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G. Pe-Piper, A. Okwese, D.J.W. Piper

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Pe-Piper, G., Okwese, A., Piper, D.J.W.
2006: Volcanic ash and lignite of the Lower Cretaceous Chaswood Formation, central Nova Scotia, Geological Survey of Canada, Open File 5080, 237 p.

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Geological Survey of Canada project GK 4550

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Preface

This Open File Report presents stratigraphic, geochemical and petrographic data and a preliminary interpretation of the lignites of the Lower Cretaceous Chaswood Formation in central Nova Scotia, with an emphasis on the recognition of volcanic ash horizons. This study allows estimates to be made of the importance of labile volcanic ash in the correlative offshore sediments of the Missisauga and Logan Canyon formations of the Scotian basin, which are the principal reservoir rocks for the gas resources of the Sable sub-basin. The entire Open File is available as a pdf file; tabular material is also presented as Excel files and graphical material as Coredraw v.9 files.

Acknowledgements: This Open File is a result of collaborative work led by Saint Mary's University and funded by an NSERC Collaborative R&D project grant, the ExxonMobil Sable Project, and Petroleum Research - Atlantic Canada (PR-AC). We thank Gordon Brown for thin sections, Bill LeBlanc and Thian Hundert for assistance with X-ray diffraction, Frank Thomas for help with scanning electron microscopy, and Patricia Stoffyn at the Regional Electron Microprobe Centre at Dalhousie University. Open File reviewed by T. Hundert and M. Parsons.

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Abstract

Lignites and coals, because of their low sedimentation rates of terrigenous detritus, commonly preserve a record of the input of volcanic ash. A reconnaissance study has been made of lignite from the Lower Cretaceous Chaswood Formation of the Elmsvale basin, central Nova Scotia in order to identify whether volcanic ash is present, and if it is, whether it could be used to correlate the poorly dated terrestrial rocks with better dated marine successions offshore. The bulk mineralogy and geochemistry of lignite and lignitic mudstones has been determined by X-ray diffraction (XRD) and whole-rock geochemical analysis of ashed samples; in addition, selected samples have been examined by electron microprobe (EMP) and scanning electron microscope (SEM).

Lignites from the Chaswood Formation have several features indicating the presence of volcanic ash: unusual abundance of high-field-strength elements (HFSE) such as Nb, Ta and Hf; the presence of augite in EMP and XRD analyses; the rare presence of euhedral quartz; and aluminophosphate-sulphate minerals that appear to pseudomorph volcanic ash. Wood or charcoal fragments appear mineralized and diagenetic talc is present. Much of the terrigenous component of the lignites consists of background detrital sediments (characterized by detrital illite) and most of any ash component has been altered to kaolinite. Bulk composition of ash is inferred to range from basaltic to rhyolitic. Ash beds are present in both the lower and the middle member of the Chaswood Formation, but our sampling density was insufficient to correlate single beds from one borehole to another. Several ash beds may be present in a single lignite unit. The closest sources of ash are the early Albian volcanic rocks within the lower Cree Member of the Orpheus graben, in a stratigraphic interval that has been previously correlated with the middle member of the Chaswood Formation, and Berriasian to Barremian volcanic rocks on the SW Grand Banks and Fogo Seamounts. These rocks show similar abundances of HFSE to the Chaswood Formation lignites. Distinctive REE patterns with low La/Nd ratios are found in many lignites from the middle member of the Chaswood Formation. They likely result from concentration in organic matter of relatively unfractionated REE in ash of similar composition to Albian volcanic rocks to the southeast.

Introduction

Purpose

The Lower Cretaceous Chaswood Formation was deposited at the same time as volcanic activity to the west and southeast. This study searched for evidence of volcanic ash in the Chaswood Formation, principally in lignite horizons that commonly preserve an undiluted record of volcanic inputs. Petrographic, mineralogic and geochemical techniques were used to identify possible volcanic products. The study was carried out to investigate whether volcanic ash might be used for stratigraphic correlation, but also sheds light on Lower Cretaceous volcanic activity in southeastern Canada and adjacent New England. The study also allows an estimate to be made of the importance of volcanic detritus in the Scotian basin.

The Chaswood Formation

The Lower Cretaceous Chaswood Formation (Stea and Pullan 2001) is the proximal, onshore equivalent of thick deltaic units that are reservoir rocks for gas and oil in the offshore Scotian Basin (Fig. 1). The Chaswood Formation is best preserved in a series of fault-bound basins in central Nova Scotia, including Elmsvale basin (Fig. 2). The formation comprises terrestrial deposits, principally fluvial sandstone and conglomerate, overbank kaolinitic mudstone on which paleosols formed, and lignite composed of swamp vegetation and the detritus from forest fires (Scott and Stea 2002). The middle member of the Chaswood Formation is probably Aptian-Albian, whereas older biostratigraphic ages (Barremian and Valanginian) have been determined for some isolated deposits (Wade and MacLean 1990; R. Fensome, pers. comm. 2002). The middle and upper members of the Chaswood Formation are likely correlative with the lower Logan Canyon Formation and the lower member with the Missisauga Formation in the offshore Scotian Basin (Pe-Piper and Piper 2004).

The term lignite has been applied to impure coals and dark carbonaceous mudstones in the Chaswood Formation. In the facies scheme of Pe-Piper et al. (2005a), the term lignite is applied to beds with > 30% organic carbon. Lignitic mudstone has organic carbon contents of 10-30%. Lignites and lignitic mudstones occur in beds < 0.5 m thick interbedded with mudstones with lower carbon contents. Lignite from the Dickie Brook borehole (near RR-97-23 in Fig. 3) was described by Hacquebard (1984), who determined an equilibrium moisture content that indicated a burial depth of about 700 m. Vitrinite reflectance (Ro) ranged from 0.27 to 0.33.

Lignitic mudstones and lignites from the middle part of the formation at the type section include palynomorphs indicating standing water environments (Eisnor 2002), although some beds have a high charcoal content interpreted to result from wildfires (Calder et al.1998; Scott and Stea 2002). In this study, lignite and lignitic mudstone has been sampled from six boreholes in the Elmsvale basin and the Shubenacadie outlier (Fig. 3). Detailed core logs of the sampled intervals are presented in Figure 4. Individual lignite beds are up to several decimetres thick and horizons of lignite and lignitic mudstone are several metres thick in places.

Boreholes in the Elmsvale basin are correlated with the type section of the Chaswood Formation, defined by Stea and Pullan (2001), based on seismic stratigraphy and correlation of major sandstone packets by Piper et al. (2005) (Fig. 5). Stea and Pullan (2001) used major lignite horizons as correlatable lithostratigraphic markers within the Chaswood Formation. Piper et al. (2005) showed that although packets of red mottled paleosols and lignitic mudstones could be correlated through the Elmsvale basin, individual beds of these latter two facies were not as continuous as packets of sandstone beds. They also showed that the member correlation proposed by Stea and Pullan (2001) was inconsistent with the seismic stratigraphy. Hundert et al. (2005) divided the Chaswood Formation into four “Packets”, with I and II corresponding to almost all of the lower member, packet III corresponding to the middle member and the extreme top of the lower member, and packet IV corresponding to the upper member at the type section. The correlation of these packets is shown in Figure 5.

The regional correlation of Piper et al. (2005) (Fig. 5) allows local correlation of lignite horizons. One lignite horizon (L5) was sampled in Packet IV. Four lignite horizons in Packet III (L4-1) can be correlated between boreholes CH97-10B, CH97-9 and SG98-4 (a distance of 4 km) but cannot be traced farther east to RR97-23 and MBR97-32A. At the Shubenacadie outlier, three lignite horizons (La-Lc) are recognised in Packet III, but their correlation with the Elmsvale basin is uncertain. One lignite horizon (Ld) is found in Packet II at the Shubenacadie outlier and numerous lignite horizons are present in Packet I in borehole MBR97-32A at the eastern end of the Elmsvale basin. Lignite from Dickie Brook (Hacquebard 1984) is also from Packet I.

Possible volcanic sources

Early Cretaceous volcanism is widespread in southeastern Canada and adjacent areas of the continental margin (Pe-Piper and Jansa, 1987; Pe-Piper et al. 1990, 1994). Six main groups of volcanic and sub-volcanic rocks are recognised (Fig. 1). The New England - Quebec igneous province of bimodal alkalic stocks and lamprophyric dykes dates mostly from 110-125 Ma (Fig. 6). Volcanoes in the Orpheus graben occur in lower Cree Member and are dated 110-125 Ma. Rather older volcanic rocks (120-130 Ma and older) are found on the SW Grand Banks margin and younger rocks in the Newfoundland (98 Ma) and New England (103-82 Ma) seamounts. Alkalic rocks are found in the Baltimore Canyon region and date from 98-103 Ma.

The New England - Quebec igneous province (McHone and Butler 1984; Manspeizer et al. 1989) includes alkalic stocks and plugs of the Monteregian hills of Quebec, bimodal gabbro-syenite small plutons in New England, and widespread lamprophyric (camptonite) dykes and sills. Eby (1984) found that slightly undersaturated plutonic rocks were emplaced between 141 and 129 Ma, whereas strongly undersaturated plutonic rocks were emplaced between 120 and 117 Ma. Most mafic dykes were emplaced in one of three intervals: 139-129 Ma, 121-117 Ma and 110-107 Ma (Eby 1985).

In Orpheus graben, basalt flows and more felsic pyroclastic rocks tens of metres thick are found in the lower Cree Member (late Aptian) (Jansa and Pe-Piper, 1985; Weir-Murphy, 2004). Similar hypabysssal intrusive rocks are known from the eastern Scotian Shelf (Hesper well) and the northwestern Grand Banks (Emerillon and Twillick wells) (Pe-Piper and Jansa, 1987). Older (Valanginian to Barremian) basalt and pyroclastic rocks many tens of metres thick and subvolcanic granite is known from the Mallard and Brant wells on the southwestern Grand Banks. Basalt at the base of the Narwhal well, on the northwestern Fogo Seamounts, is of Berriasian or older age. Lower Cretaceous trachyte has been recovered from one of the central Fogo Seamounts (Pe-Piper et al., 1994).

The New England Seamounts comprise alkali basalt, basanite and tephrite. They show a systematic age progression from 103 Ma at Bear Seamount just off the continental margin to 82 Ma at Nashville Seamount in the southeast. The Newfoundland Seamounts have yielded alkali basalt and sodic trachyandesite, dated at 98 Ma. Igneous rocks at Baltimore Canyon date from 96 - 103 Ma and consist of tephrite and phonotephrite (Pe-Piper and Jansa 1987).

Methods

Samples were taken from selected stratigraphic horizons of boreholes from the Elmsvale basin and the Shubenacadie outlier archived at the Nova Scotia Dept. of Natural Resources Core Repository at Stellarton, N.S. “Lignites” were recognised solely on the basis of colour and include “lignite”, “lignitic mudstone” and “dark grey mudstone” in the facies nomenclature of Pe-Piper et al. (2005a). In addition, interbedded “normal” mudstones were also sampled. Facies classification of the samples is summarized in Table 1.

All “lignite” samples were ashed and the geochemistry of these samples was determined at Activation Laboratories Ltd, principally using ICPMS and INAA methods. The lignite samples were pulverized, as if they were mudstones, and then they were ashed at 475°C (Code B3). The ash was used to determine major and trace elements (Code 4Litho) and base metals (Code 4b1). Unashed powdered sample was used to determine As (Code 4b-INAA). Analyses that show low totals (< 98%) have high LOI and high S. Sulphide is included in LOI (at 1000°C) but sulphate is not and would thus lower the totals. In addition, bulk geochemistry was determined on the interbedded mudstones and on a few samples from the underlying Carboniferous Green Oaks Formation in borehole GR97-19. The same analytical methods were used, except that ashing was not carried out and As was not determined. Carbon-carbonate analysis was carried out on all samples using a LECO carbon analyser by combustion of raw and acid-leached samples. The presence of sulphide and sulphate means that the cited carbonate analyses are unreliable. Spectrophotometry of all powdered samples was measured with a Minolta hand-held spectrophotometer. Data from all these analyses are presented in Table 3 for lignites and Table 4 for mudstones.

Heavy minerals were separated from a few ashed samples using the heavy liquid tetrabromoethane. Polished thin sections were prepared from these separates. Minerals were analyzed with a JEOL-733 electron microprobe equipped with four wavelength spectrometers and a Tracor Northern 145 eV energy-dispersive detector. The beam was operated at 15 kV and 20 nA, with a beam diameter of 1-10 μm. Geological standards were used. The data were reduced using a Tracor Northern ZAF matrix-correction program. Mineral chemistry data are presented in Table 2. Selected minerals were also examined in backscattered electron (BSE) mode to characterize mineral morphology. The BSE images are presented in Appendix 2.

X-ray diffraction analysis was carried out on both ashed and unashed bulk samples of “lignites” and on bulk samples of “normal” mudstones. Bulk samples used a random mount made by lightly grinding the sample and stirring it onto a diffraction slide mount using methyl alcohol. X-ray diffraction was carried out on a Siemens Kristaloflex diffractometer using Co Kα radiation. Dry samples were scanned from 2°- 52° 2θ, with a slow scan from 28.5° - 30.5° 2θ to resolve any vermiculite or chlorite - kaolinite doublet, and glycolated samples were scanned from 2° - 17° 2θ to identify expandable clays. Diagnostic d-spacings for minerals are given in Table 5. Raw peak areas were measured after removal of background. Full data are presented in Appendix 3. Summary data are presented in Table 5 for unashed lignite, Table 6 for ashed lignite and Table 7 for mudstones.

A few samples were examined by scanning electron microscope. Samples were lightly pulverised and the <150 μm fraction was sprinkled on double-sided tape on an SEM stub. An energy-dispersive system (EDS) was used to assist in mineral identification. Spot size for EDS analysis is estimated to be < 2 μm. Data are presented in Appendix 1.

Evidence for volcanic ash

1. Whole rock geochemistry of the silicate fraction

Introduction

Chemical analyses are available for all the “lignite” samples and also for a suite of “normal” mudstones that interbed with the lignites. In addition, chemical analyses are available for a suite of mudstones and sandstones from borehole RR-97-23 (Pe-Piper et al. 2005b). These samples are useful in showing the normal range of elements in a wide range of sediment types (see means and standard deviations in Table 3). Thus, a plot of Al_2O_3 vs. SiO_2 on a volatile-free basis (Fig. 7) shows a similar range of SiO_2 and Al_2O_3 contents as for “normal” mudstones and sandstones from RR-97-23, except that very silica-rich compositions are not represented in the lignites. Downhole variation in principal elements in the lignite samples is summarized in Figures 8 – 11.

Rare Earth elements

REE abundances in many lignites are quite different from those in “normal” interbedded mudstones (Fig. 12). The “normal” mudstones show a rapid decrease in abundance of the light

REE (concave-up pattern), whereas many of the lignites have little decrease in relative abundance of the light REE (convex-up pattern). Some of these lignite samples also have exceptionally high abundances of stable high-field strength elements such as Y and Nb. The convex-up REE pattern in many lignites can be expressed as a high Nd/SiO_2 ratio (Figs. 13 - 19) or low La/Nb ratio.

Samples that contain significant amounts of the minerals alunite, jarosite, hematite, pyrite or marcasite (identified principally by X-ray diffraction) do not show any obvious effects of these minerals on the REE distribution. Neither is there any systematic variation with carbon content of either REE distribution (Fig. 20), except that it is the organic-rich lignites that show the concave-up REE pattern, nor abundance of metals such as Cu, Zn and Cr (not illustrated).

High-field-strength elements

Many ashed samples from the lignites show higher abundance of Nb and Y compared with the background mudstones (Fig. 21) and likewise Yb and Ta are particularly high in some ashed samples (Fig. 22). “Normal” sandstone and mudstone from borehole RR-97-23 and from the boreholes sampled for lignite have Nb < 42 ppm and Y < 90 ppm. Values greater than this are found for 17 samples of ashed lignite with a range of silica contents. In addition, some ashed samples from lignites have exceptionally high TiO_2 and Zr contents compared with background mudstone.

2. X-ray diffraction analysis

X-ray diffraction analysis (Figs. 23-29) has revealed only two minerals that may be direct evidence for volcanic ash: augite and talc. Augite is found by XRD analysis in a substantial number of bulk lignite samples (Figs. 23-28) and in one heavy mineral separate (Table 2); it is common in mafic and intermediate volcanic rocks, but extremely rare as a detrital mineral in the Chaswood Formation. Most samples with augite have a particular stratigraphic occurrence (lignites L0, L1, L4, L5). However, no systematic geochemical distinctions are noted between samples from a particular lignite horizon with detectable augite and those without.

Talc has been recognised as a white mineral in at least one sample from lignite bed L2 at 31.53 m in borehole SG98-48, with characteristic peaks at 9.25, 3.46 and 3.11 Å. This sample also contains abundant pyrite, in addition to a high carbon content. SEM analysis showed the sample consisted of carbonaceous plant fragments, irregular masses of pyrite, and vein-like bodies of talc. Normal detrital minerals such as kaolinite, illite and quartz were not detected. Talc forms by the low temperature alteration of Mg-rich silicate minerals (e.g. McKinley et al. 2001) and we suspect that this sample represents the diagenetic alteration of a mafic volcanic ash.

The predominant clay mineral in most lignite samples is kaolinite (Figs. 23-29), with mixed-layer kaolinite - expandable layer clays also present. Kaolinite is also the predominant clay mineral in many “normal” mudstones in the Chaswood Formation, and is inferred to be in part detrital, in part pedogenic, and in part the product of diagenesis by meteoric water below the water table (Pe-Piper et al. 2005a). In normal mudstones, both illite and quartz are also abundant: both minerals are interpreted to be of detrital origin. The kaolinite to illite ratio (expressed as the ratio of raw peak areas in X-ray diffraction) is typically between 2 and 10 for mudstones from RR97-23. In contrast, the kaolinite:illite ratio for lignites from L0, L1, L4, and L5 lies between 5 and 15 and in lignites from L2 and Packet I there is commonly no illite recognised.

X-ray diffraction also shows the presence of pyrite, calcite, jarosite, marcasite, gypsum and alunite in some lignite samples.

3. Electron microprobe analysis

Samples in which electron microprobe analyses of mineral grains could be made were in general those lignites with a high proportion of apparently detrital minerals, including quartz and illite identified by X-ray diffraction (Fig. 7). The only samples from which heavy minerals could be separated were those with a high detrital component and the dominant heavy minerals (Figure 2 of Appendix 2) were ilmenite (and its alteration products including rutile), zircon, muscovite and biotite. Chemical compositions of these minerals are shown in Table 2. Most BSE images (Appendix 2) either show detrital minerals (which resemble those elsewhere in the Chaswood Formation) or charcoal fragments (with complex mineralisation in pores).

Samples of carbonized wood from MBR97-32A show pores that have rims of minerals with backscatter characteristics similar to quartz and kaolinite (Figure 1 of Appendix 2). In addition, some pores are largely or completely filled by kaolinite or quartz (Appendix 2, Figures 1, 3, 4 and 5). Although it is possible that these minerals have infiltrated from surrounding sediment, it seems more likely that they were developed diagenetically.

X-ray maps of polished thin sections of mineralised woody fragments from SG98-48 show no systematic variation in Y or P, and Y appears more abundant in clays than in wood.

4. Scanning electron microscopy

Representative scanning electron micrographs and accompanying EDS analyses are presented in Appendix 1 (in which figure numbers correspond to grain numbers). Most of every sample examined consisted of clayey aggregates with a planar fabric and a composition suggestive of kaolinite. In most samples, 1-3 % of the sample consisted of woody fragments of charcoal. EDS analysis of the charcoal suggests that much of it is mineralized, thus consistent with the BSE in electron microprobe polished thin sections which show pores in the charcoal filled with quartz and kaolinite. Analyses of mineralised woods from MBR97-32A 121.17 m seem to have higher Ca than in CH97-10B 62.42 m, consistent with the bulk chemical analyses of the two samples.

Blocky carbon-rich grains with curved faces (Grains 7, 9) were identified originally as a possible plastic contaminant, but in Grain 10 of SG98-48 32.40 m are in intimate contact with small clay flakes and probable fine silt quartz and thus of Cretaceous age. A very bubbly looking carbon-rich grain (Grain 11 in SG98-48 32.40 m) has high Si, Al, indicating mineralisation in the pores. It is interpreted as resinous substance that gave off gasses when burnt in a wildfire.

Detrital quartz grains are found in most lignite samples. In particular, a sample at 116.8 m in MBR97-32A from a whitish bed in the middle of thick lignite was tentatively identified as an ash bed during visual description of the cores, but appears to be a well sorted detrital quartz sand. Many of the quartz grains are substantially corroded (e.g., grains 5, 8).

A few quartz grains appear euhedral to subhedral or have elongation ratios > 3 suggesting a volcanic origin. Grain 3 from MBR97-32A 121.17 m has a euhedral prismatic termination. Grains 8 and 9 of CH97-10B 62.42 m are particularly subhedral. Grain 13 from SG98-48 32.40 m is a twinned quartz with euhedral terminations and a conchoidal fracture.

Blocky kaolinite, probably pseudomorphing blocky feldspar (Grain 8 in SG98-48 32.40 m) is found in several samples. Possible augite grains are also found (Grain 3 in SG98-48 32.40 m).

5. Other observations

Near the base of the Chaswood Formation in borehole RR-97-23, Pe-Piper and Dolansky (2005) found a complex aluminum-phosphate-sulphate (APS) mineral aggregate that appears to be a replacement of an original clast, 250 x 100 μm in size. The aggregate contains small inclusions of quartz grains, some of which are highly embayed, and inclusions of illite (probably after K-feldspar). The morphology of the clast (Fig. 30) and inclusions of illite after ?K-feldspar and embayed quartz suggest a protolith of felsic glass. Elsewhere, APS minerals are reported to have replaced volcanic glass in coal (Triplehorn et al. 1991).

Observations on "normal" mudstones

The distribution of key minerals and elements in "normal" mudstones that were analysed are summarized in Figures 13 - 19 (samples shown as "clays"). The observed compositions are similar to those determined from borehole RR97-23 (Pe-Piper et al. 2005b). A detailed interpretation of the geochemistry of all these samples will be the subject of another report.

The composition of the Green Oaks Formation samples is quite distinctive (Figs. 19, 29), with samples consisting of argillaceous dolostone, with the minerals illite and dolomite predominating.

Discussion

Depositional environment of lignite

Analysis of facies transitions shows that facies transitions from lignite or lignitic mudstone are most commonly with medium grey mudstone (Pe-Piper et al. 2005a). Lignites may overlie sandstones, but are rarely interbedded with sandstones (Piper et al. 2005). Lignite beds are most common close to active strike-slip faults, suggesting that they form in poorly drained sag basins along faults (Hundert et al., 2005). Palynomorph assemblages show that at least some lignites formed in swamps with running water (Eisnor 2002). Our SEM observations and the work of Calder et al. (1998) and Scott and Stea (2002) shows that many lignites have large amounts of charcoal, suggesting a source from wildfires. The heavy mineral and sand fraction mineralogy determined from EMP (Appendix 2) shows that many of the lignites have a detrital sand component that is similar to that in sandstones of the Chaswood Formation (Pe-Piper et al. 2005b), with abundant detrital quartz and ilmenite. The XRD analysis of some bulk samples, especially those that have similar bulk geochemistry to mudstones or sandstones of RR-97-23 (Fig. 7), also resembles that of mudstones from Chaswood Formation, notably in the presence of detrital illite. Thus many of the lignite samples received the same detrital minerals as the regular mudstones of the Chaswood Formation, presumably largely from overbank fluvial transport.

Geochemical character lignites that might be derived from original ash

If many of the lignite samples have a considerable detrital component, then how can the original composition of any volcanic ash be determined from the available data? Most ash appears to have altered to kaolinite or mixed-layer kaolinite - expandable layer clays, but similar clays may be of detrital origin. We suggest that there are several criteria that can be used to identify volcanic ash:

1. Samples that for many elements plot outside the range of mudstones for RR-97-23, for example with TiO_2 > 2.2 wt %, Zr > 650 ppm, Hf > 13 ppm, Ta > 2.7 ppm, Nb > 40 ppm (Figs. 7, 21, 22).
2. Horizons with no detectable illite in XRD are interpreted as having the least detrital terrigenous material. A few samples also contain no detectable quartz by XRD.
3. Samples with high organic carbon content (>20%, Figs. 7, 20) all show other features suggesting a high component of ash.
4. Samples with characteristic convex-up LREE patterns (Figs. 12, 31), expressed as a high Nd/SiO_2 ratio (Figs. 13-19) or low La/Nb ratio, may be indicative of a volcanic ash component, or may be a consequence of mobility of REE and their adsorption on organic matter (cf. Hower et al. 1999).

On the basis of such criteria, the following types of lignite sample are identified in the Chaswood Formation.

Type A. Lignite L2, in SG98-48 31-32 m, with Hf > 13 ppm, Ta > 2.7 (Fig. 32), and organic carbon > 20%. These samples are also distinctive in having La/Nd ~0.75 and Y > 200 ppm.
A1.One sample (31.64 m) with 57 % SiO_2 (volatile-free) has neither illite nor quartz detected in

XRD, but shows some augite, and has low TiO_2 and Zr. Y is very high (385 ppm), but Nb (14 ppm) is within the range of normal mudstone. A sample at 31.53 m run for XRD only shows the presence of talc (Douglas 2002).

A2. Three other samples (31.24 m, 31.98 m, 32.2 m) also have organic carbon > 20%, low La/Nd, very high Y (341-405 ppm), no detectable illite and augite, and some quartz. The TiO_2 and Zr contents are also higher than normal Chaswood sediments. The SiO_2 contents of these samples range from 69-76% (volatile-free). The remaining sample from SG98-48 (32.4 m) appears diluted with sandy terrigenous material, with SiO_2 of 87%, but nevertheless shows high Y (208 ppm).

Type B. Lignites from horizons L1, L4 and L5, at 76 m at SH94-4, 46-48 m in CH97-9, and 57-58 m in CH97-10B. These are all rather similar, with La/Nb ~0.8, high Y, and the presence of augite in XRD.

B1. Samples from L5 in CH97-10B and CH97-9 have SiO_2 59-64% and very similar abundances of HFSE, highest in the most mafic sample, suggesting some dilution in the other samples (Nb ~17 ppm, Y ~110 ppm, Zr ~135 ppm).

B2. The samples from L1 in CH97-10B range in SiO_2 from 69 - 83%, with the more siliceous rock having lower TiO_2 abundance and higher Zr. HFSE are highest in the more mafic samples (Nb ~28 ppm, Y ~120 ppm). The sample from La in SHU94-4 appears similar, with 64% SiO_2, Y 88 ppm, Nb 33 ppm, a similar REE pattern, and similar TiO_2 of ~2%.

B3. Lignite from Lb at 32 m in SH94-3 is somewhat similar, with 55% SiO_2, Y 71 ppm and Nb 21 ppm. The REE pattern resembles type D discussed below.

B4. Lignite from L4 in CH97-9 contains 64-71% SiO_2. All samples contain augite, illite and quartz in XRD. The most mafic sample has 78 ppm Y.

Type C. Two samples from lignite L0 in CH97-10B are siliceous (81-84% SiO_2) with Nd_N > La_N (i.e., rather tholeiitic). Augite was detected by XRD. MgO and TiO_2 are low, but HFSE are relatively high (Zr ~330 ppm, Y ~70 ppm, Nb ~21 ppm). Such Y values are higher than for normal sandstones at RR97-23, which indicates that if there is some dilution by detrital sand, then original Y would have been even higher. Samples from "other mudstones" that show a similar REE pattern are at 53.6 m (126 ppm Y) and 68.5-71.4 m (59-68 ppm Y) in MBR97-32A and 108 m (78 ppm Y) in CH97-10B, but augite was not detected.

Type D. Two samples at 113-114 m near the base of CH97-10B, one of which contains augite in XRD, are exceptional for their low Al_2O_3 content for SiO_2 values of 64-70%. The more mafic sample has 1% MgO. Similar or greater MgO contents are found in six samples below 184.9 m in RR97-23 [?due to dolomite or chlorite] and a similarly high value for MgO is found in a lignite sample near the base of MBR97-32A. Samples at the base of RR97-23 also have unusually low Al_2O_3 content for their SiO_2 values. The lignites at the base of CH97-10B and MBR97-32A contain about 1% TiO_2 and Y contents of 51-94 ppm. The REE patterns for these two lignites are distinctive, with a relatively flat pattern, but much higher La_N than Ce_N. Similar REE patterns are found rarely in MBR97-32A mudstones and lignite Lb from Shubenacadie.

Type E. Lignite samples from 103-122 m in MBR97-32A generally show REE patterns similar to mudstones, with high La/Nd ratios of 1.0 to 1.5. Most of the samples have unusually high TiO_2 (2.5 - 4.5%, compared with a maximum of 2.2% in RR97-23), several have high Nb (35-56 ppm) and Zr (>300 ppm), and several samples lack both quartz and illite in XRD analyses. They also show no augite in XRD.

E1. The SiO_2 content ranges from 50-63%, with the highest TiO_2 in the most silicic sample.

E2. Samples from 108-109 m are a little different: they have SiO_2 contents of 58-63%, but contain some illite and quartz and have TiO_2 of 1.5-2% and low Y, Nb and Zr. The sample at 108.66 m has a highly fractionated REE pattern and consists principally of pyrite. These samples probably have experienced dilution by detrital silt and clay.

E3. Samples from 114-122 m include one sample with no illite and quartz in XRD analyses. The samples are very siliceous (three have 89-91% SiO_2, the other 84%) and Zr contents are extraordinary (600-800 ppm, compared with a maximum of 610 ppm in RR97-23). TiO_2 ranges from 2.3-3.8%, unusually high for such a silicic rock.

In addition to these five inferred types of ash from lignites, some mudstone and sandstone samples show unusual chemical composition that may be a result of a substantial volcanic component. These samples are:

Type 1. One mudstone from RR97-23 at 145.9 m has high REE with little LREE fractionation, quite different from other clays. Y content is high (67 ppm) and SiO_2 content low (65%).

Type 2. In RR-97-23, high Nb (>35 ppm) is found in mudstones at 92.01 and 93.62 m, but their REE plots are not unusual except that total REE are quite high.

Type 3. The three sandstones with the highest LREE (relatively flat REE patterns) in RR-97-23 are 136.3, 142.3 and 142.5 m. The former has unusually high Y (60 ppm) and Nb (35 ppm), but these elements show average values in the two deeper samples.

Type 4. Rarely, there are mudstones with high La and very steep LREE fractionation, notably 94.50 and 138.5 m in RR97-23 (which have high Cr) and 48.64 m in CH97-10B (which does not have other unusual features, except fairly high Zr). The lignite sample at 108.66 m in MBR97-32A is rather similar. These horizons do not correlate with one another and the effect might be due to a detrital silt-sized mineral with very high concentrations of LREE or to scavenging of REE to form diagenetic APS minerals (Pe-Piper and Dolansky, 2005).

Stratigraphic variations in lignite geochemistry

At the base of the Chaswood Formation, at the bottom 10 m of Packet I, type D lignite is found in several cores. Some of the unusual major element geochemical features of these lignites may be the result of diagenesis close to the basal unconformity.

Throughout most of Packet I, type E lignites are abundant in MBR97-32A, and include both mafic and silicic ash input. The most distinctive feature of the ash is high TiO_2 that is difficult to distinguish in normal sediments because of the abundance of detrital ilmenite/rutile. At the extreme top of Packet 1 in RR97-23 is a mudstone with ash-like REE and Y (Type 1 above).

There is little evidence for ash input to Packet II, which was characterized in many areas by uplift and development of paleosols. At the base of this packet in RR97-23 is a sandstone with high Y and LREE (Type 3 above).

In packets III and IV, there is considerable variety in type of lignite, with type B predominating but also types A (L2) and C (L0). In addition, mudstones with high Nb are found in RR97-23 (Type 2 above). There is reasonable correlation between boreholes in the succession of ash types recognised in lignites. This correlation implies that the base of Packet IV at Shubenacadie is erosional and cuts out the L2 and L3 lignite horizons.

The origin of the convex-up REE patterns

The distinctive convex-up REE pattern (Figs. 12, 31) shows higher normalised REE (and Y) abundances than normalised abundances for high-field-strength elements such as Nb, Ta, Hf and Zr (Fig. 31), elements which are relatively stable under sedimentary conditions. This suggests that a sedimentary process might have enriched the lignite in REE. Rather similar enrichment has been described from Carboniferous coal in Kentucky, USA, by Hower et al. (1999). These authors interpreted high abundances of REE and Y as resulting from leaching of volcanic ash and adsorption on organic matter. The REE patterns for the Kentucky coals are different from the Chaswood Formation lignites of types A and B: they resemble types D and E with considerable LREE fractionation, but little variation in normalised HREE abundance.

The relative abundance of the REE (including Y) in types A and B lignites resembles that found by Spear and Pyle (2002) in the mineral monazite, which has enrichment in REE of 10^5 - 10^6 times chondrites. Monazite is present in sandstones of the upper member of the Chaswood Formation (Packet IV) (Pe-Piper et al. 2005b) and in the Belmont locality detrital monazite is highly corroded and leached (Pe-Piper et al. 2005c). This suggests that REE leached from detrital monazite might be adsorbed on organic matter in lignite. The very low P content of the lignites indicates that the REE enrichment is not a consequence of diagenetic or hydrothermal monazite in the lignites. Furthermore, no correlation was found between Y or REE content and any carbonate or sulphate minerals identified by X-ray diffraction. The abundance of Y and REE decreases stratigraphically downwards, which may indicate that their enrichment is stratigraphically controlled and related to leaching from sandstones of Packet IV. An order-of-magnitude calculation suggests that monazite is present in sufficiently low abundance in sandstones of Packet IV that 10^3 to 10^4 m thickness of sandstone would need to be completely leached to supply sufficient REE and Y to lignites with high Y enrichment.

Spidergrams of elements normalised to primitive mantle (Fig. 31) show very coherent behaviour of the elements Nb, Ta, Hf and Zr, with very similar degrees of relative enrichment in a single sample. This suggests that high values of these elements are not controlled by the precipitation of niobates or tantalates.

Source of volcanic ash

The general geochemical character of the lignites suggests that the ash was sourced in mafic to felsic subalkaline volcanoes, with the potential for moderate enrichment in Nb, Ta, Hf, Zr and Ti. The New England -Quebec igneous province, now eroded to the sub-volcanic level, appears to be an unlikely source, given the high Ta and Hf contents reported from many of the rocks (Eby 1984, 1985). Rather, there are close similarities in absolute and relative abundances of Nb, Ta, Hf, Zr and Ti between the Chaswood Formation lignites and the Lower Cretaceous volcanic rocks of the Orpheus graben and the SW Grand Banks (Fig. 32) that is strikingly different from the normal mudstones of the Chaswood Formation. The Albian volcanic rocks of the Orpheus graben (including Scatarie Bank, Twillick and Emerillon) (Fig. 33a) also most closely resemble the type A and B lignites in having rather little fractionation of the LREE and greater fractionation of the HREE, although the mafic rocks analysed do not show a significant Eu anomaly. The Valanginian to Barremian volcanic rocks of Brant and Mallard more closely resemble types D and E lignites in their REE patterns (Fig. 33b). with LREE fractionation and more uniform normalised abundances of the HREE. The strongly alkaline subvolcanic intrusions of the Monteregian Hills have more highly fractionated LREE and Nb is much more highly enriched than Y.

It has been suggested that paleowinds in the Cretaceous at the latitude of Nova Scotia were likely monsoonal from the SW (Herrle et al. 2003). However, Orpheus graben and the southwestern Grand Banks appear more important as a source of ash, rather than the more alkaline rocks of the New England - Quebec igneous province or Baltimore Canyon and Georges Bank.

Stratigraphic variations in lignite geochemistry

At the base of the Chaswood Formation, in the bottom 10 m of Packet I, type D lignite is found in several boreholes. Some of the unusual major element geochemical features of these lignites may be the result of diagenesis close to the basal unconformity.

Throughout most of Packet I, type E lignites are abundant in borehole MBR97-32A and include both mafic and silicic ash input. The most distinctive feature of the ash is high TiO_2 that is difficult to distinguish in normal sediment because of the abundance of detrital ilmenite/rutile. At the extreme top of Packet I in borehole RR97-23 is a mudstone with ash-like REE and Y

(Type 1 above).

There is little evidence for ash input to Packet II, which was characterised in may areas by uplift and development of paleosols. At the base of this packet in borehole RR97-23 is a sandstone with high LREE and Y (Type 3 above).

In packets III and IV, there is considerable variety in type of lignite, with type B predominating, but also types A (L2) and C (L0). In addition, mudstones with high Nb are found in borehole RR97-23 (Type 2 above). There is reasonable correlation between boreholes in the succession of ash types recognised in lignites. This correlation implies that the base of Packet IV at Shubenacadie is erosional and cuts out the L2 and L3 lignite horizons.

The predominance of type D and E lignite in Packet I (lower member of the Chaswood Formation) and of types A and B in Packets III and IV (middle and upper members of the Chaswood Formation) might be a consequence of a change in volcanic source from the Valanginian - Barremian volcanoes of the SW Grand Banks to the Albian volcanoes of the Orpheus graben. However, we cannot rule out that the distinctive REE patterns in Packets III and IV might result from leaching of monazite from overlying sandstones.

The amount of volcanic ash in the Scotian basin

Some 50% of the lignite samples examined appear to have little or no detrital input. The total stratigraphic section represented by such lignite is perhaps 5 m. Assuming an average of 15-20 wt % organic carbon, this corresponds to a total of 4 m of volcanic ash, distributed over the typically 100 - 150 m thick Chaswood Formation section. It is likely that a similar amount of volcanic ash fell on the offshore Scotian basin, where the corresponding stratigraphic section is commonly 1-2 km thick. In addition, rivers would have transported reworked ash to the Scotian basin. Estimating the hinterland drainage area to be four times the area of the main depocentre, the equivalent thickness of reworked ash in the Scotian basin might be in the range of 10-20 m. Whether such amounts of ash are significant for the diagenesis of the Cretaceous rocks of the Scotian basin is unknown.

Conclusions

Mineralogical and geochemical data from lignites of the Chaswood Formation shows evidence for volcanic ash in many lignites. Such evidence includes different Nb, Ta, Hf, Zr and Ti abundances compared with normal detrital mudstones, and the presence of augite, talc, and euhedral quartz. Some lignites have a terrigenous fraction similar to that in interbedded mudstones. Samples with least detrital terrigenous sediment have bulk compositions suggesting sources ranging from mafic to felsic and the trace elements indicate a sub-alkaline character, most closely matched by the Lower Cretaceous volcanic rocks of the southwestern Grand Banks and Orpheus graben.

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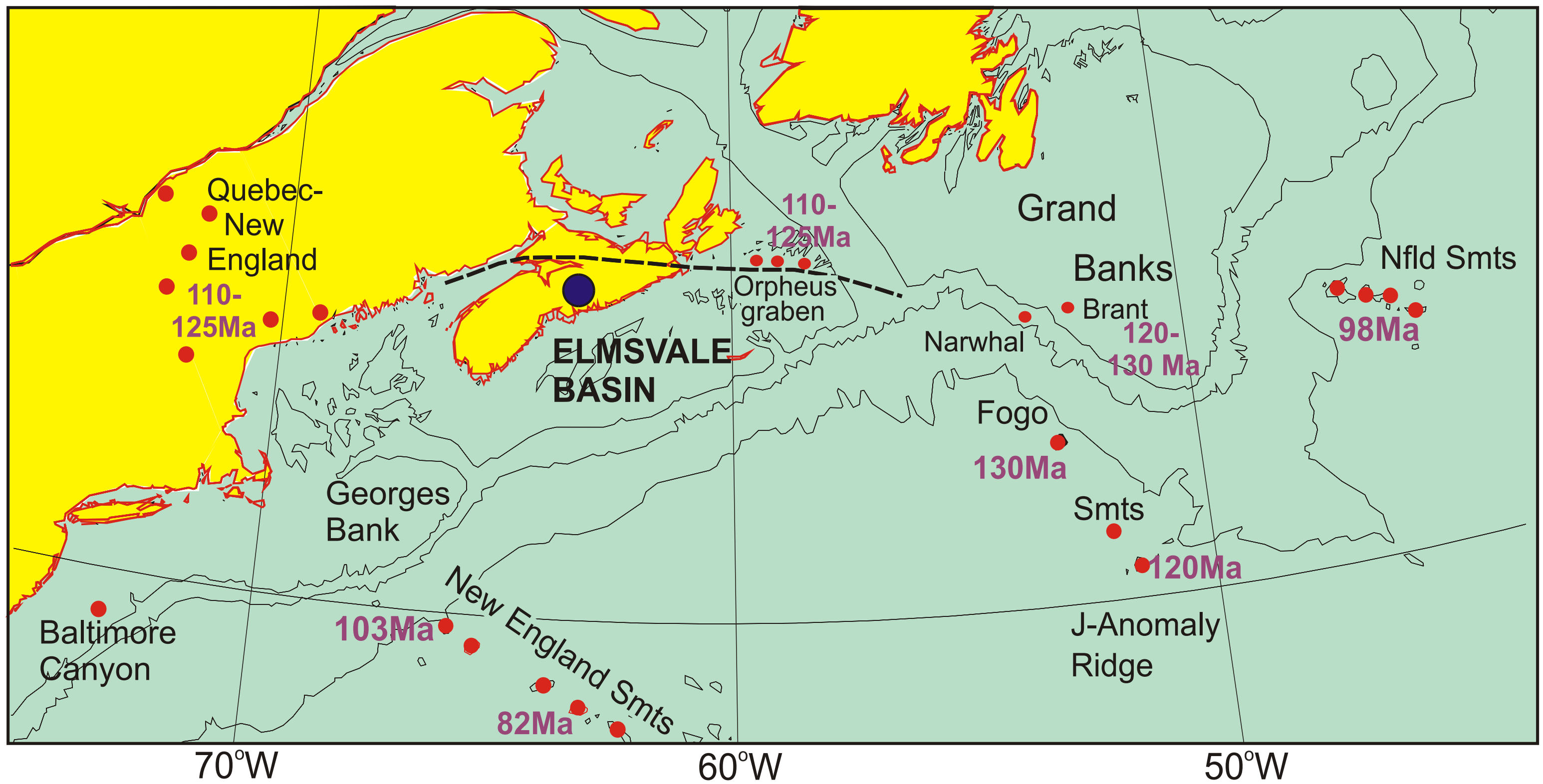


Figure 1: Regional location map showing distribution and ages of Lower Cretaceous volcanic rocks in Atlantic Canada and New England. (Based on Pe-Piper et al. 1990).

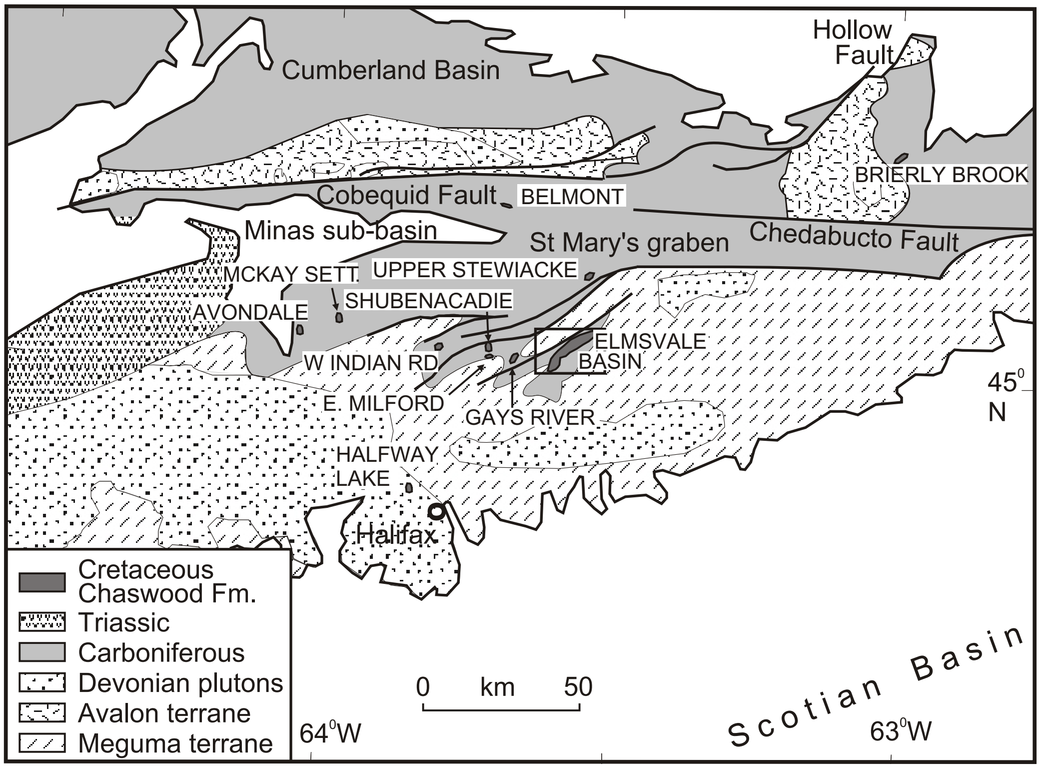


Figure 2: Geological map of central Nova Scotia showing occurrences of the Chaswood Formation.

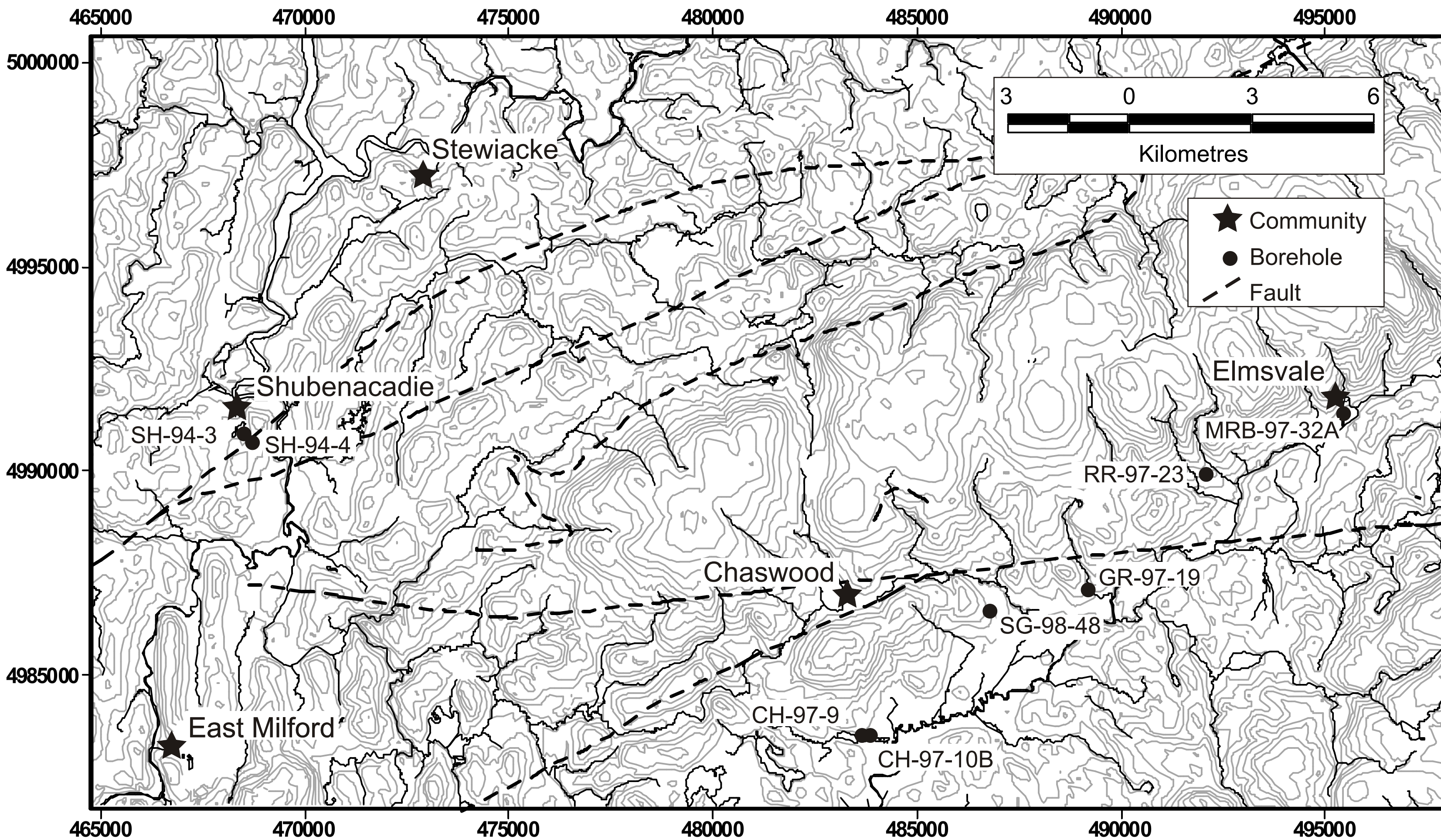


Figure 3: Map showing location of boreholes from which lignite was sampled. Also shows the location of reference borehole RR-97-23.

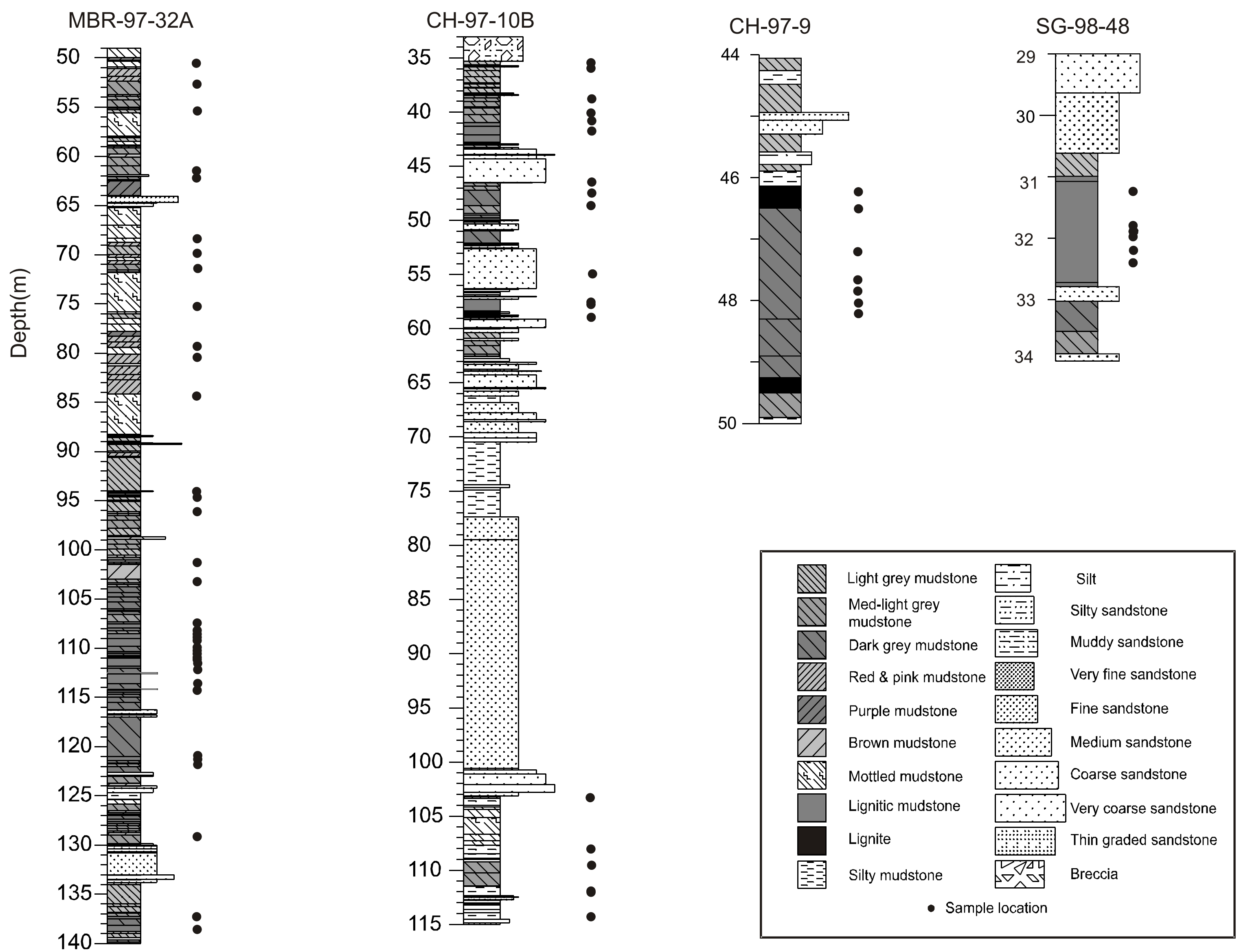


Figure 4: Detailed borehole logs showing location of samples.

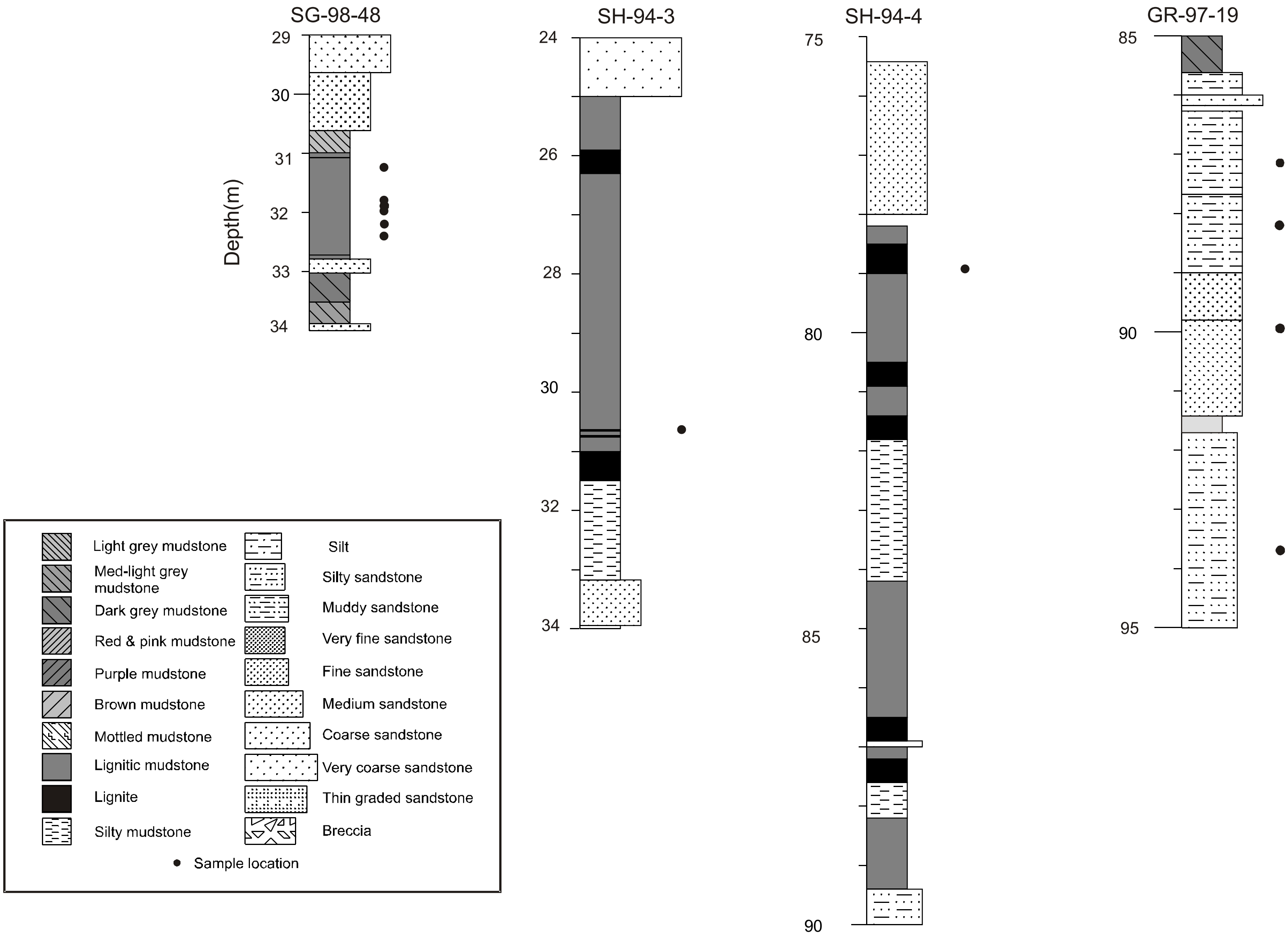


Figure 4(continued): Detailed borehole logs showing location of samples.

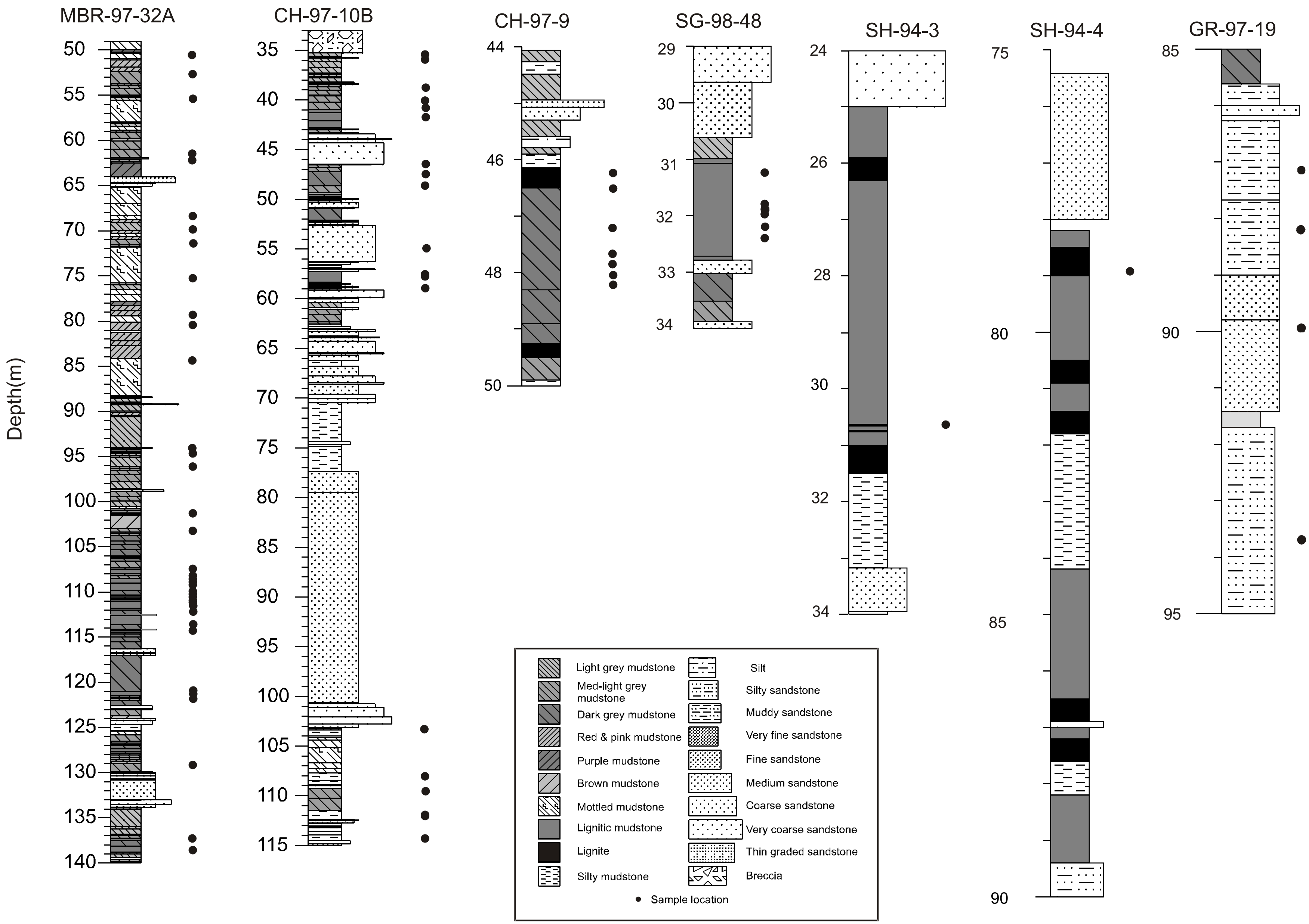


Figure 4(continued): Detailed borehole logs showing location of samples.

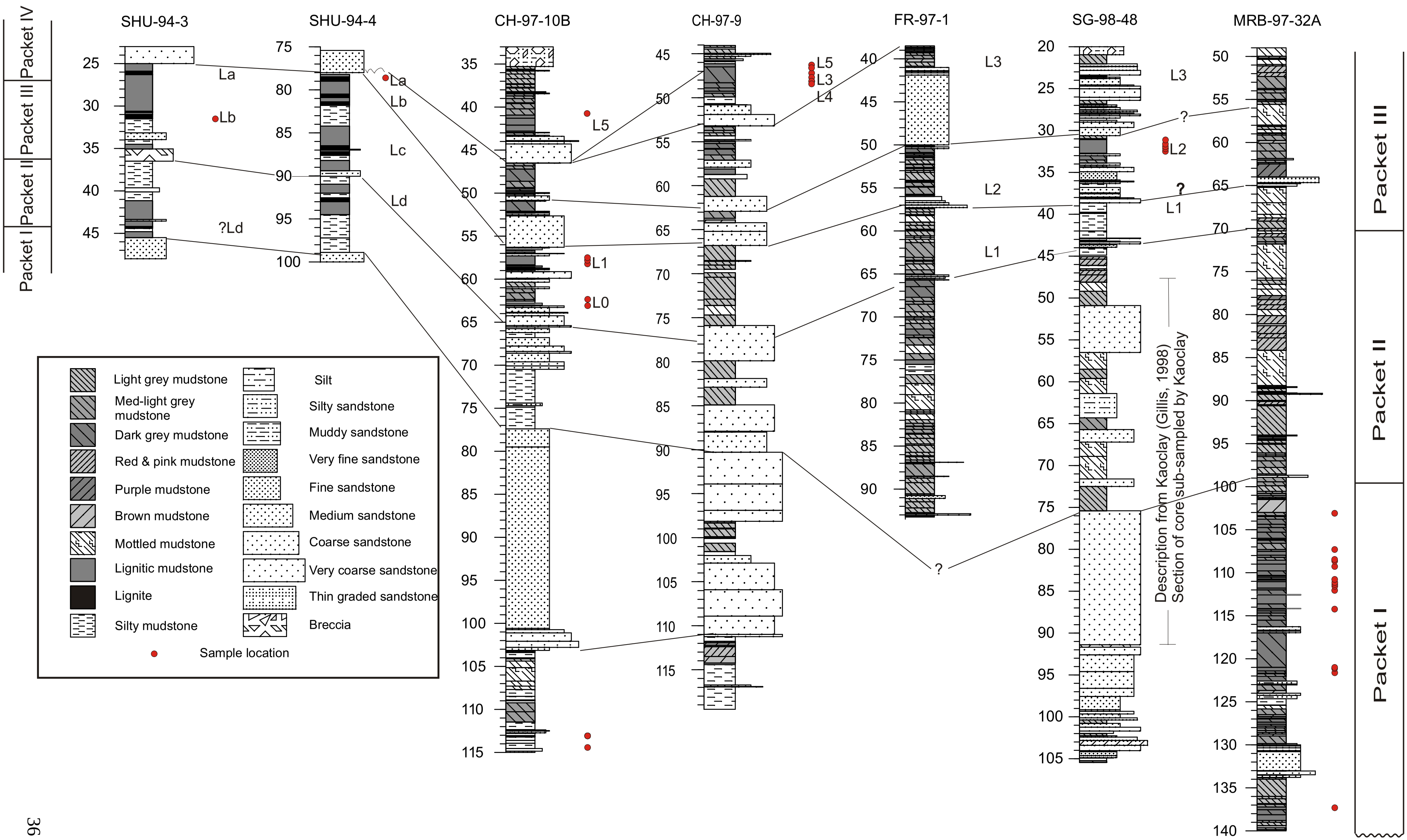


Figure 5: Stratigraphic sections from the studied boreholes, showing stratigraphic correlation after Piper et al. (2005). L1-L5 and La-Ld are correlatable beds or packets of beds of lignite.

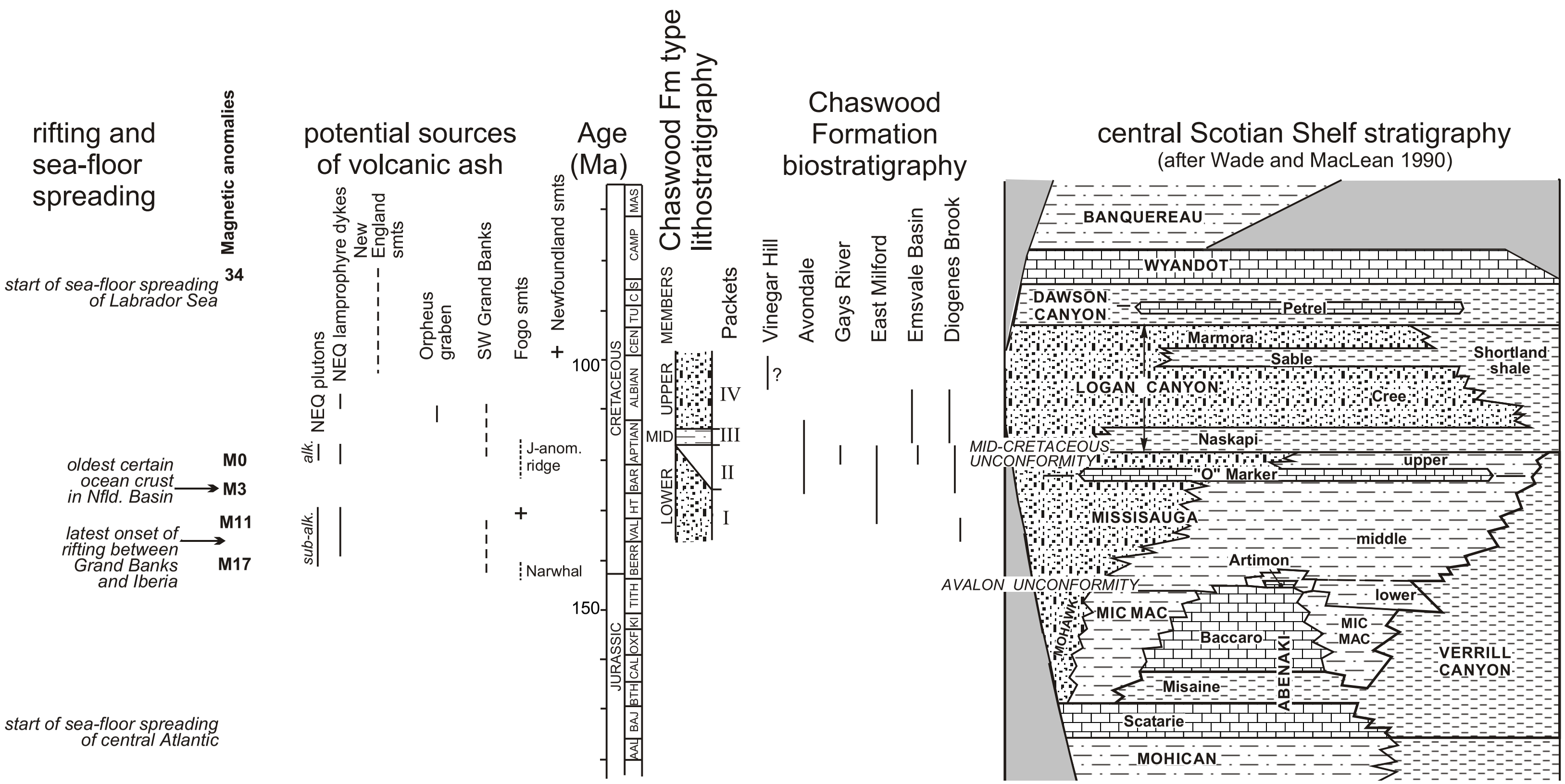


Figure 6: Summary of chronology of volcanic rocks in Atlantic Canada and New England, compared with the likely age of Chaswood Formation.

