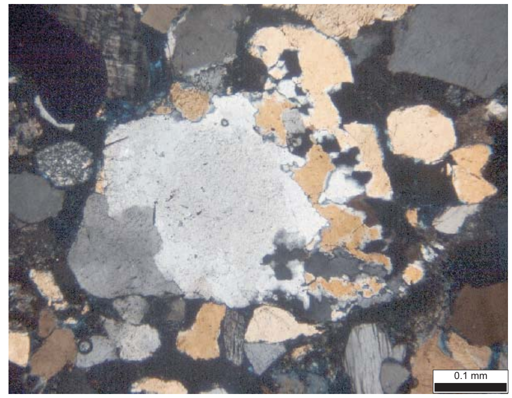
2233.62 m (pos. 10): quartz schist (N)
200x ppl



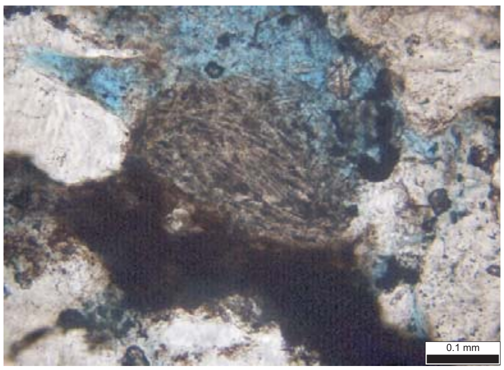
2233.62 m (pos. 10): quartz schist (N)
200x xpl

2233.62metres

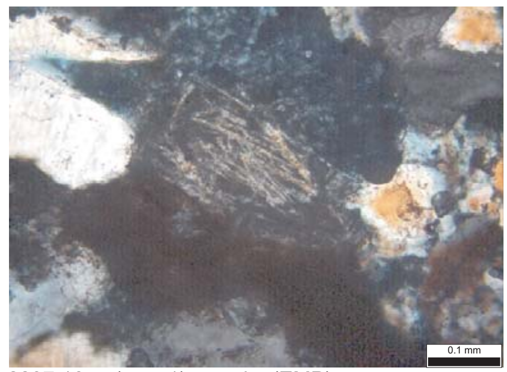

2233.62 m (pos. 11): polycrystalline quartz (from gneiss) (D). 50x ppl


2233.62 m (pos. 11): polycrystalline quartz (from gneiss) (D). 50x xpl

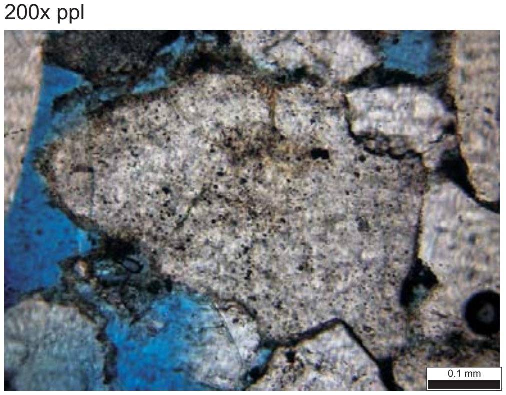
2237.16 metres



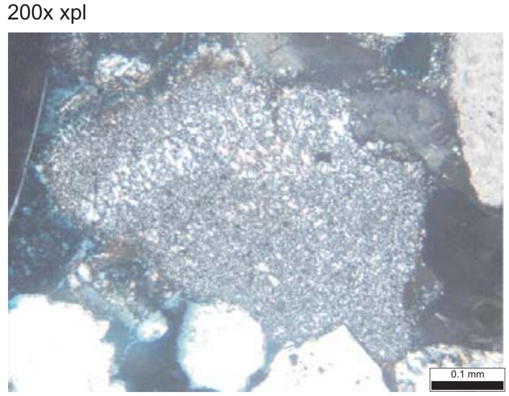
2237.16 m (pos. 1): syenite (EMP)
200x ppl



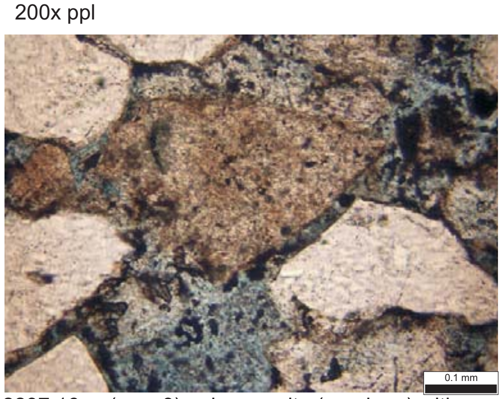
2237.16 m (pos. 1): syenite (EMP)
200x xpl



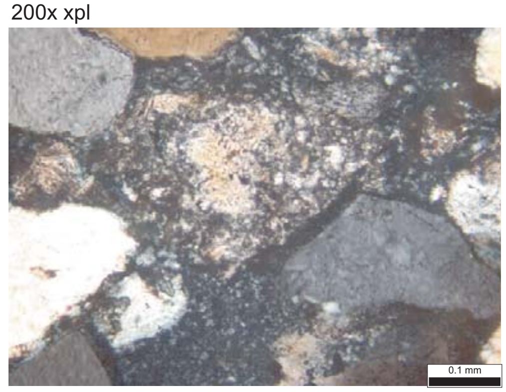
2237.16 m (pos. 2): syenite/intrusive rhyolite (O)
200x ppl



2237.16 m (pos. 2): syenite/intrusive rhyolite (O)
200x xpl

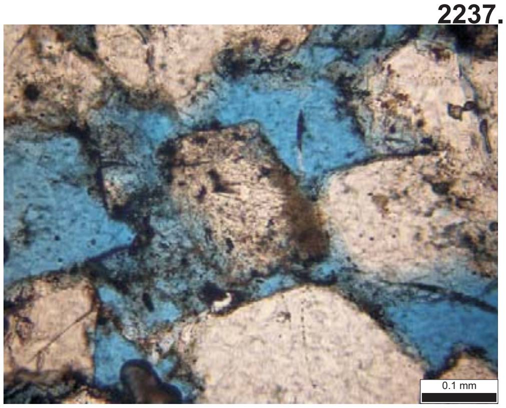


2237.16 m (pos. 3): microgranite (porphyry) with Fe-rich chl (EMP)
200x xpl

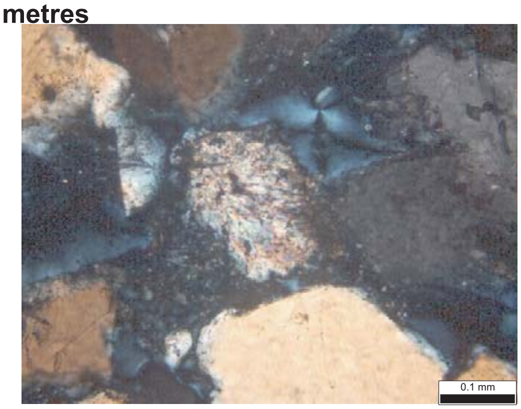


2237.16 m (pos. 3): microgranite (porphyry) with Fe-rich chl (EMP)
200x xpl

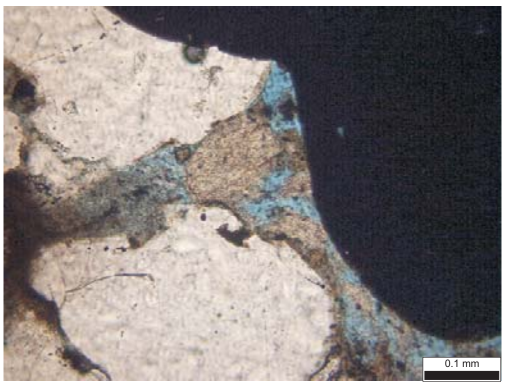
2237.16 metres



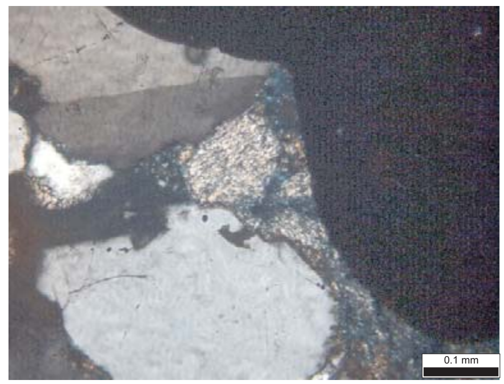
2237.16 m (pos. 3): vein quartz
200x ppl



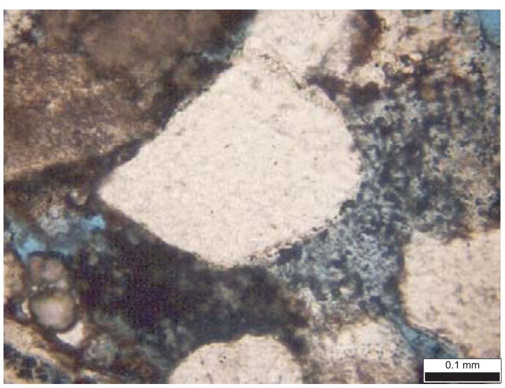
2237.16 m (pos. 3): vein quartz
200x xpl



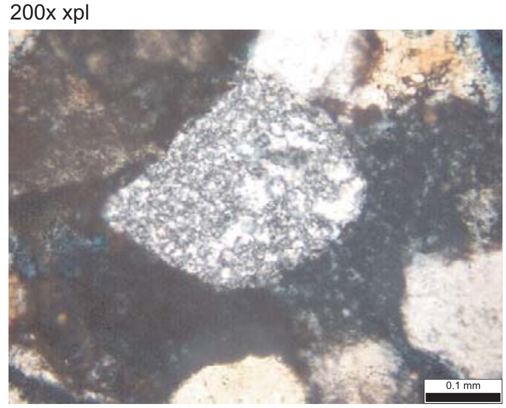
2237.16 m (pos. 4): mudstone (clast)
200x ppl



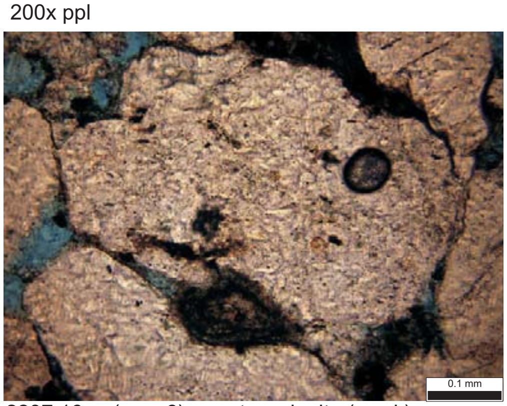
2237.16 m (pos. 4): mudstone (clast)
200x xpl



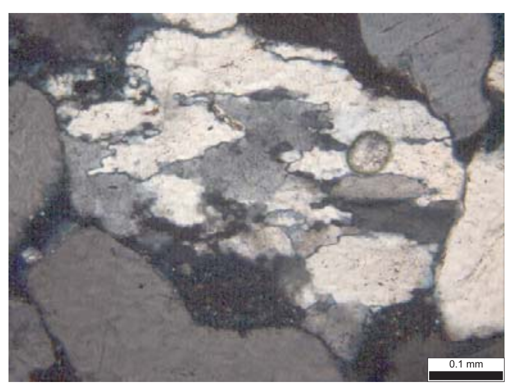
2237.16 m (pos. 5): altered basalt
200x ppl



2237.16 m (pos. 5): altered basalt
200x xpl

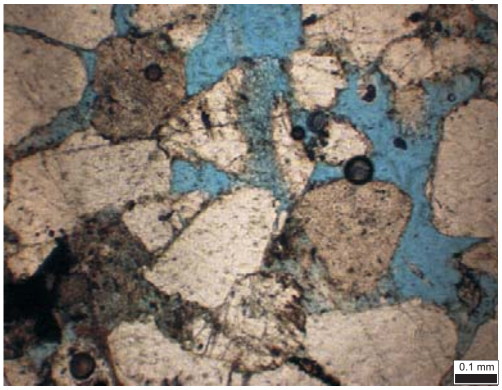


2237.16 m (pos. 6): quartz mylonite (weak)
200x ppl

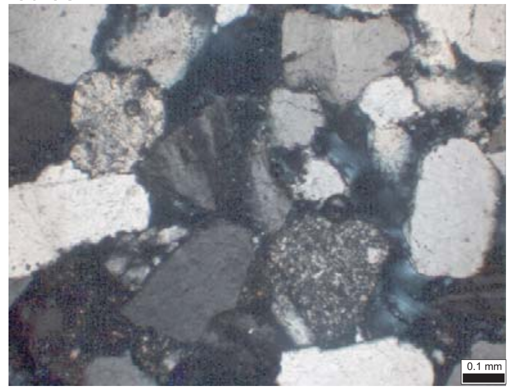


2237.16 m (pos. 6): quartz mylonite (weak)
200x ppl

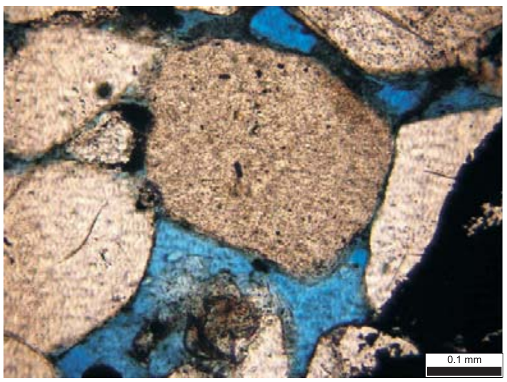
2237.16 metres



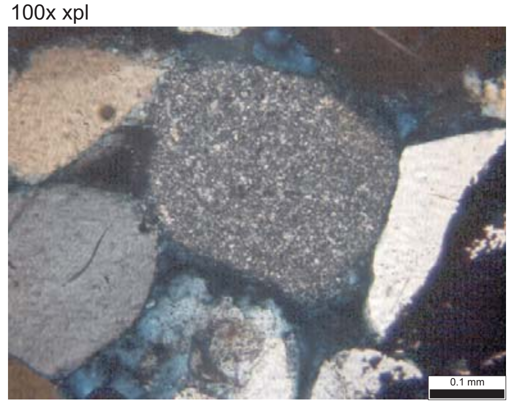
2237.16 m (pos. 6) mudstone (clast)
100x ppl



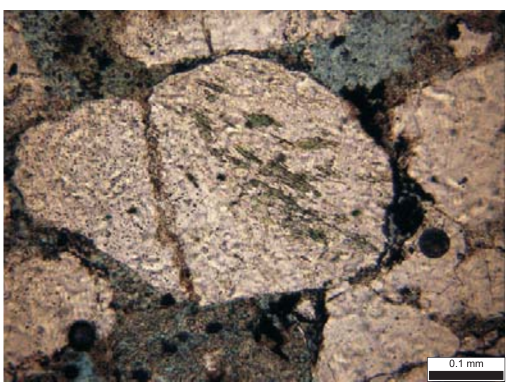
2237.16 m (pos. 6) mudstone (clast)
100x xpl



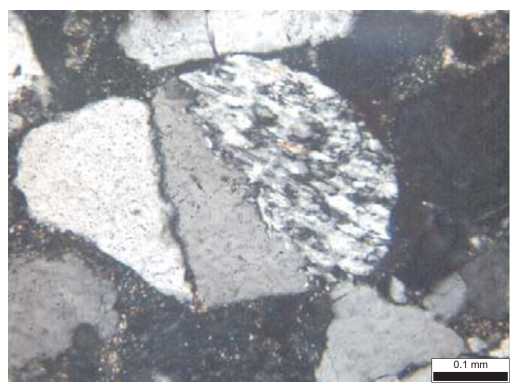
2237.16 m (pos. 7): mudstone (clast)
200x ppl



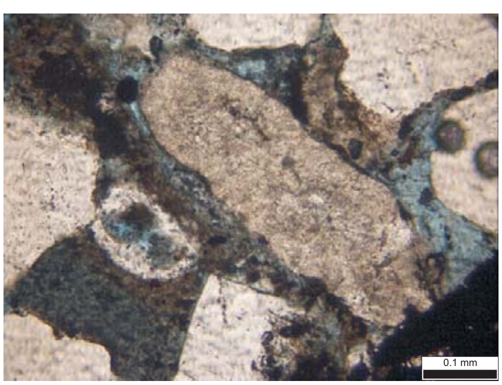
2237.16 m (pos. 7): mudstone (clast)
200x xpl



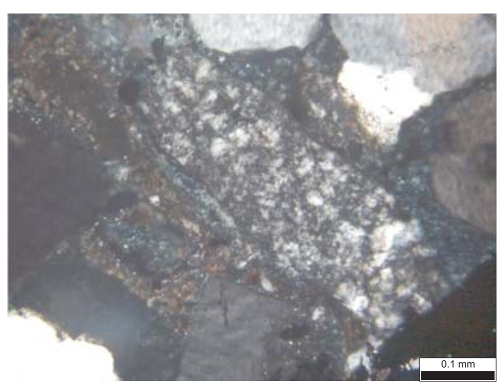
2237.16 m (pos. 8): quartz schist with quartz vein (N)
200x ppl



2237.16 m (pos. 8): quartz schist with quartz vein (N)
200x xpl

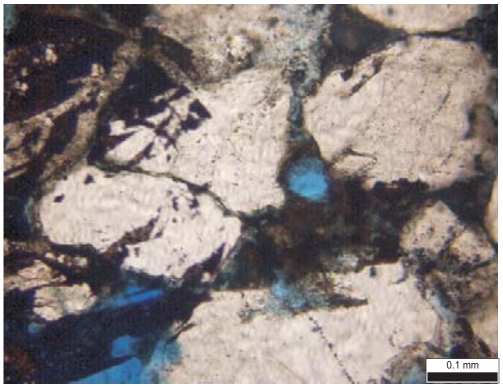


2237.16 m (pos. 10): intrusive rhyolite
200x ppl

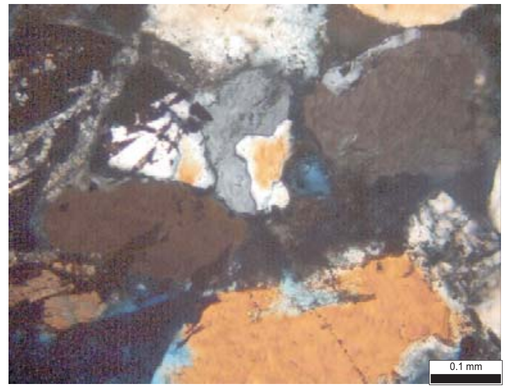


2237.16 m (pos. 10): intrusive rhyolite
200x xpl

2237.16 metres

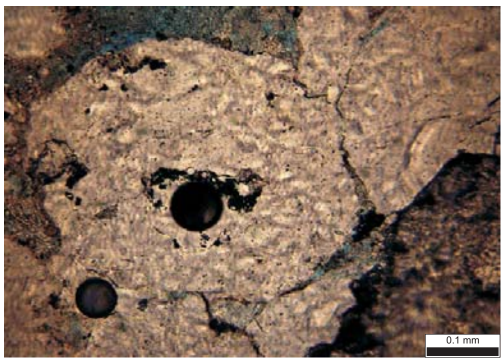


2237.16 m (pos. 12): polycrystalline quartz (from plutonic rock) (E) 200x ppl

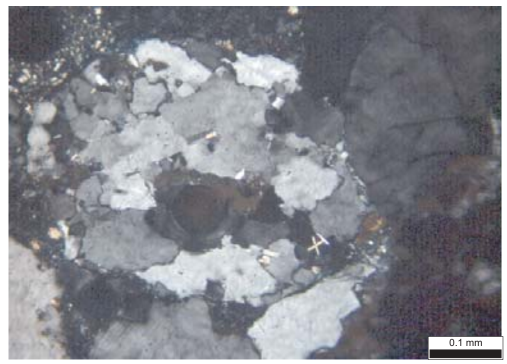


2237.16 m (pos. 12): polycrystalline quartz (from plutonic rock) (E) 200x xpl

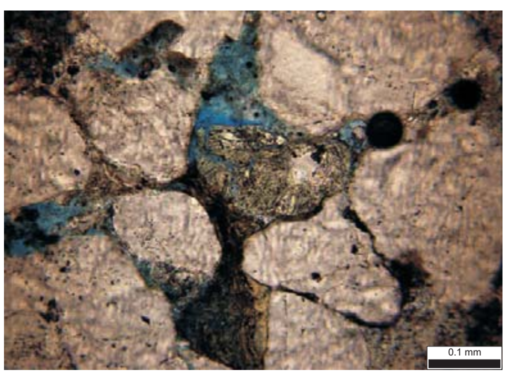
2238.65metres



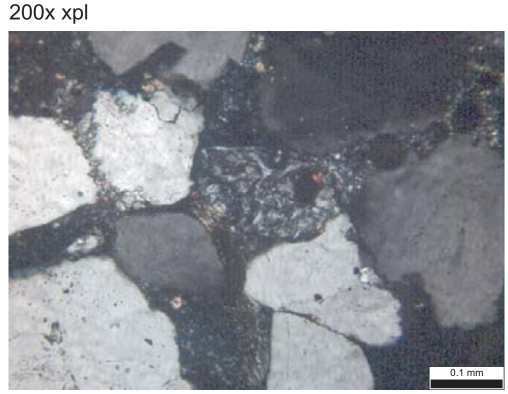
2238.65 m (pos. 3): fine grained granite (P) (EMP) (DM) 200x ppl



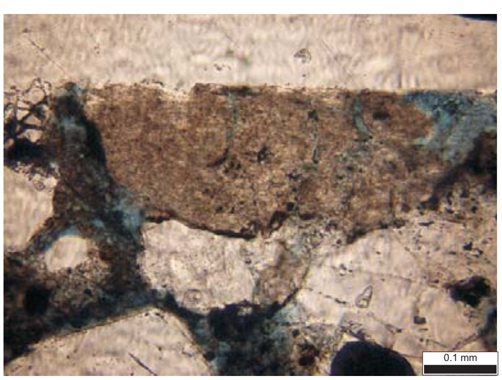
2238.65 m (pos. 3): fine grained granite (P) (EMP) (DM) 200x xpl



2238.65 m (pos. 3): intrusive rhyolite/syenite (EMP) (DM) 200x ppl



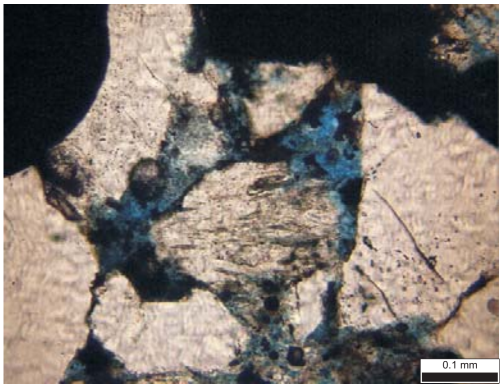
2238.65 m (pos. 3): intrusive rhyolite/syenite (EMP) (DM) 200x xpl



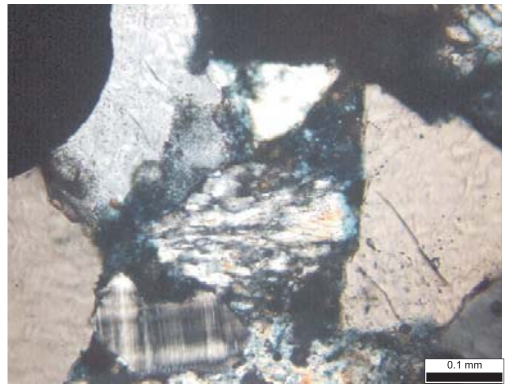
2238.65 m (pos. 4): mudstone clast 200x ppl

2238.65 m (pos. 4): mudstone clast 200x xpl

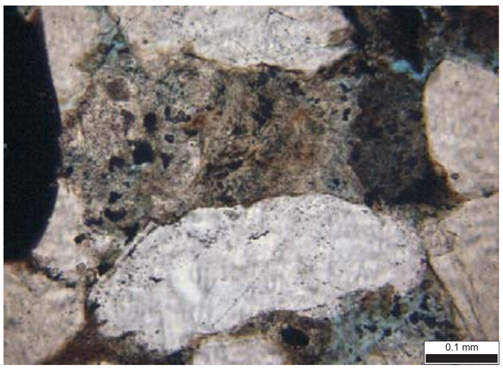
2238.65metres



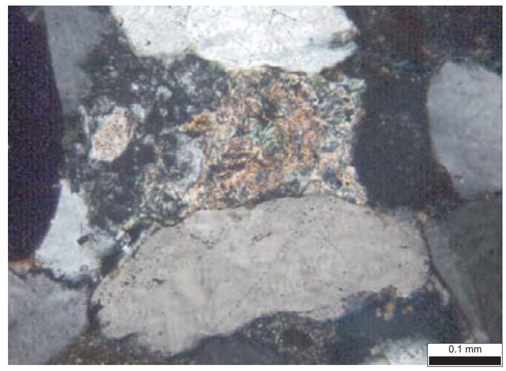
2238.65 m (pos. 5): quartz schist (N)
200x ppl



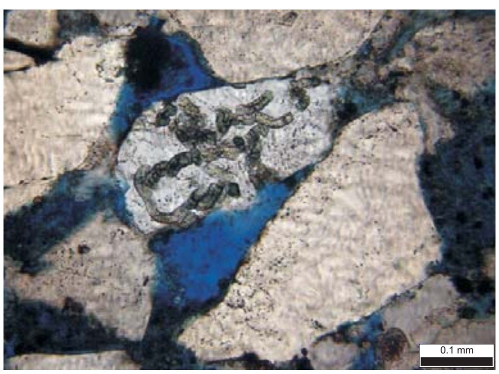
2238.65 m (pos. 5): quartz schist (N)
200x xpl



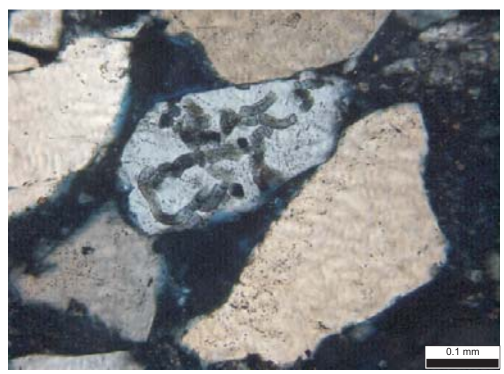
2238.65 m (pos. 6): bioclastic limestone clast
200x ppl



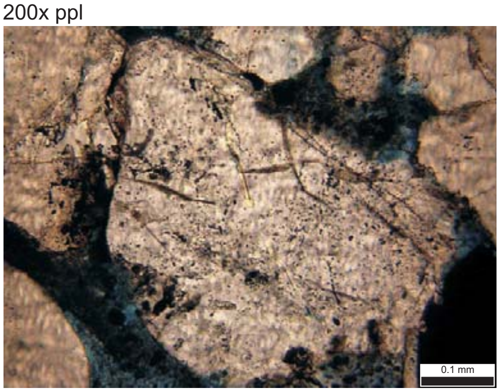
2238.65 m (pos. 6): bioclastic limestone clast
200x xpl



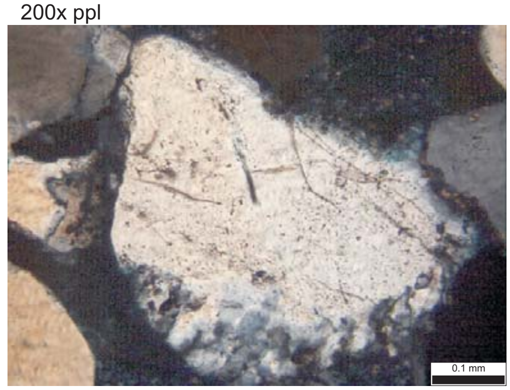
2238.65 m (pos. 7): vein quartz with inclusions of vermicular chlorite
200x ppl



2238.65 m (pos. 7): vein quartz with inclusions of vermicular chlorite
200x ppl

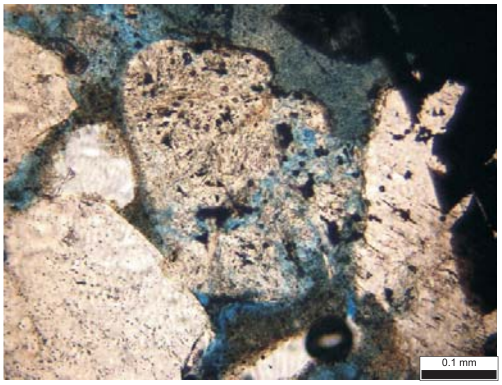


2238.65 m (pos. 7): quartz mylonite (weak)
200x ppl

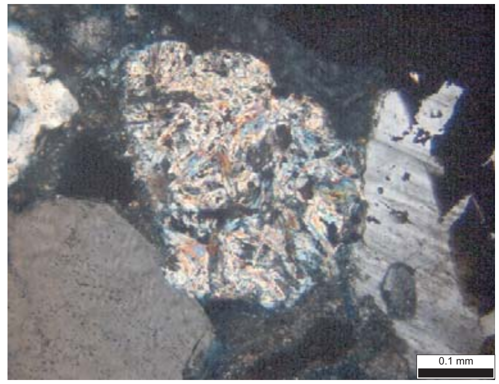


2238.65 m (pos. 7): quartz mylonite (weak)
200x xpl

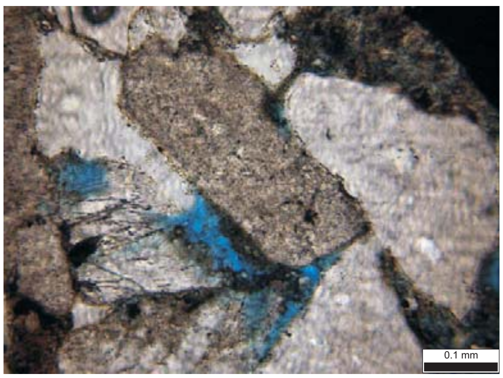
2238.65metres



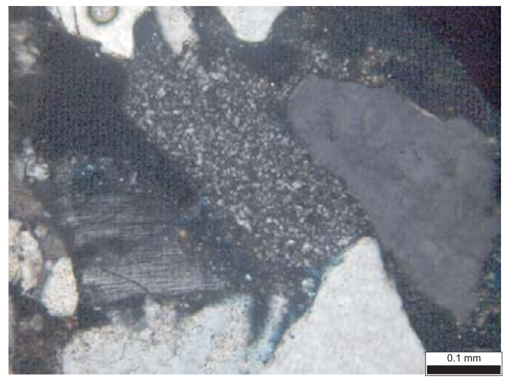
2238.65 m (pos. 7): siltstone clast with carbonate cement
200x ppl



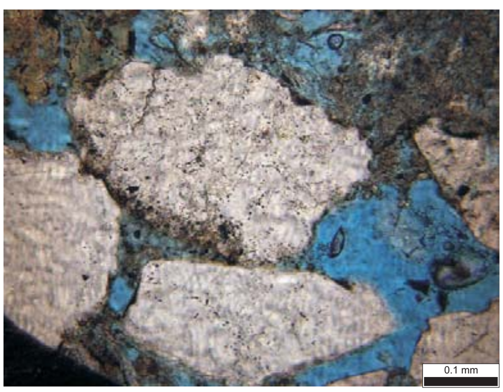
2238.65 m (pos. 7): siltstone clast with carbonate cement. 200x xpl



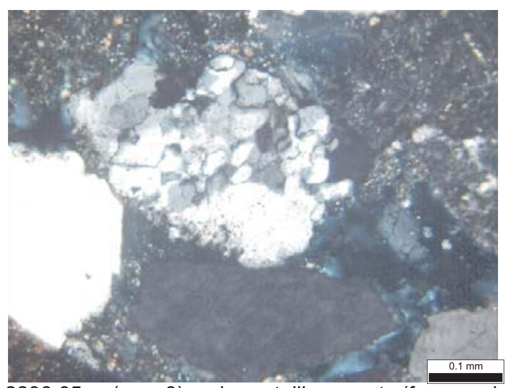
2238.65 m pos. 8): rhyolite
200x ppl



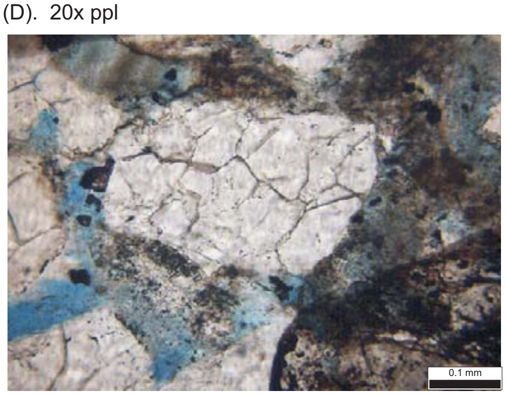
2238.65 m pos. 8): rhyolite
200x xpl



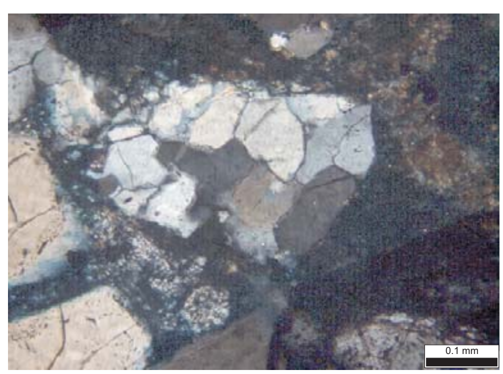
2238.65 m (pos. 8): polycrystalline quartz (from gneiss) (D). 20x ppl



2238.65 m (pos. 8): polycrystalline quartz (from gneiss) (D). 20x xpl

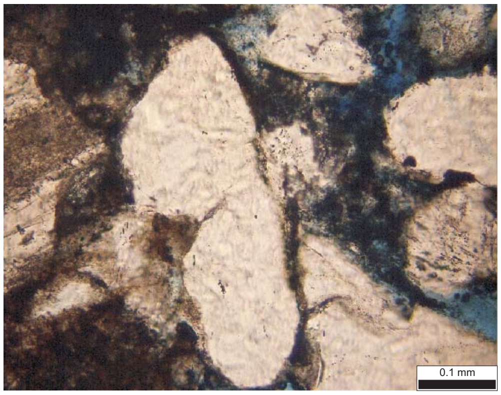


2238.65 m (pos. 9): polycrystalline quartz (from plutonic rock) (E)
200x ppl

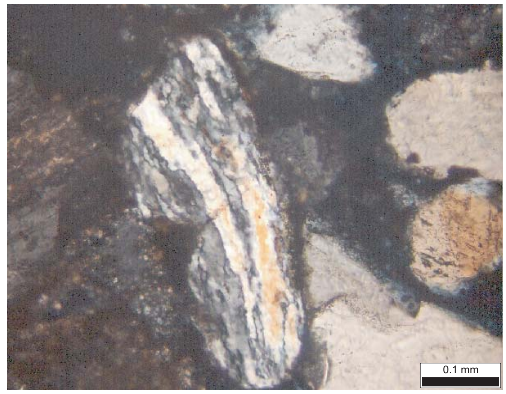


2238.65 m (pos. 9): polycrystalline quartz (from plutonic rock) (E)
200x xpl

2238.65metres

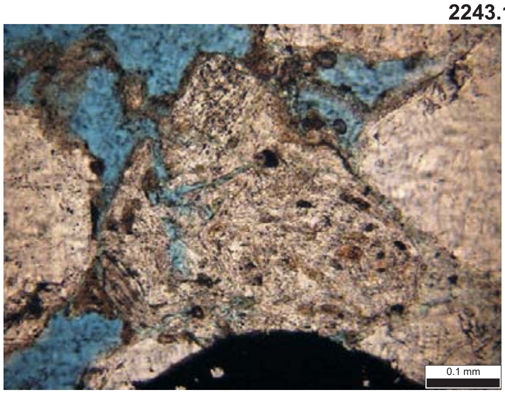


2238.65 m (pos. 10): polycrystalline quartz (from schist) (N).   200x ppl

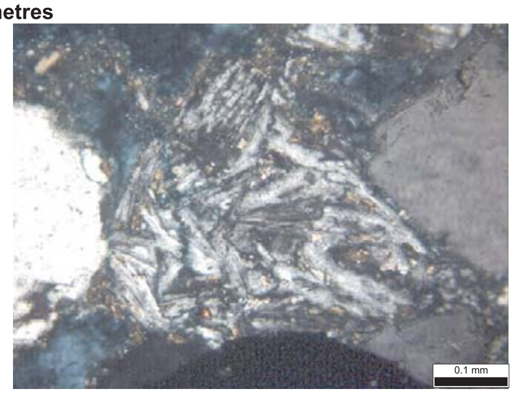


2238.65 m (pos. 10): polycrystalline quartz (from schist) (N). 200x xpl

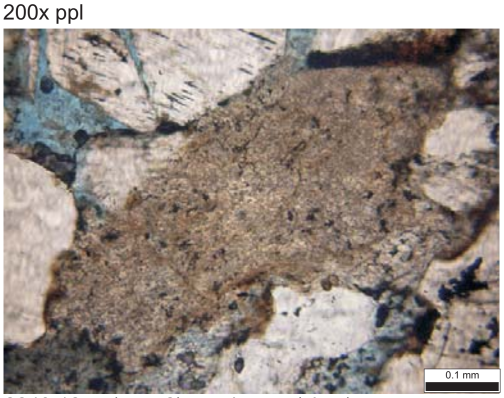
2243.12 metres



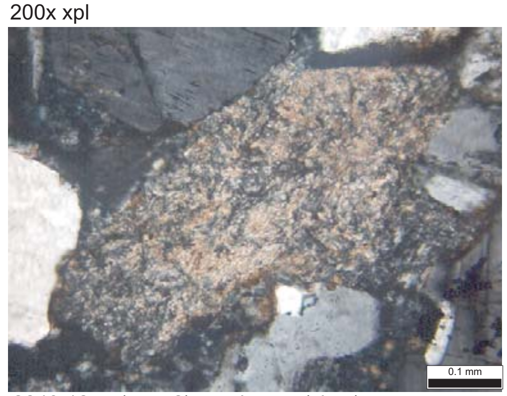
2243.12 m (pos. 1): syenite (porphyry) (EMP)
200x ppl



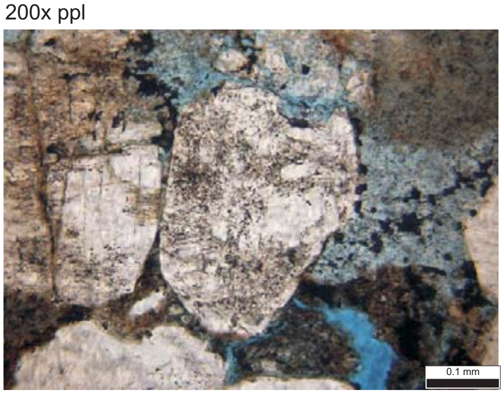
2243.12 m (pos. 1): syenite (porphyry) (EMP)
200x xpl



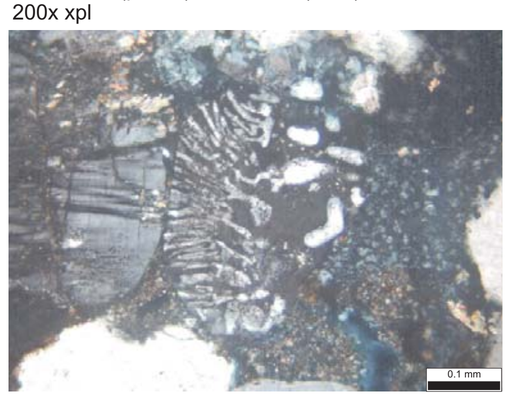
2243.12 m (pos. 2): mudstone (clast)
200x ppl



2243.12 m (pos. 2): mudstone (clast)
200x xpl

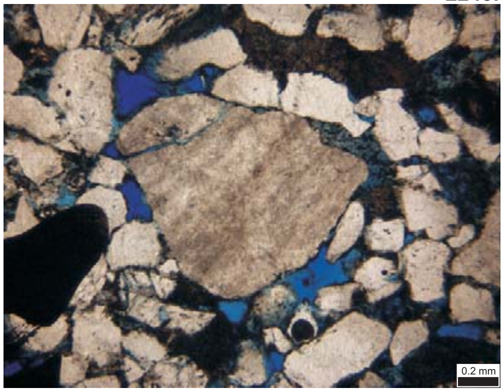


2243.12 m (pos. 2): microgranite (granophyric texture)
200x ppl

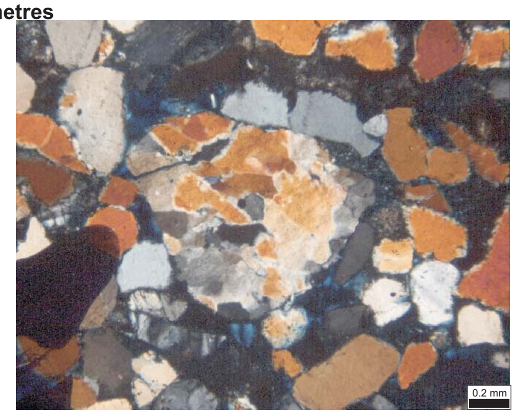


2243.12 m (pos. 2): microgranite (granophyric texture)
200x xpl

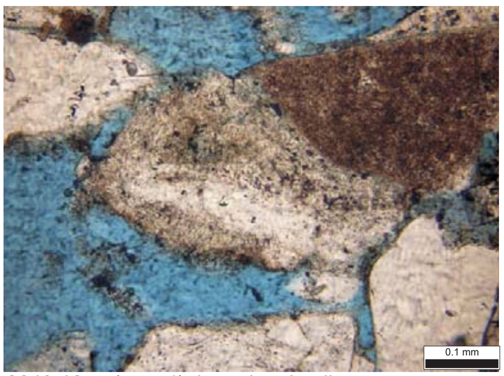
2243.12 metres



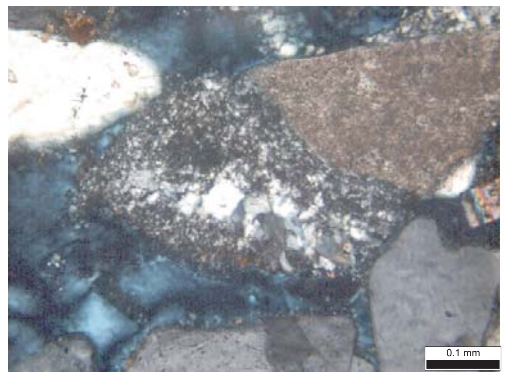
2243.12 m (pos. 3): polycrystalline quartz (weak)
50x ppl



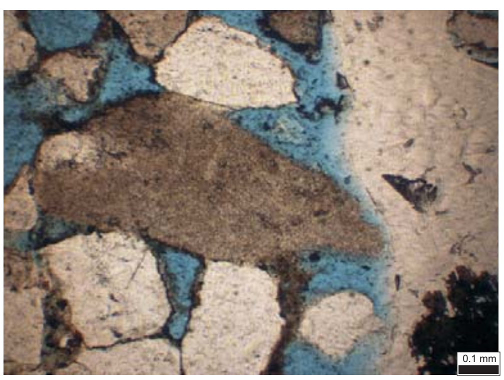
2243.12 m (pos. 3): polycrystalline quartz (weak)
50x ppl



2243.12 m (pos. 4): intrusive rhyolite
200x ppl

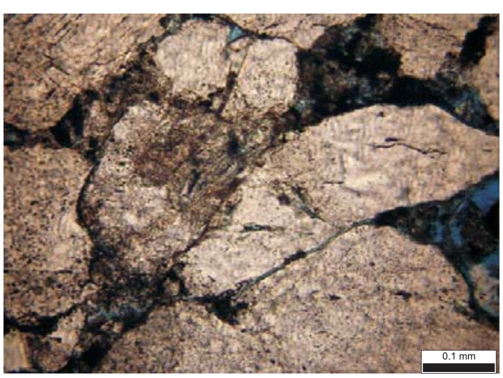


2243.12 m (pos. 4): intrusive rhyolite
200x ppl

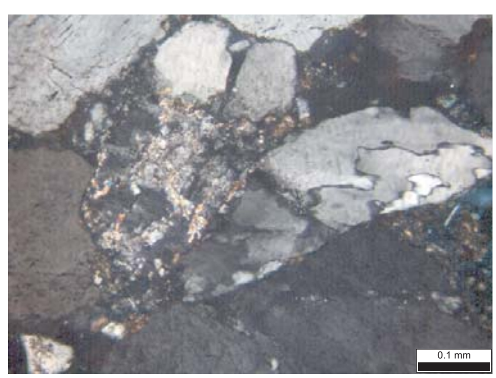


2243.12 m (pos. 4): altered feldspar crystal (DM)
100x ppl

2243.12 m (pos. 4): altered feldspar crystal (DM)
100x ppl

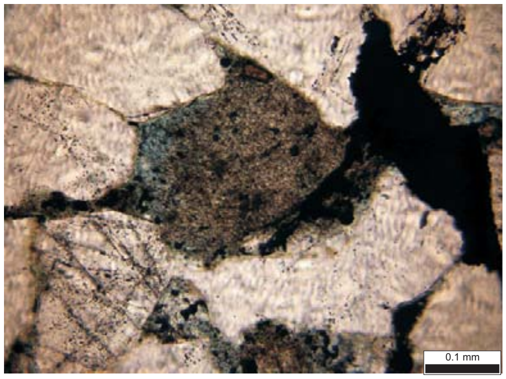


2243.12 m (pos. 5): quartz wacke (left centre), quartz mylonite (weak) (right centre)
200x ppl