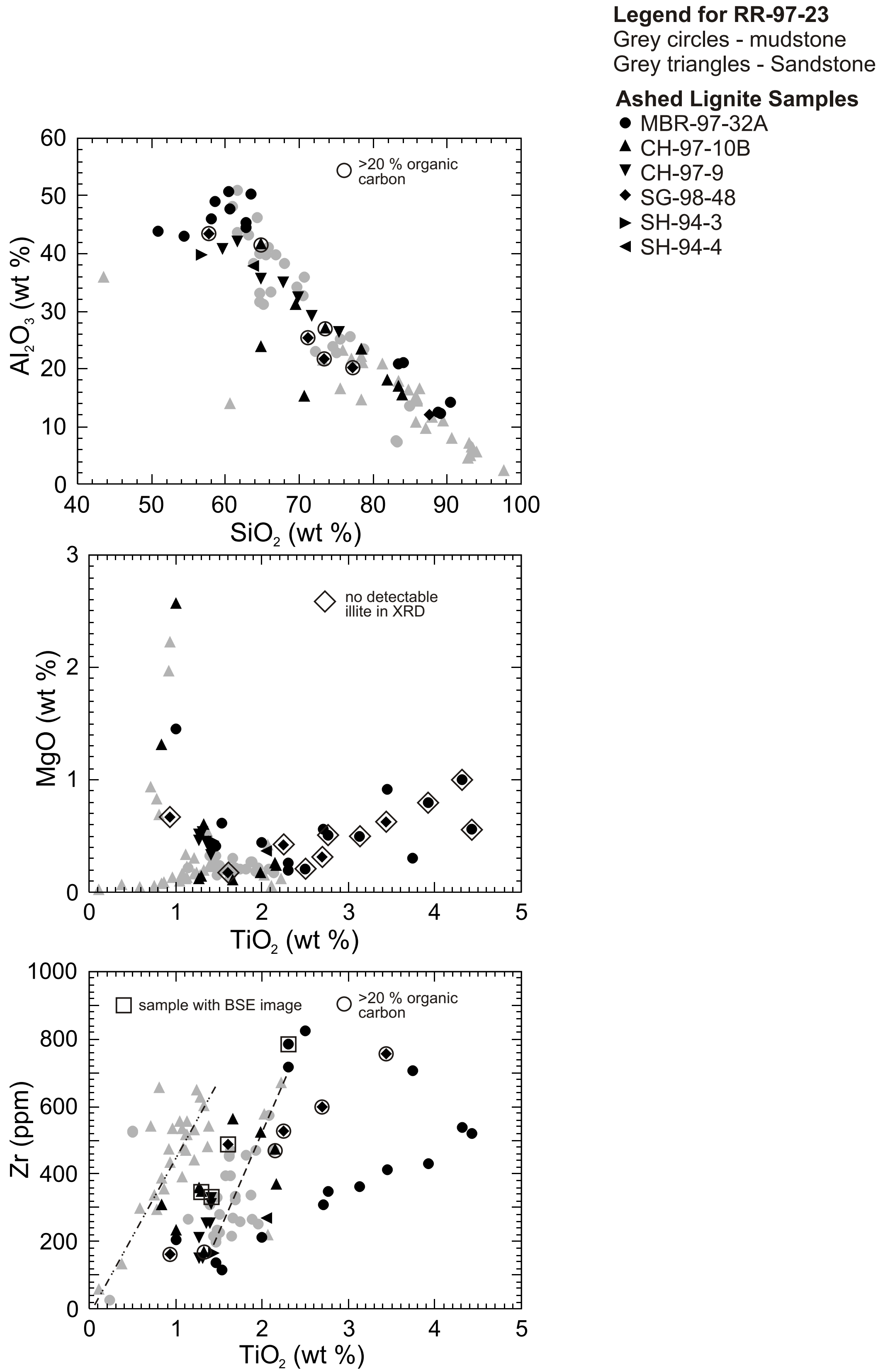


Figure 7: Whole rock geochemistry of ashed lignite samples compared with analyses from “normal” mudstone and sandstone in borehole RR-97-23 (grey circle-mudstone; grey triangles-sandstone).

MBR-97-32A

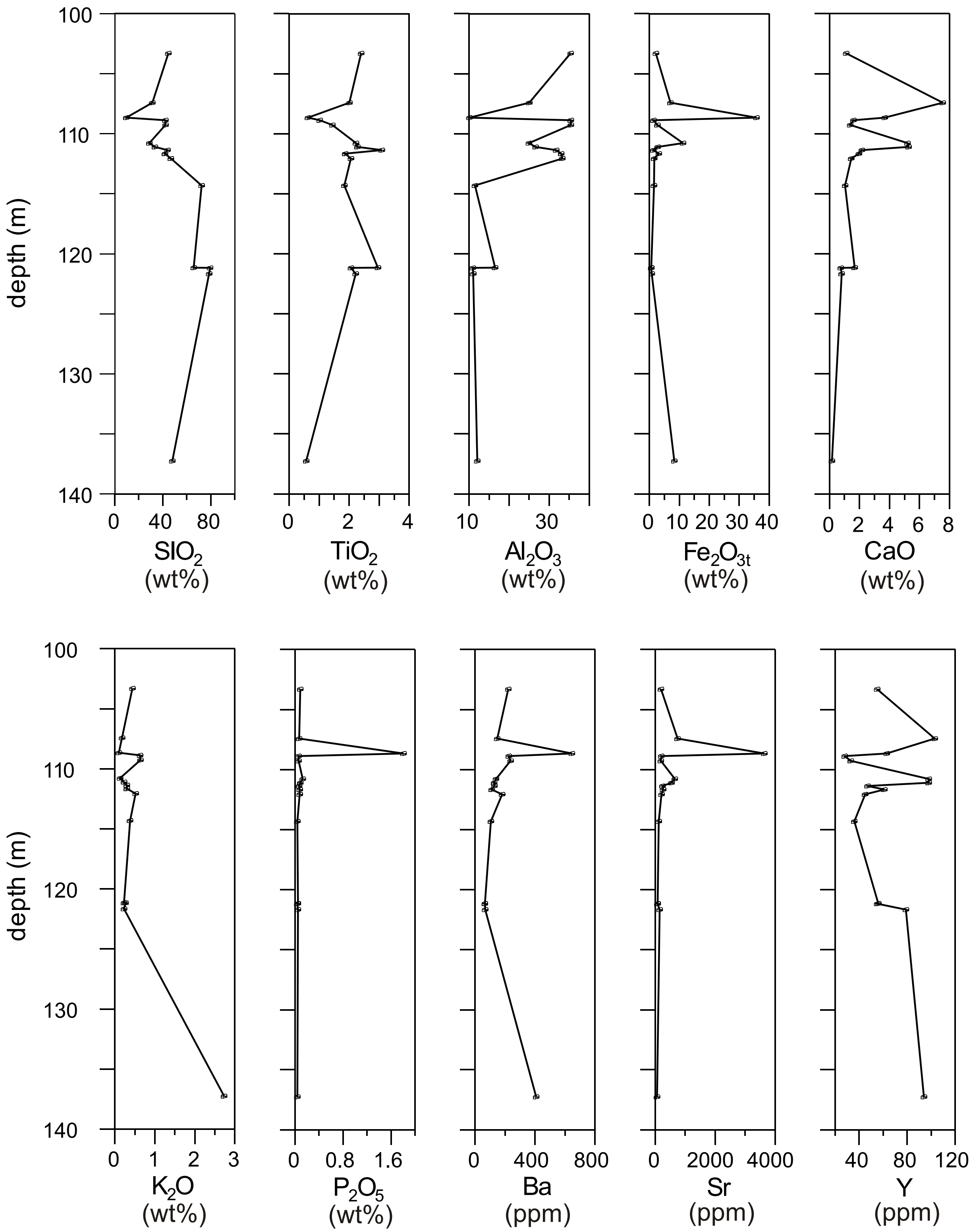
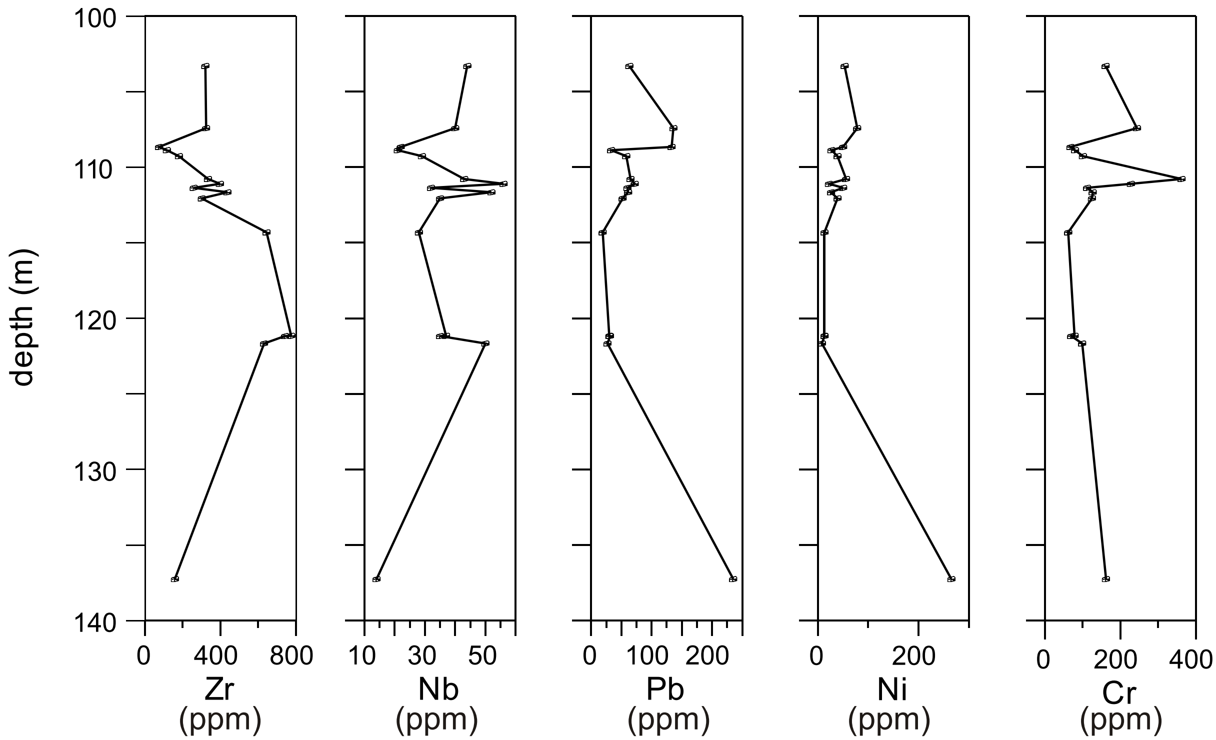


Figure 8: Downhole variation in selected major and trace elements in ashed samples from borehole MBR-97-32A.

MBR-97-32A



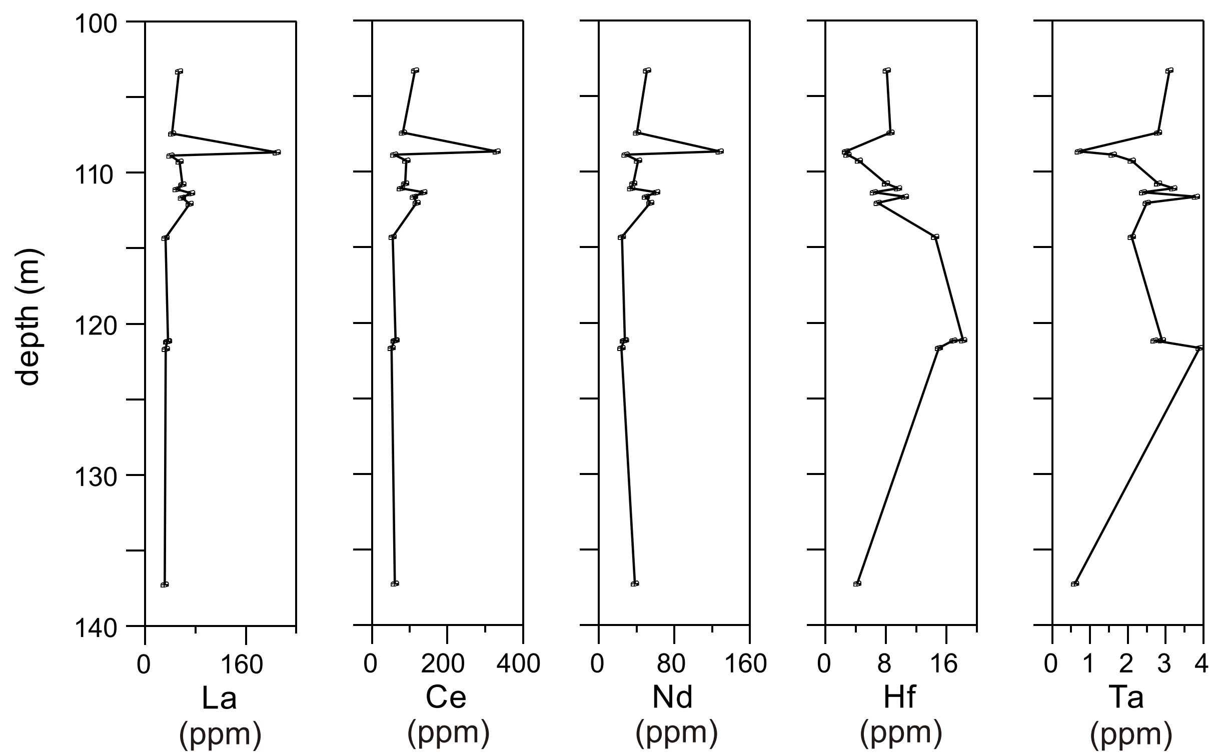


Figure 8(continued): Downhole variation in selected major and trace elements in ashed samples from borehole MBR-97-32A.

MBR-97-32A

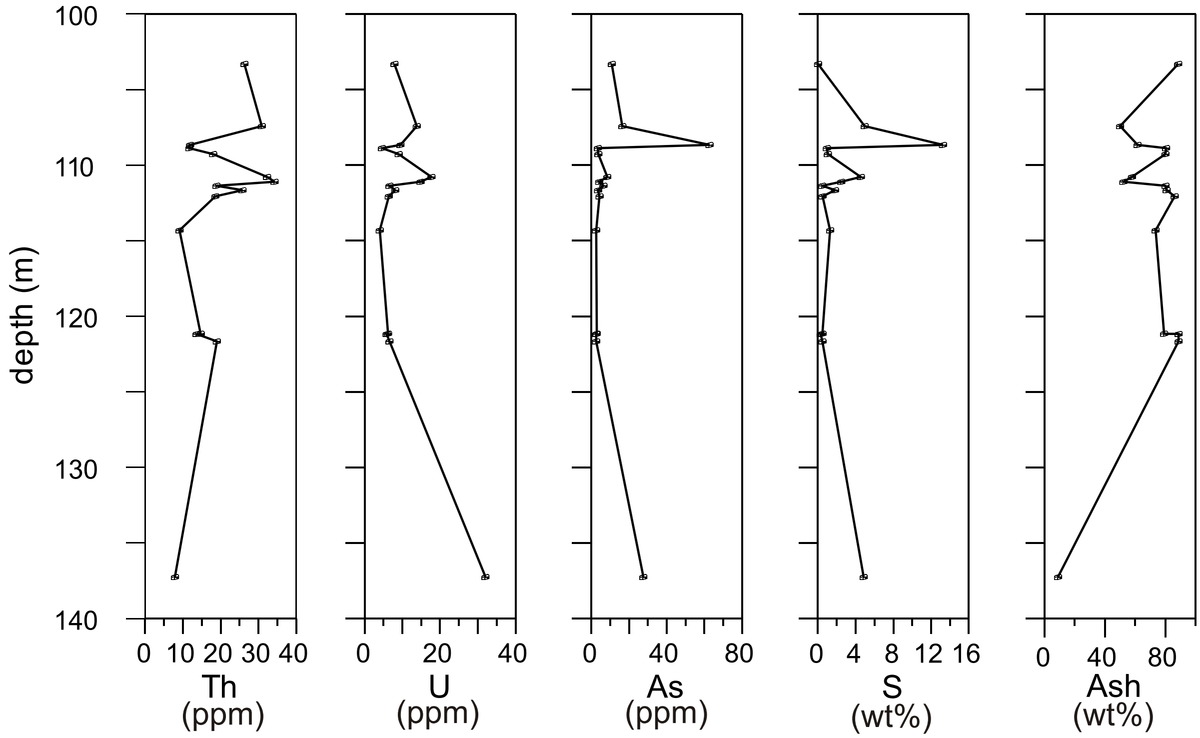


Figure 8(continued): Downhole variation in selected major and trace elements in ashed samples from borehole MBR-97-32A.

CH-97-10B

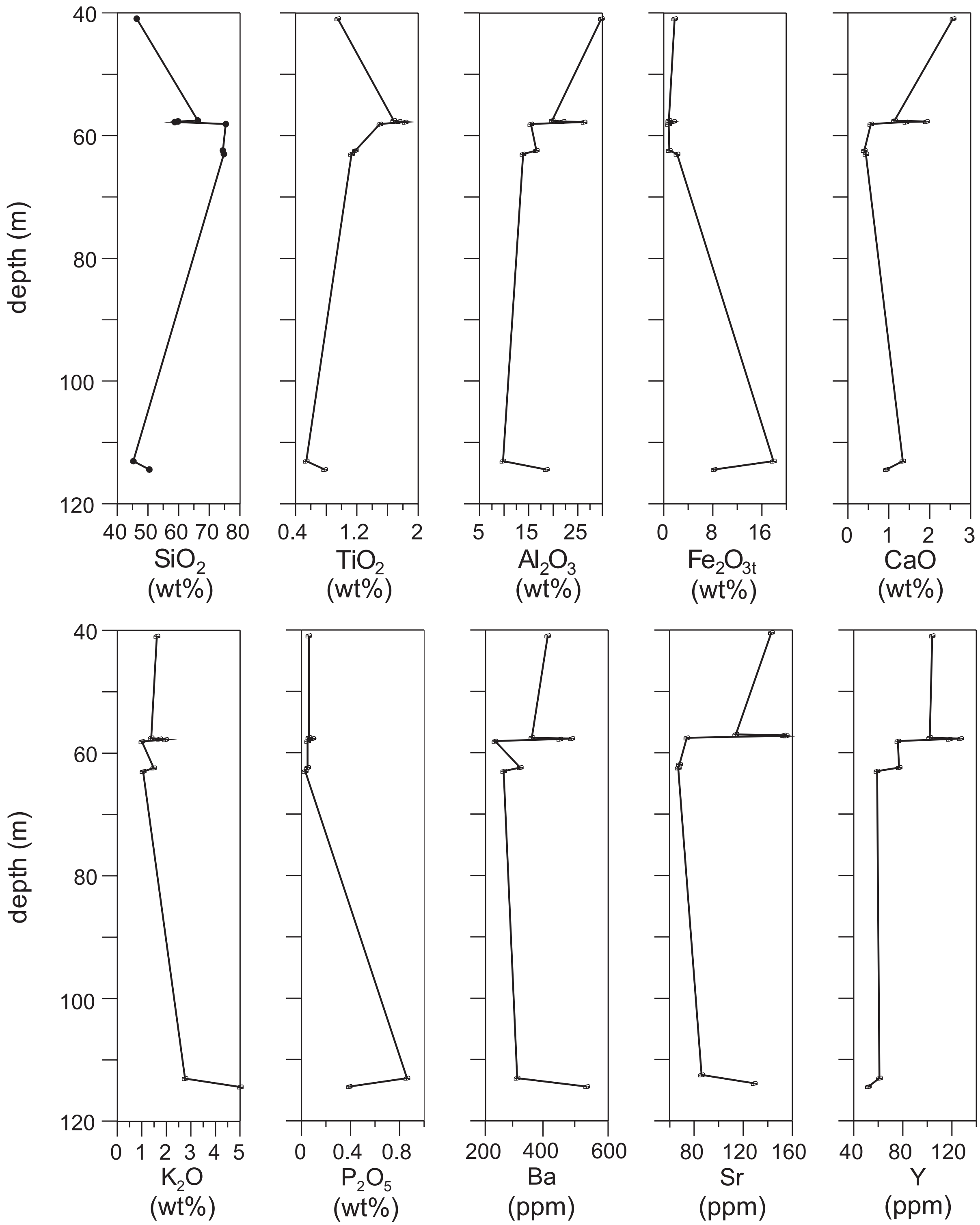


Figure 9: Downhole variation in selected major and trace elements in ashed samples from borehole CH-97-10B.

CH-97-10B

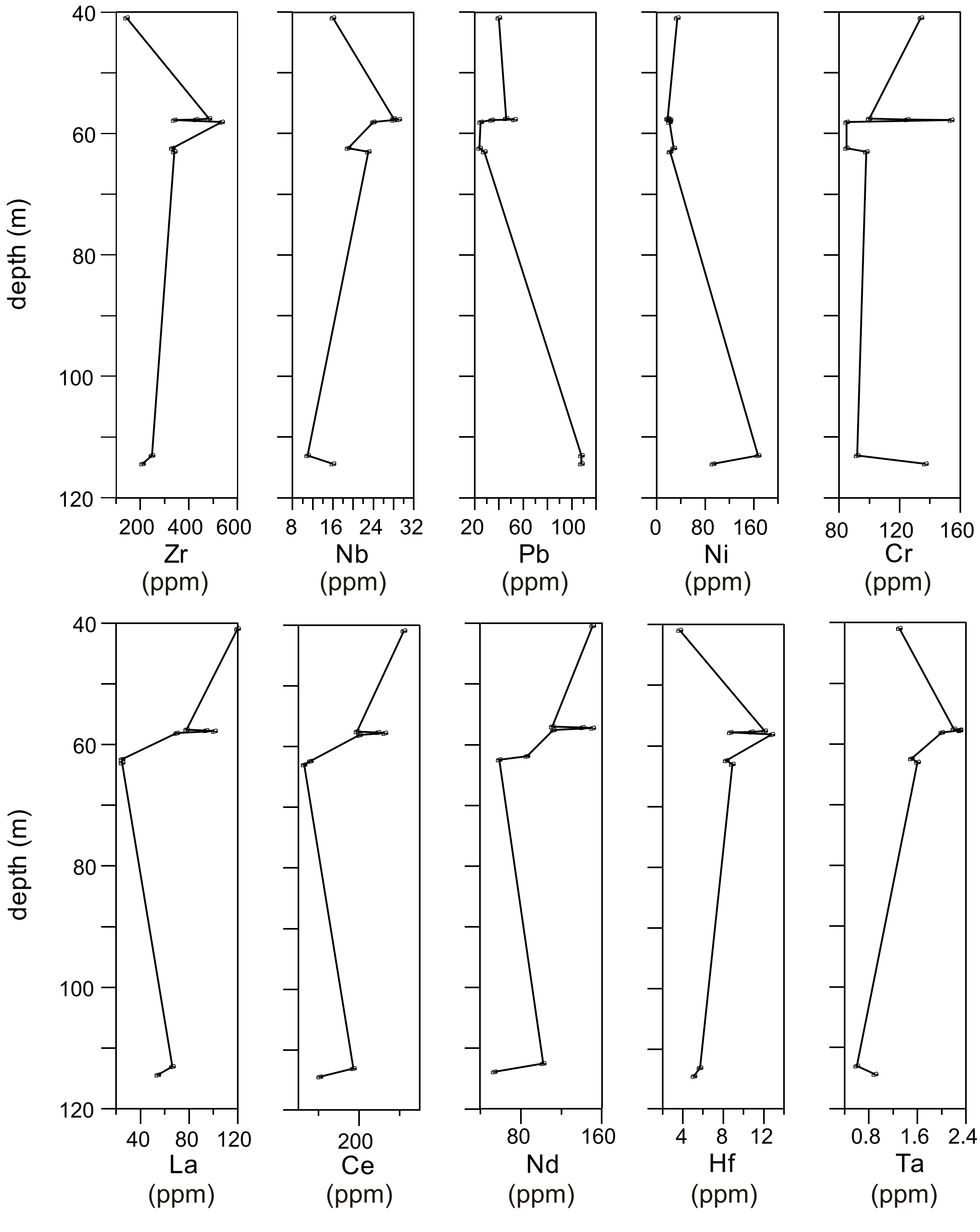


Figure 9(continued): Downhole variation in selected major and trace elements in ashed samples from borehole CH-97-10B.

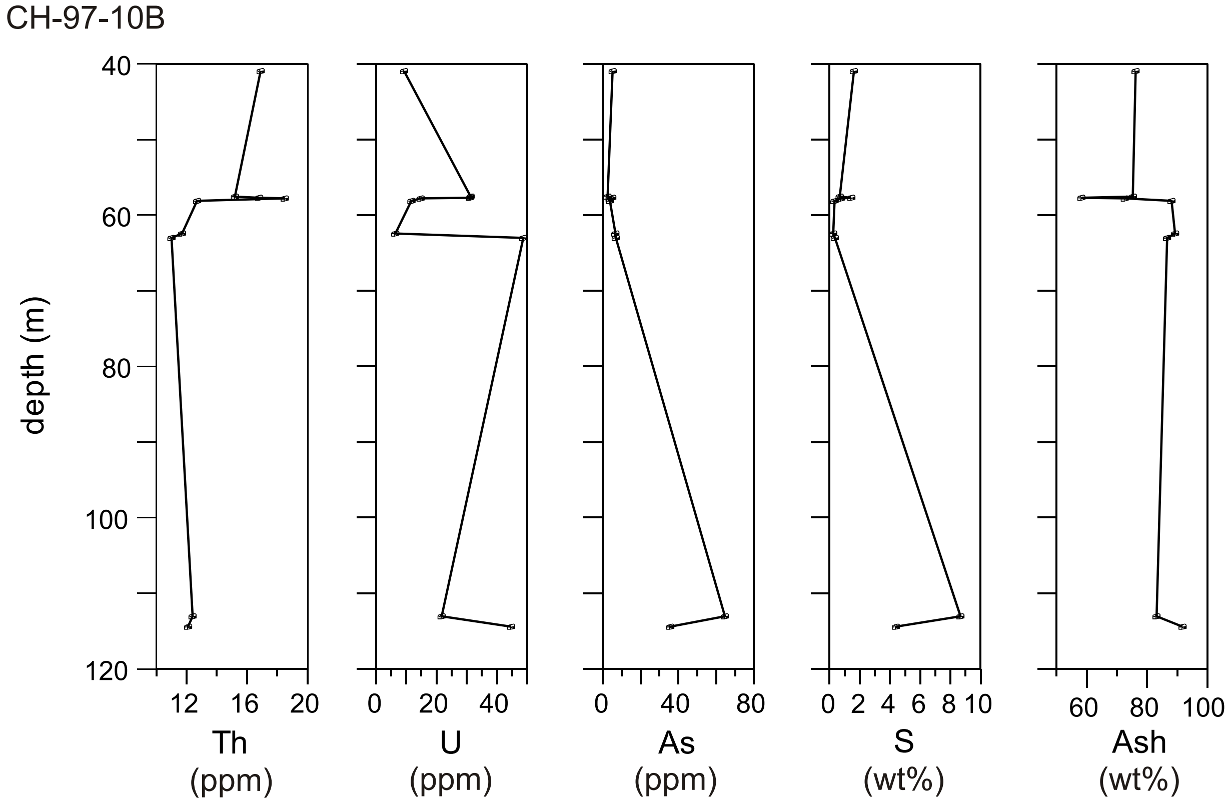


Figure 9(continued): Downhole variation in selected major and trace elements in ashed samples from borehole CH-97-10B.

CH-97-9

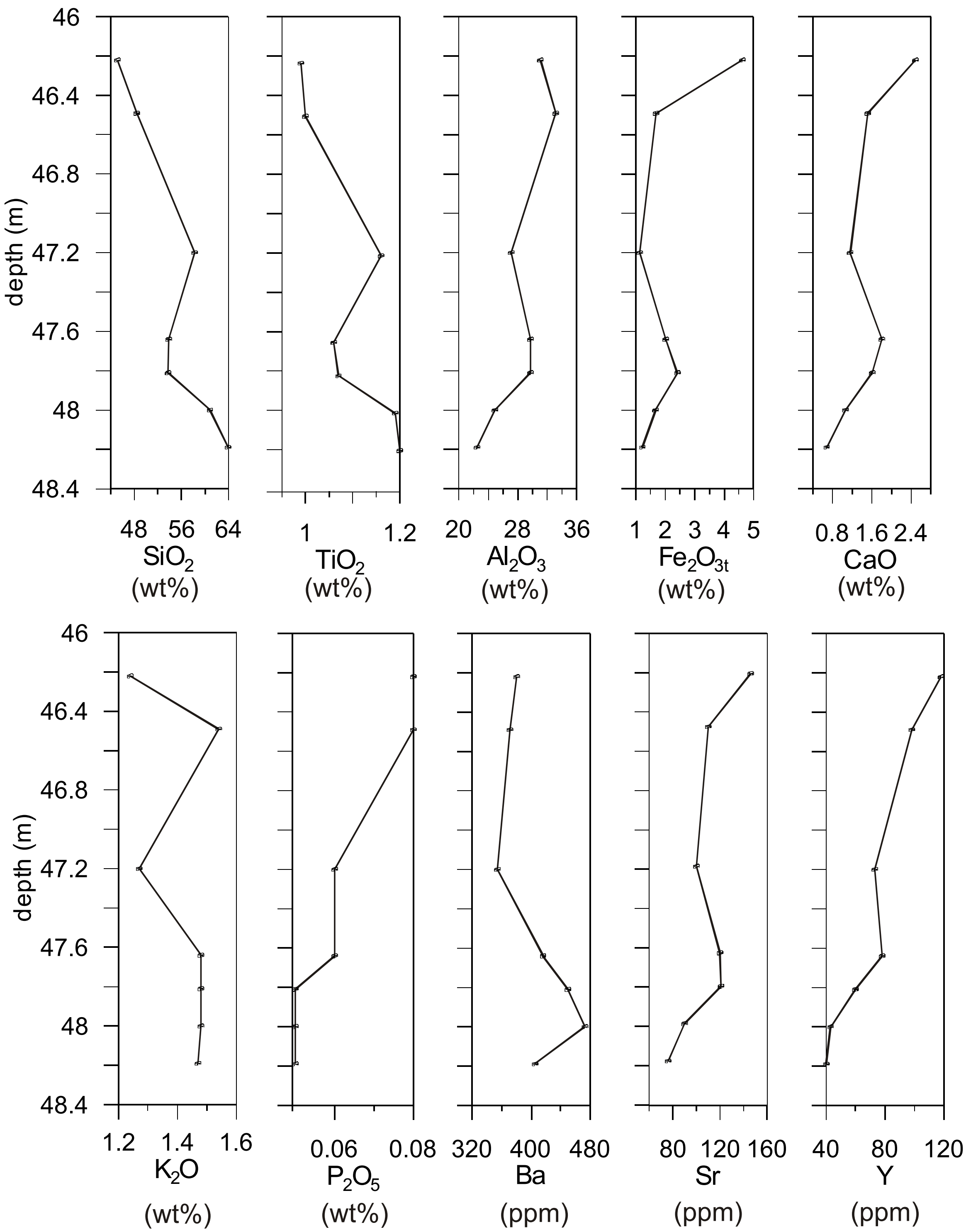


Figure 10: Downhole variation in selected major and trace elements in ashed samples from borehole CH-97-9.

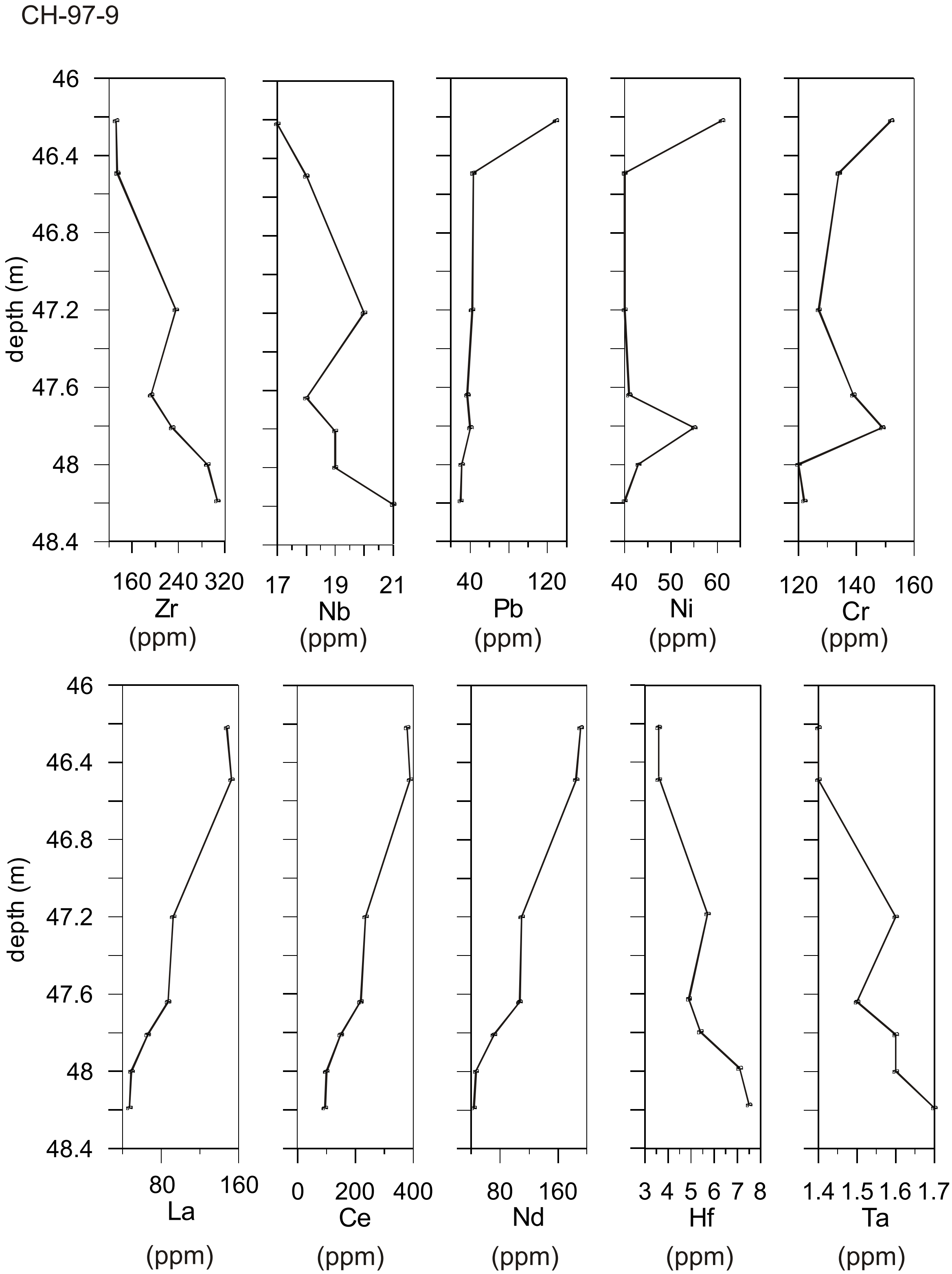


Figure 10(continued): Downhole variation in selected major and trace elements in ashed samples from borehole CH-97-9.

CH-97-9

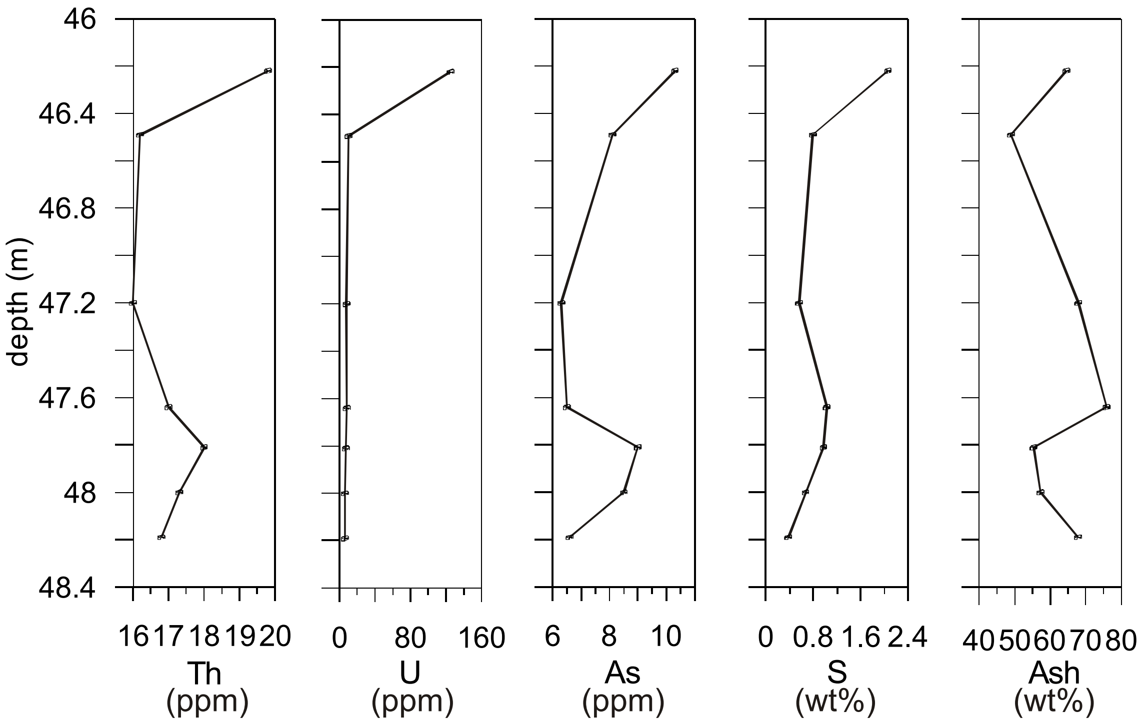


Figure 10(continued): Downhole variation in selected major and trace elements in ashed samples from borehole CH-97-9.

SG-98-48

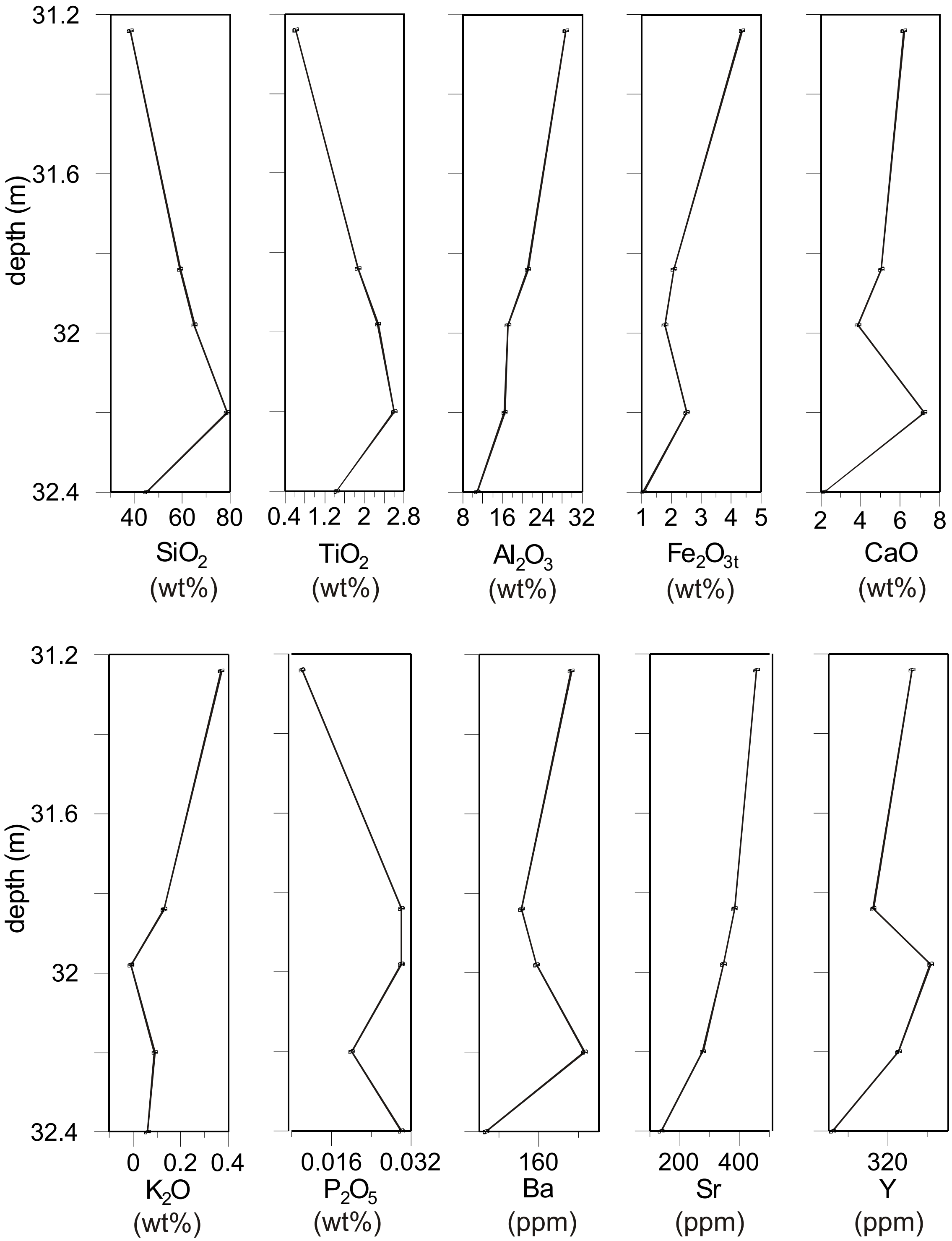


Figure 11: Downhole variation in selected major and trace elements in ashed samples from borehole SG-98-48.

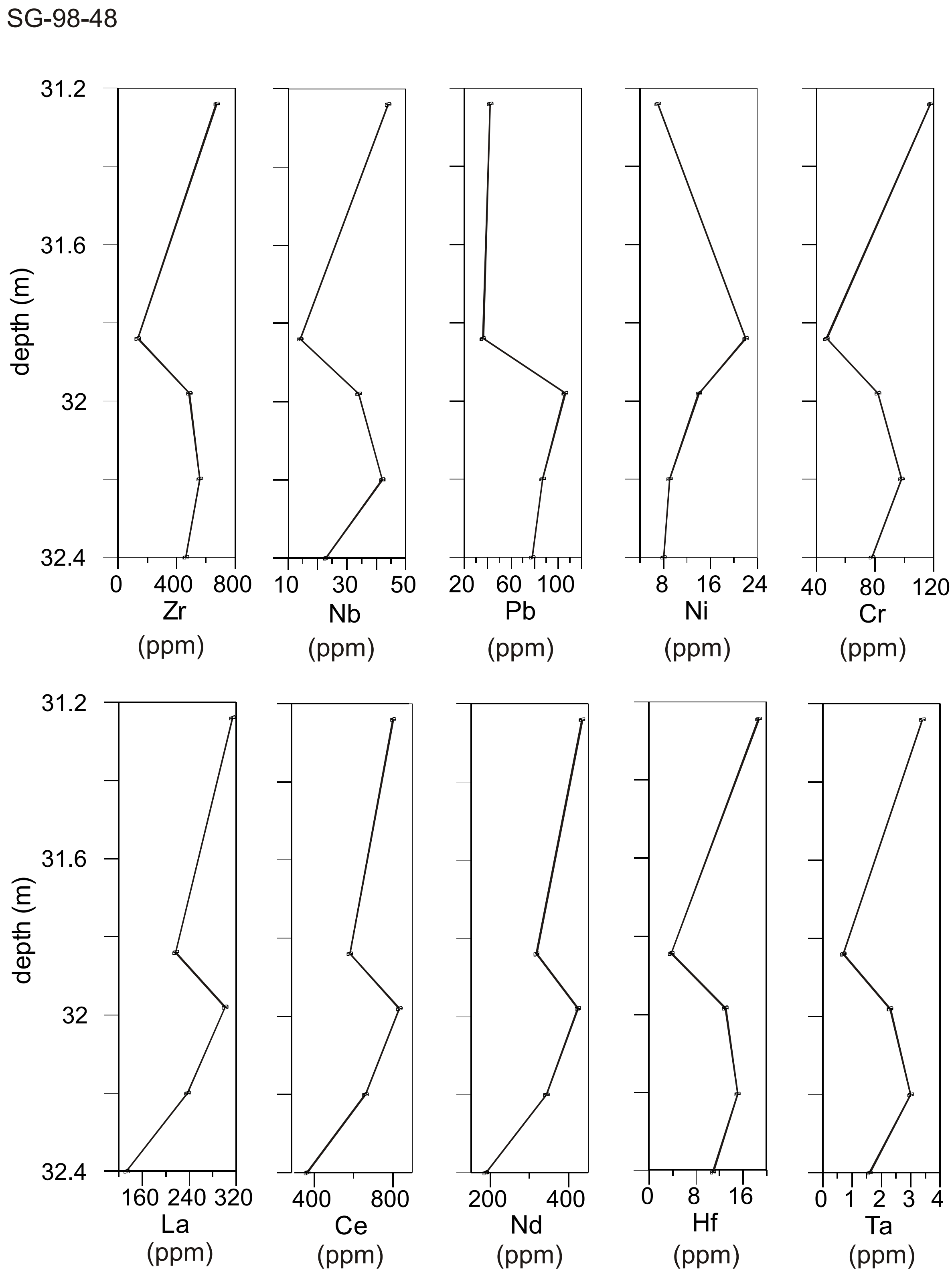


Figure 11(continued): Downhole variation in selected major and trace elements in ashed samples from borehole SG-98-48.

SG-98-48

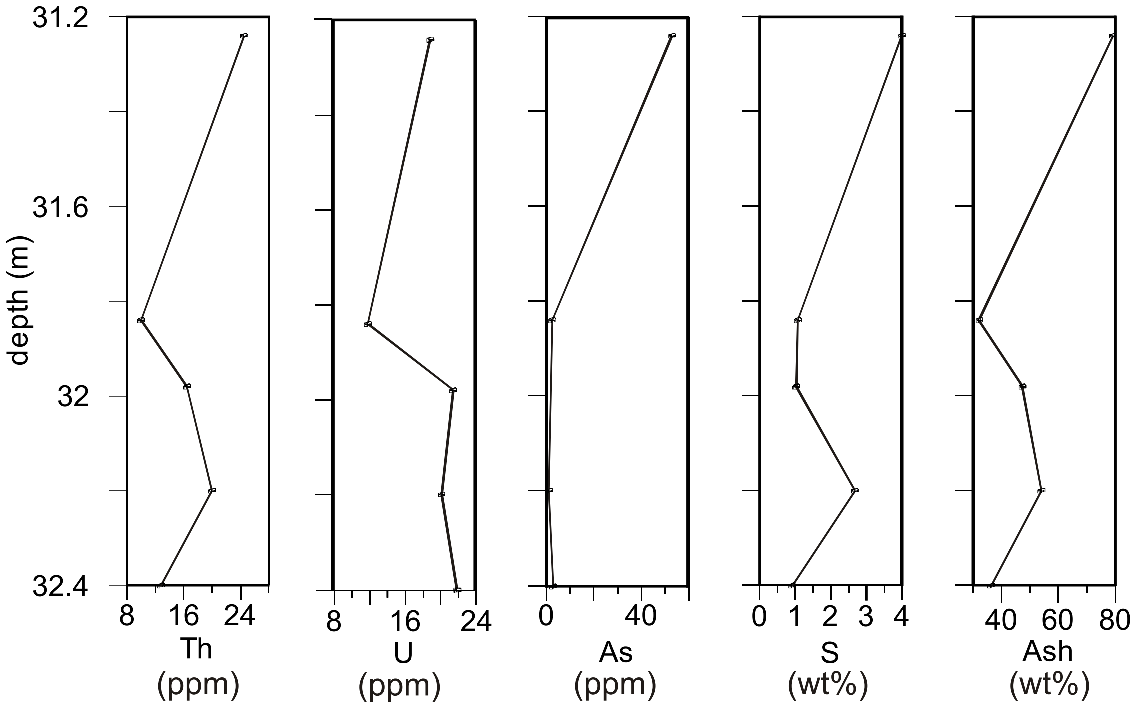


Figure 11(continued): Downhole variation in selected major and trace elements in ashed samples from borehole SG-98-48.

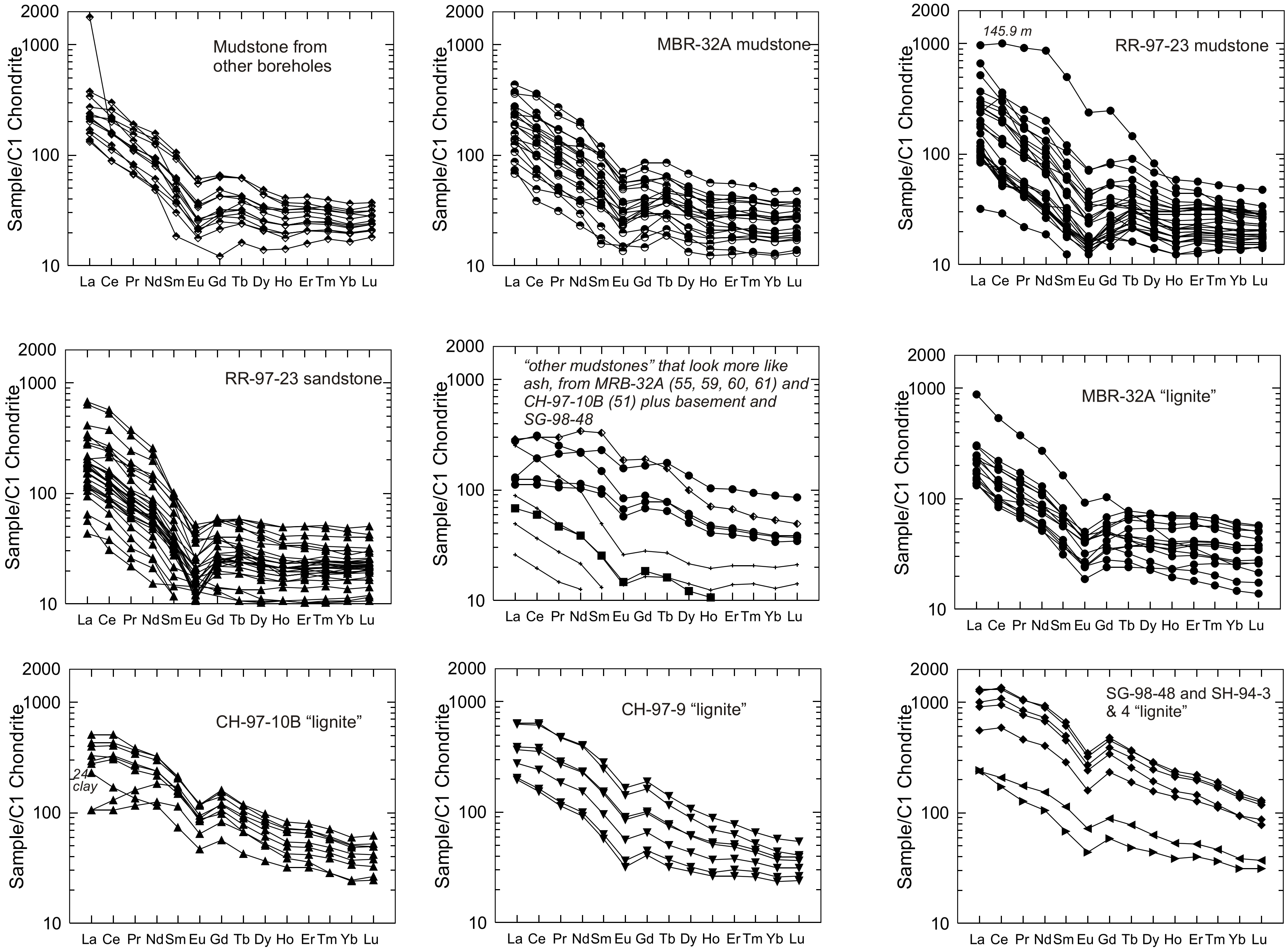


Figure 12: REE patterns in the sedimentary rocks of the Chaswood Formation.

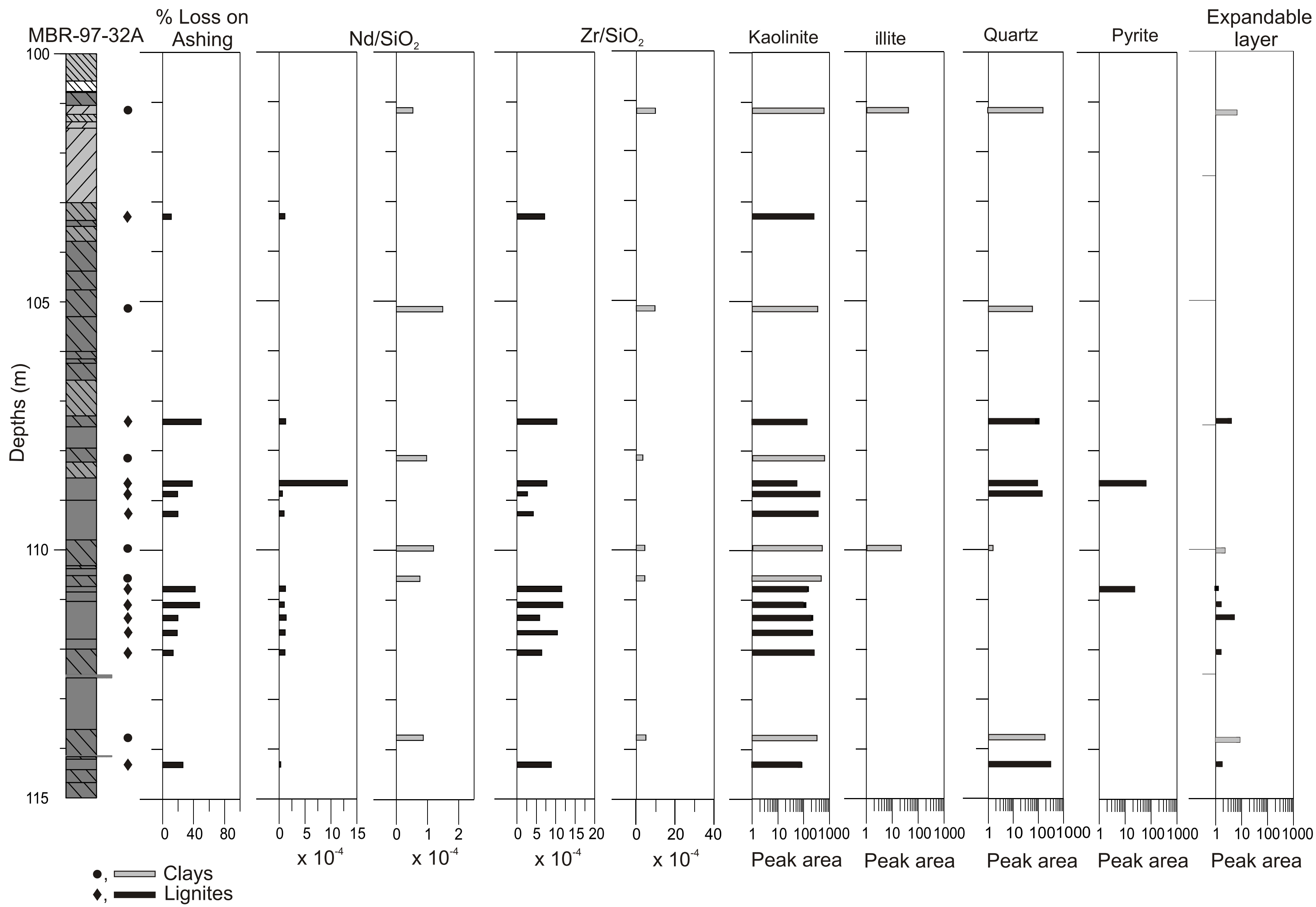


Figure 13: Downhole variation in selected geochemical and mineralogical characteristics of borehole MBR-97-32A. Lithology patterns as in Figure 4.

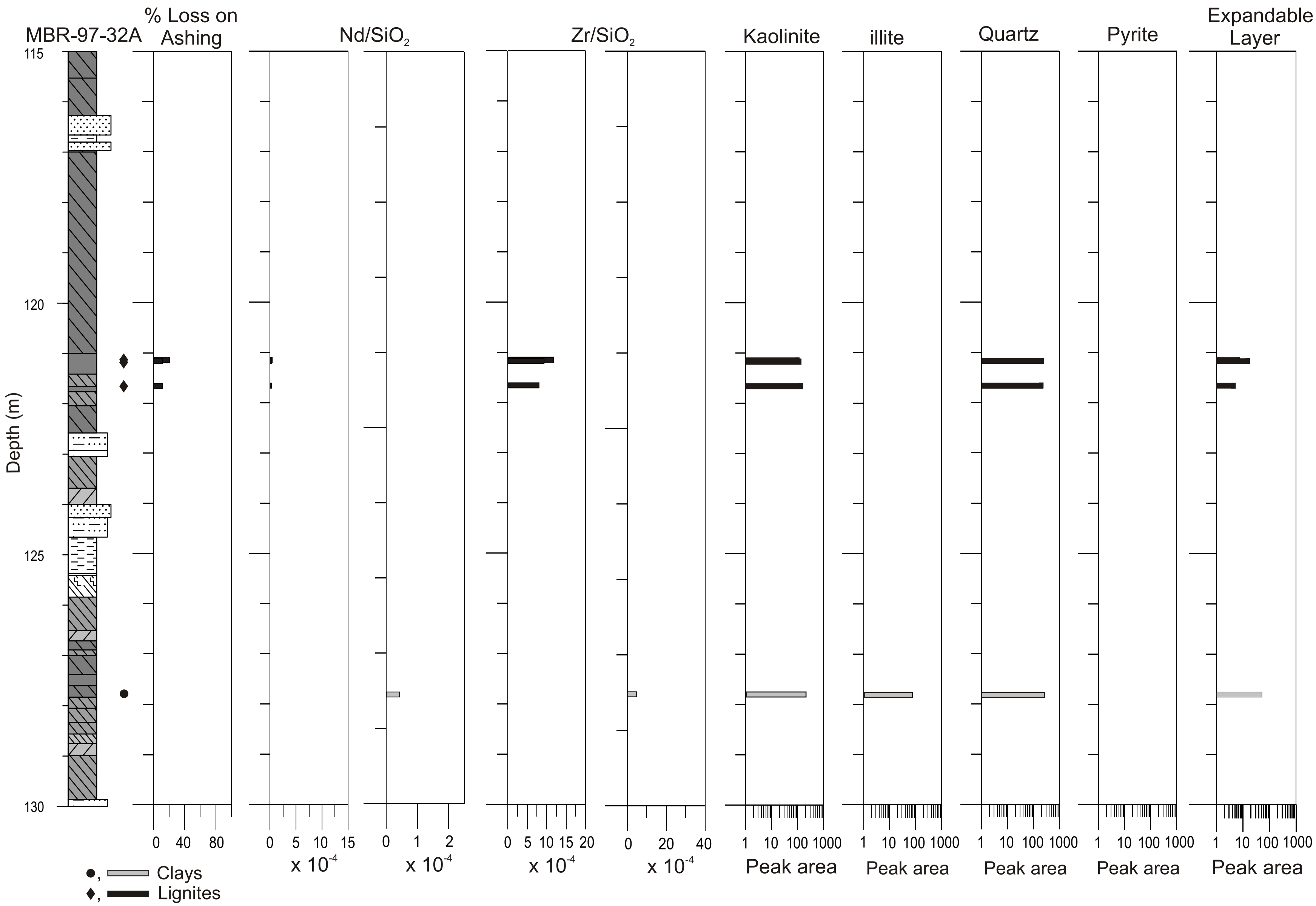


Figure 13(continued): Downhole variation in selected geochemical and mineralogical characteristics of borehole MBR-97-32A.

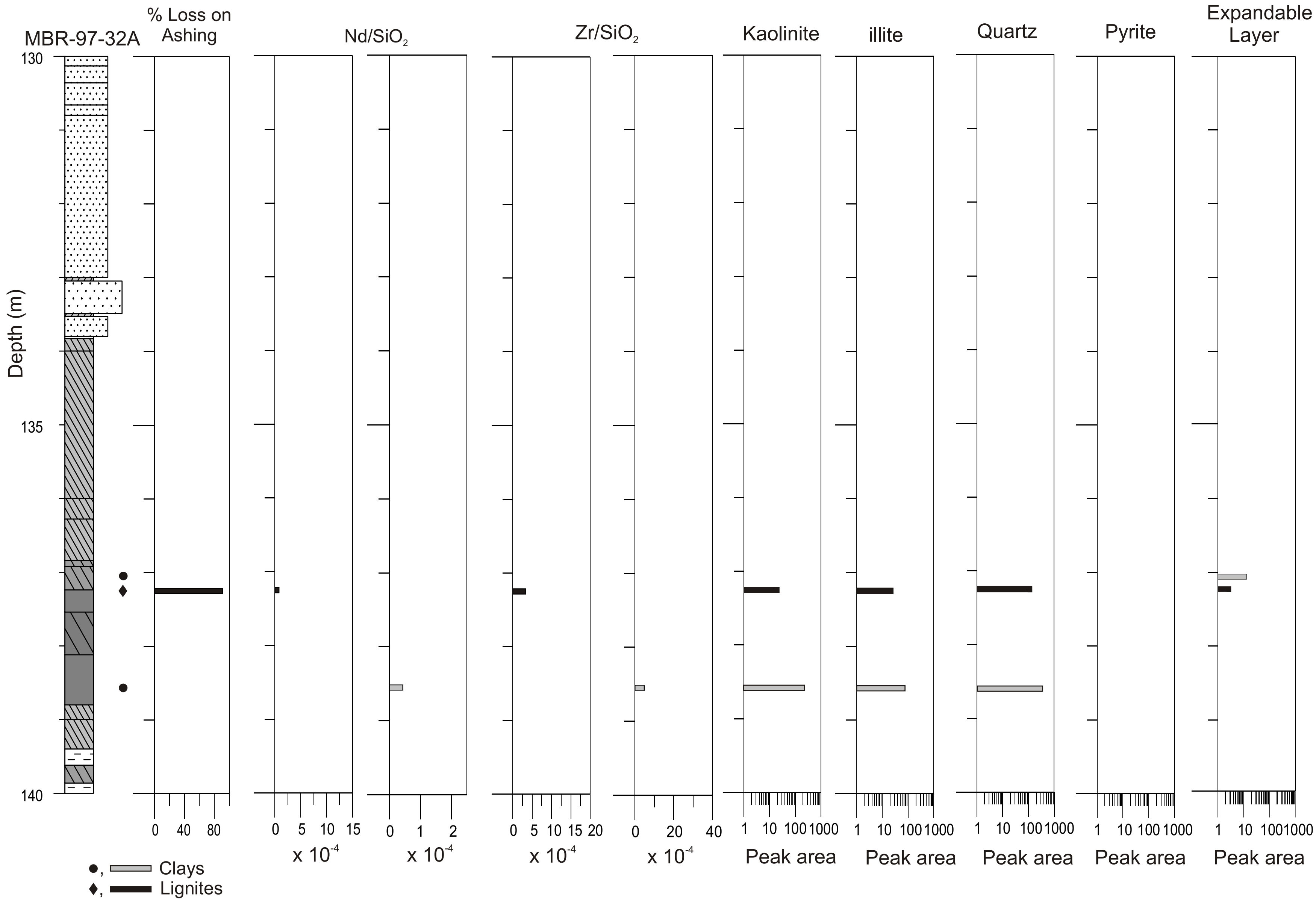


Figure 13(continued): Downhole variation in selected geochemical and mineralogical characteristics of borehole MBR-97-32A.