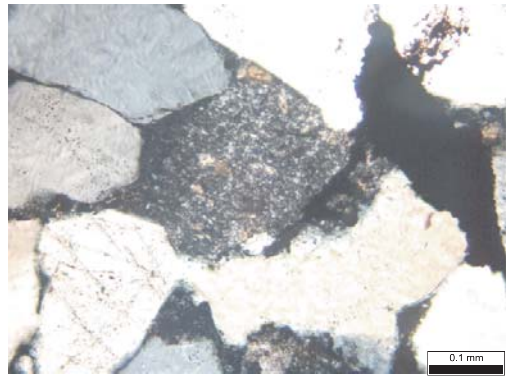


2243.12 m (pos. 5): quartz wacke (left centre), quartz mylonite (weak) (right centre)
200x ppl

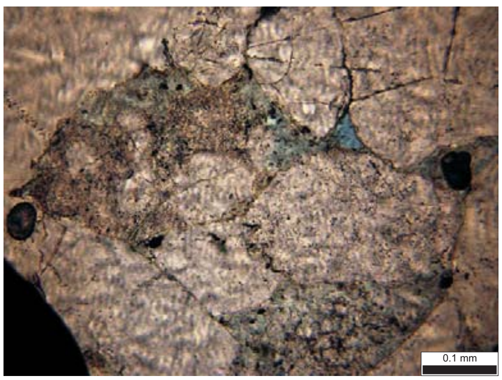
2250.17 metres



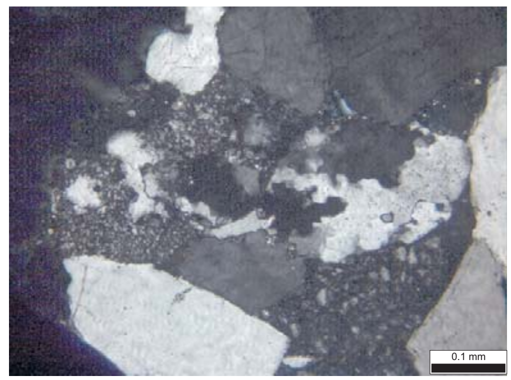
2250.17 m (pos. 1): mudstone clast
200x ppl



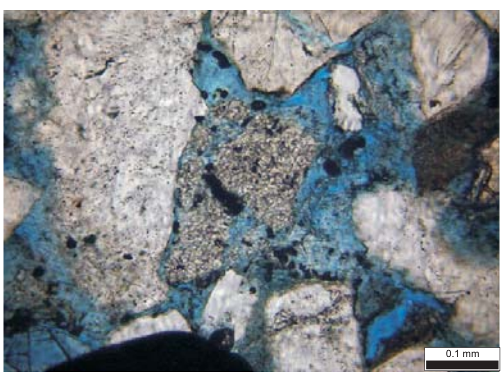
2250.17 m (pos. 1): mudstone clast
200x xpl



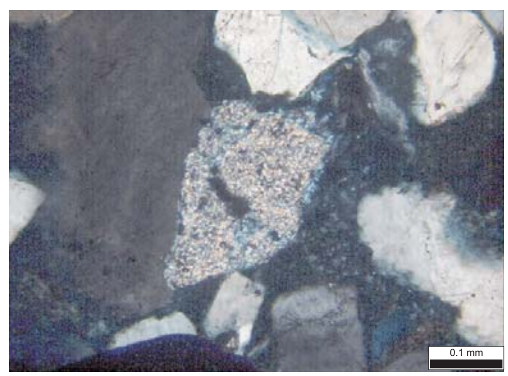
2250.17 m (pos. 2): polycrystalline quartz (from gneiss) (D). 200x ppl



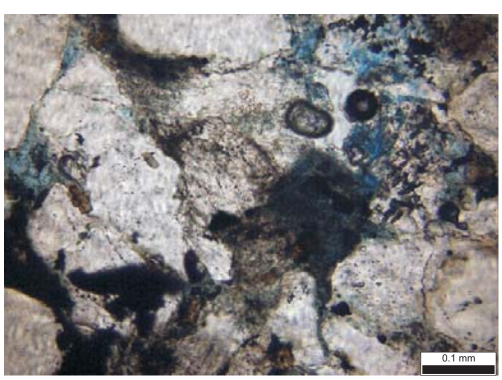
2250.17 m (pos. 2): polycrystalline quartz (from gneiss) (D). 200x xpl



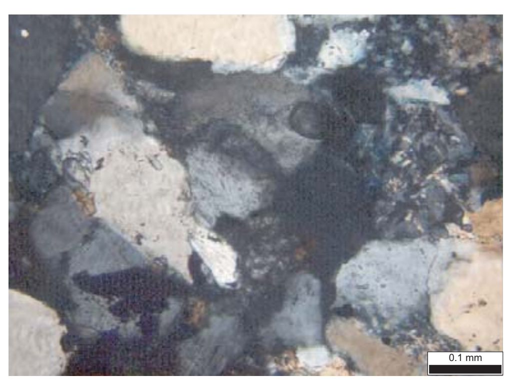
2250.17 m (pos. 3): shale
200x ppl



2250.17 m (pos. 3): shale
200x xpl

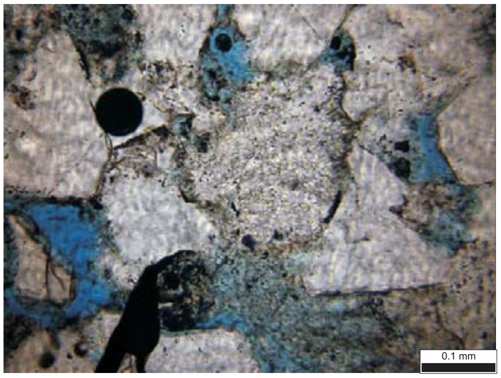


2250.17 m (pos. 4): quartz arenite (clast) (centre right)
200x ppl

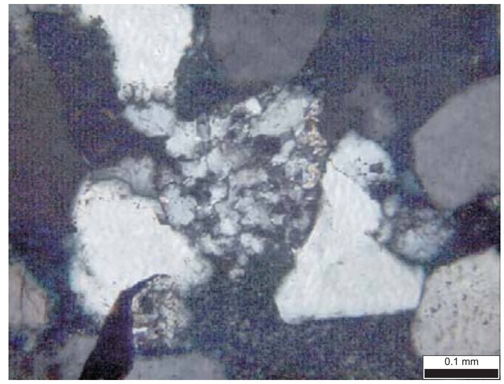


2250.17 m (pos. 4): quartz arenite (clast) (centre right)
200x ppl

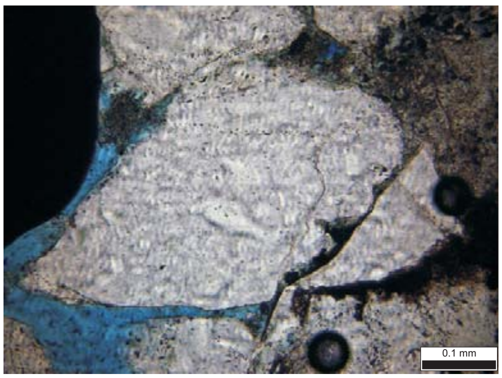
2250.17 metres



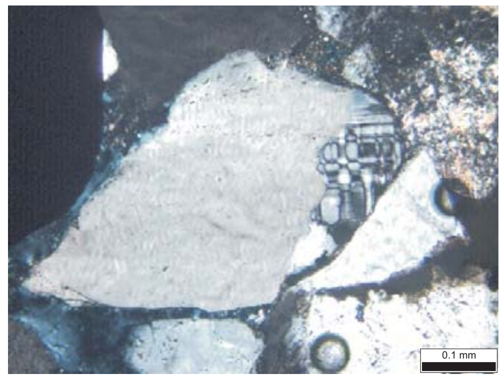
2250.17 m (pos. 5): gneiss (DM)
200x ppl



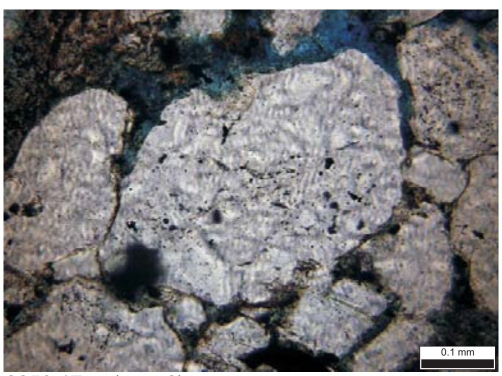
2250.17 m (pos. 5): gneiss (DM)
200x xpl



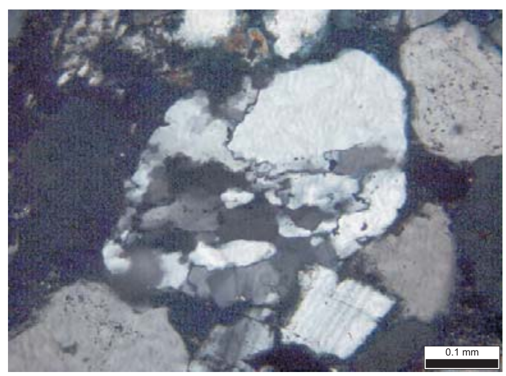
2250.17 m (pos. 6): granite
200x ppl



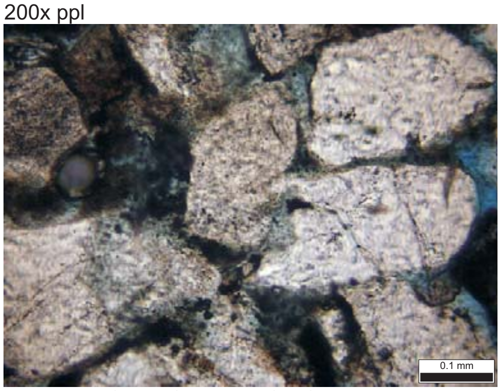
2250.17 m (pos. 6): granite
200x xpl



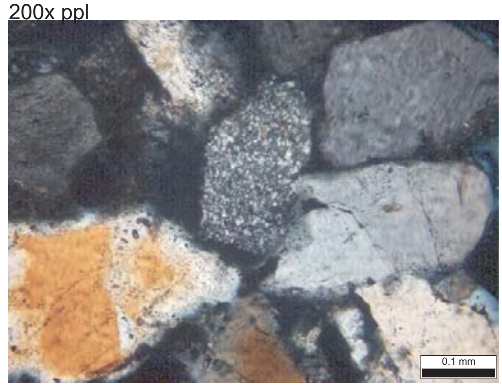
2250.17 m (pos. 6): polycrystalline quartz (weakly mylonitized
200x ppl



2250.17 m (pos. 6): polycrystalline quartz (weakly mylonitized
200x ppl

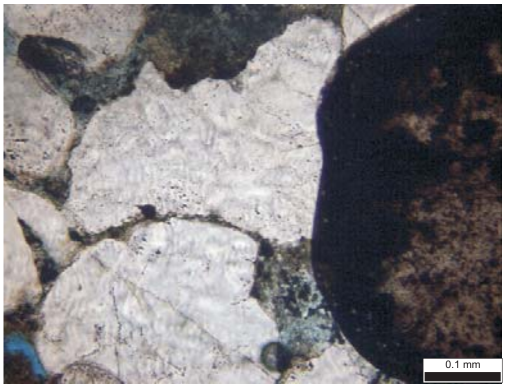


2250.17 m (pos. 8): rhyolite (DM)
200x ppl

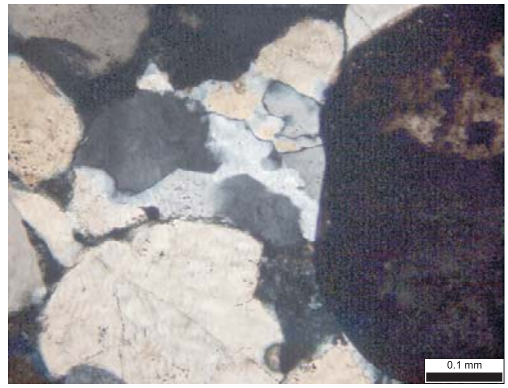


2250.17 m (pos. 8): rhyolite (DM)
200x ppl

2250.17 metres

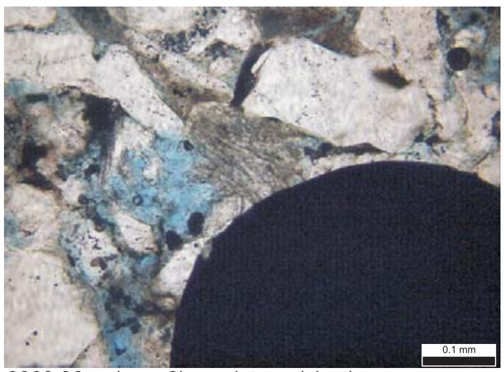


2250.17 m (pos. 9): quartz mylonite (weak)
200x ppl

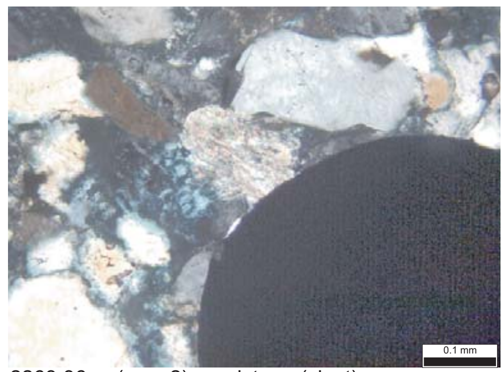


2250.17 m (pos. 9): quartz mylonite (weak)
200x ppl

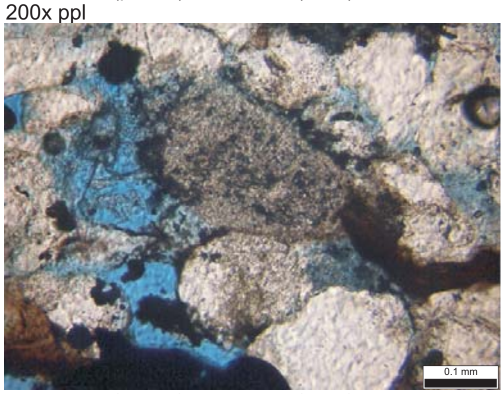
2263.36metres



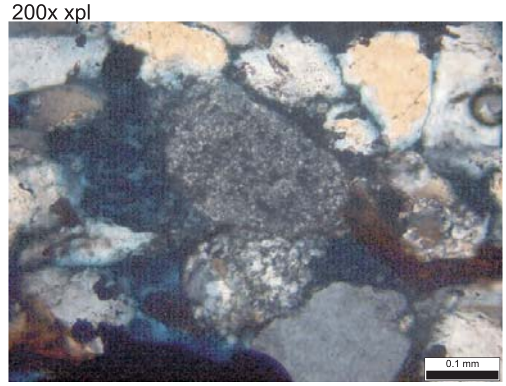
2263.36 m (pos. 2): mudstone (clast)
200x ppl



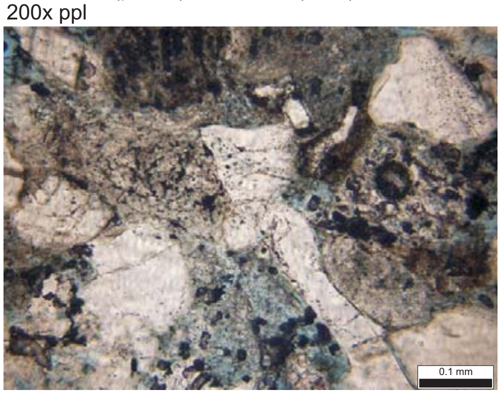
2263.36 m (pos. 2): mudstone (clast)
200x xpl



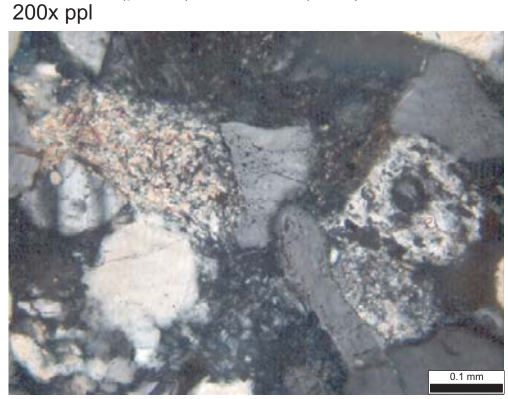
2263.36 m (pos. 3): mudstone (clast)
200x ppl



2263.36 m (pos. 3): mudstone (clast)
200x ppl

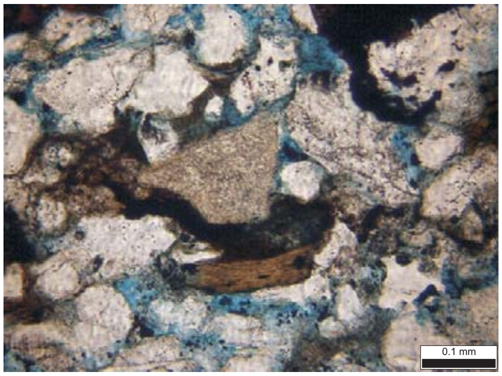


2263.36 m (pos. 4): rhyolite (centre left)
200x ppl

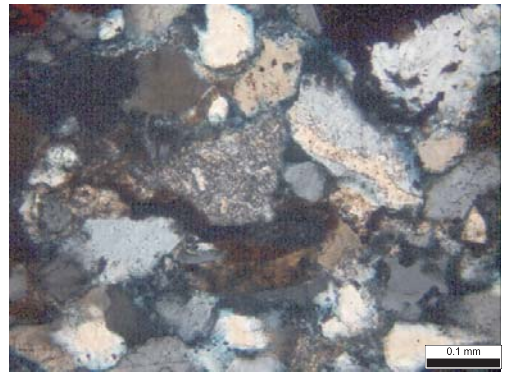


2263.36 m (pos. 4): rhyolite (centre left)
200x ppl

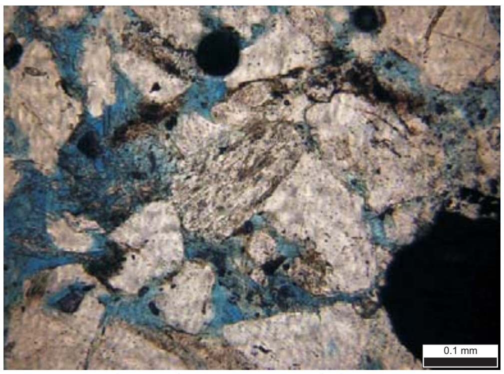
2263.36metres



2263.36 m (pos. 5): mudstone (clast)
200x ppl

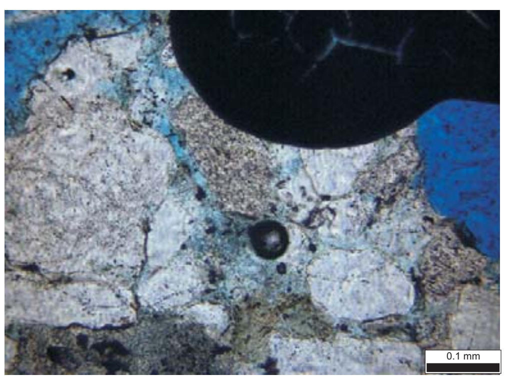


2263.36 m (pos. 5): mudstone (clast)
200x xpl

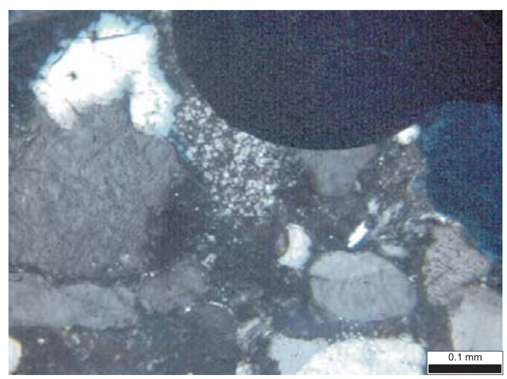


2263.36 m (pos. 6): quart schist (N)
200x ppl

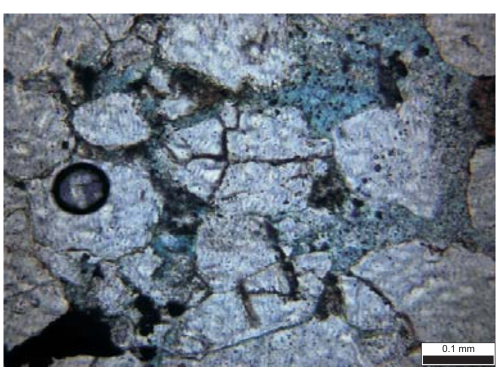
2263.36 m (pos. 6): quartz schist (N)
200x xpl



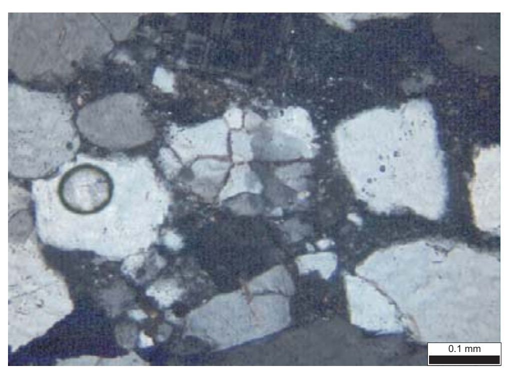
2263.36 m (pos. 8): intrusive rhyolite
200x ppl



2263.36 m (pos. 8): intrusive rhyolite
200x xpl

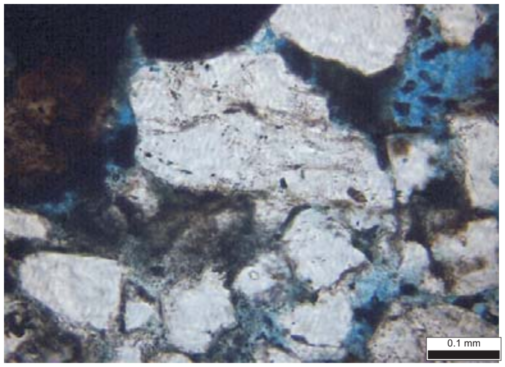


2263.36 m (pos. 8): polycrystalline quartz (from plutonic rock) (E)
200x ppl

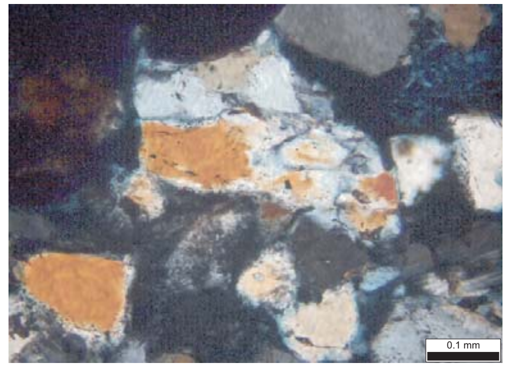


2263.36 m (pos. 8): polycrystalline quartz (from plutonic rock) (E)
200x xpl

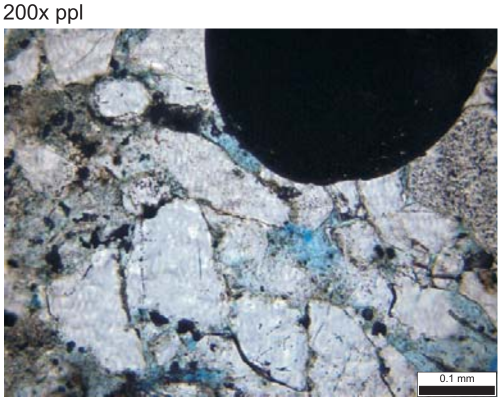
2263.36metres



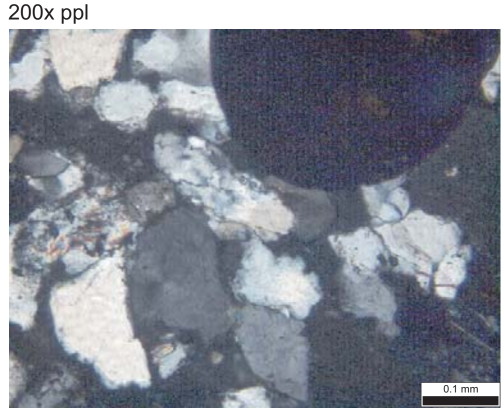
2263.36 m (pos.10): polycrystalline quartz (from plutonic rock) (E).
200x ppl



2263.36 m (pos.10): polycrystalline quartz (from plutonic rock) (E).
200x ppl

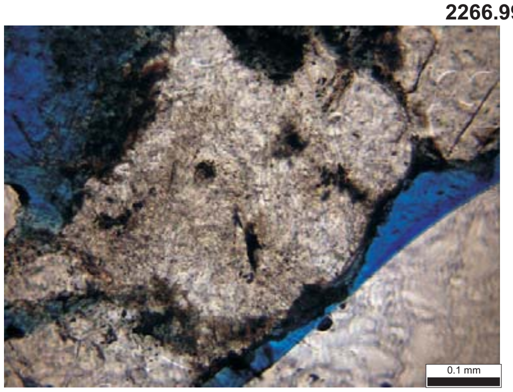


2263.36 m (pos 11): polycrystalline quartz (from gneiss) (D) 200x ppl



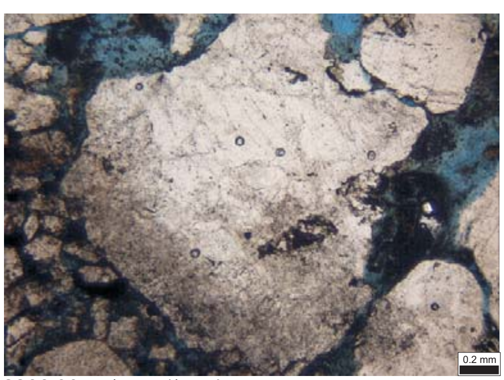
2263.36 m (pos 11): polycrystalline quartz (from gneiss) (D) 200x xpl

2266.99 metres

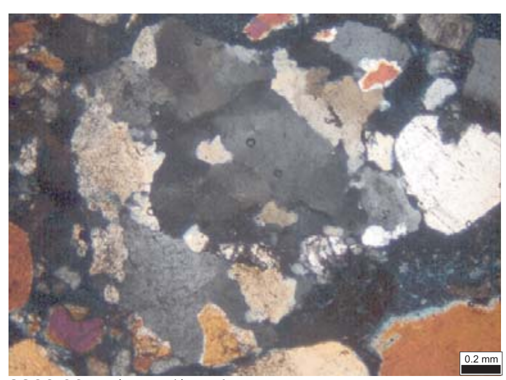


2266.99 m (pos. 1): vein quartz (X) (EMP)
200x ppl

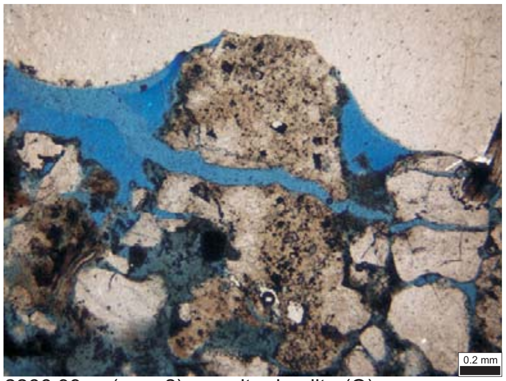
2266.99 m (pos. 1): vein quartz (X) (EMP)
200x ppl



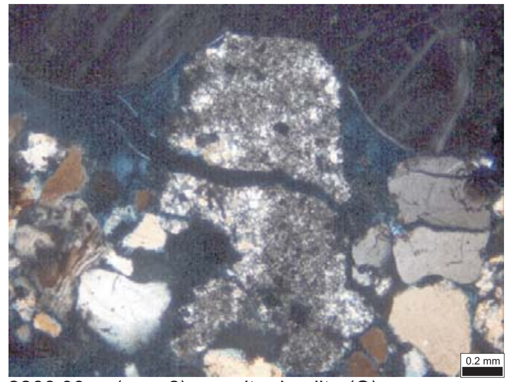
2266.99 m (pos. 1): vein quartz
50x ppl



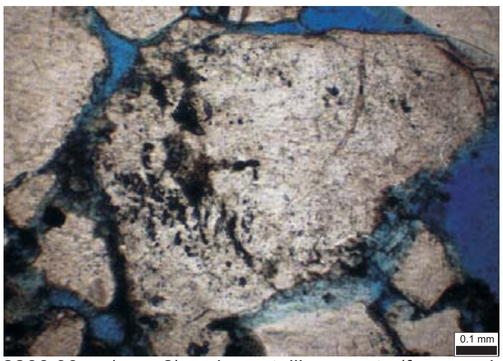
2266.99 m (pos. 1): vein quartz
50x xpl



2266.99 m (pos. 2): syenite rhyolite (O)
50x ppl

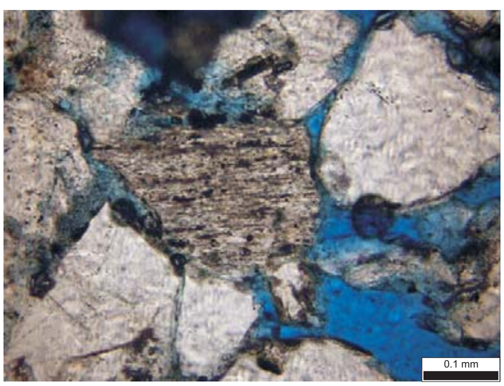


2266.99 m (pos. 2): syenite rhyolite (O)
50x ppl

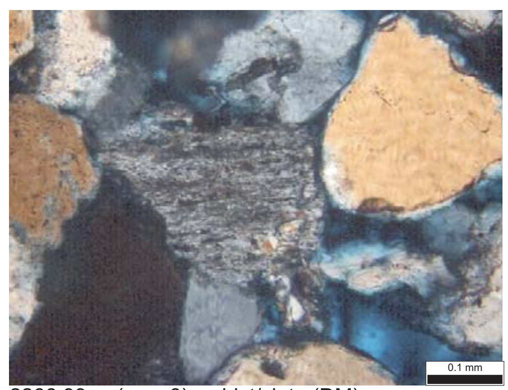


2266.99 m (pos. 2): polycrystalline quartz (from gneiss) (D) (DM)
100x ppl

2266.99 m (pos. 2): polycrystalline quartz (from gneiss) (D) (DM)
100x xpl

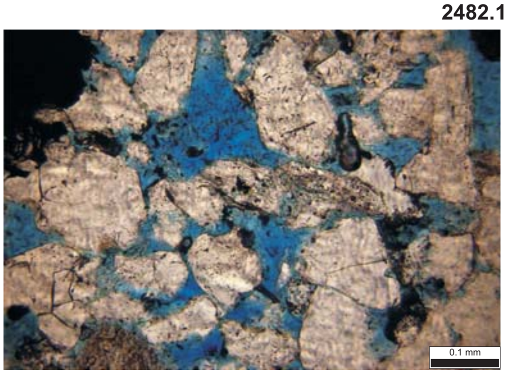


2266.99 m (pos. 3): schist/slate (DM)
200x xpl

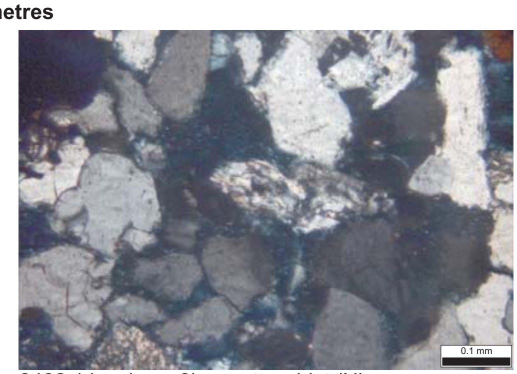


2266.99 m (pos. 3): schist/slate (DM)
200x xpl

2482.14 metres

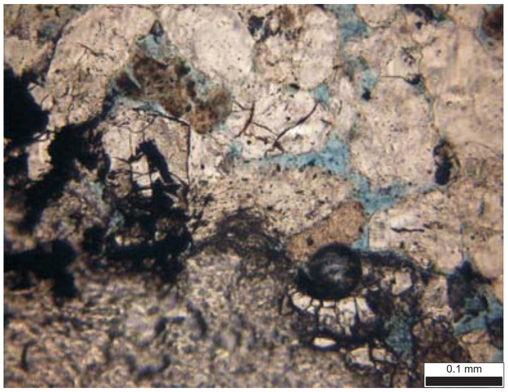


2482.14 m (pos. 2): quartz schist (N)
200x xpl

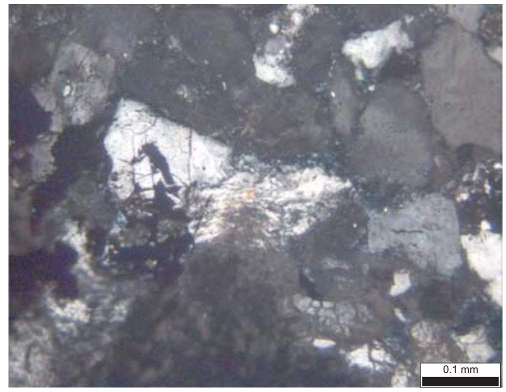


2482.14 m (pos. 2): quartz schist (N)
200x xpl

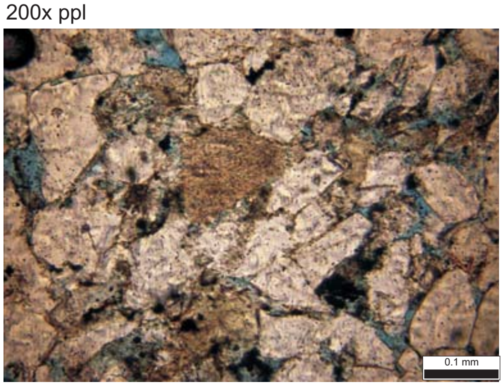
2482.14 metres



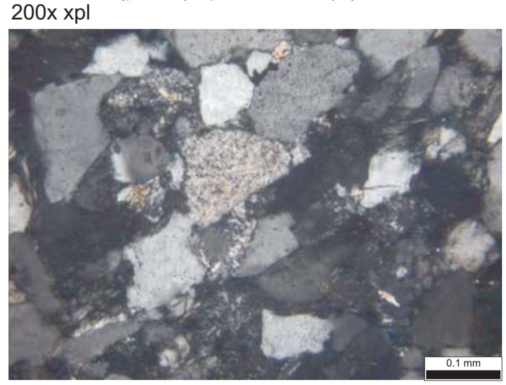
2482.14 m (pos. 3): quartz schist (N)
200x ppl



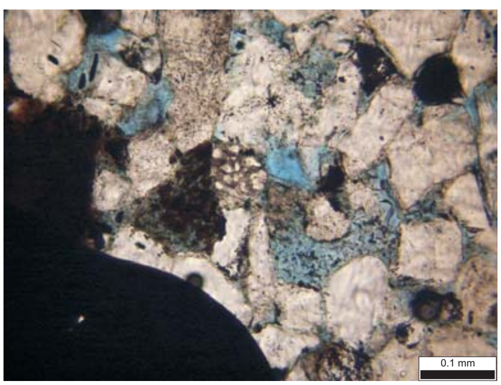
2482.14 m (pos. 3): quartz schist (N)
200x xpl



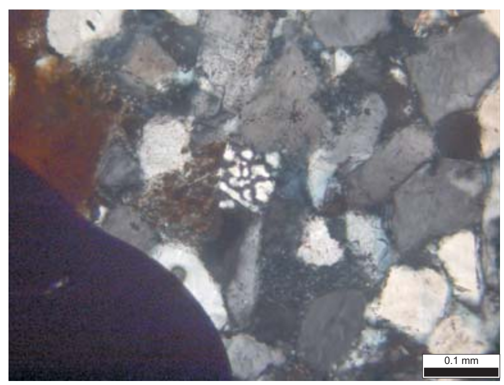
2482.14 m (pos. 4): mudstone (clast)
200x ppl



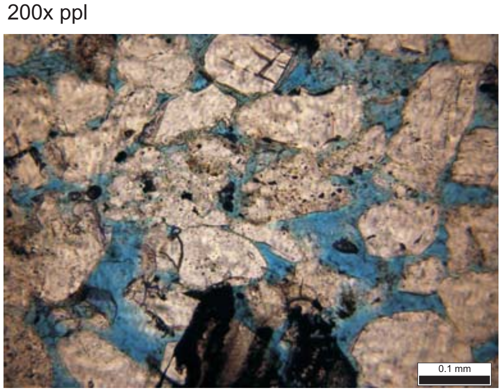
2482.14 m (pos. 4): mudstone (clast)
200x xpl



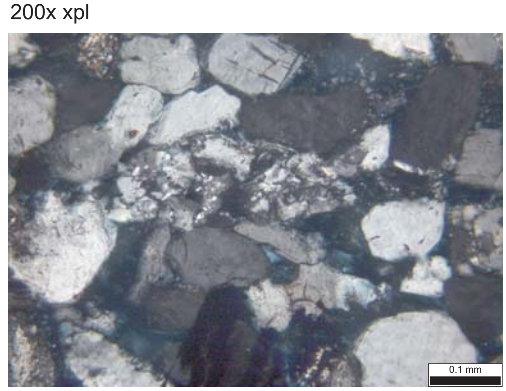
2482.14 m (pos. 5): microgranite (granophyric texture)
200x ppl



2482.14 m (pos. 5): microgranite (granophyric texture)
200x xpl

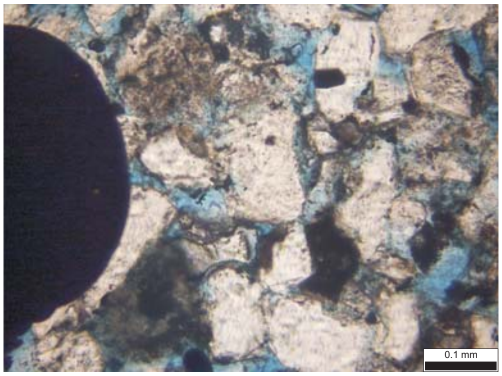


2482.14 m (pos. 6): quartz arenite clast
200x ppl

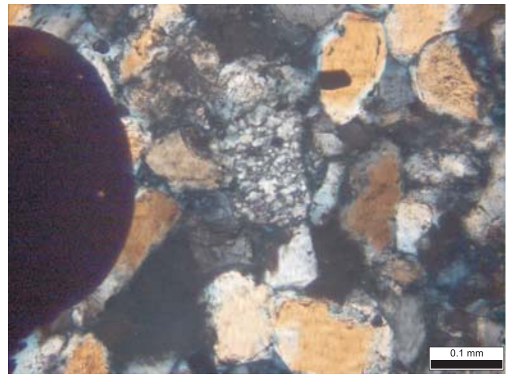


2482.14 m (pos. 6): quartz arenite clast
200x xpl

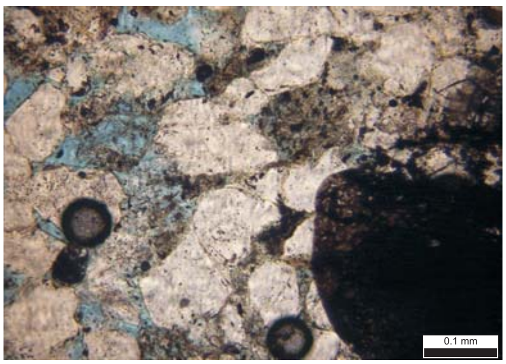
2482.14 metres



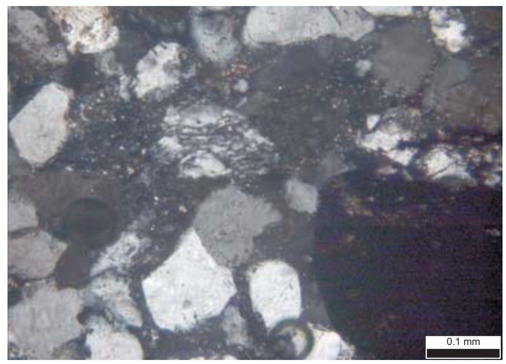
2482.14 m (pos. 7): intrusive rhyolite
200x ppl



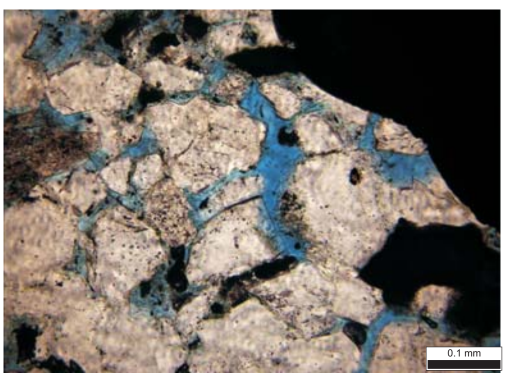
2482.14 m (pos. 7): intrusive rhyolite
200x xpl



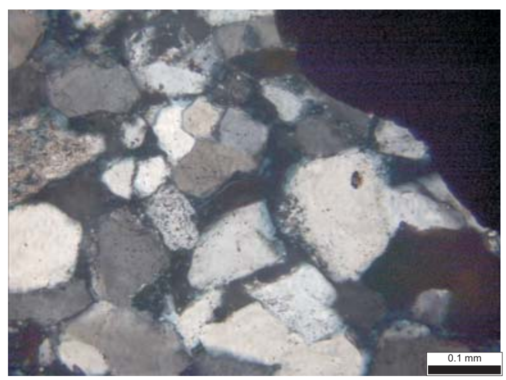
2482.14 m (pos. 8): polycrystalline quartz (from schist) (N). 200x ppl



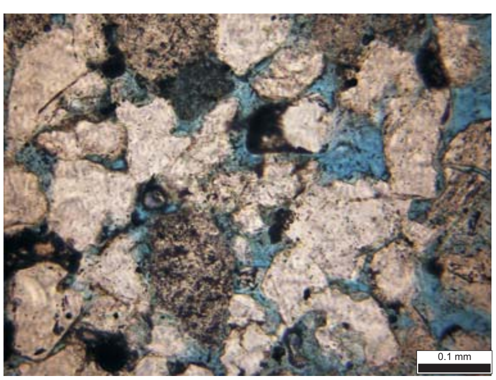
2482.14 m (pos. 8): polycrystalline quartz (from schist) (N). 200x xpl



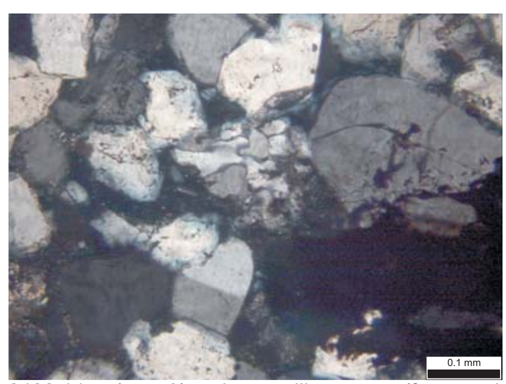
2482.14 m (pos. 9): polycrystalline quartz (from plutonic rocks) (E). 200x ppl



2482.14 m (pos. 9): polycrystalline quartz (from plutonic rocks) (E). 200x xpl

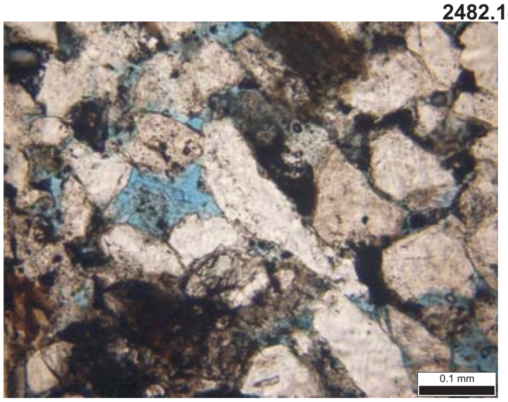


2482.14 m (pos. 9): polycrystalline quartz (from gneiss) (D)
200x ppl

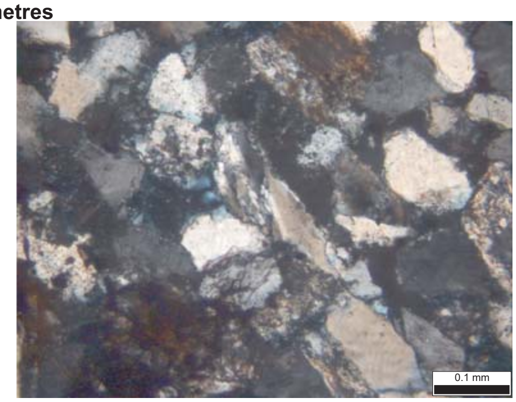


2482.14 m (pos. 9): polycrystalline quartz (from gneiss) (D)
200x xpl

2482.14 metres

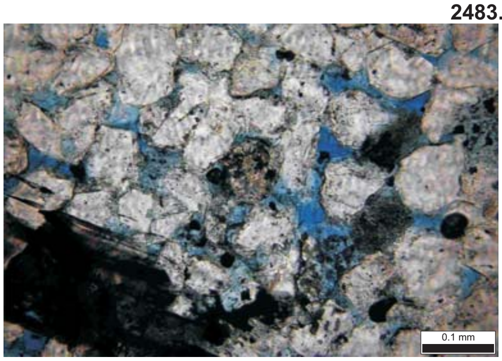


2482.14 m (pos. 11): polycrystalline quartz (from schist)
(N)200x ppl

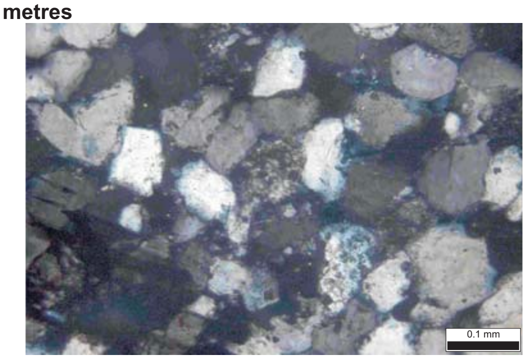


2482.14 m (pos. 11): polycrystalline quartz (from schist)
(N) 200x xpl

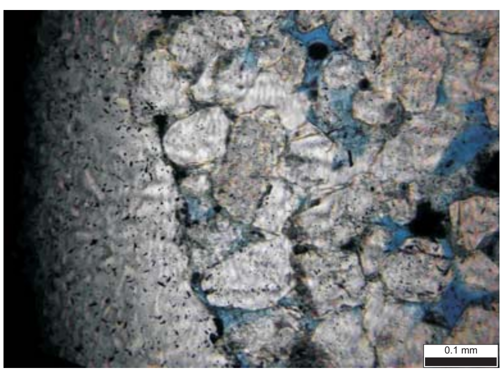
2483.55 metres



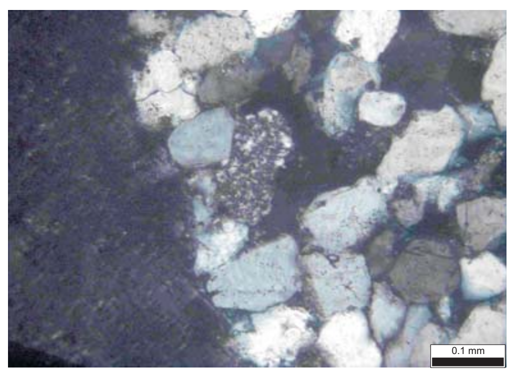
2483.55 m (pos. 1): mudstone
200x ppl



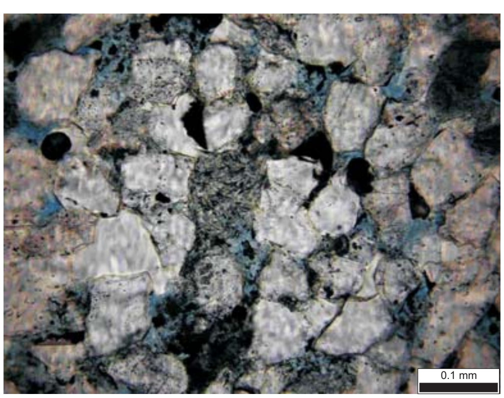
2483.55 m (pos. 1): mudstone
200x xpl



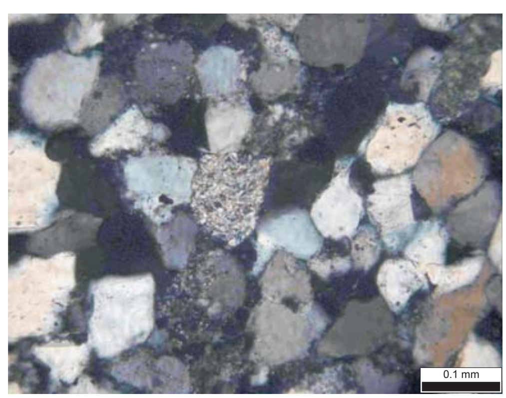
2483.55 m (pos. 1): rhyolite
200x ppl



2483.55 m (pos. 1): rhyolite
200x xpl

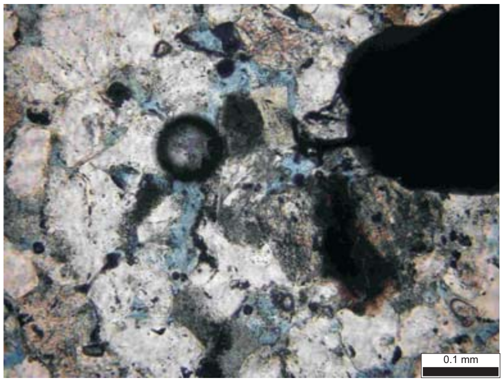


2483.55 m (pos. 1): rhyolite (DM)
200x ppl

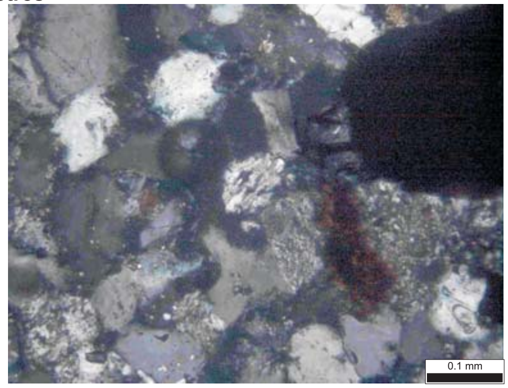


2483.55 m (pos. 1): rhyolite (DM)
200x xpl

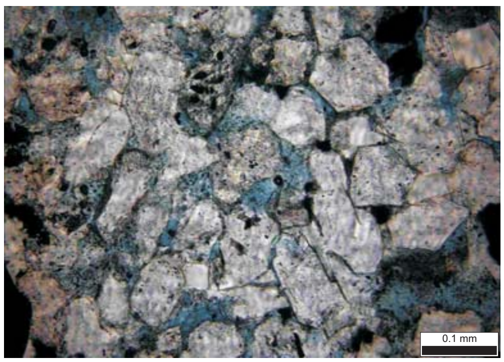
2483.55 metres



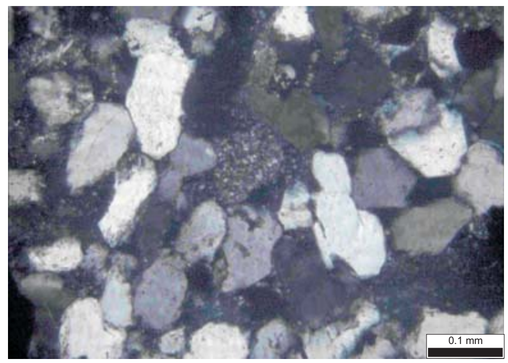
2483.55 m (pos. 2): polycrystalline quartz (from schist)
200x ppl



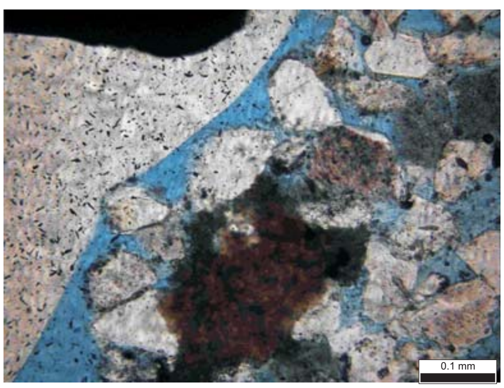
2483.55 m (pos. 2): polycrystalline quartz (from schist)
200x ppl



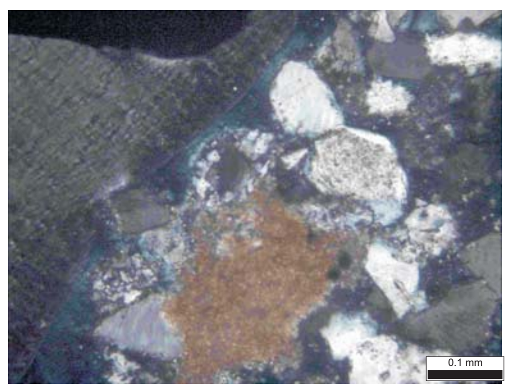
2483.55 m (pos. 3): rhyolite
200x ppl



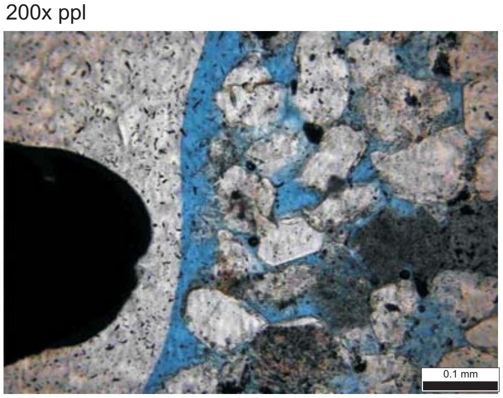
2483.55 m (pos. 3): rhyolite
200x xpl



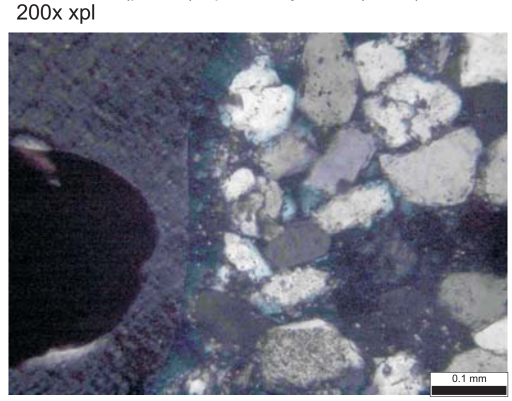
2483.55 m (pos. 4):quartz mylonite (weak)
200x ppl



2483.55 m (pos. 4): quartz mylonite (weak)
200x xpl

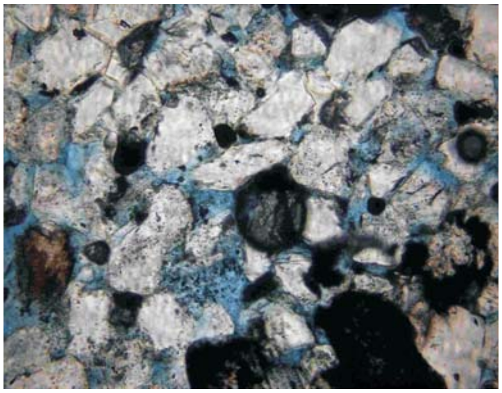


2483.55 m (pos. 5): polycrystalline quartz (from plutonic rock)
200x ppl

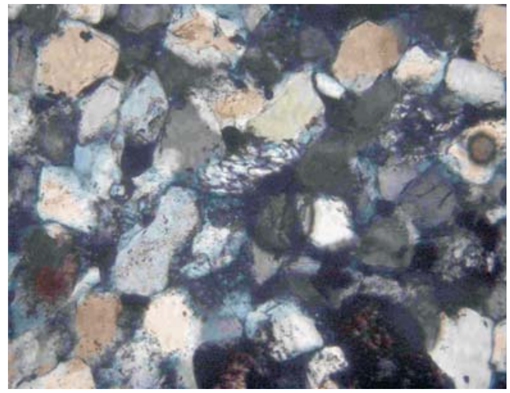


2483.55 m (pos. 5): polycrystalline quartz (from plutonic rock)
200x xpl

2483.55 metres

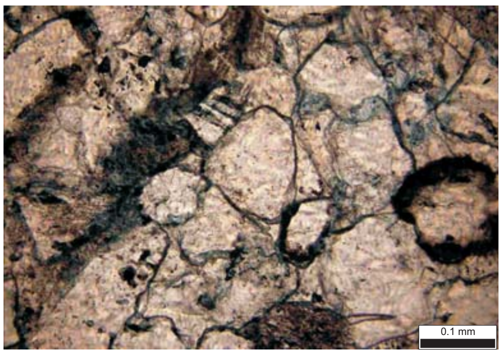


2483.55 m (pos. 5): quartz mylonite (strong)
200x ppl

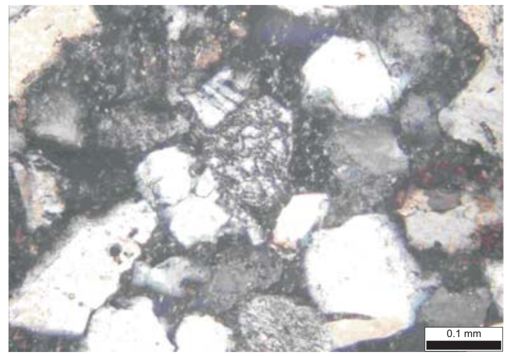


2483.55 m (pos. 5): quartz mylonite (strong)
200x xpl

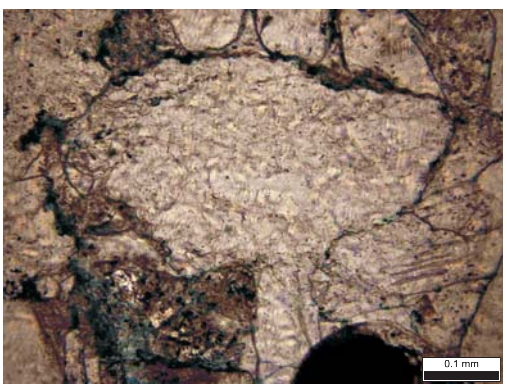
2933.62 metres



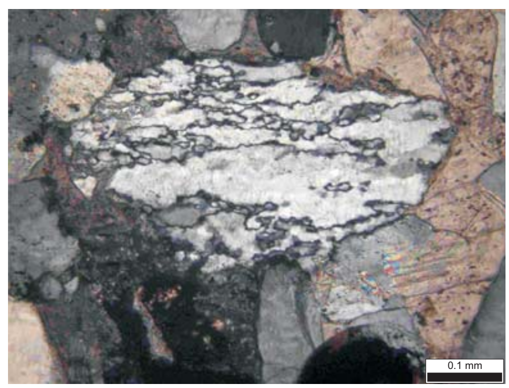
2933.62 m (pos. 1): intrusive rhyolite
200x ppl



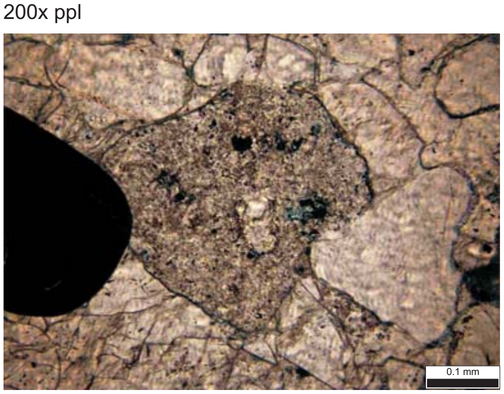
2933.62 m (pos. 1): intrusive rhyolite
200x xpl



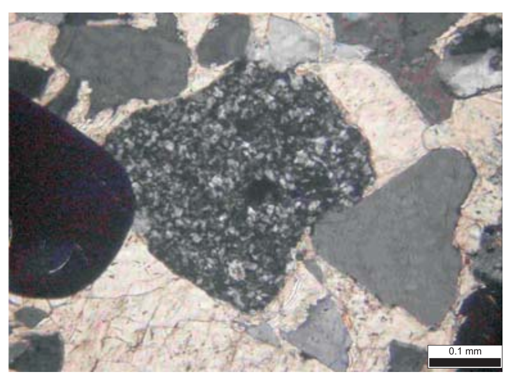
2933.62m (pos. 1): quartz mylonite (strong)
200x ppl



2933.62m (pos. 1): quartz mylonite (strong)
200x xpl

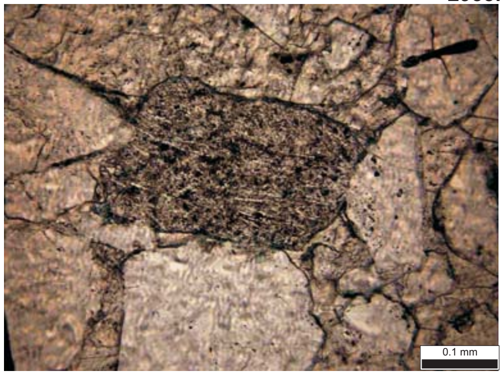


2933.62 m (pos. 3): rhyolite (S) (DM)
200x ppl

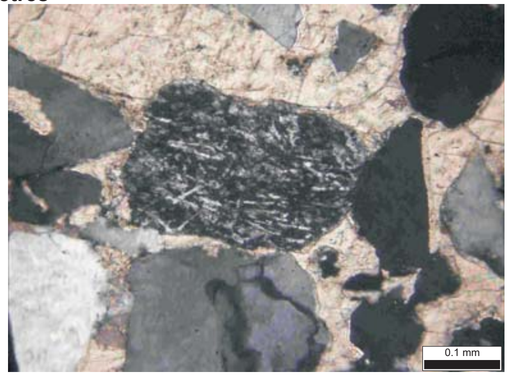


2933.62 m (pos. 3): rhyolite (S) (DM)
200x xpl

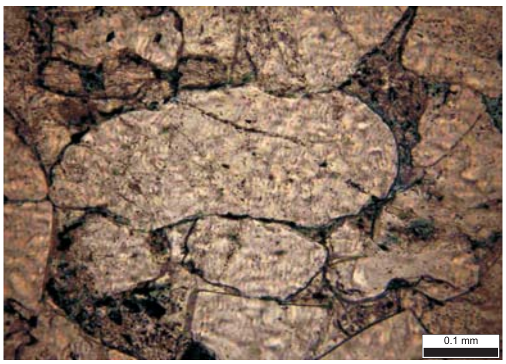
2933.62 metres



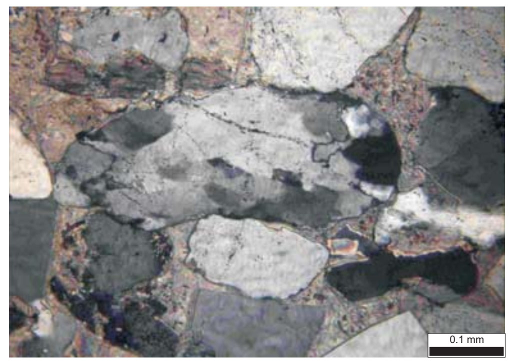
2933.62 m (pos. 3): microgranite (T) (DM)
200x ppl



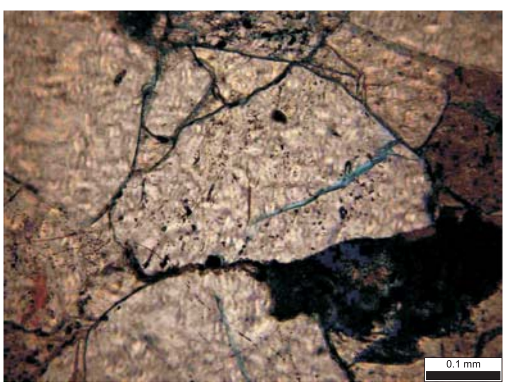
2933.62 m (pos. 3): microgranite (T) (DM)
200x xpl



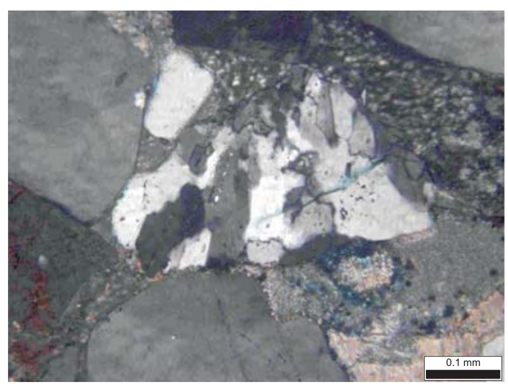
2933.62 m (pos. 3): polycrystalline quartz (from gneiss)
(D) (DM) 200x ppl



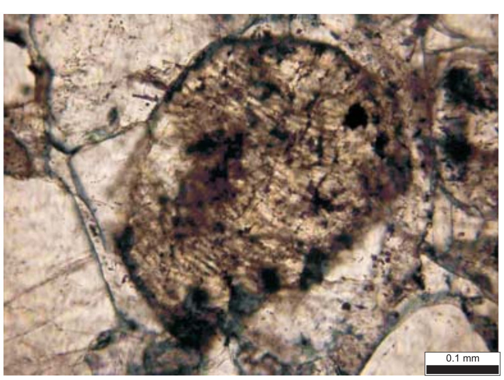
2933.62 m (pos. 3): polycrystalline quartz (from gneiss)
(D) (DM) 200x xpl



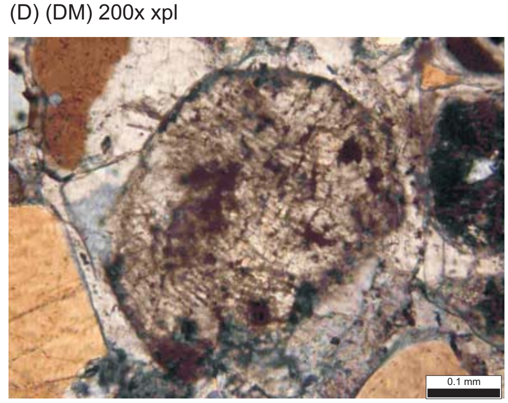
2933.62 m (pos. 3): polycrystalline quartz (from gneiss)
(D) (DM) 200x ppl



2933.62 m (pos. 3): polycrystalline quartz (from gneiss)
(D) (DM) 200x xpl



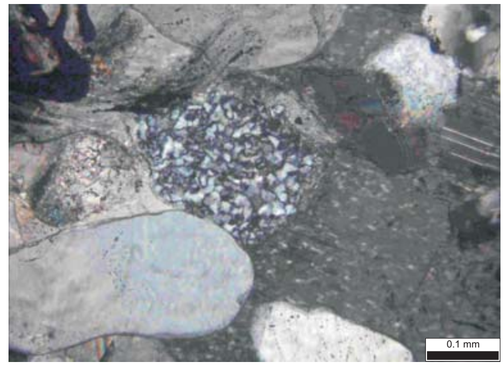
2933.62 m (pos. 4): carbonate clast (bioclast)
200x ppl



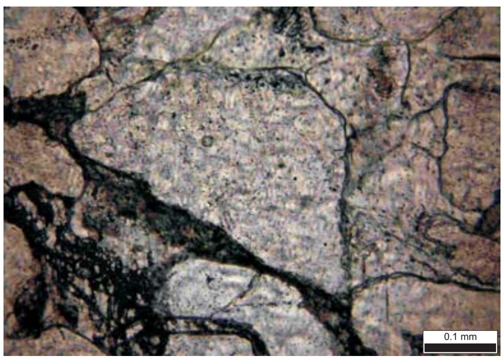
2933.62 m (pos. 3): carbonate clast (bioclast)
200x xpl

2936.06 metres

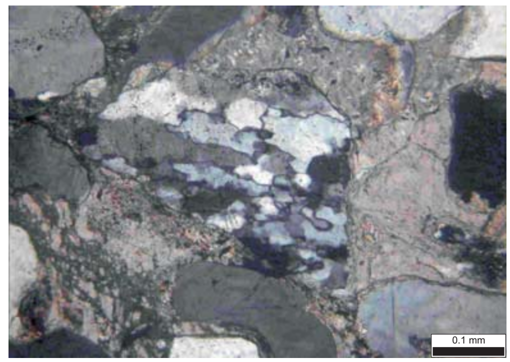
2936.06 m (pos. 1): intrusive rhyolite (S) (DM)
200x ppl



2936.06 m (pos. 1): intrusive rhyolite (S) (DM)
200x xpl

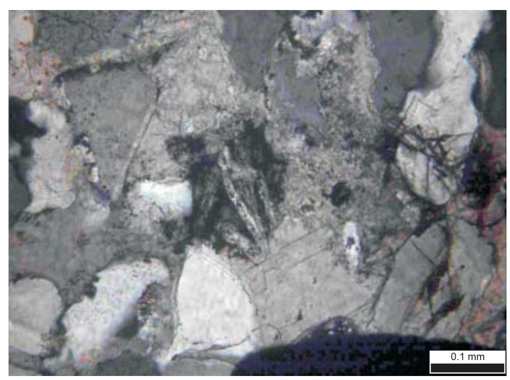


2936.06 m (pos. 1): quartz mylonite (from gneiss)
200x ppl

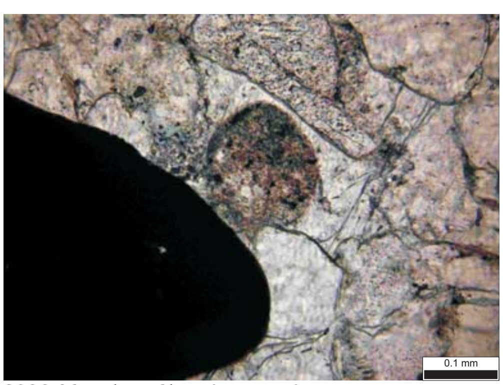


2936.06 m (pos. 1): quartz mylonite (from gneiss)
200x ppl

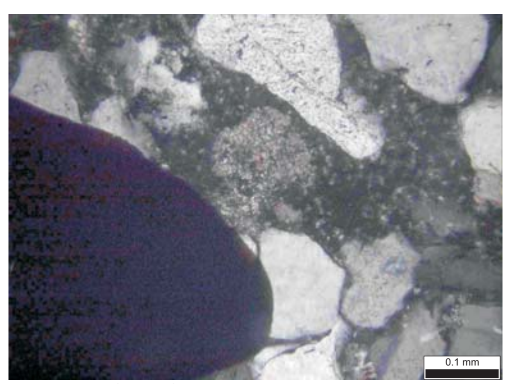
2936.06 m (pos 3): intrusive rhyolite (porphyry) (EMP)
200x ppl



2936.06 m (pos 3): intrusive rhyolite (porphyry) (EMP)
200x xpl

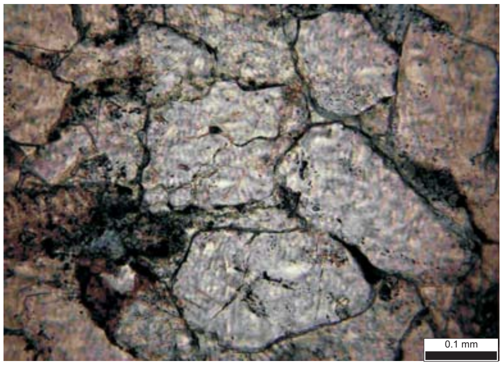


2936.06 m (pos 3):carbonate clast
200x ppl

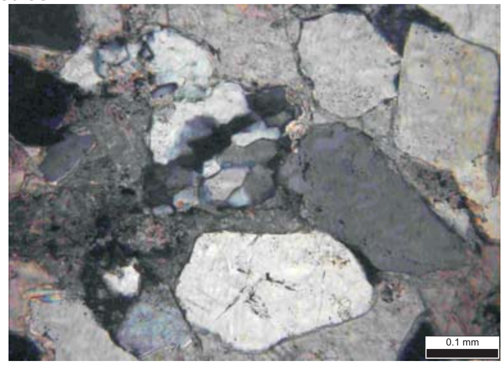


2936.06 m (pos 3):carbonate clast
200x xpl

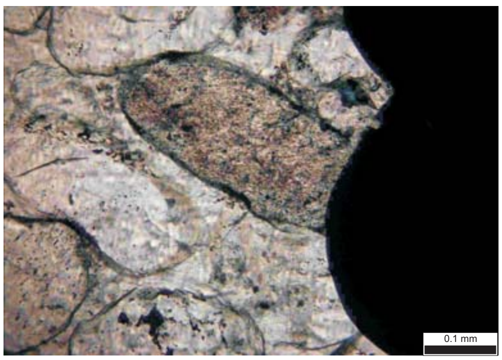
2936.06 metres



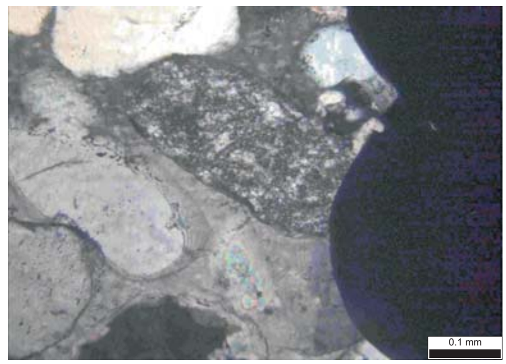
2936.06 m (pos 3): polycrystalline quartz (from gneiss) (D) 200x ppl



2936.06 m (pos 3): polycrystalline quartz (from gneiss) (D) 200x xpl

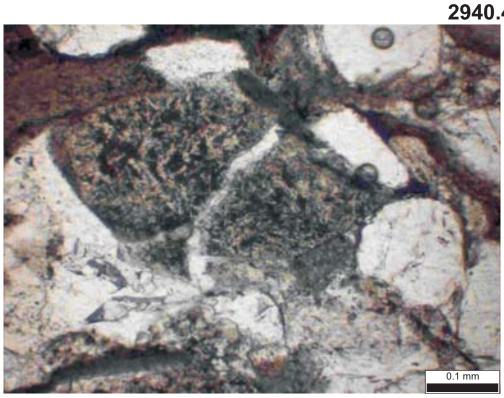


2936.06 m (pos 4): intrusive rhyolite
200x ppl

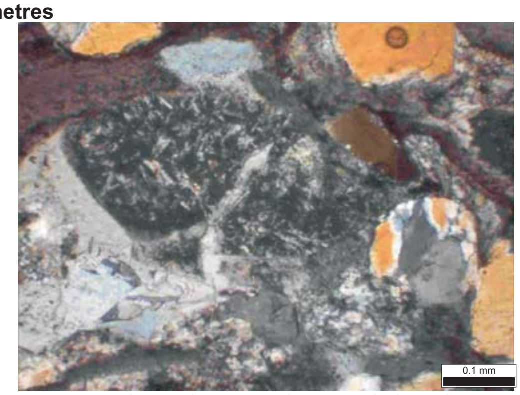


2936.06 m (pos 4): intrusive rhyolite
200x xpl

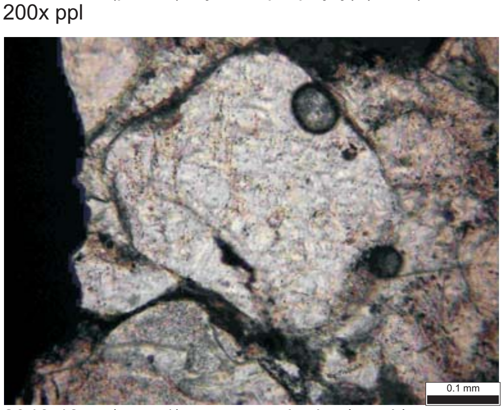
2940.48metres



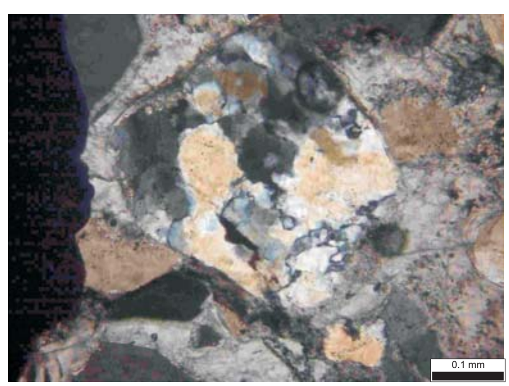
2940.48 m (pos. 1): syenite porphyry) (EMP)
200x ppl



2940.48 m (pos. 1): syenite (porphyry) (EMP)
200x xpl

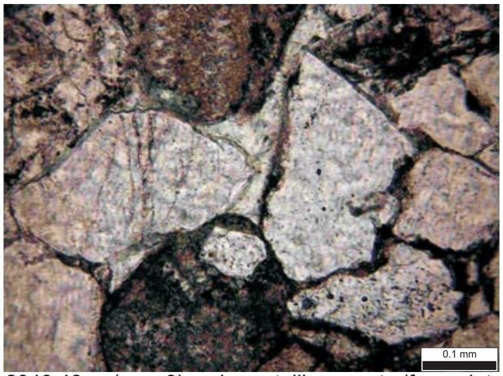


2940.48 m (pos. 1): quartz mylonite (weak)
200x ppl

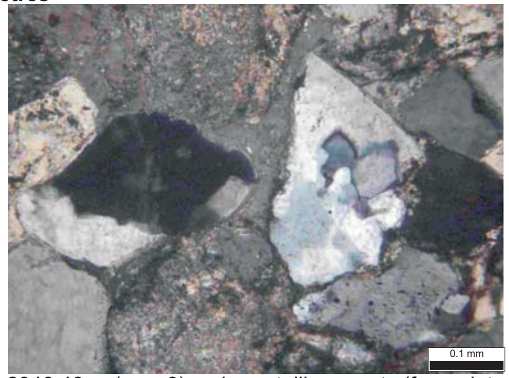


2940.48 m (pos. 1): quartz mylonite (weak)
200x xpl

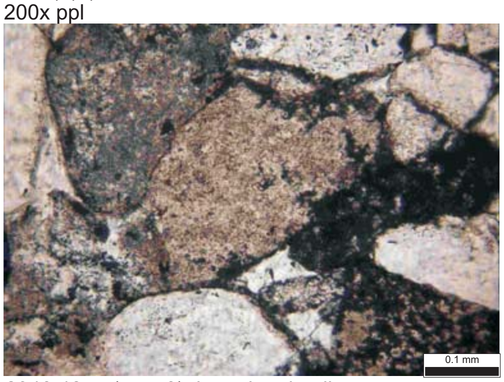
2940.48metres



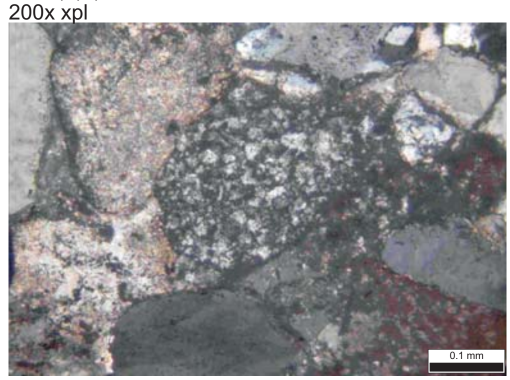
2940.48 m (pos. 3): polycrystalline quartz (from plutonic rocks) (E)
200x ppl



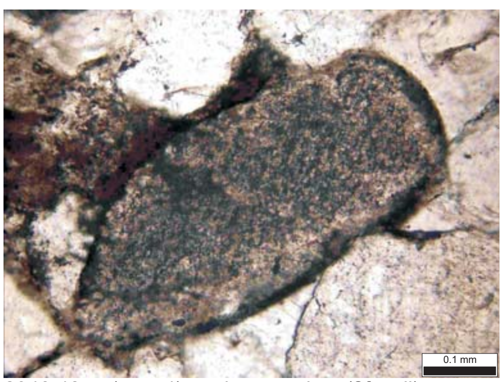
2940.48 m (pos. 3): polycrystalline quartz (from plutonic rocks) (E)
200x xpl



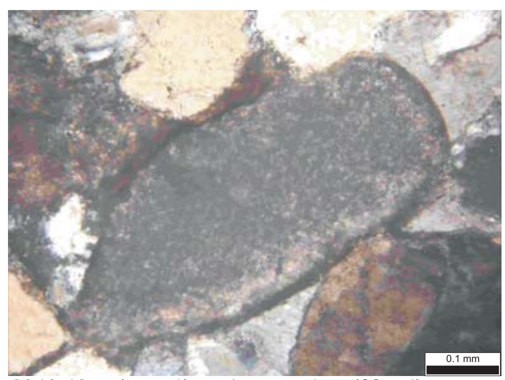
2940.48 m (pos. 3): intrusive rhyolite
200x ppl



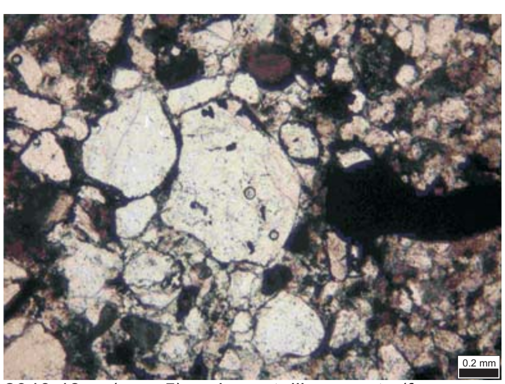
2940.48 m (pos. 3): intrusive rhyolite
200x xpl



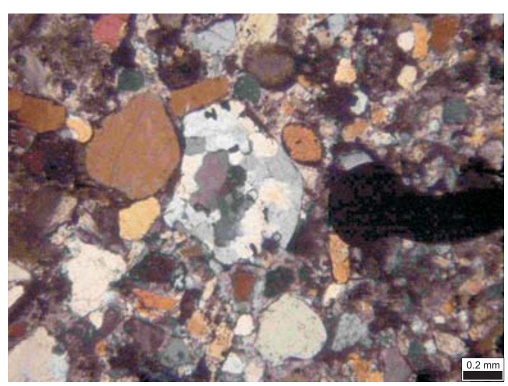
2940.48 m (pos. 4): carbonate clast (?fossil)
200x ppl



2940.48 m (pos. 4): carbonate clast (?fossi)
200x xpl

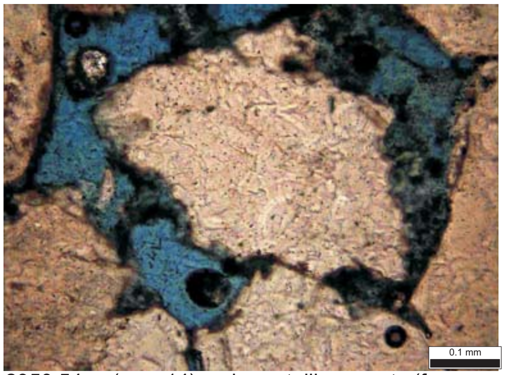


2940.48 m (pos. 5): polycrystalline quartz (from gneiss) (D)
50x ppl

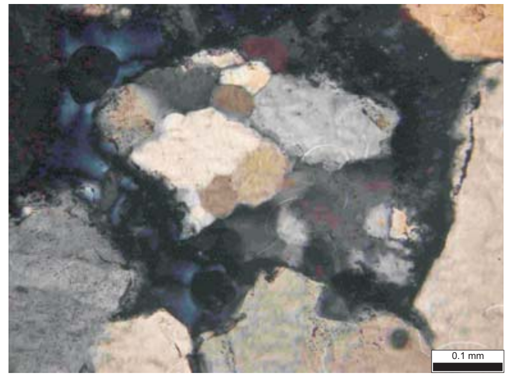


2940.48 m (pos. 5): polycrystalline quartz (from gneiss) (D)
50x xpl

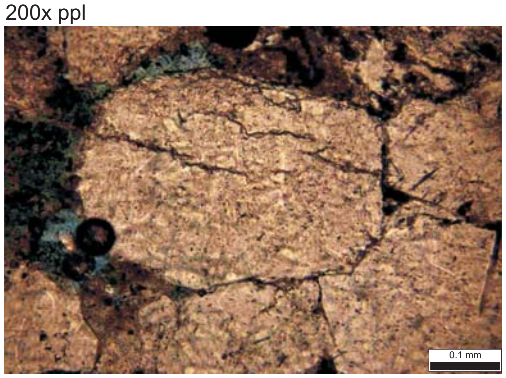
2950.54 metres



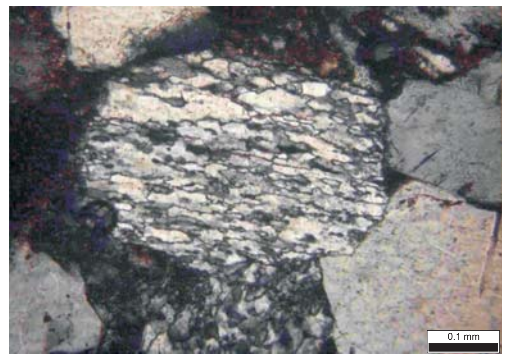
2950.54 m (pos. 14): polycrystalline quartz (from plutonic rock) (E)
200x ppl



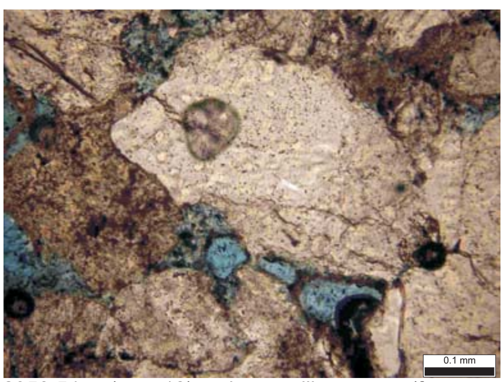
2950.54 m (pos. 14): polycrystalline quartz (from plutonic rock) (E). 200x xpl



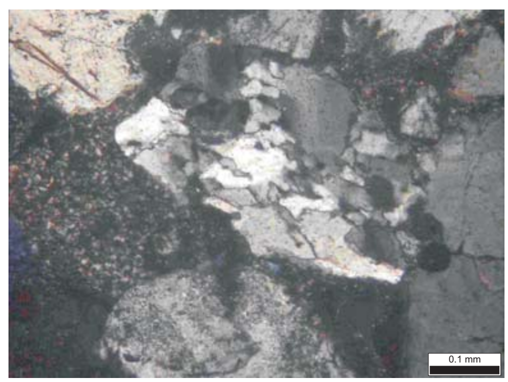
2950.54 m (pos. 18): polycrystalline quartz (from schist) (N)
200x ppl



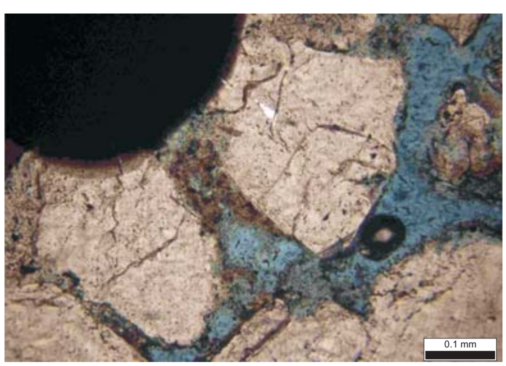
2950.54 m (pos. 18): polycrystalline quartz (from schist) (N)
200x xpl



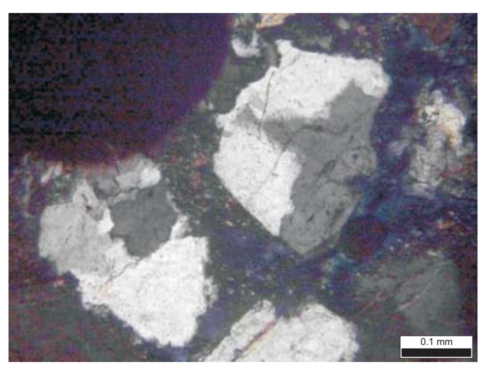
2950.54 m (pos. 18): polycrystalline quartz (from gneiss) (D) 200x ppl