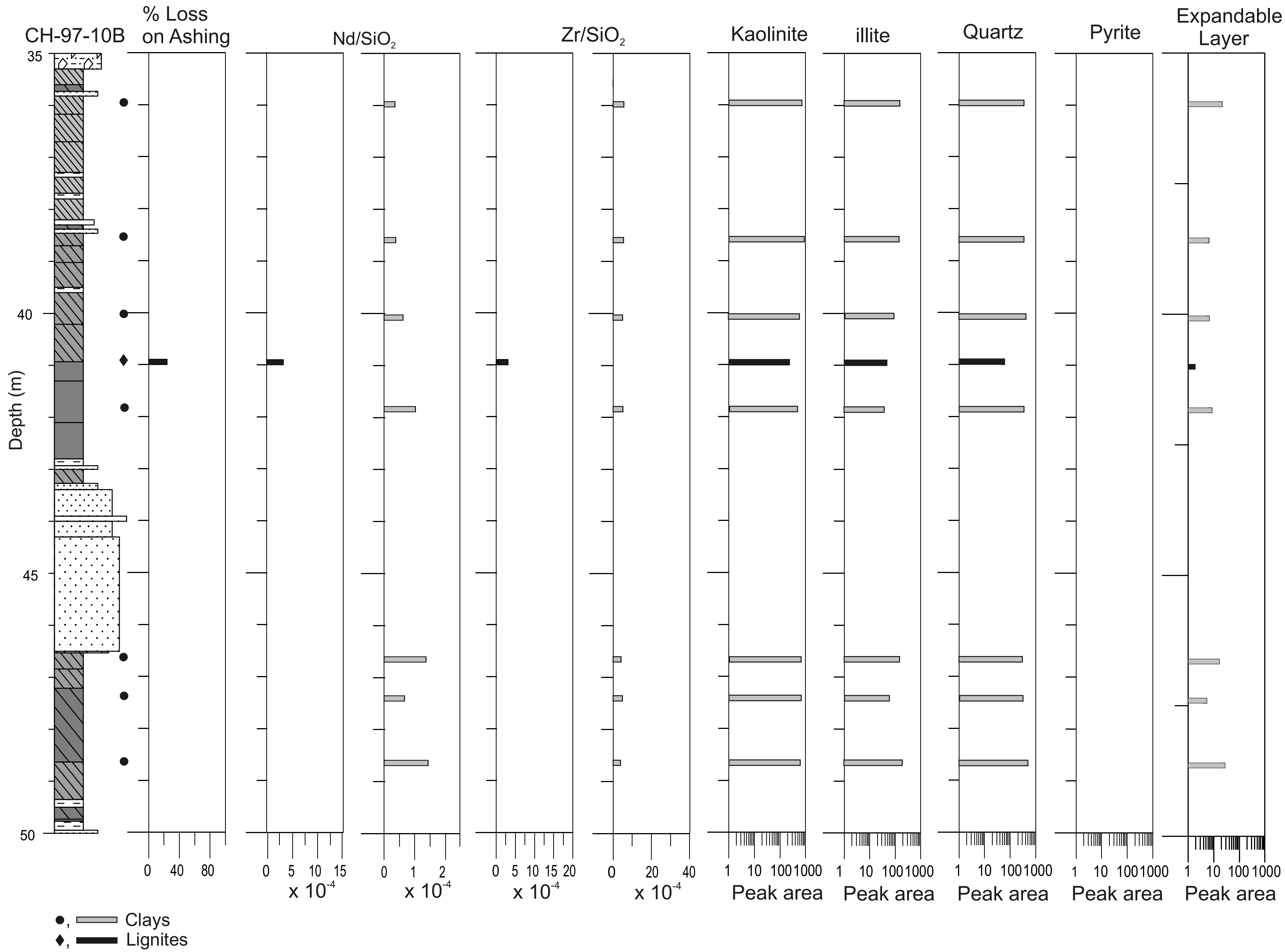


Figure 14: Downhole variation in selected geochemical and mineralogical characteristics of borehole CH-97-10B.

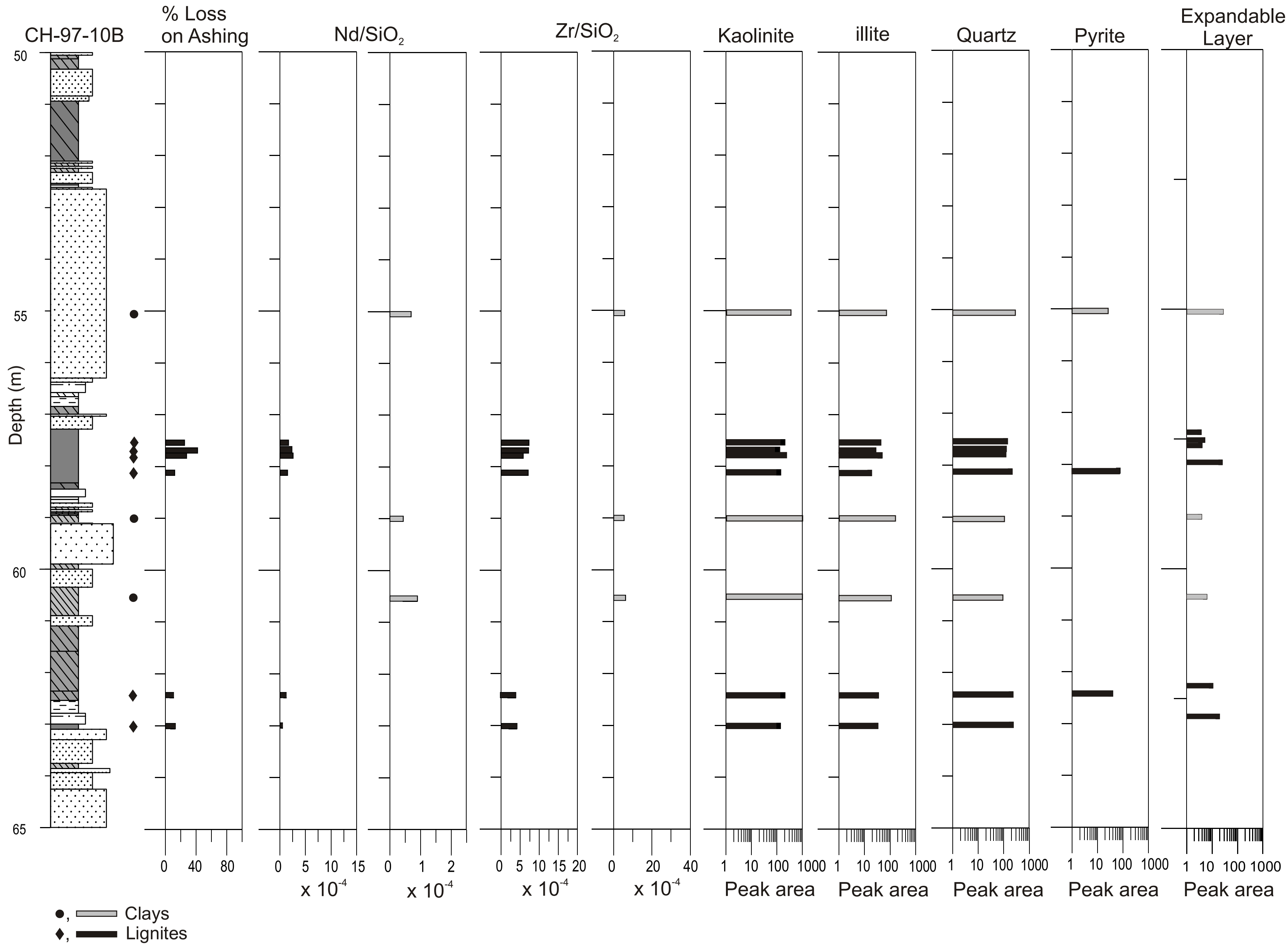


Figure 14(continued): Downhole variation in selected geochemical and mineralogical characteristics of borehole CH-97-10B.

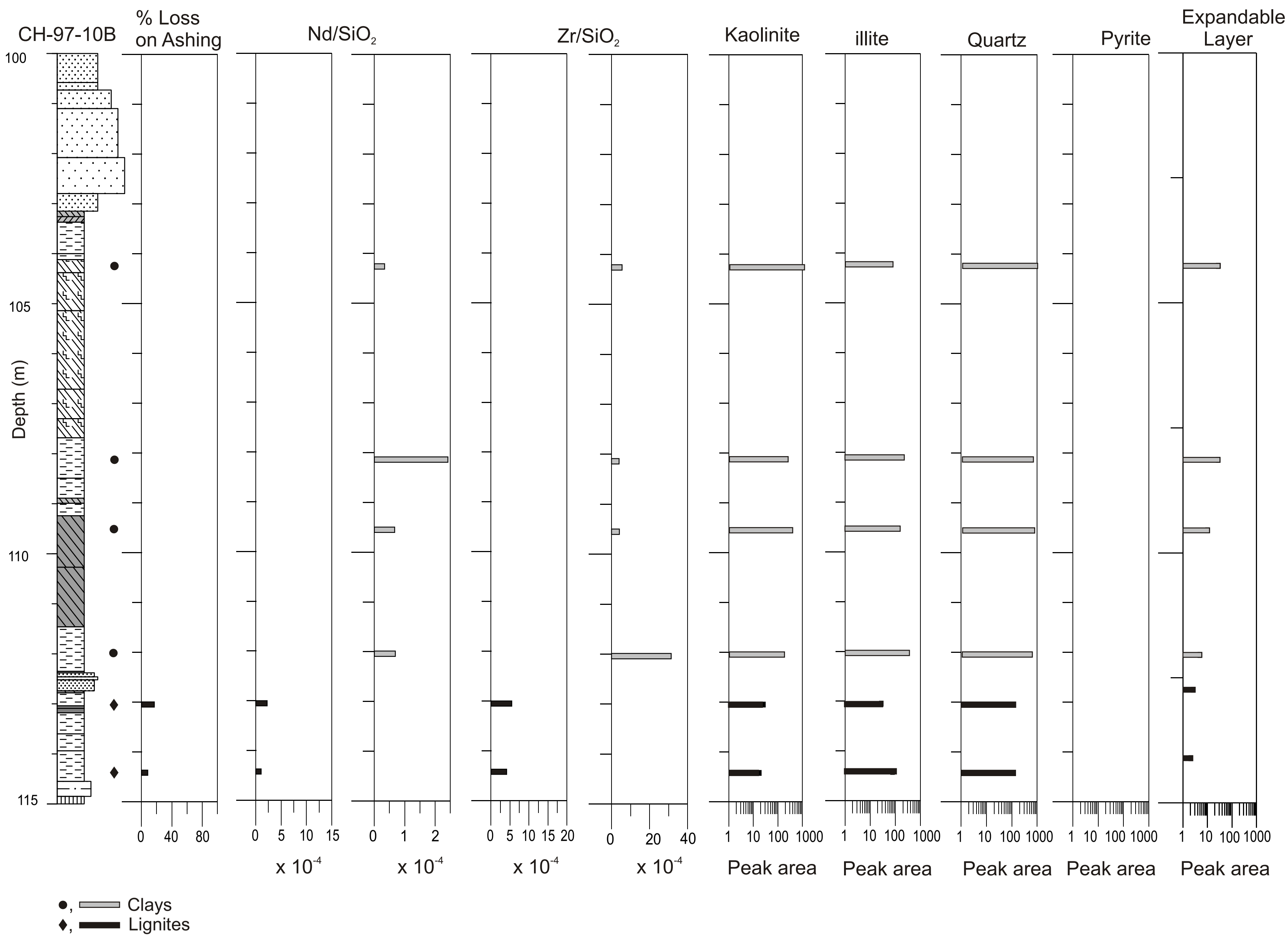


Figure 14(continued): Downhole variation in selected geochemical and mineralogical characteristics of borehole CH-97-10B.

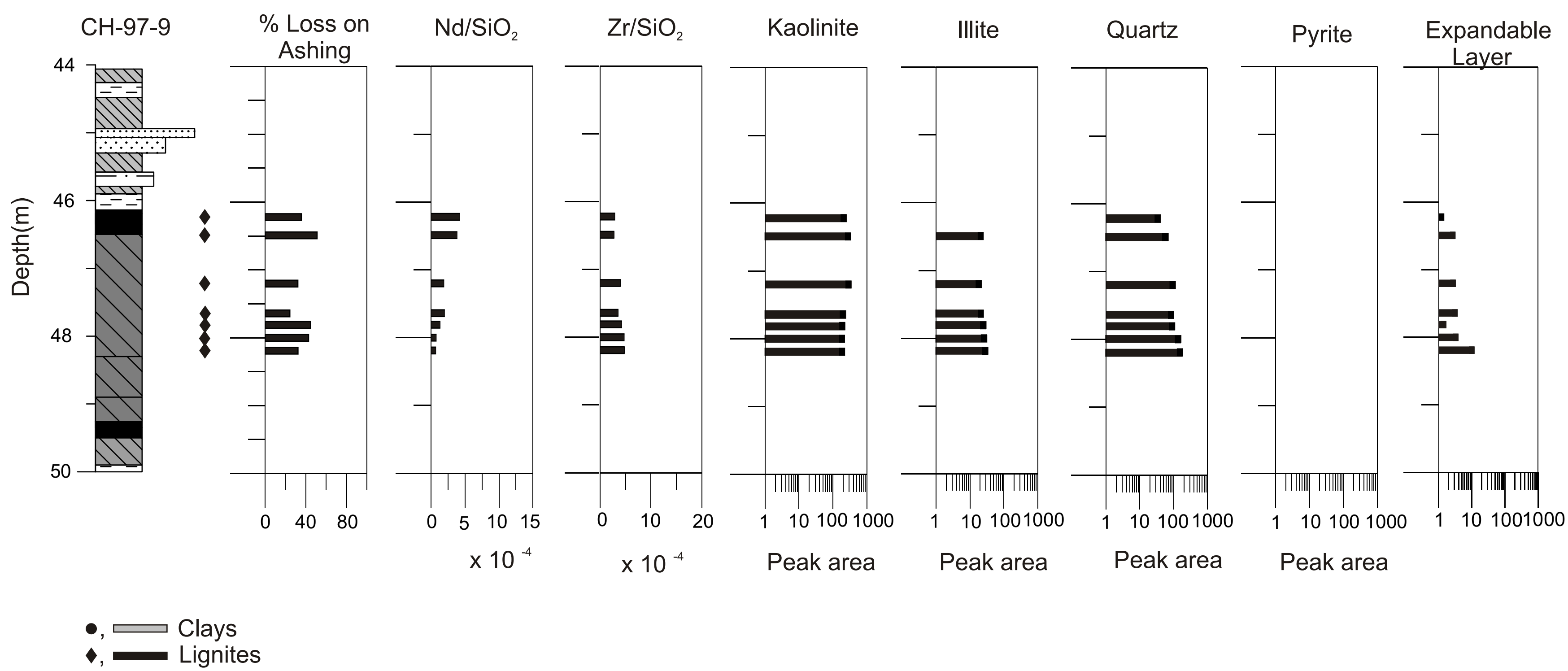


Figure 15: Downhole variation in selected geochemical and mineralogical characteristics of borehole CH-97-9.

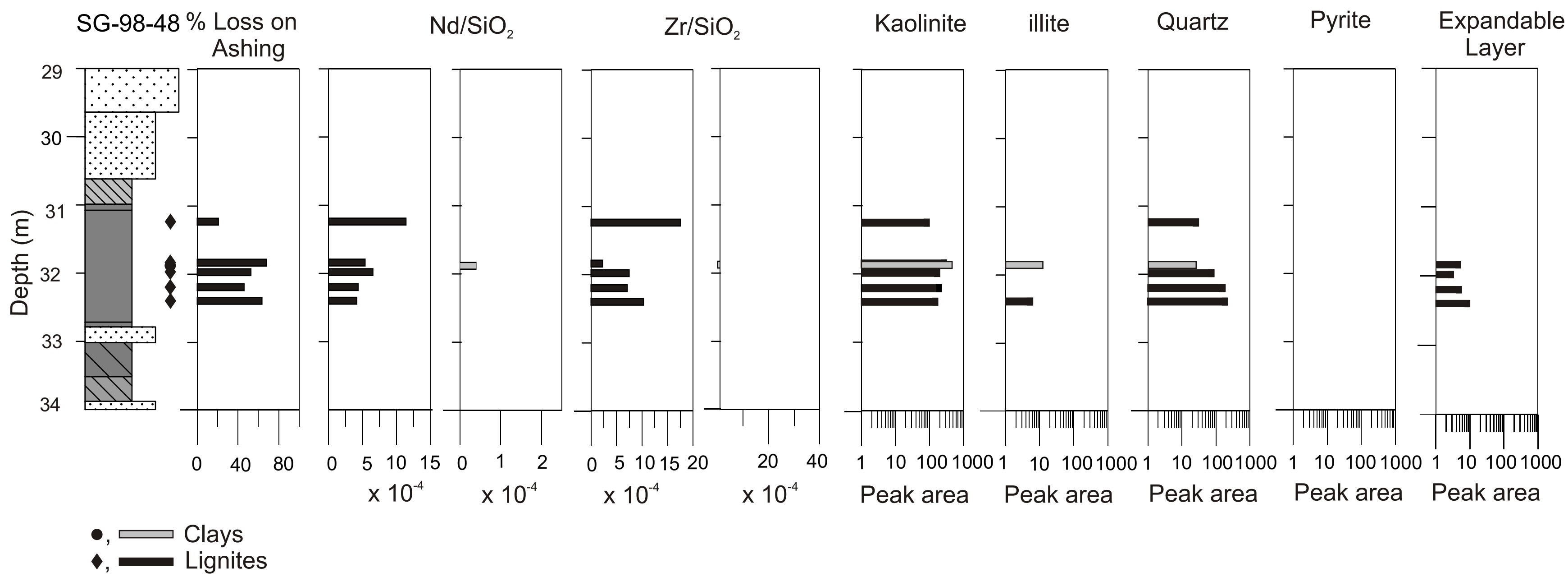


Figure 16: Downhole variation in selected geochemical and mineralogical characteristics of borehole SG-98-48.

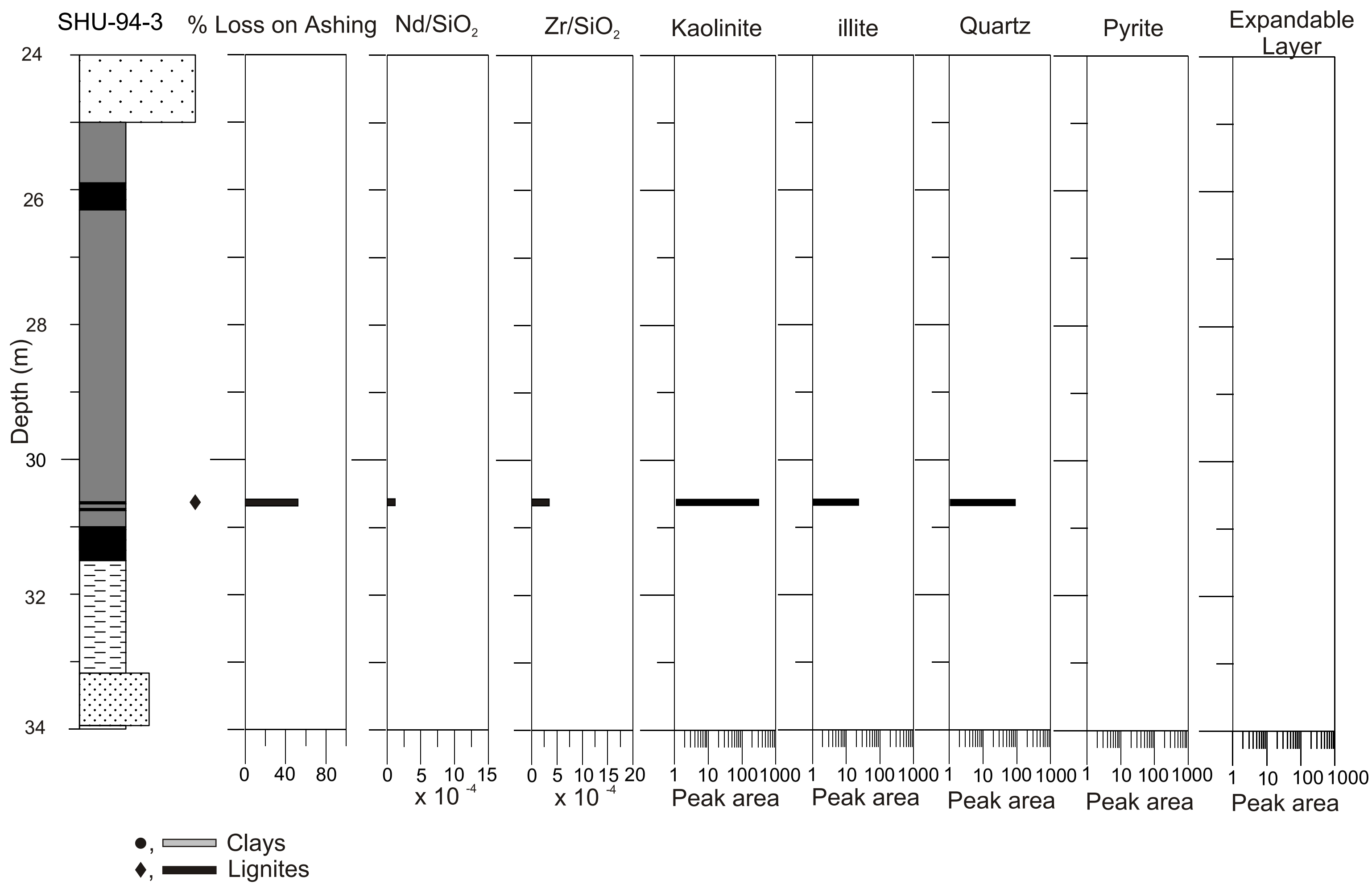


Figure 17: Downhole variation in selected geochemical and mineralogical characteristics of borehole SHU-94-3.

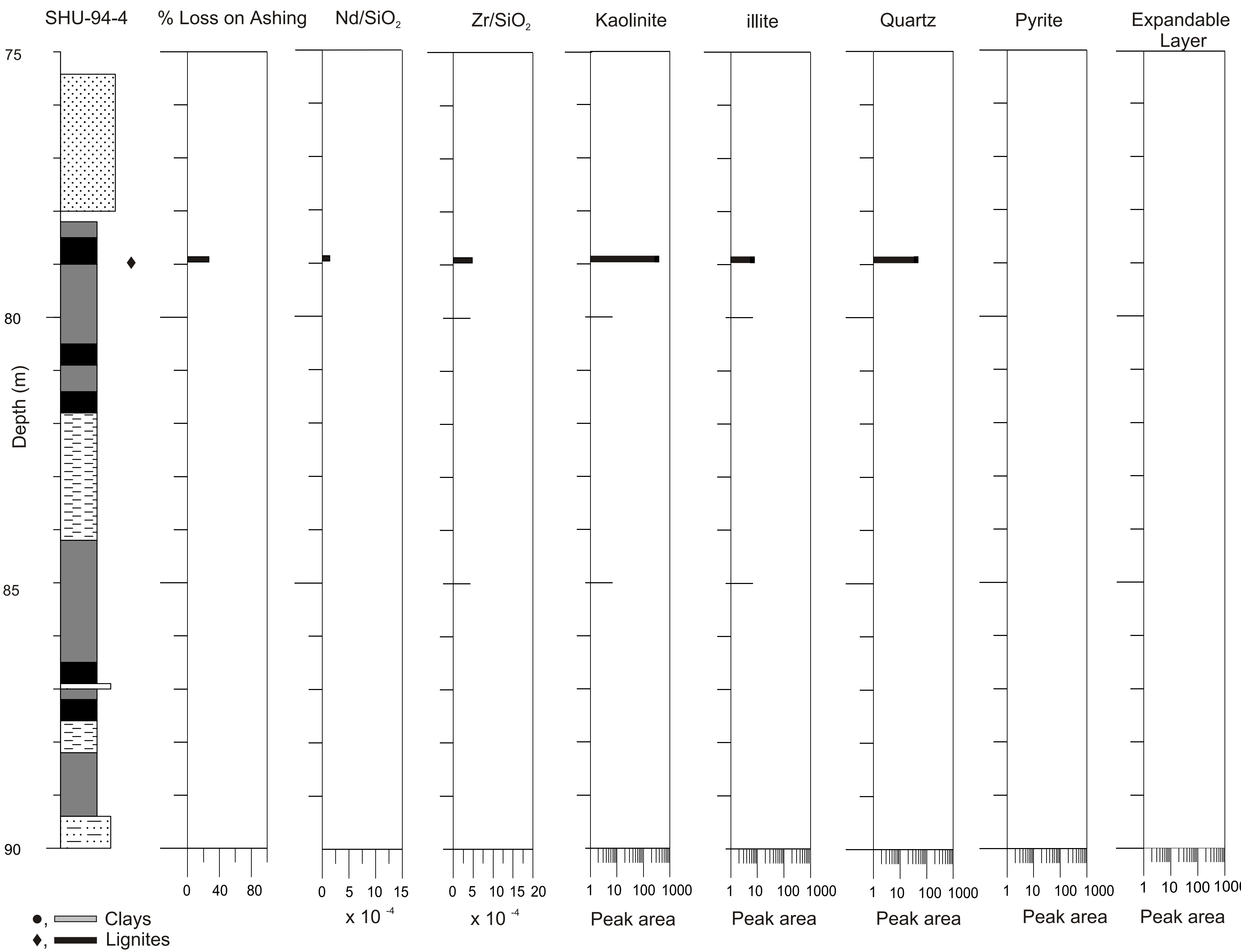


Figure 18: Downhole variation in selected geochemical and mineralogical characteristics of borehole SHU-94-4.

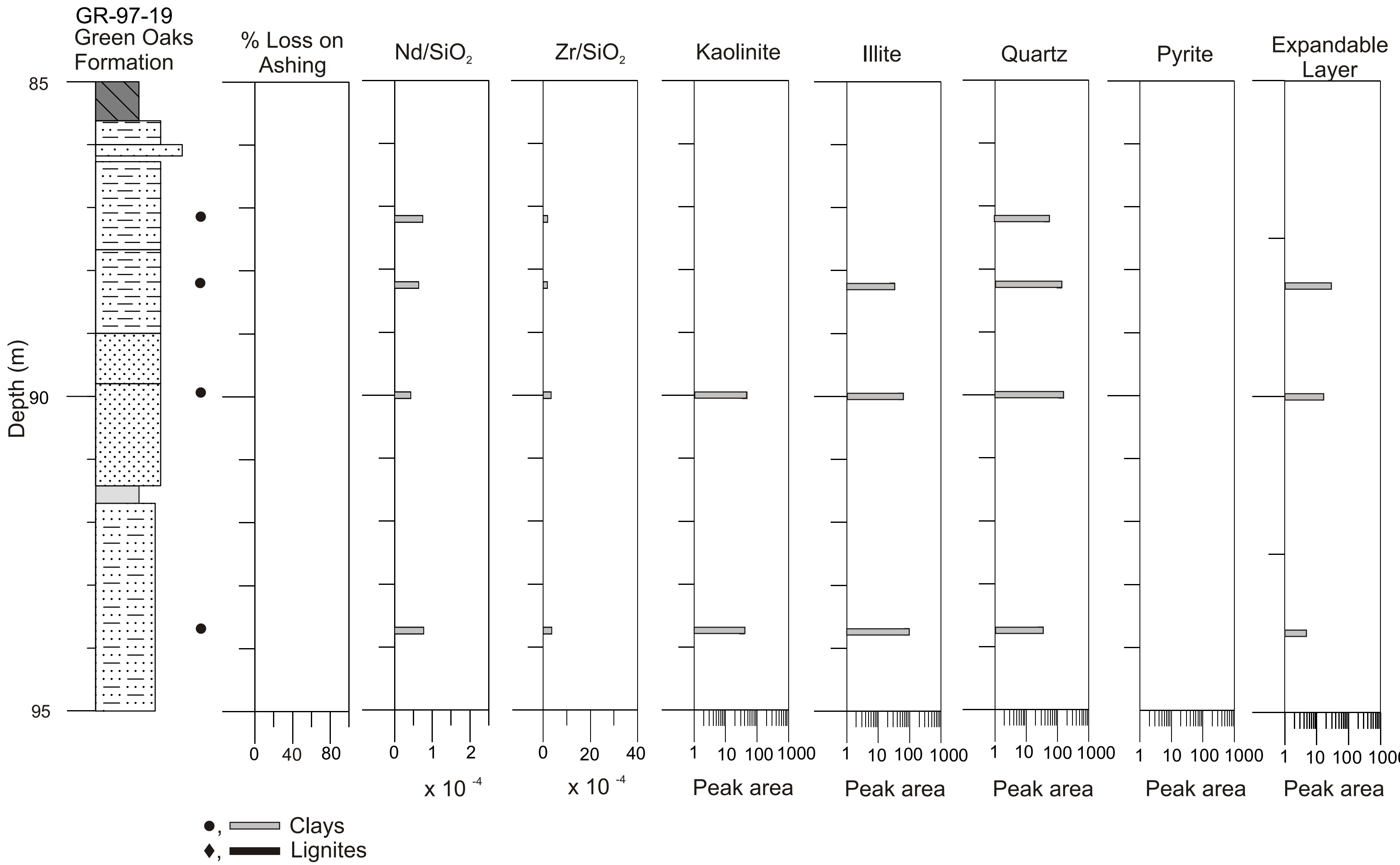


Figure 19: Downhole variation in selected geochemical and mineralogical characteristics of borehole GR-97-19.

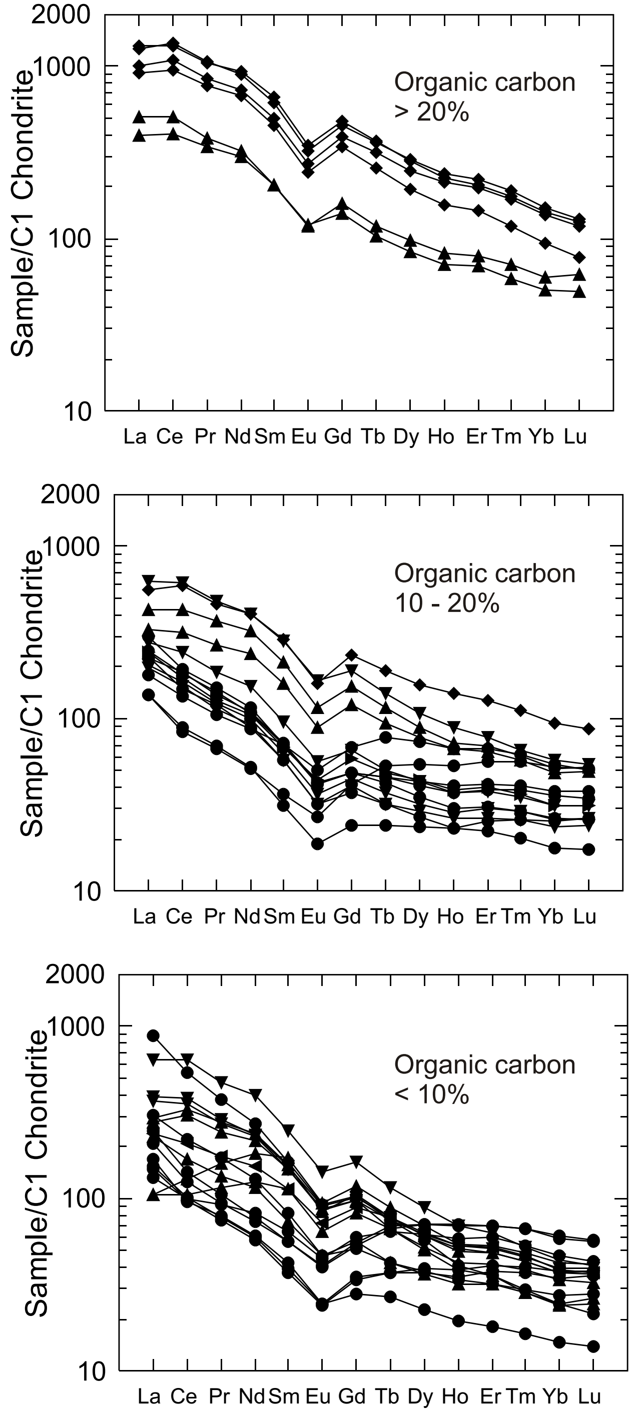


Figure 20: Variation in REE patterns with organic carbon content in ashed “lignite”samples.

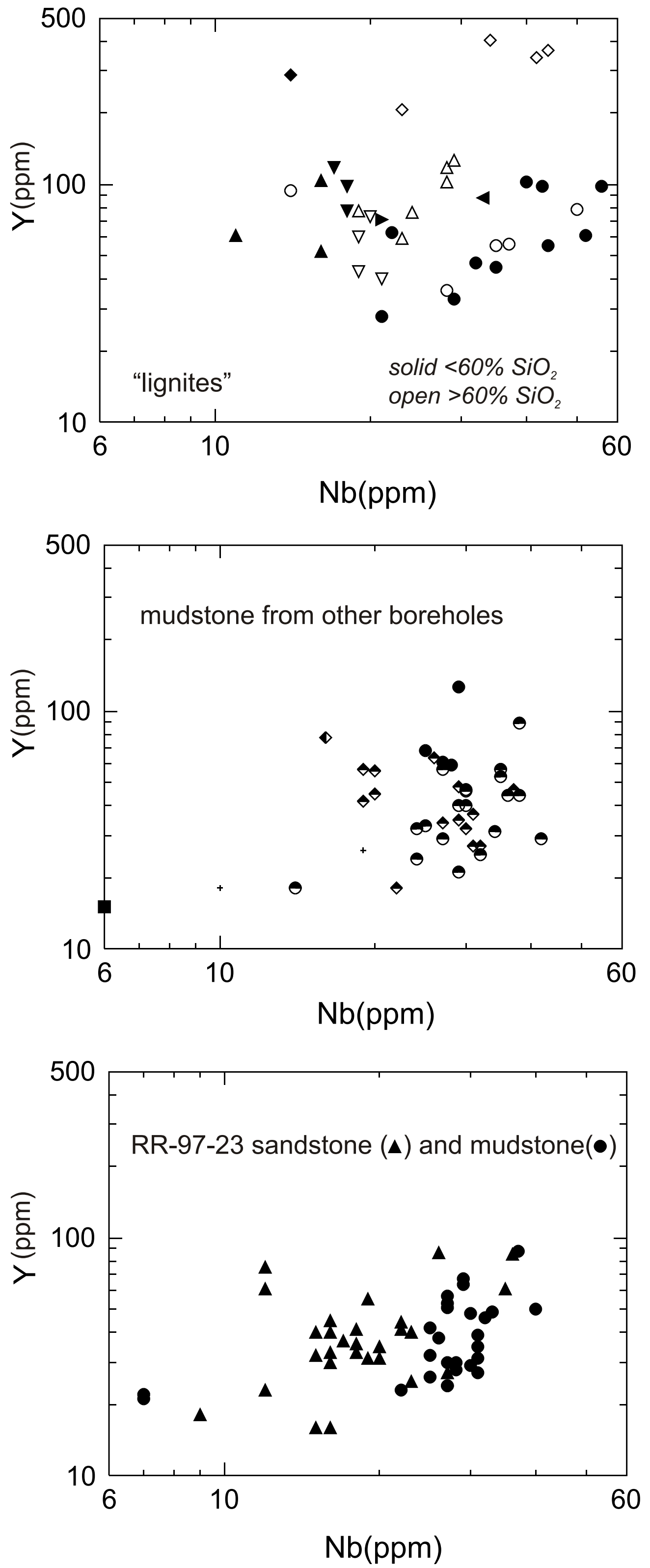


Figure 21: Y and Nb contents of ashed "lignite" and comparative mudstone and sandstone.

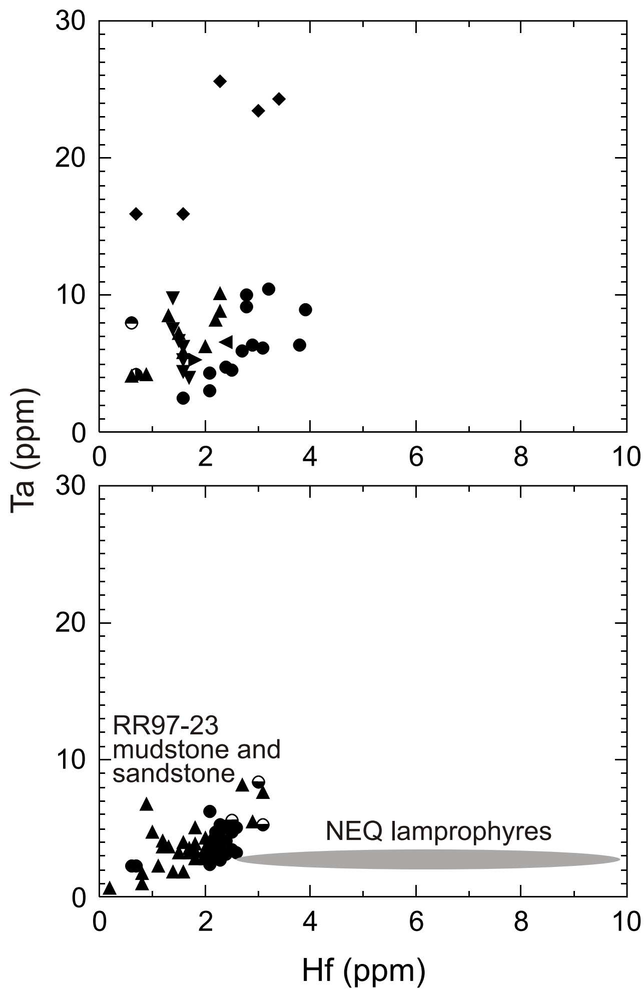


Figure 22: Hf and Ta contents of ashed lignite samples compared with “normal” mudstone and sandstone.

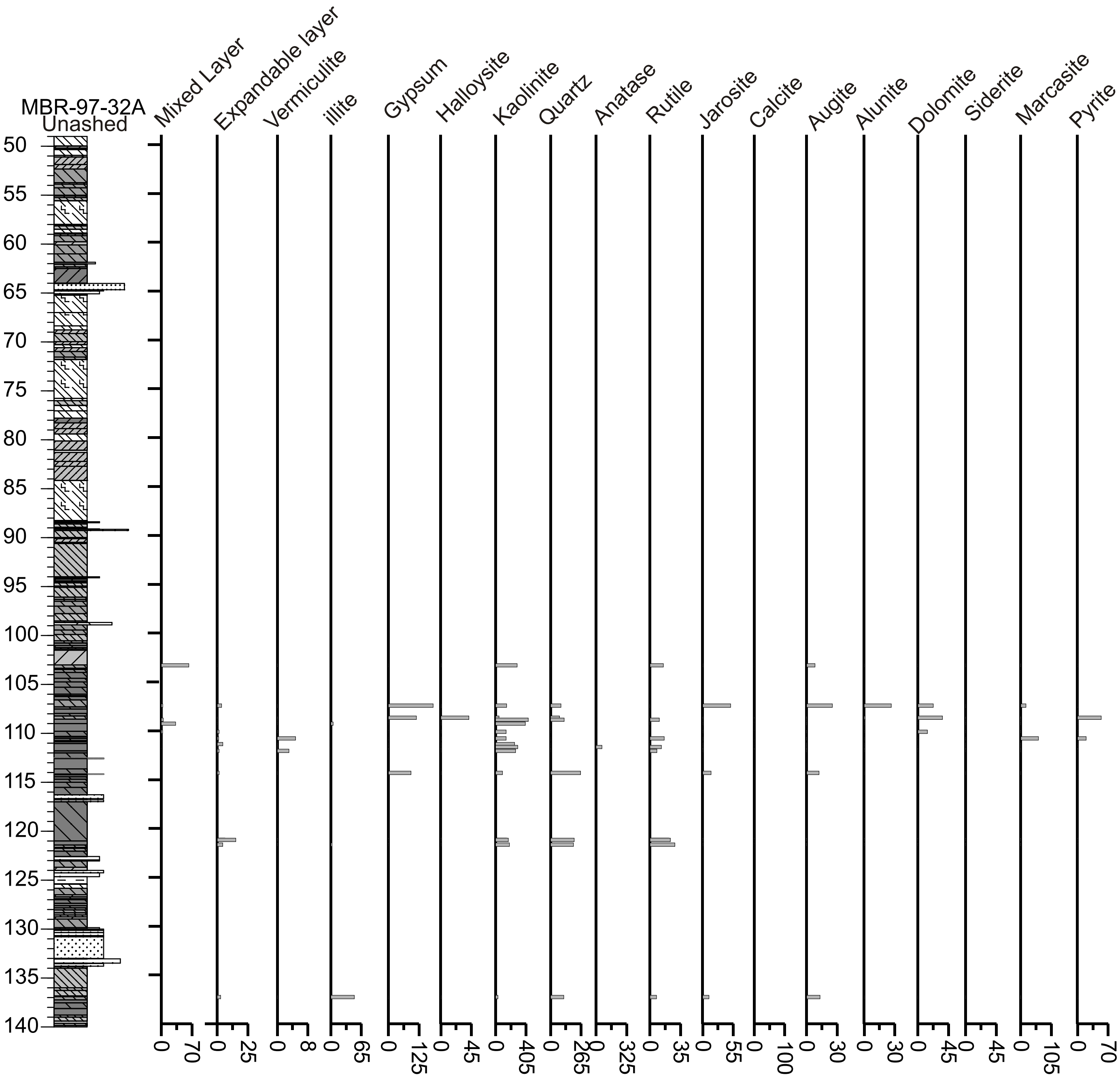


Figure 23a: Downhole variation in mineral abundance determined by XRD on bulk unashed “lignite” samples from MBR-97-32A. Abundance expressed as peak area. Lithology patterns as in Figure 4.

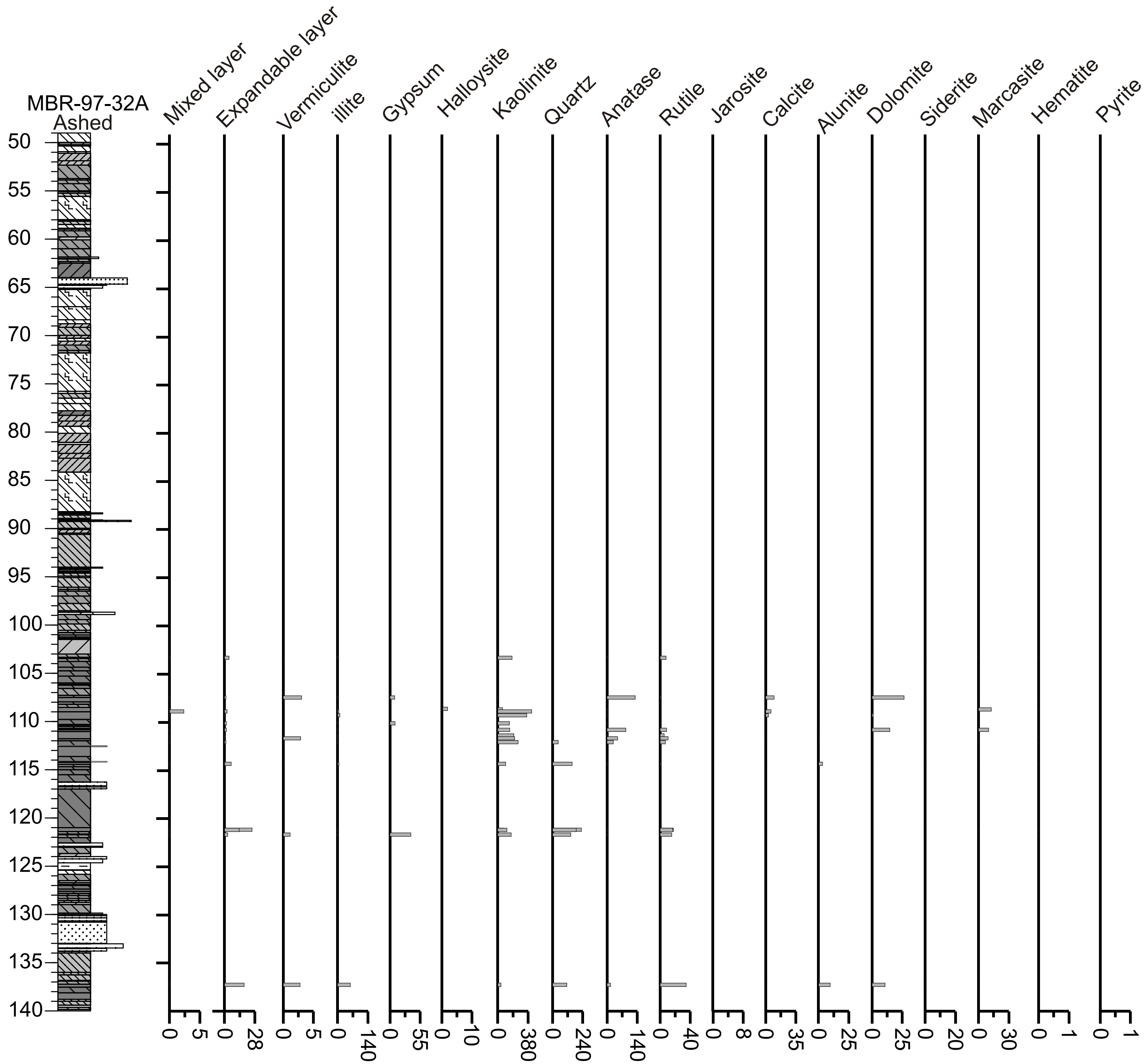


Figure 23b: Downhole variation in mineral abundance determined by XRD on bulk ashed “lignite” samples from MBR-97-32A.

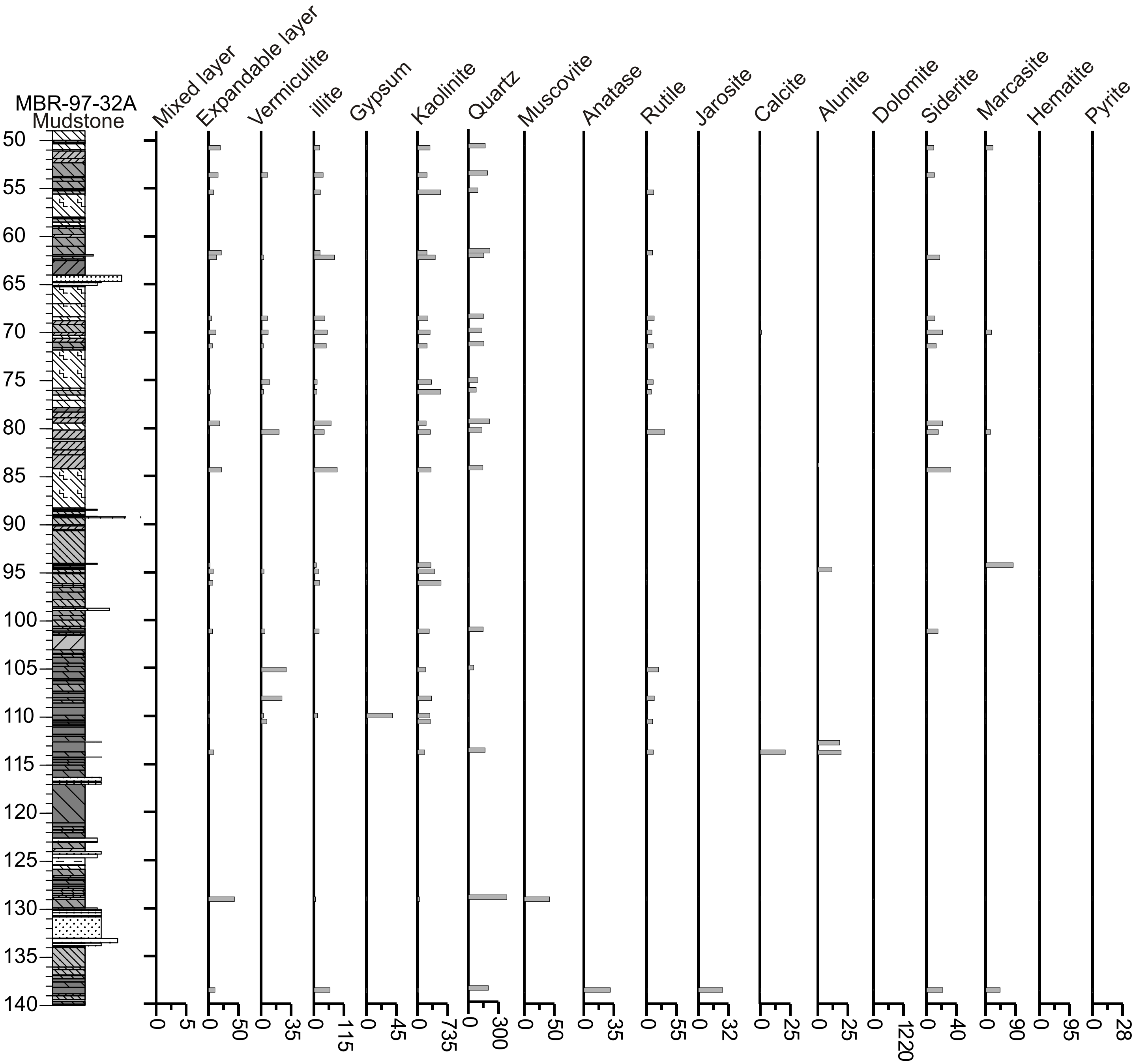


Figure 23c: Downhole variation in mineral abundance determined by XRD on bulk mudstone samples from MBR-97-32A.

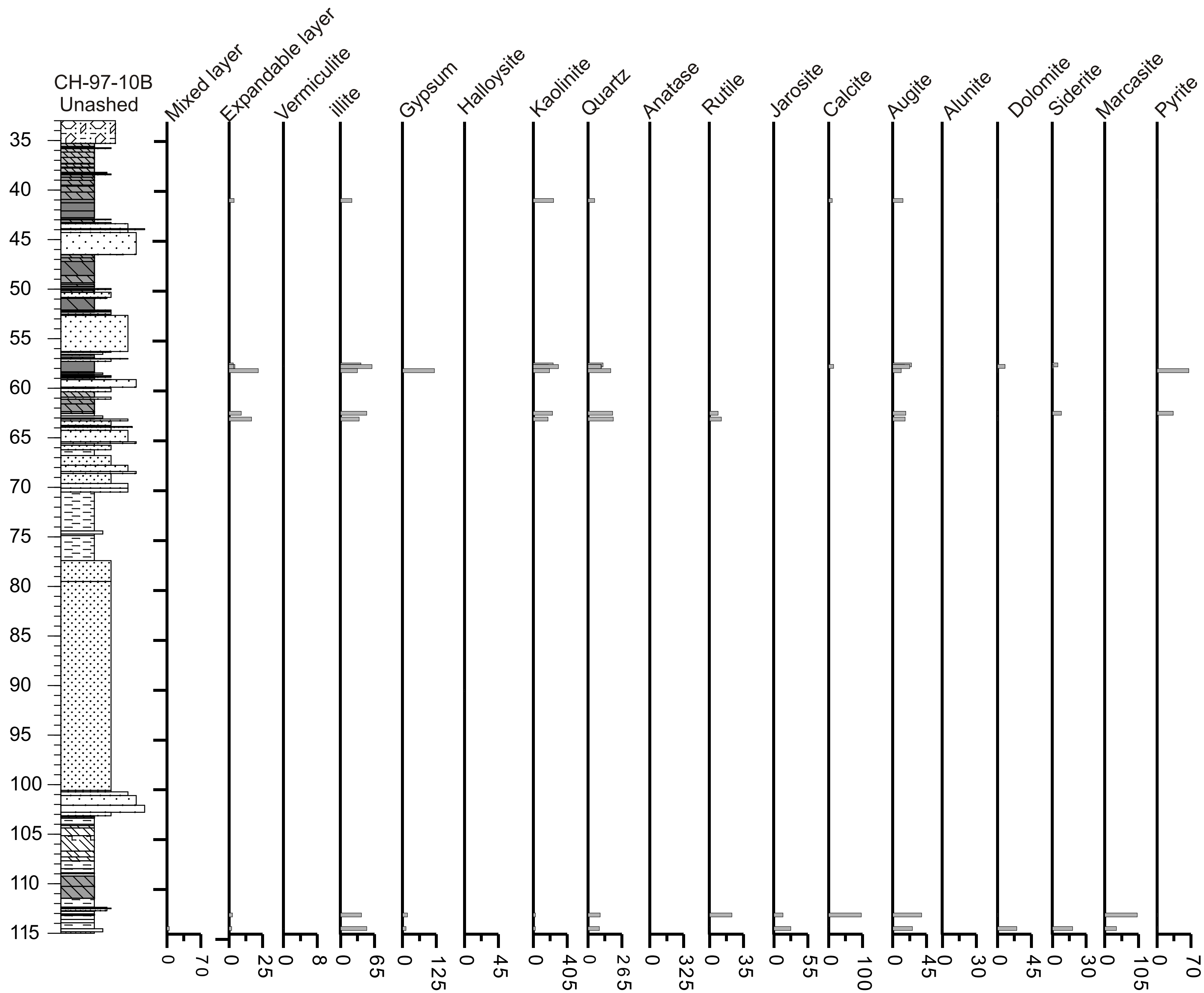


Figure 24a: Downhole variation in mineral abundance determined by XRD on bulk unashed “lignite” samples from CH-97-10B.

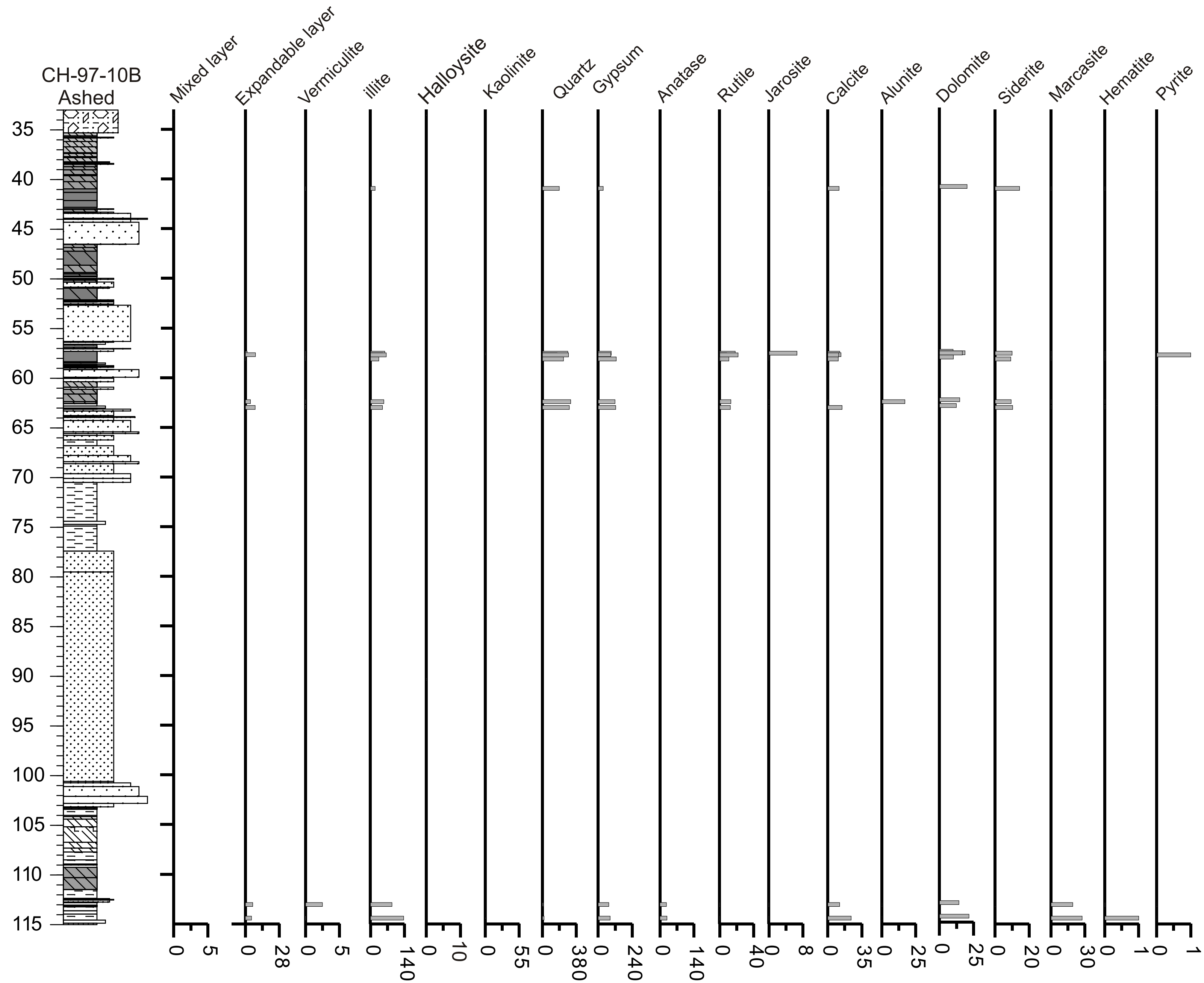


Figure 24b: Downhole variation in mineral abundance determined by XRD on bulk ashed "lignite" samples from CH-97-10B.

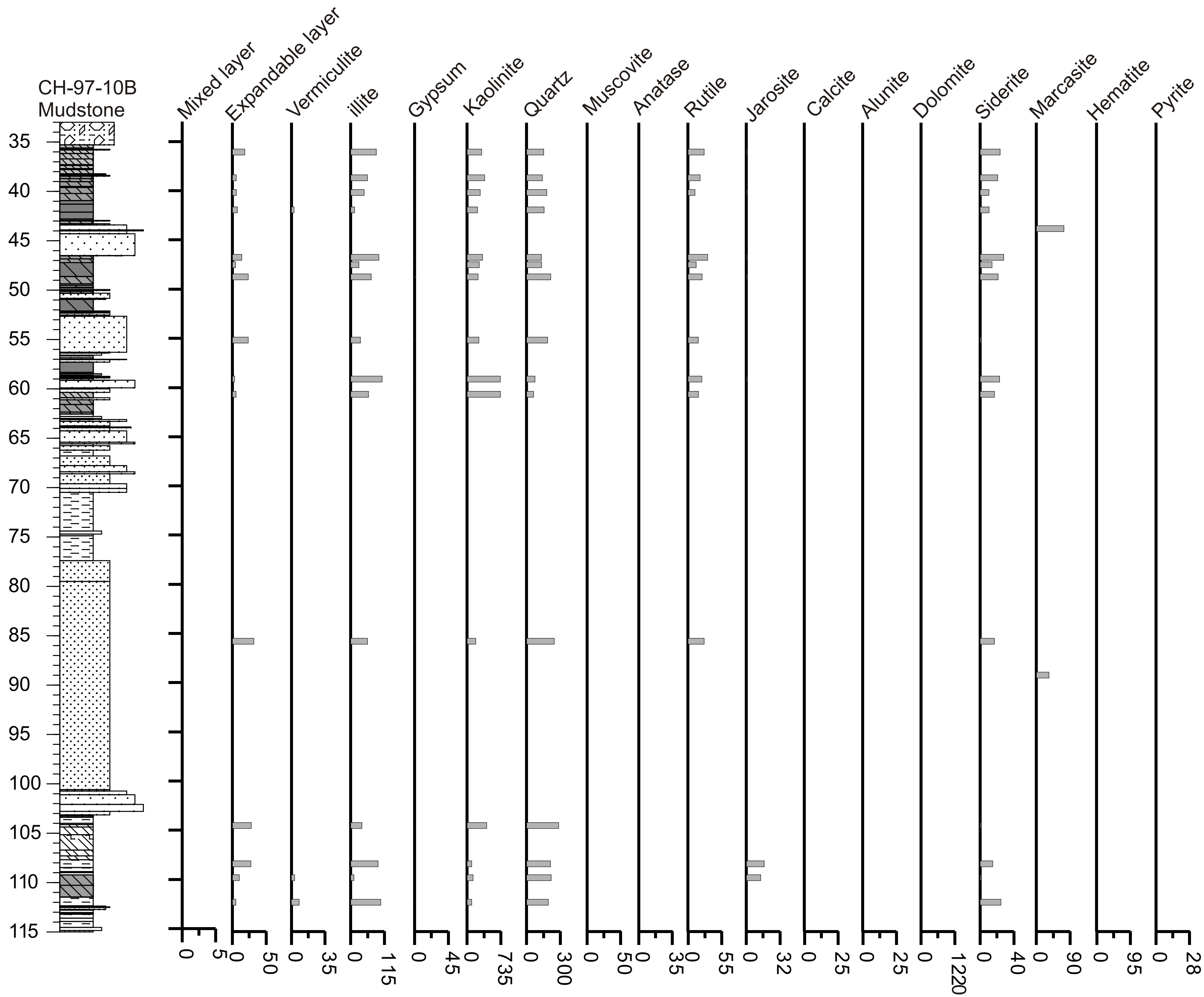


Figure 24c: Downhole variation in mineral abundance determined by XRD on bulk mudstone samples from CH-97-10B.

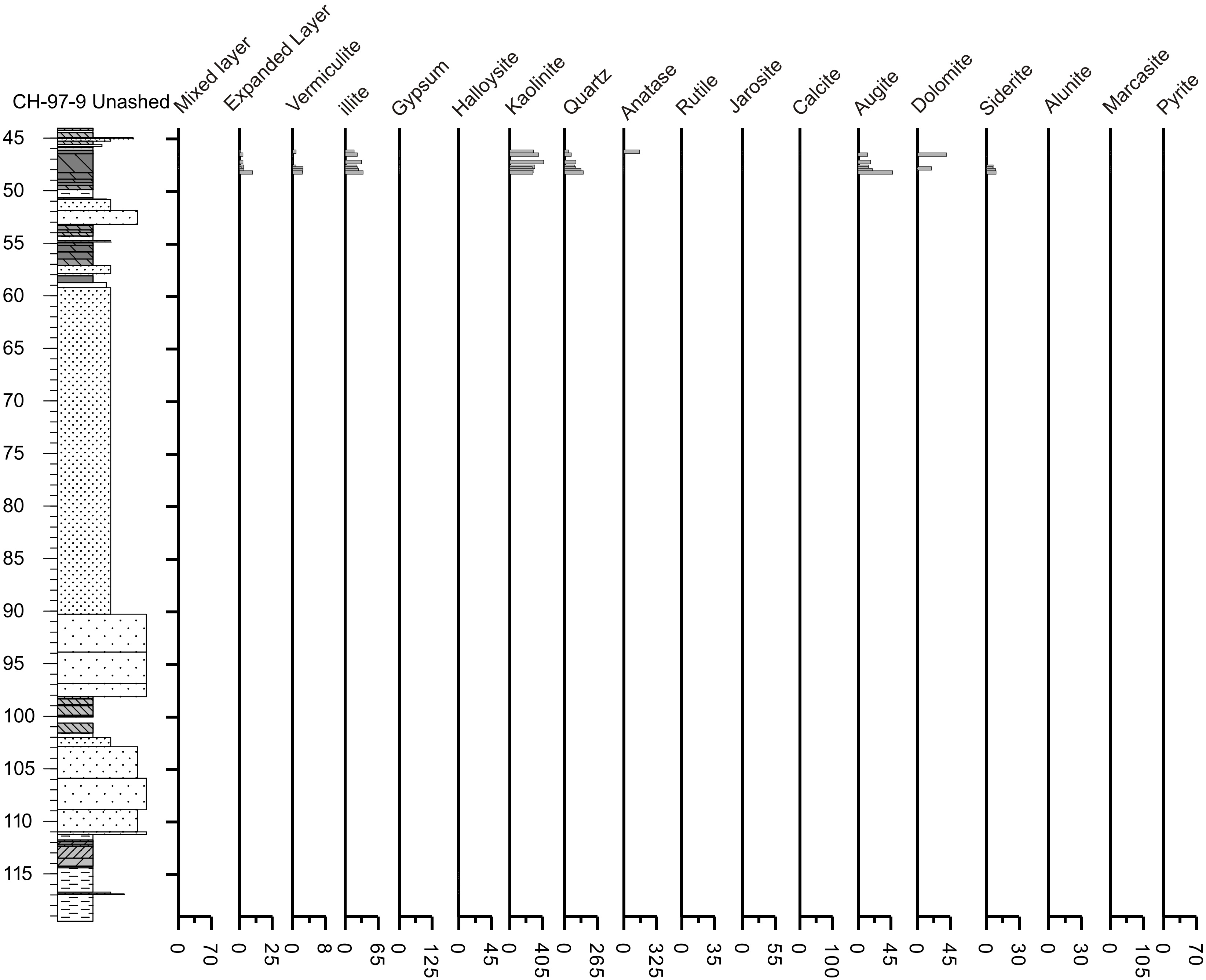


Figure 25a: Downhole variation in mineral abundance determined by XRD in bulk unashed “lignite” samples from CH-97-9.

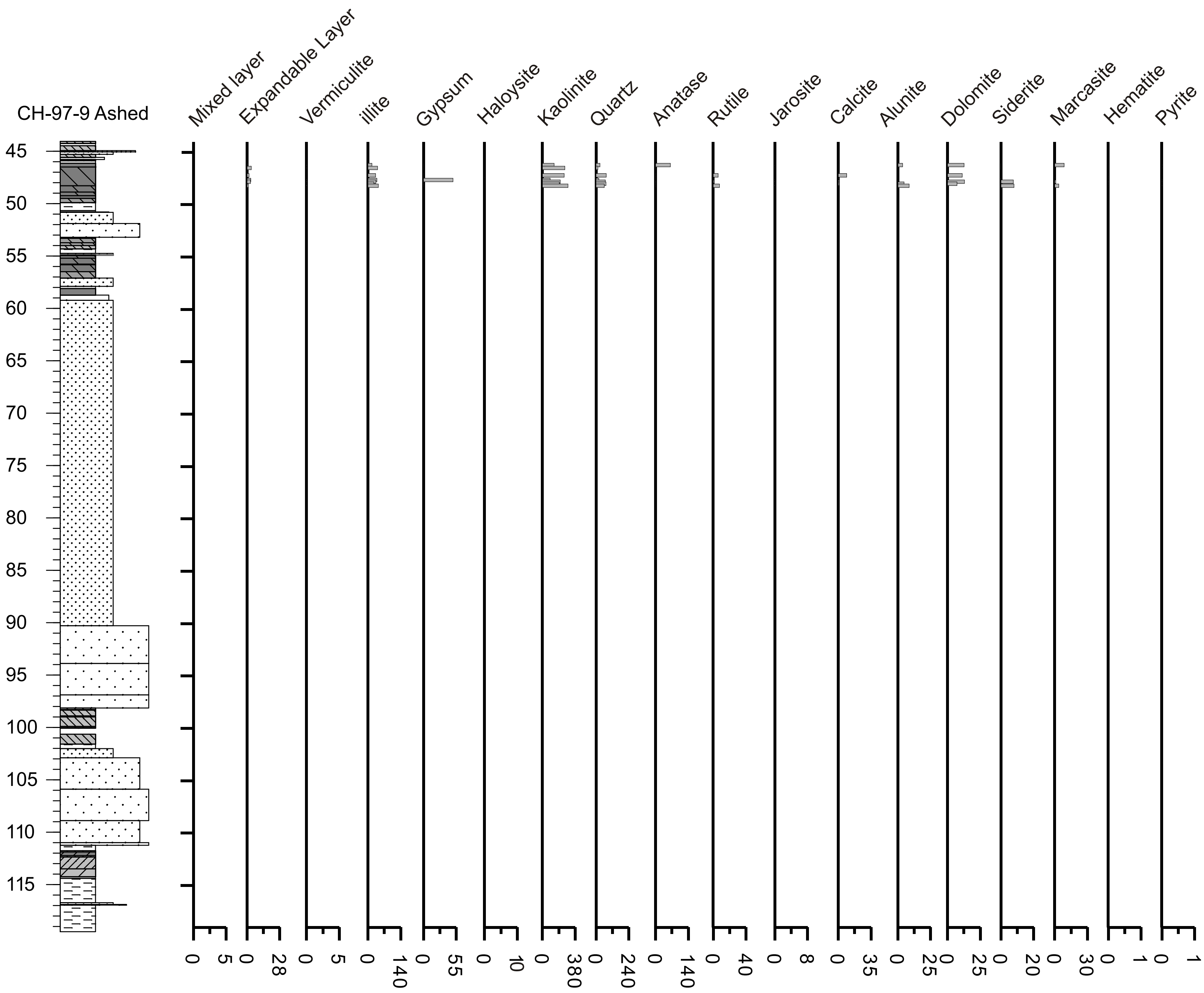


Figure 25b: Downhole variation in mineral abundance determined by XRD in bulk ashed “lignite” samples from CH-97-9.

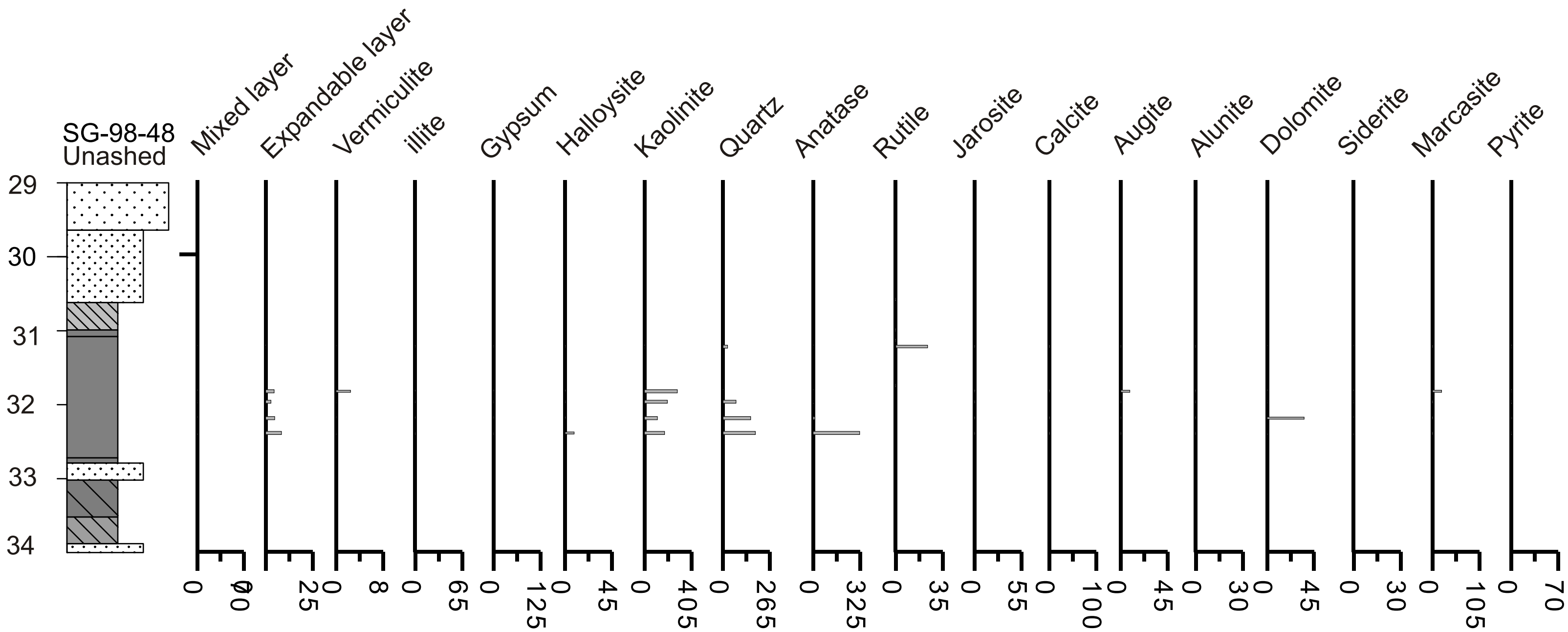


Figure 26a: Downhole variation in mineral abundance determined by XRD on bulk unashed “lignite” samples from SG-98-48.

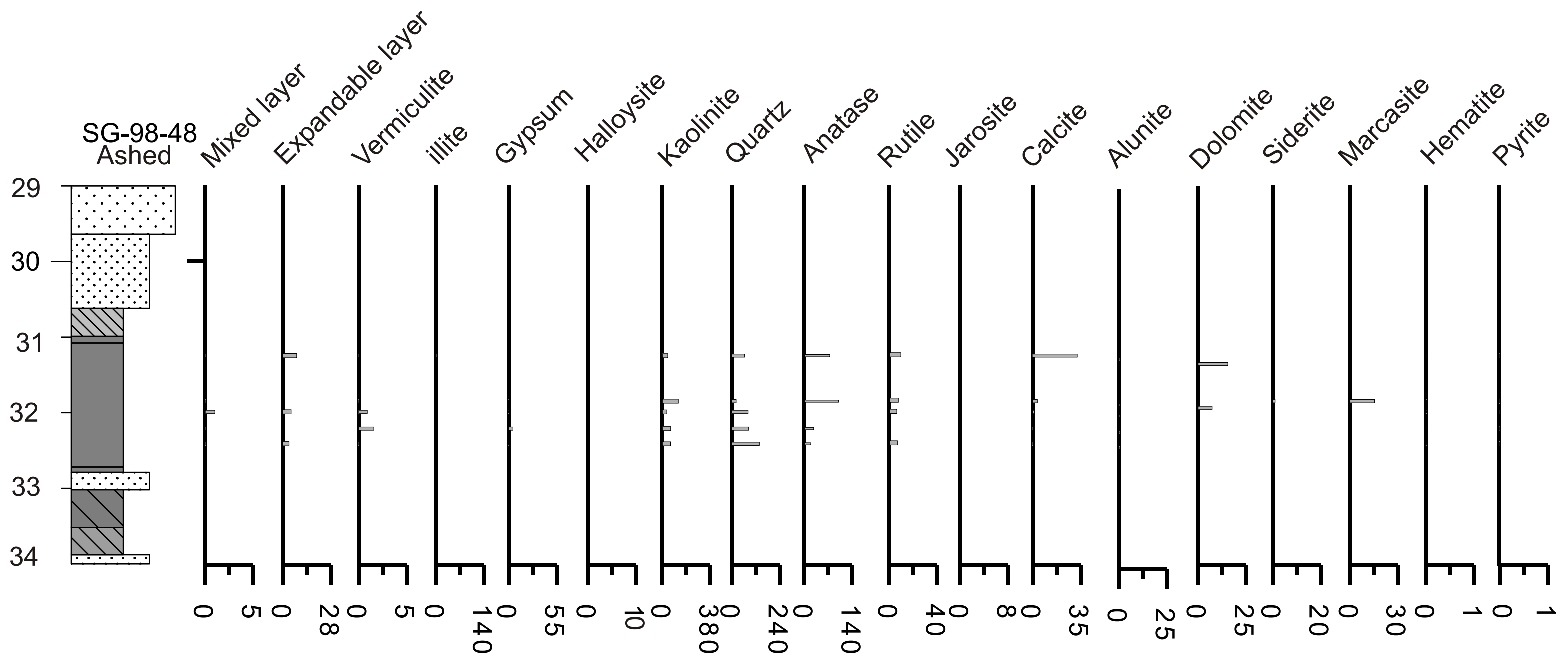


Figure 26b: Downhole variation in mineral abundance determined by XRD on bulk ashed “lignite” samples from SG-98-48.

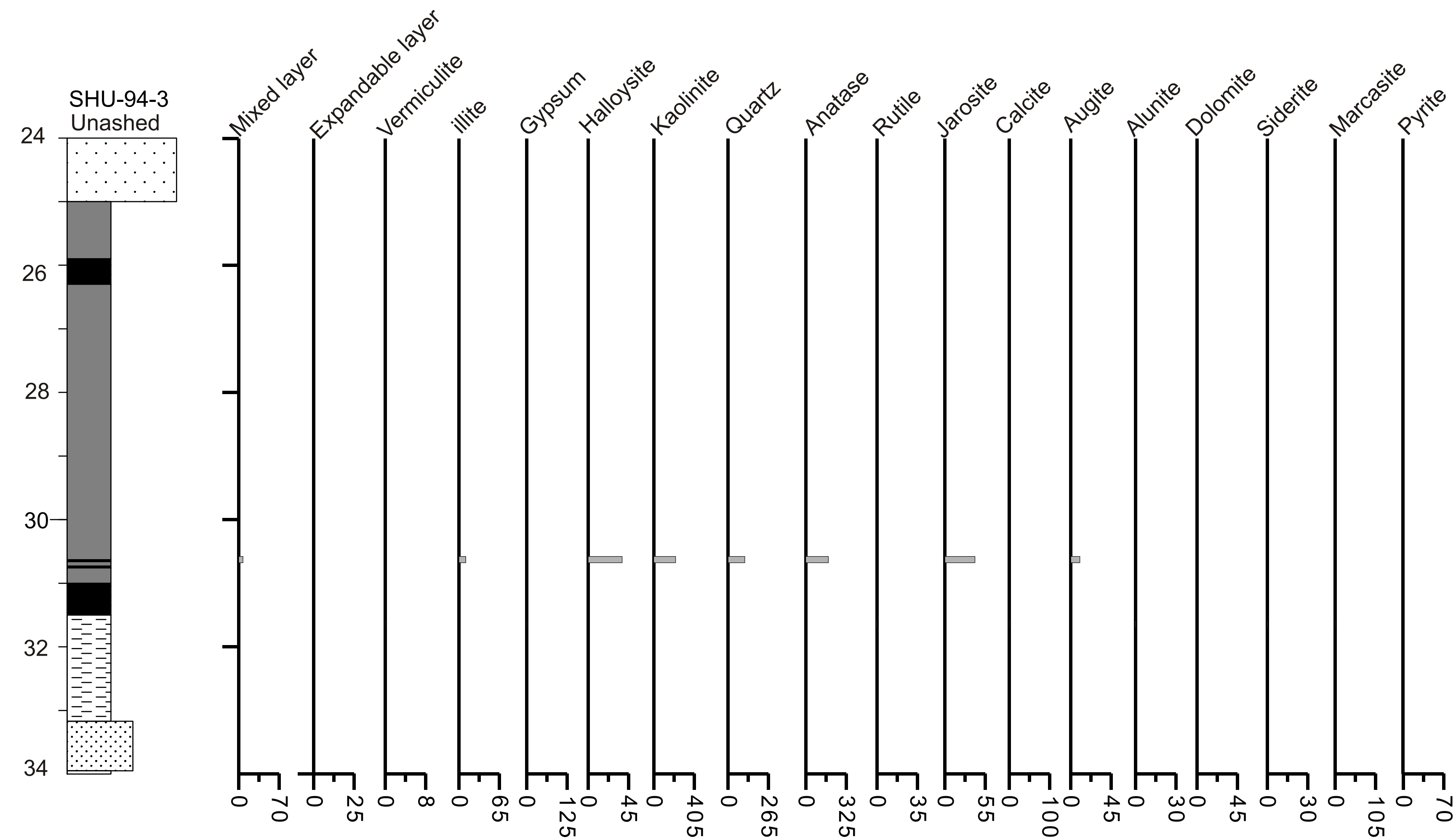


Figure 27a: Downhole variation in mineral abundance determined by XRD on bulk unashed “lignite” samples from SHU-94-3.

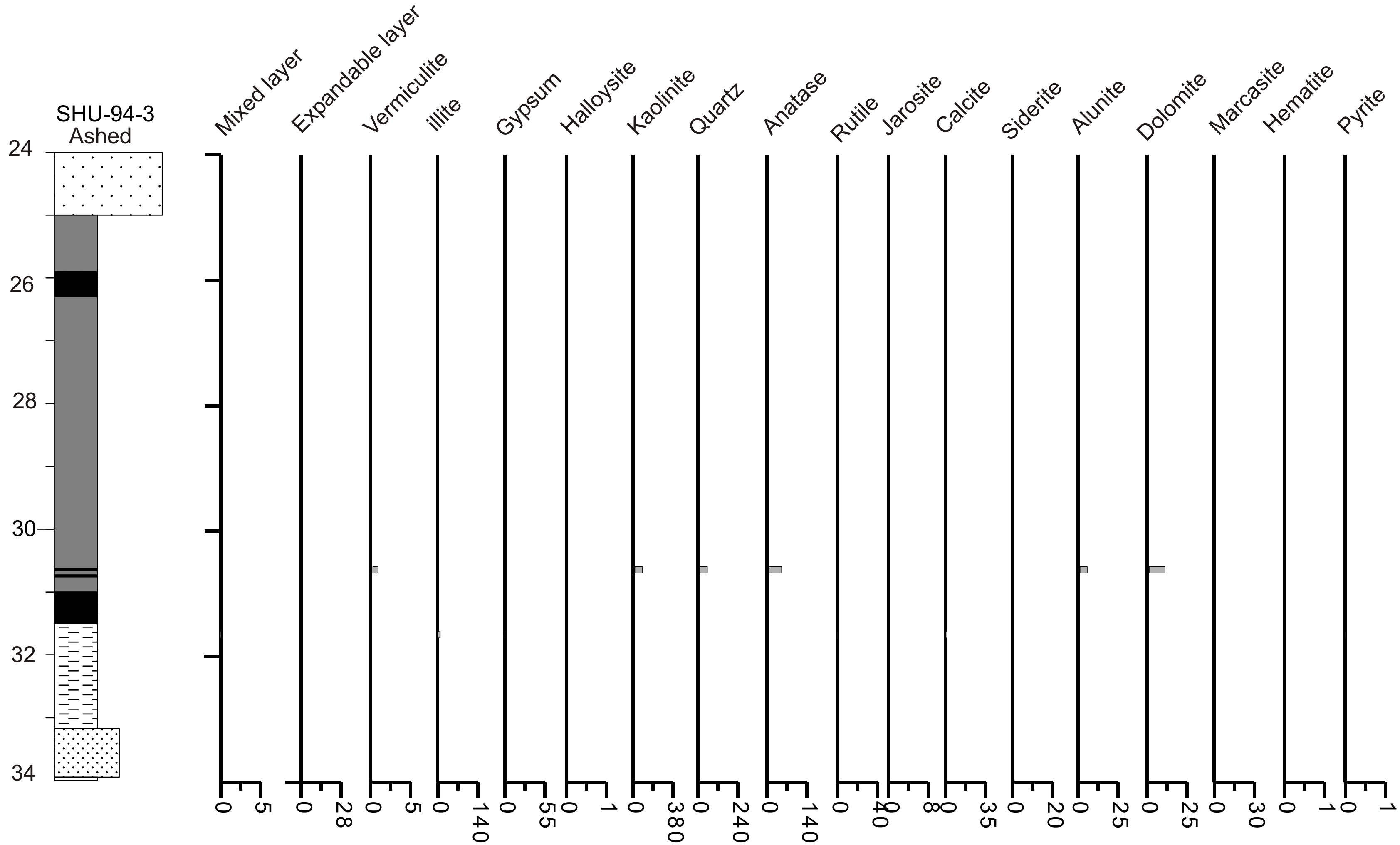


Figure 27b: Downhole variation in mineral abundance determined by XRD on bulk ashed “lignite” samples from SHU-94-3.

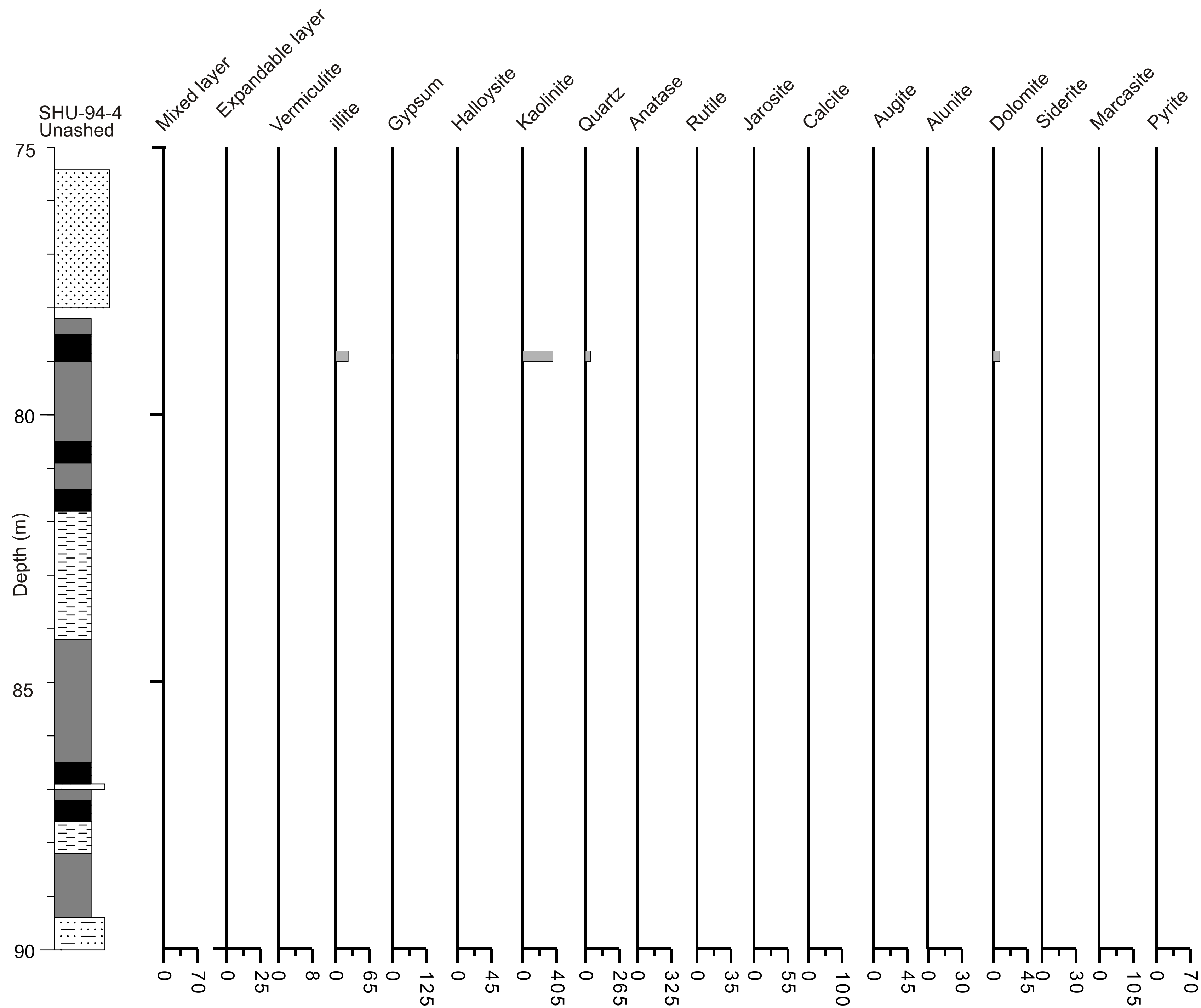


Figure 28a: Downhole variation in mineral abundance determined by XRD on bulk unashed “lignite” samples from SHU-94-4.

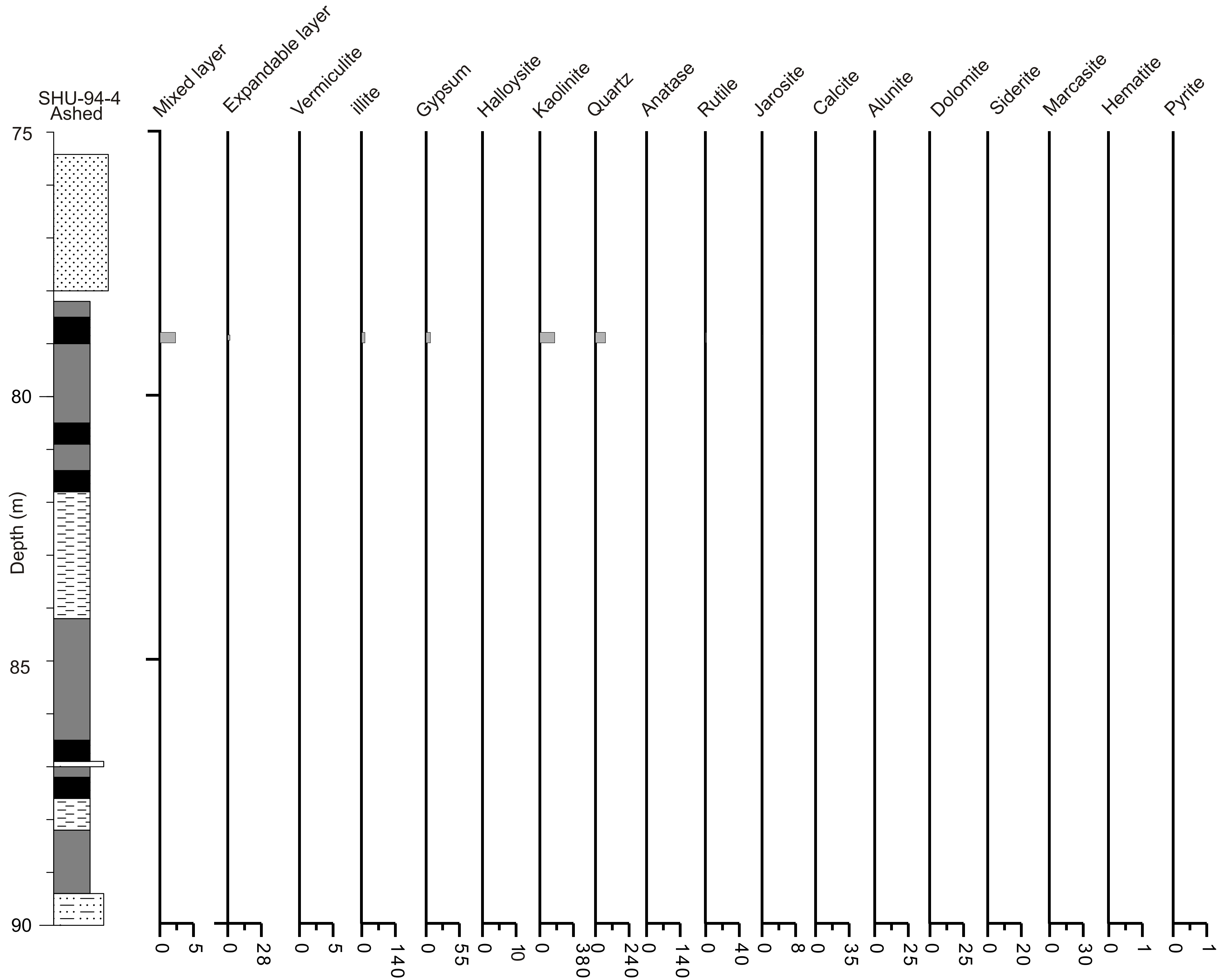


Figure 28b: Downhole variation in mineral abundance determined by XRD on bulk ashed “lignite” samples from SHU-94-4.

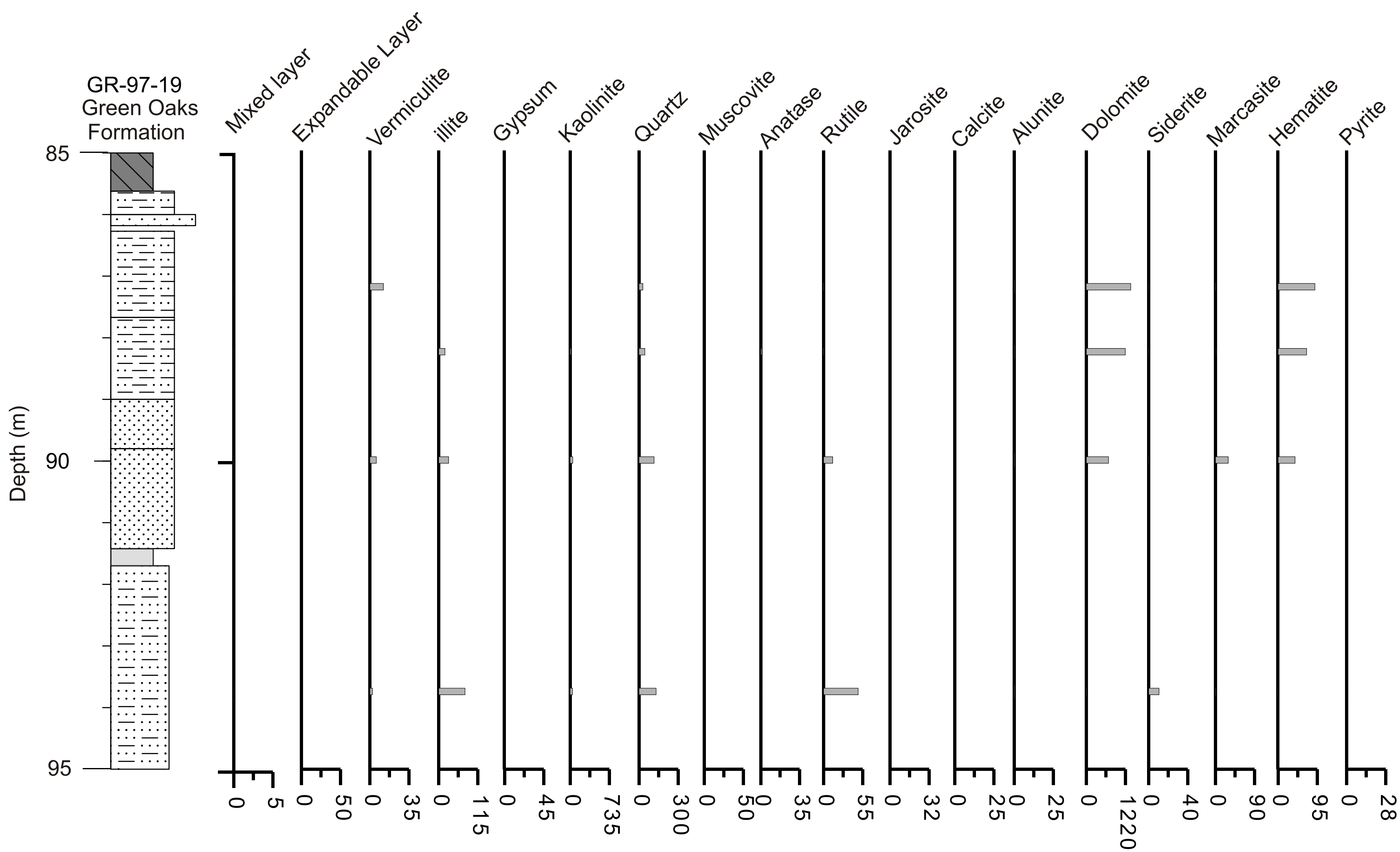


Figure 29: Downhole variation in mineral abundance determined by XRD on bulk samples from GR-97-19.

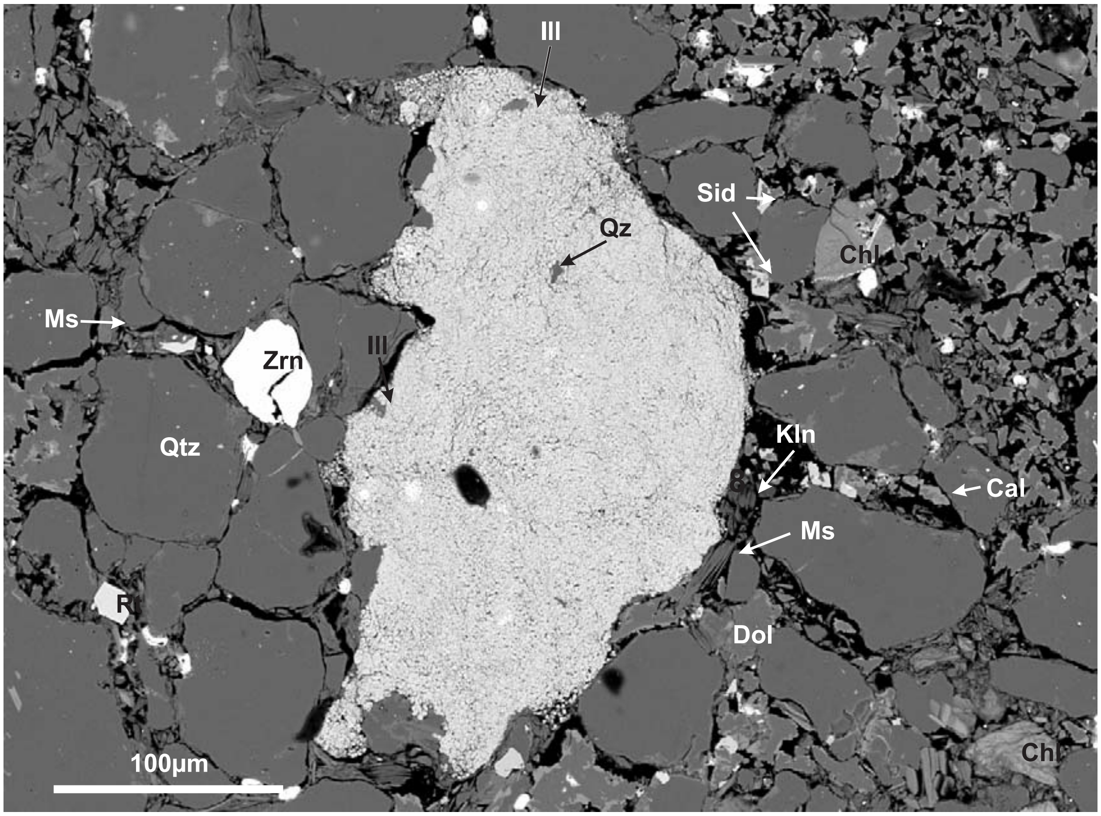


Figure 30: APS mineral pseudomorphic volcanic ash from near the base of the Chaswood Formation in borehole RR-97-23 (from Pe-Piper and Dolansky, 2005). Cal = calcite; chl = chlorite; Dol = dolomite; Ill = illite; Kln = kaolinite; Ms = muscovite; Qtz = quartz; Rt = rutile; Sid = siderite; Zrn = zircon.

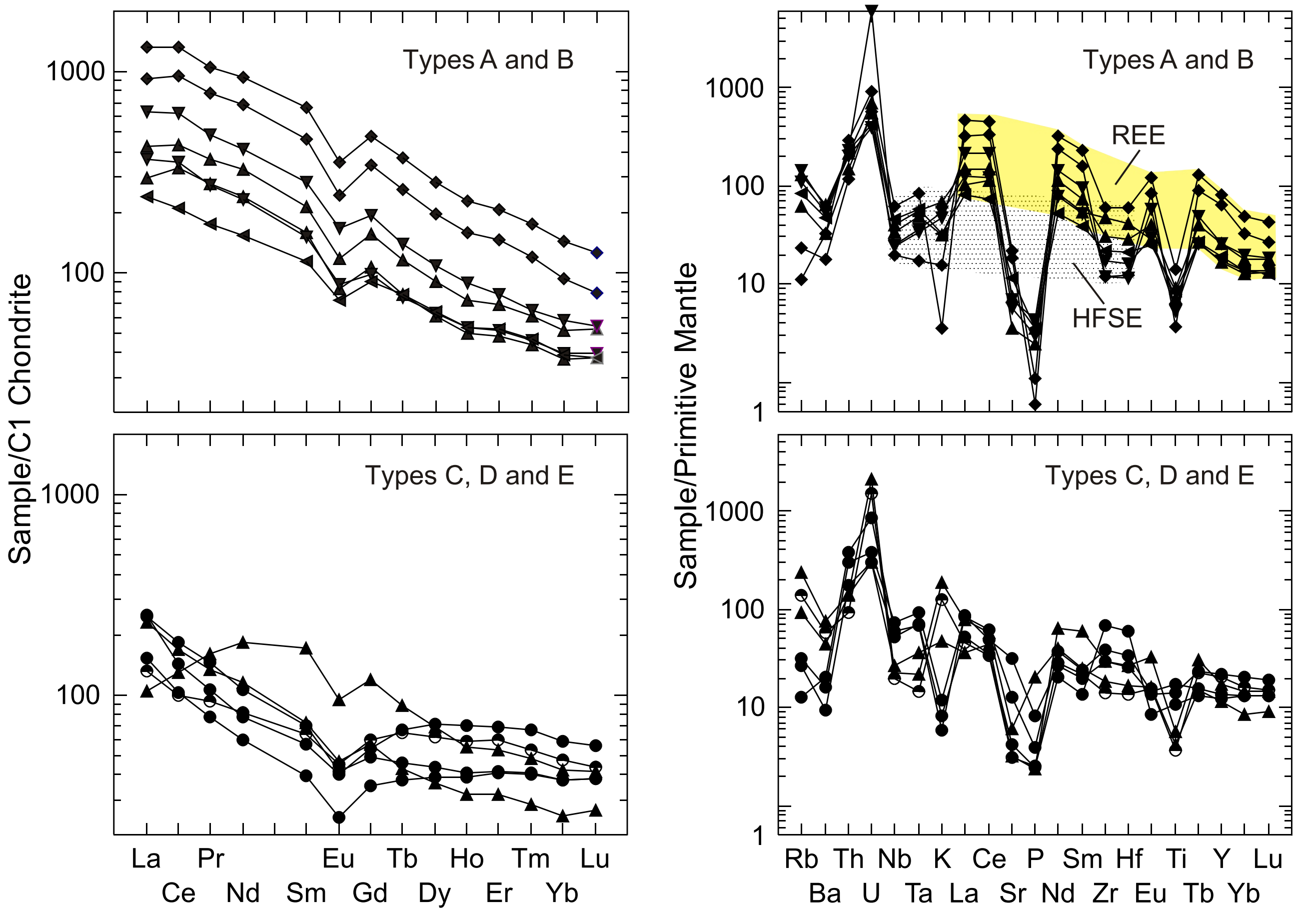


Figure 31: REE and trace element variation for the different geochemical types of lignite recognised in this study.

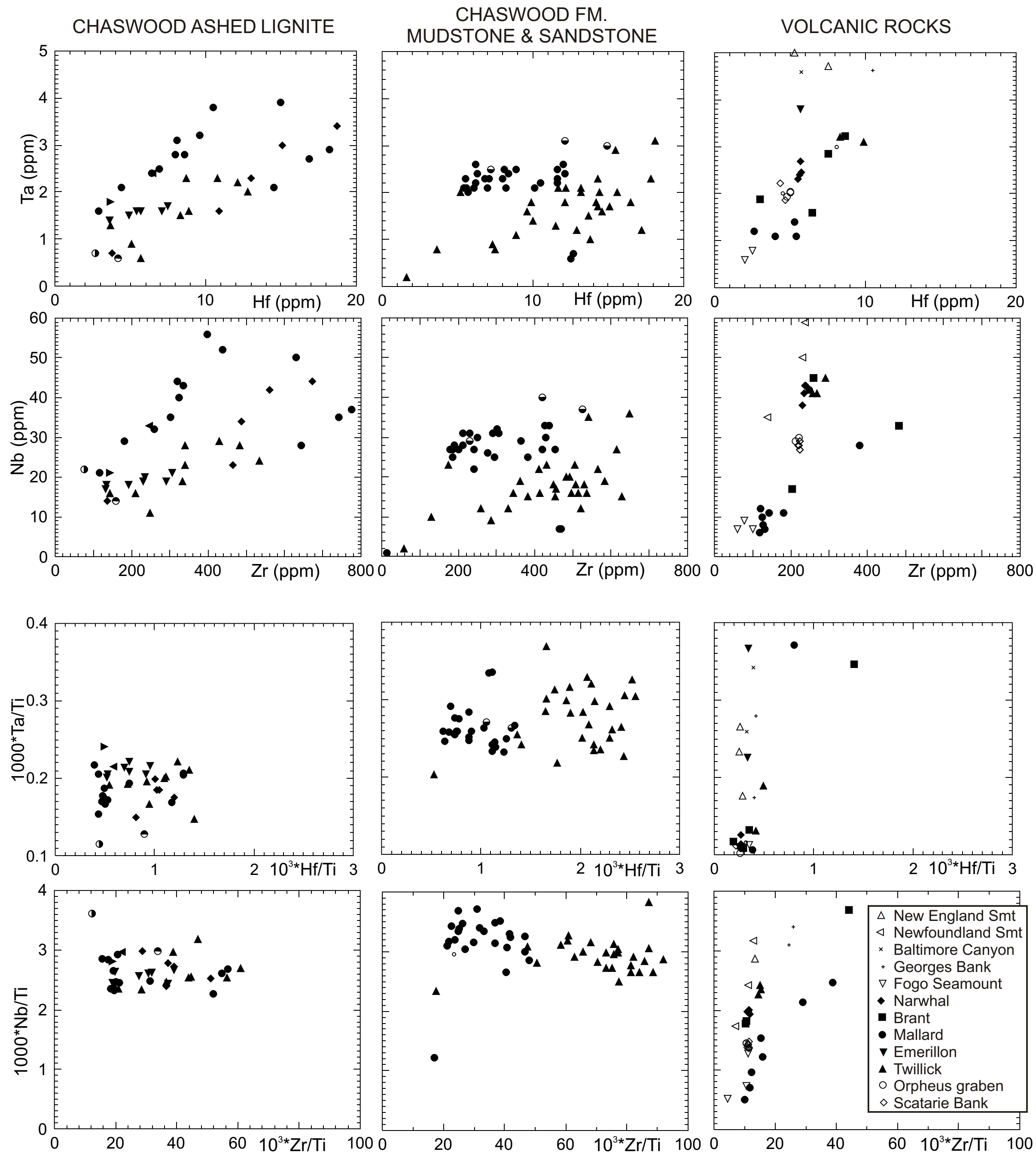


Figure 32: Comparison of variation in Nb, Ta, Hf, Zr and Ti from Chaswood Formation lignite, normal mudstone and sandstone of the Chaswood Formation, and potential volcanic sources.

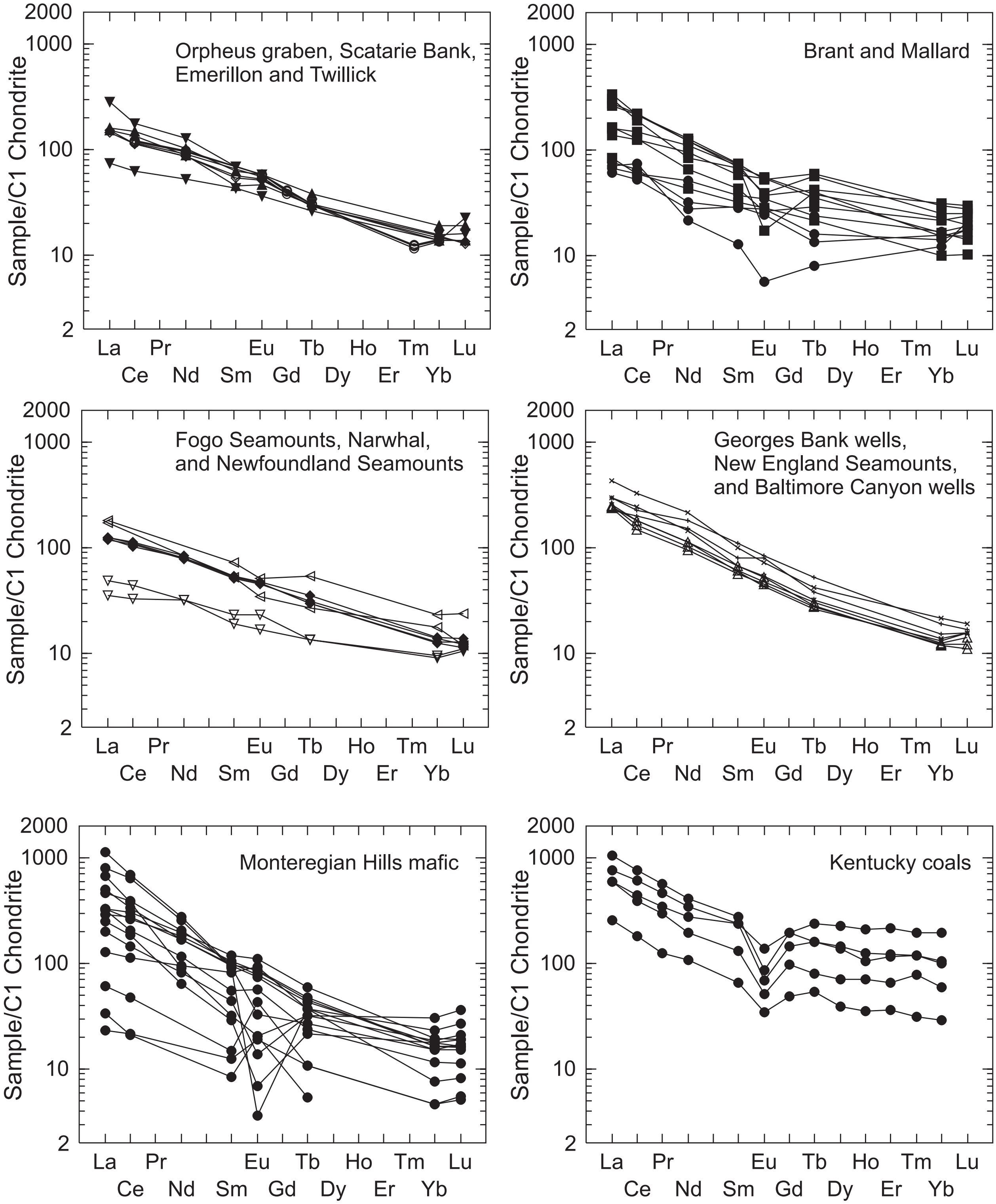


Figure 33: REE plots from potential source areas and from enriched Carboniferous coals from Kentucky(Hower et al. 1999), for comparison with Fig. 31.

Table 1: Facies types of analysed samples		
Boreholes	**Depths(m)**	**Facies**
MBR-97-32A	50.78	Mottled mudstone (pinkish)
MBR-97-32A	53.62	Brown mudstone (Black patches)
MBR-97-32A	55.42	Light grey mudstone
MBR-97-32A	61.72	Dark grey silt mudstone
MBR-97-32A	62.20	Dark grey mudstone
MBR-97-32A	68.55	Brown mudstone (Black patches)
MBR-97-32A	70.00	Dark grey mudstone (light brown patches)
MBR-97-32A	71.42	Mottled mudstone (red and black spots)
MBR-97-32A	75.20	Mottled mudstone (red colouration)
MBR-97-32A	76.22	Light grey mudstone
MBR-97-32A	79.50	Brown mudstone
MBR-97-32A	80.40	Mottled mudstone (Red/Brown)
MBR-97-32A	84.34	Mottled mudstone
MBR-97-32A	94.27	Light grey mudstone (red colouration)
MBR-97-32A	94.93	Dark grey mudstone
MBR-97-32A	96.13	Dark grey mudstone
MBR-97-32A	101.17	Dark grey mudstone (black patches)
MBR-97-32A	103.30	Lignite
MBR-97-32A	105.16	Black mudstone
MBR-97-32A	107.42	Lignite
MBR-97-32A	108.15	Dark grey mudstone (brownish)
MBR-97-32A	108.66	Lignite
MBR-97-32A	108.87	Lignite
MBR-97-32A	109.27	Lignite
MBR-97-32A	109.96	Black mudstone
MBR-97-32A	110.57	Dary grey mudstone (black spots)
MBR-97-32A	110.78	Lignite
MBR-97-32A	111.10	Lignite
MBR-97-32A	111.36	Lignite
MBR-97-32A	111.66	Lignite
MBR-97-32A	112.06	Lignite
MBR-97-32A	113.70	Black mudstone
MBR-97-32A	114.31	Lignite
MBR-97-32A	121.15	Lignite
MBR-97-32A	121.17	Lignite
MBR-97-32A	121.66	Lignite
MBR-97-32A	129.08	Brown silt mudstone (Coal present)
MBR-97-32A	137.25	Lignite
MBR-97-32A	138.55	Black mudstone
CH-97-10B	35.57	Dark grey mudstone
CH-97-10B	35.98	Light grey mudstone
CH-97-10B	38.59	Light grey (brownish) mudstone
CH-97-10B	40.08	Dark grey mudstone (Coal patches)
CH-97-10B	40.95	Lignite
CH-97-10B	41.84	Black mudstone (Coal Patches)
CH-97-10B	46.65	Brown mudstone (Black patches)
CH-97-10B	47.40	Black mudstone

Table 1(continued): Facies types of analysed samples		
Boreholes	**Depths(m)**	**Facies**
CH-97-10B	48.64	Dark grey mudstone
CH-97-10B	55.05	Light grey (brownish) mudstone
CH-97-10B	57.54	Lignite
CH-97-10B	57.69	Lignite
CH-97-10B	57.71	Lignite
CH-97-10B	58.12	Lignite
CH-97-10B	59.00	Light grey mudstone
CH-97-10B	60.54	Light grey mudstone
CH-97-10B	62.42	Lignite
CH-97-10B	63.01	Lignite
CH-97-10B	104.26	Mottled mudstone
CH-97-10B	108.14	Mottled mudstone
CH-97-10B	109.55	Green mudstone (Brown patches)
CH-97-10B	112.04	Green mudstone
CH-97-10B	112.05	Lignite
CH-97-10B	114.42	Lignite
CH-97-9	46.22	Lignite
CH-97-9	46.49	Lignite
CH-97-9	47.20	Lignite
CH-97-9	47.64	Lignite
CH-97-9	47.81	Lignite
CH-97-9	48.00	Lignite
CH-97-9	48.19	Lignite
SG-98-48	31.24	Lignite
SG-98-48	31.84	Lignite
SG-98-48	31.98	Lignite
SG-98-48	32.20	Lignite
SG-98-48	32.40	Lignite
SH-94-3	30.70	Lignite
SH-94-4	78.91	Lignite
GR-97-19	87.20	Light grey mudstone (Carboniferous)
GR-97-19	88.25	Black mudstone (Carboniferous)
GR-97-19	90.00	Dark grey mudstone (Carboniferous)
GR-97-19	93.74	Black mudstone (Carboniferous)

Table 2: Electron microprobe chemical analyses of detrital and diagenetic minerals in representative lignite samples

Borehole	Depth (m)	Mineral	Analysis no.*	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO_t	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	ZrO_2	BaO	SO_3	Total
MRB-97-32A	116.80	Garnet (spes.)	963	34.38	0.13	21.35	0.02	8.48	28.81	0.22	4.78	-	-	-	-	0.28	0.01	98.45
MRB-97-32A	116.80	Ilmenite[+]	964	0.61	71.73	1.19	0.19	13.98	1.74	0.01	0.03	-	-	0.04	0.17	1.03	0.32	91.05
MRB-97-32A	116.80	Zircon	965	30.59	0.16	0.02	0.11	0.14	0.09	0.06	0.04	0.09	-	-	66.06	0.75	0.05	98.17
MRB-97-32A	116.80	Tourmaline	966	32.24	0.32	32.69	-	10.11	0.12	4.02	0.11	1.75	-	-	-	-	-	81.37
MRB-97-32A	116.80	Rutile	967	0.86	81.62	1.28	0.65	3.64	0.01	0.02	0.03	0.03	-	0.03	0.19	1.33	0.64	90.34
MRB-97-32A	116.80	Muscovite	968	38.98	0.29	33.25	0.01	1.90	-	0.41	-	0.83	8.36	-	-	0.32	0.01	84.35
MRB-97-32A	116.80	Muscovite	969	40.88	0.43	33.34	-	1.22	-	0.56	-	0.34	9.53	-	-	0.29	0.04	86.63
MRB-97-32A	116.80	Tourmaline	970	31.44	0.61	27.61	-	10.29	0.01	7.03	2.11	1.39	-	-	-	0.12	-	80.61
MRB-97-32A	116.80	Tourmaline	971	33.99	0.13	35.39	-	6.83	-	4.53	0.24	1.26	-	-	-	-	-	82.37
MRB-97-32A	116.80	Zircon	972	31.68	0.40	0.29	0.36	0.41	0.38	0.33	0.32	0.35	-	0.34	64.19	0.61	0.34	100.00
MRB-97-32A	116.80	Ilmenite[+]	973	0.70	61.26	0.18	0.07	24.69	1.81	0.06	0.05	-	-	-	0.12	1.06	0.30	90.30
MRB-97-32A	121.17 (h*)	Altered Ilm	423	0.50	80.61	1.82	0.31	8.66	0.22	0.05	0.81	0.04	-	0.46	0.14	1.32	0.53	95.47
MRB-97-32A	121.17 (h)	Altered Ilm	425	0.16	73.58	1.62	0.34	2.21	0.00	-	0.05	0.04	-	0.21	0.28	1.35	0.51	80.35
MRB-97-32A	121.17 (h)	Altered Ilm	440	-	78.90	0.05	-	0.27	-	-	0.03	0.02	-	-	-	1.61	-	80.87
MRB-97-32A	121.17 (h)	Altered Ilm	449	-	62.25	0.50	-	22.54	2.99	1.24	0.26	-	-	0.02	-	0.91	0.27	90.98
MRB-97-32A	121.17 (h)	Altered Ilm	450	-	89.10	0.43	0.12	0.61	-	-	0.10	-	-	0.03	-	1.33	0.15	91.87
MRB-97-32A	121.17 (h)	Altered Ilm	461	-	84.68	0.61	0.44	0.73	-	-	0.19	-	-	-	-	1.33	0.21	88.17
MRB-97-32A	121.17 (h)	Ankerite	443	-	0.14	0.01	-	15.51	1.18	9.35	26.46	0.01	-	-	-	-	0.01	52.68
MRB-97-32A	121.17 (h)	Biotite	454	37.25	1.37	16.29	-	20.53	0.07	8.66	-	-	9.30	-	-	-	-	93.47
MRB-97-32A	121.17 (h)	Chlorite	455	25.39	-	20.87	-	24.26	0.36	13.88	-	-	-	-	-	-	-	84.75
MRB-97-32A	121.17 (h)	Cpx	458	51.29	1.13	3.42	0.21	8.45	0.22	14.28	19.69	0.52	0.16	0.16	0.16	0.16	0.16	100.03
MRB-97-32A	121.17 (h)	Cpx	460	53.21	0.34	3.07	0.25	7.27	0.19	17.10	17.47	0.35	0.16	0.16	0.16	0.16	0.16	100.05
MRB-97-32A	121.17 (h)	Muscovite	453	46.23	0.80	32.79	-	1.97	-	0.88	-	0.24	10.32	-	-	-	-	93.23
MRB-97-32A	121.17 (h)	Muscovite	456	48.03	-	30.51	-	2.97	-	1.65	-	0.02	10.80	-	-	-	-	93.98
MRB-97-32A	121.17 (h)	Plagioclase	451	53.06	-	29.58	-	0.46	-	-	12.53	4.11	0.14	-	-	-	-	99.89
MRB-97-32A	121.17 (h)	Staurolite	457	28.01	0.35	55.10	-	12.55	0.09	1.32	-	-	-	-	-	-	-	97.42
MRB-97-32A	121.17 (h)	Staurolite	459	27.99	0.35	55.27	-	11.66	0.18	1.44	-	-	-	-	-	-	-	96.88
MRB-97-32A	121.17 (h)	Tourmaline	452	35.26	0.20	33.84	-	13.34	0.25	0.47	0.02	1.95	-	-	-	-	-	85.33
MRB-97-32A	121.17 (h)	Zircon	424	32.16	-	0.08	0.08	0.14	0.10	0.07	0.01	0.10	-	0.16	66.93	0.09	0.07	100.00
MRB-97-32A	121.17 (h)	Zircon	430	31.89	0.02	0.04	0.08	0.19	0.10	0.07	0.01	0.08	-	0.12	67.25	0.08	0.07	100.00
MRB-97-32A	121.17 (h)	Zircon	439	31.68	0.08	0.06	0.08	0.24	0.10	0.06	0.02	0.09	-	0.15	67.29	0.12	0.03	100.00
MRB-97-32A	121.17 (h)	Zircon	441	31.95	0.06	0.05	0.09	0.15	0.08	0.07	0.01	0.09	-	0.11	67.18	0.12	0.05	100.00
MRB-97-32A	121.17 (h)	Zircon	446	34.23	0.10	-	-	0.06	0.01	0.01	-	-	0.01	-	63.66	-	0.07	98.14
MRB-97-32A	121.17	Magnetite	914	-	0.14	0.02	0.10	92.71	0.22	-	0.07	-	-	0.03	0.33	2.49	0.07	96.18
MRB-97-32A	121.17	Rutile	915	-	96.63	0.03	0.17	0.87	0.02	-	0.02	0.02	-	0.01	0.12	1.53	0.06	99.47
MRB-97-32A	121.17	Kaolinite	918	43.26	0.14	36.96	0.06	0.19	0.05	0.13	0.40	0.06	0.19	-	-	0.10	0.03	81.58
MRB-97-32A	121.17	Rutile	924	0.49	92.61	1.08	1.22	0.85	0.43	0.44	0.53	-	-	0.54	-	1.81	-	100.00
MRB-97-32A	121.17	Rutile	925	0.05	96.78	0.08	0.04	0.37	-	-	0.05	-	0.01	0.02	-	1.15	-	98.55
MRB-97-32A	121.17	Zircon	926	31.07	0.17	0.20	0.22	0.38	0.31	0.31	0.17	0.31	0.25	0.40	65.48	0.49	0.23	100.00
MRB-97-32A	121.17	Rutile	927	0.13	95.50	0.23	0.03	0.71	-	0.00	0.05	-	0.01	0.02	-	1.42	-	98.10
MRB-97-32A	121.17	Rutile	934	0.75	93.70	0.43	0.26	0.90	0.31	0.21	0.39	0.25	0.22	0.18	0.31	1.90	0.20	100.00
MRB-97-32A	121.17	Rutile	935	1.06	82.75	2.42	1.46	2.93	0.86	0.77	1.28	0.77	0.76	0.89	1.04	2.24	0.78	100.01
MRB-97-32A	121.17	Rutile	936	0.16	95.90	0.18	0.15	0.51	0.14	0.05	0.18	0.07	0.06	0.06	0.13	1.82	0.09	99.49
MRB-97-32A	121.17	Kaolinite	941	38.51	2.31	30.99	0.98	1.63	1.03	1.26	1.87	1.03	1.36	0.96	-	1.08	1.00	84.00
MRB-97-32A	121.17	Tourmaline	943	33.12	0.56	32.01	0.08	11.15	0.24	4.21	0.52	1.89	0.10	0.05	-	0.30	0.02	84.25
MRB-97-32A	121.17	Kaolinite	944	43.10	0.10	37.76	0.03	0.23	0.06	0.09	0.16	0.04	0.02	0.07	-	0.23	0.04	81.93
MRB-97-32A	121.17	Tourmaline	945	33.50	1.16	31.78	0.09	8.59	0.12	5.57	0.60	1.70	0.04	0.03	-	0.29	0.03	83.51
MRB-97-32A	121.17	Tourmaline	946	32.96	0.19	33.13	-	8.77	0.21	5.11	0.13	1.97	-	-	-	-	0.01	82.48
MRB-97-32A	121.17	?Kaolinite	949	32.08	9.74	25.15	1.83	2.62	1.80	2.15	2.48	1.84	2.41	-	-	-	1.87	83.96
CH97-10B	62.42-62.49	Altered Ilm	463	-	88.49	0.05	-	1.00	-	-	0.07	-	0.02	-	-	1.31	-	90.94
CH97-10B	62.42-62.49	Altered Ilm	464	0.25	62.97	0.41	-	22.93	2.01	0.01	0.06	-	0.03	-	-	0.86	-	89.52
CH97-10B	62.42-62.49	Altered Ilm	465	-	87.28	0.60	-	0.83	-	-	0.08	-	-	-	-	1.17	0.04	90.00
CH97-10B	62.42-62.49	Altered Ilm	468	0.18	81.68	0.20	0.01	0.48	0.01	-	0.06	-	0.01	-	-	1.37	0.01	84.02
CH97-10B	62.42-62.49	Altered Ilm	470	0.16	63.77	0.39	0.09	16.55	0.82	0.02	0.09	-	-	0.10	-	1.11	0.11	83.21
CH97-10B	62.42-62.49	Altered Ilm	473	0.22	68.81	0.44	0.02	19.67	0.19	0.03	0.10	0.01	0.07	0.14	0.03	1.17	0.02	90.91

Table 2(continued): Electron microprobe chemical analyses of detrital and diagenetic minerals in representative lignite samples

Borehole	Depth (m)	Mineral	Analysis no.*	SiO_2	TiO_2	Al_2O_3	Cr_2O_3	FeO_t	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	ZrO_2	BaO	SO_3	Total
CH97-10B	62.42-62.49	Altered Ilm	475	3.97	82.73	3.25	0.14	0.25	-	0.03	0.05	0.02	0.23	-	-	1.35	-	92.01
CH97-10B	62.42-62.49	Altered Ilm	476	1.98	85.69	3.97	0.11	0.75	-	0.03	0.11	0.19	0.15	0.30	0.10	1.39	0.07	94.82
CH97-10B	62.42-62.49	Muscovite	479	47.38	0.21	37.79	0.03	0.24	0.01	0.12	0.04	0.64	5.46	-	-	0.14	0.04	92.11
CH97-10B	62.42-62.49	Muscovite	480	48.58	0.39	35.46	0.04	1.13	-	0.78	0.01	0.61	8.32	-	-	0.27	-	95.59
CH97-10B	62.42-62.49	Muscovite	481	46.89	0.12	37.53	0.03	0.36	0.01	0.20	0.01	0.95	8.71	-	-	0.19	-	95.00
CH97-10B	62.42-62.49	Muscovite	482	48.21	0.16	38.40	-	0.37	0.01	0.21	0.03	0.62	7.16	-	-	0.14	0.01	95.31
CH97-10B	62.42-62.49	Rutile	471	0.07	97.66	0.07	0.13	0.19	-	0.01	0.01	0.01	0.05	-	-	1.55	-	99.75
CH97-10B	62.42-62.49	Rutile	472	2.01	92.23	1.58	0.35	0.69	-	0.30	0.38	0.32	0.40	-	-	1.74	-	100.00
CH97-10B	62.42-62.49	Rutile	474	1.10	93.85	0.44	-	0.57	-	-	0.35	0.01	0.10	-	0.20	1.65	-	98.28
CH97-10B	62.42-62.49	Zircon	462	33.74	-	-	-	0.03	-	-	0.02	0.02	-	0.08	63.87	-	-	97.75
CH97-9	48.19-48.23	Ilmenite+	491	12.55	64.53	9.26	0.10	0.84	0.03	0.21	0.18	0.04	1.19	0.02	0.03	1.13	0.04	90.19
CH97-9	48.19-48.23	Ilmenite+	496	0.27	75.82	0.86	0.21	13.21	0.33	0.06	0.25	0.01	-	0.41	0.35	1.48	0.07	93.33
CH97-9	48.19-48.23	Ilmenite+	499	0.07	87.29	0.65	0.11	6.58	0.07	0.02	0.12	0.02	-	0.17	0.21	1.59	0.05	96.95
CH97-9	48.19-48.23	Rutile	490	-	97.68	0.07	0.04	0.15	0.04	-	0.05	0.00	-	-	0.17	1.76	0.02	100.00
CH97-9	48.19-48.23	Rutile	492	-	99.59	0.14	0.05	0.15	0.01	-	0.10	0.01	-	0.01	0.18	1.69	0.04	101.98
CH97-9	48.19-48.23	Rutile	493	0.02	98.92	0.12	0.04	0.21	0.04	-	0.08	0.01	-	0.01	0.15	1.62	0.02	101.25
CH97-9	48.19-48.23	Rutile	497	0.53	93.45	0.57	0.41	0.47	0.37	0.33	0.39	0.34	-	0.36	0.45	1.98	0.34	100.00
CH97-9	48.19-48.23	Rutile	498	0.71	95.17	0.25	0.07	1.13	0.12	-	0.22	0.17	-	0.04	0.14	1.85	0.04	99.91
CH97-9	48.19-48.23	Zircon	494	31.40	0.23	0.06	0.15	0.18	0.15	0.05	0.07	0.08	-	0.24	66.92	0.33	0.15	100.01
SG98-48	32.40-32.44	Ilmenite+	502	0.42	78.03	1.65	0.27	5.02	0.14	0.03	0.67	-	0.05	0.38	0.19	1.47	0.07	88.41
SG98-48	32.40-32.44	Ilmenite+	504	0.11	76.81	1.56	0.20	9.36	0.16	0.03	0.55	-	0.05	0.12	0.15	1.45	0.06	90.62
SG98-48	32.40-32.44	Ilmenite+	506	0.16	85.12	1.07	0.09	2.25	0.11	0.03	0.55	-	0.04	0.17	0.19	1.54	0.09	91.41
SG98-48	32.40-32.44	Ilmenite+	512	0.07	67.46	0.94	0.08	17.14	1.45	0.04	0.39	-	0.07	0.20	0.16	1.27	0.05	89.32
SG98-48	32.40-32.44	Rutile	501	-	99.14	0.14	0.04	0.27	0.10	0.03	0.13	-	0.06	0.07	0.09	1.66	0.04	101.75
SG98-48	32.40-32.44	Rutile	505	-	95.82	0.31	0.30	0.98	0.07	0.01	0.26	0.02	0.06	0.17	0.17	1.71	0.06	99.91
SG98-48	32.40-32.44	Staurolite	509	27.31	0.42	54.89	0.04	13.59	0.29	1.59	0.04	-	0.02	0.01	-	0.02	-	98.21
SG98-48	32.40-32.44	Zircon	503	31.72	0.25	0.09	0.16	0.29	0.15	0.07	0.14	0.06	0.08	0.38	66.06	0.41	0.13	100.00
SG98-48	32.40-32.44	Zircon	510	31.66	0.27	0.07	0.16	0.26	0.17	0.07	0.14	0.07	0.09	0.15	66.51	0.34	0.05	99.99
SG98-48	32.40-32.44	Zircon	511	31.10	0.23	0.07	0.14	0.29	0.17	0.07	0.12	0.08	0.10	0.44	66.83	0.28	0.10	100.01
SG98-48	32.40-32.44	Kaolinite	956	44.72	0.08	38.64	0.05	0.08	0.04	0.08	0.10	0.06	0.10	-	0.07	-	0.03	84.04
SG98-48	32.40-32.44	Kaolinite	957	44.02	0.11	38.55	0.06	0.09	0.06	0.06	0.12	0.05	0.03	-	0.09	0.20	0.06	83.50
SG98-48	32.40-32.44	Rutile	958	6.65	79.27	4.20	0.66	1.03	0.68	0.90	0.75	0.63	1.45	0.59	0.75	1.84	0.62	100.00
SG98-48	32.40-32.44	Rutile	961	0.12	96.54	0.15	0.11	0.20	0.11	0.05	0.12	0.06	0.06	0.02	0.31	1.55	0.05	99.46
SG98-48	32.40-32.44	Tourmaline	962	34.09	0.37	34.97	0.07	11.04	0.22	2.64	0.09	1.64	0.03	0.01	0.06	0.08	0.02	85.33

*: These analyses are for heavy mineral separates; all others are for polished thin sections of appropriate hand specimens that could withstand polishing.

+: All the ilmenite analyses come from ilmenite grains that are altering to rutile; the low totals are probably due to the porous state of the grains.