2950.54 m (pos. 18): polycrystalline quartz (from gneiss) (D) 200x xpl

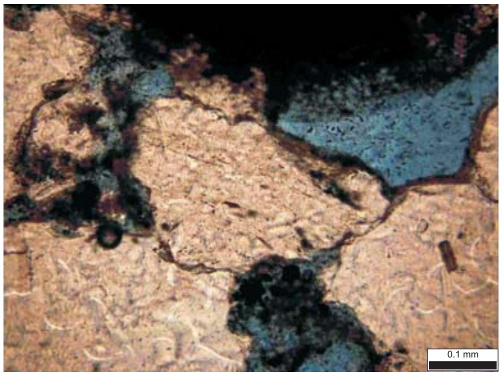


2950.54 m (pos. 18): polycrystalline quartz (from plutonic rocks) (E)
200x ppl

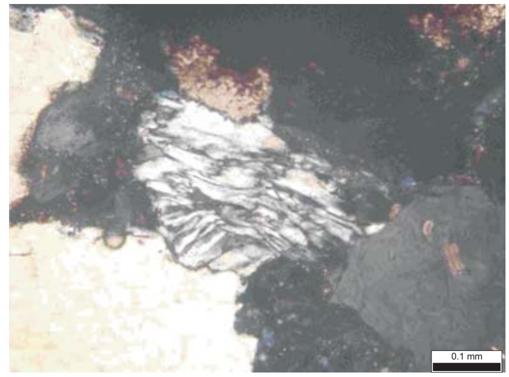


2950.54 m (pos. 18): polycrystalline quartz (from plutonic rocks) (E)
200x xpl

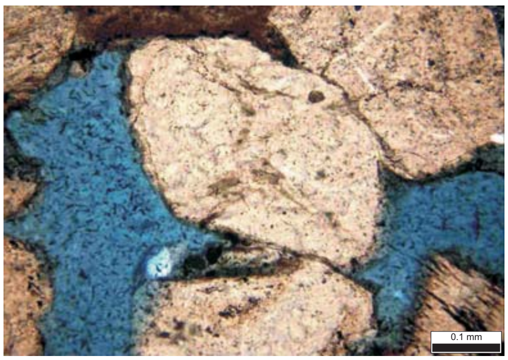
2950.54 metres



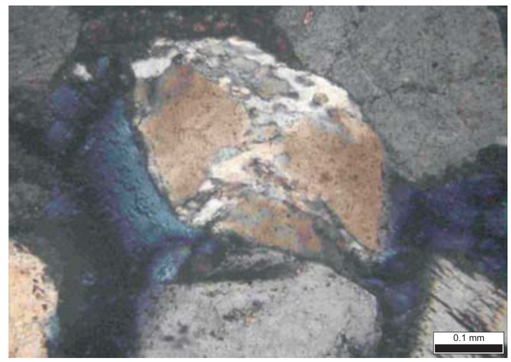
2950.54 m (pos. 20): vein quartz (X)
200x ppl



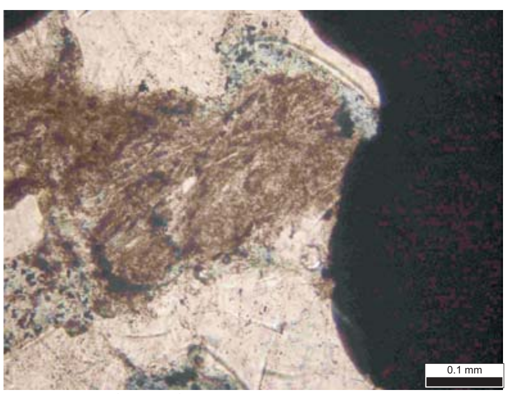
2950.54 m (pos. 20): vein quartz (X)
200x xpl



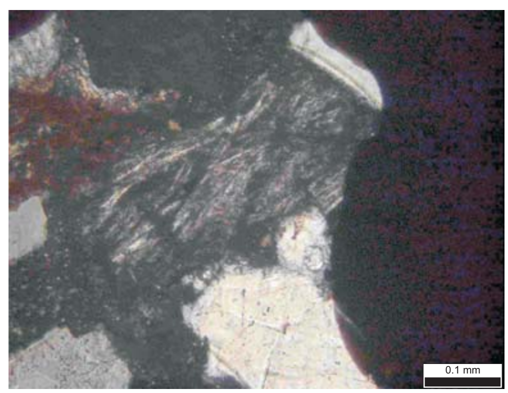
2950.54 m (pos. 21): quartz arenite (clast)
200x ppl



2950.54 m (pos. 21): quartz arenite (clast)
200x xpl



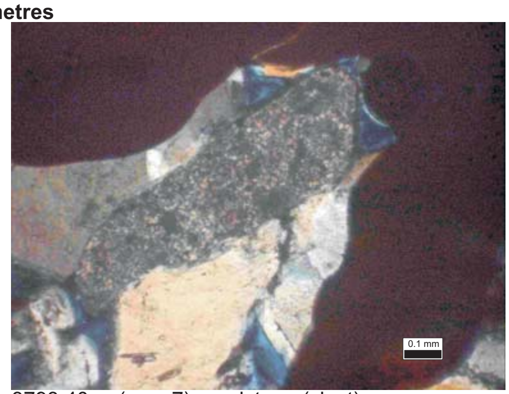
2950.54 m (pos. 5): intrusive rhyolite
200x ppl



2950.54 m (pos. 5): intrusive rhyolite
200x ppl

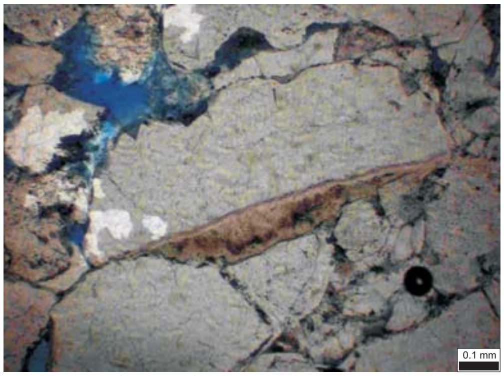
3793.40 metres

3793.40 m (pos. 7): mudstone (clast)
100x ppl

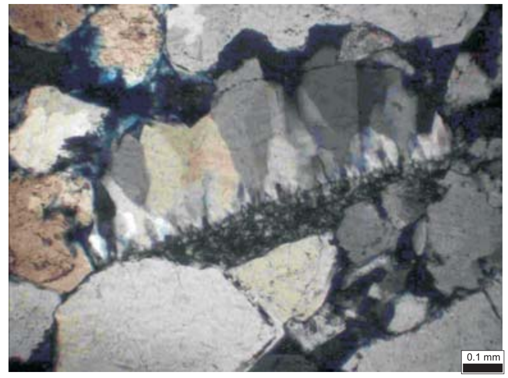


3793.40 m (pos. 7): mudstone (clast)
100x ppl

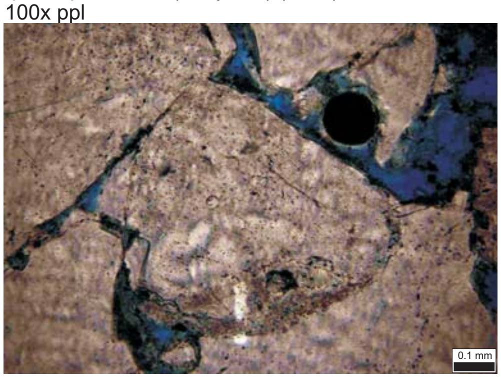
3793.40 metres



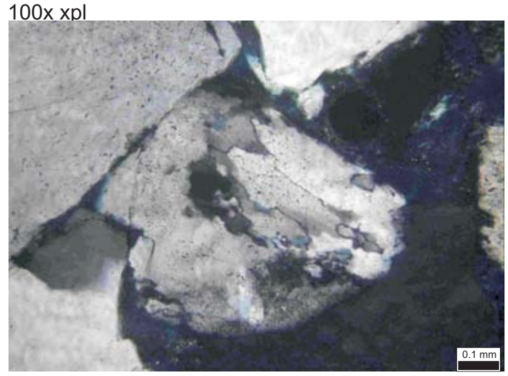
3793.40 m (pos. 18): polycrystalline quartz against quartz plus albite (? rhyolite) (EMP)
100x ppl



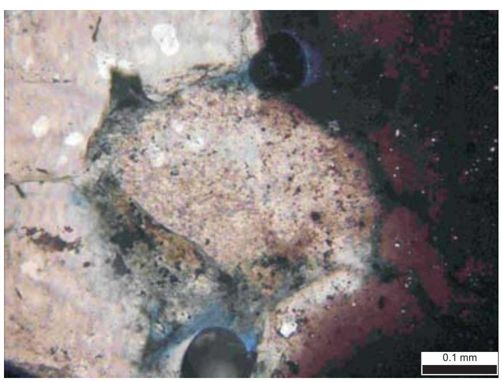
3793.40 m (pos. 18): polycrystalline quartz against quartz plus albite (?rhyolite) (EMP)
100x xpl



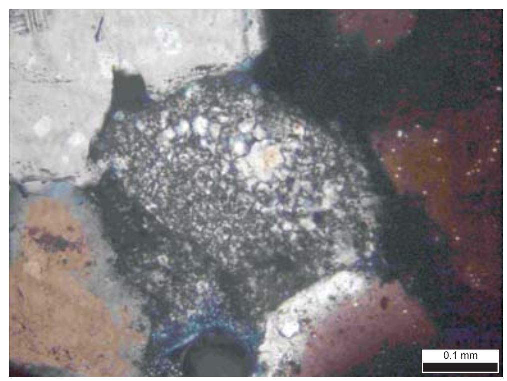
3793.40 m (pos. 18): polycrystalline quartz (from gneiss) (D)
100x ppl



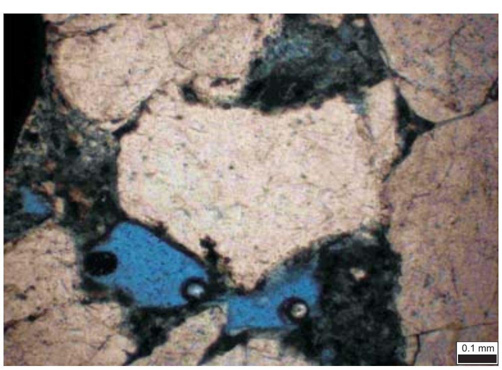
3793.40 m (pos. 18): polycrystalline quartz (from gneiss) (D)
100x xpl



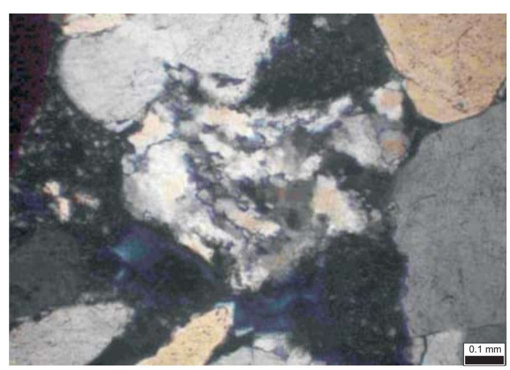
3793.40 m (pos. 19): chert (EMP) (DM)
200x ppl



3793.40 m (pos. 19): chert (EMP) (DM)
200x xpl

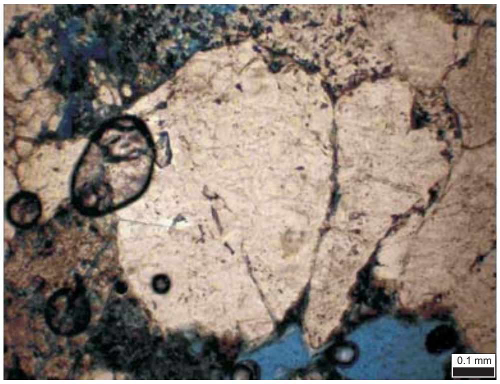


3793.40 m (pos. 20): quartz mylonite (strong) (EMP)
100x ppl

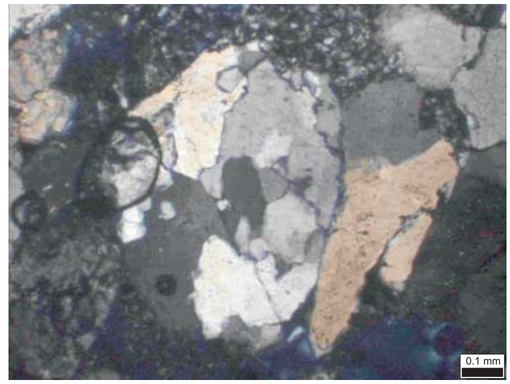


3793.40 m (pos. 20): quartz mylonite (strong) (EMP)
100x xpl

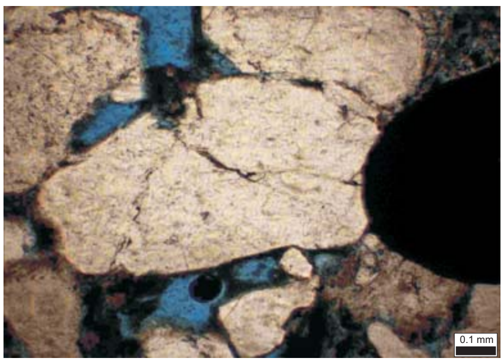
3793.40 metres



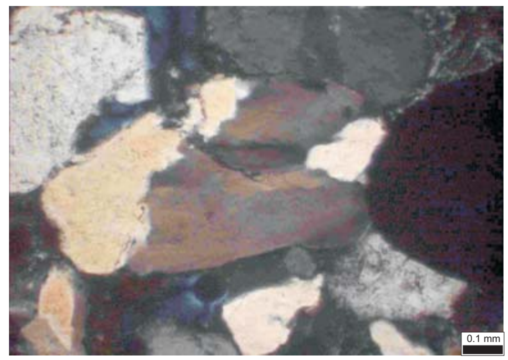
3793.40 m (pos. 20): polycrystalline quartz (from gneiss) (D) 100x ppl



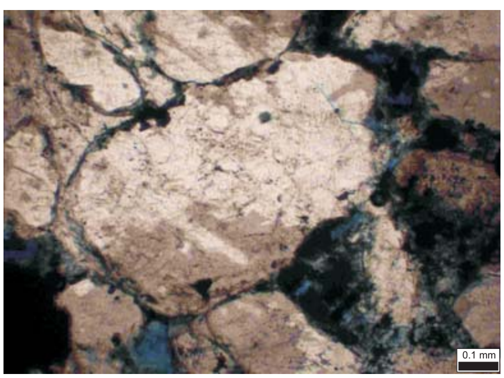
3793.40 m (pos. 20): polycrystalline quartz (from gneiss) (D) 100x xpl



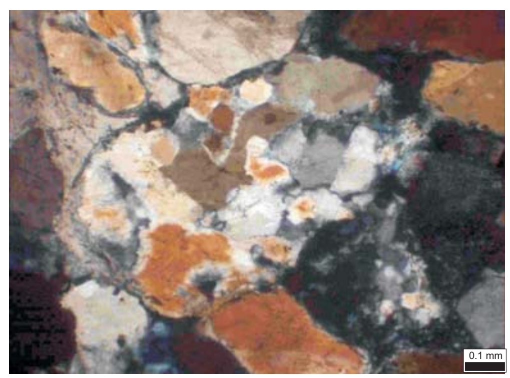
3793.40 m (pos. 20): polycrystalline quartz (from plutonic rock) (E)
100x ppl



3793.40 m (pos. 20): polycrystalline quartz (from plutonic rock) (E)
100x xpl

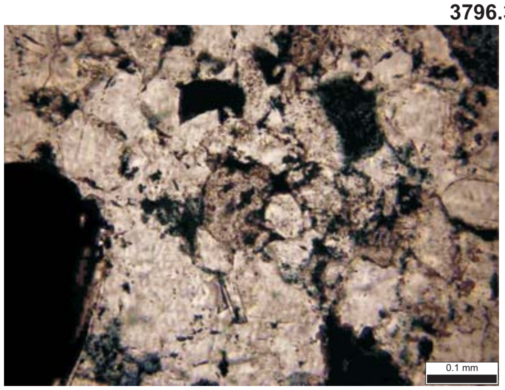


3793.40 m (pos. 22): polycrystalline quartz (from gneiss) (D) 100x ppl

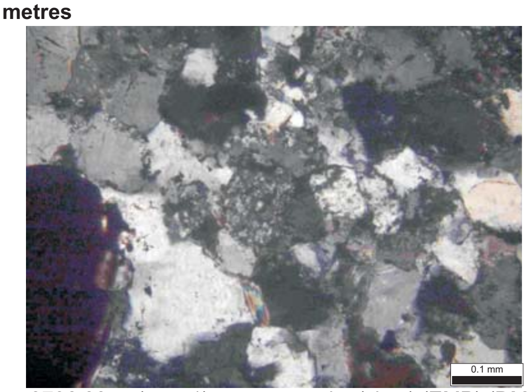


3793.40 m (pos. 22): polycrystalline quartz (from gneiss) (D) 100x xpl

3796.33 metres

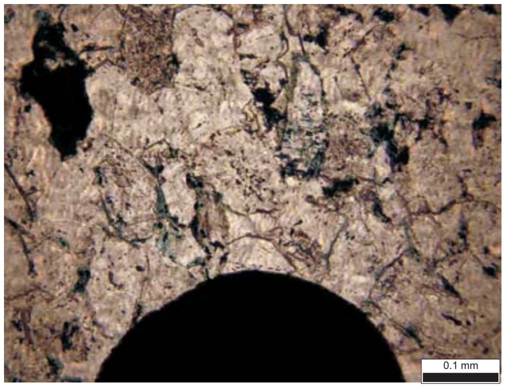


3796.33 m (pos. 1): quartz arenite (clast) (EMP) (DM)
200x ppl

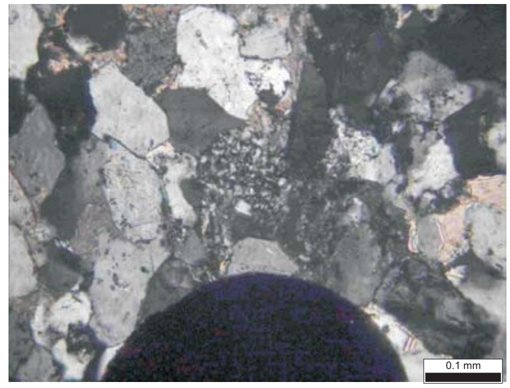


3796.33 m (pos. 1): quartz arenite (clast) (EMP) (DM)
200x xpl

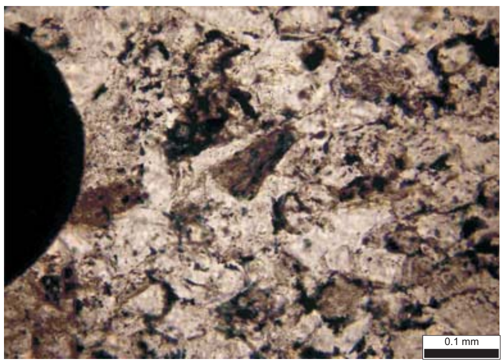
3796.33 metres



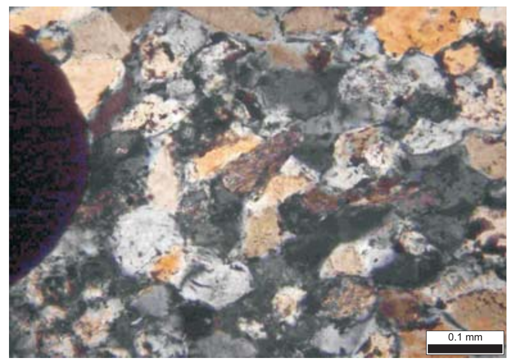
3796.33 m (pos. 2):chert (Y) (EMP)
200x ppl



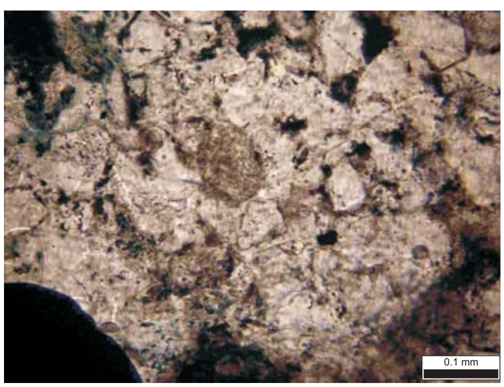
3796.33 m (pos. 2):chert (Y) (EMP)
200x ppl



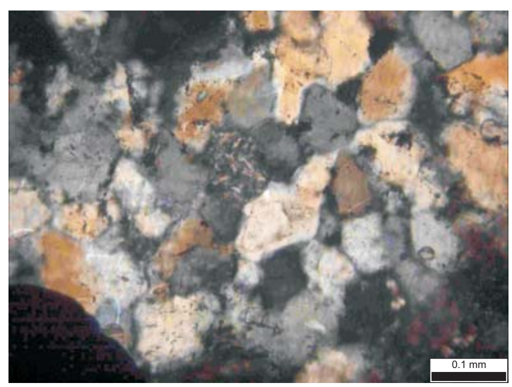
3796.33 m (pos. 3): carbonate
200x ppl



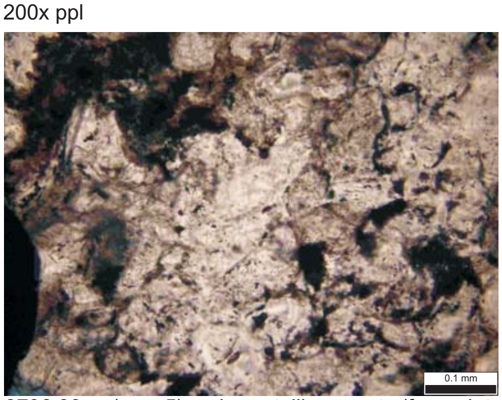
3796.33 m (pos. 3): carbonate
200x xpl



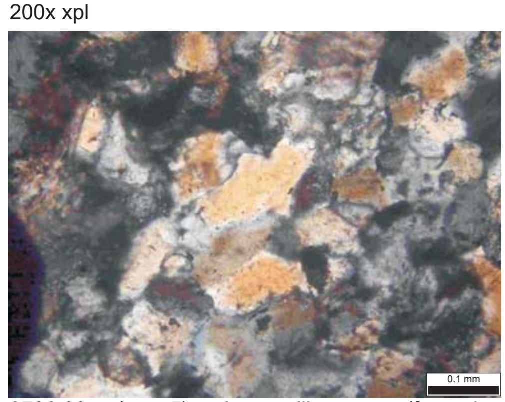
3796.33 m (pos. 4): rhyolite
200x ppl



3796.33 m (pos. 4): rhyolite
200x xpl

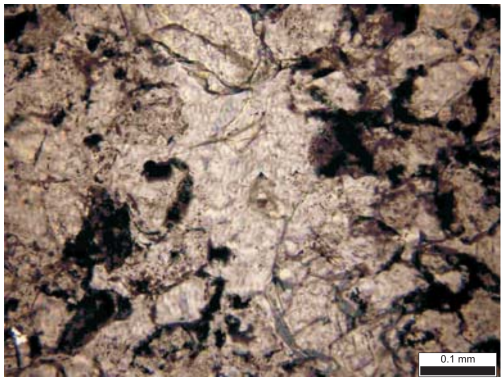


3796.33 m (pos. 5): polycrystalline quartz (from plutonic rock) (E)
200x ppl

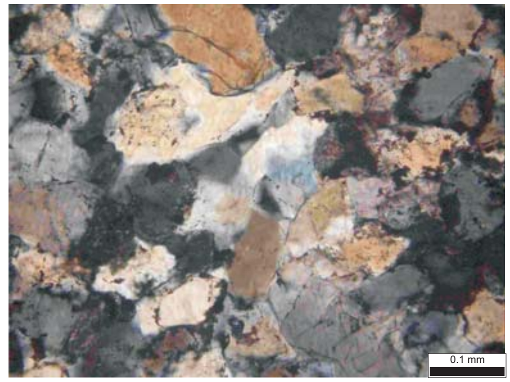


3796.33 m (pos. 5): polycrystalline quartz (from plutonic rock) (E)
200x xpl

3796.33 metres



3796.33 m (pos. 6): polycrystalline quartz (from gneiss)
(D) 200x ppl



3796.33 m (pos. 6): polycrystalline quartz (from gneiss)
(D) 200x xpl

* <u>Abbreviations</u>

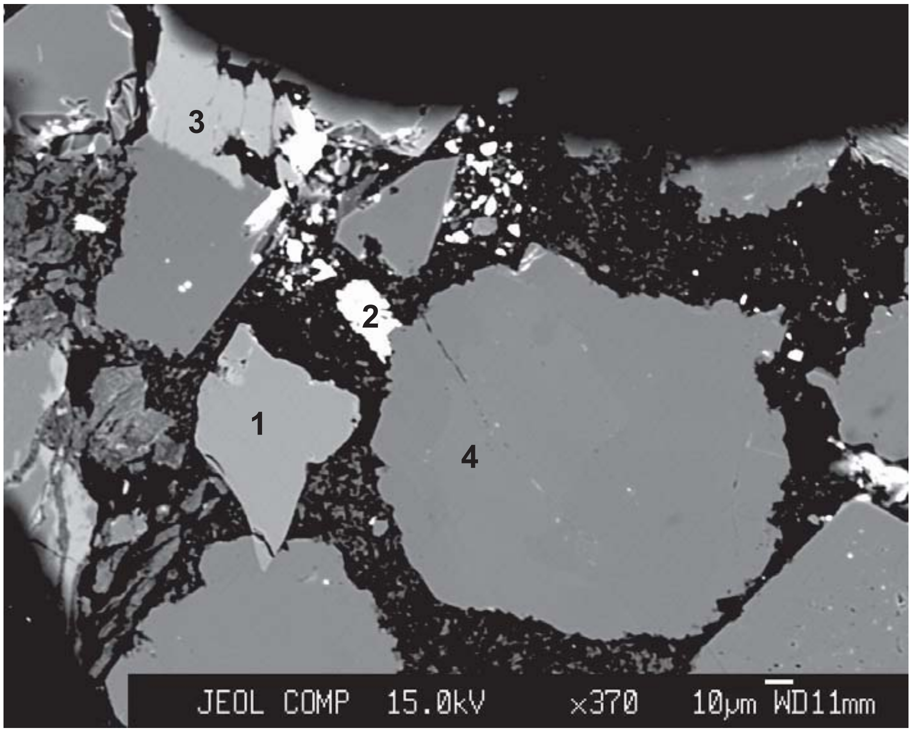
ppl = plane polarized light
xpl = cross polarized light
EMP = electron microprobe study was done
DM = detailed microscope examination was done
A, B, etc = types of similar lithologies

<u>Note</u>

The legend of every microphotograph always, unless otherwise stated, describes the clast that occupies the centre of the field of view.

Appendix IV

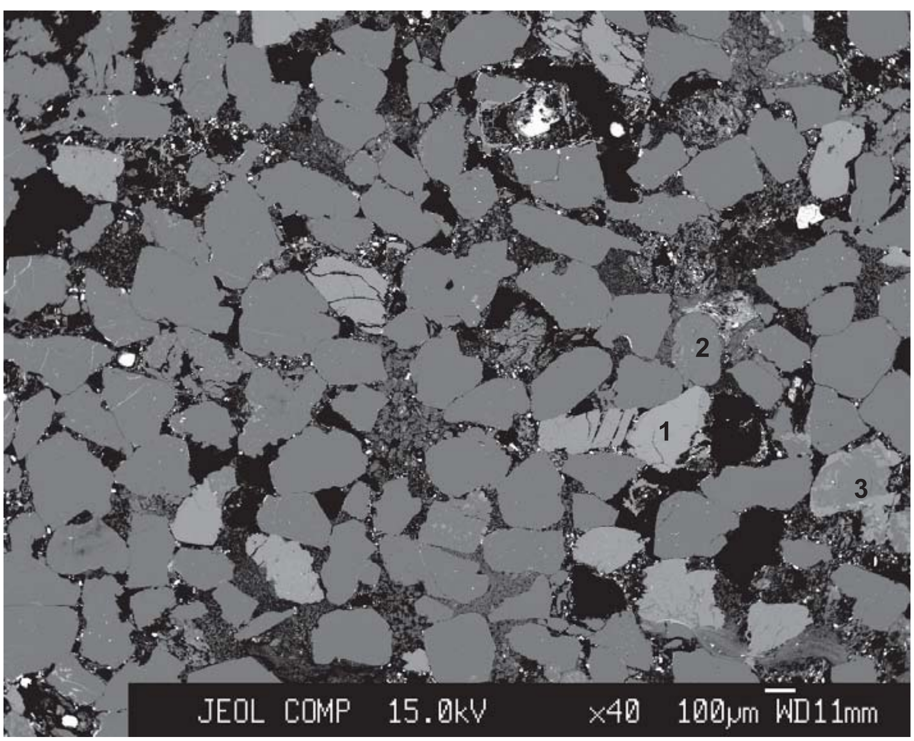
Back-scattered electron images of detrital mineral grains



1. Tourmaline
2. Rutile
3. K-feldspar
4. Quartz

p. 106 (16)*

Figure 1 A-99 2210.37m

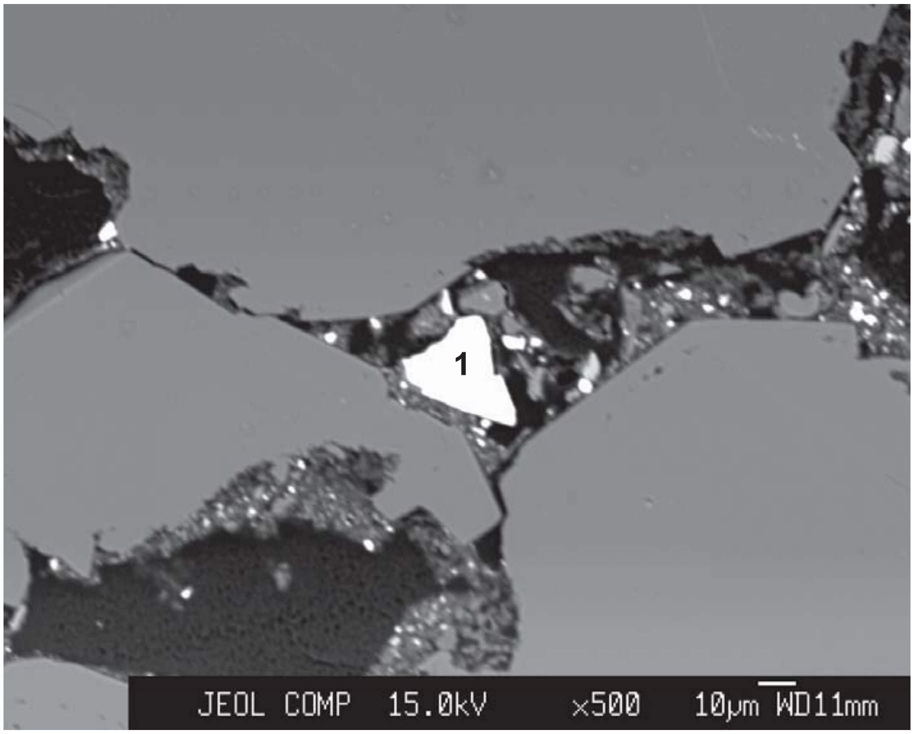


1. K-feldspar
2. K-feldspar
3. Plagioclase

p. 181 (16B)

Figure 2 A-99 2211.47m

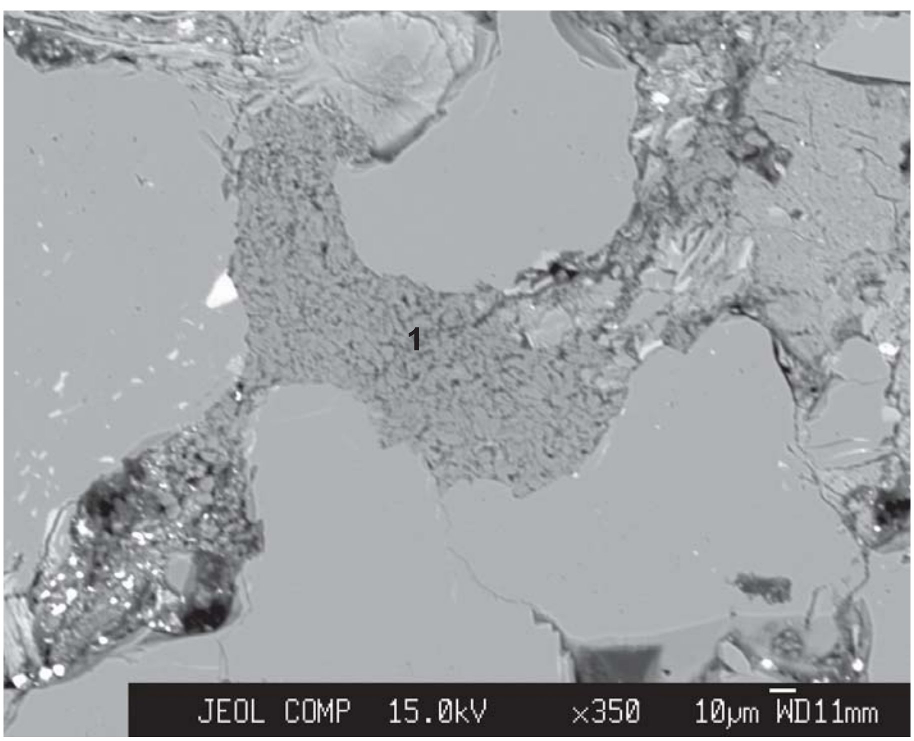
* The number in the parenthesis refers to the number of the binder with the original electron microprobe data.



1. Barite

p. 2 (16B)

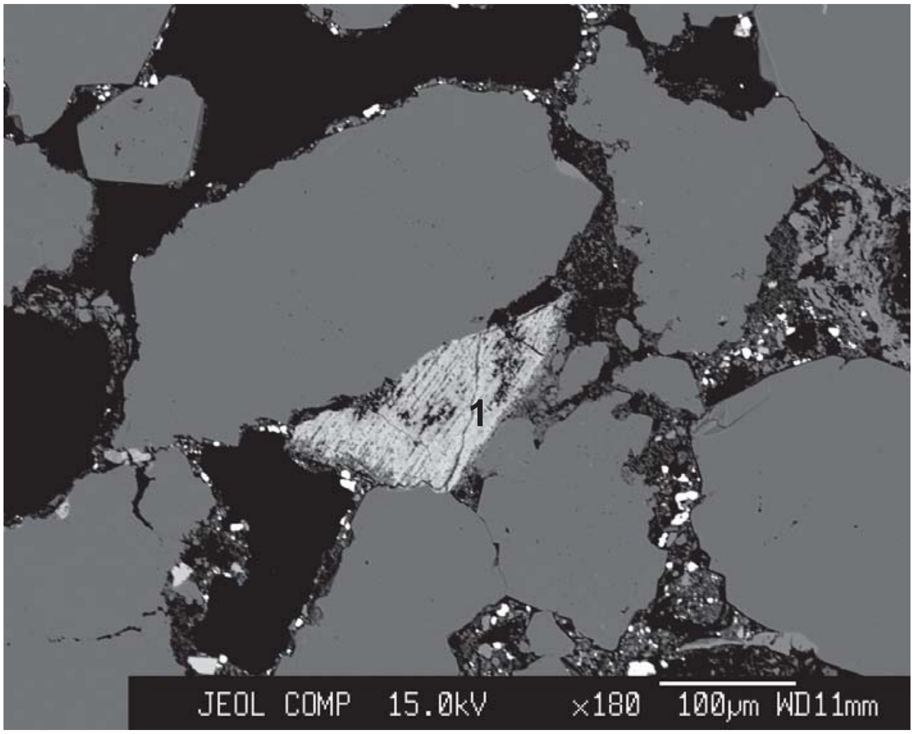
Figure 3 A-99 2212.91m



1. Kaolinite

p. 3 (16B)

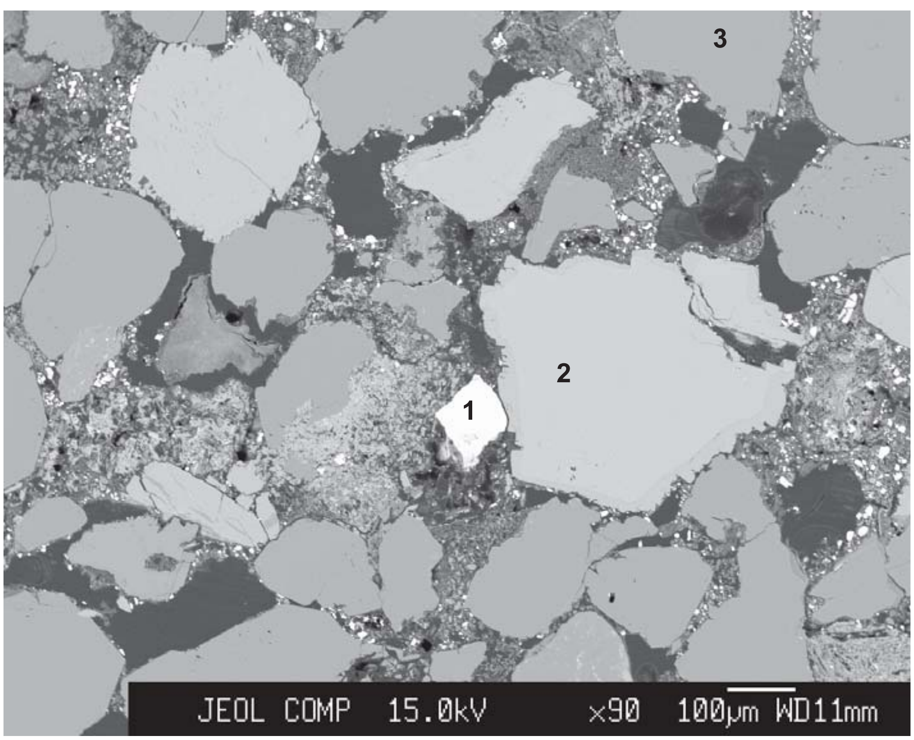
Figure 4 A-99 2212.91m



1. Ilmenite

p. 4 (16B)

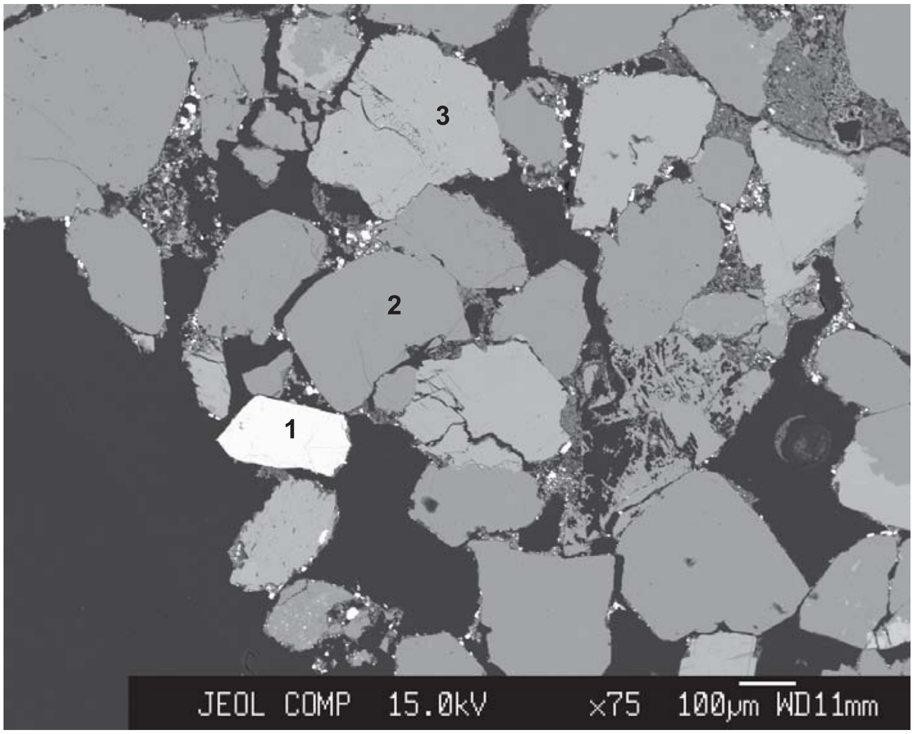
Figure 5 A-99 2212.91m



1. Garnet
2. K-feldspar
3. Quartz

p. 5 (16B)

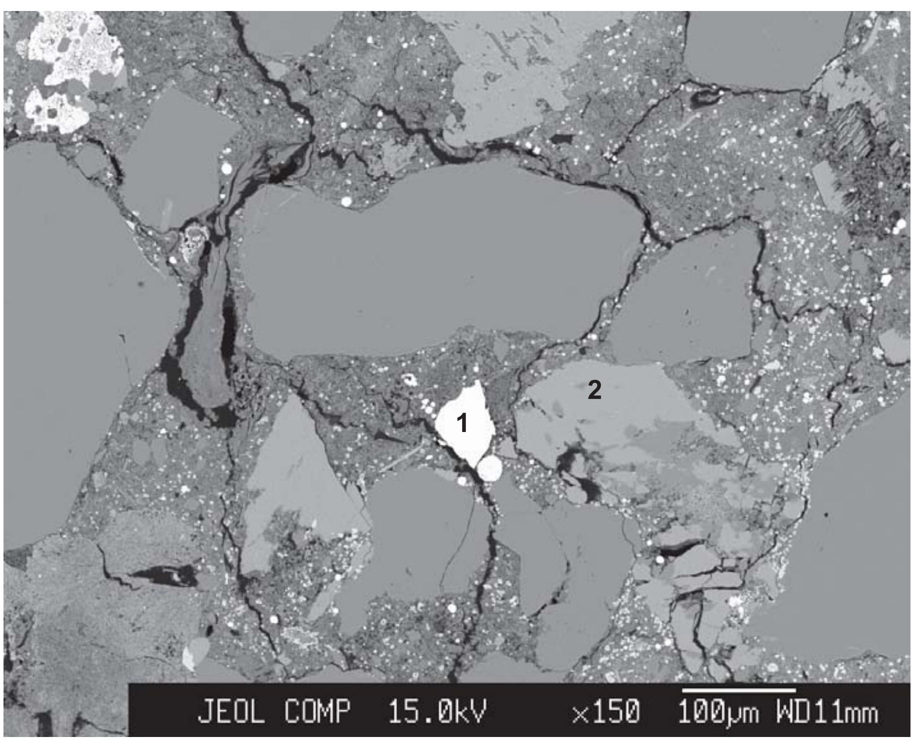
Figure 6 A-99 2212.91m



1. Chromite
2. Quartz
3. K-feldspar

p. 6 (16B)

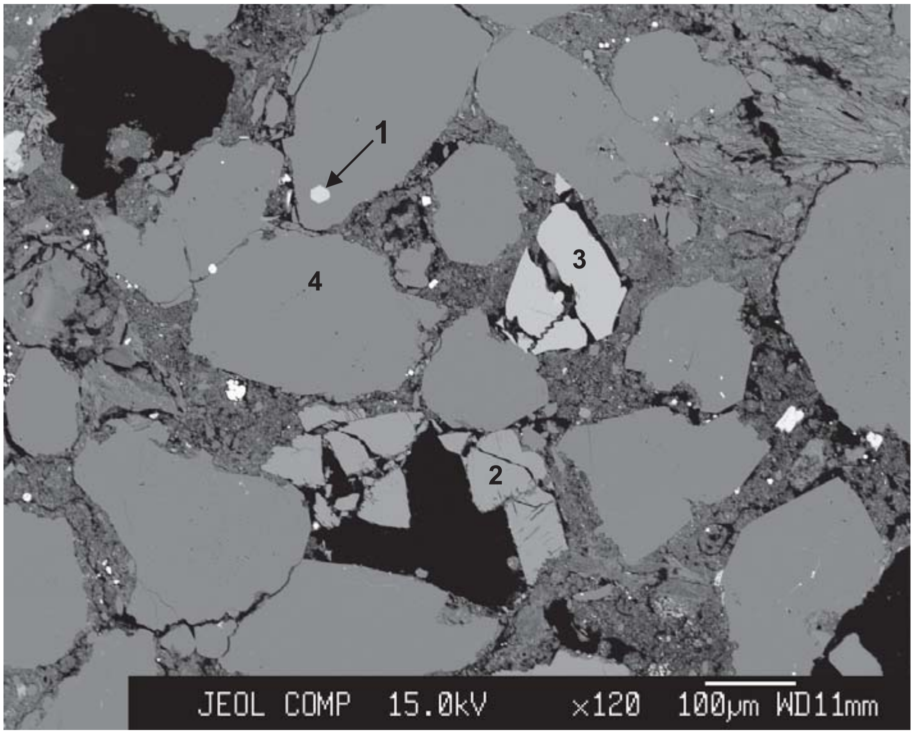
Figure 7 A-99 2212.91m



1. Chromite
2. K-feldspar

p. 40 (16B)