Table 3: Whole rock chemical analyses, XRD and colour of representative ashed lignite samples

Ashed Lignites Wells	Major Elements Depths(m)	SiO_2	TiO_2	Al_2O_3	Fe_2O_{3t}	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	LOI	Total	Trace Elements and REE (ppm) Ba	Rb	Sr	Y	Zr	Nb	Pb	Ga	Zn	Cu	Ni	V	Cr	La	Ce	Pr	Nd	Sm
MBR-97-32A	103.3	44.68	2.4	35.36	2.2	0.01	0.38	1.11	0.34	0.44	0.09	11.69	98.69	222	18	196	55	320	44	63	59	40	53	53	226	161	53.8	114	13.1	51.1	11.1
	107.42	31.37	2.01	25.02	7.05	0.02	0.53	7.55	0.19	0.18	0.07	21.63	95.98	148	7	752	103	324	40	136	46	20	96	78	376	244	42.8	81.9	10.1	40.5	10.8
	108.66	9.69	0.63	10.08	35.74	0.01	0.25	3.68	0.14	0.1	1.81	34.05	96.18	646	4	3640	63	75	22	133	25	13	68	50	107	68	209	330	35.9	128	25
	108.87	42.22	1.02	35.42	1.42	0.01	0.29	1.6	0.31	0.63	0.06	15.88	98.86	225	32	207	28	116	21	33	43	30	36	27	106	80	40.1	58.7	7.6	28.4	6.5
	109.27	42.37	1.44	35.42	2.71	0.01	0.32	1.38	0.21	0.64	0.06	14.43	99	237	32	193	33	180	29	58	42	42	57	39	123	101	54.7	91	11.5	41.6	8.8
	110.78	28.87	2.23	24.93	11.25	0.02	0.45	5.2	0.09	0.13	0.13	22.57	95.85	140	8	659	98	334	43	65	54	27	86	56	337	362	59.1	87.8	10.1	36.5	8.7
	111.10	33.52	2.28	26.59	2.79	0.02	0.53	5.27	0.18	0.23	0.09	26.2	97.7	128	12	544	98	397	56	72	57	39	123	22	338	228	49.8	76.6	8.98	34.2	8.7
	111.36	44.02	3.09	31.74	1.37	0.01	0.39	2.16	0.16	0.3	0.07	15.9	99.2	130	20	248	47	259	32	60	53	49	67	50	142	112	73	136	16.3	60.9	12.7
	111.66	41.85	1.87	33	3.18	0.01	0.39	1.96	0.14	0.3	0.08	16.49	99.28	111	20	268	61	437	52	61	61	35	57	26	161	127	58.3	111	13.7	49.9	10.8
	112.06	46.86	2.06	33.29	1.67	0.01	0.38	1.45	0.17	0.52	0.08	13.68	100.19	181	33	215	45	301	35	52	51	53	41	39	156	125	70.7	118	14.5	54.5	10.9
	114.31	72.43	1.84	11.44	1.56	0.01	0.21	1.04	0.17	0.38	0.04	10.18	99.3	106	21	122	36	644	28	19	42	89	21	13	71	62	32.3	54.7	6.55	24.5	4.8
	121.15	65.88	2.96	16.47	0.68	0.01	0.24	1.68	0.14	0.23	0.05	10.61	98.94	66	17	87	56	775	37	30	20	36	36	13	83	79	36.4	62.4	7.42	27.7	6
	121.17	79.52	2.06	10.9	0.65	0.01	0.17	0.75	0.09	0.27	0.04	5.57	100.03	66	17	80	55	742	35	31	19	39	34	13	80	70	34.9	59.6	7.12	26.6	5.7
	121.66	78.68	2.22	11.01	0.83	0.01	0.18	0.81	0.07	0.23	0.05	5.84	99.93	68	15	153	79	631	50	27	25	27	35	8	124	99	32.7	51.9	6.38	24	5.6
	137.25	47.99	0.57	12.02	8.34	0.02	0.83	0.16	0.17	2.73	0.04	21.71	94.57	408	89	66	94	159	14	235	16	327	73	265	208	162	31.1	60.7	8.77	38.3	9.8
CH-97-10B	40.95	46.34	0.95	29.81	1.79	0.02	0.43	2.57	0.31	1.5	0.06	14.72	98.5	403	86	143	104	143	16	40	69	271	86	34	219	134	120	311	36.4	151	31.2
	57.54	66.28	1.68	19.78	0.84	0.01	0.15	1.14	0.36	1.27	0.06	7.69	99.27	351	57	114	102	483	28	46	36	129	50	18	99	100	78	195	25.4	111	24.5
	57.69	59.81	1.75	22	1.59	0.01	0.21	1.92	0.45	1.61	0.09	9.09	98.52	481	71	153	127	430	29	53	79	344	55	20	176	125	94.1	247	32.6	141	31.6
	57.79	58.72	1.83	26.29	1	0.01	0.2	1.42	0.48	1.86	0.07	8.13	99.99	442	82	155	118	340	28	34	48	100	51	22	206	154	101	264	34.9	151	32.6
	58.12	75.39	1.5	15.44	0.81	0.01	0.1	0.56	0.23	0.89	0.05	4.78	99.77	231	39	74	76	535	24	25	23	50	25	21	115	85	69.8	201	26.4	112	24.1
	62.42	74.44	1.18	16.55	0.91	0.01	0.13	0.4	0.26	1.37	0.05	4.55	99.85	313	59	68	77	332	19	24	26	229	28	28	107	85	24.8	79.4	15.3	86	26.3
	63.01	74.79	1.13	13.86	2.18	0.01	0.11	0.44	0.22	0.94	0.03	4.92	98.63	259	46	67	59	340	23	28	25	110	33	22	256	98	24.8	64.4	11.1	58.6	17.4
	113.05	45.26	0.54	9.75	17.89	0.1	0.84	1.34	0.2	2.65	0.86	19.31	98.73	303	82	86	61	248	11	108	15	1432	42	167	99	92	66.3	186	22.9	102	22.5
	114.42	50.46	0.78	18.57	8.23	0.05	2	0.94	0.35	4.9	0.39	10.07	96.74	530	151	129	52	209	16	108	27	51	77	93	164	137	54.3	103	12.8	53.7	11.2
CH-97-9	46.22	45.16	0.99	31.07	4.62	0.02	0.41	2.49	0.32	1.24	0.08	12.18	98.6	380	70	146	118	132	17	129	69	264	104	61	320	152	148	379	45.6	191	42.9
	46.49	48.41	1	33.16	1.69	0.02	0.41	1.52	0.28	1.54	0.08	10.91	99.02	371	85	110	98	134	18	43	41	611	78	40	170	134	153	389	45	185	37.9
	47.20	58.25	1.16	27.11	1.13	0.01	0.32	1.16	0.25	1.27	0.06	7.96	98.68	354	68	100	73	235	20	42	36	70	54	40	124	127	92.5	235	27.3	110	23.4
	47.64	53.85	1.06	29.73	2.02	0.02	0.39	1.8	0.25	1.48	0.06	8.36	99.01	416	91	120	78	193	18	37	49	154	71	41	131	139	87.1	218	25.9	107	22.9
	47.81	53.77	1.07	29.73	2.41	0.01	0.36	1.61	0.24	1.48	0.05	10.78	99.67	450	95	121	60	229	19	40	47	338	68	55	151	149	66	149	17.6	71.5	14.6
	48.00	60.86	1.19	24.9	1.67	0.01	0.31	1.06	0.2	1.48	0.05	7.51	99.25	473	81	90	43	290	19	31	34	472	57	43	130	120	49	100	11.6	46.6	9.7
	48.19	63.92	1.2	22.47	1.22	0.01	0.28	0.68	0.27	1.47	0.05	7.28	98.84	405	84	76	40	307	21	30	30	164	53	40	136	122	47	95	10.9	43.5	8.8
SG-98-48	31.24	38.26	0.62	28.77	4.36	0.04	0.44	6.19	0.26	0.37	0.01	16.56	95.87	225	7	459	368	673	44	42	31	25	99	7	114	118	314	803	100	435	101
	31.84	59.12	1.87	21.09	2.08	0.03	0.35	5.05	0.29	0.13	0.03	7.71	97.76	125	15	385	290	135	14	36	33	78	42	22	88	47	217	581	74	318	70.2
	31.98	65.07	2.27	17.09	1.78	0.03	0.26	3.87	-	-	0.03	6.73	97.06	155	7	347	405	487	34	106	26	23	75	14	69	82	301	835	101	424	93.4
	32.2	78.83	2.6	16.39	2.51	0.05	0.47	7.21	0.17	0.09	0.02	10.97	95.97	252	4	278	341	560	42	87	27	21	91	9	69	98	237	661	80.3	343	77
	32.40	45.16	1.44	10.85	1.06	0.02	0.16	2.19	0.07	0.06	0.03	4.92	99.62	53	5	138	208	465	23	78	20	18	125	8	54	78	133	363	44.4	188	44.2
SH-94-3	31.76	41.05	1.04	28.77	9.49	0.01	0.33	1.35	0.44	1.09	0.05	13.55	97.18	310	61	195	71	142	21	33	76	214	58	502	129	117	57.3	105	12.1	49.7	10.5
SH-94-4	75.91	51.58	1.66	30.6	2.74	0.01	0.3	1.56	-	0.87	0.07	9.55	98.86	325	53	243	88	245	33	47	45	33	77	46	164	154	56	128	16.6	71.8	17.3
	Sandstone																														
RR-97-23	Mean	72.7	0.95	11.86	3.72	0.1	0.97	1.23	0.27	1.2	0.06	6.78	99.83	293.06	53.34	73.91	37.16	457.47	17.47	33.28	16.88	109.8	26.16	24.28	59.03	50.84	47.18	97.15	10.12	36.95	6.57
	SD	18.19	0.44	5.76	5.93	0.18	3.14	4.81	0.1	0.96	0.04	7.56	0.46	199.57	29.53	54.95	20.11	148.99	7.69	51.33	8.66	226.1	29.61	22.16	36.03	33.83	35.24	78.38	7.88	27.42	4.19
RR-97-23	Mudstone																														
	Mean	56.42	1.29	26.95	2.69	0.02	0.23	0.21	0.36	1.76	0.05	9.65	99.64	535.17	87.52	136.28	39.72	292	28	35.41	38.1	35.86	53.07	33.97	106.69	97	61	117	13	49	10
	SD	8.94	0.24	6.89	2.19	0.02	0.14	0.07	0.10	0.59	0.06	2.88	0.48	291.79	26.83	104.78	15.35	101.58	5.16	19.77	1037	14.4	48.54	12	29.31	18.69	47.2	114.46	15.54	72.39	13.66

Table 3(continued): Whole rock chemical analyses, XRD and colour of representative ashed lignite samples

Ashed Lignites	Trace Elements Continued																								Carbon			Colour		
Wells	**Depths**	**Eu**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Co**	**Cs**	**Hf**	**Sb**	**Sc**	**Ta**	**Th**	**U**	**As**	**S**	**Tl**	**Bi**	**Sn**	**Ash %**	**O.C %**	**I.C %**	**$CaCO_3$ %**	**L**	**A**	**B**
MBR-97-32A	103.3	2.46	10	1.7	10.3	2.1	6.4	0.98	6.1	0.88	17	2.3	8.1	0.8	38	3.1	26.3	7.9	10.9	0.3	0.5	9	13	88.53	16.9	-	-	51.71	2.96	4.59
	107.42	2.91	14.1	2.9	18.8	3.8	11	1.57	9.2	1.27	17	0.8	8.6	2.5	58	2.8	30.9	13.8	16.5	4.97	0.8	7	16	50.01	13.1	-	-	37.68	0.48	0.33
	108.66	5.38	21.1	2.8	14.7	2.3	5.9	0.75	4.2	0.54	7	0.5	2.7	5.8	16	0.7	11.9	9.5	62.7	13.37	3.2	20	7	61.58	6.63	-	-	39.62	0.94	1.43
	108.87	1.43	5.8	1	5.8	1.1	3	0.42	2.5	0.35	6	3	2.9	-	17	1.6	11.7	4.6	3.5	0.96	0.3	4	4	80.46	7.09	-	-	51.38	0.9	1.71
	109.27	1.86	7.7	1.2	6.9	1.3	3.7	0.52	3	0.44	9	3.9	4.4	-	24	2.1	18	9	3.8	1.07	0.6	5	5	80.05	15	0.40	3.33	48.02	1.26	2.27
	110.78	2.32	11	2.5	18	4	11.5	1.71	10	1.42	7	1	8	1	89	2.8	32.3	17.7	8.5	4.56	0.4	13	4	57.82	6.58	-	-	39.6	0.59	0.36
	111.10	2.39	11.3	2.6	18.1	3.9	11.6	1.71	10.4	1.47	5	1.6	9.6	0.8	53	3.2	34.3	14.8	4.2	2.49	-	8	3	53.21	9.53	1.17	9.75	38.91	0.54	0.34
	111.36	2.7	10.6	1.6	9.6	1.9	5.3	0.76	4.7	0.71	11	5.1	6.4	-	26	2.4	18.9	6.6	6.5	0.48	0.2	12	8	80.09	8.81	1.15	9.58	43.13	1.27	1.7
	111.66	2.42	10	1.7	11	2.3	6.9	1.04	6.4	0.97	8	5.9	10.5	0.5	26	3.8	25.8	8.1	3.6	1.82	0.4	10	4	80.9	12	8.10	67.50	43.51	1.54	2.08
	112.06	2.44	9.9	1.6	9	1.7	5.1	0.74	4.5	0.66	10	9.6	6.9	-	26	2.5	18.6	6.4	4.4	0.5	0.4	7	5	86.19	11	8.60	71.67	47.74	1.92	2.97
	114.31	1.08	4.9	0.9	6	1.3	4.2	0.66	4.3	0.67	6	5.9	14.5	-	10	2.1	9.1	4	2.6	1.31	0.3	7	1	73.55	10.48	-	-	42.95	1.91	2.63
	121.15	1.42	7.2	1.4	9.9	2.2	6.7	1.02	6.4	0.97	4	4.5	18.2	-	13	2.9	14.7	6.2	2.9	0.49	-	8	6	79.2	7.26	2.84	23.67	46.76	1.34	2
	121.17	1.4	6.9	1.4	9.5	2	6.3	0.95	5.9	0.91	4	4.6	16.9	-	12	2.7	13.6	5.8	2.6	0.3	0.2	6	4	88.78	9.45	-	-	45.74	1.35	2.16
	121.66	1.56	8.5	2	13.8	3	9.4	1.44	8.9	1.31	3	3.5	15	-	22	3.9	19	6.6	2.6	0.49	0.3	10	4	88.75	12.3	3.80	31.67	41.03	0.86	1.11
	137.25	2.61	12.2	2.4	15.7	3.3	9.8	1.36	8	1.1	92	5	4.2	1.4	12	0.6	7.9	32	27.6	4.86	3.2	6	-	80.94	3.04	-	-	39.89	1.39	1.58
CH-97-10B	40.95	6.93	28.7	3.9	21.4	4	11.4	1.49	8.5	1.26	9	9.6	3.7	0.8	32	1.3	16.9	9.3	5.2	1.61	1.1	5	5	76.17	25.75	-	-	42.05	1.21	1.68
	57.54	5.13	24.8	3.5	19.9	3.8	10.7	1.46	8.2	1.25	5	4.8	12.1	-	19	2.2	15.2	31.3	2.5	0.67	0.7	6	5	75.25	15.1	-	-	43.55	1.57	2.39
	57.69	6.82	33.1	4.4	24.8	4.7	13.2	1.79	10.1	1.57	7	6.1	10.8	0.9	24	2.3	16.8	31.1	5	1.44	1	6	6	58.22	21.9	0.20	1.67	42.71	1.63	1.99
	57.79	6.77	31.8	4.3	22.8	4.1	11.5	1.55	8.8	1.33	7	7.2	8.7	-	25	2.3	18.5	14.8	3.6	0.76	0.9	5	5	72.58	15.7	-	-	44.27	1.54	2.31
	58.12	4.84	21.8	2.9	15.5	2.8	8	1.11	6.3	0.96	11	3.4	12.8	-	18	2	12.7	11.7	3.8	0.33	0.8	6	4	88.04	5.17	-	-	50.24	1.57	2.44
	62.42	5.49	24.4	3.3	17.6	3.1	8.8	1.23	7.2	1.06	14	5.5	8.3	-	17	1.5	11.7	6.4	6.7	0.24	1	3	4	89.21	5.77	0.05	0.42	52.84	2.4	4.03
	63.01	3.74	17	2.5	13.3	2.4	6.9	0.98	5.8	0.83	10	4.5	8.9	-	20	1.6	11	48.7	6.9	0.35	0.8	5	4	86.59	7.97	-	-	46.78	2.22	3.46
	113.05	5.09	20.2	2.5	12.9	2.2	5.9	0.72	4.1	0.62	144	4.6	5.7	3.2	9	0.6	12.4	21.7	64.6	8.66	8.2	7	4	83.07	6.4	0.36	3.00	42.57	2.34	3.75
	114.42	2.7	11.6	1.6	9.3	1.8	5.3	0.72	4.2	0.67	34	9.3	5.1	1.8	16	0.9	12.1	44.7	35.7	4.39	2.3	6	2	91.68	4.65	-	-	46.86	2.69	4.79
CH-97-9	46.22	9.6	39.2	5.2	27.3	5	12.9	1.66	9.8	1.38	28	9.8	3.6	1.1	57	1.4	19.8	125	10.3	2.06	8.9	3	7	48.91	11.6	12.20	101.67	39.7	0.79	0.92
	46.49	8.28	33.6	4.3	22.5	3.9	10.4	1.33	7.5	1.04	11	10.1	3.6	0.8	28	1.4	16.2	10.1	8.1	0.79	3.1	4	6	67.89	8.31	8.49	70.75	46.45	1.08	1.71
	47.20	5.21	20.7	2.9	15.4	2.9	8	1.1	6.3	0.93	14	7	5.7	0.6	26	1.6	16	7.8	6.3	0.56	1.5	3	10	75.77	8.87	3.73	31.08	49.48	1.63	2.72
	47.64	5.01	20.2	2.8	15.8	3	8.5	1.17	6.7	1	19	8.7	4.9	1	24	1.5	17	8.2	6.5	1.03	1.4	5	6	55.29	9.69	13.61	113.42	44.22	2.07	2.83
	47.81	3.25	13.6	1.9	11	2.1	6.3	0.89	5.3	0.79	43	8.9	5.4	-	24	1.6	18	6.9	9	0.97	2.9	2	5	57.25	10.6	11.50	95.83	47.67	2.09	2.92
	48.00	2.13	9.2	1.4	8.1	1.6	5	0.74	4.4	0.67	25	7.5	7.1	-	21	1.6	17.3	5.9	8.5	0.67	1.8	2	6	67.78	13.6	3.30	27.50	45.53	2.38	3.37
	48.19	1.84	8.4	1.2	7.4	1.5	4.4	0.66	4	0.61	22	7.8	7.5	0.6	21	1.7	16.8	6.2	6.6	0.38	1.5	6	6	79.11	10.6	0.50	4.17	50.94	2.71	4.61
SG-98-48	31.24	20.4	98.1	13.8	71.4	12.8	34.2	4.46	24.3	3.17	2	0.8	18.7	1.6	38	3.4	24.5	18.9	53	4	0.4	3	7	32.12	25.6	0.20	1.67	37.11	0.49	0.38
	31.84	14.1	70.6	9.7	49.4	8.9	24	3.04	15.9	1.99	8	1.5	3.8	-	16	0.7	10	11.9	2.4	1.07	0.1	8	12	47.29	27.3	0.60	5.00	39.35	0.62	0.63
	31.98	18.9	94.3	13.5	73	13.5	36.6	4.8	25.6	3.31	4	0.9	13	-	42	2.3	16.5	21.5	-	1.03	-	8	16	54.04	24.8	-	-	38.3	0.59	0.28
	32.2	15.8	80.9	11.9	63.1	12	32.6	4.36	23.4	3.02	2	0.6	15.1	-	39	3	20	20.2	1	2.68	0.1	6	19	36.42	21.5	1.80	15.00	39.38	0.59	0.28
	32.40	9.24	48.1	7.1	39.8	7.9	21.1	2.83	15.9	2.2	2	0.5	10.9	-	39	1.6	12.8	21.9	2.9	0.91	0.2	5	5	64.48	19.35	-	-	38.27	0.59	0.44
SH-94-3	31.76	2.57	12	1.8	11.3	2.2	6.6	0.93	5.3	0.8	79	8.8	3.7	0.8	25	1.8	16.8	10.1	45.5	3.5	3.4	5	22	47.62	12.4	9.00	75.00	38.47	1.58	2.34
SH-94-4	75.91	4.21	18.4	2.9	16.2	3	8.7	1.18	6.6	0.95	16	7	6.5	0.8	29	2.4	19.8	8.7	13.9	1.12	1.6	8	24	73.25	9.95	1.55	12.92	44.79	1.59	2.33
	Sandstone																													
RR-97-23	Mean	1.14	5.76	1.01	6.03	1.22	3.6	0.56	3.59	0.55	7.13	4.37	12.73	1.32	11.16	1.66	10.91	6.12												
	SD	0.75	3.21	0.55	3.21	0.64	1.87	0.28	1.75	0.26	12.83	2.17	6.97	1	4.85	0.66	4.13	5.62												
RR-97-23	Mudstone																													
	Mean	2	9	1	8	1	4	1	4	1	12	7	8	1	22	2	16	7												
	SD	2.44	8.83	0.96	3.63	0.6	1.64	0.22	1.33	0.18	13.67	2.58	2.68	0.21	5.27	0.39	4.06	4.34												

Table 4: Whole rock chemical analyses, XRD and colour of representative mudstone samples.

Mudstone	Major Elements(wt. %)													Trace elements and REE (ppm)																		
Wells	**Depths**	**SiO_2**	**TiO_2**	**Al_2O_3**	**Fe_2O_{3t}**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**LOI**	**Total**	**Ba**	**Rb**	**Sr**	**Y**	**Zr**	**Nb**	**Pb**	**Ga**	**Zn**	**Cu**	**Ni**	**V**	**Cr**	**La**	**Ce**	**Pr**	**Nd**	**Sm**	**Eu**
MBR-97-32A	50.78	61.31	1.27	22.56	2.96	0.01	0.15	0.16	0.21	1.45	-	8.64	98.73	1040	68	62	24	292	24	12	30	33	8	28	96	80	25.4	42.2	4.26	13.9	2.4	0.55
	53.62	62.1	1.48	21.91	2.27	0.02	0.16	0.32	0.27	1.6	-	9.18	99.31	381	82	81	126	378	29	22	31	53	33	48	111	77	30.8	119	20.2	103	35.2	9.13
	55.42	50.93	1.32	32.36	1.26	0.01	0.17	0.29	0.26	1.6	-	12.03	100.23	364	73	84	57	208	27	82	41	40	13	48	74	94	89.9	150	13.1	46.5	12.2	2.95
	61.72	62.72	1.89	19.08	1.2	0.01	0.16	0.42	0.17	0.97	-	12.98	99.6	309	47	72	89	435	38	33	28	162	27	34	133	86	85.8	209	22	86.8	18.6	4.12
	62.2	57.14	1.26	26.33	1.5	0.02	0.29	0.26	0.25	2.07	-	10.98	100.1	441	115	71	46	289	30	28	37	155	32	56	128	87	45.1	99.8	11.9	56.2	15.8	3.6
	68.55	56.48	1.37	25.15	3.36	0.02	0.21	0.43	0.34	1.67	-	10.97	99.99	391	84	104	59	301	28	20	34	43	37	39	152	95	26.6	68.3	10	48.7	14.1	3.35
	70	53.86	1.31	24.68	3.19	0.02	0.22	0.6	0.32	1.66	-	13.04	98.9	394	89	106	68	258	25	24	34	38	49	37	128	97	29.5	77.1	11.1	53.2	15.6	3.91
	71.42	55.32	1.27	25.09	3.44	0.02	0.3	0.55	0.39	1.79	0.02	10.75	98.94	460	95	122	61	274	27	70	36	37	24	37	172	95	66.3	189	24.2	101	22.7	4.9
	75.2	49.03	1.78	29.69	3.69	0.01	0.2	0.42	0.25	1.13	-	13.86	100.06	1260	53	101	44	349	36	46	42	36	21	45	209	120	37.1	61.4	6.26	23.1	5.4	1.39
	76.22	46.42	1.5	34.84	1.47	0.01	0.2	0.34	0.25	1.09	-	13.62	99.74	304	52	92	25	239	32	30	48	36	48	50	173	116	32.9	45.6	4.89	16.9	3.5	0.87
	79.5	67.89	1.72	18.42	1.95	0.02	0.15	0.2	0.36	1.77	-	6.36	98.84	400	85	95	57	539	35	24	28	25	15	23	96	66	20.8	38.7	4.71	18.5	5.1	1.36
	80.4	58.19	1.71	23.68	2.81	0.02	0.17	0.42	0.32	1.46	-	10.16	98.93	335	72	109	53	488	35	26	35	35	14	40	109	86	16.2	30.2	4.23	18.1	6.4	1.8
	84.34	59.26	1.36	25.32	1.6	0.01	0.18	0.18	0.54	2.61	-	7.65	98.71	601	125	130	40	316	29	33	33	24	18	32	107	81	17.3	23.5	2.99	10.9	2.7	0.79
	94.27	40.38	1.17	28.27	14.5	0.01	0.18	0.38	0.22	1.02	0.17	13.1	99.4	305	53	135	33	173	25	56	48	32	19	35	328	91	56.4	99.4	9.66	32.5	7.7	1.83
	94.93	44.29	1.06	35.32	1.53	0.01	0.27	0.48	0.25	1.15	-	15.29	99.64	354	58	129	32	129	24	45	49	41	69	66	103	92	65.4	134	16	63.2	15.5	3.29
	96.13	44.6	1.17	35.33	1.25	0.01	0.2	0.35	0.23	1.24	0.07	14.54	98.98	385	64	215	29	152	27	71	48	41	58	49	133	119	104	222	26	93.4	15.8	2.86
	101.17	57.48	1.44	25.07	1.75	0.02	0.25	0.28	0.2	1.34	0.06	11.04	98.93	425	62	95	47	402	30	37	36	72	28	42	94	74	29.9	62.5	7.8	30.7	7	1.33
	105.16	41.57	2.72	28.14	1.65	0.01	0.31	1.05	0.21	0.51	0.09	23.82	100.08	248	22	229	58	393	-	47	49	49	28	45	163	126	55.8	136	16.4	62	14.6	3.26
	108.15	40.85	1.26	35.97	1.66	0.01	0.26	0.44	0.19	0.4	-	17.86	98.9	382	17	98	21	134	29	30	46	36	20	56	94	90	44.4	87.7	10.7	39.9	8.5	1.74
	109.96	40.2	1.54	32.04	2.24	0.01	0.28	0.68	0.22	1.06	-	20.51	98.78	324	61	160	31	189	34	44	46	70	40	69	130	120	62.7	110	13.2	48.2	10.2	2.19
	110.57	43.16	1.82	34.15	1.39	0.01	0.26	0.6	0.15	0.38	-	16.99	98.91	159	21	133	29	229	42	47	54	40	37	58	114	102	45.2	79.5	9.1	32.8	6.9	1.51
	113.76	52.39	2.11	21	1.55	0.01	0.23	1.07	0.06	0.29	0.05	21.27	100.03	100	19	152	44	409	38	31	30	30	23	26	110	73	52.3	107	12.2	45.4	9.5	2.06
	129.08	83.28	1.58	8.7	0.95	0.01	0.08	0.18	0.09	0.43	-	4.7	100	118	23	37	40	596	30	18	13	19	14	15	54	63	33.3	75.2	8.39	31	7	1.51
	138.55	59.05	0.72	13.31	4.59	0.03	1.17	0.12	0.2	3.49	-	13.61	96.29	415	125	81	18	215	14	83	17	75	35	87	116	97	32.4	59.7	6.54	25.3	5.7	1.16
CH-97-10B	35.57	67.48	1.93	19.11	0.78	0.01	0.16	0.17	0.36	1.81	-	7.11	98.92	421	91	83	47	382	37	15	27	21	62	24	158	107	31.4	54.7	6.45	24	5.6	1.27
	35.98	59.08	1.55	25.68	0.86	-	0.13	0.23	0.54	1.97	0.04	9.06	99.14	495	67	127	32	323	30	38	28	15	28	72	117	87	32.4	54.2	6.34	22.5	4.6	1.02
	38.59	59.75	1.44	25.45	0.94	0.01	0.21	0.39	0.45	1.75	-	9.29	99.68	445	83	102	35	298	29	17	35	18	8	34	114	123	50.4	97.6	10.4	37.1	7.5	1.54
	40.08	56.63	1.34	20.05	1.73	0.01	0.16	0.75	0.31	1.21	-	16.91	99.1	337	57	103	64	291	26	25	28	21	36	34	221	127	56.4	124	14.6	57.9	14.1	3.22
	41.84	53.53	1.03	19.97	0.74	0.01	0.2	0.89	0.2	1	-	21.34	98.91	275	49	83	57	222	19	27	23	15	40	19	102	98	65	157	18.2	73.1	16	3.51
	46.65	58.89	1.49	26.26	0.83	0.01	0.19	0.25	0.56	2.36	-	8.61	99.45	582	120	126	37	287	31	18	35	23	7	41	113	115	52	96.5	10.7	39.2	7.1	1.47
	47.4	45.48	1.05	22.96	1.34	0.01	0.18	0.69	0.31	1.41	-	25.45	98.88	351	68	99	56	176	20	102	28	76	54	40	173	111	53.8	130	16	65.3	14.9	3.22
	48.64	62.18	1.54	21.34	1.33	0.01	0.17	0.28	0.41	1.8	-	10.09	99.15	433	87	89	48	353	29	31	26	26	25	47	101	95	420	94.4	11.2	43	9.2	1.95
	55.05	65.33	1.35	22.45	0.78	0.01	0.16	0.21	0.37	1.54	-	7.83	100.03	379	76	87	34	356	27	11	30	19	6	41	109	89	37.5	68.7	7.88	28.4	5.8	1.18
	59	45.05	1.53	29.38	6.44	0.01	0.16	0.16	0.38	1.65	-	14.3	99.06	418	79	117	27	280	31	46	33	14	13	45	325	168	80.5	135	12.9	40.5	6.4	1.25
	60.54	47.96	1.59	33.96	0.98	-	0.17	0.16	0.31	1.59	-	12.06	98.78	407	72	108	27	276	32	37	39	21	7	34	118	107	88.4	184	18	59.9	8.3	1.47
	104.26	67.08	0.97	16.53	6.73	0.01	0.3	0.2	0.1	1.26	0.05	5.76	98.99	334	55	123	18	366	22	5	21	4	7	3	143	101	40.2	75.6	7.44	22.5	2.8	0.58
	108.14	65.8	0.79	15.25	4.02	0.01	1.03	0.17	0.16	3.7	-	8.71	99.64	340	109	108	78	262	16	14	18	13	32	27	103	70	67.8	182	28.6	159	50	10.9
	109.55	65.68	0.96	15.68	4.49	0.01	1.41	0.28	0.11	3.91	0.08	7.18	99.79	271	113	99	45	261	20	-	18	29	9	37	102	72	50	98.1	11.1	43.8	9.4	2.17
	112.04	63.74	0.93	16.59	4.48	0.02	2.05	0.44	0.17	4.8	0.17	5.62	99.01	432	146	117	42	248	19	-	20	82	9	47	113	77	48.1	96.8	11	43.9	9.1	2.04
SG-98-48	31.88	45.13	0.25	33.64	0.34	-	0.09	0.34	0.12	0.42	-	19.74	100.07	89	18	35	15	43	6	-	10	16	5	17	21	-	16.2	36.6	4.46	18.1	3.9	0.85
GR-97-19	87.2	7.91	0.1	2.22	1.55	0.07	18.6	26.4	0.08	0.6	-	42.08	99.61	67	16	93	6	30	2	4	2	-	5	11	35	-	6.1	11.9	1.4	5.9	1.4	0.31
	88.25	15.83	0.2	4.16	2.18	0.07	16.18	22.89	0.11	1.1	-	36.46	99.18	144	34	110	10	75	4	10	5	-	10	18	52	23	11.6	22.4	2.62	10.1	2	0.45
	90	41.76	0.49	8.18	3.37	0.06	8.99	12.25	0.14	2.08	-	21.47	98.79	236	63	88	18	196	10	15	9	15	14	22	59	39	21.1	41.9	4.72	17.9	3.8	0.8
	93.74	58.83	0.99	18.53	4.67	0.03	2.86	0.61	0.19	5.9	0.13	6.97	99.71	487	160	156	26	221	19	4	22	48	4	35	129	86	59.7	118	12.7	45.5	7.5	1.5

Table 4(continued): Whole rock chemical analyses, XRD and colour of representative mudstone samples.

Mudstone																					Carbon			Colour		
Wells	Depths	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Co	Cs	Hf	Sb	Sc	Ta	Th	U	Sn	Tl	S	O.C %	I.C %	CaCO3 %	L	A	B
MBR-97-32A	50.78	3	0.7	4.2	0.9	2.8	0.44	2.8	0.45	5	6.7	9	1.3	20	2	14	4	10	0.9	0.02	0.03	0.01	0.08	69.99	12.16	13.39
	53.62	34	6.6	34.3	5.9	16.7	2.4	15	2.19	9	6.9	10.8	1.1	19	2	15.9	3.7	8	0.8	0.008	0.58	0.04	0.33	61.14	5.13	10.65
	55.42	11.6	2.4	13.4	2.5	7.2	1.04	6.4	0.96	9	5.9	6.5	1.2	26	2	14.3	3.6	13	1.1	0.006	0.08	0.01	0.08	78.69	3.97	6.73
	61.72	17.5	3.2	17.3	3.2	9.1	1.34	8	1.2	21	5.6	13	0.8	24	2.8	17.9	7.7	9	0.7	0.065	3.53	0.17	1.42	57.95	1.97	4.03
	62.2	15.4	2.4	11.7	1.9	5.4	0.74	4.7	0.7	27	10.4	8.5	0.9	24	2.3	15.4	7.6	13	1.7	0.053	1.03	0.09	0.75	64.82	2.87	6
	68.55	13.9	2.4	12.7	2.3	6.5	0.95	5.8	0.88	8	6.8	8.7	0.9	24	2	18.4	6.3	8	1	0.008	0.74	0.05	0.42	59.85	5.89	12.44
	70	16.1	2.9	15.6	2.7	7.5	1.06	6.6	0.98	7	7.9	7.8	0.9	26	1.9	18.5	6.1	10	1.4	0.006	1.98	0.11	0.92	56.97	4.18	9.89
	71.42	18.3	2.9	14.7	2.6	7.2	1.02	6.4	0.95	7	7.1	8	1	24	1.9	18.8	4.4	7	1	0.009	0.66	0.04	0.33	63.49	5.4	13.46
	75.2	6.4	1.4	8.7	1.7	5.1	0.81	5	0.8	8	4.5	10.4	2.3	33	2.6	22.9	4.8	10	0.9	0.015	0.31	0.02	0.17	65.3	11.09	15.78
	76.22	3.7	0.8	4.8	1	3	0.48	3.1	0.49	8	3.9	7.1	1.2	24	2.3	21.2	6.7	9	0.9	0.004	0.03	0.01	0.08	81.16	6.39	11.6
	79.5	6.8	1.7	10.7	2.2	6.7	1.04	6.3	0.97	3	5.9	15.6	1.6	23	2.5	19.9	4.3	9	1.2	0.005	0.14	0.01	0.08	70.7	7.37	16.24
	80.4	8.1	1.8	10.9	2.1	6.3	0.95	6	0.95	6	5.2	14	1.2	36	2.6	19.5	4	11	0.8	0.004	0.44	0.06	0.50	61.52	9.18	13.26
	84.34	4.3	1.1	7.3	1.5	4.7	0.73	4.4	0.68	4	8.1	9.4	1.4	21	2	14.4	3.4	8	1.5	0.002	0.03	0.25	2.08	78.34	7.86	10.17
	94.27	7.4	1.6	8.9	1.6	4.5	0.67	4.3	0.67	8	5.3	5.2	2.7	30	2	19.2	5.2	12	1	0.011	0.66	0.03	0.25	57.97	15.2	20.39
	94.93	12.6	2	9.4	1.5	3.8	0.51	3.3	0.5	23	5.5	4.1	1.1	25	1.9	18.1	9.3	10	1.2	0.027	0.73	0.05	0.42	63.06	4.57	7.43
	96.13	10.5	1.6	7.3	1.2	3.5	0.48	3	0.46	16	6	4.6	0.8	25	2.3	18.5	6.6	17	1.1	0.009	0.56	0.03	0.25	64.15	3.84	6.46
	101.17	6.1	1.1	5.5	1	3	0.45	2.8	0.43	11	6.5	11.6	1.9	21	2.6	18.5	6.8	15	0.9	0.098	0.66	0.02	0.17	61.41	3.78	6.98
	105.16	12.2	2.3	12.2	2.3	6.5	0.97	6	0.88	8	2.8	10	1.6	29	4.1	16	10.2	14	0.5	0.075	6.46	0.43	3.58	45.8	1.29	2.22
	108.15	6.5	1	4.6	0.8	2.3	0.33	2.1	0.33	12	1.7	4.4	1.9	12	2.1	9.8	4.3	9	0.4	0.158	0.55	0.05	0.42	65.38	4.32	8.15
	109.96	8.4	1.5	7.2	1.3	3.7	0.53	3.3	0.5	19	8.3	6.1	1.1	21	2.6	17.1	6.8	8	1.6	0.644	2.75	0.26	2.17	54.2	2.11	3.93
	110.57	5.7	1.1	5.7	1.1	3.5	0.56	3.5	0.56	15	3.1	7.2	0.8	16	3	13.5	4.8	8	0.4	0.108	0.81	-	-	60.82	4.37	7.23
	113.76	8.4	1.5	8.1	1.6	4.8	0.74	4.7	0.72	5	5.5	10.3	1.4	19	3.1	11.7	4.8	11	0.3	0.588	6.29	0.12	1.00	46.25	1.43	2.22
	129.08	6.8	1.4	7.7	1.5	4.7	0.73	4.5	0.73	6	2.5	17.8	1.2	8	2.2	7.3	4.9	5	0.5	0.347	0.46	-	-	63.01	49.34	6.62
	138.55	4.4	0.7	3.4	0.7	2.1	0.34	2.2	0.35	37	6.6	6.4	2.1	13	1.1	8.7	17.6	3	3.2	3.721	2.33	0.13	1.08	49.34	3.49	6.62
CH-97-10B	35.57	6.1	1.4	8.2	1.8	5.5	0.88	5.4	0.87	5	7.1	12.6	0.7	25	3.2	15	15.6	44	1.3	0.049	-	-	-	74.38	3	6.96
	35.98	4.4	0.9	5.2	1.1	3.4	0.54	3.3	0.53	79	4.6	8.2	1.3	21	2.6	12.5	7.6	11	-0.1	0.181	0.09	0.01	0.08	58.83	1.74	3.83
	38.59	6.2	1.2	6.4	1.3	4	0.6	3.7	0.6	5	5.9	9.5	0.7	27	2.4	14.9	7.2	8	2.3	0.032	0.32	0.52	4.33	68.05	4.53	8046
	40.08	12.9	2.3	12.3	2.3	6.9	1	6.2	0.95	10	4.6	9.3	1.1	20	2.2	13	6.8	6	0.9	0.853	5.26	0.05	0.42	50.29	1.76	3.25
	41.84	13.5	2.3	11.1	2	5.6	0.8	5	0.71	3	4.4	7	0.6	17	1.6	12.1	5.8	6	0.3	0.096	8.4	0.08	0.67	45.1	1.47	2.56
	46.65	6.5	1.2	6.5	1.3	4.1	0.64	3.9	0.61	5	8.5	9.2	0.9	21	2.5	15.4	8.3	10	2.8	0.035	0.22	-	-	73.17	4.81	9.57
	47.4	13.2	2.3	11.3	2.1	6	0.85	5.2	0.79	14	6	5.9	1	21	1.6	12.7	13.1	6	0.5	0.591	10.3	0.6	5.00	43.87	2	3.7
	48.64	8.8	1.6	8.8	1.8	5.4	0.82	5	0.79	25	6.2	11.6	0.9	19	2.5	14	6.6	7	1.6	0.464	1.14	0.37	3.08	59.23	2.78	5.31
	55.05	5.7	1.1	6.3	1.3	4.1	0.63	3.8	0.6	5	6.3	10.4	0.8	22	2.2	14.8	5.9	10	1.5	0.029	0.18	0.01	0.08	72.77	4.42	8.3
	59	5.1	0.9	5.3	1	3.4	0.54	3.4	0.53	8	5.6	9	2.9	26	2.7	19.1	5.1	8	1.3	5.225	0.05	-	-	81.92	1.13	5.67
	60.54	5.7	1	5.5	1.1	3.4	0.52	3.3	0.52	5	6	9	1.3	20	2.9	19.3	5.1	11	1.1	0.04	0.04	-	-	86.67	1.42	5.5
	104.26	2.5	0.6	3.5	0.8	2.6	0.44	2.8	0.46	-	3.3	11.1	1.3	16	1.7	18.3	4.8	8	0.6	0.008	0.04	-	-	64.12	7.24	6
	108.14	39.2	5.9	25.3	4	11.1	1.46	9	1.26	18	7.5	7.8	1.5	13	1.1	12.5	5.9	5	1.2	1.94	0.3	-	-	65.61	1.7	5.76
	109.55	9.9	1.6	8.6	1.7	5.1	0.74	4.5	0.72	10	7.5	7.9	1.4	15	1.4	14.3	4	5	1	0.881	0.13	-	-	72.68	0.65	5.15
	112.04	8.7	1.5	7.6	1.5	4.6	0.67	4	0.64	15	9.5	7.4	1.4	16	1.4	13.8	8.1	10	1.4	0.239	0.24	0.02	0.17	69.45	0.56	4.42
SG-98-48	31.88	3.8	0.6	3.1	0.6	1.6	0.23	1.3	0.17	4	1.6	1.3	-	3	0.5	1.5	1.2	6	0.2	0.021	2.58	-	0.75	65.59	2.22	5.21
GR-97-19	87.2	1.3	0.2	1	0.2	0.6	0.09	0.6	0.09	-	0.9	0.9	-	2	0.1	1.4	8.7	5	0.4	0.332	2.67	9.33	77.75	63.38	3.97	8.14
	88.25	1.9	0.3	1.7	0.4	1.1	0.17	1	0.18	2	2	2.2	0.8	4	0.3	2.8	11.8	5	0.6	0.674	1.49	9.21	76.75	57.73	4.28	8.57
	90	3.4	0.6	3.6	0.7	2.3	0.36	2.2	0.36	7	3.8	6	1.7	7	0.8	6.7	7.4	8	0.7	1.156	0.41	5.13	42.75	63.8	3.14	7.79
	93.74	5.8	1	5.4	1.1	3.4	0.53	3.4	0.53	8	10.9	6.9	-	19	1.4	17.5	3.2	9	1.3	0.094	0.37	0.03	0.25	63.98	1.35	4.92

Table 5: Peak areas of identified minerals in unashed "lignite"samples

Sample	Unashed	Mixed	Expandable	Vermiculite	Illite	Gypsum	Halloysite	Kaolinite	Quartz	Anatase	Rutile	Jarosite	Calcite	Augite	Alunite	Siderite	Marcasit	Hematit	Pyrite	Unknown
Measured d spacing		**20**	**16.5-17.5**	**14-14.5**	**10.0**	**7.6**	**7.5**	**7.0**	**4.25**	**3.52**	**3.25**	**3.06-3.09**	**3.04**	**3.00**	**2.89-2.99**	**2.79**	**2.71**	**2.69**	**2.42**	**d spacing**
MRB9732A 103.30	UA	0	0	62.87	0	0	0	285.1	0	0	15.32	0	0	0	8.148	0	0	0	0	
MRB9732A 107.42	UA	0	3.49	3.45	0	72.98	0	145.9	90.09	0	0	50.14	T	0	25.2	26.48	17.51	22.59	0	7.74
MRB9732A 108.66	UA	0	0	0	0	45.67	41.19	45.43	77.45	0	0	0	0	0	0	T	0	35.95	54.04	
MRB9732A 108.87	UA	0	0	4.56	0	0	0	432.3	117.7	0	10.64	0	0	0	0	0	0	0	0	
MRB9732A 109.27	UA	0	0	32.72	4.96	0	0	394.2	T	0	0	0	0	0	0	0	0	0	0	
MRB9732A 110.78	UA	4.77	1.104	0	0	0	0	139.4	0	0	16.24	0	0	0	0	0	60.38	0	19.59	
MRB9732A 111.10	UA	0	1.408	3.12	0	0	0	140.1	0	0	0	0	0	0	0	0	0	13.82	0	
MRB9732A 111.36	UA	0	4.52	1.01	0	0	0	251	0	0	0	0	0	0	0	0	0		0	
MRB9732A 111.66	UA	0	0	0	0	0	0	293.6	0	62.34	13.03	0	0	0	0	0	0	0	0	
MRB9732A 112.06	UA	3.05	1.38	0	0	0	0	263.8	0	0	7.894	0	0	0	0	0	0	0	0	
MRB9732A 114.31	UA	0	1.54	0	0	36.79	0	91.13	259.7	0	0	14.95	0	0	12.11	0	0	0	0	7.8
MRB9732A 121.15	UA	0	6.23	0	0	0	0	145.9	0	0	21.42	0	0	0	0	0	0	0	0	3.8
MRB9732A 121.17	UA	0	15.14	0	0	0	0	168.2	204.4	0	23.19	0	0	0	0	0	0	0	0	
MRB9732A 121.66	UA	0	4.36	0	2.49	0	0	182.3	198.4	0	28.41	0	0	0	0	0	0	0	0	
MRB9732A 137.25	UA	0	2.69	0	49.93	0	0	31.08	114.7	0	7.382	11.15	0	0	13.07	0	0	0	0	
CH9710B 40.95	UA	0	3.79	0	21.61	0	0	242.3	51.44	0	0	0	10.75	13.5	0	0	0	0	0	
CH9710B 57.54	UA	0	3.2	0	38.94	0	0	237.6	117.2	0	0	0	0	24.77	0	4.773	0	0	0	
CH9710B 57.69	UA	0	4.44	0	39.32	0	0	181.8	104.7	0	0	0	14.85	15.71	0	0	0	9.921	0	
CH9710B 57.71	UA	0	3.47	0	60.27	0	0	301.2	101.3	0	0	0	0	22.56	0	T	0	0	0	
CH9710B 58.12	UA	0	21.66	0	32.32	117.3	0	194.9	178.6	0	0	0	0	11.21	0	0	0	0	65.54	
CH9710B 62.42	UA	0	9.15	0	50.29	0	0	230.2	192.5	0	8.873	0	0	17.24	0	7.865	0	0	33.27	
CH9710B 63.01	UA	0	16.68	0	35.63	0	0	177.1	197.7	0	12.16	0	0	16.4	0	0	0	0	0	
CH9710B 113.05	UA	0	2.56	0	39.94	18.15	0	25.75	95.57	T	23.08	14.77	96.97	38.39	0	0	100.9	0	0	7.69
CH9710B 114.42	UA	0	2.04	5.08	125	12.42	0	23.63	88.57	0	0	27.49	0	26.04	0	17.83	36.19	25.6	0	
CH979 46.22	UA	0.85	0.86	1.36	17.63	0	0	294.6	33.32	156.5	0	0	0	0	0	0	0	0	0	
CH979 46.49	UA	0	2.68	0	23.82	0	0	357.4	55.46	0	0	0	0	13.01	0	0	0	39.93	0	
CH979 47.20	UA	0	2.71	1.38	32.04	0	0	418.4	92.61	0	0	0	0	17.01	0	0	0	0	0	
CH979 47.64	UA	0.79	3.08	0	23.06	0	0	309.6	82.81	0	0	0	0	14.15	0	6.09	0	0	0	
CH979 47.81	UA	2.52	1.41	0	23.96	0	0	278.4	90.09	0	0	0	0	14.2	0	5.761	0	19.33	0	
CH979 48.00	UA	2.45	3.26	0	26.18	0	0	298.3	133.6	0	0	0	0	19.57	0	8.339	0	0	0	
CH979 48.19	UA	2.38	10.01	0.55	35.32	0	0	286.9	152.1	0	0	0	0	47.11	0	8.738	0	0	0	
SH9848 31.24	UA	0	0	0	0		0	0	25.92	0	0	0	0	0	0	0	0	0	0	
SH9848 31.84	UA	2.45	4.53	0	0	0	0	283.2	0	0	0	0	0	8.692	0	0	20.07	0	0	
SH9848 31.98	UA	0	2.77	0	0	0	0	198.1	72.72	0	0	0	T	0	0	0	0	0	0	
SH9848 32.20	UA	0	4.84	0	0	0	0	111.1	155.5	11.98	23.66	0	0	0	0	0	0	35.47	T	
SH9848 32.40	UA	0	8.42	0	0	0	8.686	172.9	182.8	321.8	0	0	0	0	0	0	0	0	0	
SH943 30.70	UA	0	0	7.32	10.82	0	37.8	219.1	109.1	181.6	0	40.92	0	10.04	0	0	0	0	0	
SH944 78.91	UA	0	0	0	24.83	0	0	356	40.03	0	0	0	0	0	0	0	0	8.835	0	

Table 6: Peak areas of identified minerals in ashed "lignite" samples

Sample	Ashed	Mixed Layer	Expandable	Vermiculite	Illite	Gypsum	Halloysite	Kaolinite	Quartz	Anatase	Rutile	Jarosite	Calcite	Alunite	Dolomite	Siderite	Marcasite	Hematite	Pyrite
Measured d spacing		**20**	**16.5-17.5**	**14-14.5**	**10.0**	**7.6**	**7.5**	**7.0**	**4.25**	**3.52**	**3.25**	**3.06-3.13**	**3.04**	**2.89-3.00**	**2.89**	**2.79**	**2.71**	**2.69**	**2.42**
MRB9732A 103.30	A	0	4.18	0	0	0	0	179.4	0	0	7.8	0	0	0	0	0	0	0	0
MRB9732A 107.42	A	0	1.39	3.04	0	8.64	0	0	0	131.1	tr	0	9.85	0	26.5	0	0	0	0
MRB9732A 108.66	A	0	0	0	0	0	3.3	59.27	0	0	0	0	0	0	0	0	12.56	0	0
MRB9732A 108.87	A	2.36	2.39	0	4.97	0	0	427.8	0	0	0	0	6.14	0	0	0	0	0	0
MRB9732A 109.27	A	0	0	0	10.23	0	0	364.5	0	0	0	0	3.19	0	tr	0	0	0	0
MRB9732A 110.78	A	0	1.69	0	0	0	0	150	0	87.28	8.41	0	0	0	14.67	0	10	0	0
MRB9732A 111.10	A	0	1.68	0	0	9.31	0	145.9	0	0	0	0	0	0	0	0	0	0	0
MRB9732A 111.36	A	0	0	0	0	0	0	201.5	0	0	5.36	0	0	0	0	0	0	0	0
MRB9732A 111.66	A	0	0	2.89	0	0	0	211.6	0	49.43	10.57	0	0	0	0	0	0	0	0
MRB9732A 112.06	A	0	1.19	0	0	0	0	255.1	44.68	29.24	6.96	0	0	0	0	0	0	0	0
MRB9732A 114.31	A	0	6.18	0	5.75	0	0	98.97	155.9	0	tr	0	0	6.31	0	0	0	0	0
MRB9732A 121.15	A	0	25.5	0	0	0	0	72.17	229.8	0	17.39	0	0	0	0	0	0	0	0
MRB9732A 121.17	A	0	13.51	0	0	0	0	114.8	188.5	0	16.78	0	0	0	0	0	0	0	0
MRB9732A 121.66	A	0	2.94	1.15	0	37.98	0	169.4	144.8	0	15.39	0	0	0	0	0	0	0	0
MRB9732A 137.25	A	0	18.15	2.79	58.64	0	0	39.21	113.3	16.45	34.62	0	0	19.18	10.69	0	0	0	0
CH9710B 40.95	A	0	0	0	19.02	0	0	188.1	35.99	0	0	0	11.63	0	20.27	14.39	0	0	0
CH9710B 57.54	A	0	1.48	0	58.6	0	0	284.5	91.8	0	18.27	6.59	12.31	0	10.05	9.99	0	0	0
CH9710B 57.69	A	0	8.25	0	50.13	0	0	164.8	89.66	0	8.17	0	13.64	0	18.83	0	0	0	0
CH9710B 57.71	A	0	0	0	65.2	0	0	291.1	75..52	0	21.56	0	11.16	0	16.79	0	0	0	tr
CH9710B 58.12	A	0	0	0	33.92	0	0	235.5	128.1	0	10.7	0	10.78	0	10.22	9.23	0	0	0
CH9710B 62.42	A	0	4.14	0	54.95	0	0	315.6	118.8	0	13.1	0	0	16.87	14.88	9.41	0	0	0
CH9710B 63.01	A	0	8.03	0	49.25	0	0	300.4	123.9	0	12.47	0	14.73	0	12.36	10.32	0	0	0
CH9710B 113.05	A	0	6.04	2.48	88.61	0	0	9.79	74.65	26.97	0	0	12.16	0	14.35	0	19.2	0	0
CH9710B 114.42	A	0	5.01	0	136.5	0	0	18.89	84.32	28.95	0	0	24.14	0	21.72	0	27.43	t	0
CH979 46.22	A	0	0	0	16.75	0	0	135.4	29.2	63.42	0	0	0	7.06	12.65	0	8.68	0	0
CH979 46.49	A	0	3.63	0	40.78	0	0	260.4	13.51	0	0	0	0	0	0	0	0	0	0
CH979 47.20	A	0	1.72	0	32.72	0	0	251.8	75.28	0	5.88	0	8.99	0	11.22	tr	0	0	0
CH979 47.64	A	0	3.14	0	38.27	49.5	0	89.53	20.86	0	0	0	0	0	0	0	0	0	0
CH979 47.81	A	0	2.96	0	33.73	0	0	206.9	68.08	0	s	0	s	0	12.95	7.51	tr	0	0
CH979 48.00	A	0	0	0	25.17	0	0	196.3	72.74	0	0	0	tr	9.19	7.16	0	0	0	0
CH979 48.19	A	2.06	1.09	0	44.35	0	0	296.7	60.18	0	7.5	0	0	17.03	0	7.94	3.68	0	0
SH9848 31.24	A	0	8.08	0	2.31	0	0	41.9	65.14	74.19	6.26	0	32.49	0	15.51	0	0	0	0
SH9848 31.84	A	0	0	0	0	0	0	125.5	22.61	98.94	0	0	3.38	0	7.3	tr	15.52	0	0
SH9848 31.98	A	1.01	4.82	0.91	1.62	0	5.4	34.46	82.51	s	5.69	0	s	0	0	0	0	0	0
SH9848 32.20	A	0	0	1.58	0	5.01	0	64.67	85.47	26.85	7.03	0	0	0	0	0	0	0	0
SH9848 32.40	A	0	3.61	0	0	0	4.66	63.76	139.1	18.65	9.07	0	0	0	0	0	0	0	0
SH943 30.70	A	0	0	0.64	8.53	0	5.52	71.75	43.76	43.83	0	0	tr	8.91	9.79	0	0	0	0
SH944 78.91	A	2.3	1.96	0	13.18	7.23	0	169.1	72.07	tr	s	0	0	0	0	0	0	0	0

Table 7: Peak areas of identified minerals in mudstone samples

Samples	Expandable	Vermiculite	illite	Gypsum	Kaolinite	Quartz	Jarosite	Muscovite	Anatase	Rutile	Calcite	Alunite	Dolomite	Siderite	Marcasite	Hematite	Pyrite
Measured d spacing	**16.5-17.5**	**14-14.5**	**10.0**	**7.6**	**7.0**	**4.25**	**3.11-3.13**	**3.7**	**3.52**	**3.25**	**3.04**	**2.98-3.00**	**2.89**	**2.79**	**2.71**	**2.69**	**2.42**
MRB-97-32A 50.78	19.9	0	21.84	0	304.8	167.7	0	0	0	t	0	0	0	9.76	21.83	0	0
MRB-97-32A 53.62	16.21	7.55	34.77	0	234.1	190.7	0	0	0	t	0	0	0	10.66	0	0	0
MRB-97-32A 55.42	8.692	0	24.43	0	566.6	95.53	0	0	0	12.86	0	0	0	s	0	0	0
MRB-97-32A 61.72	21.51	0	23.14	0	231.8	214.7	0	0	0	10.61	0	0	0	t	0	0	0
MRB-97- 32A 62.20	13.7	2.94	78.2	0	434.4	153.3	0	0	0	t	0	0	0	17.84	0	0	0
MRB-97-32A 68.55	5.35	7.28	41.45	0	256.2	150.4	0	0	0	13.55	0	0	0	11.22	0	0	0
MRB-97-32A 70.00	0	0	50.58	0	208.2	135.6	0	0	0	9.72	t	0	0	21.37	0	0	0
MRB-97-32A 71.42	6.68	2.33	46.82	0	236	154.7	0	0	0	11.94	0	0	0	12.97	0	0	0
MRB-97-32A 75.20	0	9.97	11.79	0	343.1	94.86	0	0	0	11.86	0	19.38	0	s	0	0	0
MRB-97-32A 76.22	3.26	2.61	11.01	0	570.7	77.43	t	0	0	8.4	0	18.17	0	s	0	0	0
MRB-97-32A 79.50	19.05	0	65.51	0	211.5	209.7	0	0	0	s	0	0	0	21.55	0	0	0
MRB-97-32A 80.40	0	20.86	39.17	0	314.4	136	0	0	0	33.06	0	0	0	15.82	14.4	0	0
MRB-97-32A 84.34	21.8	0	88.94	0	332	144.1	0	0	0	s	0	0	0	32.45	0	0	0
MRB-97-32A 94.27	2.57	0	8.83	0	329.4	t	0	0	0	t	0	11.81	0	t	82.3	0	0
MRB-97-32A 94.93	8.1	3.26	16.72	0	414.7	0	0	0	0	0	0	0	9.82	s	0	0	0
MRB-97-32A 96.13	7.47	0	21.71	0	575.1	0	0	0	0	0	0	0	0	0	0	0	0
MRB-97-32A 101.17	6.8	4.39	19.13	0	287.4	148	0	0	0	t	0	0	0	15.41	0	0	0
MRB-97-32A 105.16	0	29.13	0	0	194.5	52.76	0	0	0	21.45	0	t	0	0	0	0	0
MRB-97-32A 108.15	0	24.25	0	0	345.4	0	0	0	0	13.89	0	0	0	0	0	0	0
MRB-97-32A 109.96	2.15	2.65	13.27	0	303.9	s	0	0	38.73	s	0	0	0	s	0	0	0
MRB-97-32A 110.57	0	6.63	0	0	312.8	0	0	0	0	10.7	0	0	0	0	0	0	0
MRB-97-32A 113.76	8.98	0	0	0	175.2	166.5	0	0	t	12.11	20.88	0	0	t	0	0	0
MRB-97-32A 129.08	43.43	0	5.75	0	50.86	384.2	0	42.26	0	0	0	0	0	0	0	0	0
MRB-97-32A 138.55	10.96	0	61.21	30.79	22.03	198.7	25.98	0	0	t	0	0	0	21.71	43.3	0	0
CH-97-10B 35.98	18.24	0	87.24	0	317.6	151.9	t	0	0	26.27	0	0	0	23.62	0	0	0
CH-97-10B 38.59	5.553	0	57.29	0	382.7	140.3	0	0	0	19.48	0	0	0	20.83	0	0	0
CH-97-10B 40.08	5.705	0	45.84	0	285.6	179.5	t	0	0	11.24	0	0	0	10.43	0	0	0
CH-97 10B 41.84	7.249	2.85	13.35	0	227.1	155.8	0	0	0	0	0	0	10.48	10.59	0	0	0
CH-97-10B 46.65	13.9	0	96.16	0	333.8	131.7	t	0	0	31.99	0	0	0	27.82	0	0	0
CH97-10B 47.40	4.548	0	28.03	0	264.5	133.8	0	0	0	13.28	0	0	0	14.04	t	0	0
CH-97-10B 48.64	23.41	0	69.96	0	237.3	214.9	t	0	t	22.84	0	0	0	21.3	0	0	0
CH-97 10B 55.05	23.36	0	33.14	0	254.5	187.6	0	0	0	16.71	0	0	0	s	0	0	0
CH-97-10B 59.00	3.277	0	107.3	0	722.7	74.72	t	0	0	22.46	0	0	0	23.06	33.36	0	22.86*
CH-97-10B 60.54	5.332	0	60.55	0	727.1	62.88	0	0	0	16.92	0	0	0	16.97	0	0	0
CH-97-10B 85.57	31.82	0	57.45	0	188	245.7	0	0	0	26.27	0	0	0	16.78	0	0	0
CH-97-10B 104.26	28.01	0	38.14	0	426.9	285.4	0	0	0	0	0	0	0	s	73.58	0	0
CH-97 10B 108.14	27.47	0	93.48	0	98.55	212.3	26.39	0	0	0	0	0	0	14.87	t	0	0
CH-97-10B 109.55	10.21	3.41	11.2	0	130.4	218.1	21.2	0	0	0	0	0	0	s	s	0	0
CH-97-10B 112.04	4.936	8.07	102.5	0	98.83	192.8	0	0	0	0	0	0	0	24.67	0	0	0
GR-97-19 87.20	0	12.1	0	0	0	29.19	0	0	0	0	0	0	1385	0	0	89.31	0
GR-97-19 88.25	24.05	0	18.57	t	17.47	44.78	0	0	0	0	0	0	1212.9	0	t	69.31	0
GR-97-19 90.00	13.61	5.731	28.87	0	49.83	115.2	0	0	0	12.67	0	0	695.4	0	28.99	40.94	0
GR-97-19 93.74	4.012	2.28	77.5	0	44.18	131.2	0	0	0	48.62	0	0	s	10.58	0	0	0

APPENDICES

APPENDIX 1
Scanning electron micrographs and electron dispersive system (EDS) spectra analyses of lignite samples

A: Borehole MBR-97-32A

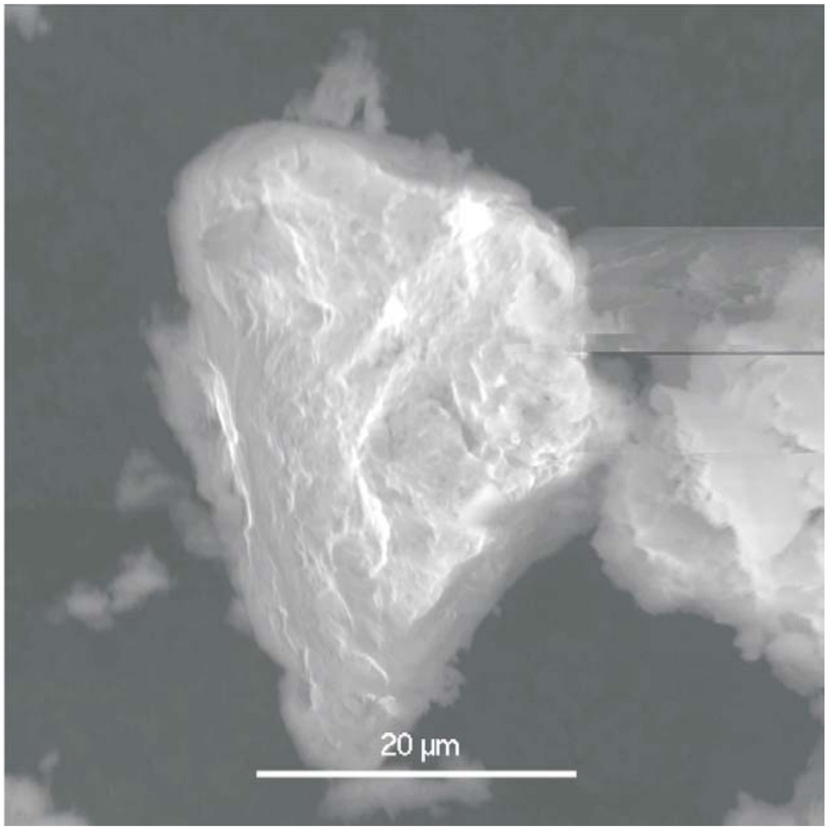
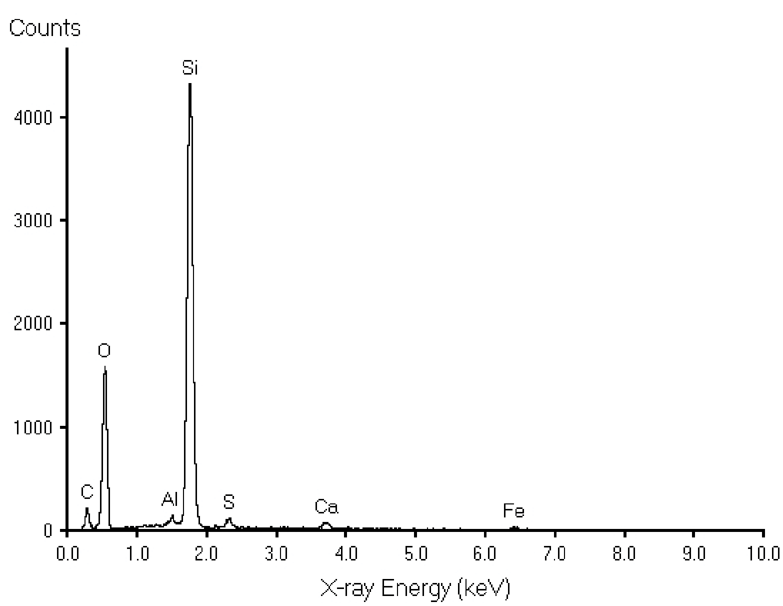


Figure 1: Quartz + Pyrite + Kaolinite
Borehole MBR97-32A 107.42m-107.46m



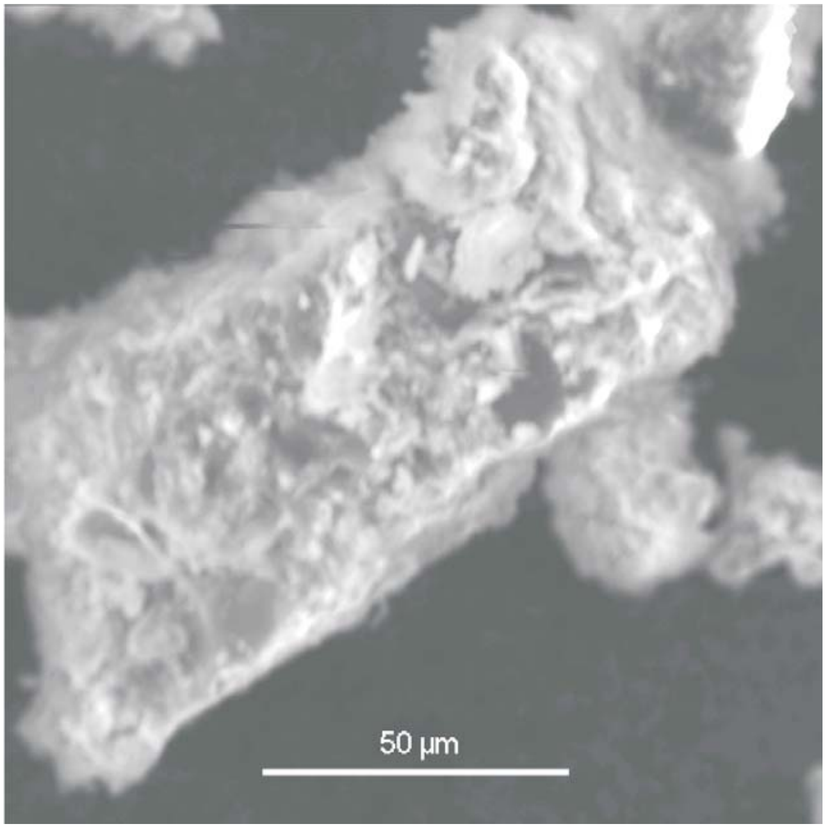
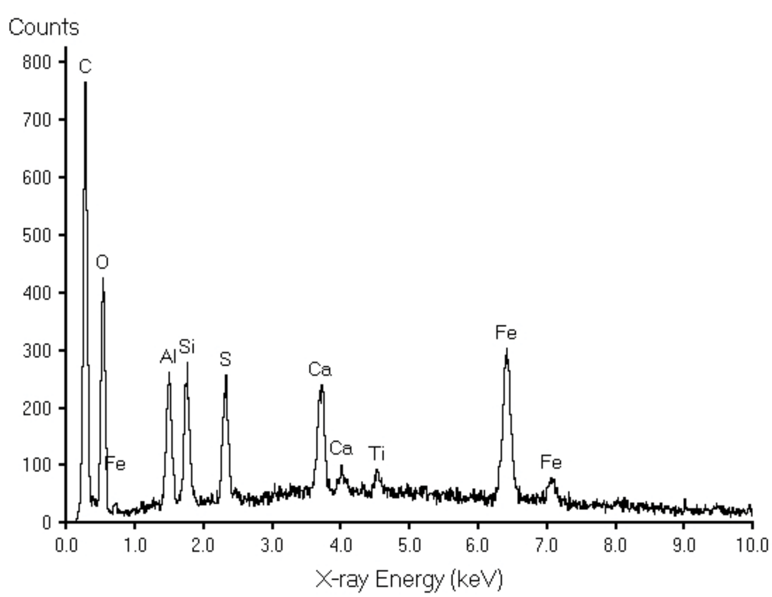


Figure 2: ??
Borehole MBR97-32A 107.42m-107.46m



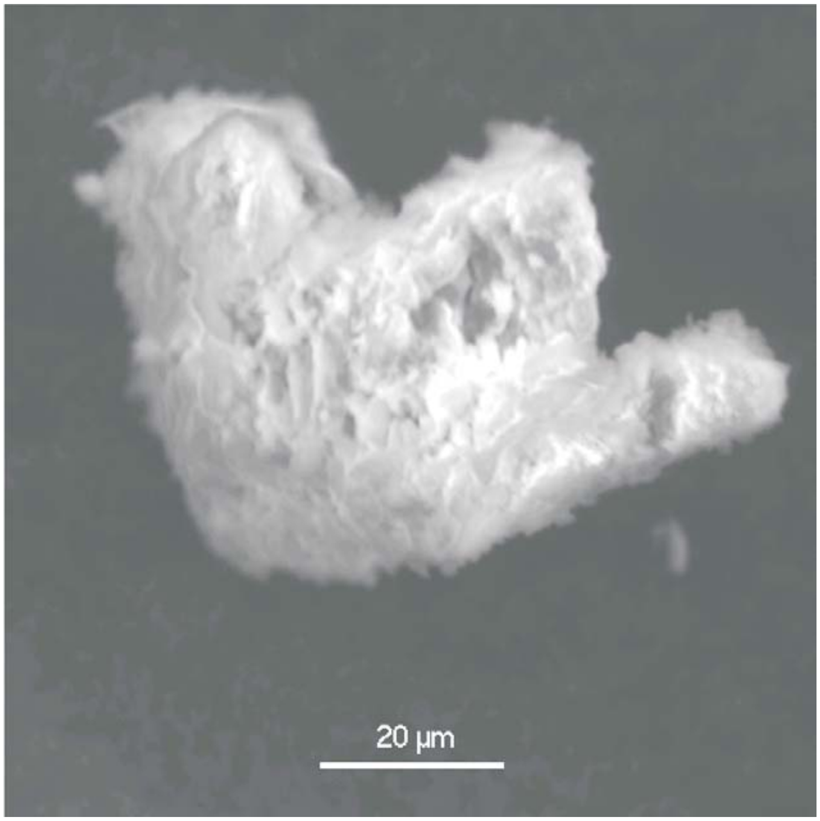
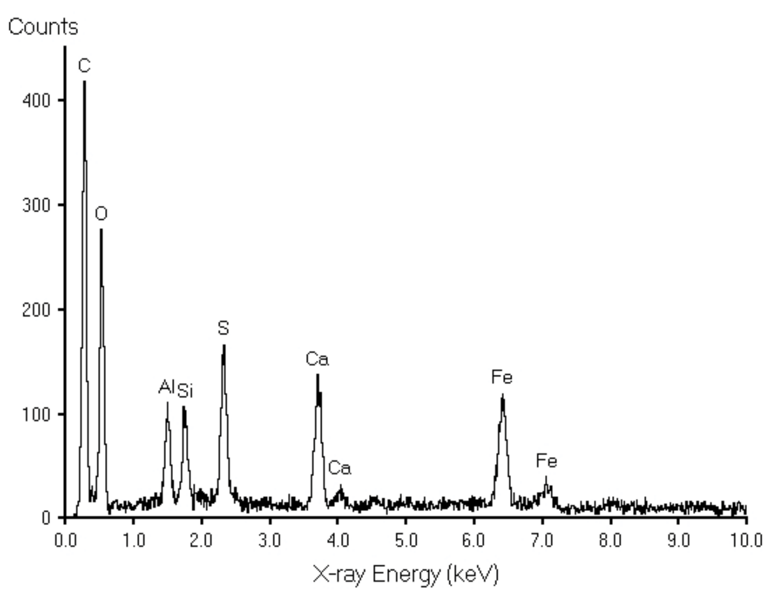


Figure 3: Different crystal (??)
Borehole MBR97-32A 107.42m-107.46m



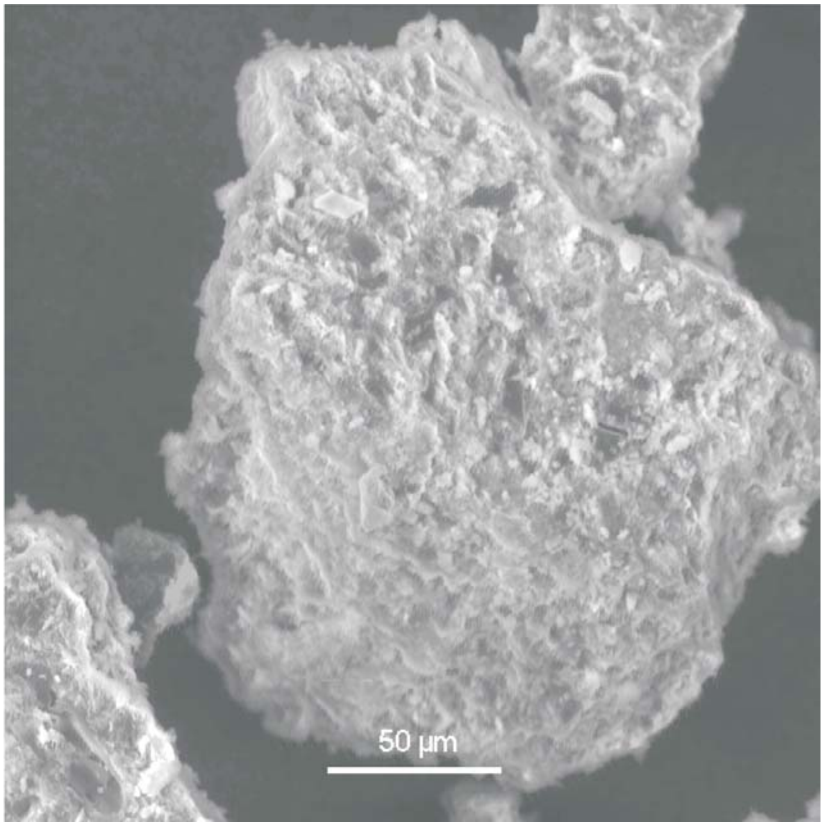
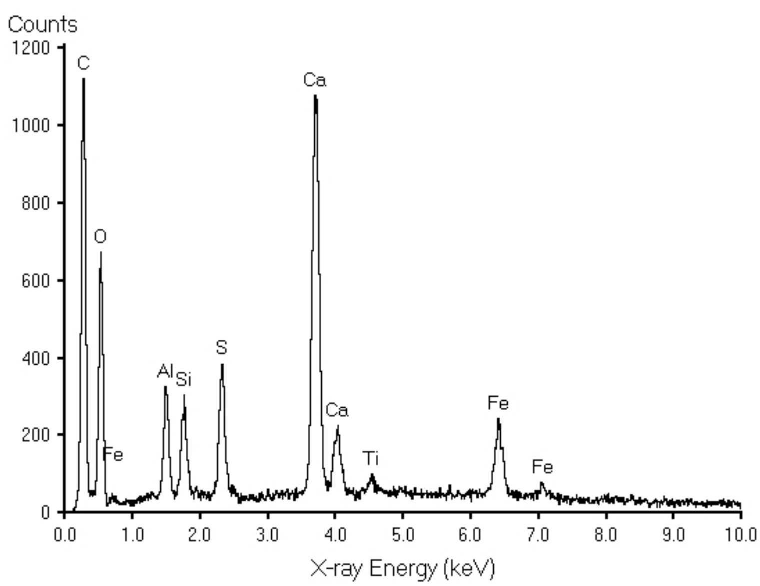


Figure 4: ??
Borehole MBR97-32A 107.42m-107.46m



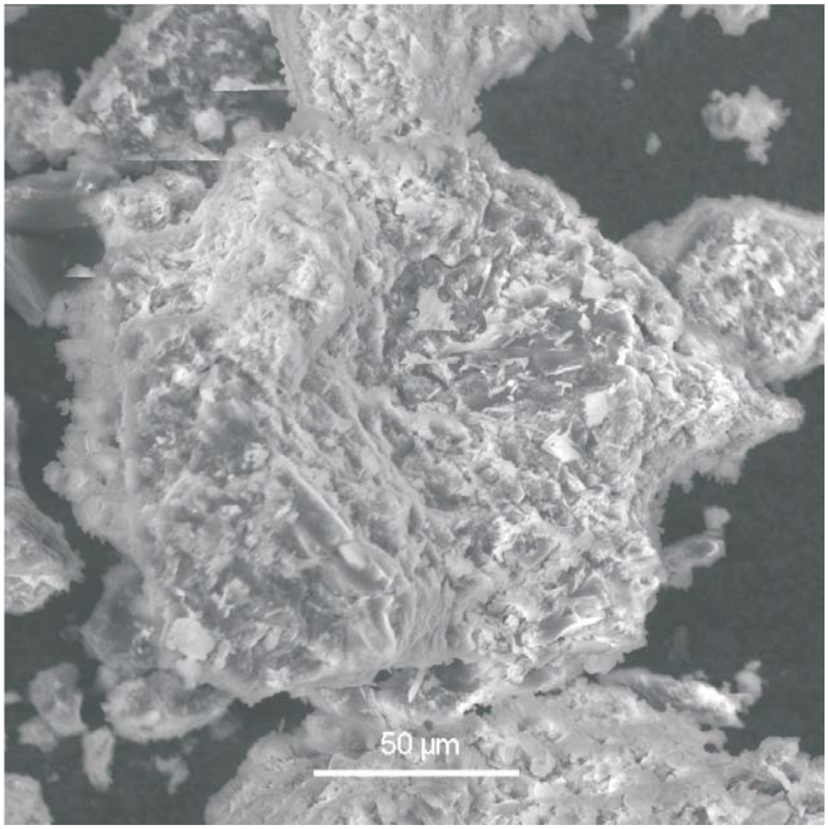
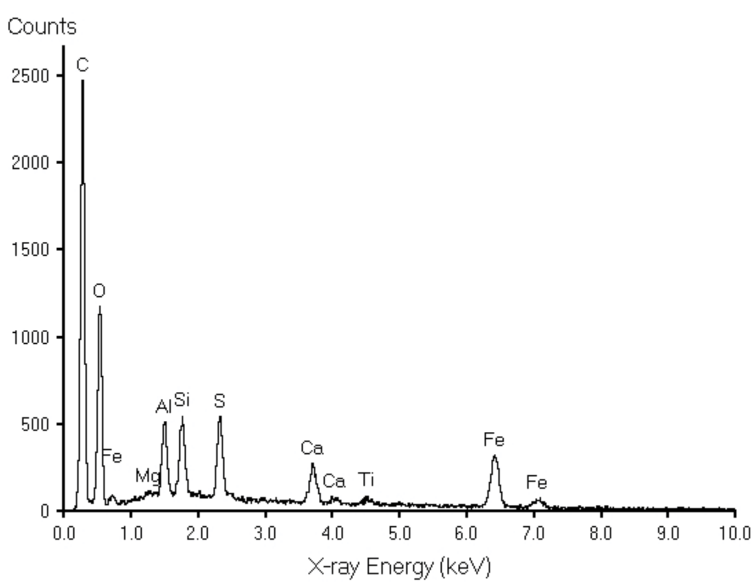


Figure 5: ??
Borehole MBR97-32A 107.42m-107.46m



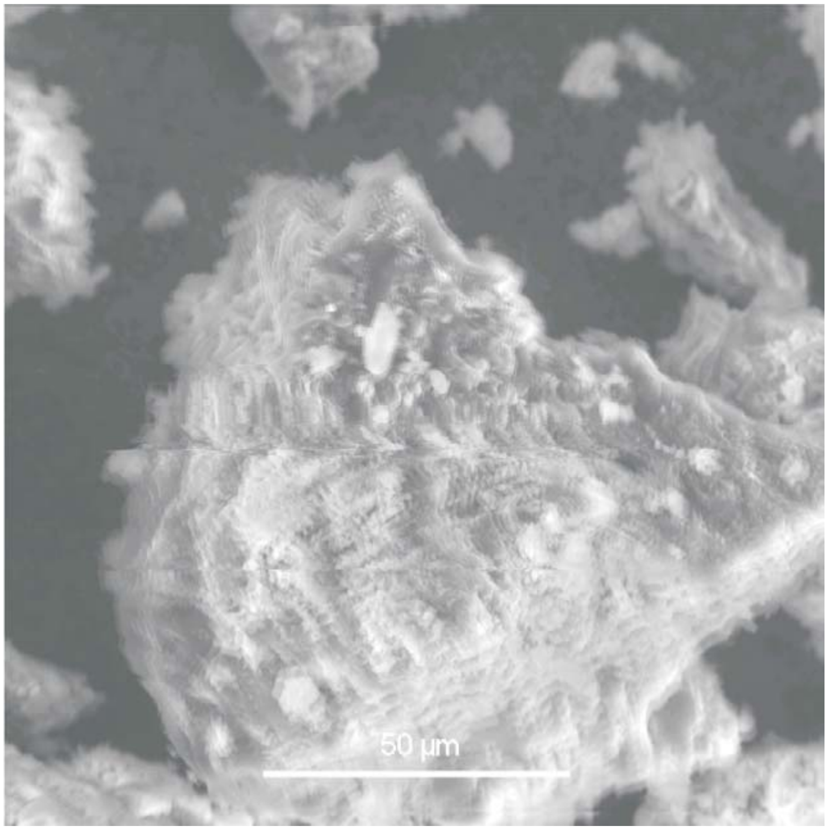
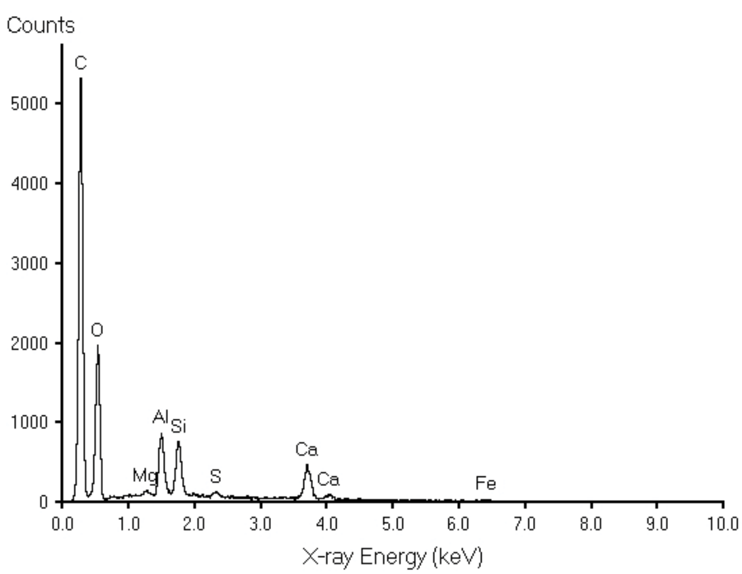


Figure 6: ??
Borehole MBR97-32A 107.42m-107.46m



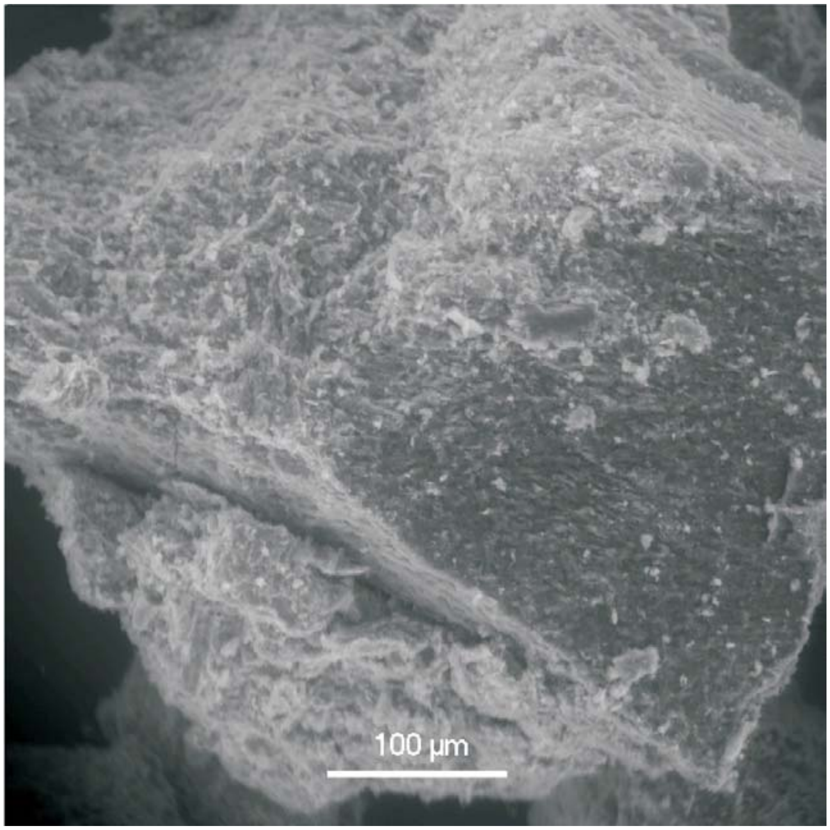
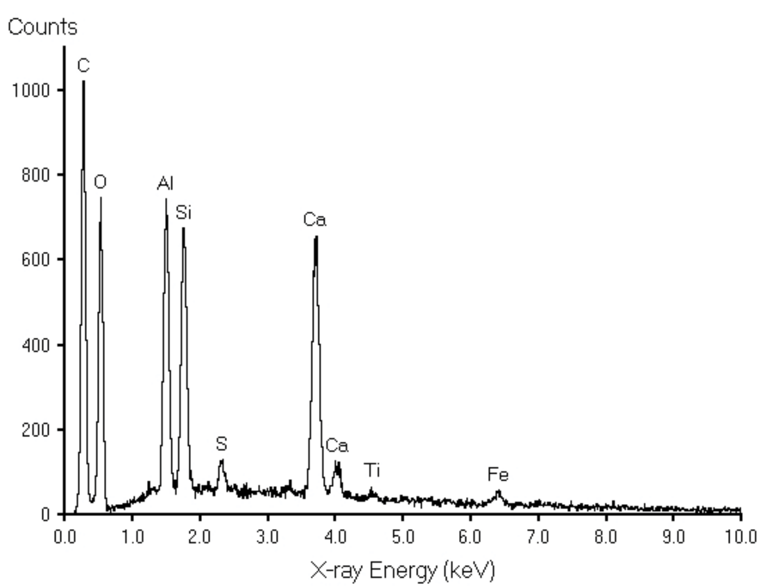


Figure 7: Staurolite + Pyrite + Calcite
Borehole MBR97-32A 108.87m-108.90m



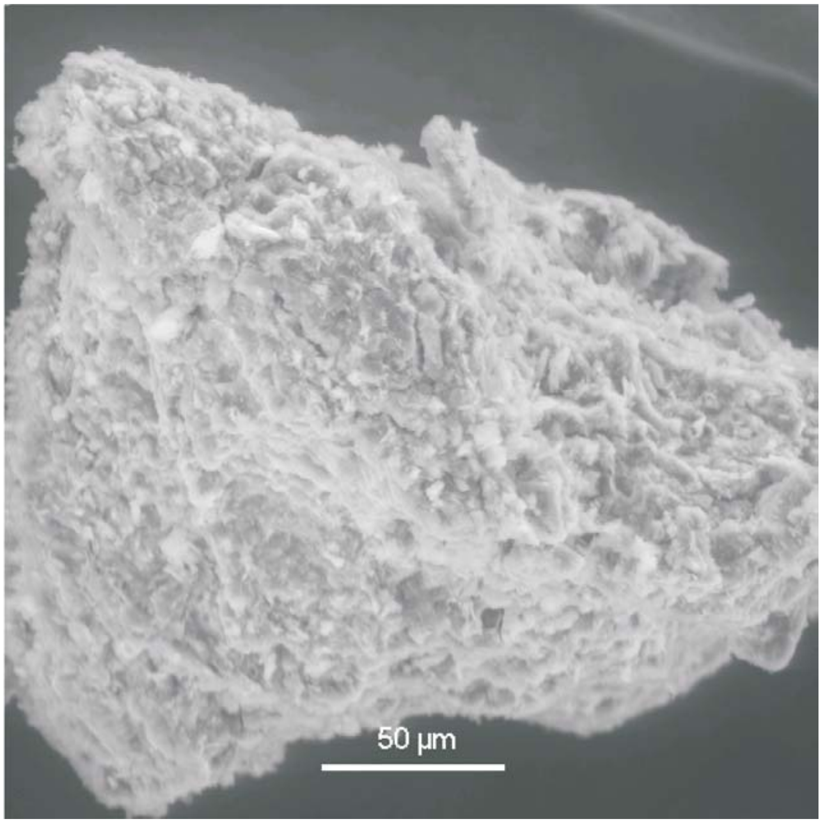
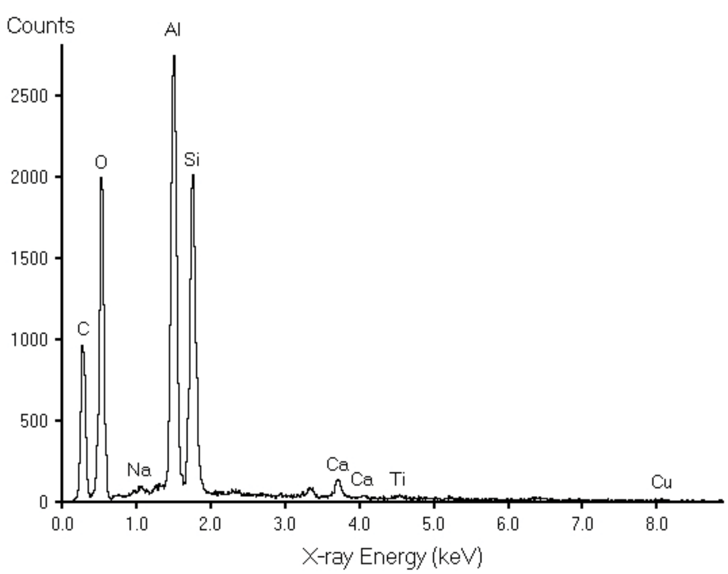


Figure 8: Staurolite (different grain)
Borehole MBR97-32A 108.87m-108.90m



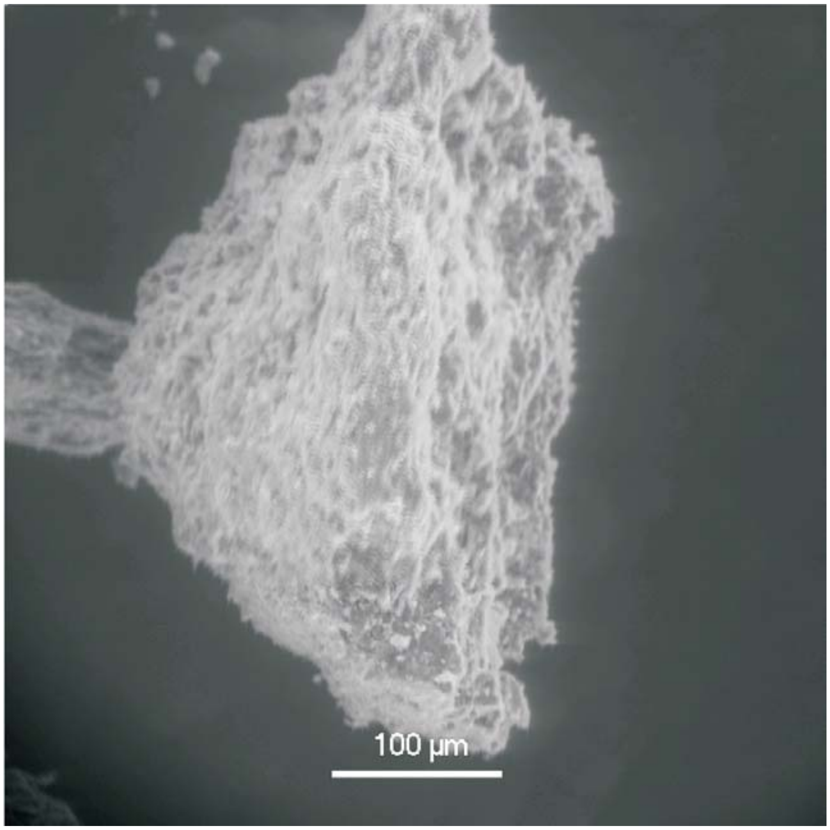
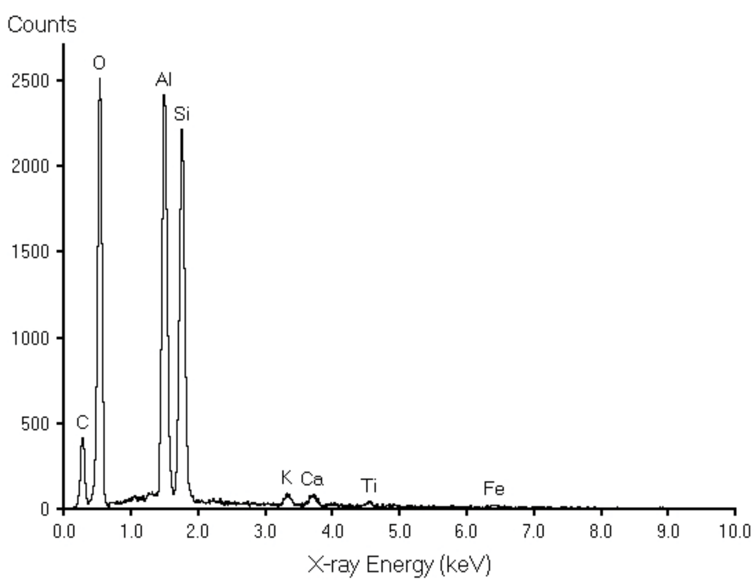


Figure 9: Staurolite Mineral
Borehole MBR97-32A 108.87m-108.90m



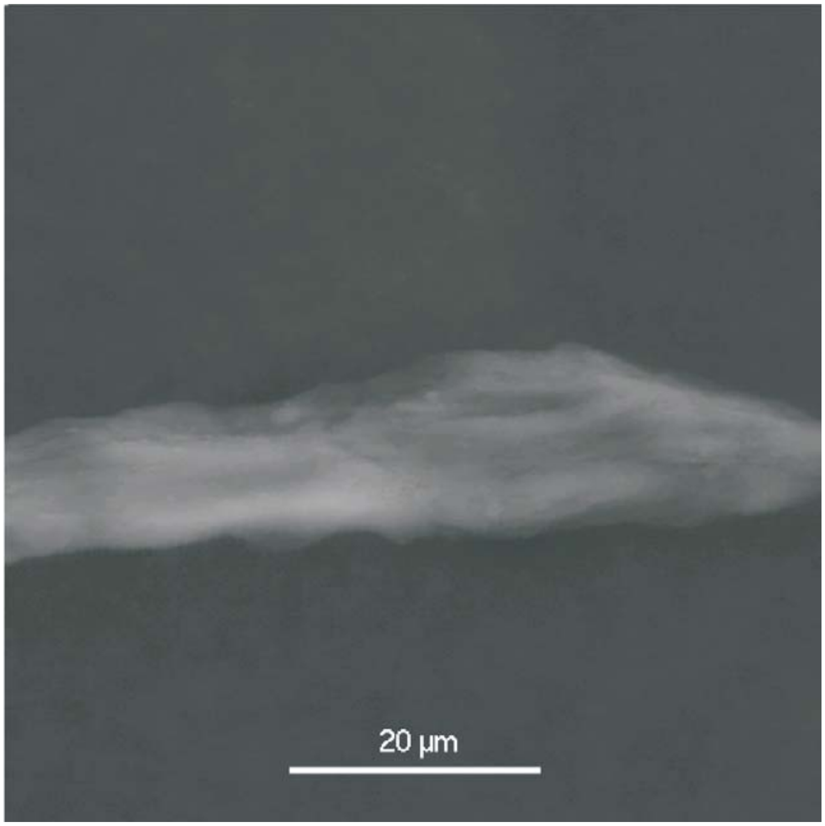
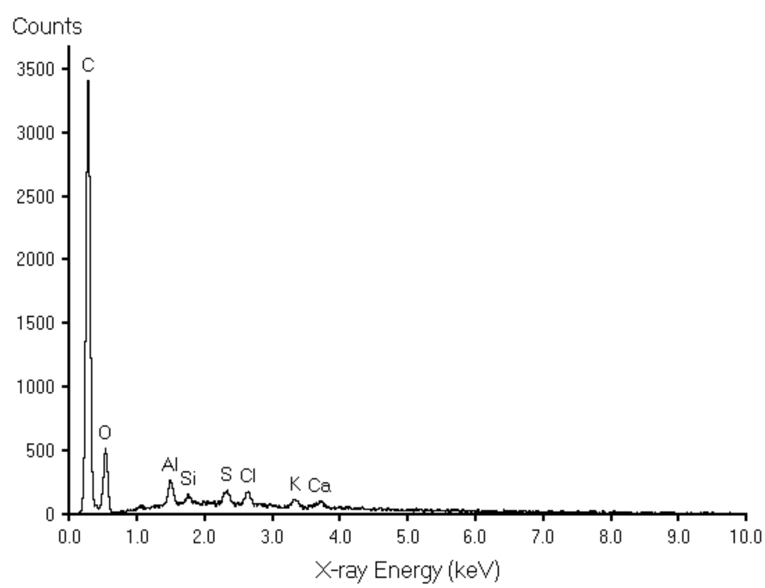


Figure 10: ?? (Small crystal)
Borehole MBR97-32A 108.87m-108.90m



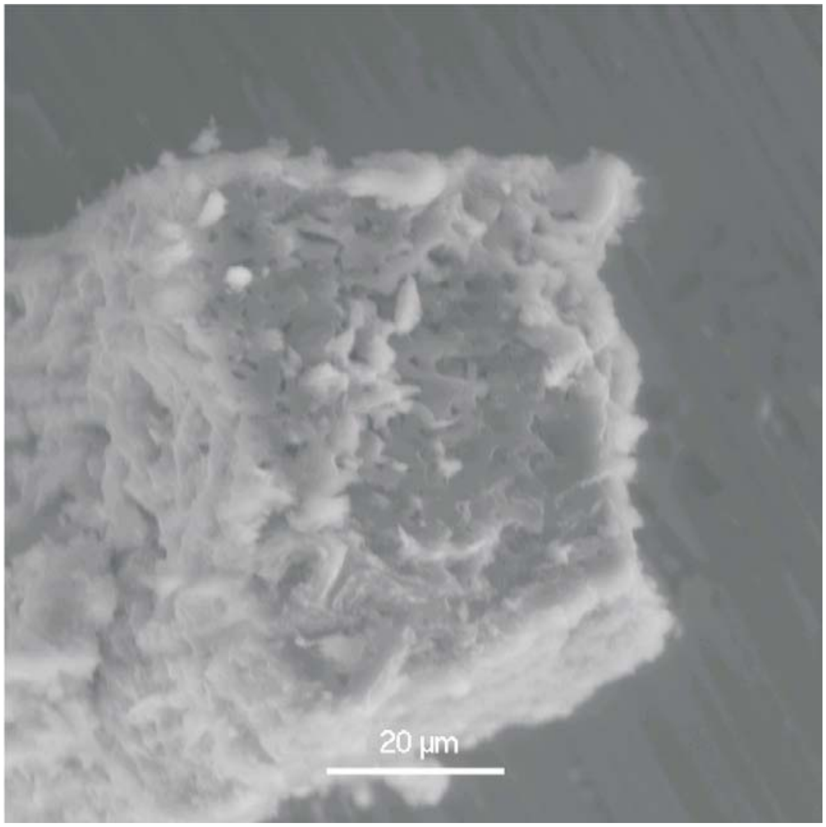
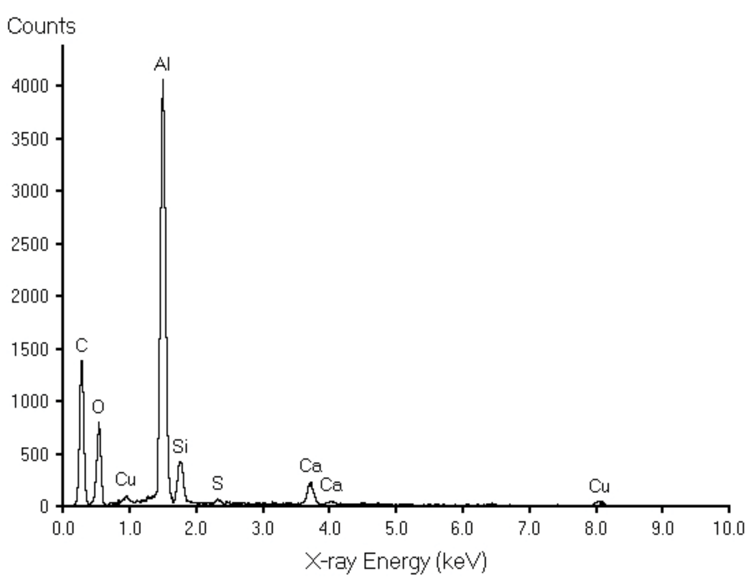


Figure 11: Corundum (?)
Borehole MBR97-32A 108.87m-108.90m



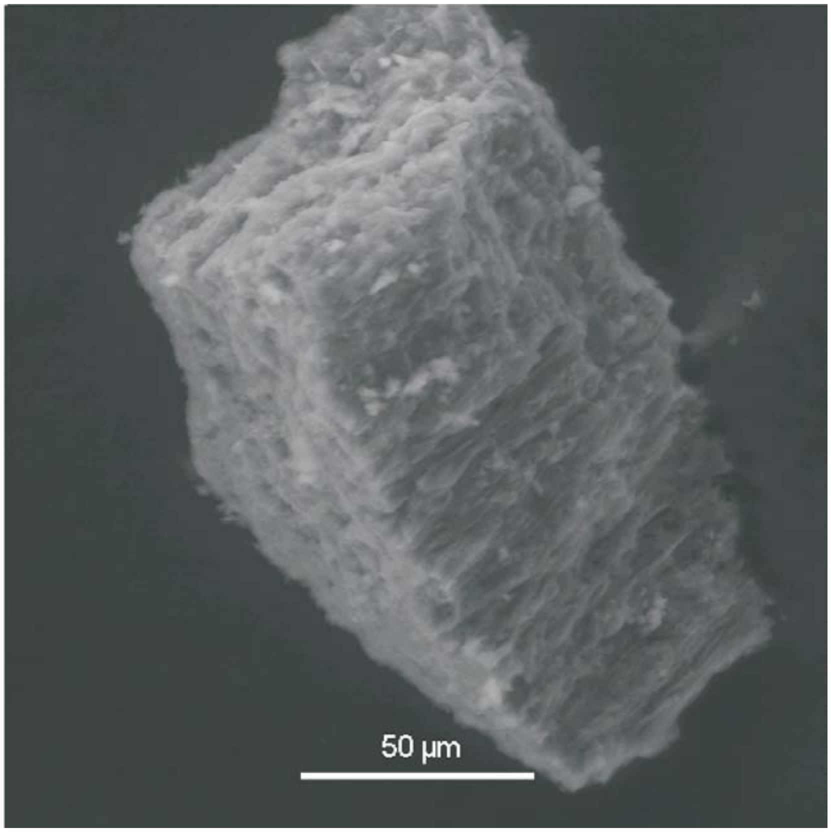
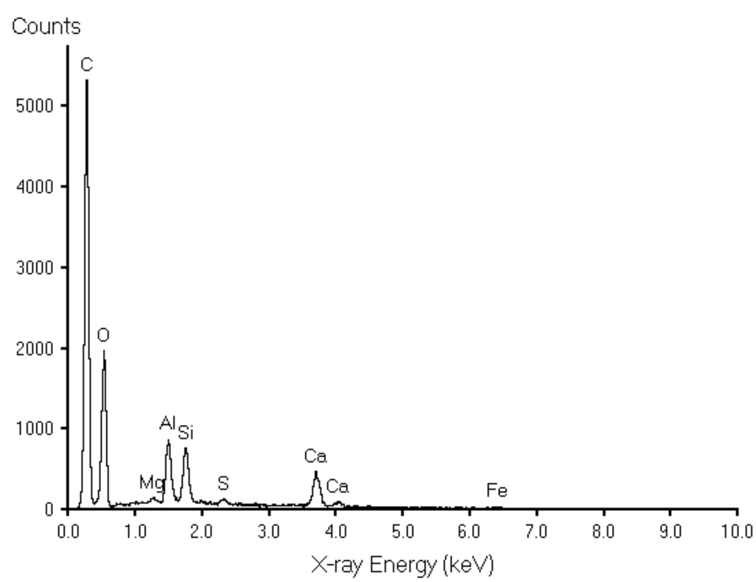


Figure 12: ??
Borehole MBR97-32A 108.87m-108.90m



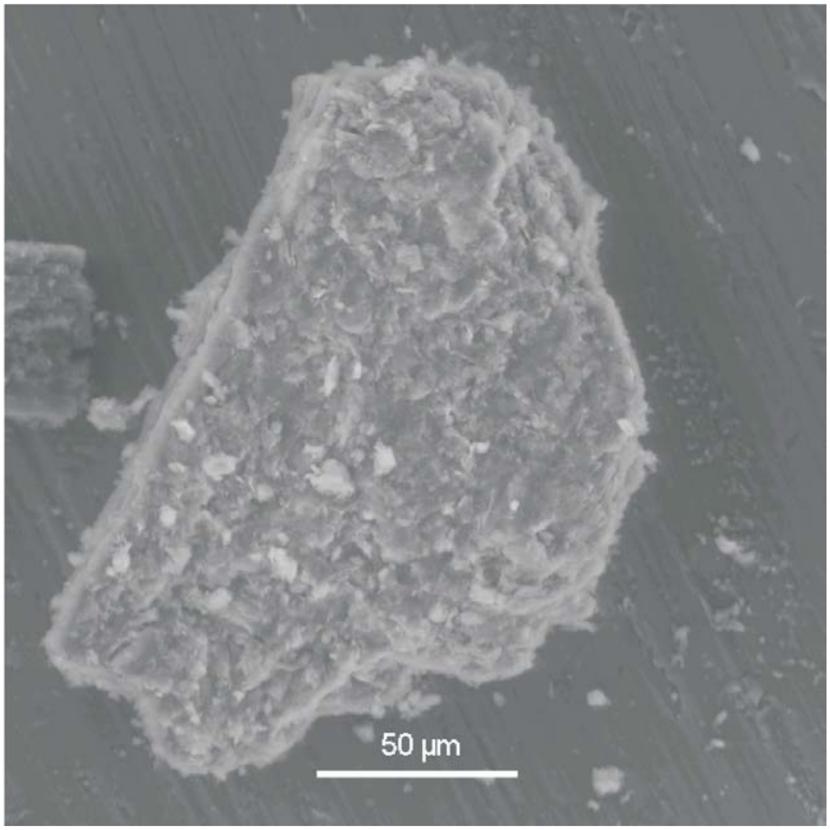
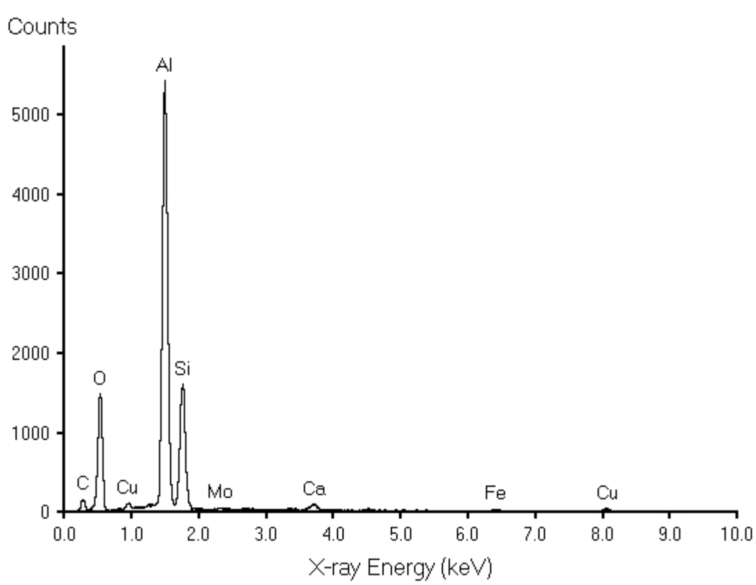


Figure 13: ??
Borehole MBR97-32A 108.87m-108.90m



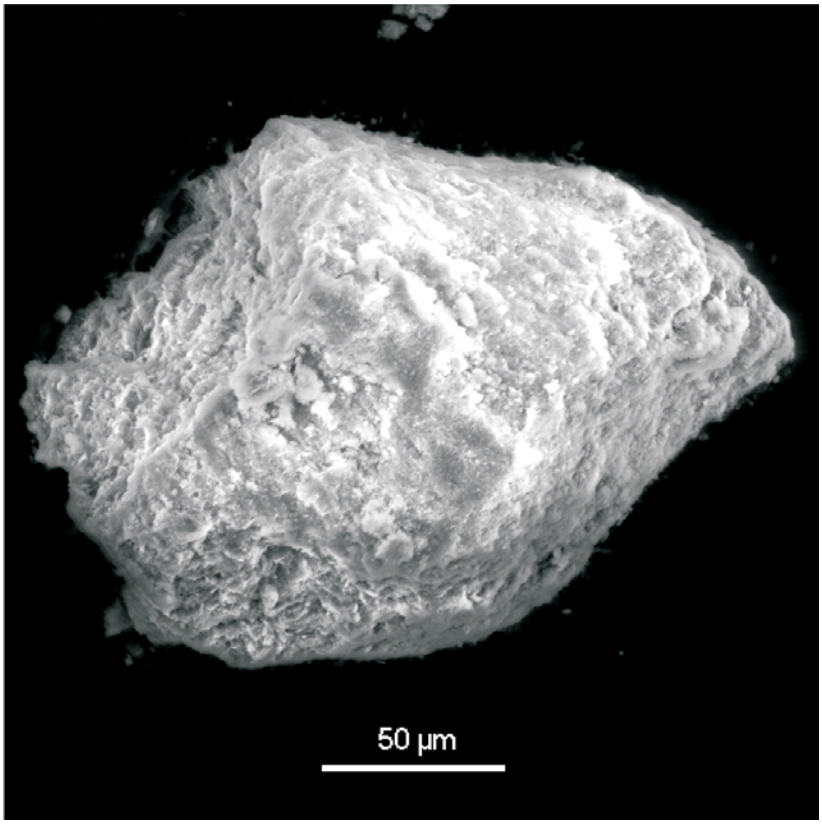
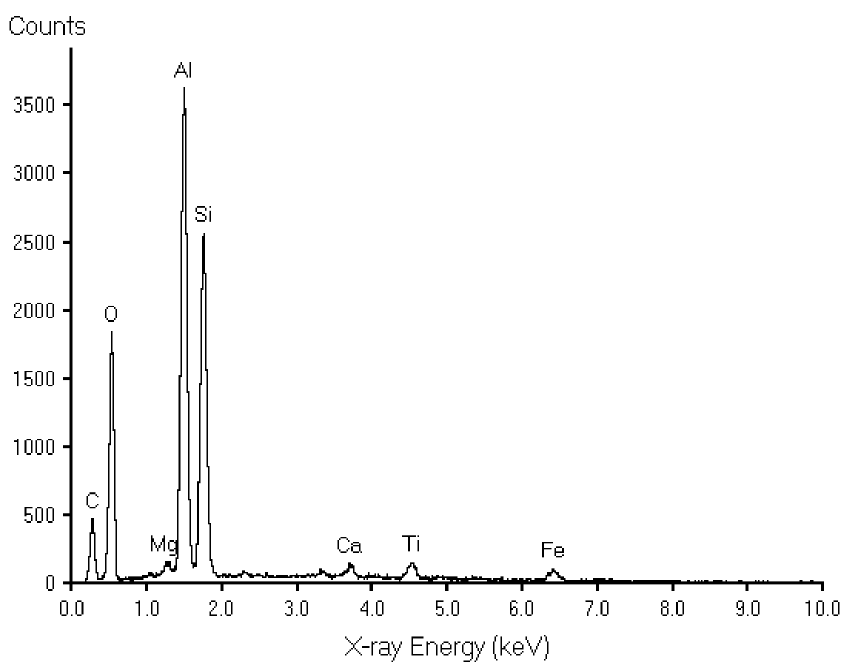


Figure 14: Clayey aggregate with Kaolinite composition
note: planar fabric
Borehole MBR97-32A 103.30m



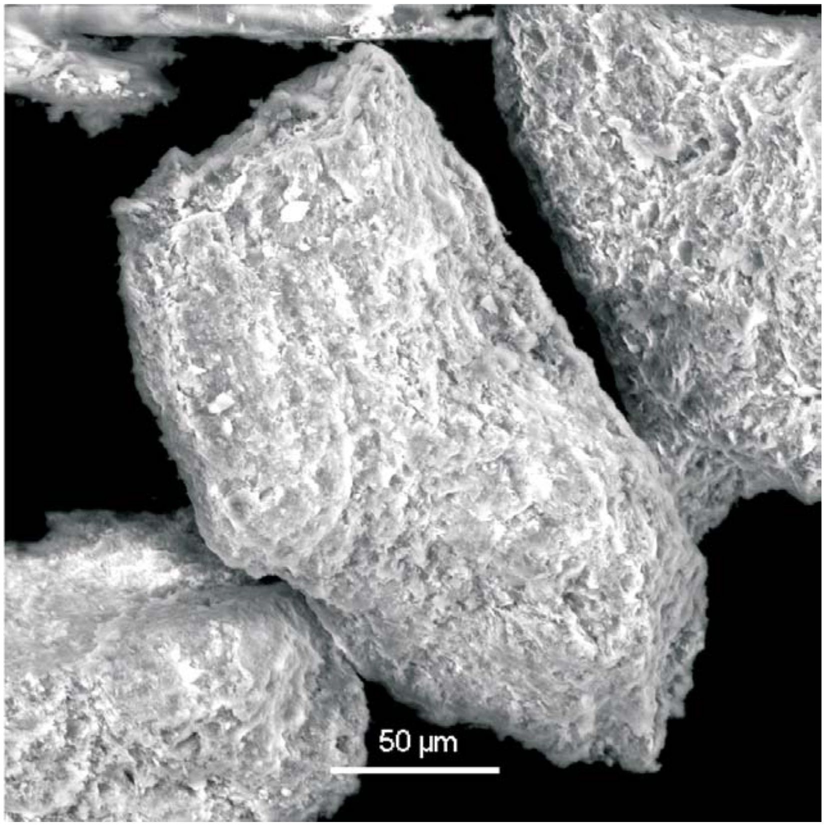
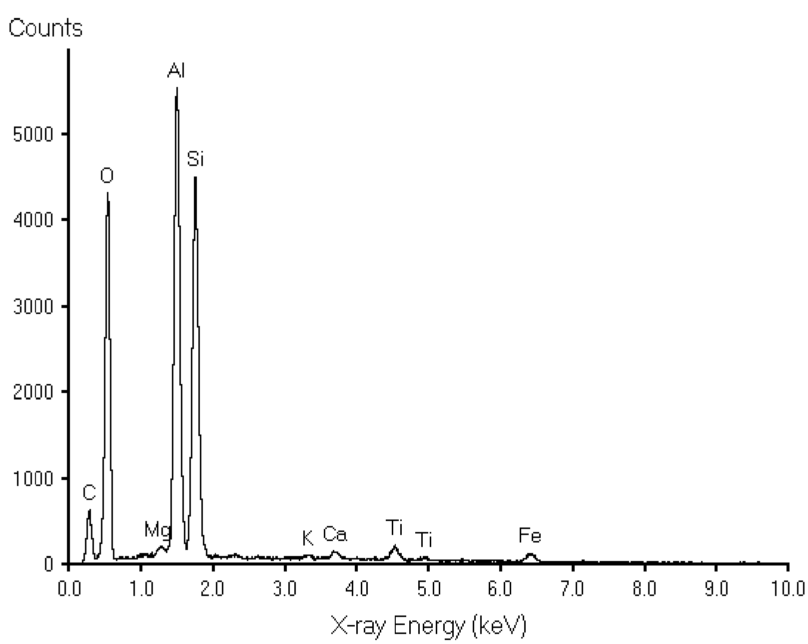


Figure 15: Clayey aggregate with Kaolinite composition
Borehole MBR97-32A 103.30m



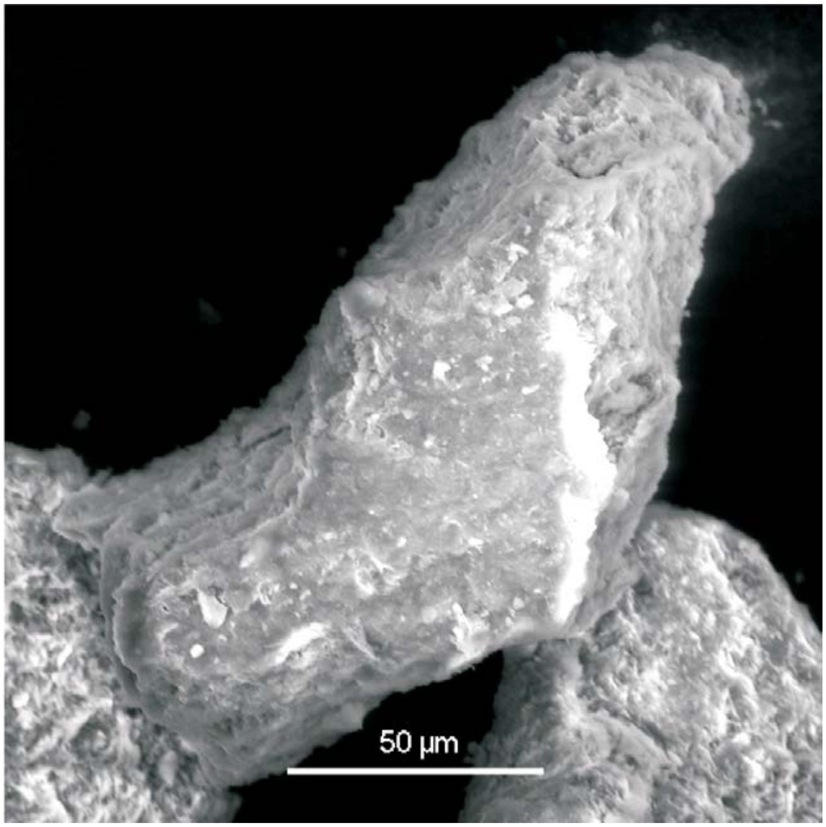
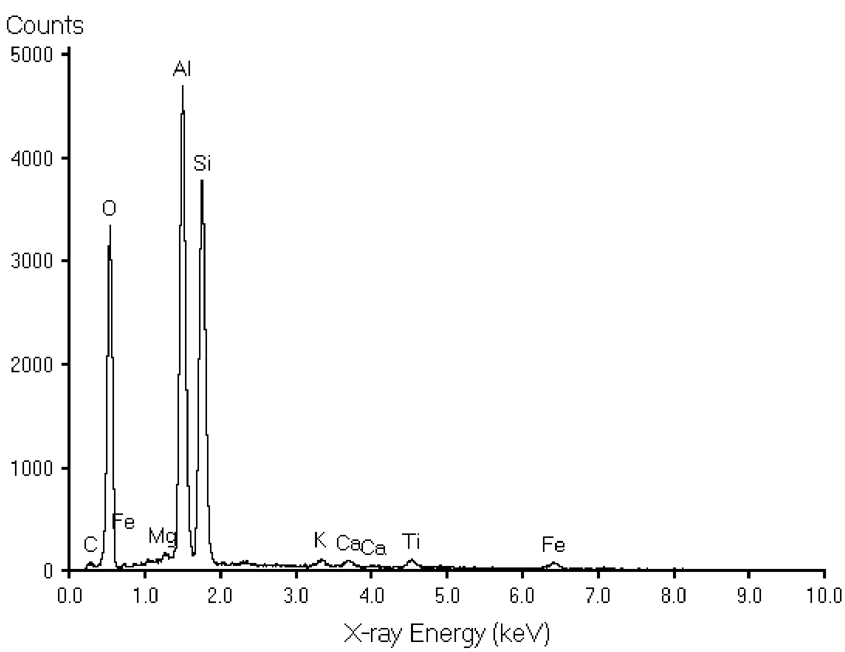


Figure 16: Clayey aggregate with Kaolinite composition
Borehole MBR97-32A 103.30m



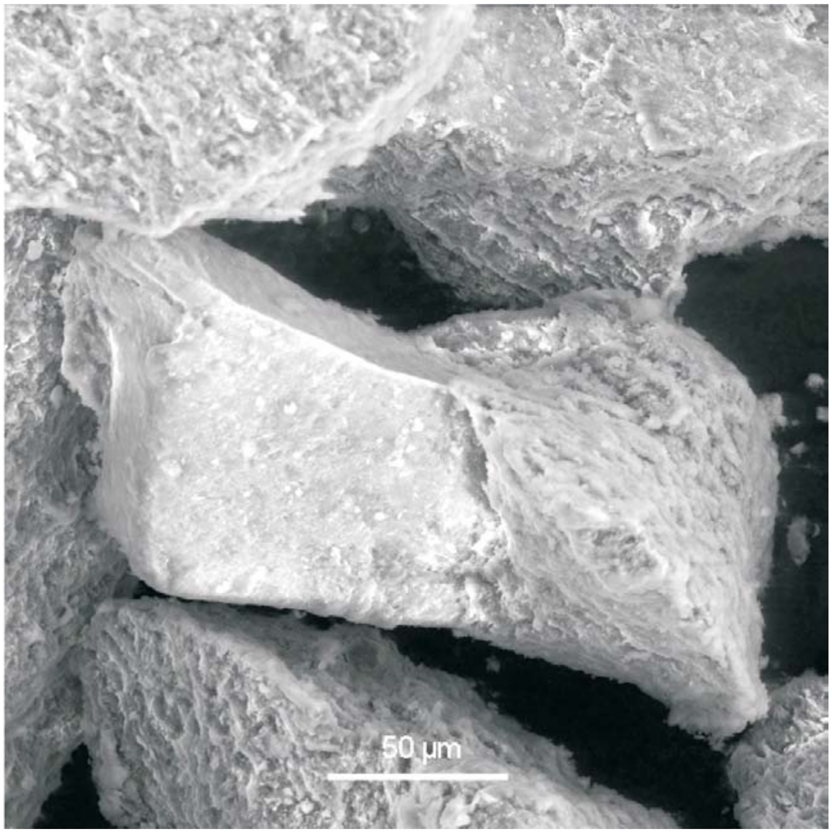
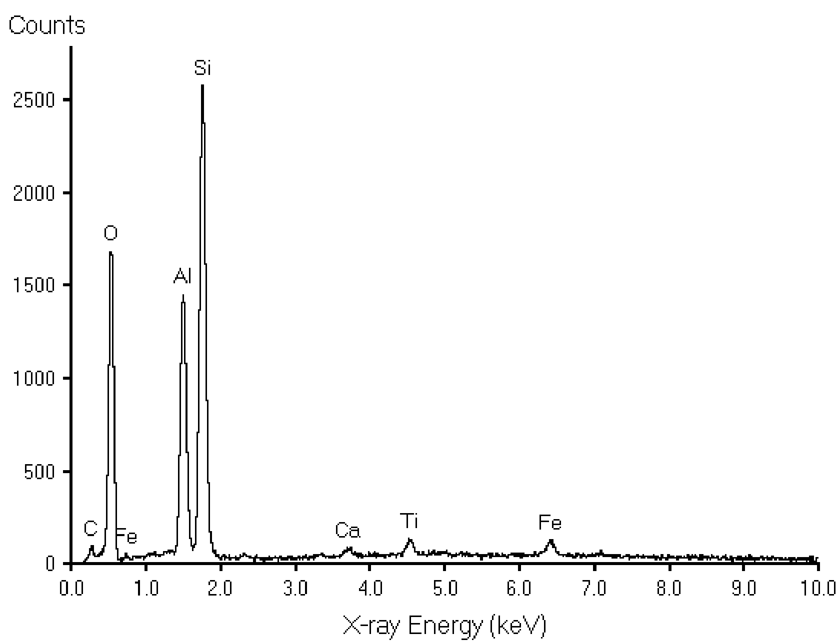


Figure 17: Euhedral quartz grain seen as part of clayey aggregate
Borehole MBR97-32A 103.30m



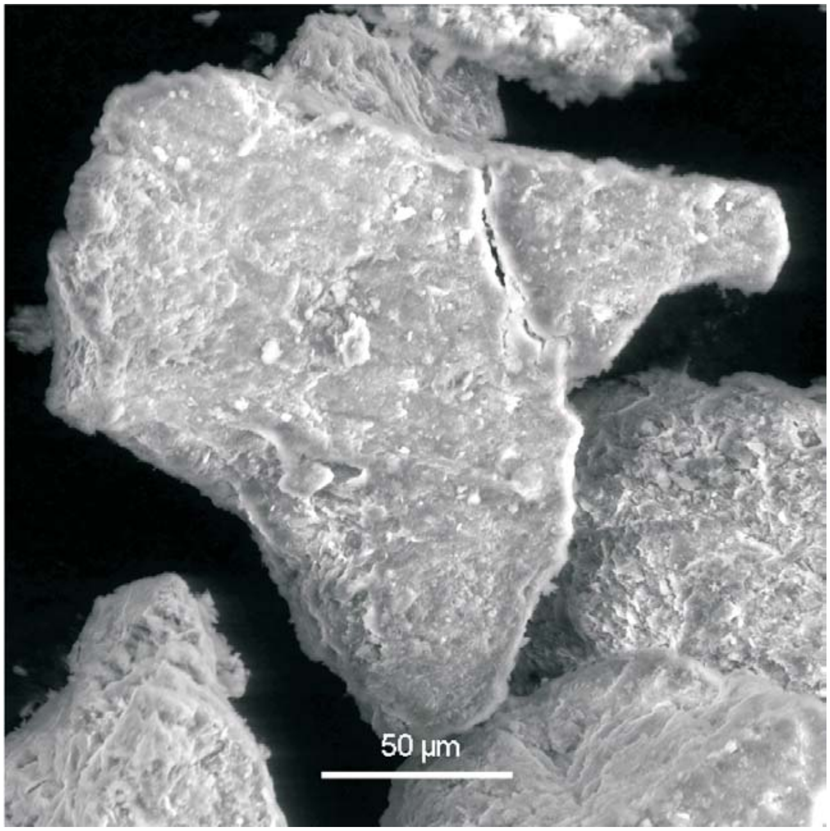
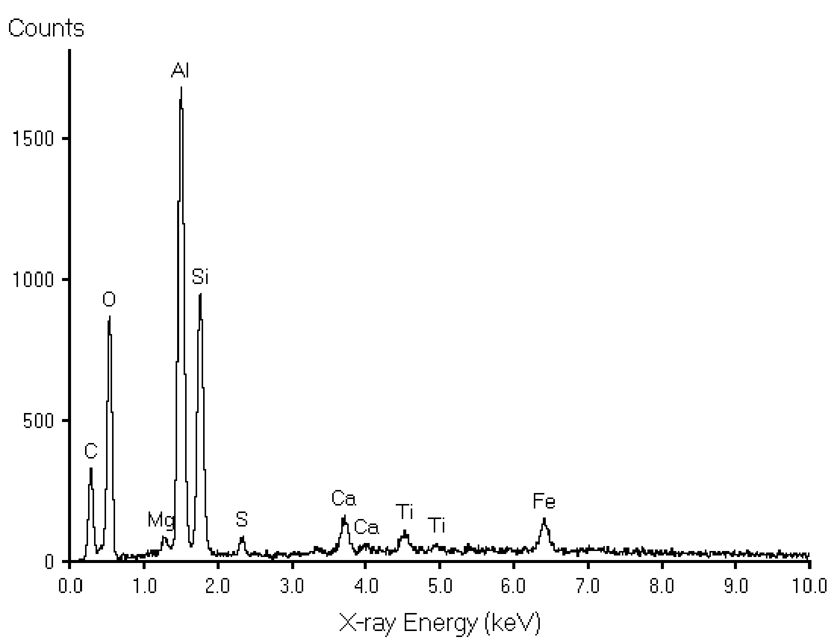


Figure 18: A flaky Clayey aggregate of kaolinite composition
Borehole MBR97-32A 103.30m



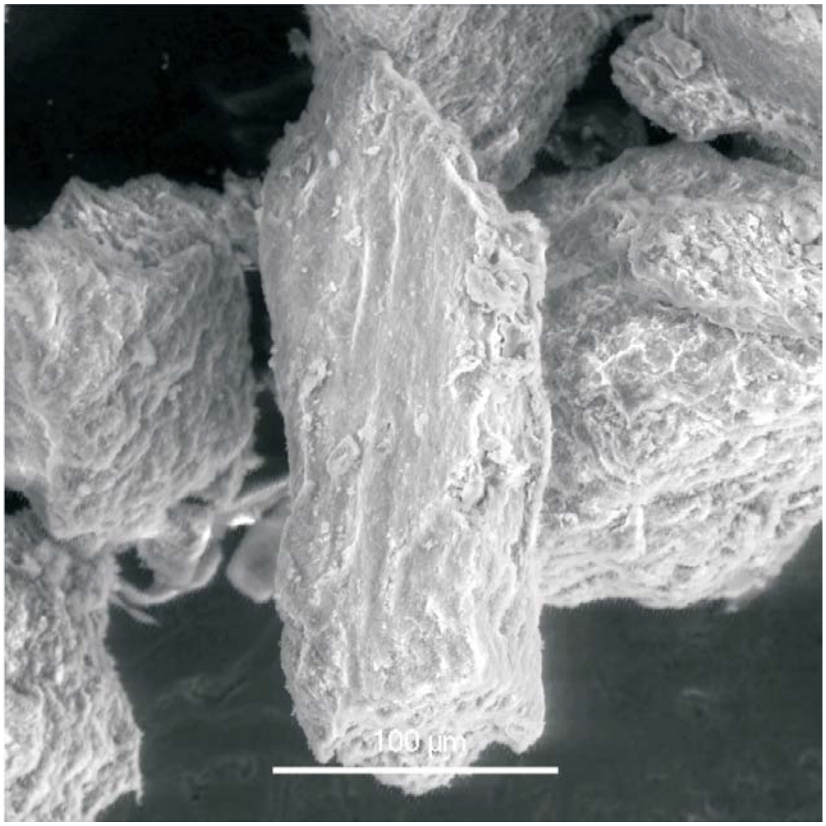
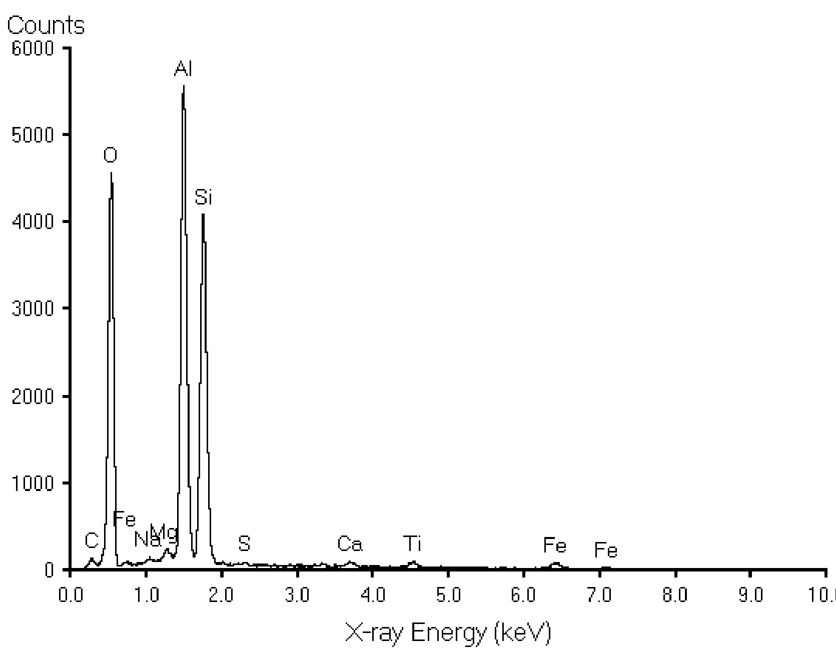


Figure 19: Clayey aggregate with Kaolinite composition
and planar fabric
Borehole MBR97-32A 103.30m