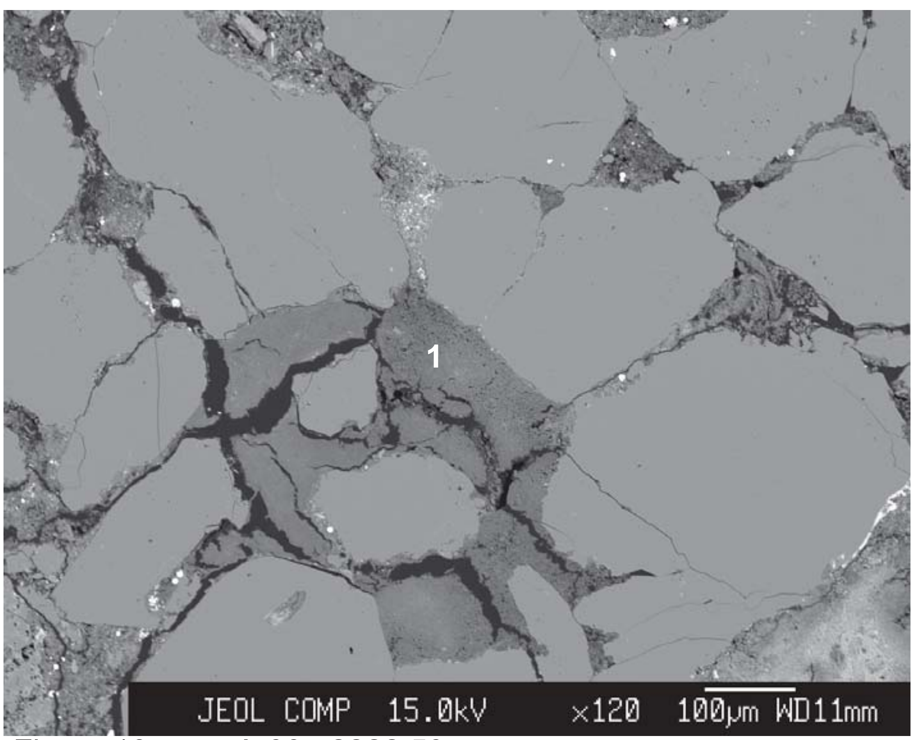
Figure 8 A-99 2222.59m



1. Apatite
2. K-feldspar
3. Garnet
4. Quartz

p. 41 (16B)

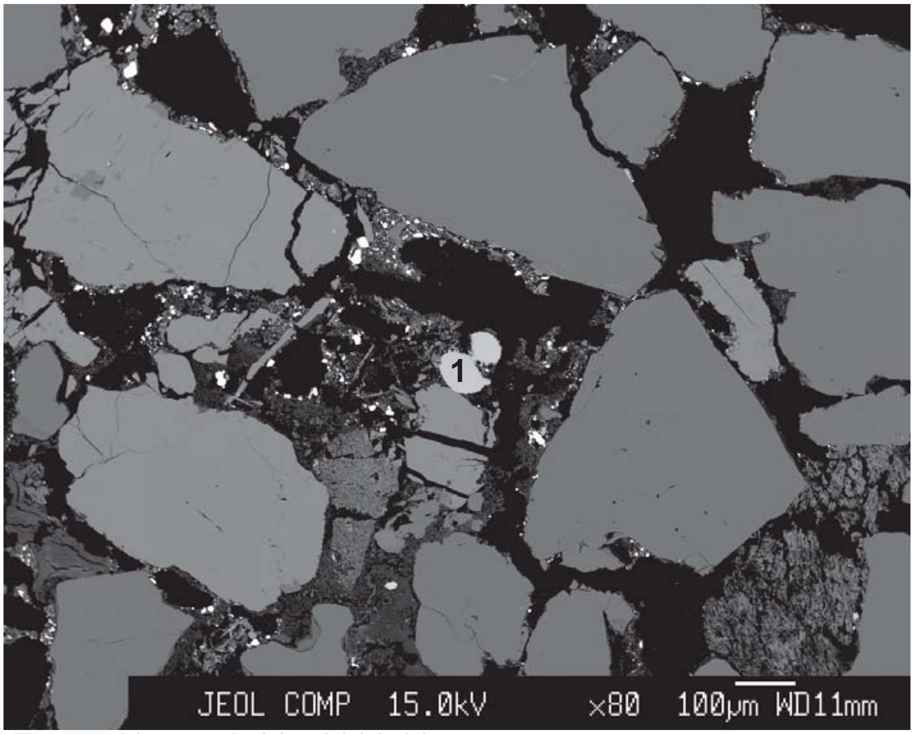
Figure 9 A-99 2222.59m



1. Kaolinite

p. 42 (16B)

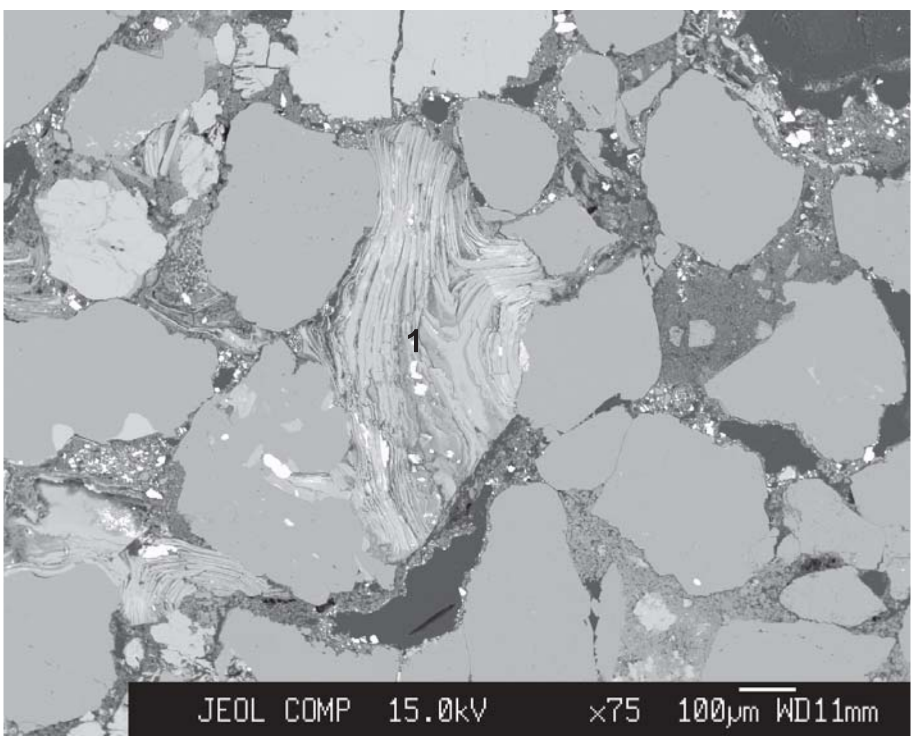
Figure 10 A-99 2222.59m



1. Siderite

p. 83 (16B)

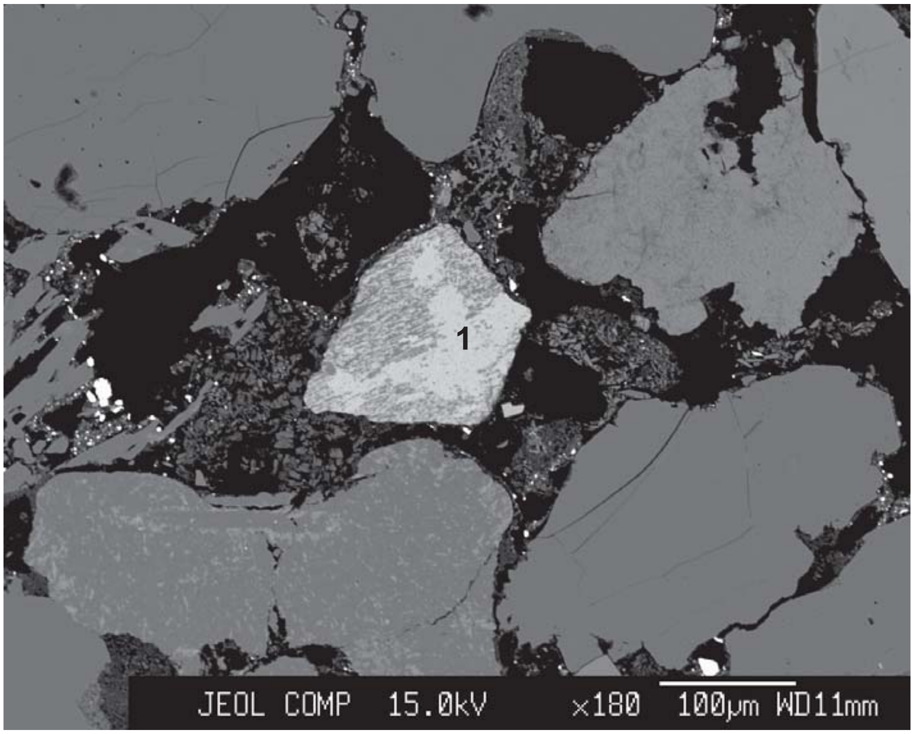
Figure 11 A-99 2230.62m



1. Muscovite

p. 84 (16B)

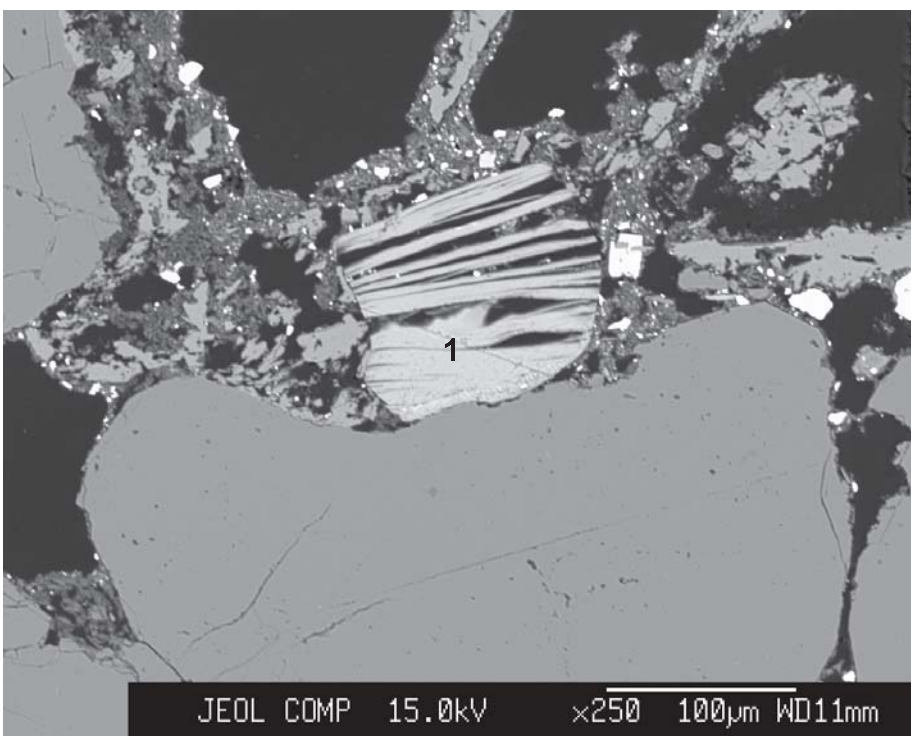
Figure 12 A-99 2230.62m



1. Rutile (altered ilmenite)

p. 85 (16B)

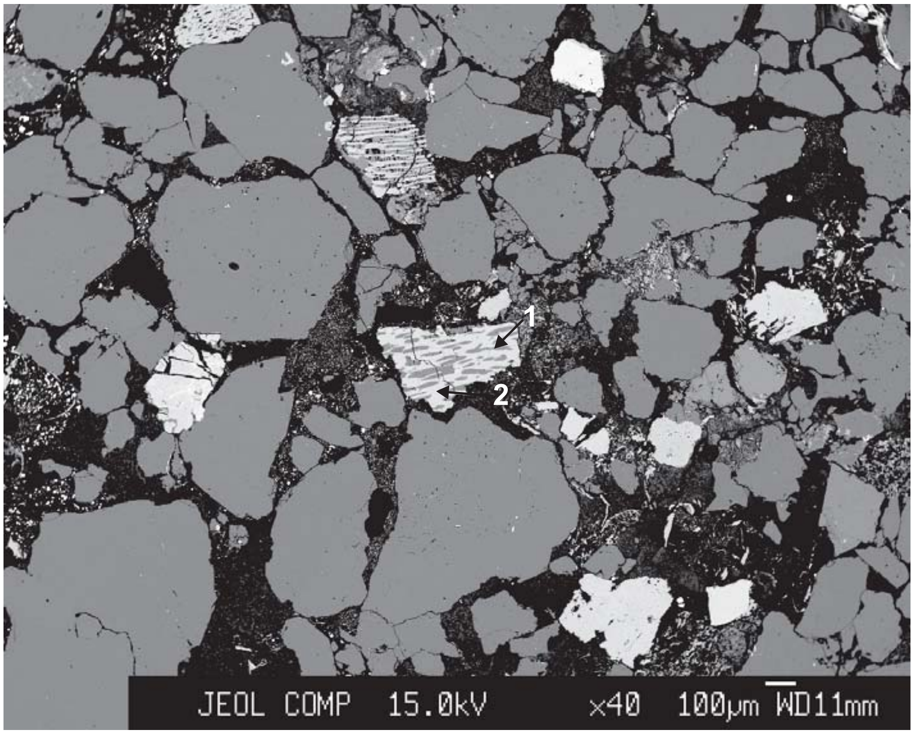
Figure 13 A-99 2230.62m



1. Biotite

p. 86 (16B)

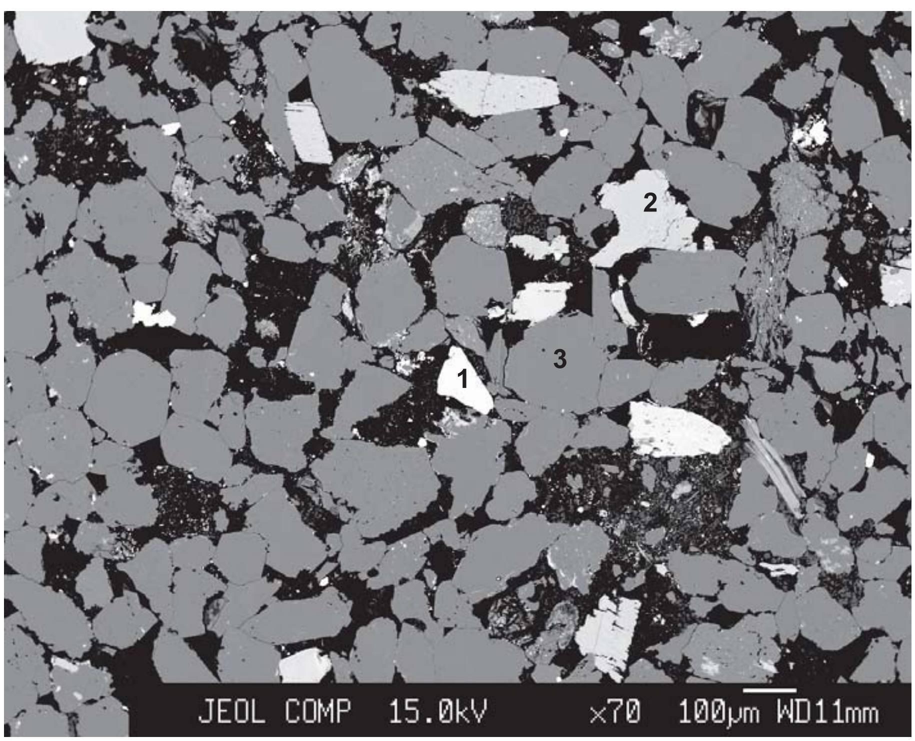
Figure 14 A-99 2230.62m



1. Albite
2. K-fledspar

p. 139 (168)

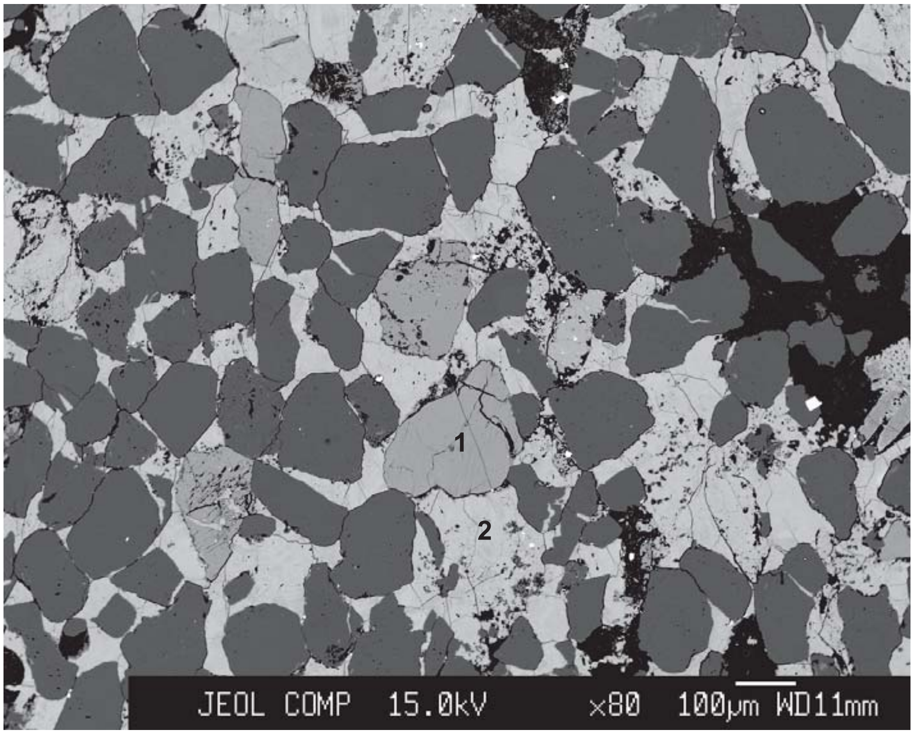
Figure 15 A-99 2266.99m



1. Chromite
2. K-feldspar
3. Quartz

p. 124 (16B)

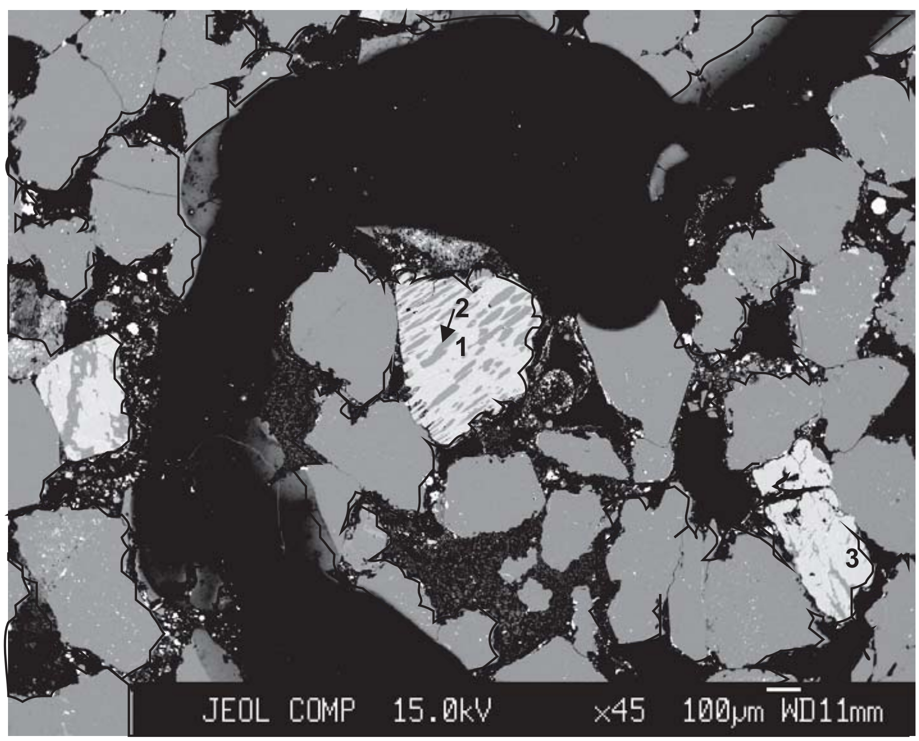
Figure 16 A-99 2470.66m



1. K-feldspar
2. Calcite

p. 167 (16B)

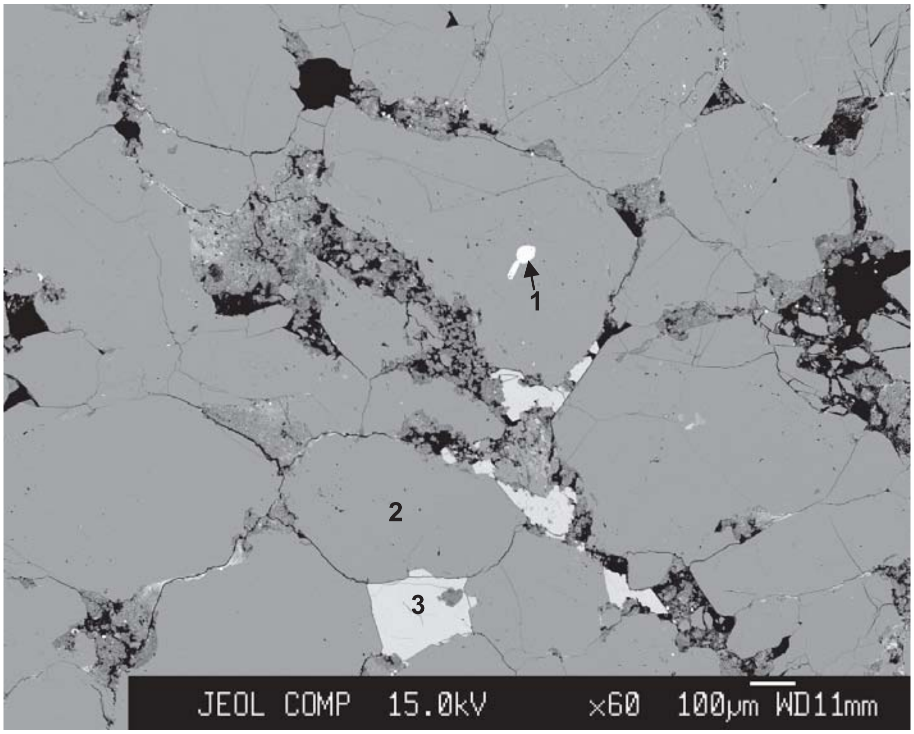
Figure 17 A-99 2933.62m



1. K-feldspar
2. Albite
3. K-feldspar

p. 198 (16B)

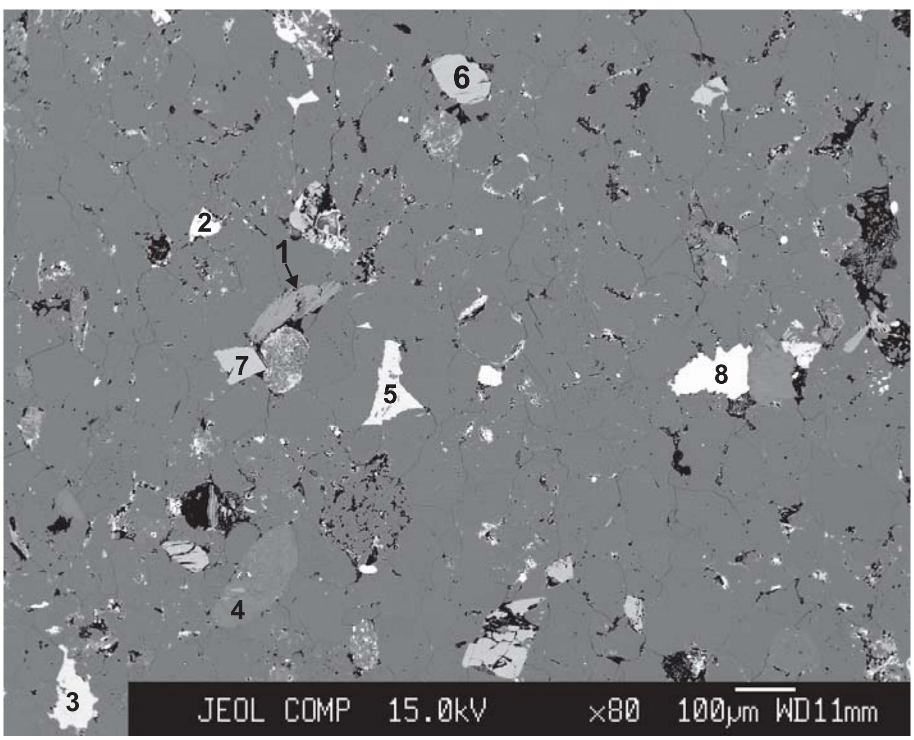
Figure 18 A-99 2950.54m



1. Monazite
2. Quartz
3. Carbonate(Ankerite)

p. 153 (16B)

Figure 19 A-99 3794.17m



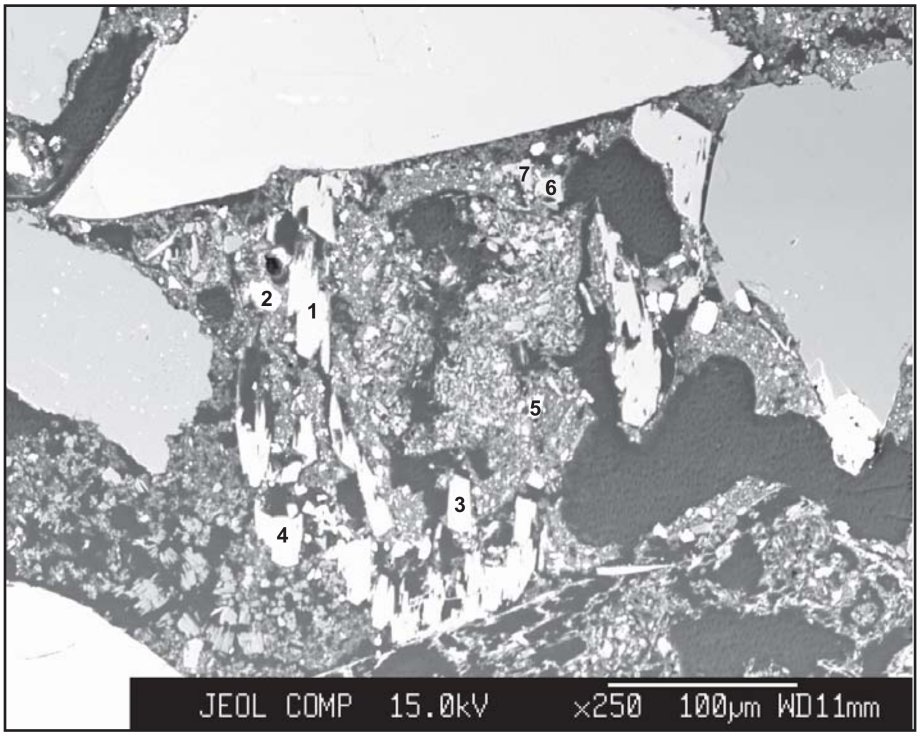
1. Muscovite
2. Rutile
3. Ankerite
4. Plagioclase
5. Ankerite
6. K-feldspar
7. K-feldspar
8. Barite

p. 117 (16B)

Figure 20 A-99 3796.33m

Appendix V

Back-scattered electron images of lithic clasts

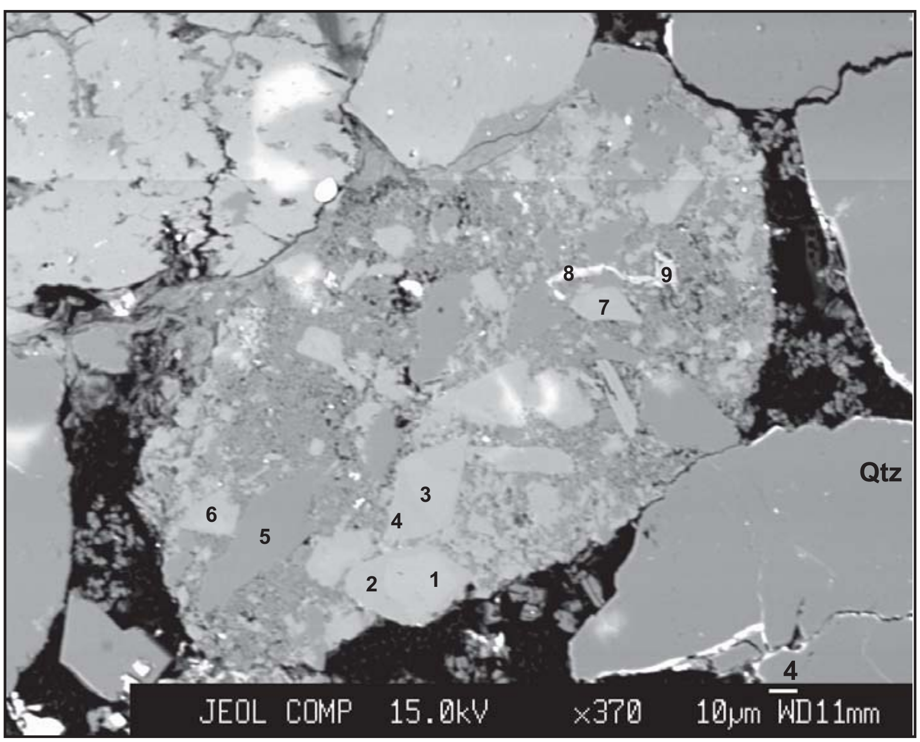


Altered K-feldspar crystal

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

p. 148 (16C)[1]

Figure 1 A-99 2208.09m



Rhyolite (brittle def.) or pyroclastic

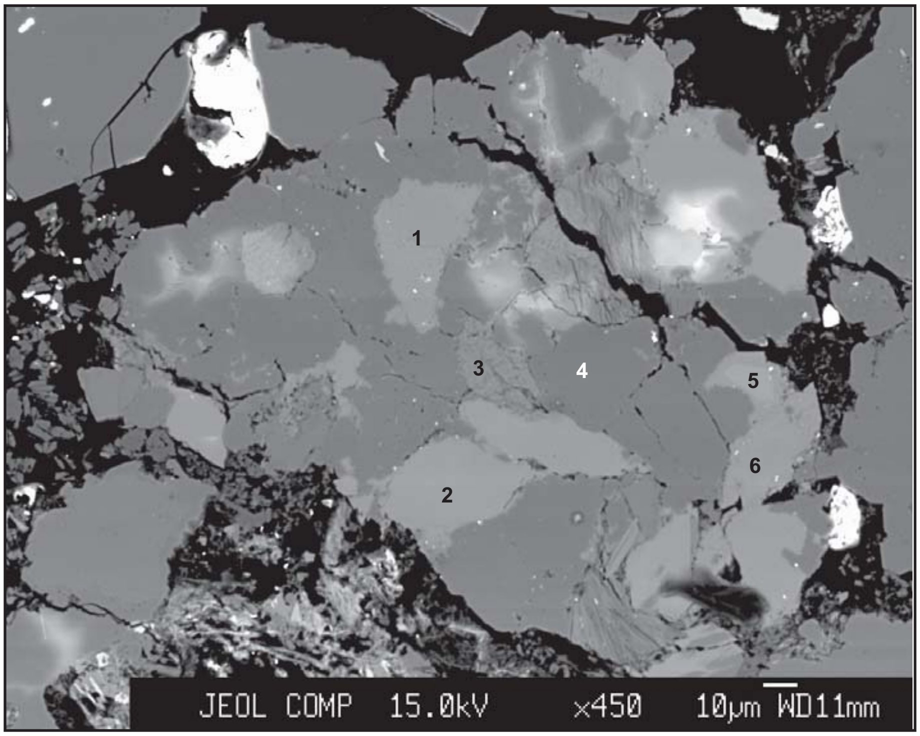
1: K-feldspar (zoned)
2: K-feldspar (zoned)
3: K-feldspar (zoned)
4: K-feldspar (zoned)
5: Quartz
6: K-feldspar
7: K-feldspar
8: Chlorite
9: Chlorite

K-feldspar cores contain Ba, but rims do not.

p. 157 (16C)

Figure 2 A-99 2210.37m

[1]: This refers to the binder with the original electron microprobe data

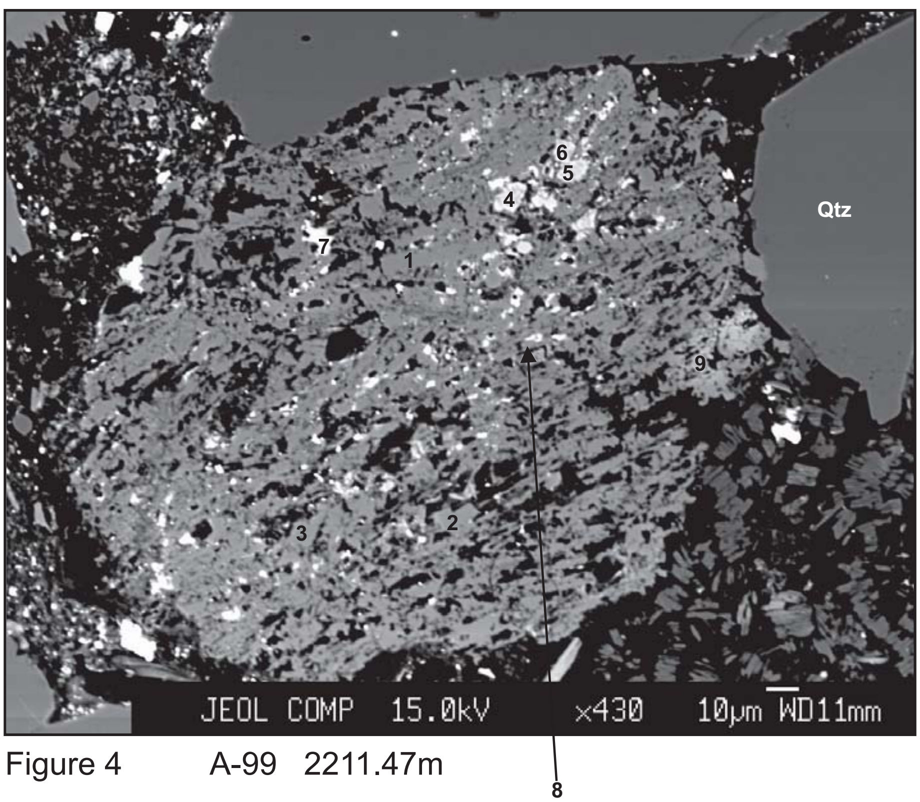


Granite

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

p. 270 (16C)

Figure 3 A-99 2210.37m

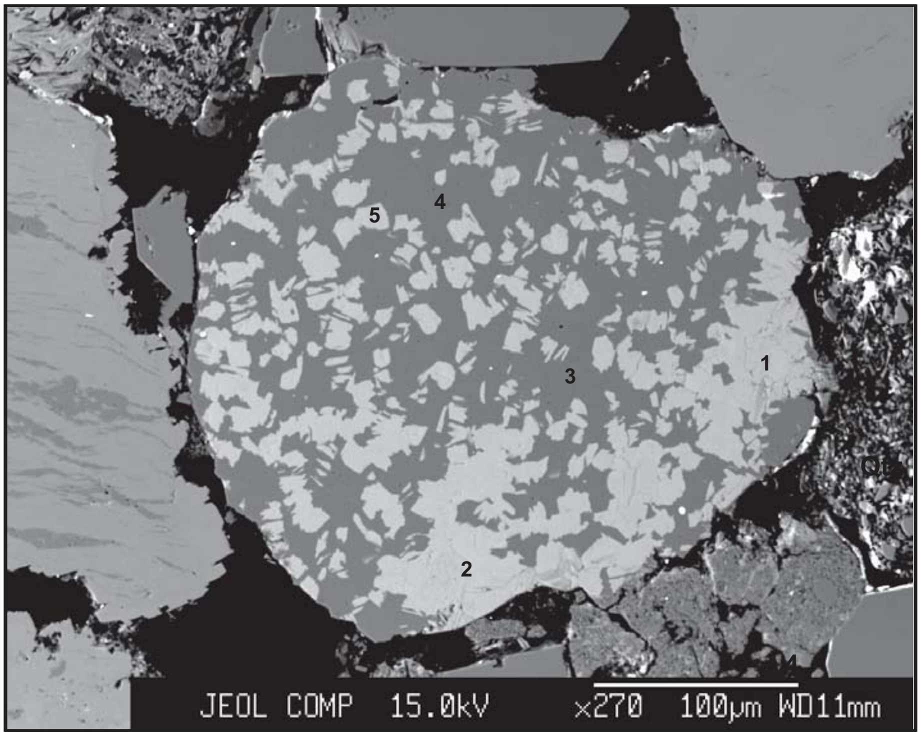


Microgranite

1: K-feldspar
2: K-feldspar
3: K-feldspar
4: Ilmenite
5: Ilmenite
6 :Ilmenite
7: K-feldspar (alt.)
8: K-feldspar (alt.)
9: K-feldspar (alt.)

p. 34 (16C)

Figure 4 A-99 2211.47m

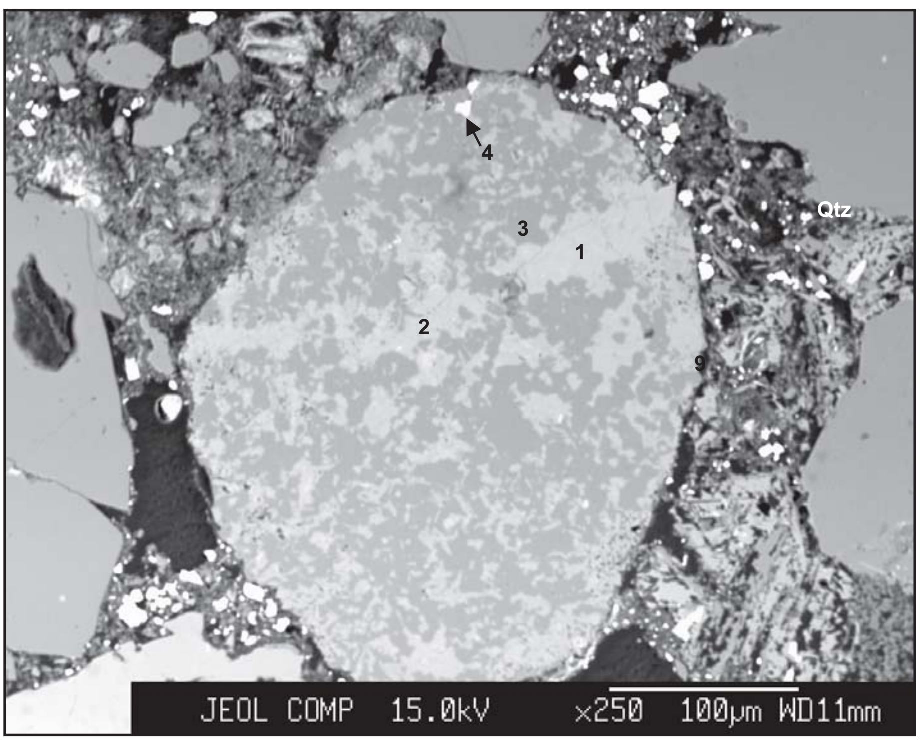


Hydrothermal vein quartz (50%) with chlorite vermicules (50%)

1: Chlorite
2: Chlorite
3: Quartz
4: Quartz
5: Chlorite

p. 167 (16C)

Figure 5 A-99 2212.20m

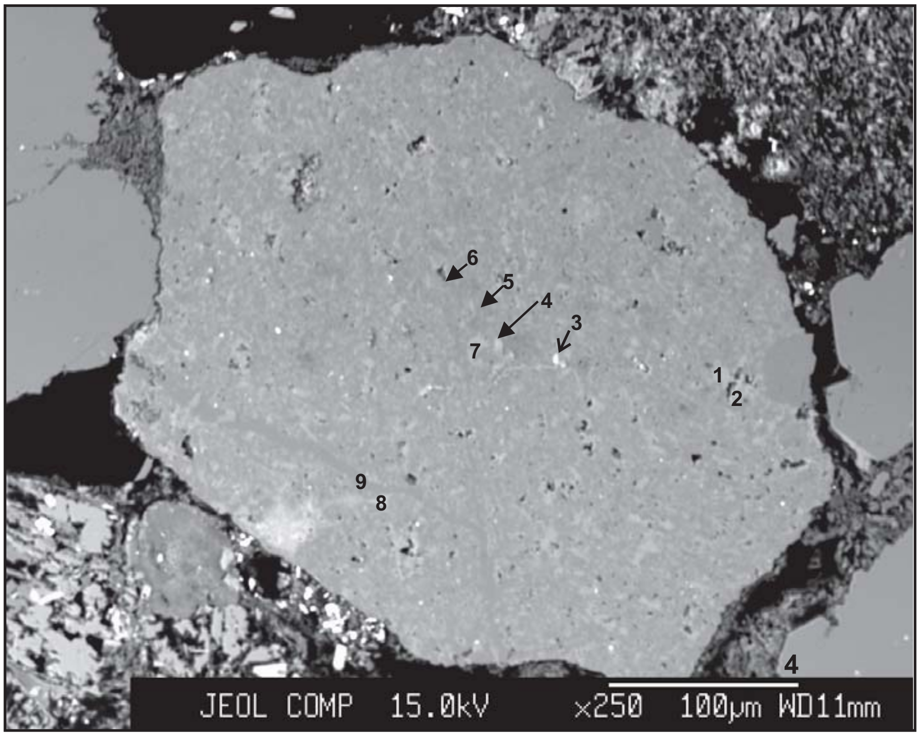


Microgranite (porphyry)

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

p. 173 (16C)

Figure 6 A-99 2212.20m

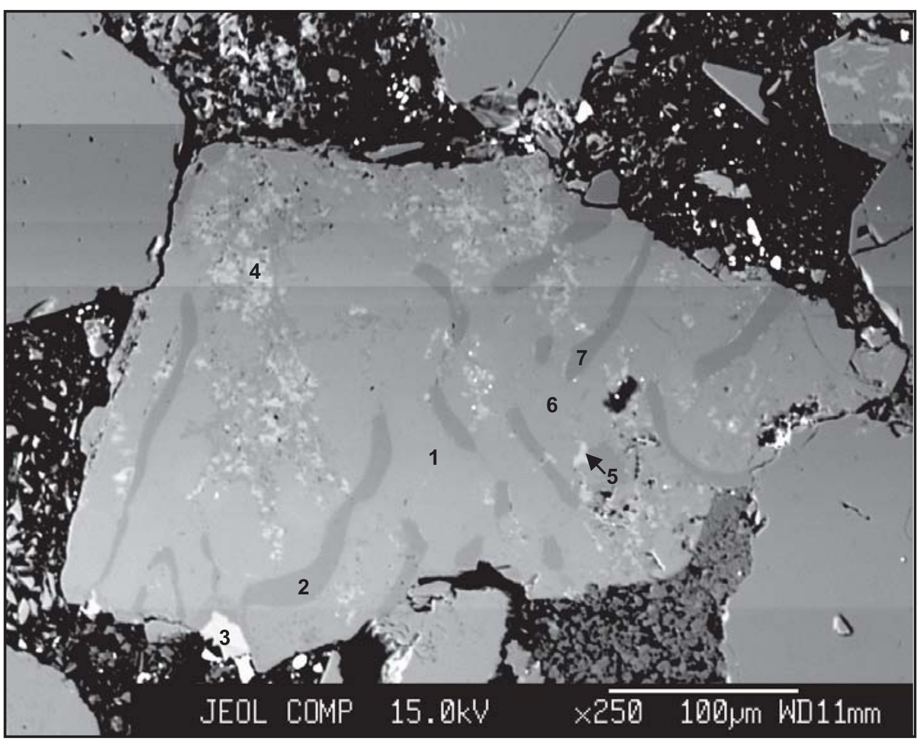


Microgranite (porphyry)

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

p. 177 (16C)

Figure 7 A-99 2212.20m

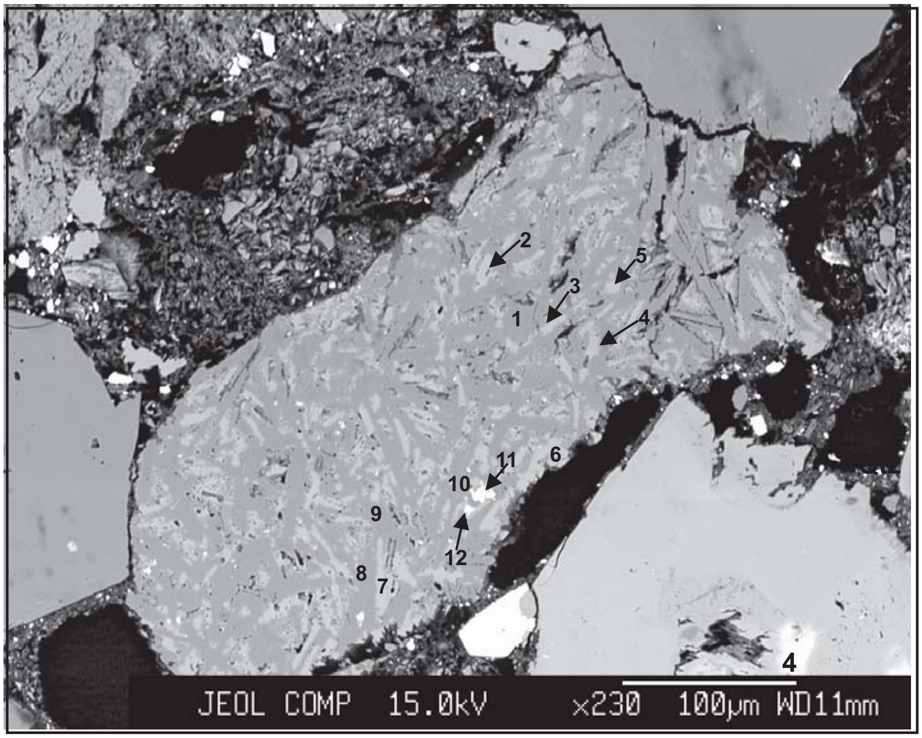


Myrmekite textures in microgranite

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

p. 187 (16C)

Figure 8 A-99 2212.91m

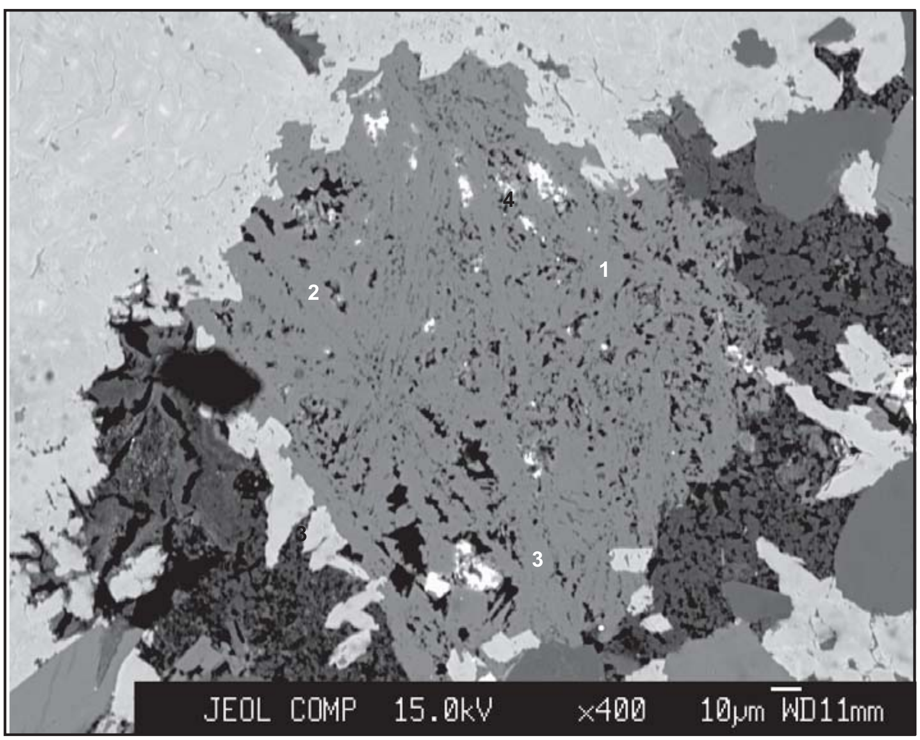


Intrusive rhyolite (porphyry)

1: Quartz
2-7: K-feldspar
8-10: Quartz
11-12: Siderite

p. 48 (16C)

Figure 9 A-99 2212.91m

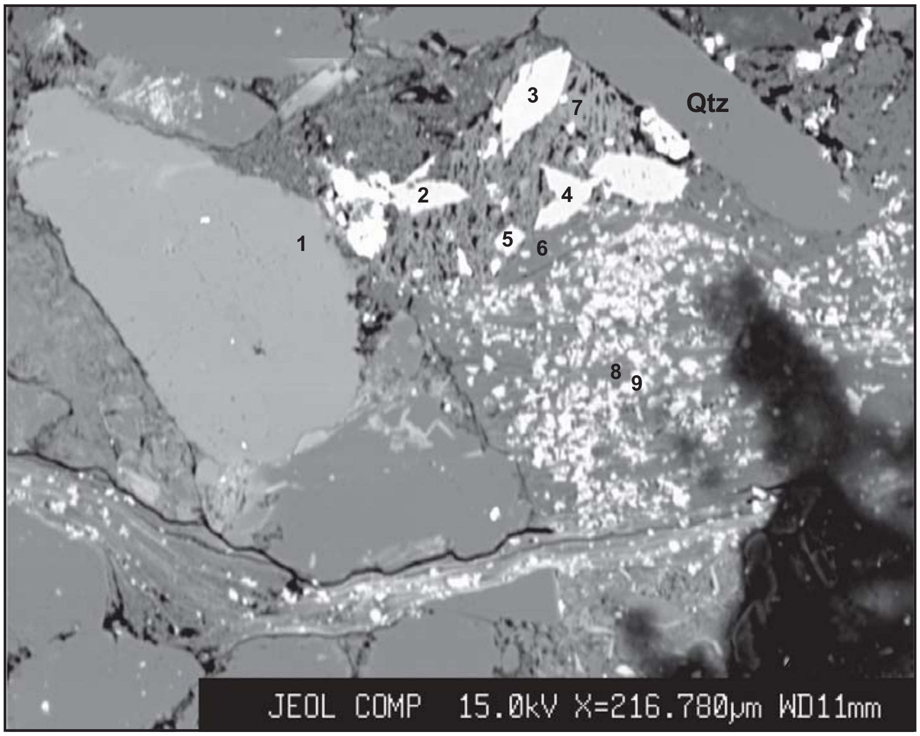


Trachyte?