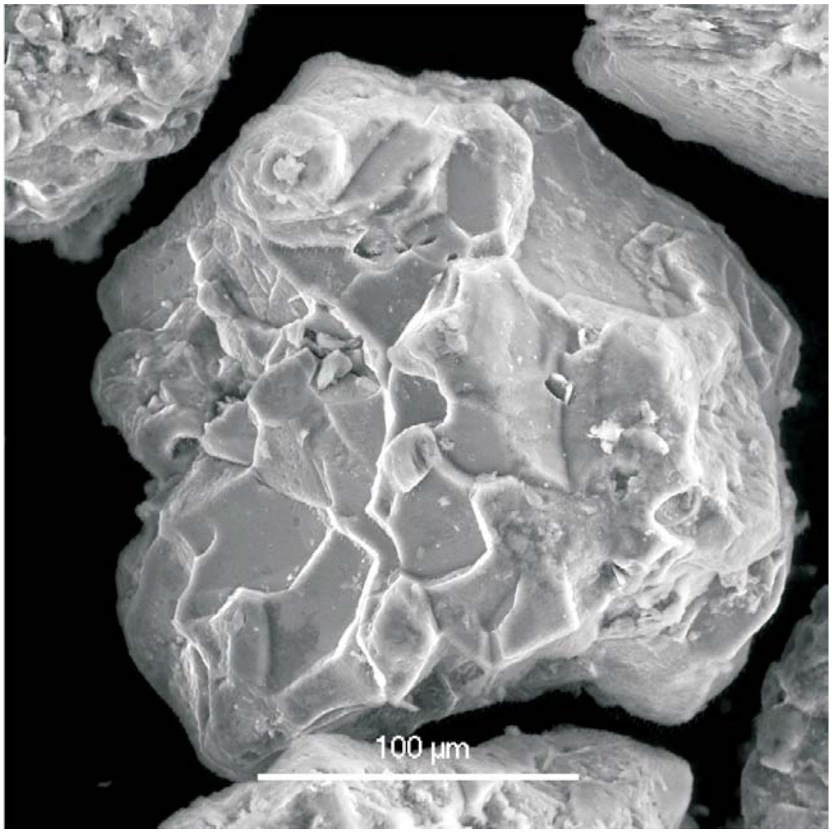
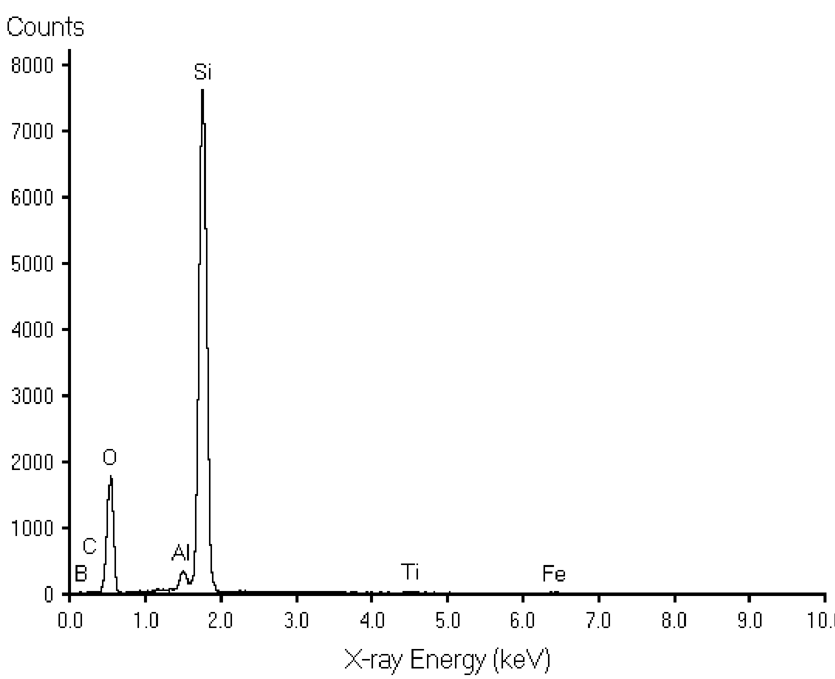


Figure 20: fine sand grain with quartz composition
Borehole MBR97-32A 116.80m-116.83m



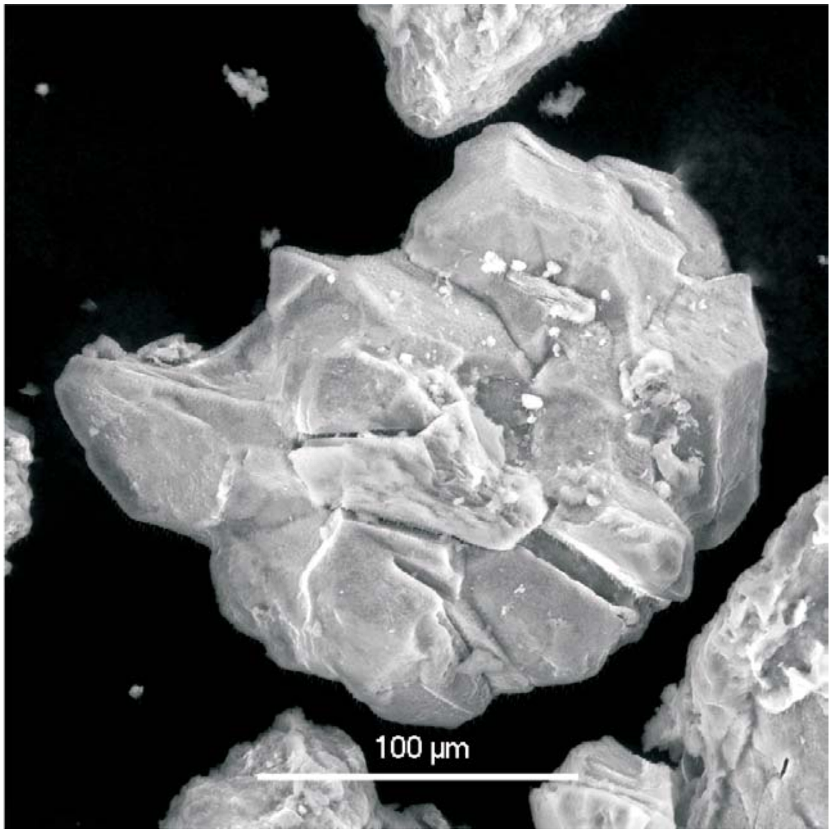
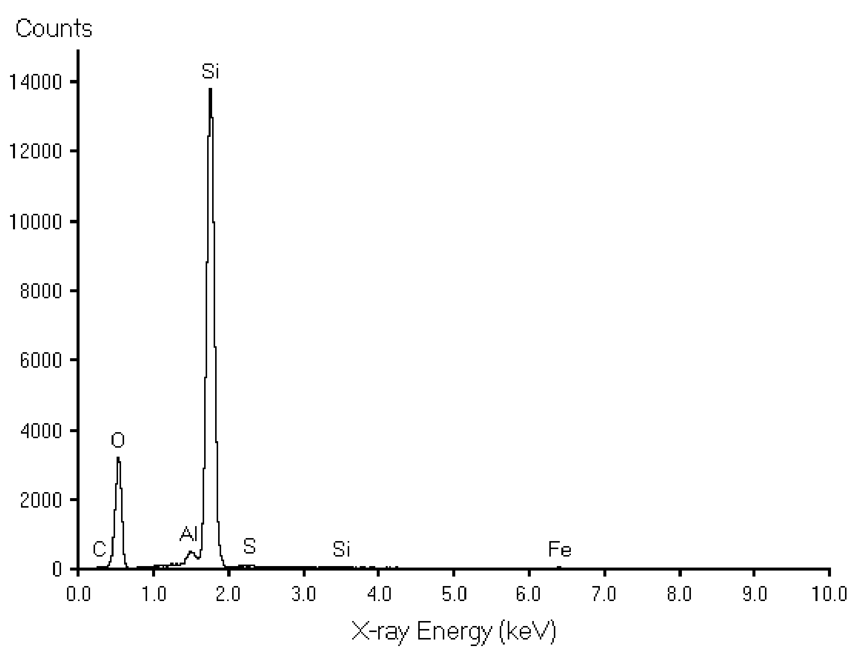


Figure 21: Peculiar fine sand grain with quartz mineral composition
Borehole MBR97-32A 116.80m-116.83m



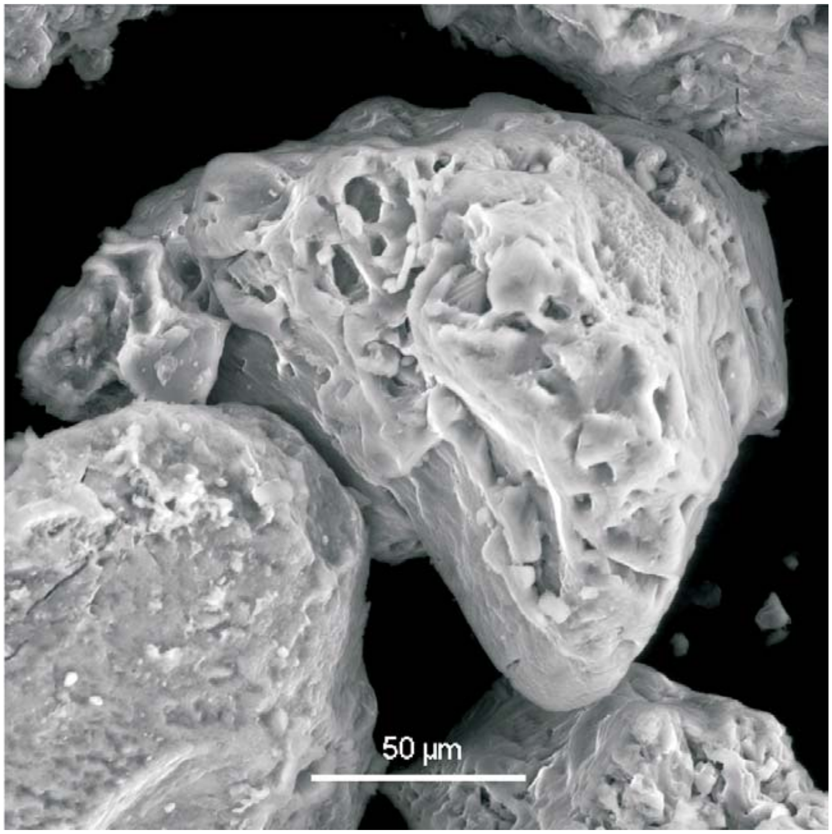
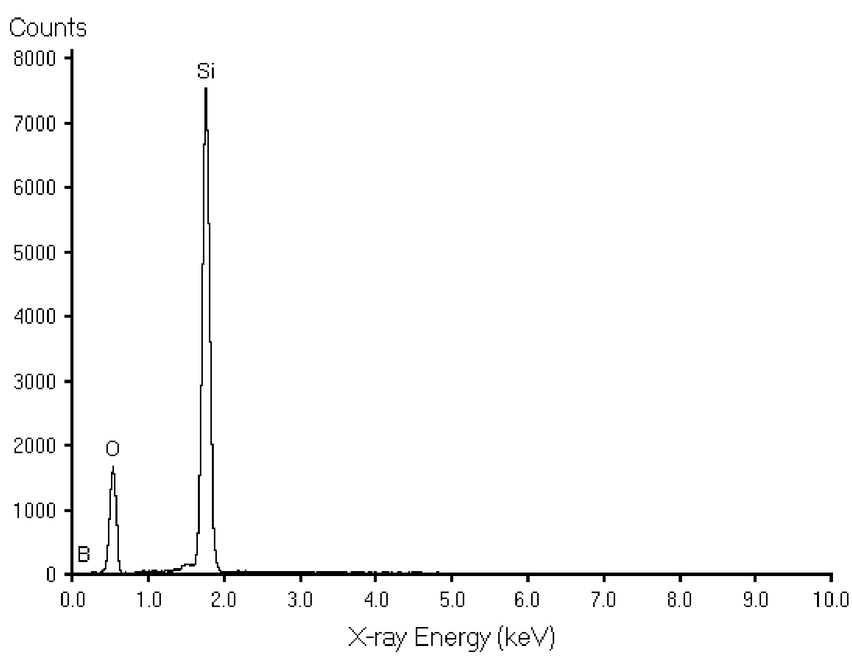


Figure 22: Detrital quartz grain sharing dissolution features
Borehole MBR97-32A 116.80m-116.83m



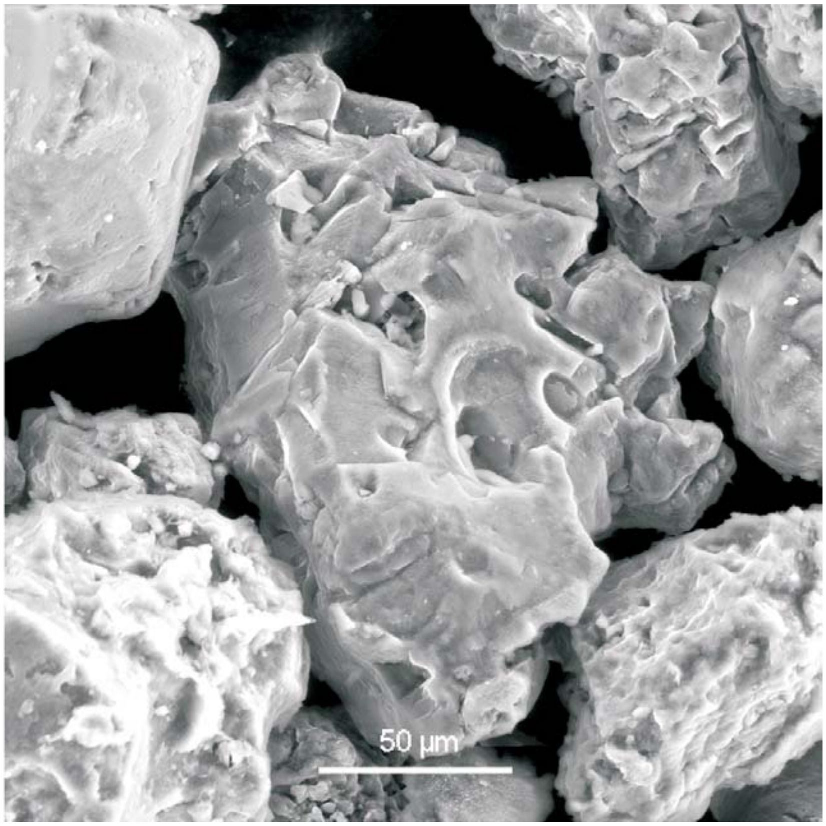
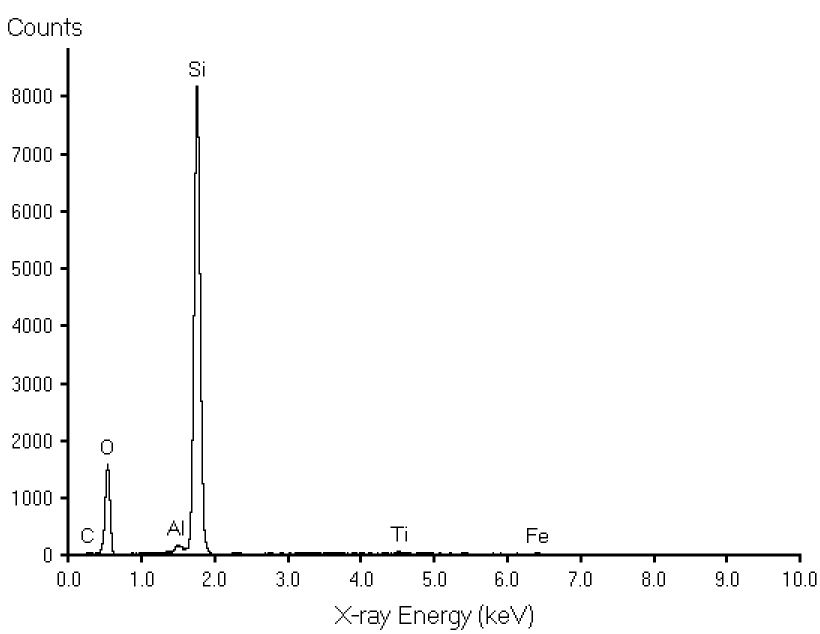


Figure 23: Well sorted detrital quartz sand. Grains show dissolution features
Borehole MBR97-32A 116.80m-116.83m



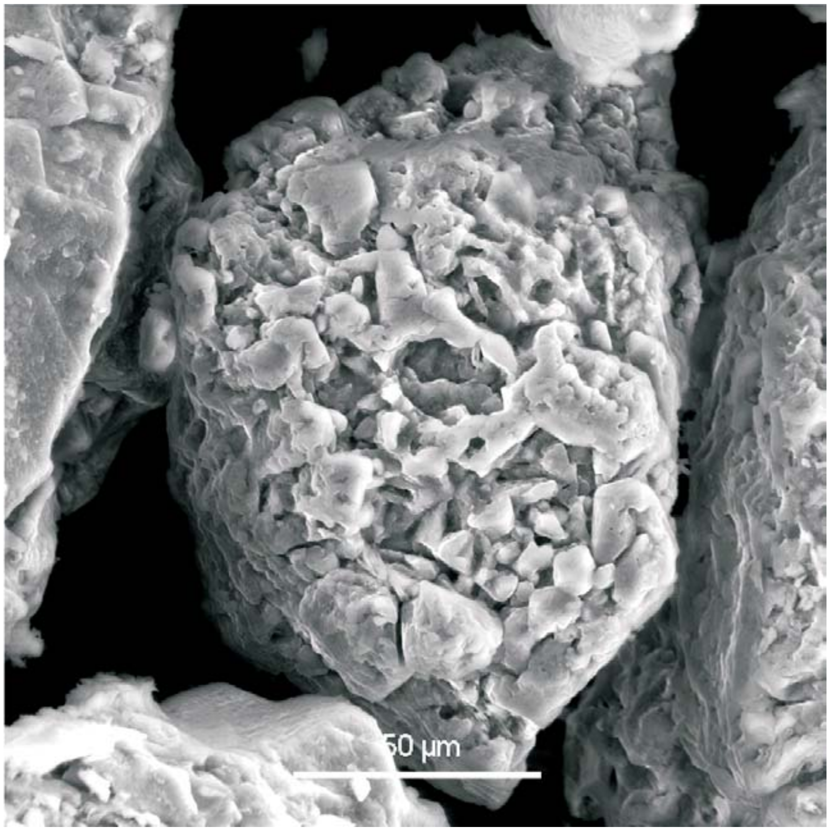
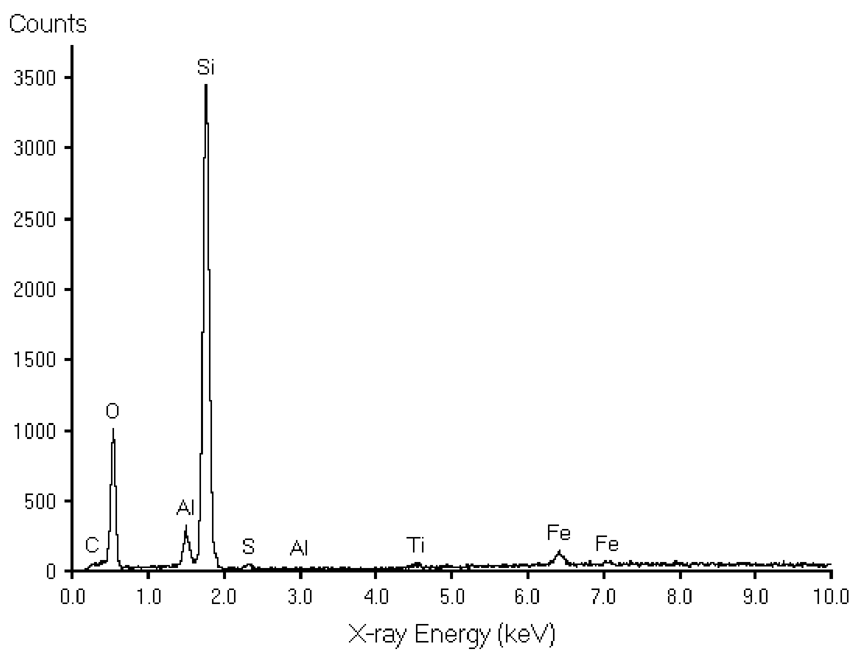


Figure 24: Corroded, detrital quartz grain
Borehole MBR97-32A 116.80m-116.83m



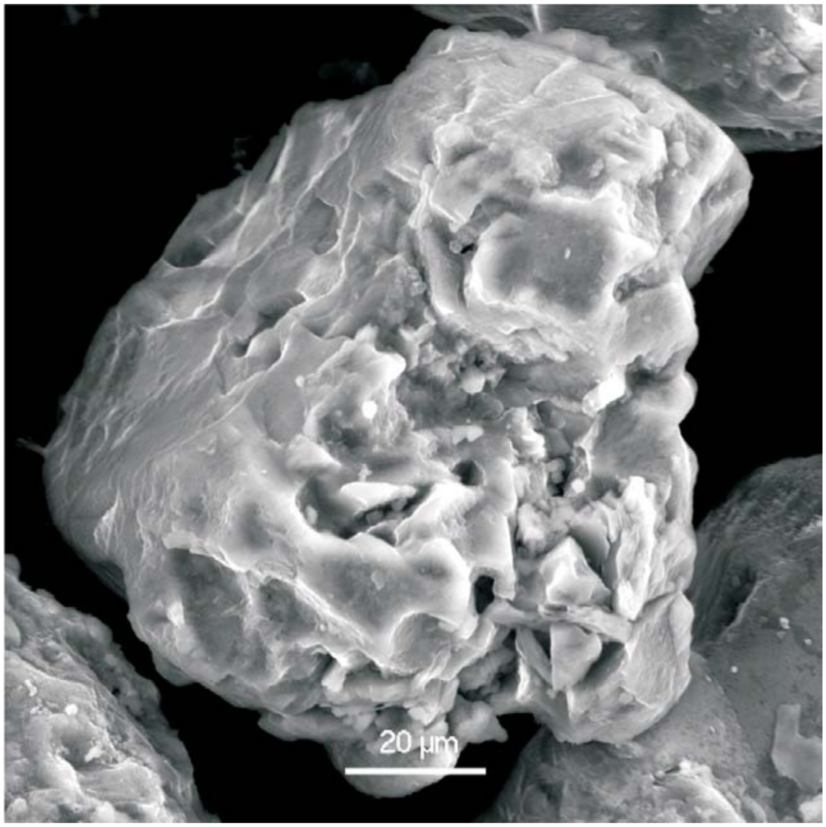
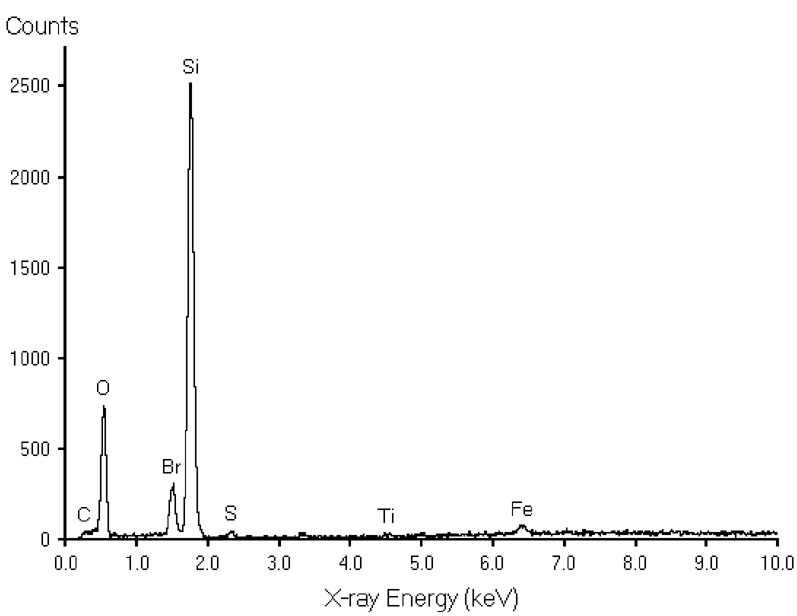


Figure 25: Well sorted detrital quartz sand with corroded grain
Borehole MBR97-32A 116.80m-116.83m



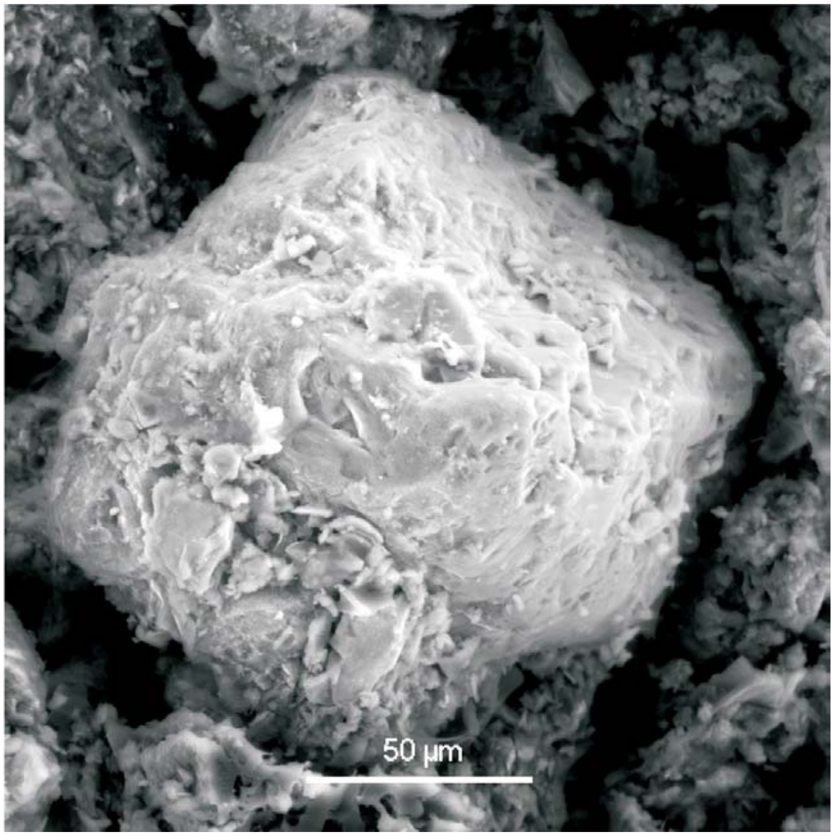
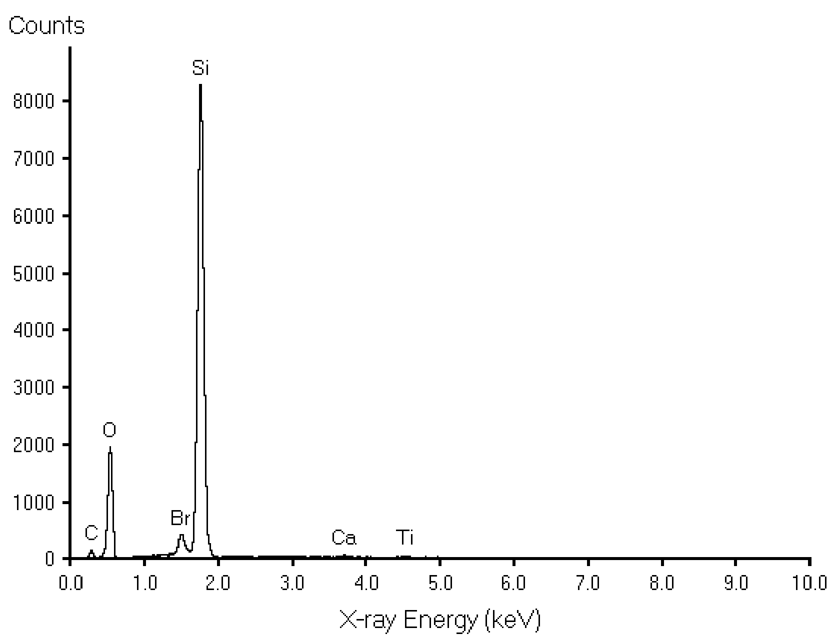


Figure 26: Detrital quartz grain
Borehole MBR97-32A 121.17m-121.20m



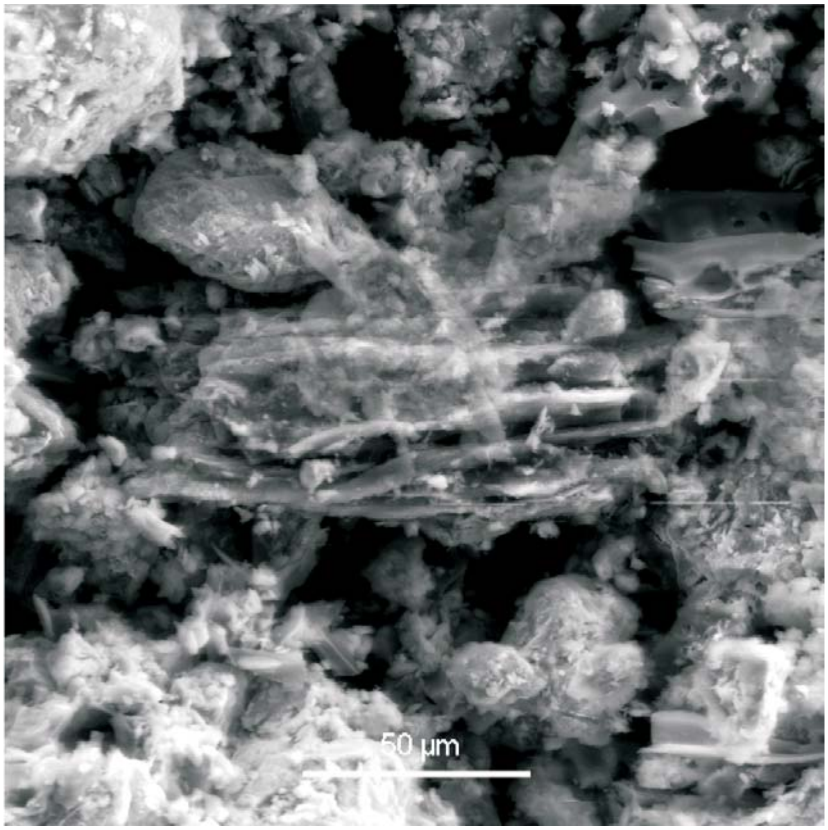
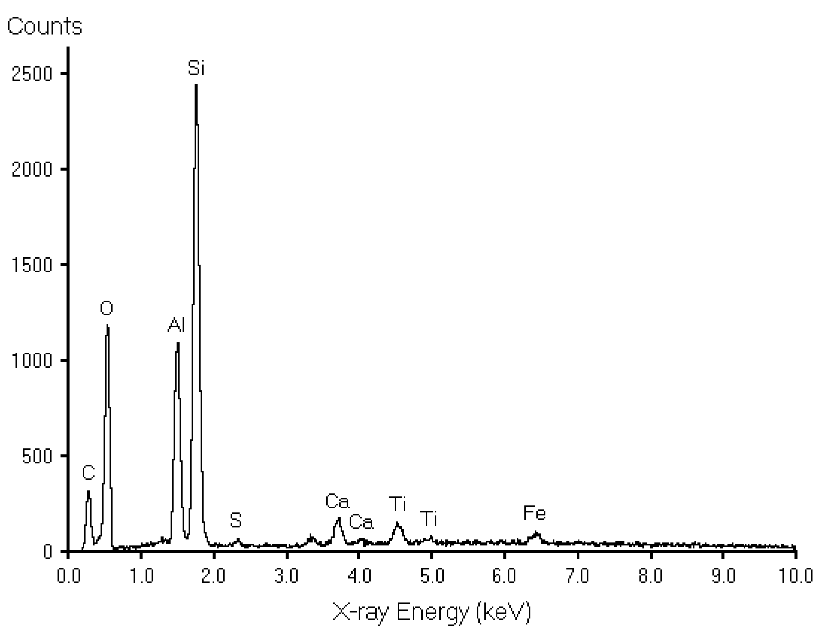


Figure 27: Mineralized woody fragment
Borehole MBR97-32A 121.17m-121.20m



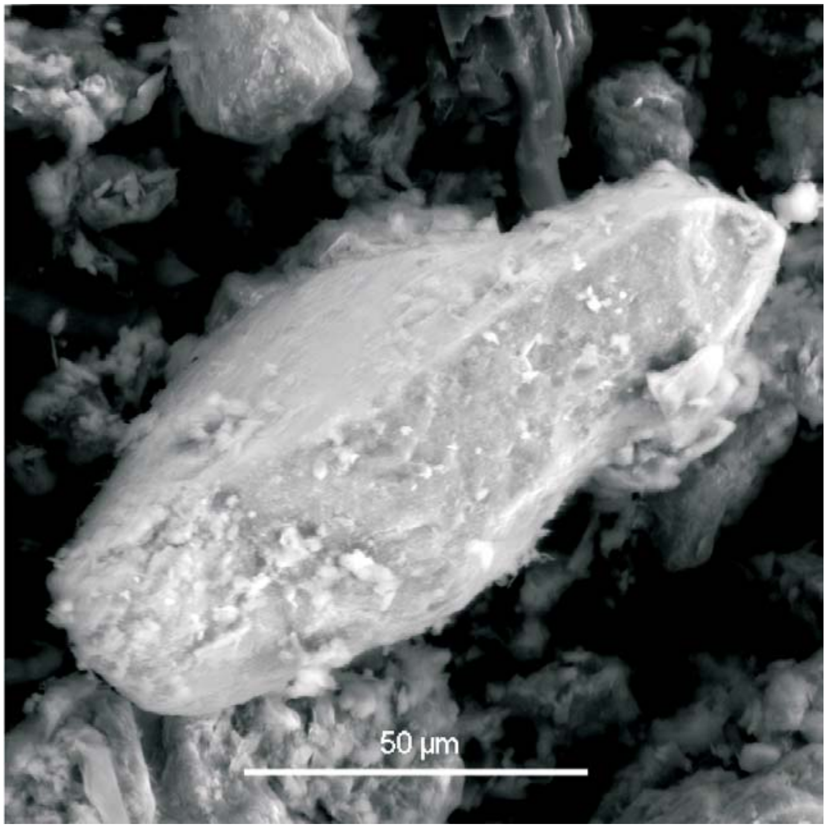
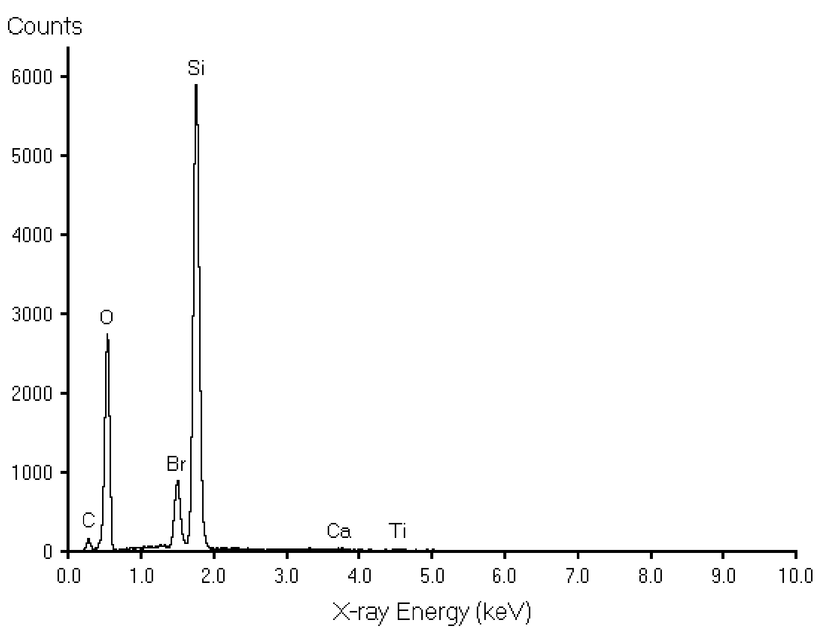


Figure 28: Detrital subhedral quartz
Borehole MBR97-32A 121.17m-121.20m



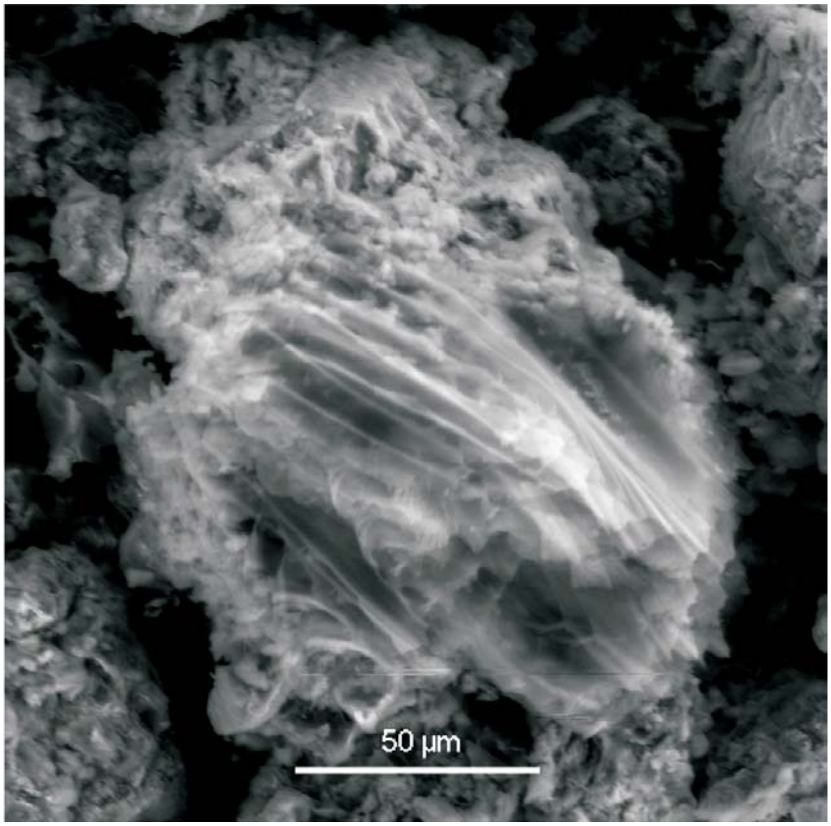
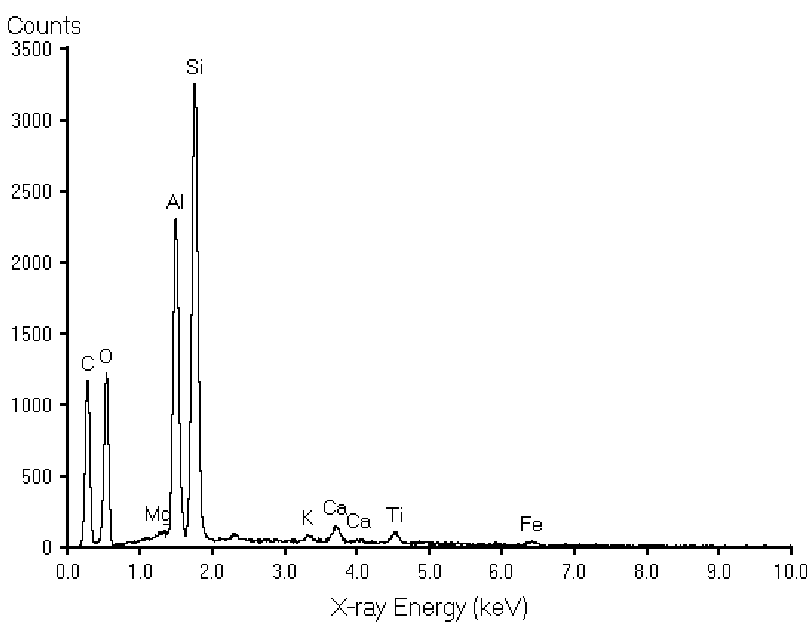


Figure 29: Clearly mineralized wood piece
Borehole MBR97-32A 121.17m-121.20m



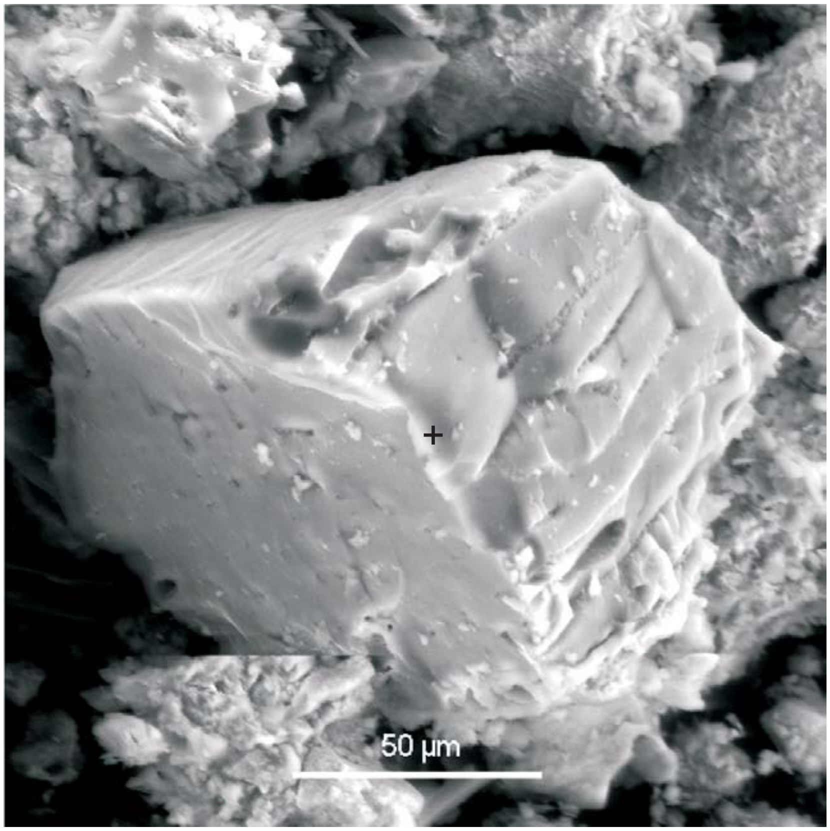
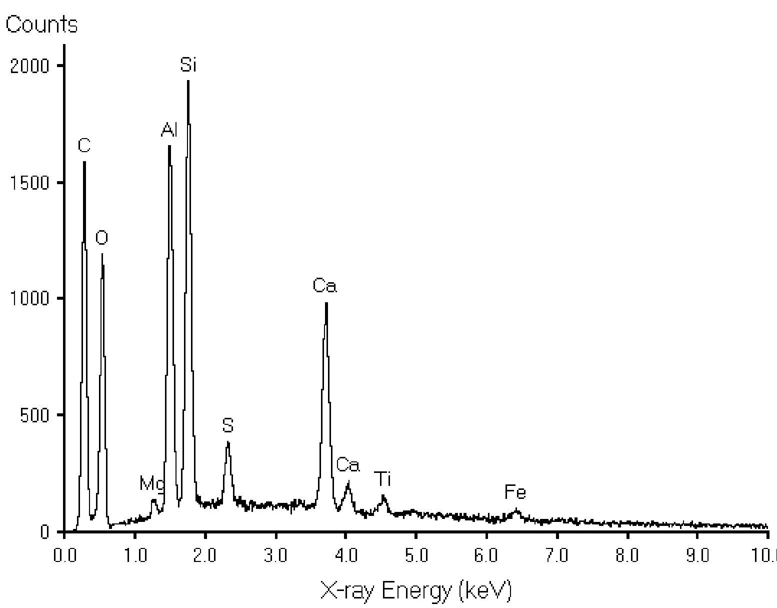


Figure 30: Hard-looking mineral with a strange composition
Borehole MBR97-32A 121.17m-121.20m



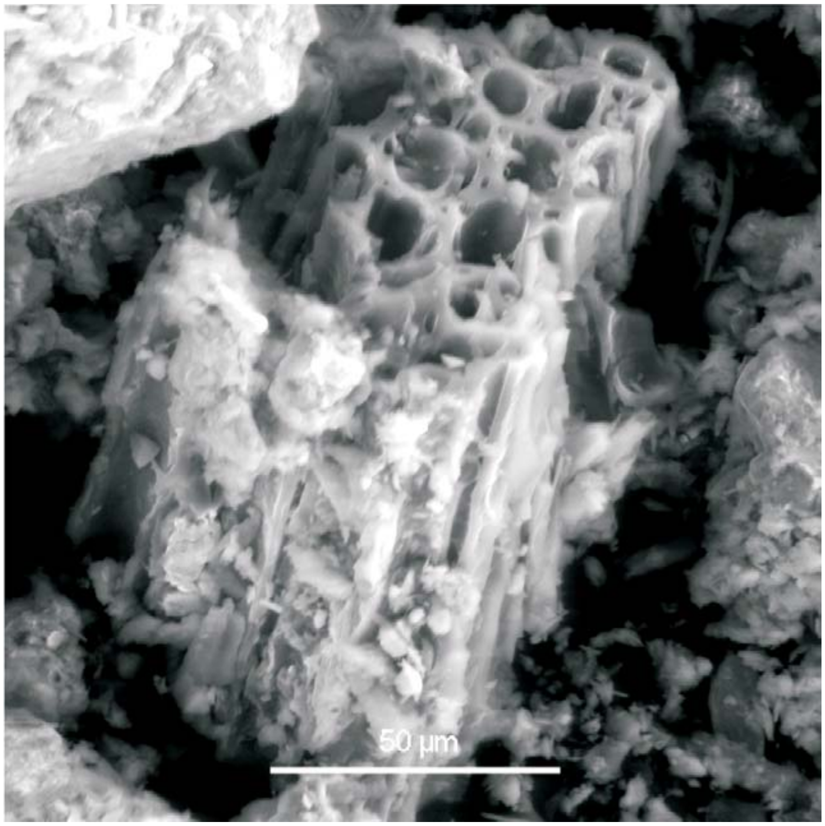
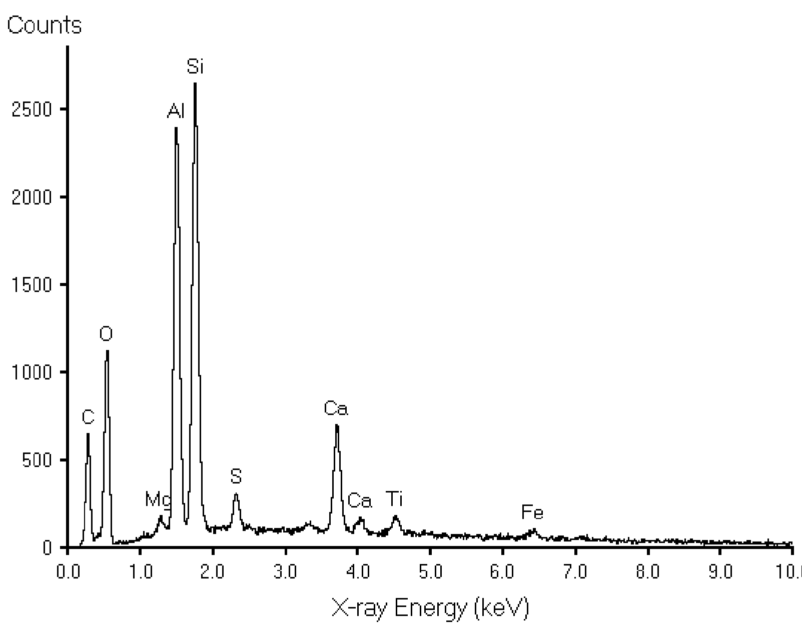


Figure 31: Mineralized wood piece
Borehole MBR97-32A 121.17m-121.20m



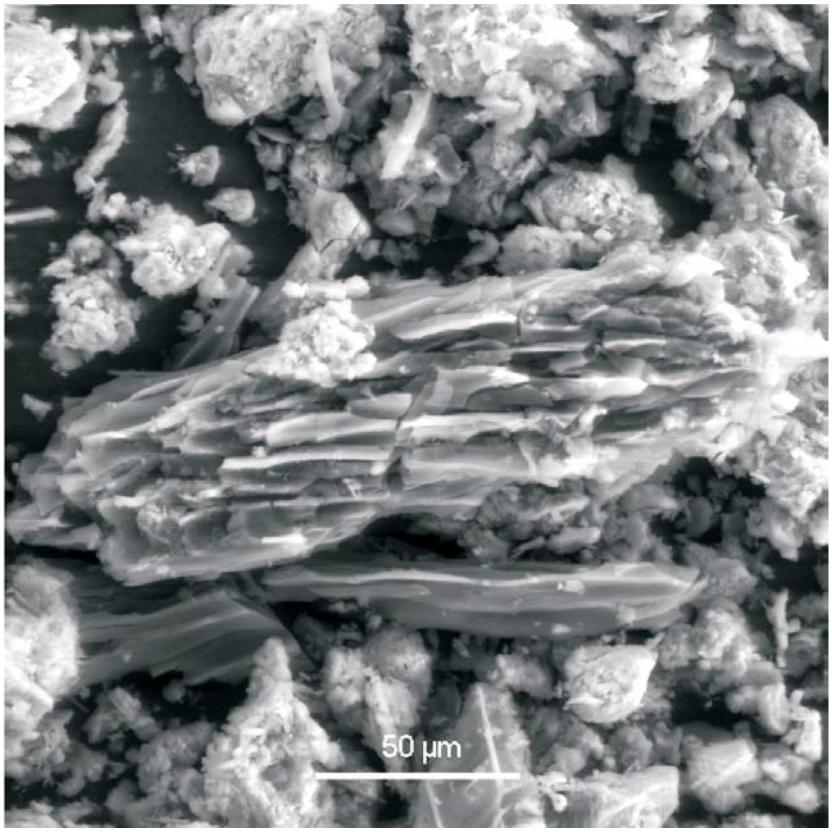
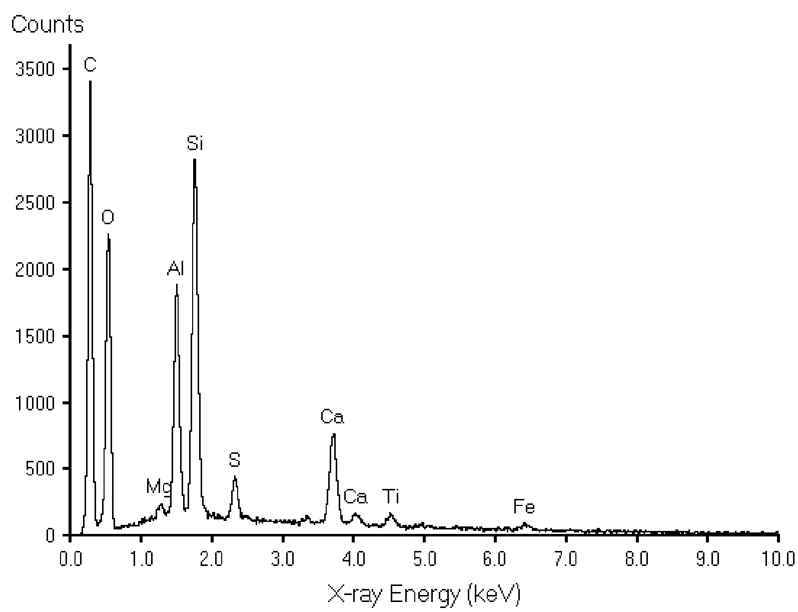


Figure 32: Mineralized wood fragment (high carbon from tape)
Borehole MBR97-32A 121.17m-121.20m



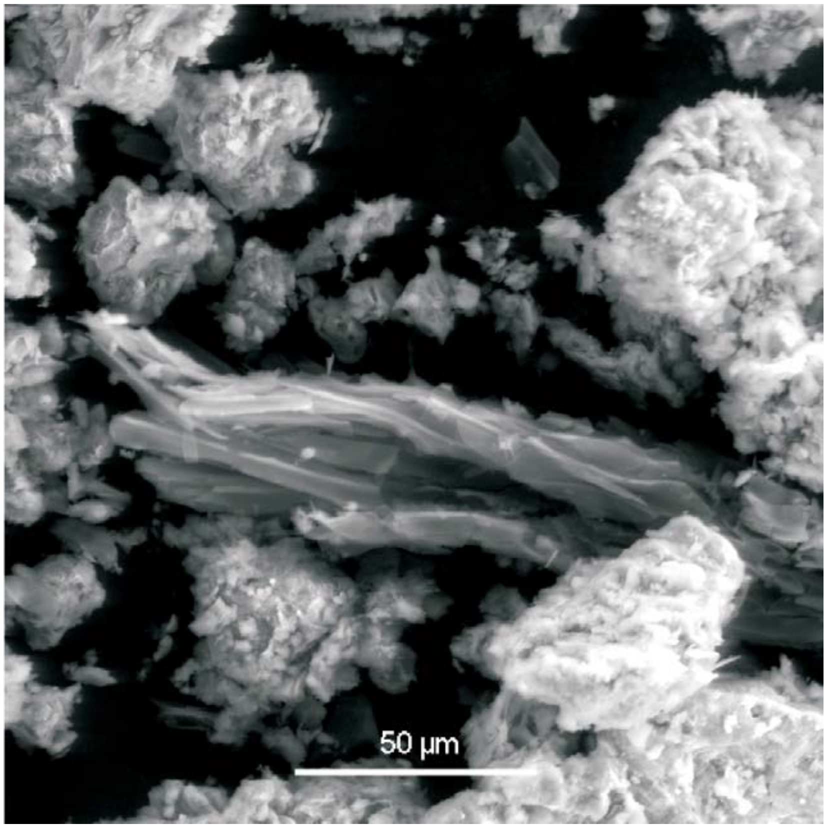
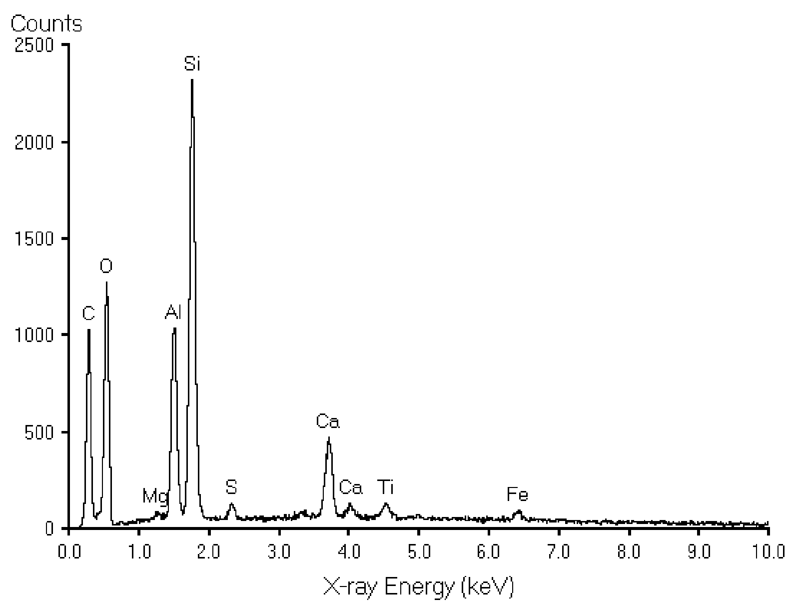


Figure 33: Wood fragment on carbon tape
Borehole MBR97-32A 121.17m-121.20m



APPENDIX 1
Scanning electron micrographs and electron dispersive system (EDS) spectra analyses of lignite samples

B: Borehole CH-97-10B

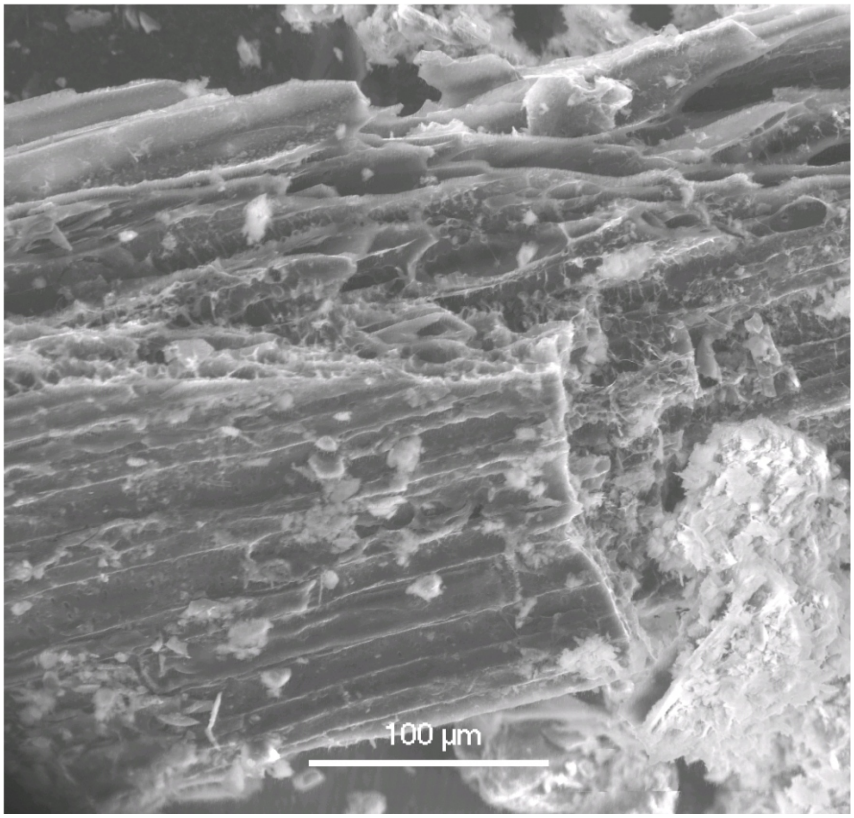
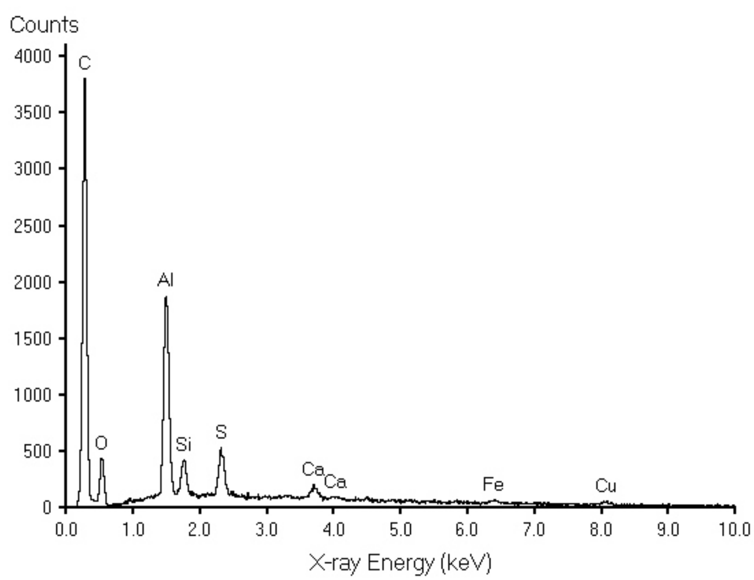


Figure 1: Staurolite + Pyrite (?) Mineral
Borehole CH97-10B 57.69m-57.71m



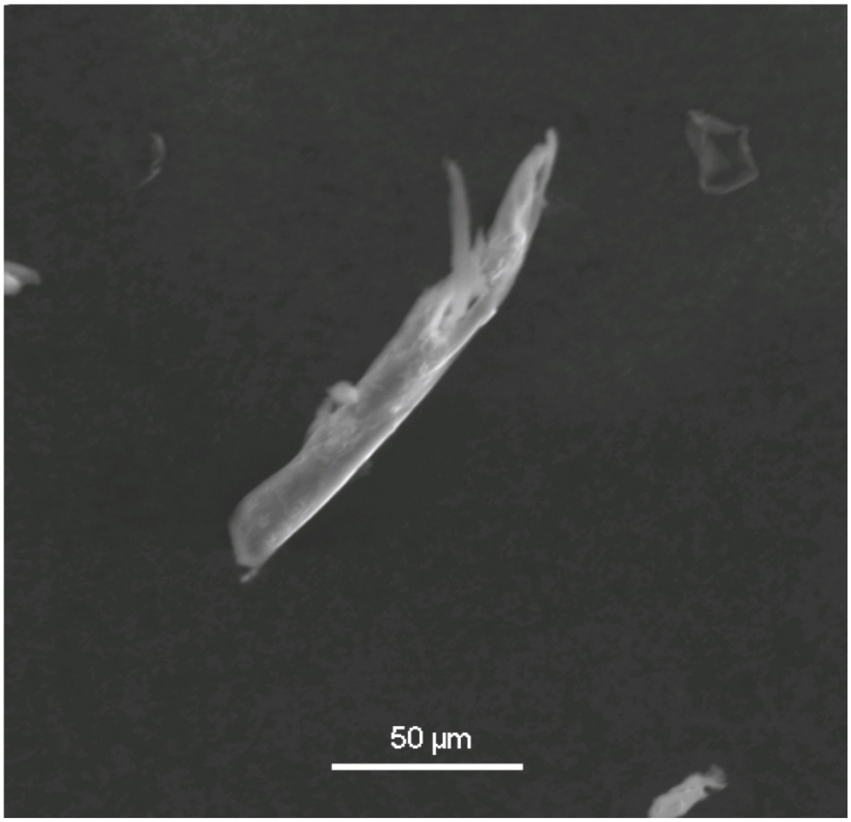
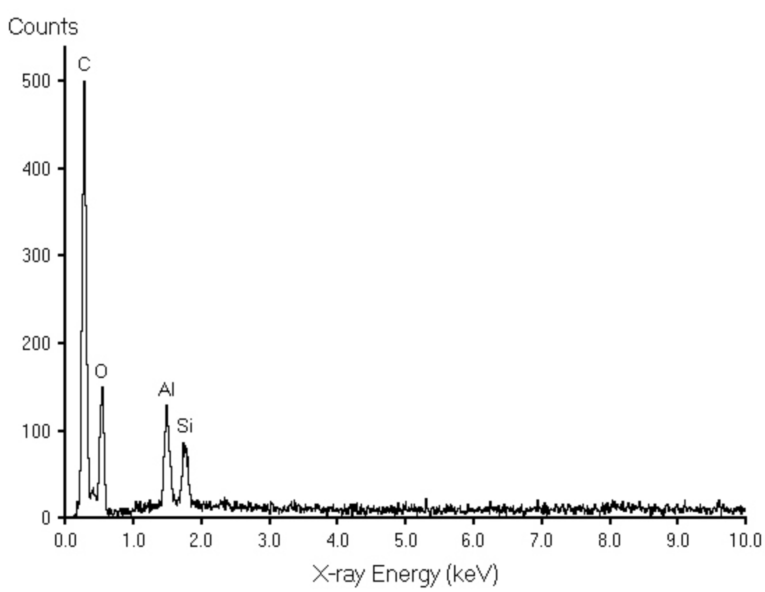


Figure 2: Staurolite, Jarosite (?) Mineral
Borehole CH97-10B 57.69m-57.71m



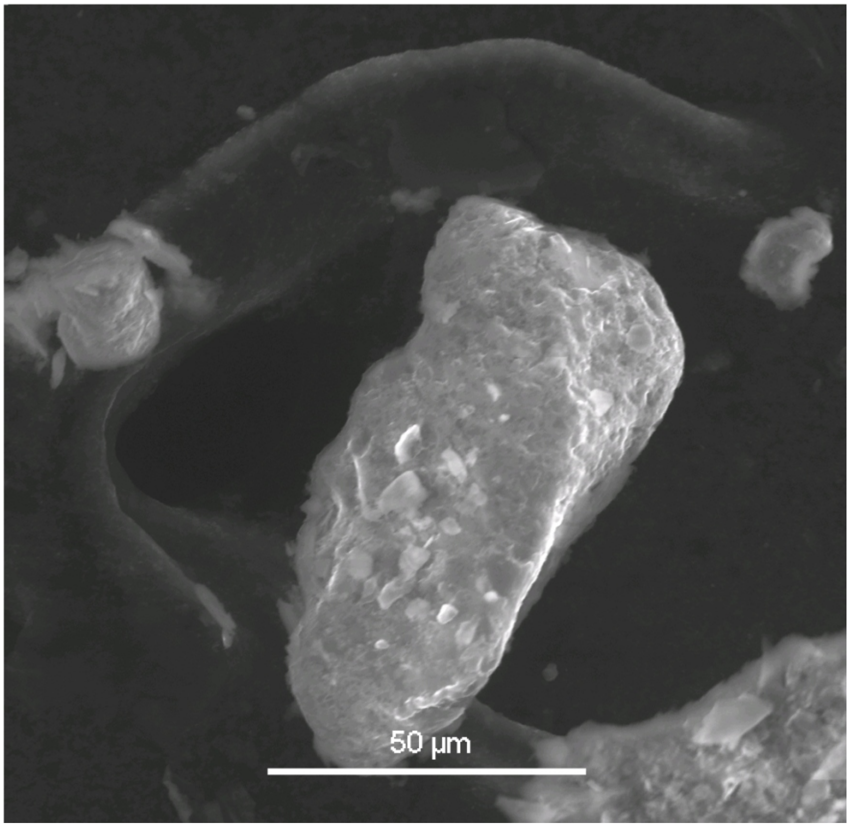
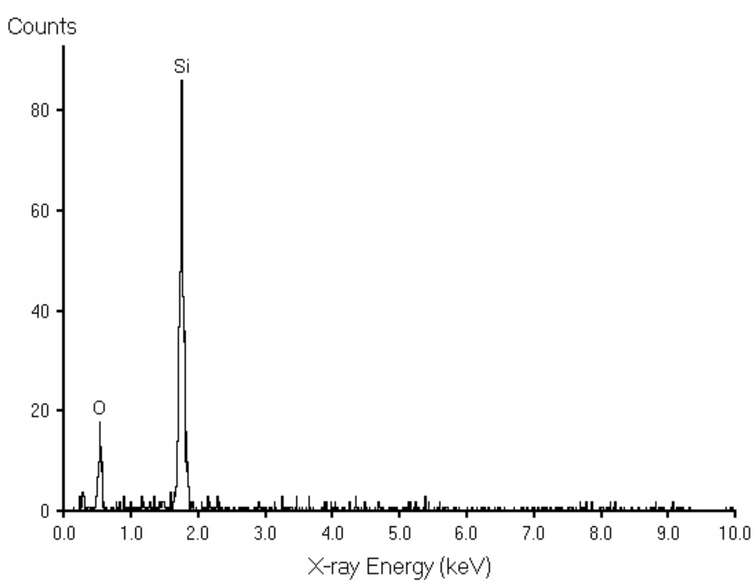