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

p. 44 (16C)

Figure 10 A-99 2217.57m

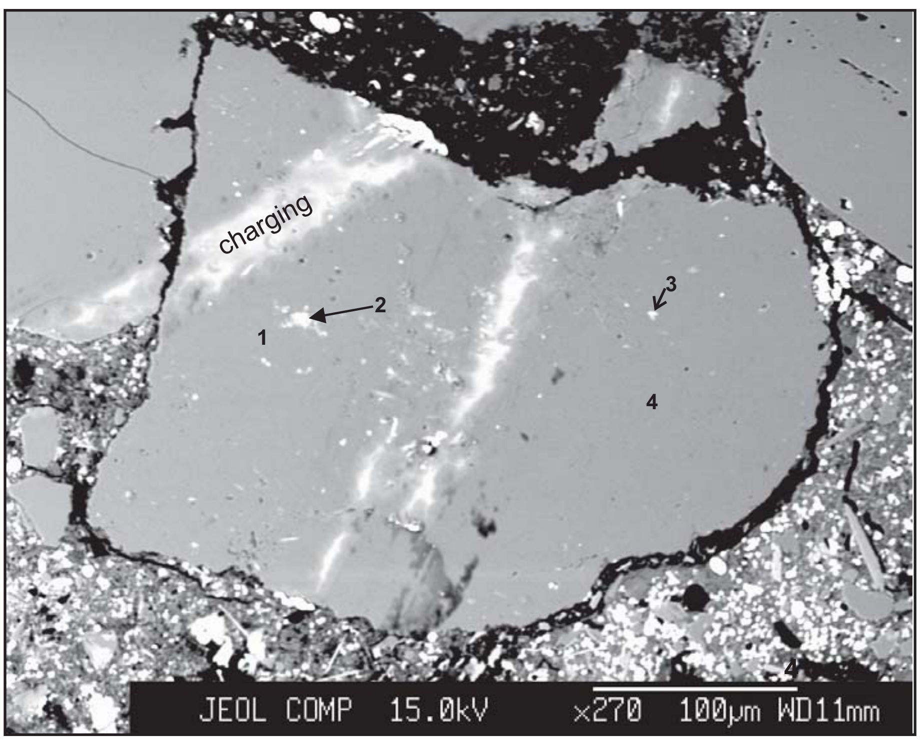


Porphyry or Cement?

1: K-feldspar
2-5: Siderite
6: Kaolinite
7: K-feldspar
8: Kaolinite
9: Siderite

p. 59 (16C)

Figure 11 A-99 2217.96m

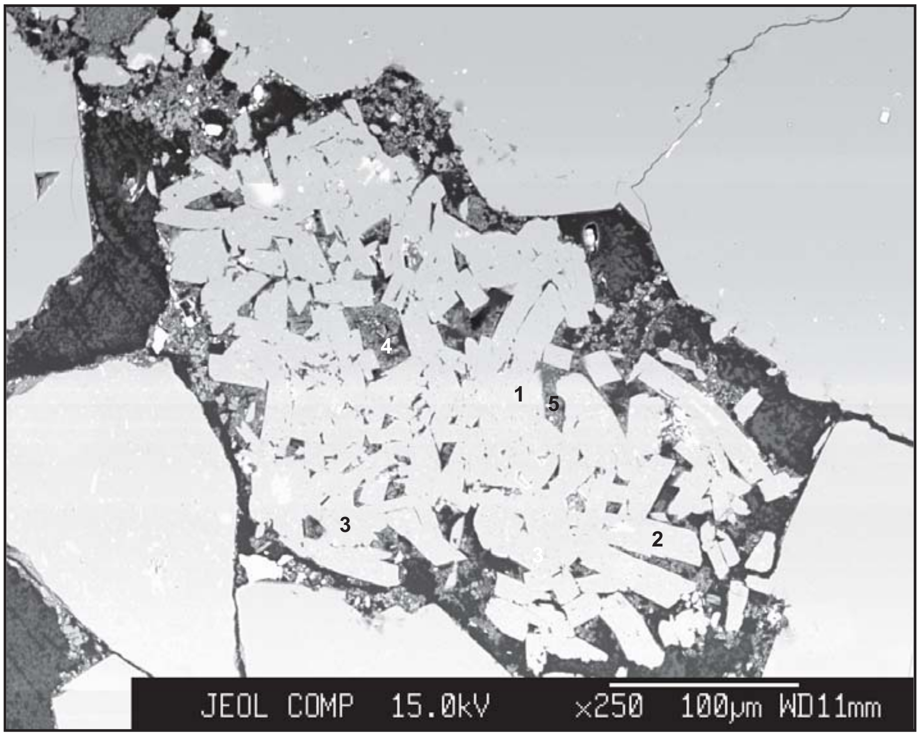


Quartz grain with apatite inclusions

1: Quartz
2: Apatite
3: Apatite
4: Quartz

p. 195 (16C)

Figure 12 A-99 2222.59m

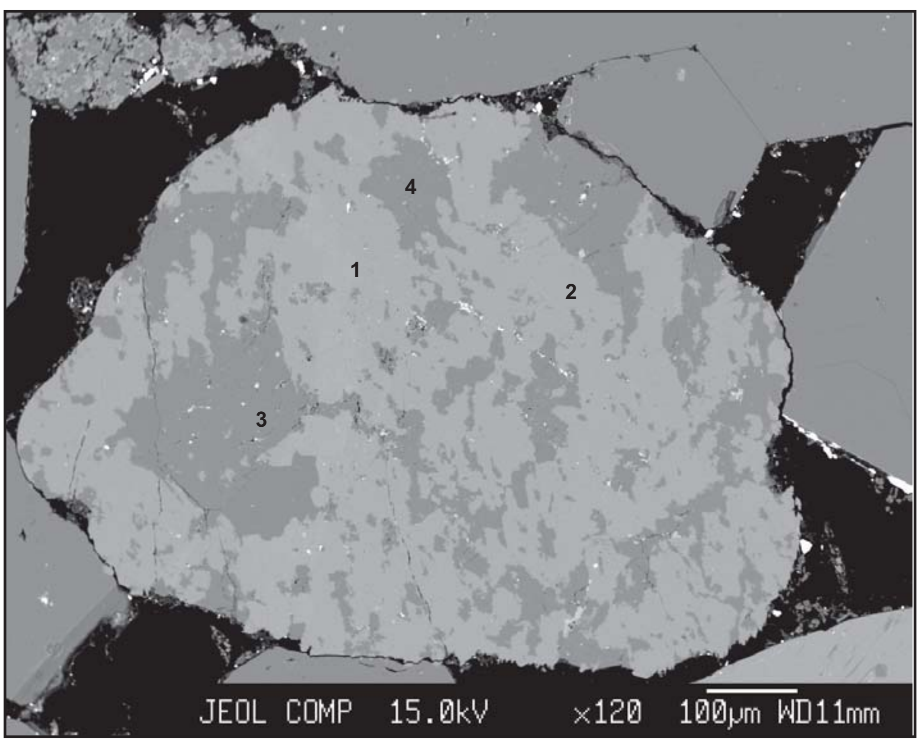


Microgranite or intrusive rhyolite

1: Albite
2: Albite
3: Albite
4: Kaolinite
5: Kaolinite

p. 67 (16C)

Figure 13 A-99 2225.45m

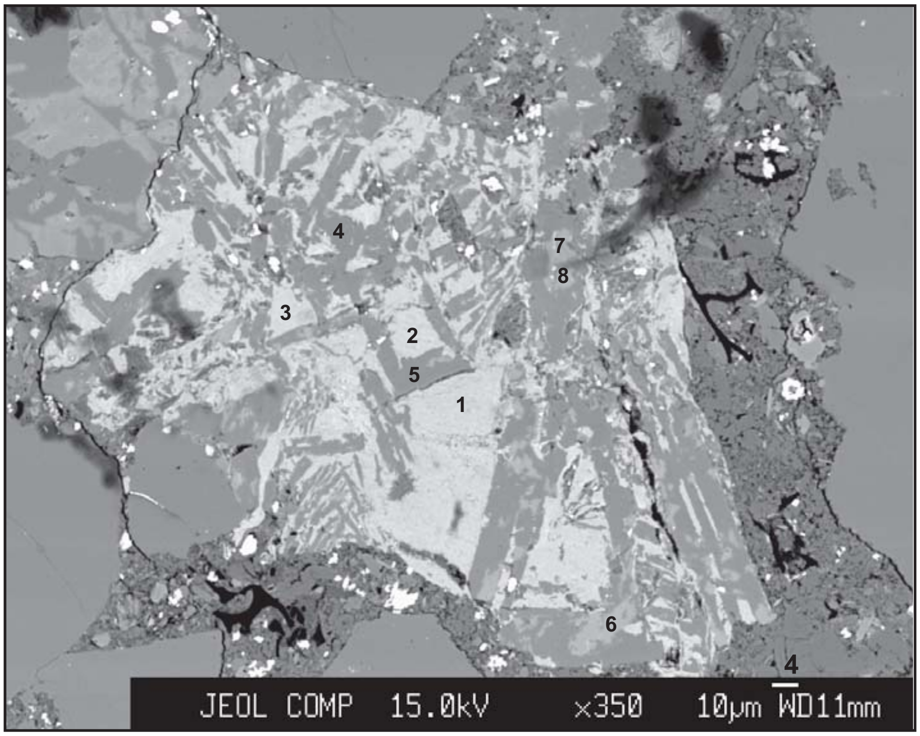


Syenite or intrusive rhyolite

1: K-feldspar
2: K-feldspar
3: Plagioclase
4: Plagioclase

p. 278 (16C)

Figure 14 A-99 2225.45m

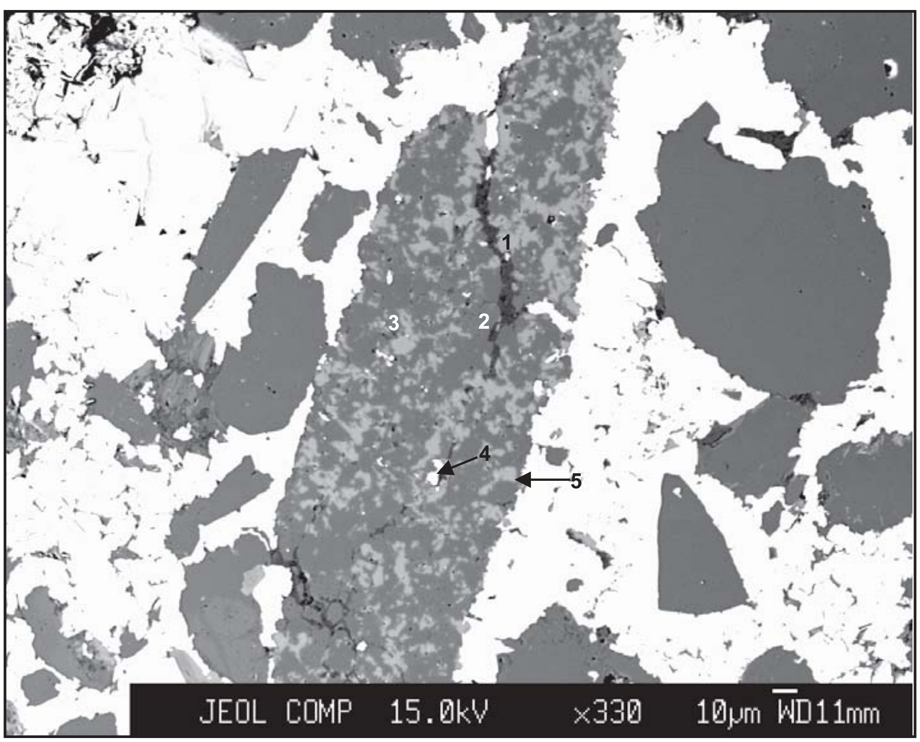


Subvolcanic
(quartz diorite?)

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

p. 72 (16C)

Figure 15 A-99 2227.34m

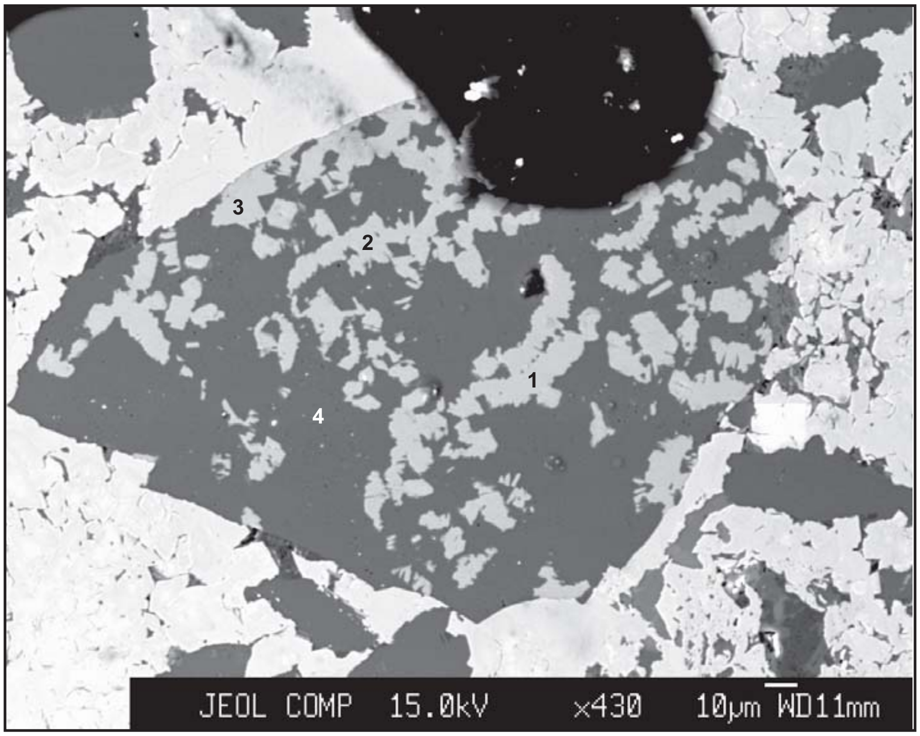


Microgranite
(porphyry)

1: K-feldspar
2: Albite
3: Albite
4: Ilmenite
5: K-feldspar

p. 200 (16C)

Figure 16 A-99 2227.34m

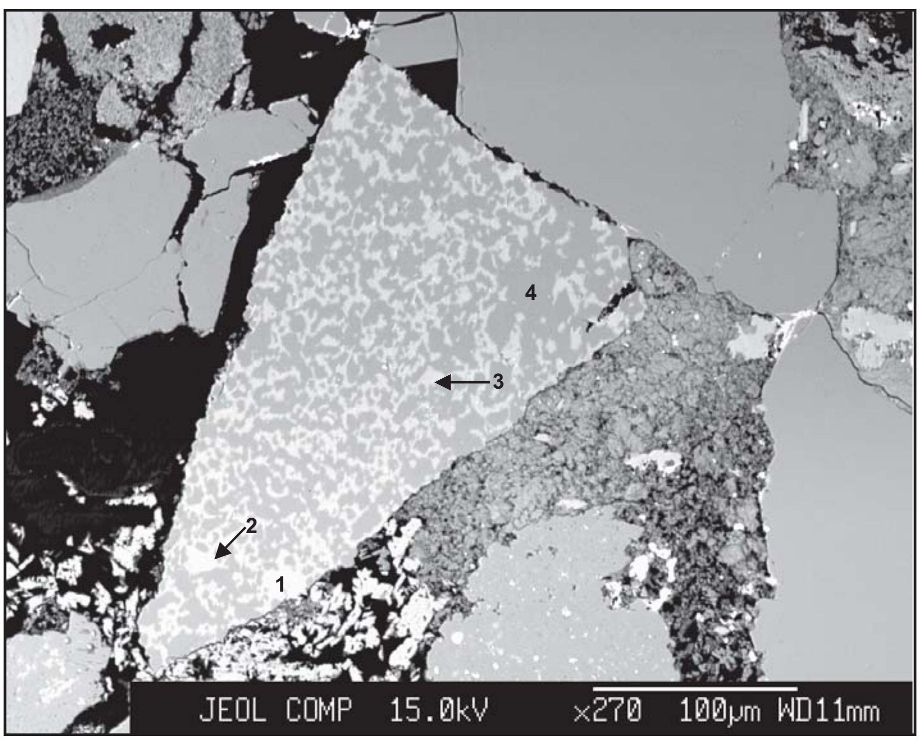


Quartz grain with chlorite vermicules

1: Chlorite
2: Chlorite
3: Chlorite
4: Quartz

p. 206 (16C)

Figure 17 A-99 2227.34m

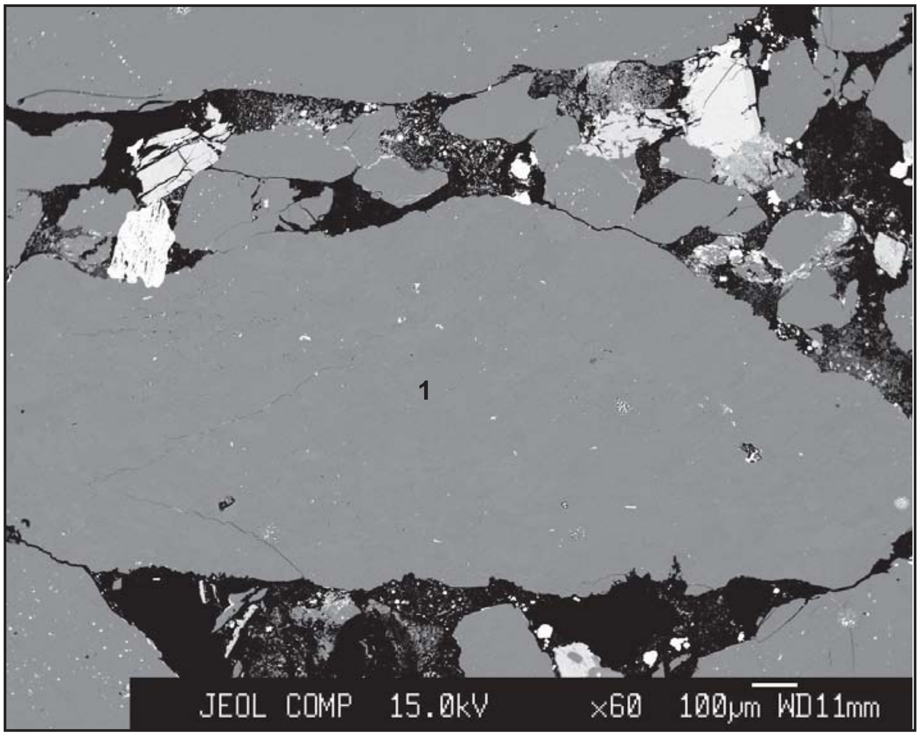


Microgranite (porphyry)

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

p. 212 (16C)

Figure 18 A-99 2228.42m

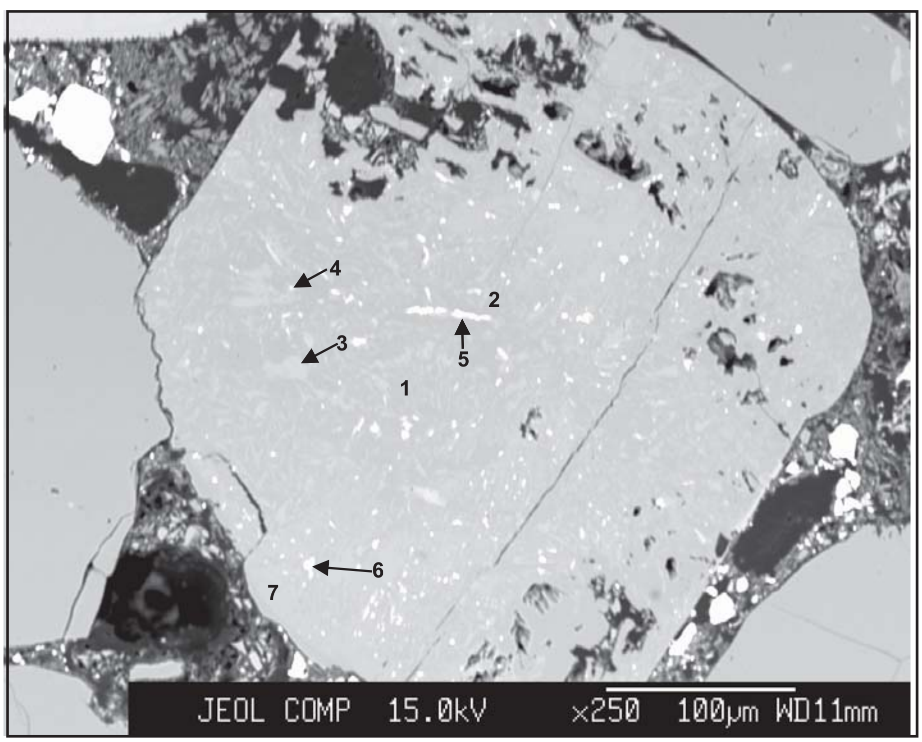


Quartz mylonite

1: quartz

p. 95 (16)

Figure 19 A-99 2228.82m

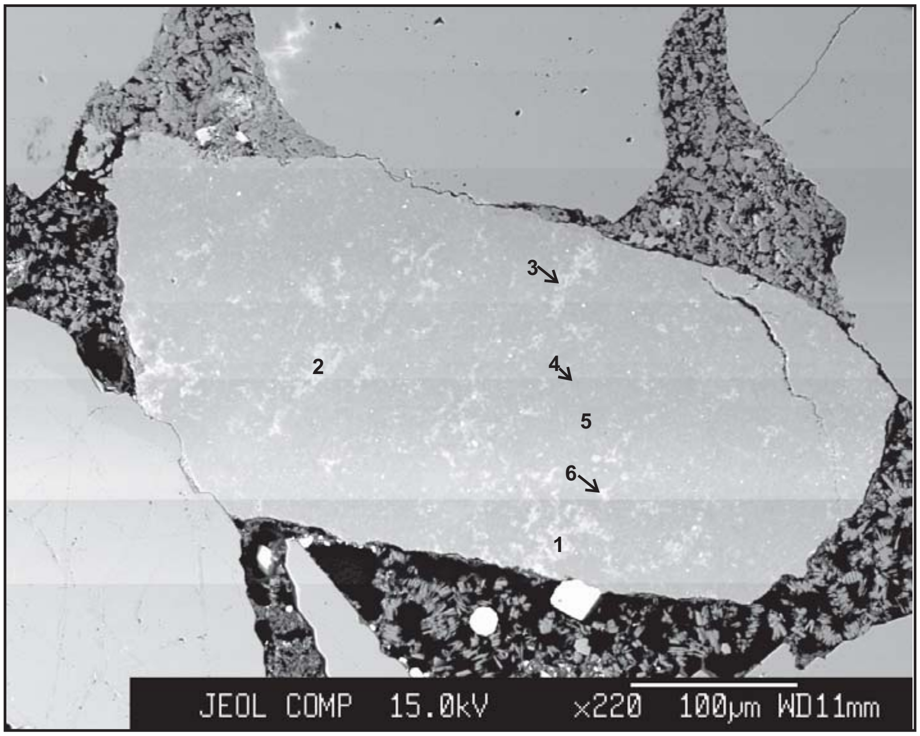


Albite crystal (? from a granodiorite)

1: Albite
2: Albite
3: Muscovite
4: Siderite
5: ? mixture
6: Siderite
7: Plagioclase

p. 80 (16C)

Figure 20 A-99 2230.62Bm

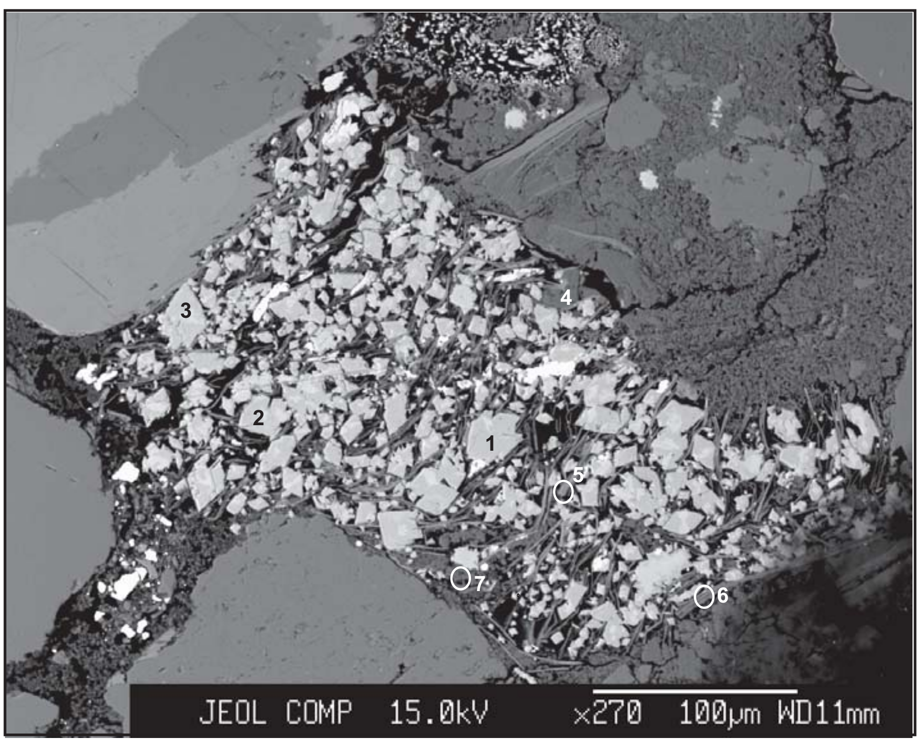


Microgranite with Mg-chlorite

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

p. 217 (16C)

Figure 21 A-99 2230.62Bm

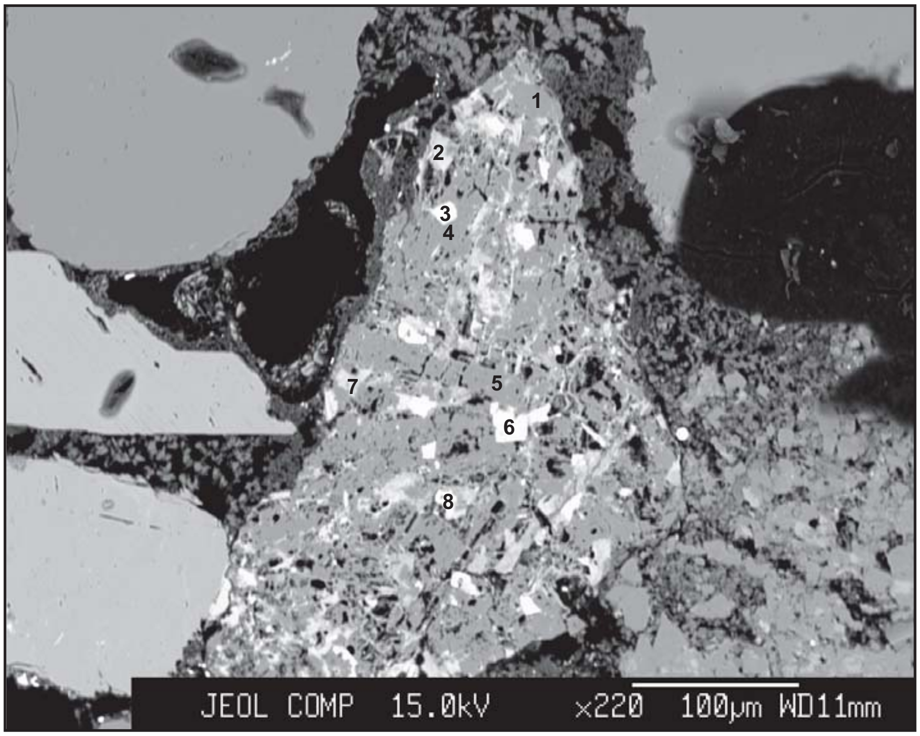


Pore filling

1: Siderite
2: Siderite
3: Siderite
4: Kaolinite
5: Chlorite
6: ?Ilmenite
7: ?Chlorite

p. 225 (16C)

Figure 22 A-99 2230.62Bm

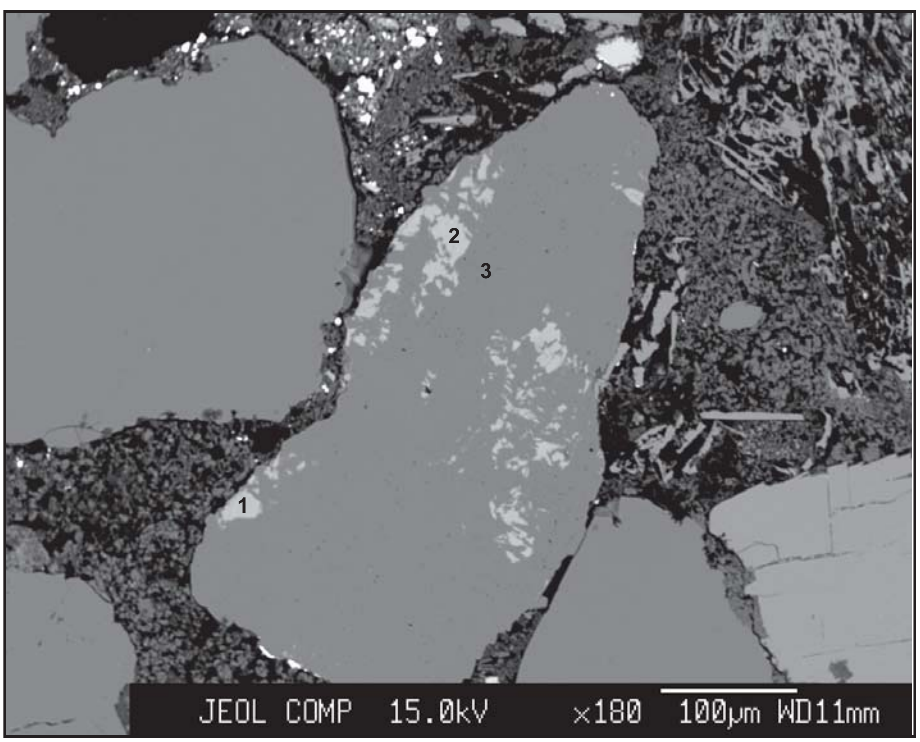


Feldspar-rich diabase

1: Albite
2: Chlorite
3: Ilmenite (rt)
4: Albite
5: Albite
6: Ilmenite (leuc)
7: ?Chlorite
8: ?Ilmenite

p. 87 (16C)

Figure23 A-99 2230.62Bm

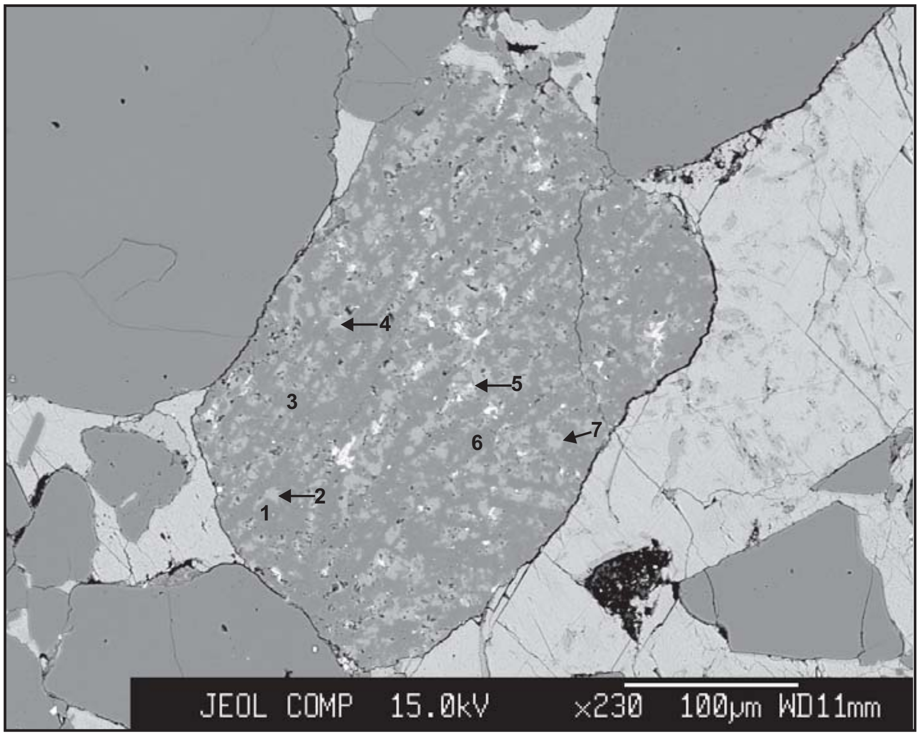


Gneiss with chlorite

1: Chlorite
2: Chlorite
3: Quartz

p. 283 (16C)

Figure 24 A-99 2230.62Bm

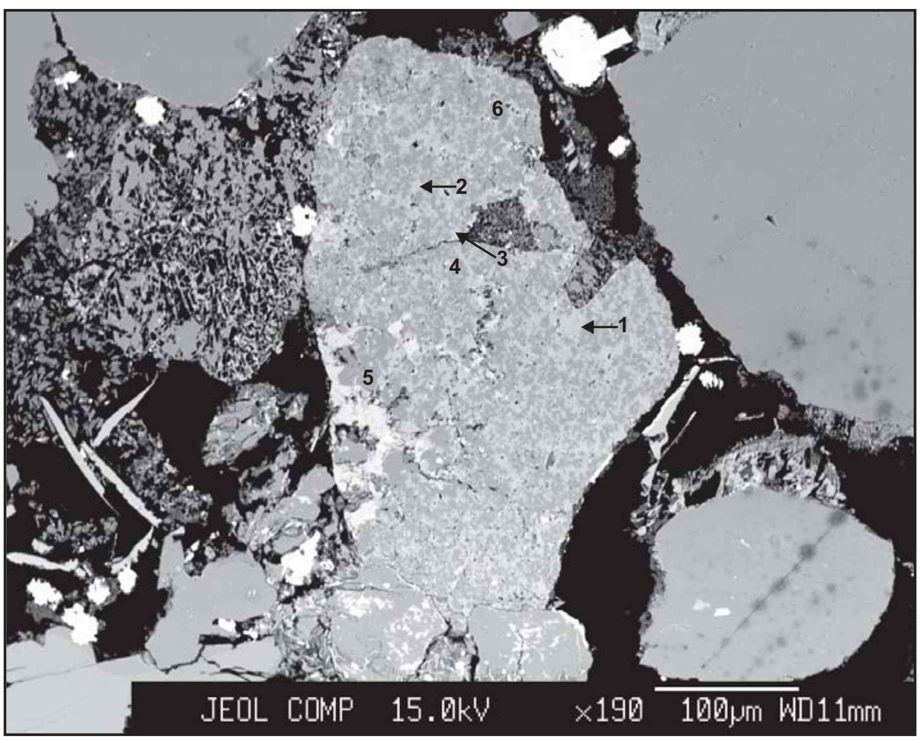


Intrusive rhyolite

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

p. 95 (16C)

Figure 25 A-99 2233.62m

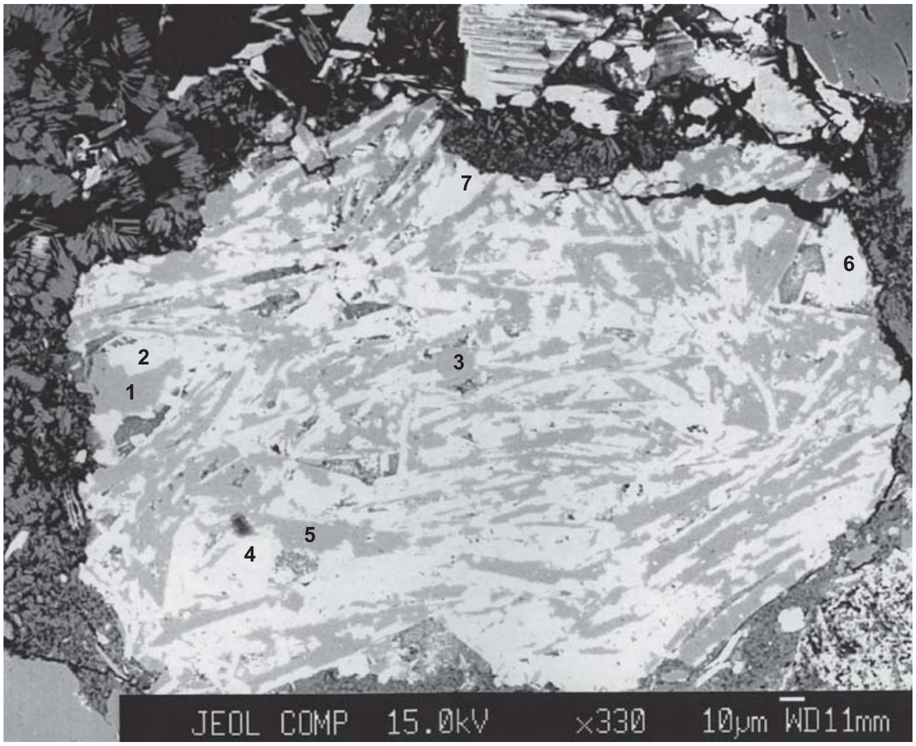


Intrusive rhyolite (porphyry)

1-3: K-feldspar
4-6: Quartz

p. 102 (16C)

Figure 26 A-99 2233.62m

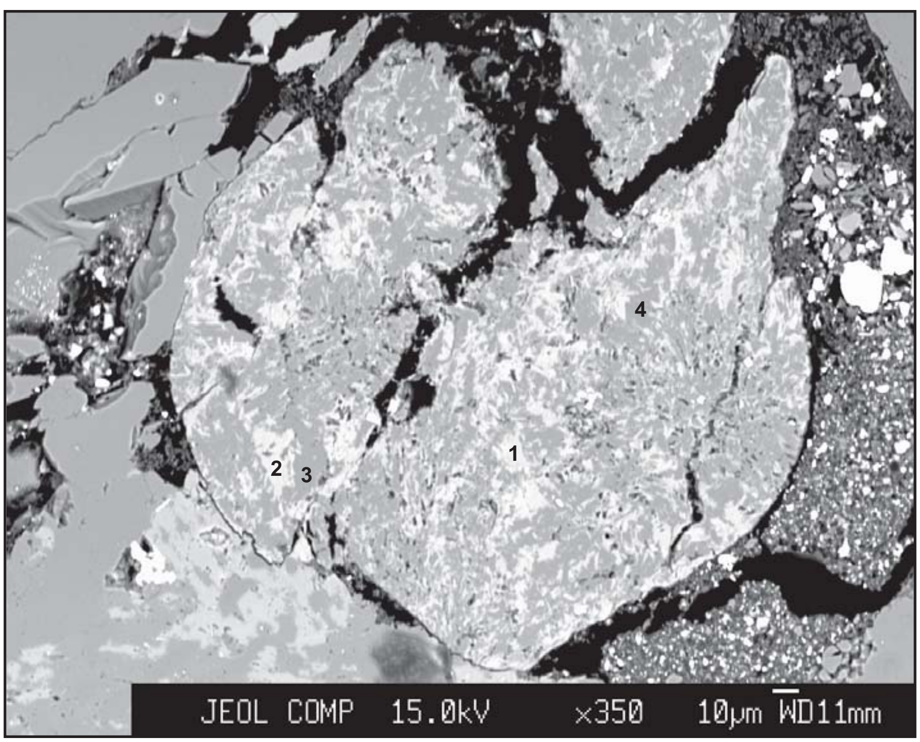


Syenite(porphyry)

1: Albite
2: K-feldspar
3: Albite
4: K-feldspar
5: Albite
6: Chlorite
7: Chlorite

p. 108 (16C)

Figure 27 A-99 2237.16

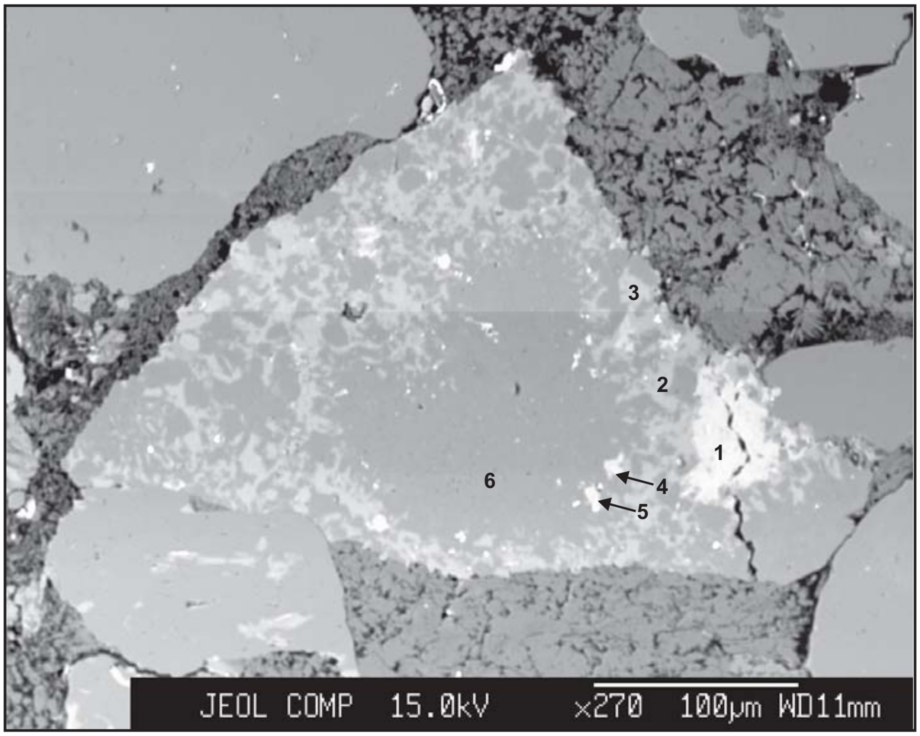


Altered basalt

1: Chlorite (normal)
2: Chlorite (normal)
3: Albite
4: Albite

p. 142 (16C)

Figure 28 A-99 2237.16m

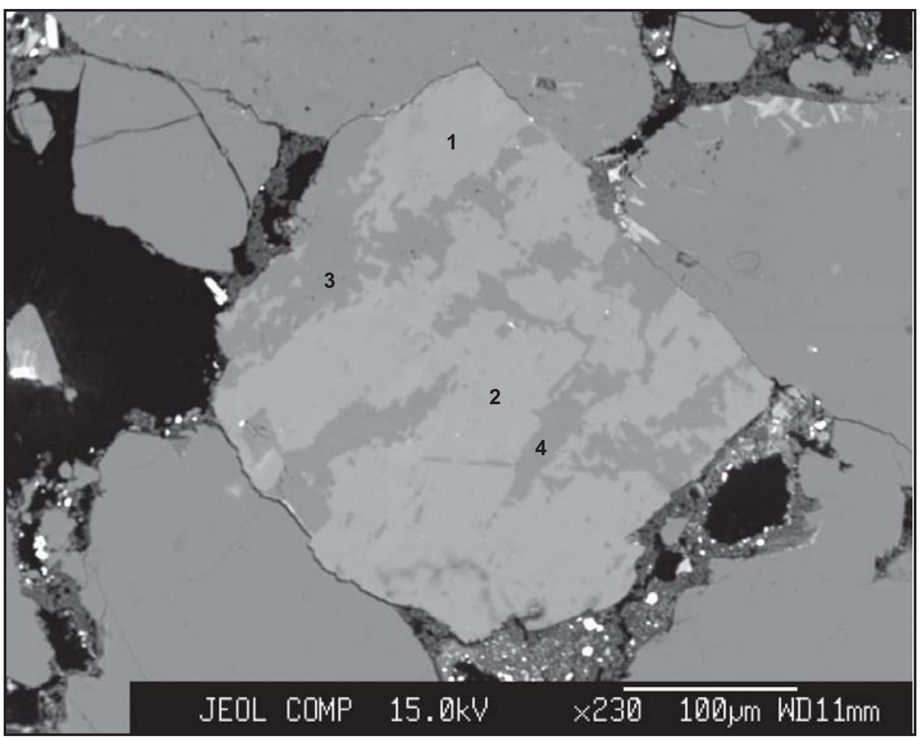


Microgranite with Fe- chlorite (porphyry)

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

p. 234 (16C)

Figure 29 A-99 2237.16

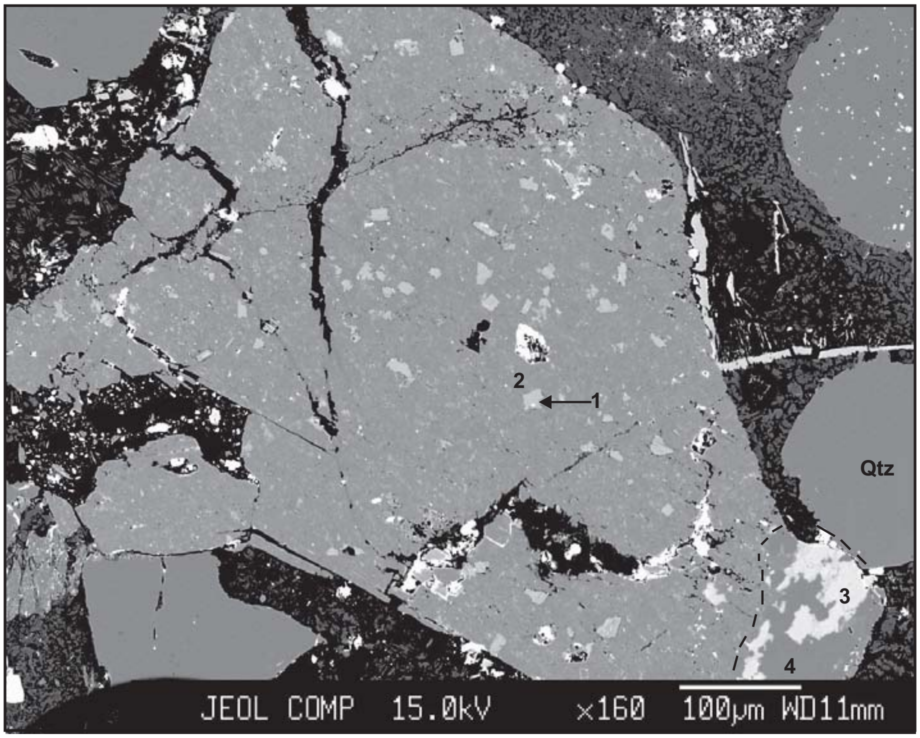


Syenite or intrusive rhyolite

1: K-feldspar
2: K-feldspar
3: Plagioclase
4: Plagioclase

p. 297 (16C)

Figure 30 A-99 2237.16

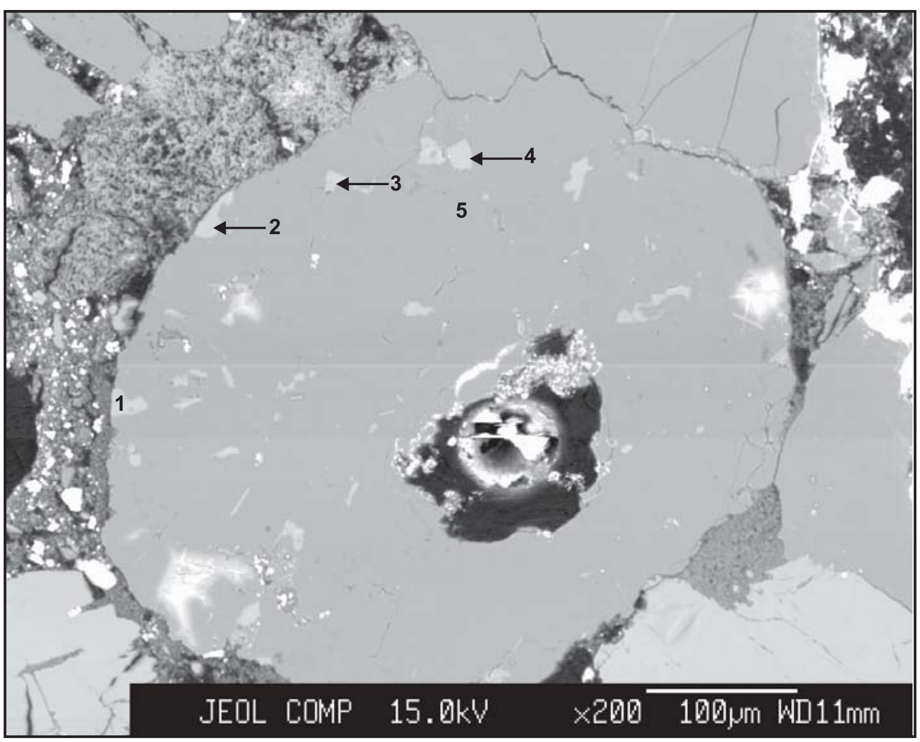


Altered granite

1: Muscovite (inclusion in albite)
2: Albite (host)
3: K-feldspar
4: Quartz

p. 100 (16)

Figure 31 A-99 2238.26

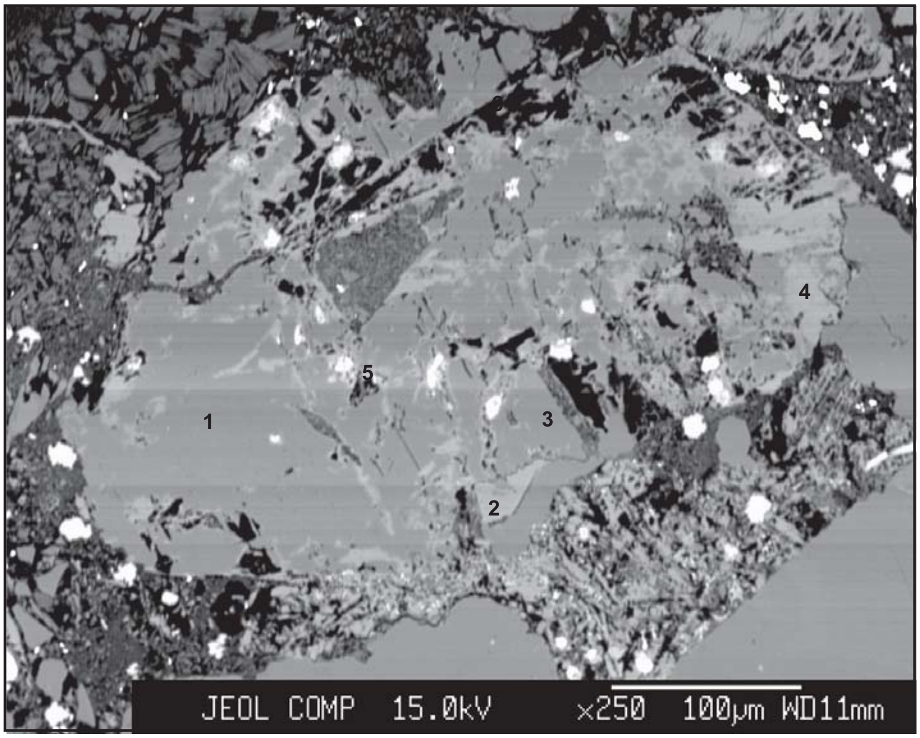


Fine-grained granite

1: K-feldspar
2: K-feldspar
3: K-feldspar
4: Muscovite
5: Quartz

p. 288 (16C)

Figure 32 A-99 2238.26

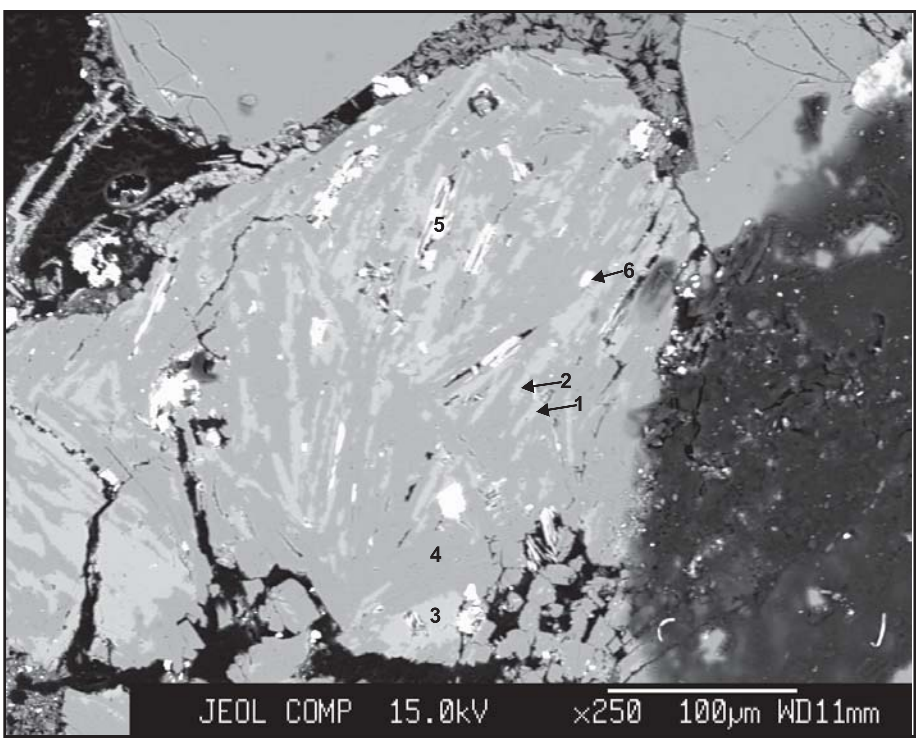


Syenite (porphyry)

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

p. 115 (16C)

Figure 33 A-99 2238.65m

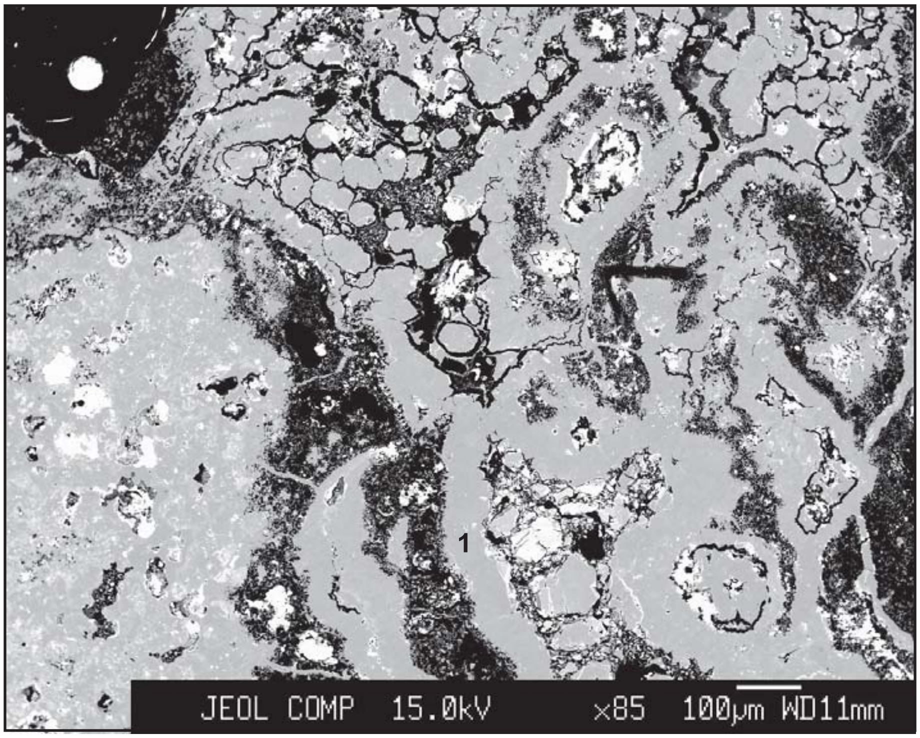


Syenite (porphyry)

1: Kaolinite
2: K-feldspar
3: K-feldspar
4: Albite
5: ?Chlorite
6: ?Chlorite

p. 120 (16C)

Figure 34 A-99 2243.12m

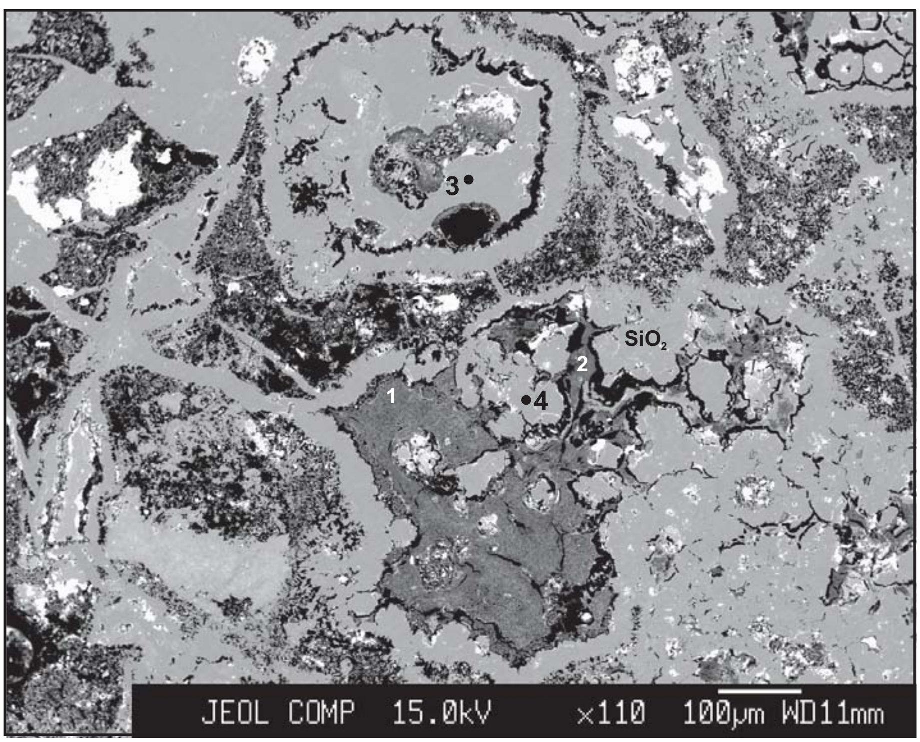


pyroclastic clast

1: SiO_2
2: SiO_2

p. 96 (16)

Figure 35 A-99 2247.41m

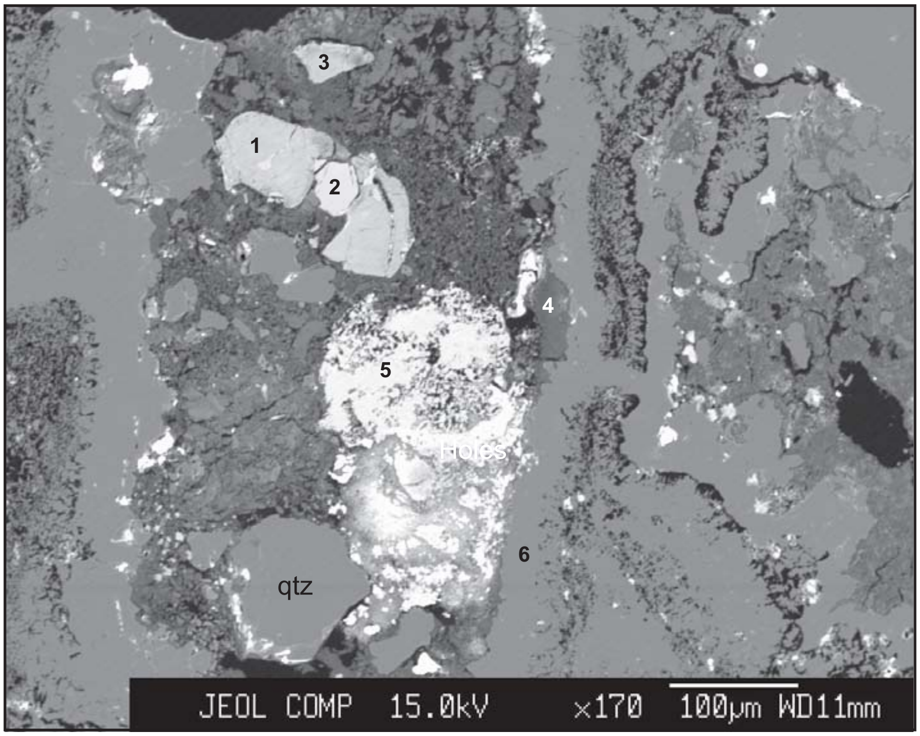


Pyroclastic clast

1: Chlorite?
2: Chlorite?
3. SiO_2
4. SiO_2

p. 97 (16)

Figure 36 A-99 2247.41

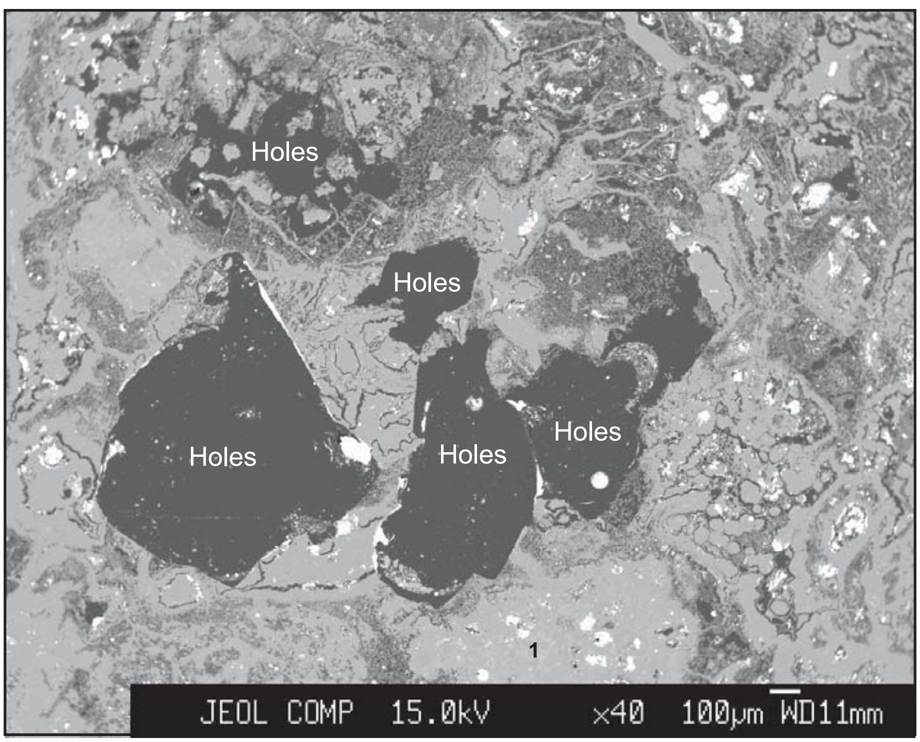


Pyroclastic clast

1: Ilmenite
2: Calcite
3: Ilmenite
4: ?Kaolinite
5: Rutile
6: SiO_2
7: Pyrite

p. 109-4 (16)

Figure 37 A-99 2247.41

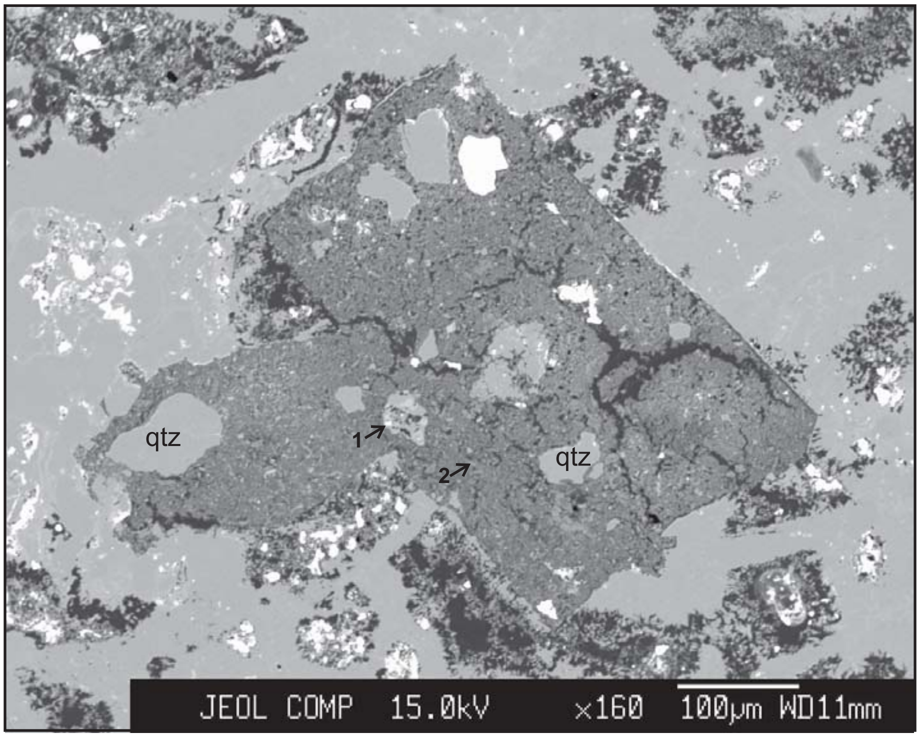


Detrital silcret or clast similar to Scott's Bay Fm. exhalative chert (clast in pyroclastic clast)

1: SiO_2

p. 109-2 (16)

Figure 38 A-99 2247.41

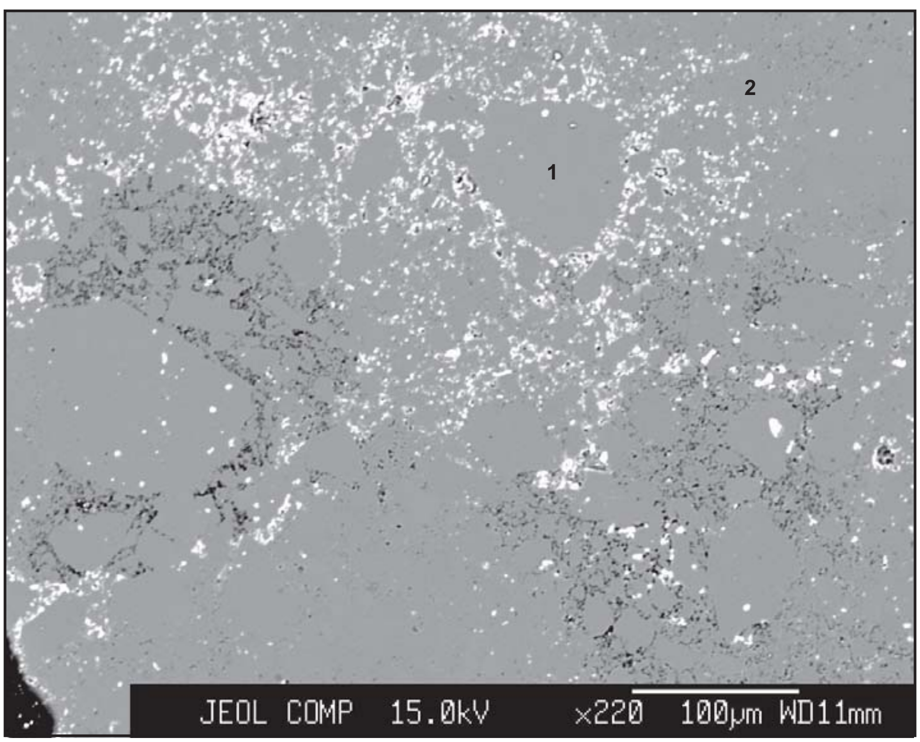


Clay clast similar to Chaswood Fm. (clast in pyroclastic clast)

1: Ilmenite (rt)
2: Kaolinite

p. 109-3 (16)

Figure 39 A-99 2247.41m

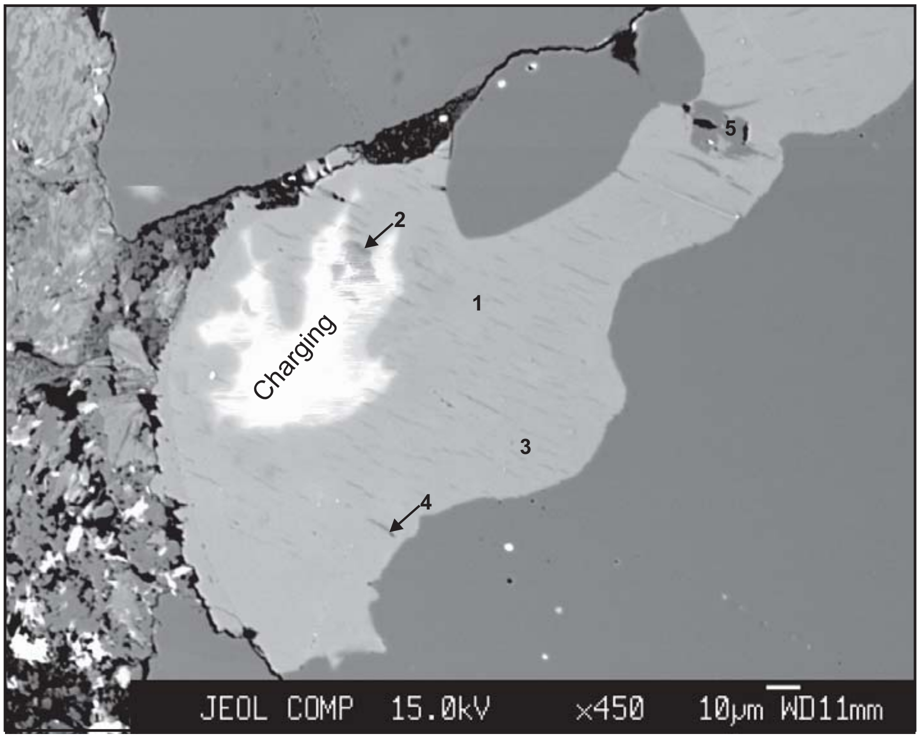


Silica cemented quartz arenite clast

1, 2: Quartz

p. 109-1 (16)

Figure 40 A-99 2247.41m

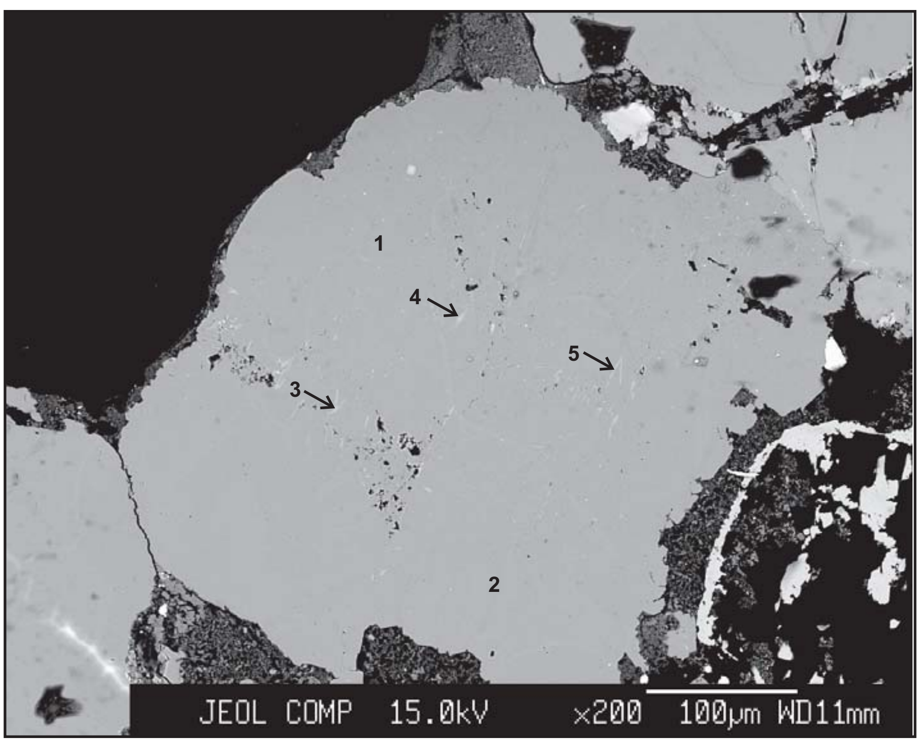


Perthite crystal

1: K-feldspar
2: Plagioclase
3: K-feldspar
4: K-feldspar
5: Plagioclase

p. 241 (16C)

Figure 41 A-99 2250.17m

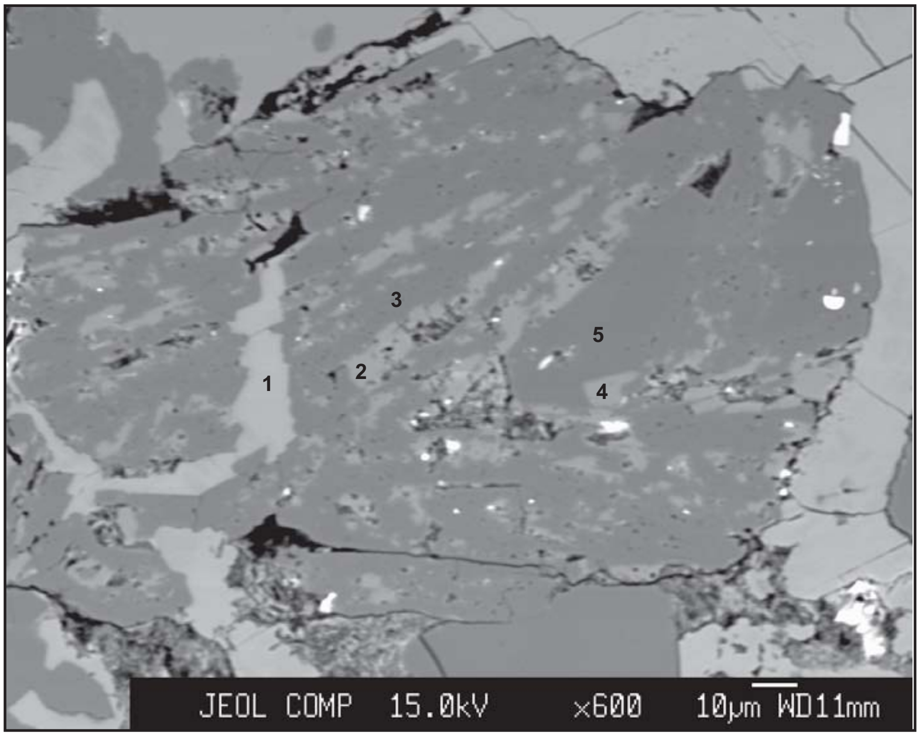


Quartz with K-feldspar inclusions

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

p. 295 (16C)

Figure 42 A-99 2266.99m

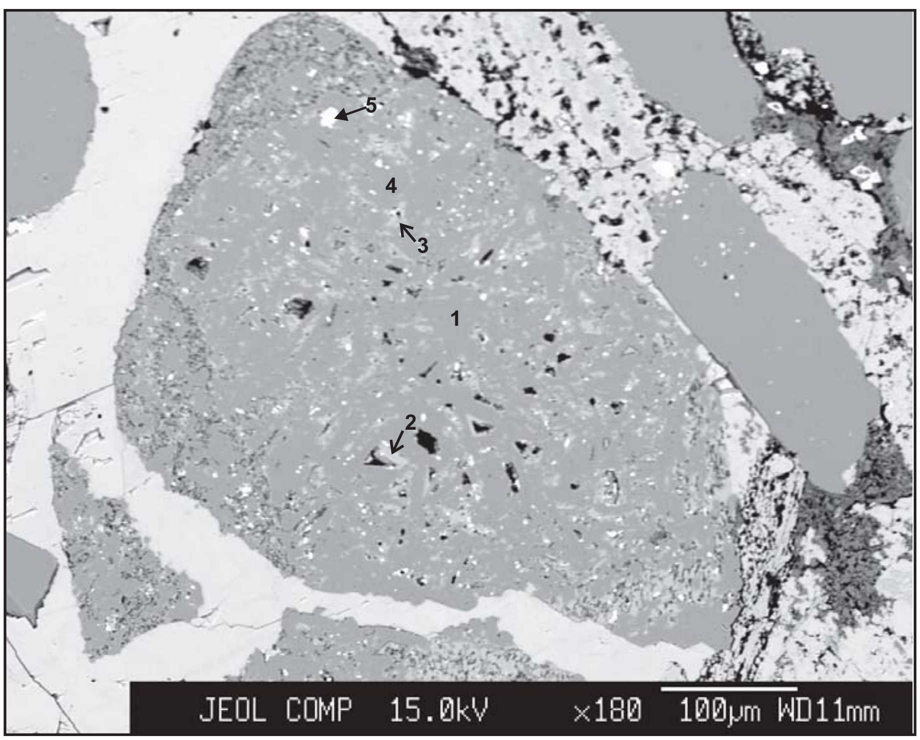


Intrusive rhyolite (porphyry)

1: Calcite
2: K-feldspar
3: Albite
4: K-feldspar
5: Quartz

p. 132 (16C)

Figure 43 A-99 2936.06m

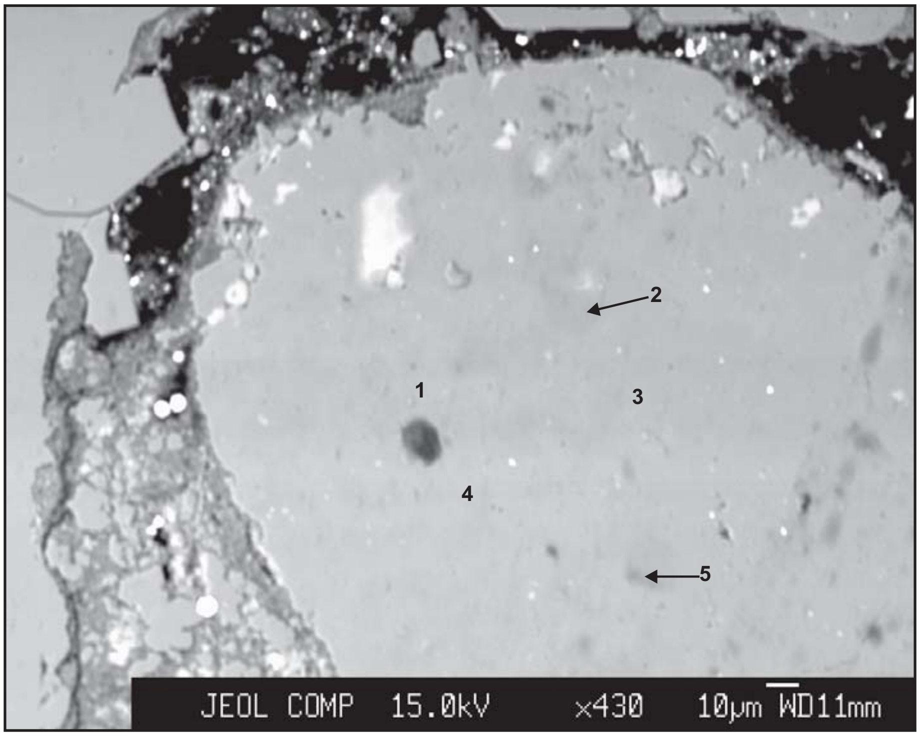


Syenite (porphyry)

1: Albite
2: K-feldspar
3: K-feldspar
4: Albite
5: Monazite

p. 137 (16C)

Figure 44 A-99 2940.48m

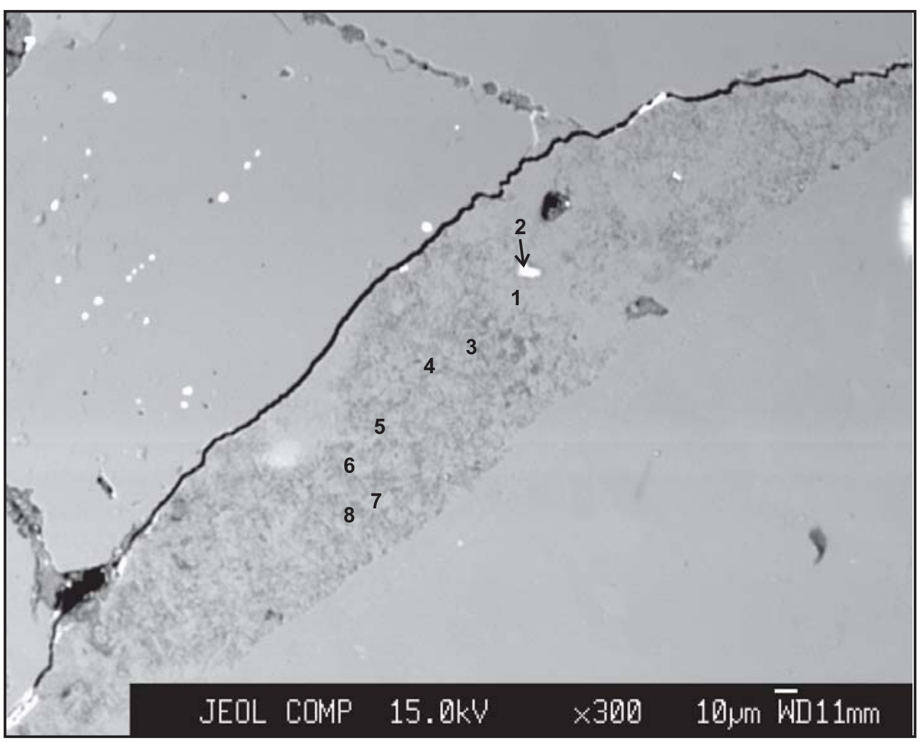


Rhyolite

1:Albite
2: Quartz
3: Albite
4: Albite
5: Quartz

p. 247 (16C)

Figure 45 A-99 3793.40m

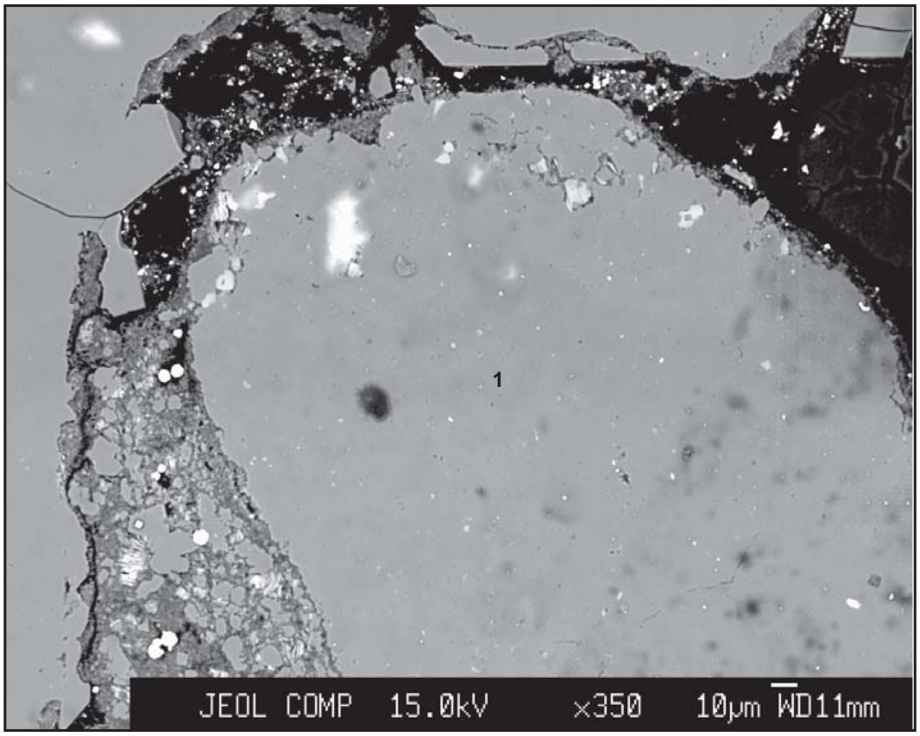


? Rhyolite

1: Quartz
2: Quartz + Na_2O
3: Quartz
4: Quartz
5: Quartz
6: Quartz
7: Quartz
8: Quartz

p. 253 (16C)

Figure 46 A-99 3793.40m

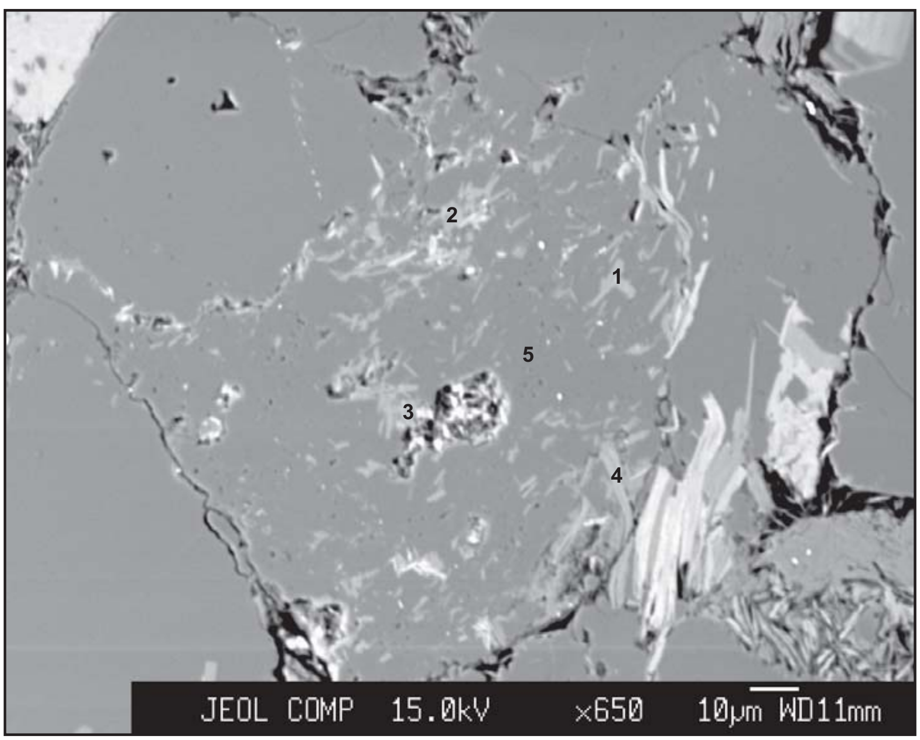


Chert

1: Quartz

p. 296 (16C)

Figure 47 A-99 3793.40m



Quartz crystal with inclusions (probably hydrothermal)

1: Musc. + quartz
2: Muscovite
3: Muscovite
4: Muscovite
5: Quartz

p. 264 (16C)

Figure 48 A-99 3796.33m

Appendix VI

Clast lithologies:
Identified by microphotographs, electron microprobe analyses and electron backscatter images

Notes

A

[1]: EMP indicates that the clast has been analyzed by electron probe
[2]: A etc is a letter for a particular lithology
[3]: DM indicates detailed microscopic examination of the clast

B

Notes on the identified igneous lithologies:
1. fine-grained granite
2. granodiorite
3. intrusive rhyolite: fine-grained felsic rock with holocrystalline groundmass
4. microgranite: very similar to intrusive rhyolite but coarser
5. syenite: very similar to intrusive rhyolite and microgranite but without quartz

Lithologies 3, 4, and 5 sometimes are also grouped together as high-level felsic rocks. The word “porphyry” beside them indicates porphyritic texture.

6. rhyolite: very fine grained felsic rock with qtz + ab + Kfeld and with or without some flow texture.
7. trachyte: only if a trachytic or subtrachytic texture is present, otherwise syenite.

Depth (m)	Pos.	Final name
2208.09	8	intrusive rhyolite
2208.09	16	mudstone intraclast
2208.09	19	mica-quartz schist
2208.09	20	polycrystalline quartz (weakly foliated) (EMP[1]) (A)[2]
2208.09	22	intrusive rhyolite
2208.09	new position	K-spar crystal altered to various things including barite
2210.37	3	poorly sorted fine grained quartz arenite (clast)
2210.37	4	polycrystalline quartz (from plutonic rock) (EMP) (B)
2210.37	5	siltstone (far right centre) (DM[3])
2210.37	5	shale (far right centre) (DM)
2210.37	5	volcanic
2210.37	7	siltstone
2210.37	6	polycrystalline quartz (from schist)
2210.37	7	polycrystalline quartz (from schist)
2210.37	8	siltstone
2210.37	9	intrusive rhyolite
2210.37	new position	granite (EMP)
2210.37	12	quartz mylonite (weak)
2210.37	12	polycrystalline quartz (from gneiss) (D)
2210.37	14	polycrystalline quartz (from plutonic rock) (E)
2210.37	new position	rhyolite (brittle deformation) or pyroclastic (EMP)
2211.47	3	microgranite (EMP)
2211.47	4	microgranite (Upper centre)
2211.47	4	quartz mylonite (weak) (lower centre)
2211.47	4	polycrystalline quartz (from plutonic rock) (E)
2211.47	5	polycrystalline quartz (from fine grained schist) (F)
2211.47	6	poorly-sorted fine grained quartz arenite (clast)
2211.47	7	slate
2211.47	8	claystone intraclast
2211.47	9	polycrystalline quartz (from plutonic rock) (E)
2211.47	10	polycrystalline quartz (from gneiss) (D)
2212.2	1	microgranite/intrusive rhyolite (G). Looks very similar to 2225.45 pos. 10
2212.2	2	quartz mylonite (weak)(upper right)
		mudstone intraclast (lower left)
2212.2	3	intrusive rhyolite
2212.2	4	polycrystalline quartz (from plutonic rock) (E)
2212.2	4	50% chl (clean), with vermicular texture plus 50% quartz. This clast probably comes from microgranite or hydrothermal vein (EMP)
2212.2	5	intrusive rhyolite
2212.2	6	microgranite (porphyry) (EMP)

2212.2	7	microgranite (porphyry) (EMP)
2212.2	8	quartz mylonite (weak)
2212.91	1	myrmekite texture in microgranite (EMP)
2212.91	2	quartz arenite clast (EMP)
2212.91	3	intrusive rhyolite (porphyry) (EMP)
2212.91	3	intrusive rhyolite (porphyry)
2212.91	4	intrusive rhyolite
2212.91	5	quartz schist (H)
2212.91	6	quartz mylonite (weak)
2212.91	7	laminated siltstone
2212.91	new position	myrmekite textures in microgranite
2217.21	1	polycrystalline quartz (weakly foliated) (A)
2217.21	3	mudstone (clast)
2217.21	4	rhyolite (upper centre)
2217.21	5	rhyolite
2217.21	6	polycrystalline uartz (from plutonic rock)
2217.57	1	mudstone (clast)
2217.57	2	K-feldspar clot (from felsic high level plutonic rock) (EMP)
2217.57	3	rhyolite
2217.57	4	polycrystalline rock (from plutonic rock) (E)
2217.96	1	porphyry or cement? (EMP)
2217.96	2	rhyolite
2217.96	3	polycrystalline quartz (from plutonic rock)
2222.59	1	polycrystalline quartz (from plutonic rock) (E)
2222.59	2	quartz mylonite (weak)
2222.59	2	polycrystalline quartz (from gneiss) (D)
2222.59	2	quartz mylonite (weak)
2222.59	3	syenite/intrusive rhyolite (O)
2222.59	3	shale
2222.59	new position	quartz grain with inclusions of apatite altering to Al-phosphates (EMP)
2225.45	5	polycrystalline quartz (from gneiss) (D)
2225.45	7	polycrstalline quartz (from plutonic rock) (E)
2225.45	7	polycrystalline (from plutonic rock)
2225.45	8	mudstone (clast)(upper right)
2225.45	8	quartz mylonite (strong) (lower left)
2225.45	10	felty groundmass probably from an intrusive rhyolite (EMP)
2225.45	12	fine-grained grey-wacke (I) (DM)
2225.45	14	mudstone (clast)
2225.45	15	quartz mylonite (strong)
2225.45	16	syenite/intrusive rhyolite (K) (EMP)
2227.34	1	rhyolite
2227.34	2	rhyolite

2227.34	new position	microgranite with K-feldspar, plag, ilm (porphyry) (EMP)
2227.34	3	60% qz plus 40%vermicular chl. chl may be altered from sodic amphibole as seen in microgranites from the Mallard (M-45) well (vermicular intergrowths of quartz and sodic amphibole) or this may be a clast from a quartz vein
2227.34	4	rhyolite
2227.34	5	quartz diorite (centre)
2227.34	5	quartz (from plutonic rock) (upper right)
2228.42	1	quartz mylonite (weak)
2228.42	1	rhyolite
2228.42	2	microgranite (porphyry) (centre left)
2228.42	3	quartz arenite (clast)
2228.82	1	poorly-sorted quartz arenite (clast)
2228.42	1	poorly-sorted quartz arenite (clast)
2228.82	3	quartz mylonite (strong)
2228.82	4	quartz arenite (L) (DM)
2228.82	6	microgranite (granophyric texture)
2230.62B	1	polycrystalline quartz (from plutonic rock) (E)
2230.62B	2	quartzite/slate (DM)
2230.62B	4	siderite nodule (as a clast)?
2230.62B	5	plagioclase crystal with inclusions of ms, and ferromagnesian minerals altering to siderite probably from a granodiorite
2230.62B	6	microgranite (porphyry) with Mg-rich chl (EMP)
2230.62B	6	quartz mylonite (weak)
2230.62B	7	feldspar-rich diabase (EMP)
2230.62B	9	polycrystalline quartz (from a plutonic rock) (E)
2230.62B	10	gneiss with chlorite (D) (EMP)
2233.62	3	pore filling (sd+kln+chl+ill) (EMP)
2233.62	3	intrusive rhyolite (porphyry) (EMP)
2233.62	4	microgranite (granophyric texture)
2233.62	5	mica schist (DM)
2233.62	8	intrusive rhyolite (porphyry)
2233.62	9	polycrystalline quartz (from plutonic rock) (E)
2233.62	9	limestone
2233.62	10	quartz schist (N)
2233.63	11	polycrystalline quartz (from gneiss)(D)
2237.16	1	syenite (EMP)
2237.16	2	syenite/intrusive rhyolite (O)
2237.16	3	microgranite (porphyry) with Fe-rich chl (EMP)
2237.16	3	vein quartz (X)
2237.16	4	mudstone (clast)
2237.16	5	altered basalt
2237.16	6	quartz mylonite (weak)
2237.16	6	mudstone (clast) (lower centre)

2237.16	7	mudstone (clast)
2237.16	8	quartz schist with quartz vein (N)
2237.16	10	intrusive rhyolite
2237.16	12	polycrystalline quartz (from a plutonic rock) (E)
2238.65	3	fine grained granite (P) (EMP) (DM)
2238.65	3	intrusive rhyolite/syenite (EMP) (DM)
2238.65	4	mudstone (clast)
2238.65	5	quartz schist (N)
2238.65	6	bioclastic limestone clast
2238.65	7	vein quartz with inclusion of vermicular chlorite
2238.65	7	quartz mylonite (weak)
2238.65	7	siltstone clast with carbonate cement
2238.65	8	rhyolite
2238.65	8	polycrystalline quartz (from gneiss) (D)
2238.65	9	polycrystalline quartz (from plutonic rock) (E)
2238.65	10	polycrystalline quartz (from schist)(N)
2238.65	3	syenite (porphyry)
2243.12	1	syenite (porphyry) (EMP)
2243.12	2	mudstone (clast)
2243.12	2	microgranite (granophyric texture)
2243.12	3	quartz mylonite (weak)
2243.12	4	intrusive rhyolite (with altered feldspar phenocryst (O) (DM)
2243.12	4	altered feldspar crystal (DM)
2243.12	5	quartz-wacke (left centre)
		quartz mylonite (weak)(right centre)
2250.17	1	mudstone
2250.17	2	polycrystalline quartz (from gneiss) (D)
2240.17	3	shale
2250.17	4	quartz arenite (clast) (centre right)
2250.17	5	gneiss (DM)
2250.17	6	granite
2250.17	6	quartz mylonite (weak)
2250.17	new position	perthite crystal (EMP)
2250.17	8	rhyolite (DM)
2250.17	9	quartz mylonite (weak)
2263.36	2	mudstone
2263.36	3	mudstone
2263.36	4	rhyolite (centre left)
2263.36	5	mudstone (clast)
2263.36	6	quartz schist (N)
2263.36	8	intrusive rhyolite
2263.36	8	polycrystalline quartz (from plutonic rock) (E)

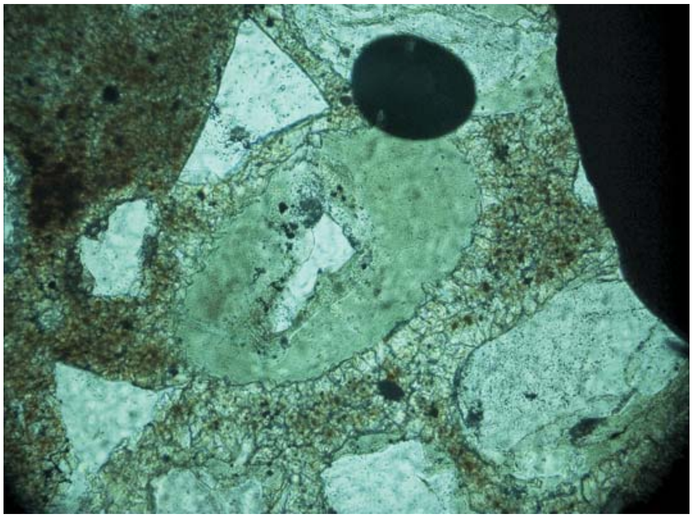
2263.36	10	polycrystalline quartz (from plutonic rock) (E)
2263.36	11	polycrystalline quartz (from gneiss) (D)
2266.99	1	vein quartz (X) (EMP)
2266.99	1	vein quartz
2266.99	2	syenite/intrusive rhyolite (O)
2266.99	2	polycrystalline quartz (from gneiss)(D) (DM)
2266.99	3	schist/slate (DM)
2282.14	2	quartz schist (N)
2482.14	3	quartz schist (N)
2482.14	4	mudstone (clast)
2482.14	5	microgranite (granophyric texture)
2482.14	6	quartz arenite (clast)
2482.14	7	intrusive rhyolite
2482.14	8	polycrystalline quartz (from schist) (N)
2282.14	9	polycrystalline quartz (from plutonic rock) (E)
2482.14	9	polycrystalline quartz (from gneiss) (D)
2482.14	11	polycrystalline quartz (from schist) (N)
2483.55	1	mudstone
2483.55	1	rhyolite
2483.55	1	rhyolite (DM)
2483.55	2	polycrystalline quartz (from schist) (N)
2483.55	3	rhyolite
2483.55	4	quartz mylonite (weak)
2483.55	5	polycrystalline quartz (from plutonic rock)
2483.55	5	quartz mylonite (strong)
2933.62	1	intrusive rhyolite
2933.62	1	quartz mylonite (strong)
2933.62	3	rhyolite (S) (DM)
2933.62	3	microgranite (T) (DM)
2933.62	3	polycrystalline quartz (from gneiss) (D) (DM)
2933.62	3	polycrystallline quartz (from gneiss) (D) (DM)
2933.62	3	carbonate clast (bioclast)
2936.06	1	Intrusive rhyolite (S) (DM)
2936.06	1	quartz mylonite (from gneiss)
2936.06	3	intrusive rhyolite (porphyry) (EMP)
2936.06	3	carbonate clast
2936.06	3	polycrystalline quartz (from gneiss) (D)
2936.06	4	intrusive rhyolite
2940.48	1	syenite (porphyry) (EMP)
2940.48	1	quartz mylonite (weak)
2940.48	3	polycrystalline quartz (from plutonic rock) (E)
2940.48	3	intrusive rhyolite

2940.48	4	carbonate clast (?fossil)
2940.48	5	polycrystalline quartz (from gneiss) (D)
2950.54	14	polycrystalline quartz (from plutonic rock) (E)
2950.54	18	polycrystalline quartz (from schist) (N)
2950.54	18	polycrystalline quartz (from gneiss) (D)
2950.54	18	polycrystalline quartz (from plutonic rock) (E)
2950.54	20	vein quartz (X)
2950.54	21	quartz arenite (clast)
2950.54	5	intrusive rhyolite
3796.33	1	quartz arenite (clast) (EMP) (DM)
3796.33	2	chert (Y) (EMP)
3793.4	20	polycrystalline quartz (from gneiss) (D)
3793.4	20	polycrystalline quartz (from plutonic rock) (E)
3793.4	18	polycrystalline quartz against quartz plus albite (?rhyolite) (EMP)
3793.4	18	polycrystalline quartz (from gneiss) (D)
3793.4	22	polycrystalline quartz (from gneiss) (D)
3793.4	7	mudstone (clast)
3796.33	3	carbonate
3796.33	4	rhyolite
3796.33	5	polycrystalline quartz (from plutonic rock) (E)
3796.33	6	polycrystalline quartz (from gneiss) (D)
3793.40	new position	rhyolite (quartz+albite) (EMP)
3793.40	19	chert (EMP) (DM)
3793.40	20	quartz mylonite (strong) (EMP)

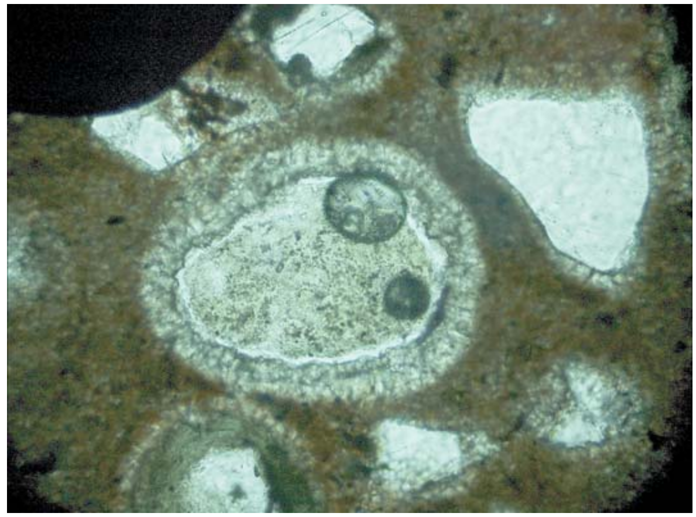
Appendix VII

Coated Grains at 2276.11m depth

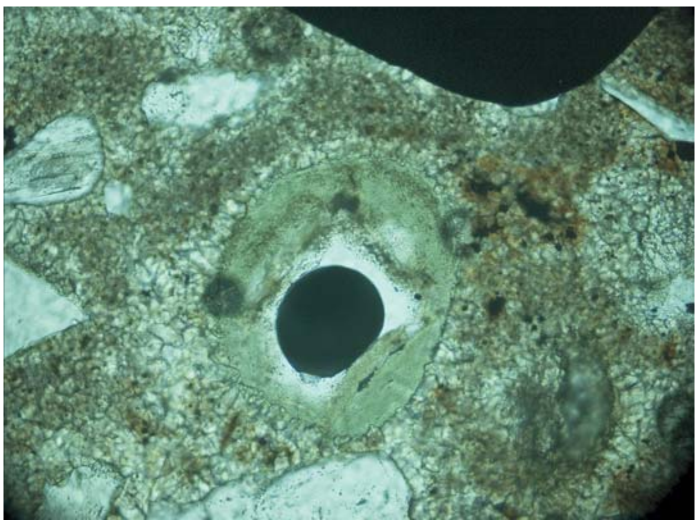
Microphotographs of
representative coated grains
(Figure 1)



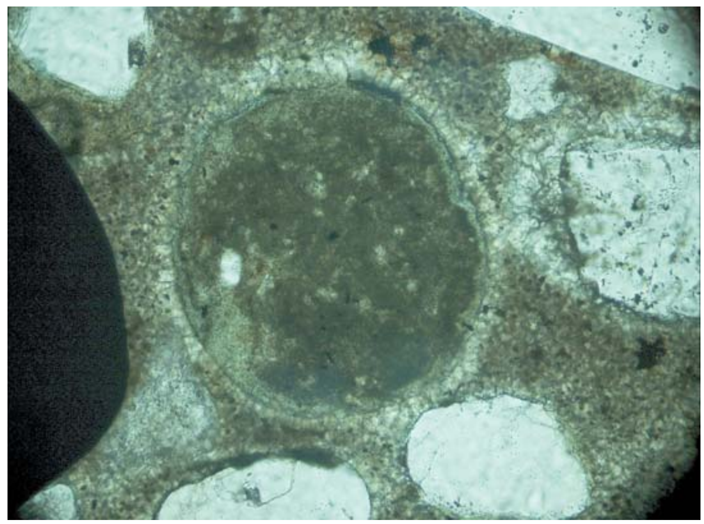
Grain 2



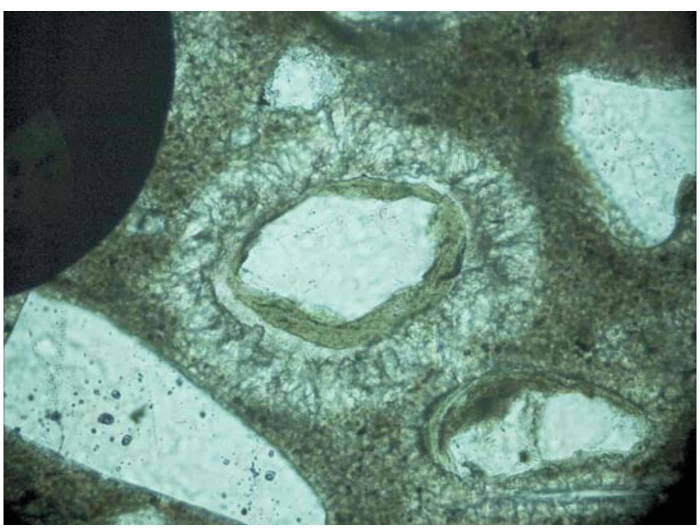
Grain 3



Grain 4

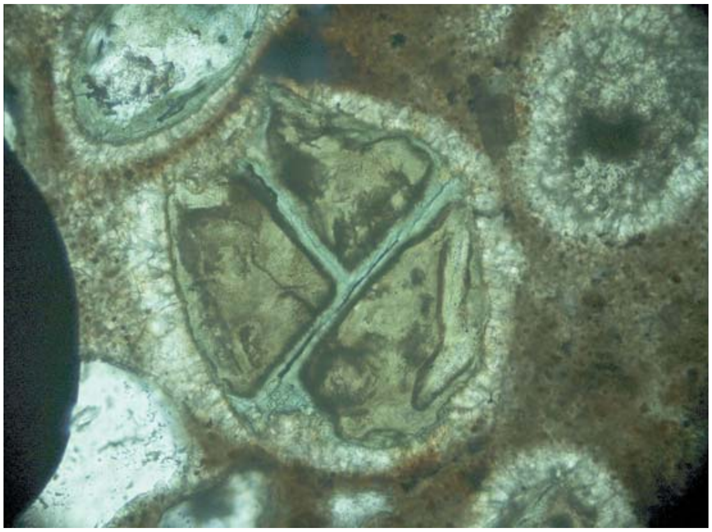


Grain 5a

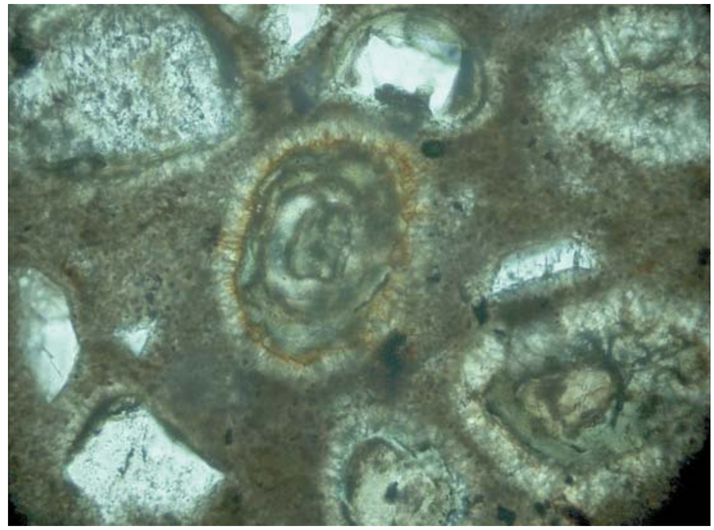


Grain 5b

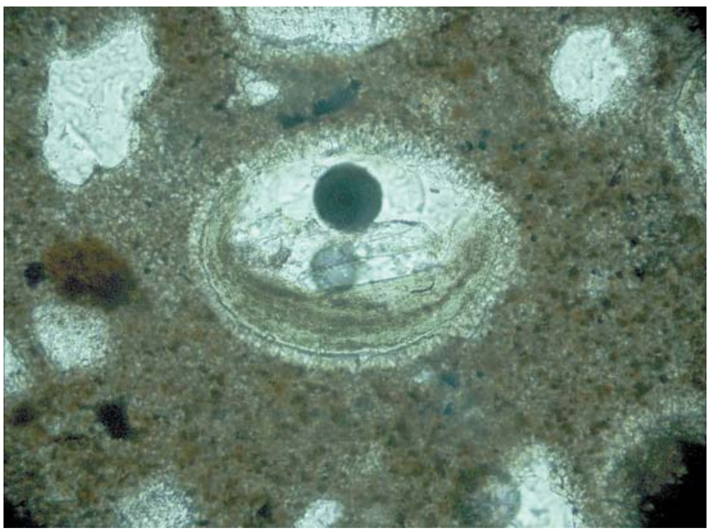
Grain 6



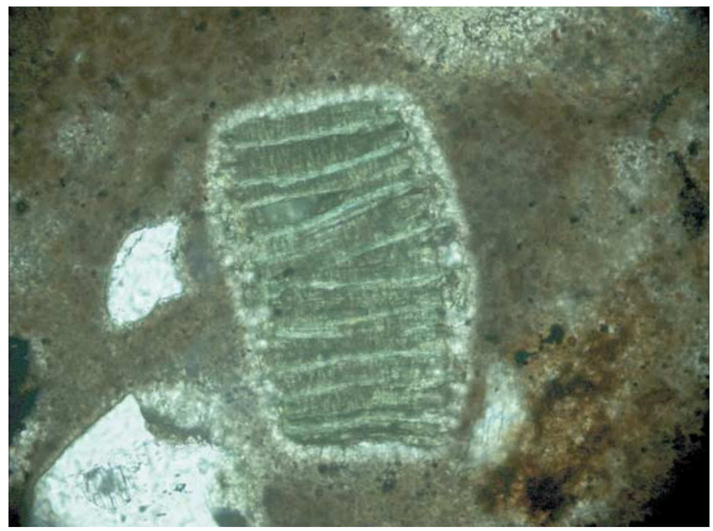
Grain 7



Grain 8

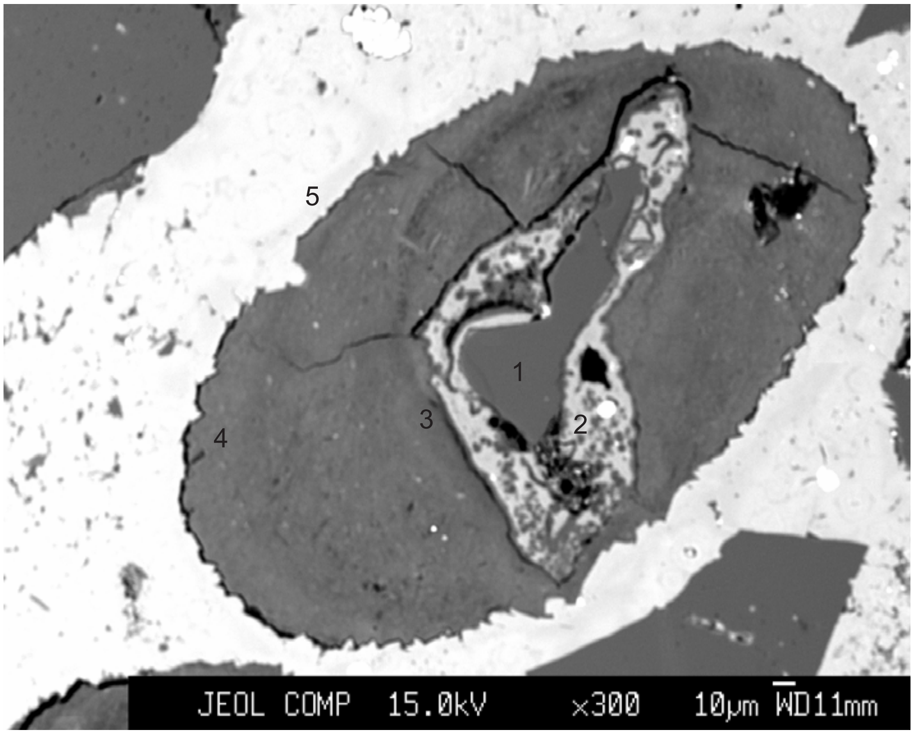


Grain 9



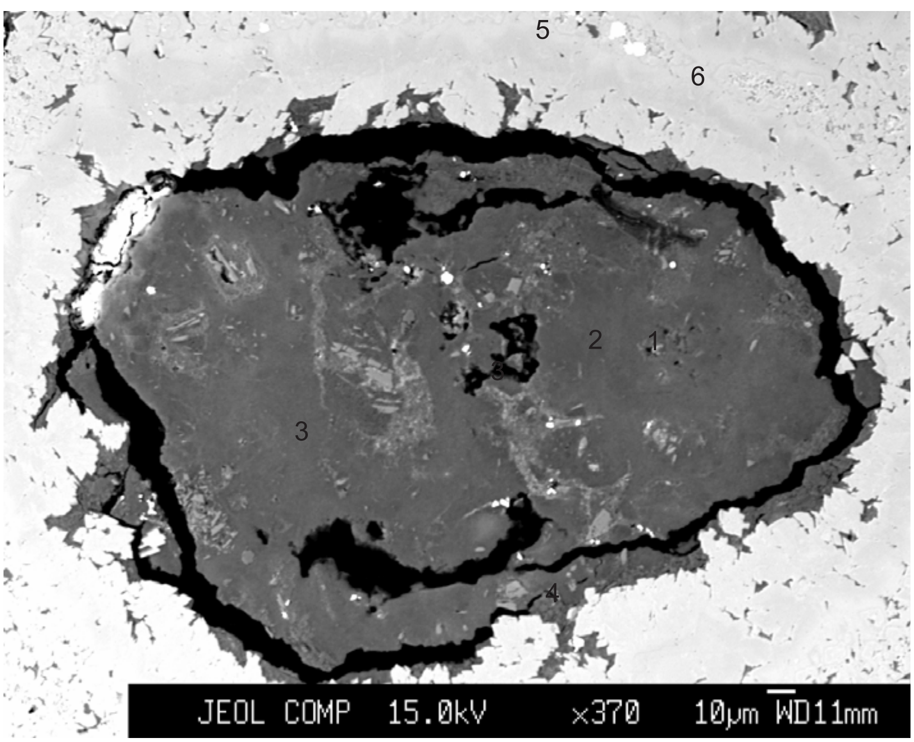
Grain 10

Back-scattered
electron (BSE) images of
representative coated grains



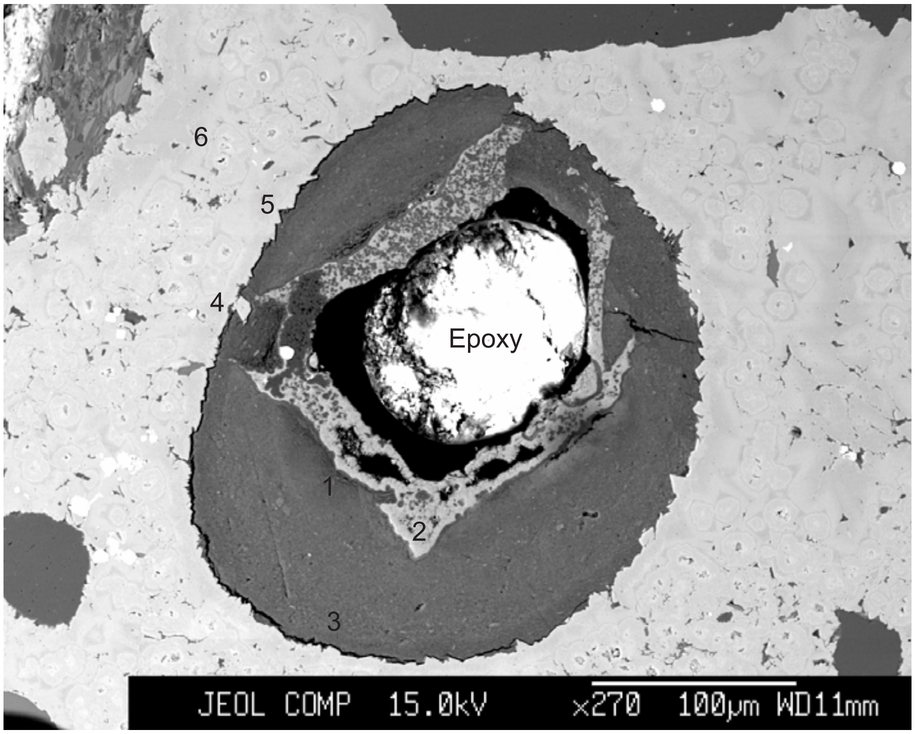
1 = Quartz
2 = Chlorite
3 = ? Glauconite
4 = Glauconite
5 = Siderite

Grain 2



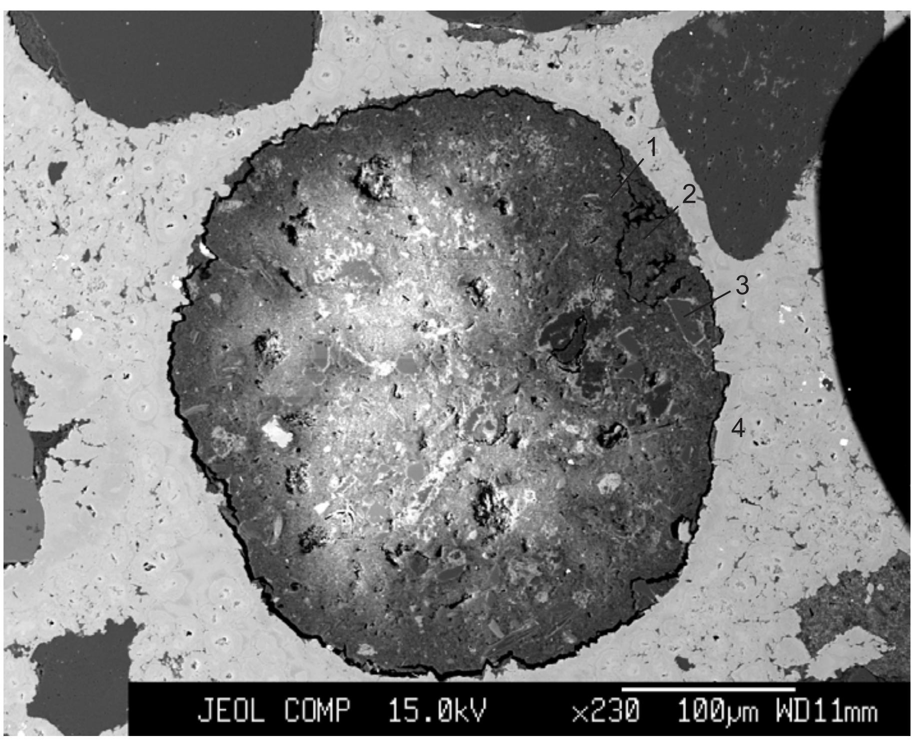
1 = Chlorite
2 = ? Glauconite
3 = ? Chlorite
4 = ? Chlorite
5 = Siderite
6 = Siderite

Grain 3



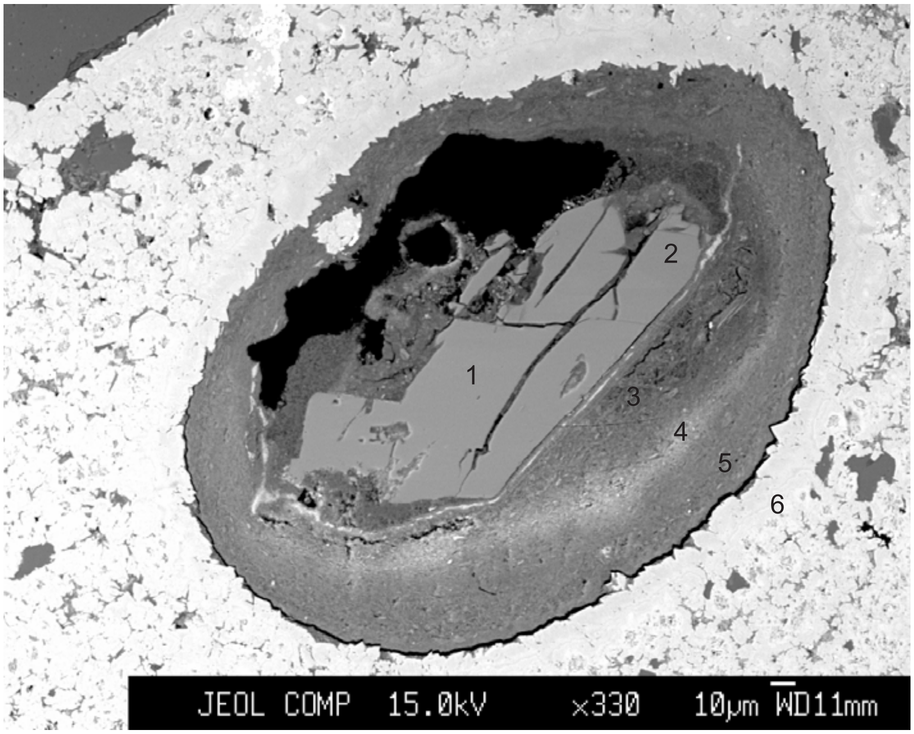
1 = ? Glauconite
2 = Chlorite
3 = Glauconite
4 = Siderite
5 = Siderite
6 = Siderite

Grain 4



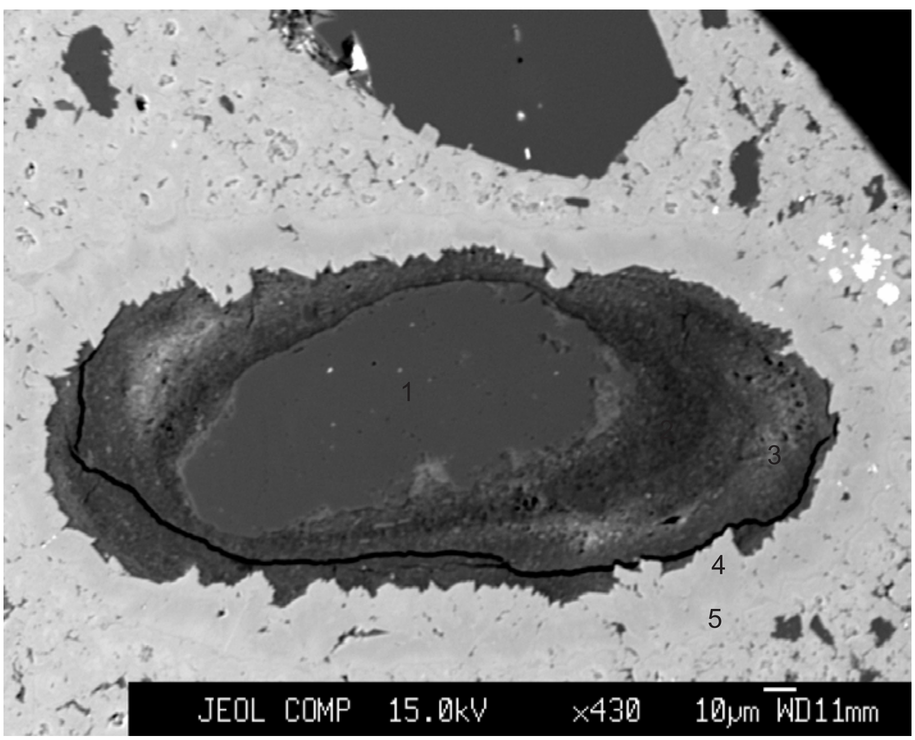
1 = ? Chlorite+Glauconite
2 = Chlorite+Glauconite
3 = Ab
4 = Siderite

Grain 5a



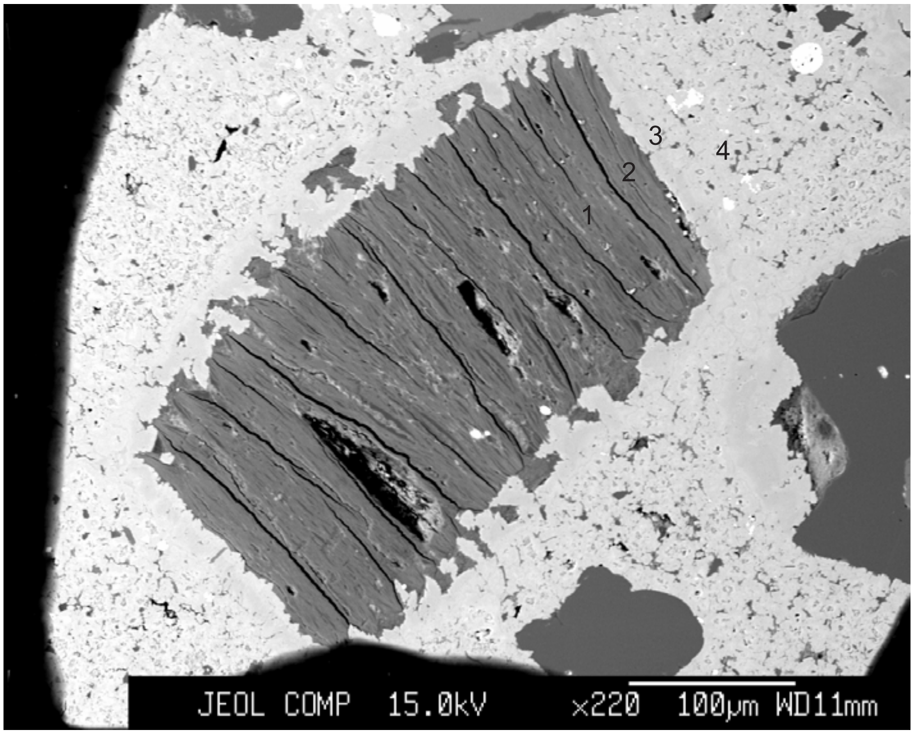
1 = K-feldspar
2 = K-feldspar
3 = ? Glauconite
4 = ? Glauconite
5 = Glauconite
6 = Siderite

Grain 5b



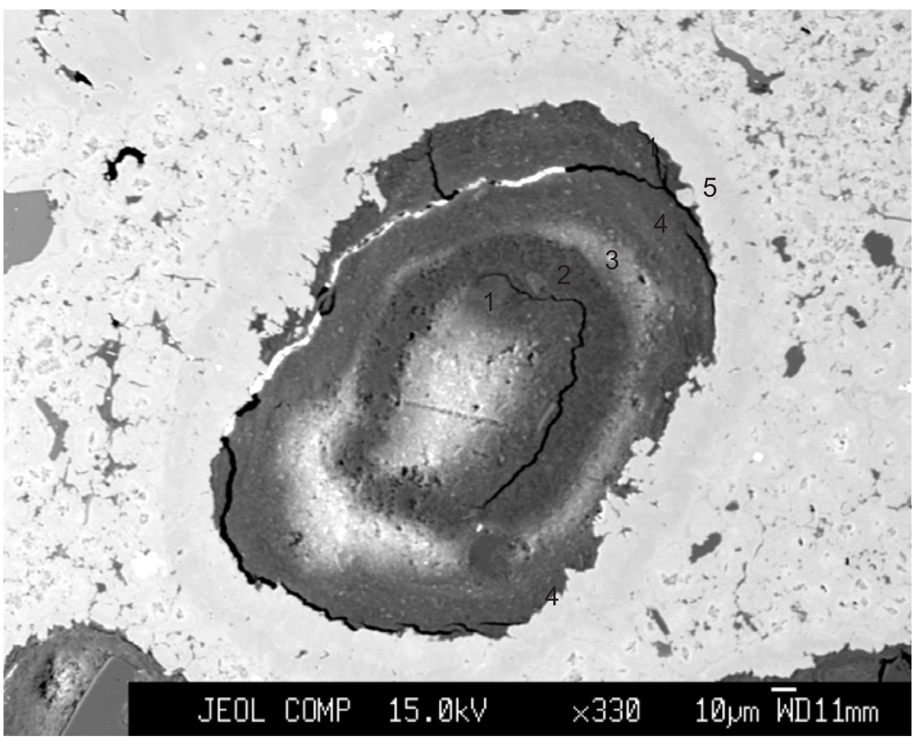
1 = Quartz
2 = Halloysite
3 = Glauconite
4 = Siderite
5 = Siderite

Grain 6



1 = Glauconite+Chlorite
2 = Glauconite+Chlorite
3 = Siderite
4 = Siderite

Grain 10



1 = Glauconite
2 = Kaolinite
3 = Chlorite
4 = Glauconite
5 = Siderite

Grain 8