Figure 3:Augular quartz in Borehole CH97-10B 57.69m-57.71m



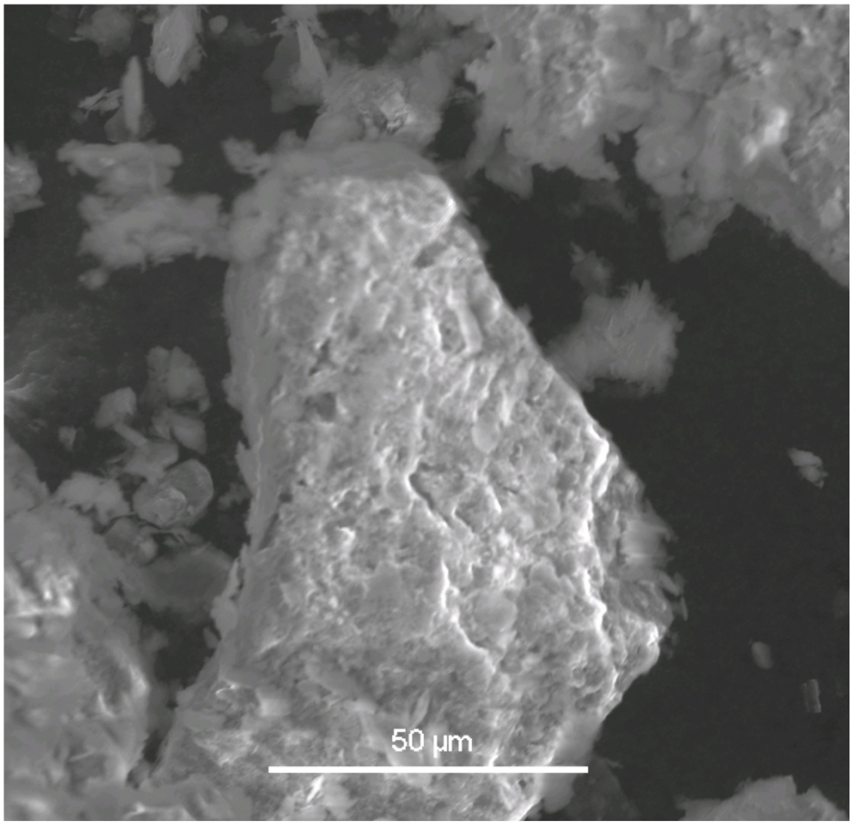
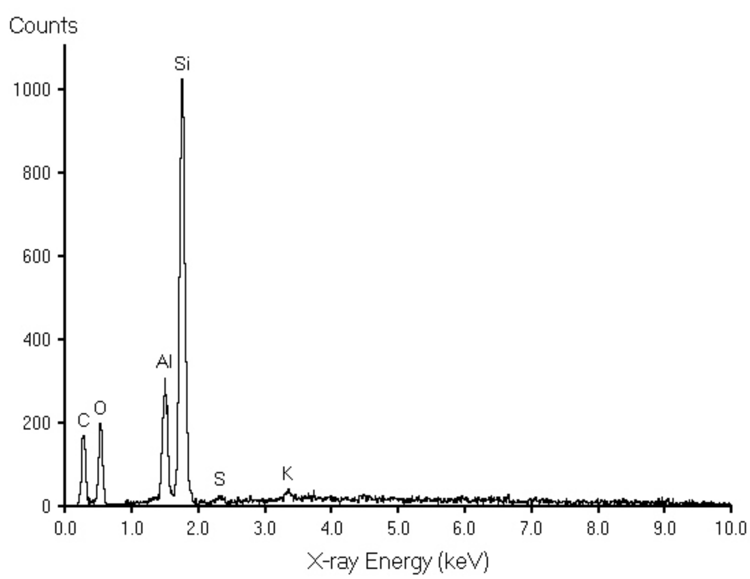


Figure 4:Quartz + Muscovite Mineral
Borehole CH97-10B 57.69m-57.71m



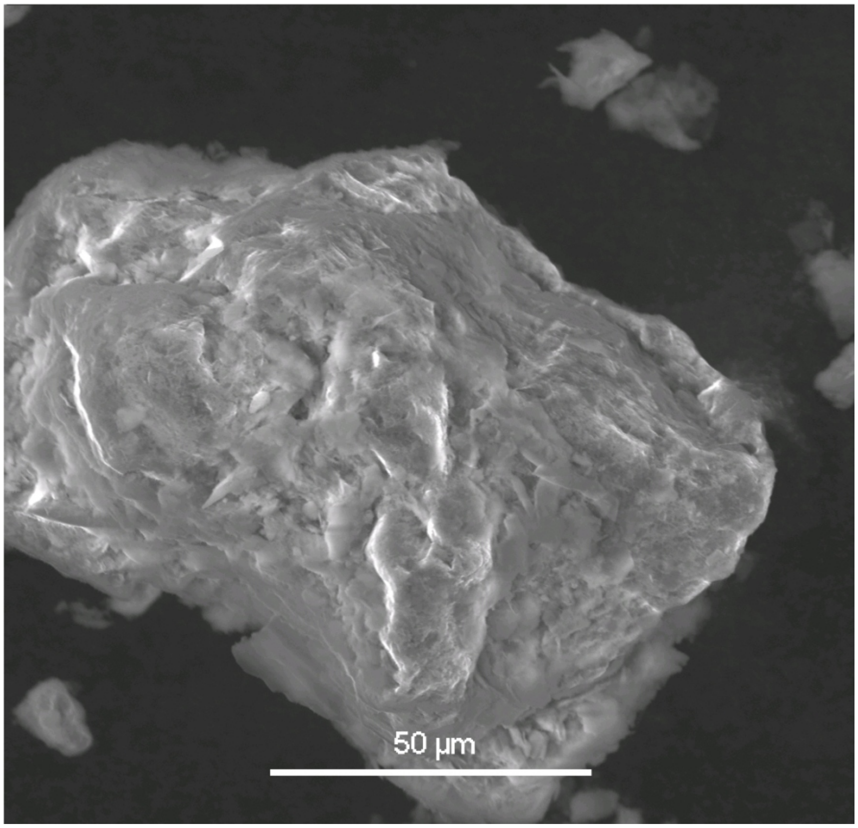
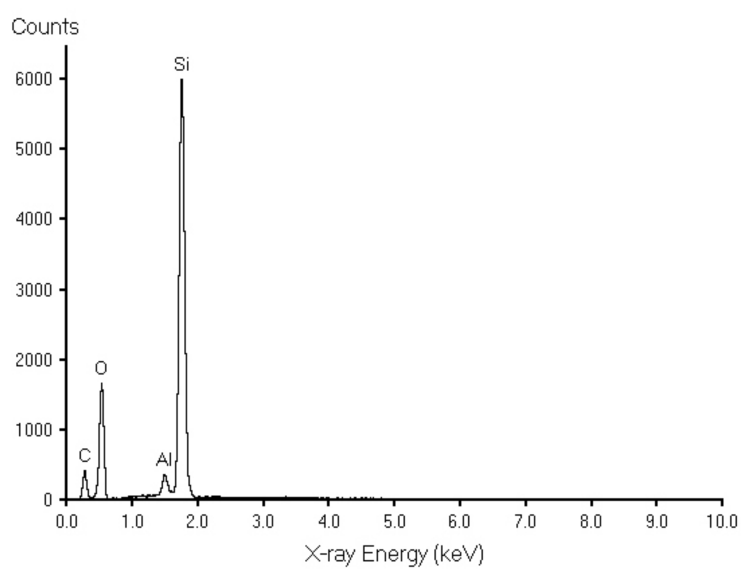


Figure 5:Quartz + Kaolinite Mineral
Borehole CH97-10B 57.69m-57.71m



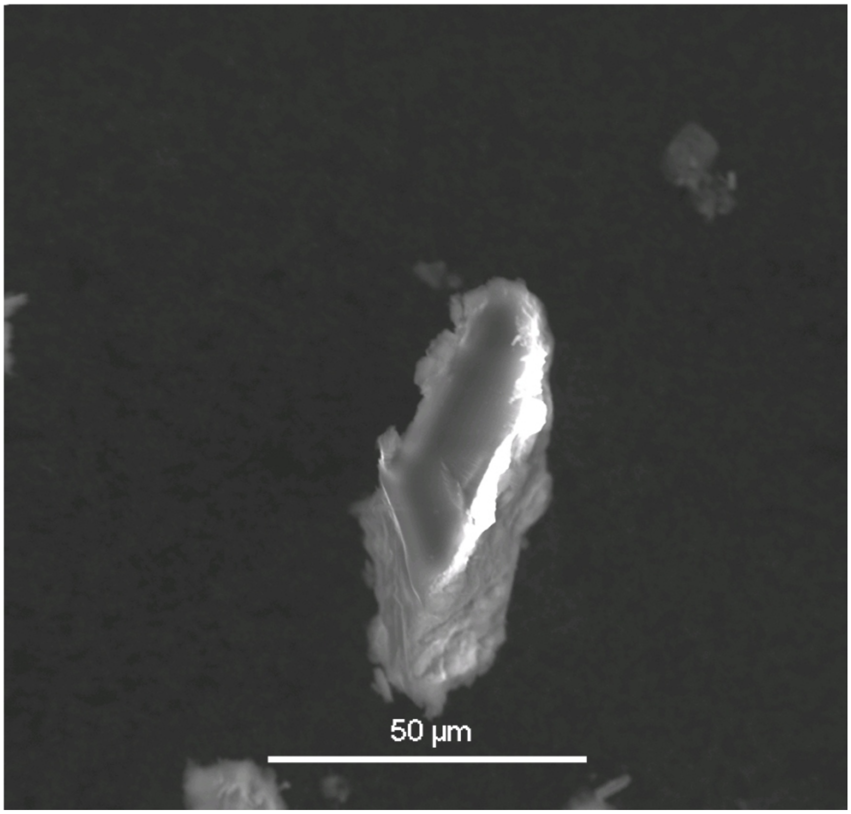
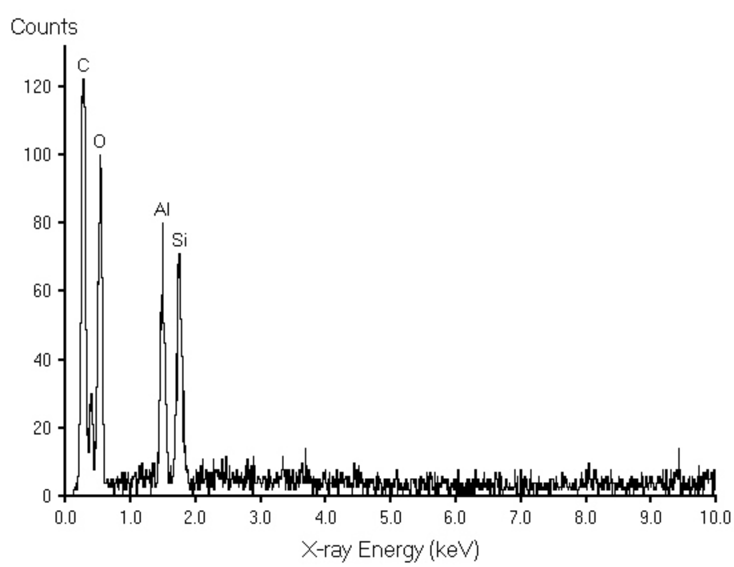


Figure 6: Staurolite, Jarosite (?) Mineral
Borehole CH97-10B 57.69m-57.71m



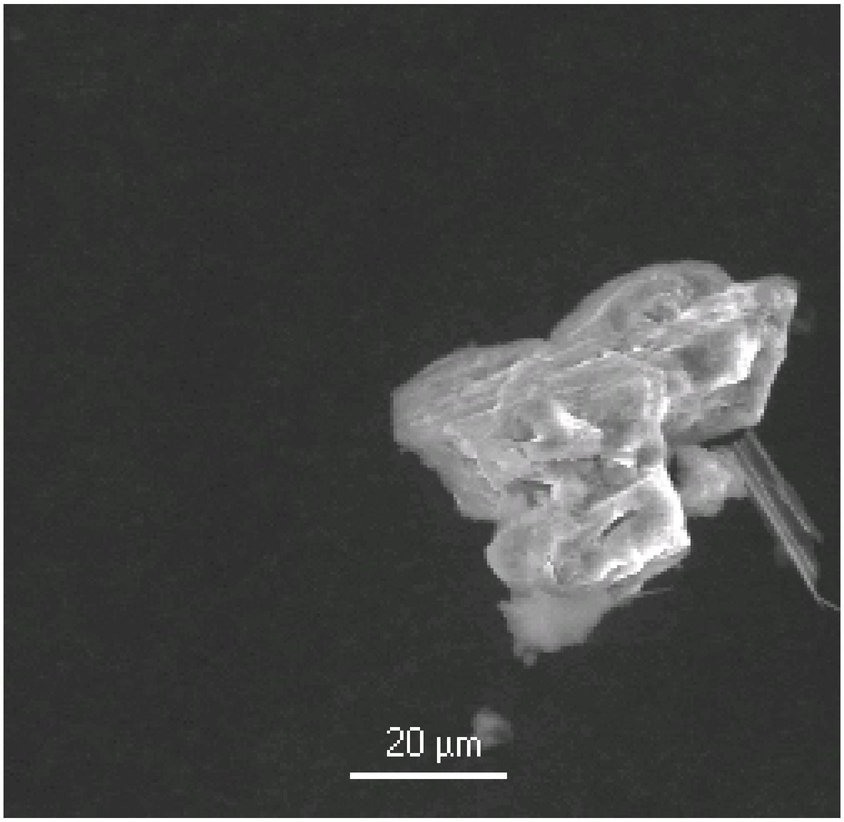
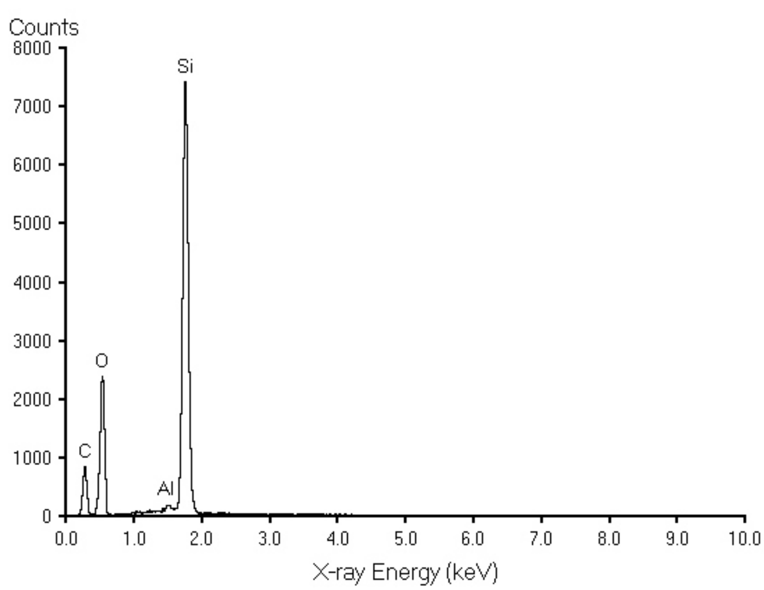


Figure 7:Quartz + Kaolinite
Borehole CH97-10B 57.69m-57.71m



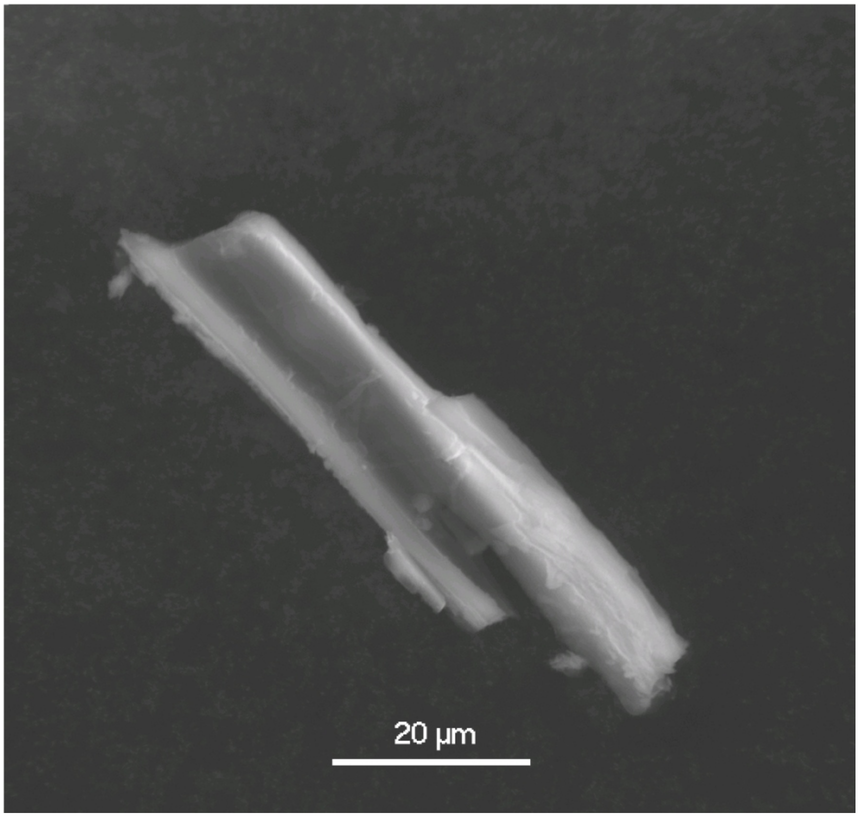
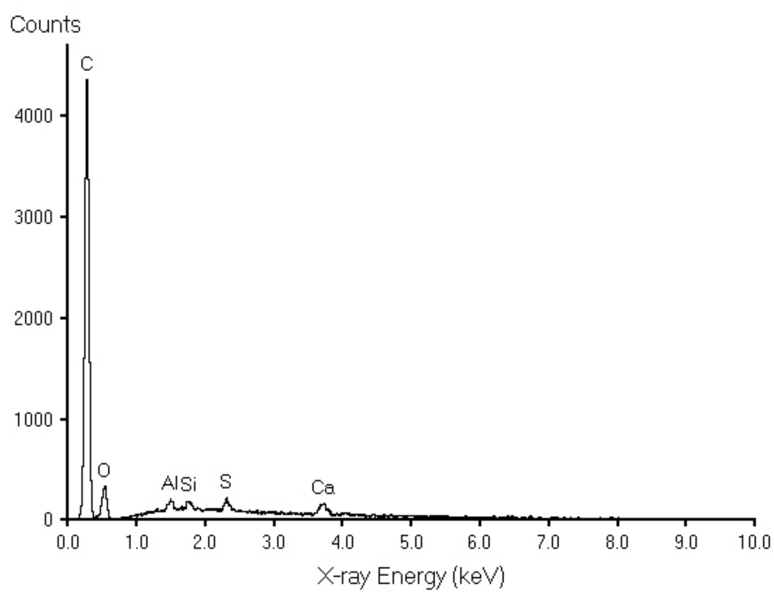


Figure 8: ?? Wood
Borehole CH97-10B 57.69m - 57.71m



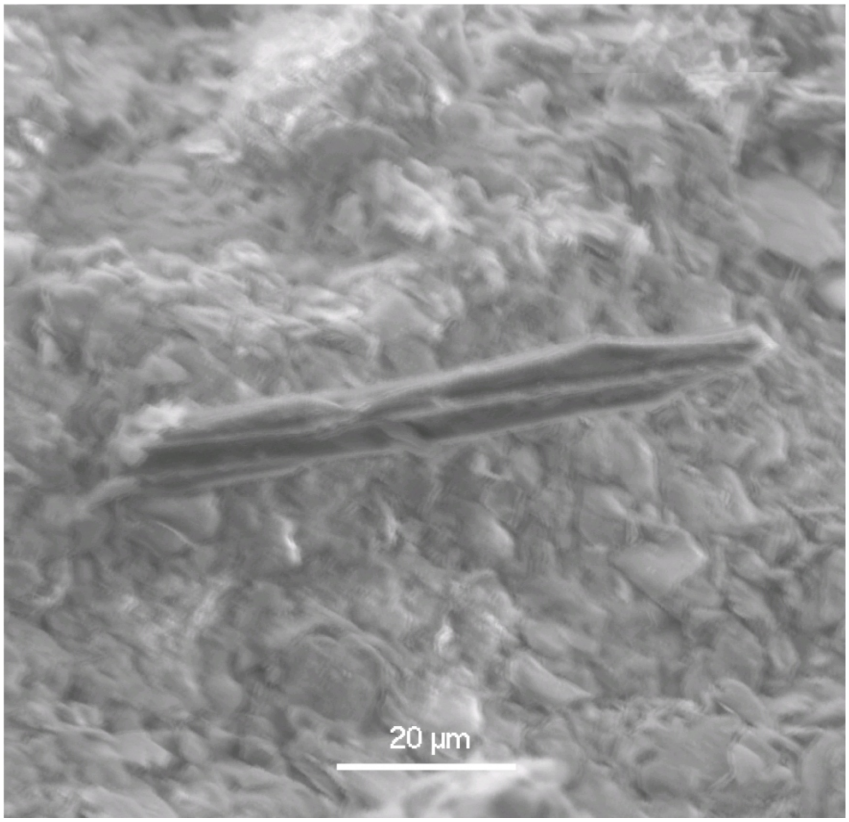
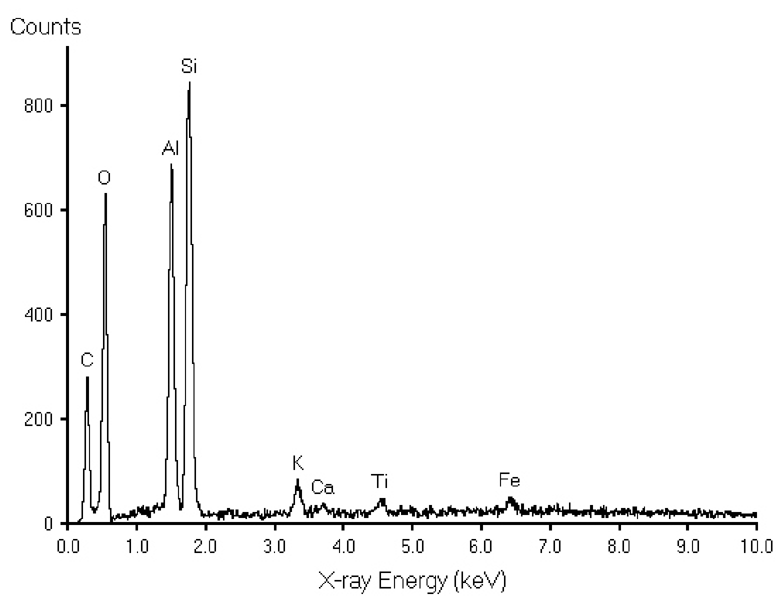


Figure 9: Muscovite (?) Morphology looks like zircon
Borehole CH97-10B 62.42m-62.49m



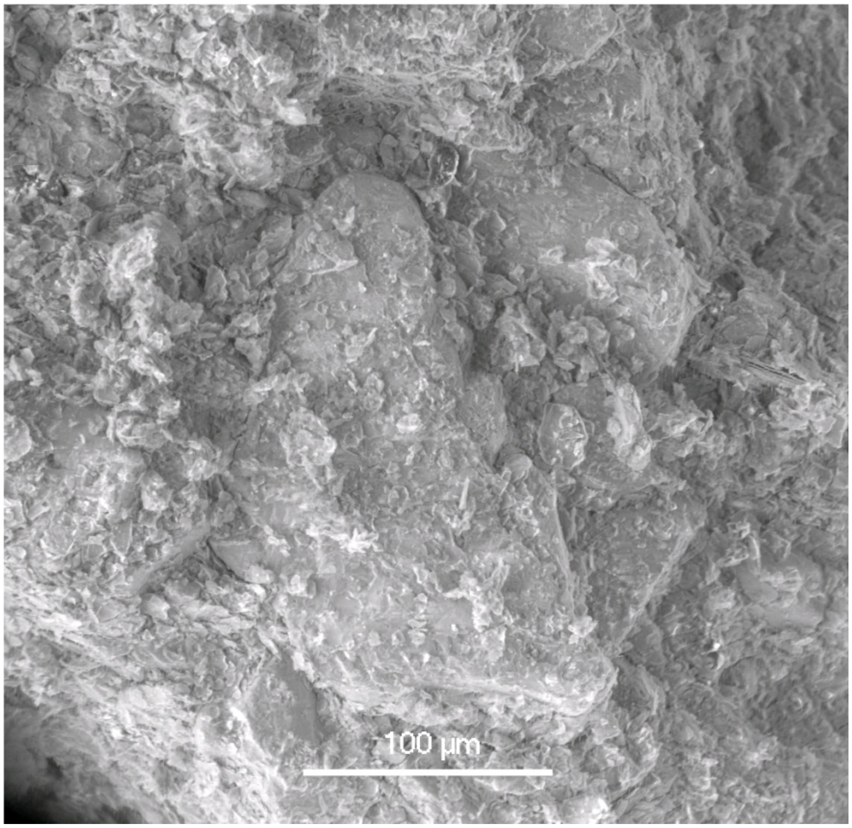
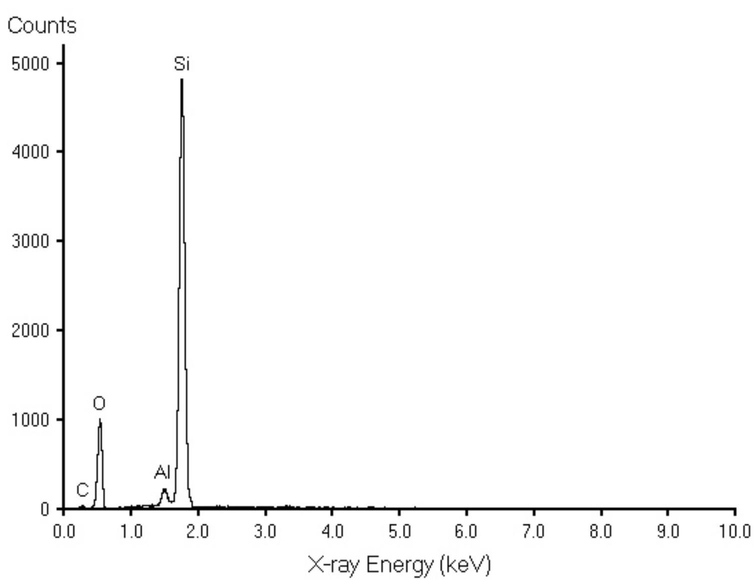


Figure 10: Quartz (sub-hexdral)
Borehole CH97-10B 62.42m-62.49m



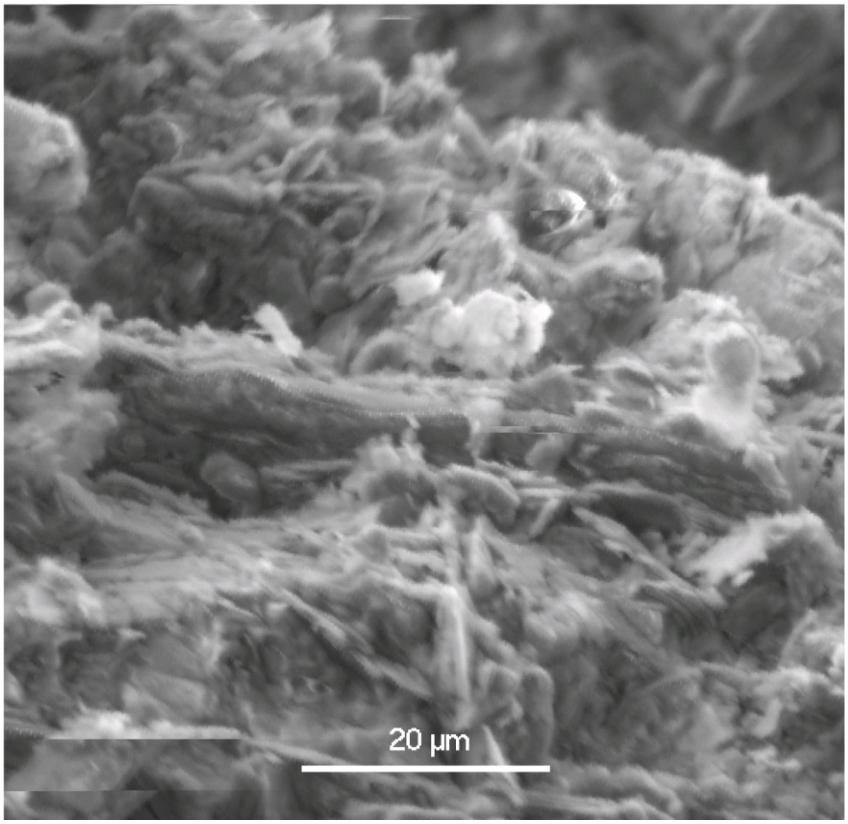
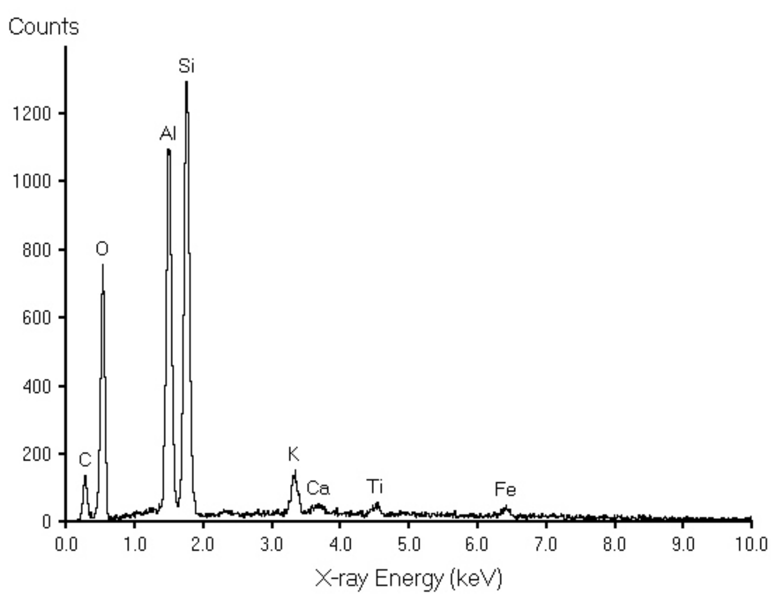


Figure 11: Muscovite/k-feldspar (detrital)
Borehole CH97-10B 62.42m-62.49m



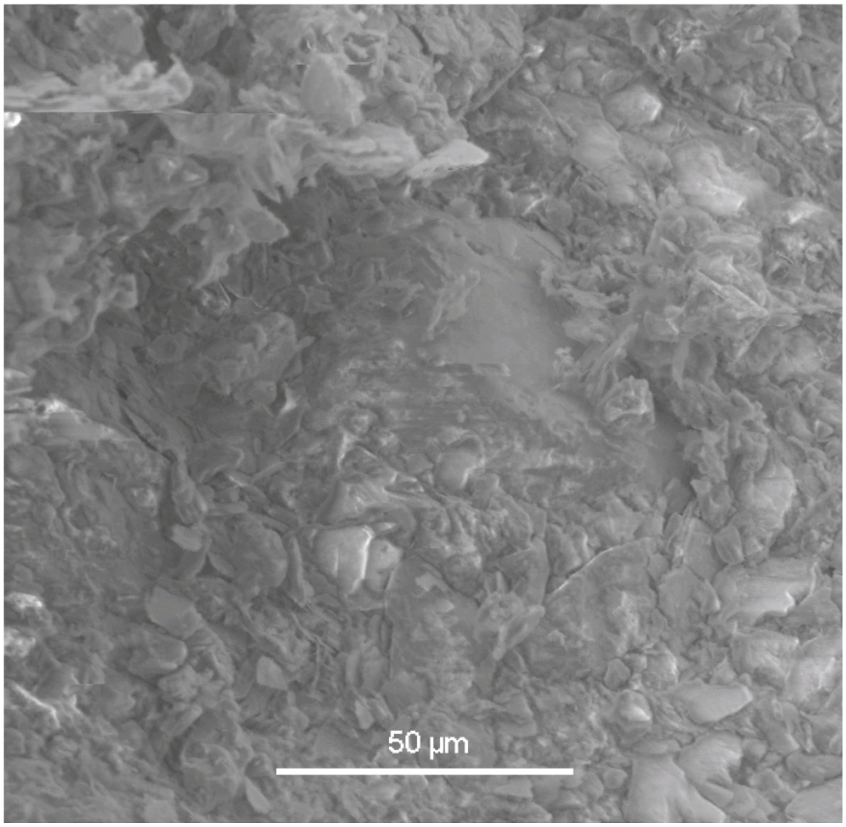
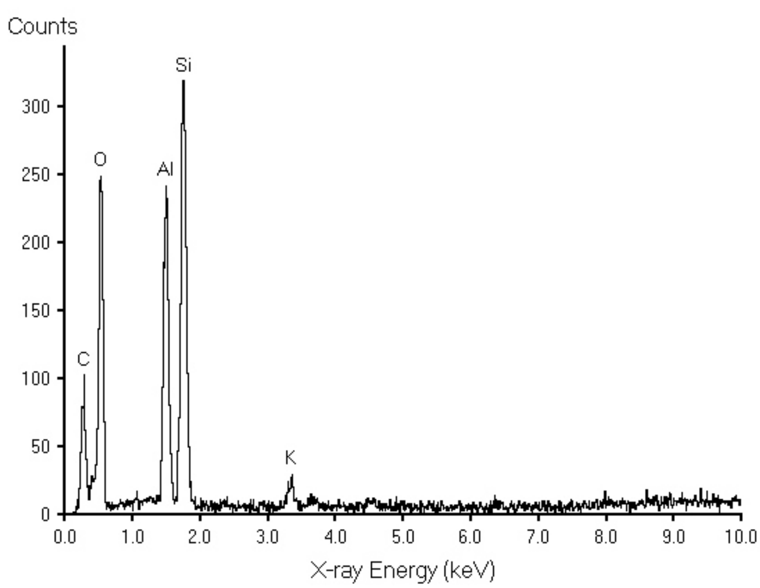


Figure 12: Muscovite Mineral
Borehole CH97-10B 62.42m-62.49m



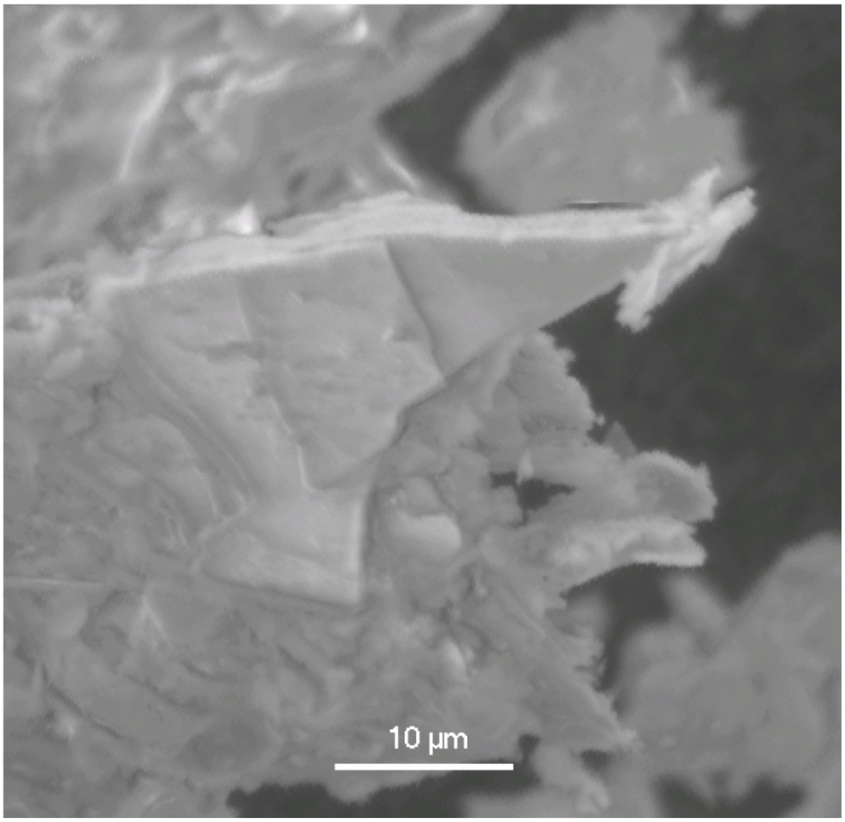
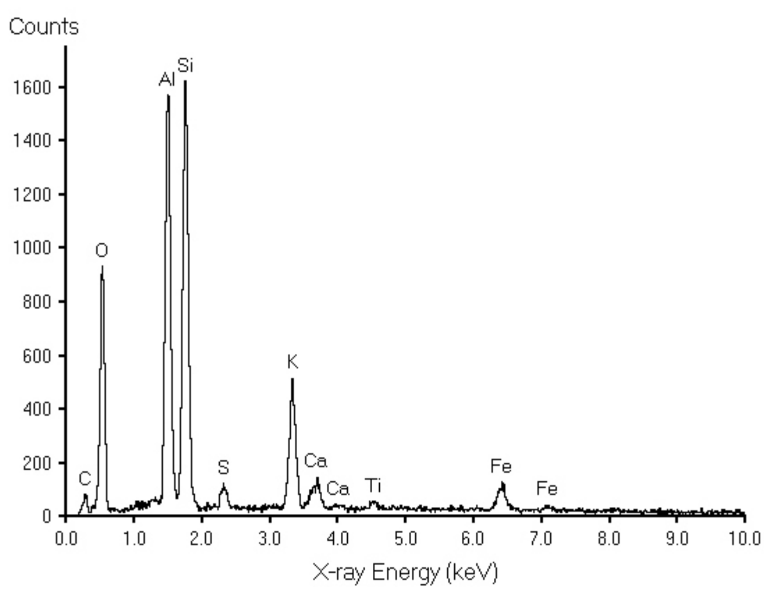


Figure 13: ??
Borehole CH97-10B 62.42m-62.49m



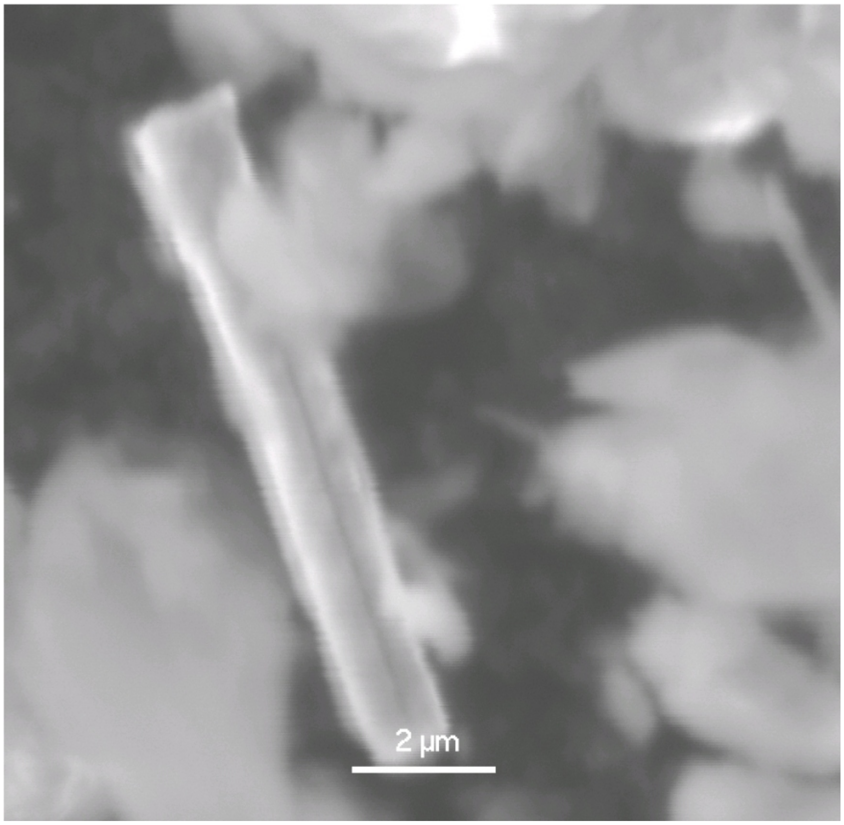


Figure 14: ??
Borehole CH97-10B 62.42m-62.49m

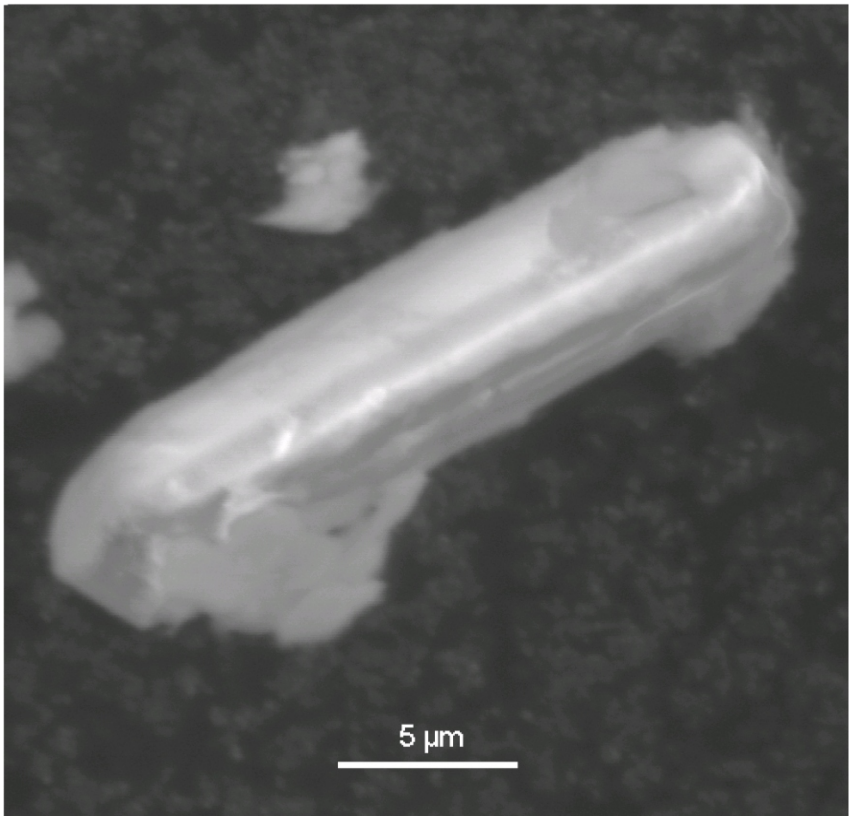
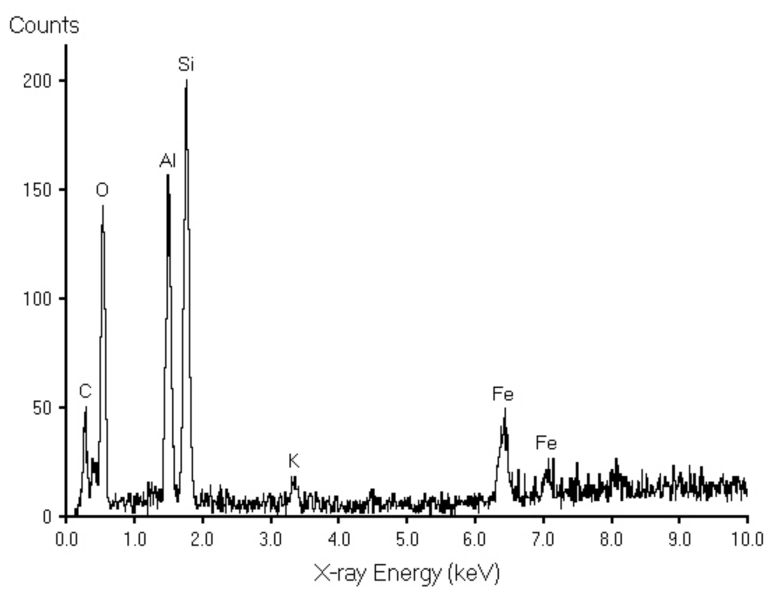


Figure 15: Morphology is that of a zircon
Borehole CH97-10B 62.42m-62.49m



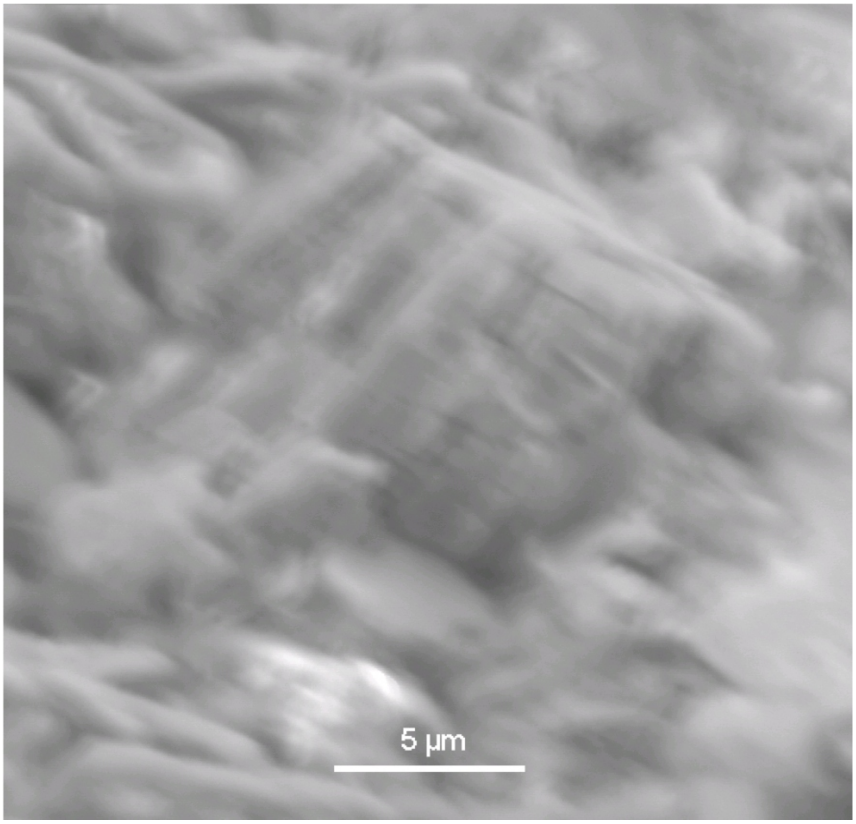
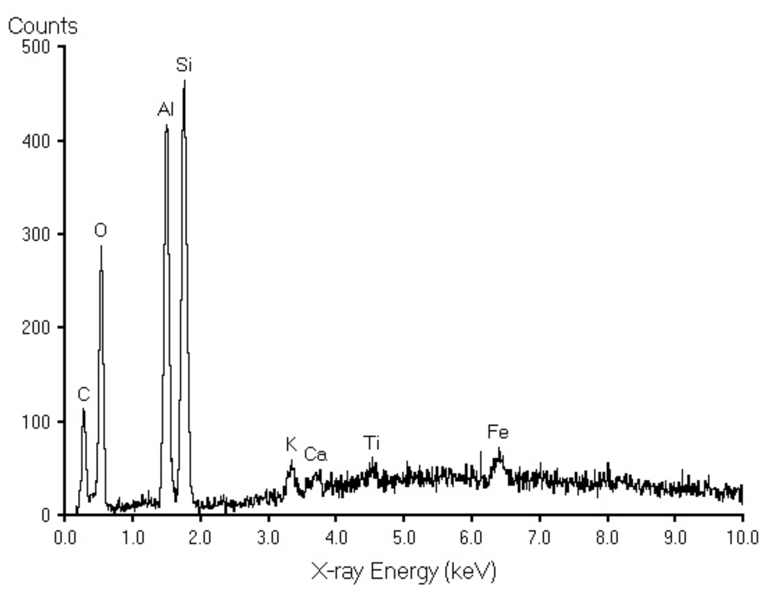


Figure 16: Kaolinite + ??
Borehole CH97-10B 62.42m-62.49m



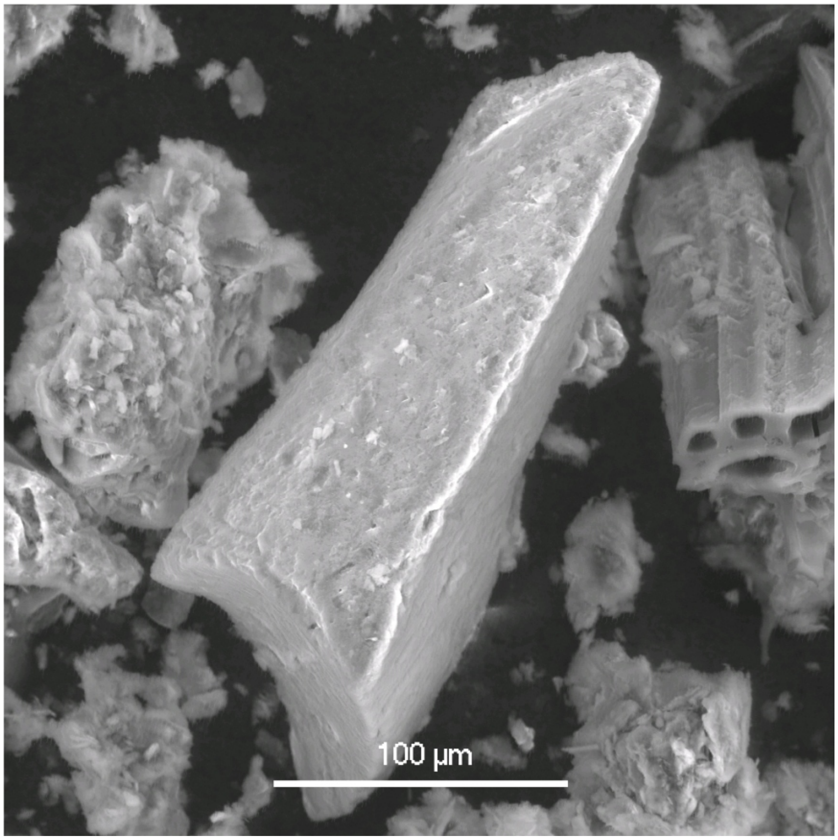
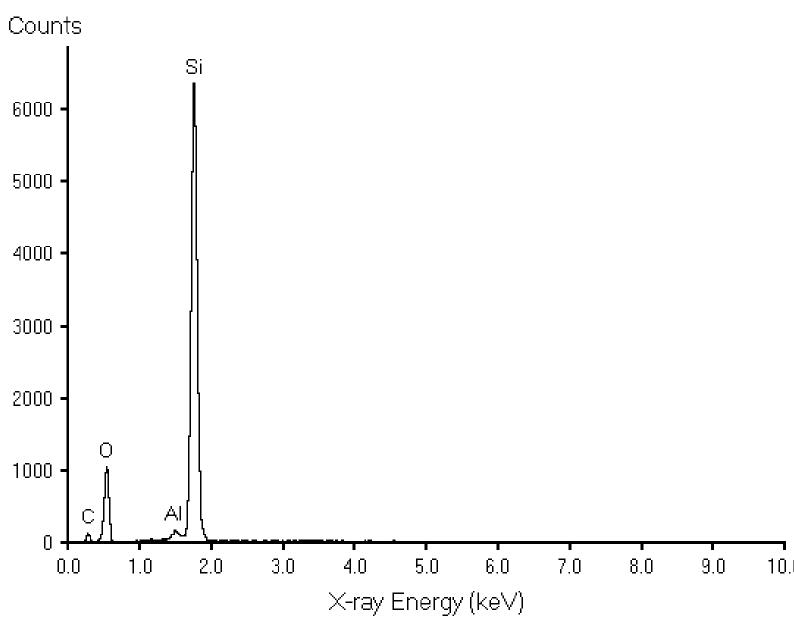


Figure 17: Euhedral quartz grain
Borehole CH97-10B 57.69m-57.71m



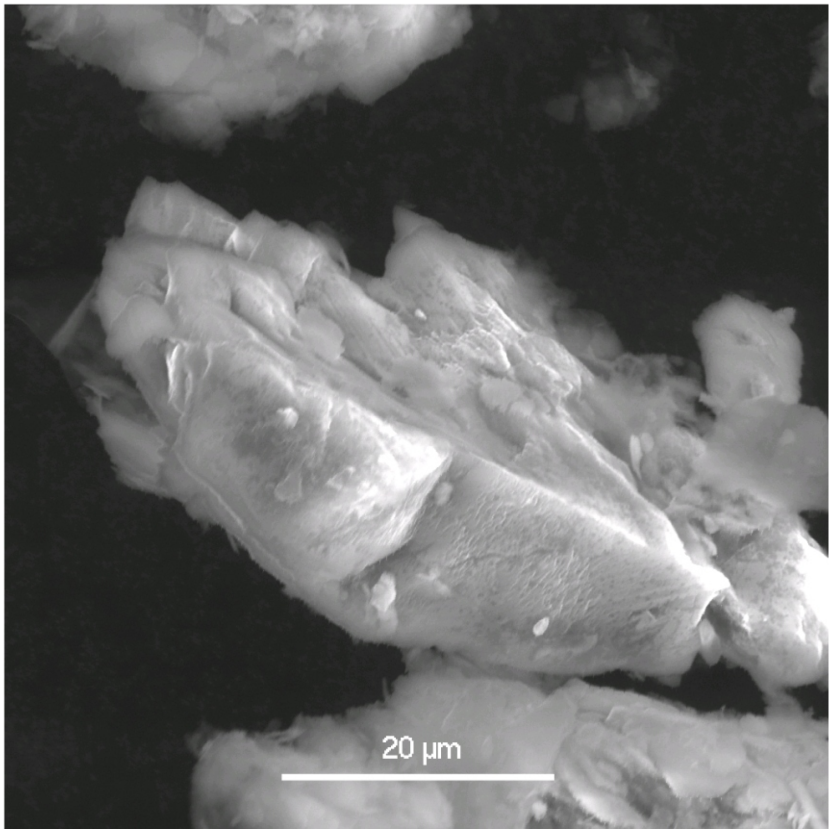
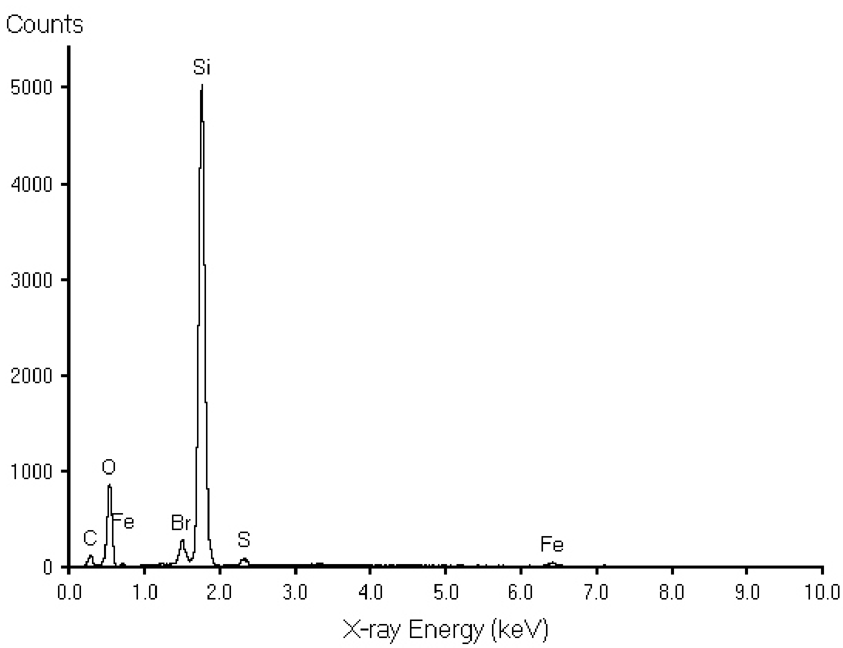


Figure 18: Quartz grain
Borehole CH97-10B 57.69m-57.71m



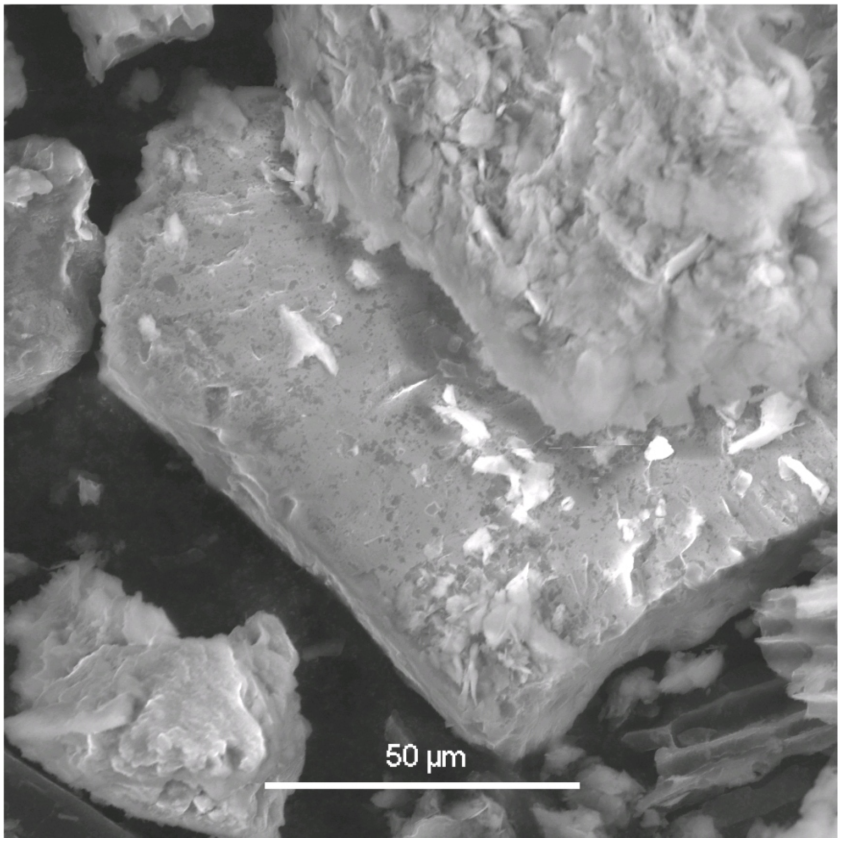
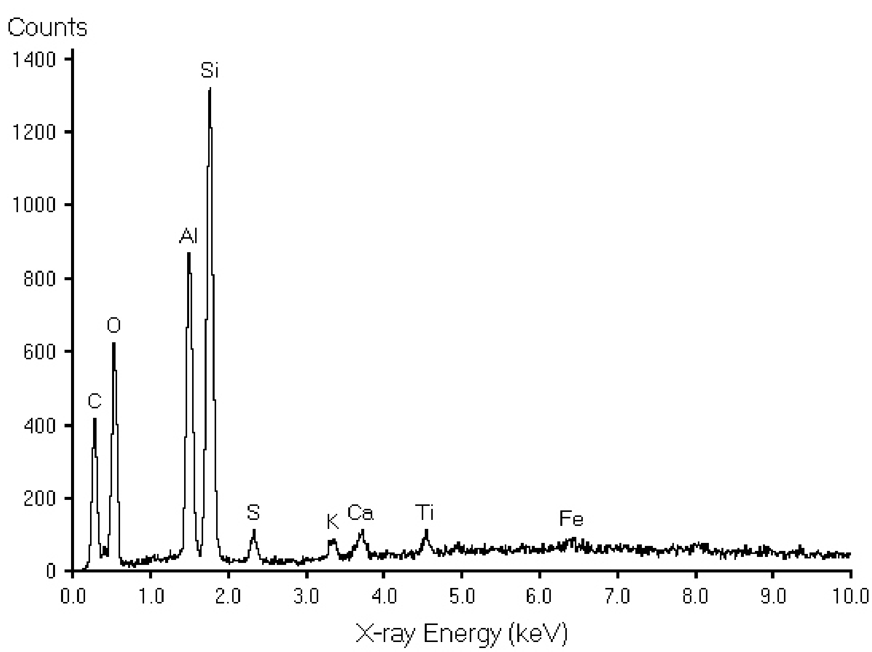


Figure 19: Mineralized woody fragment
Borehole CH97-10B 57.69m-57.71m



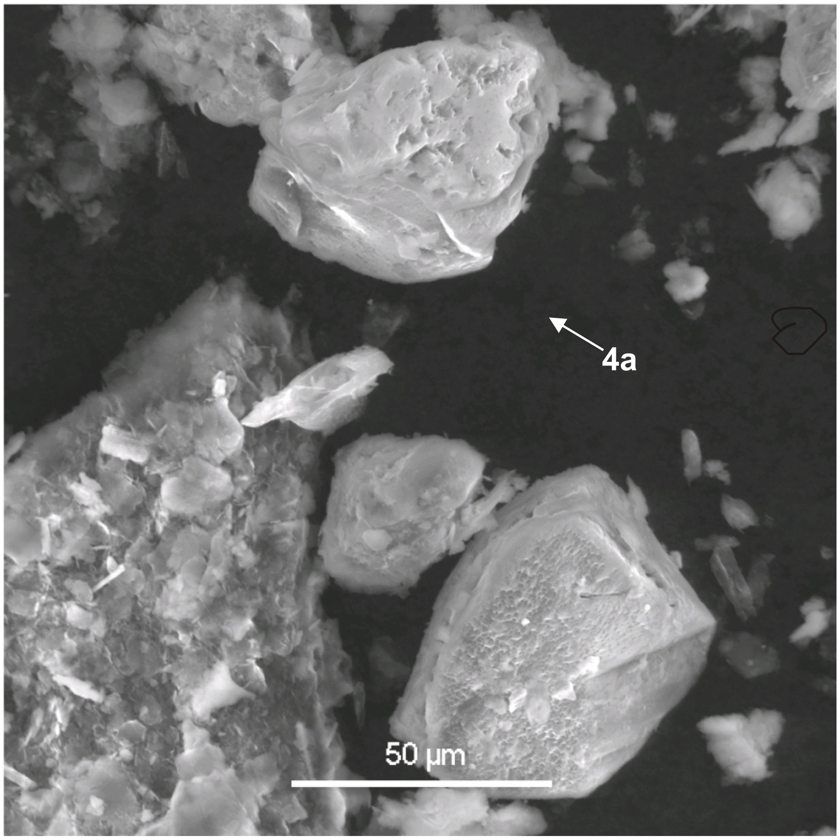
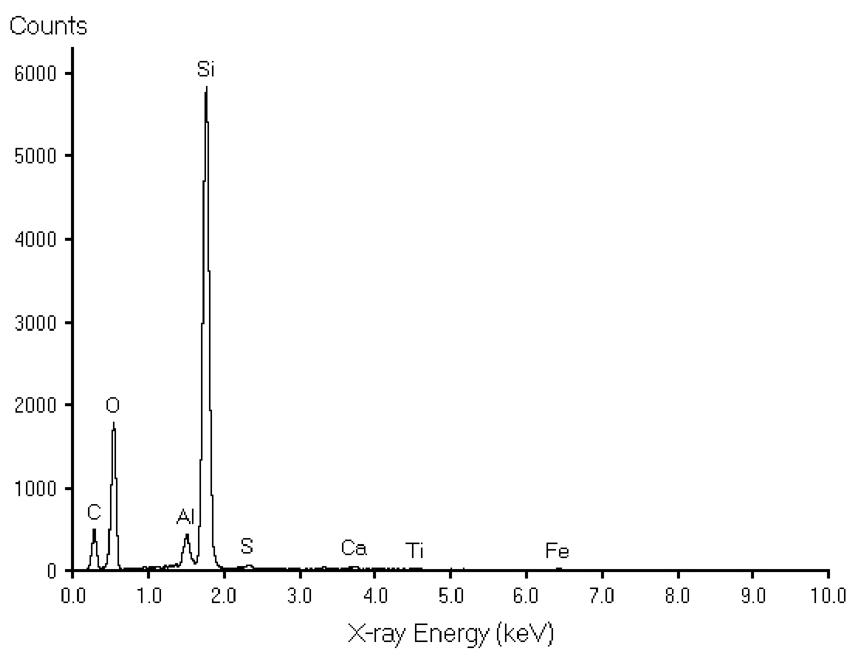


Figure 20: Quartz grain
Borehole CH97-10B 57.69m-57.71m



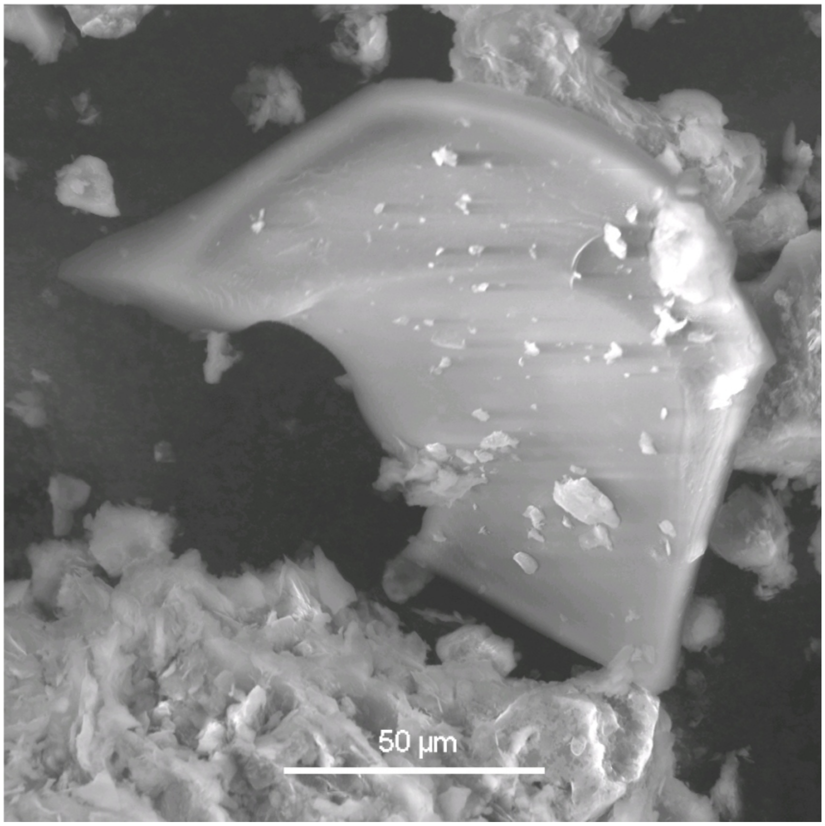
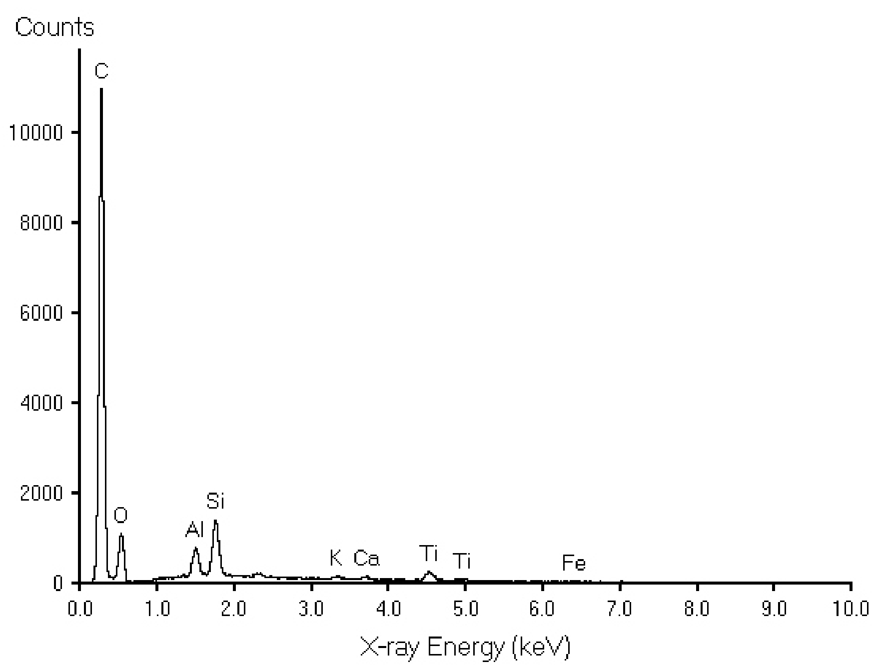


Figure 21: High carbon woody fragment
Borehole CH97-10B 57.69m-57.71m



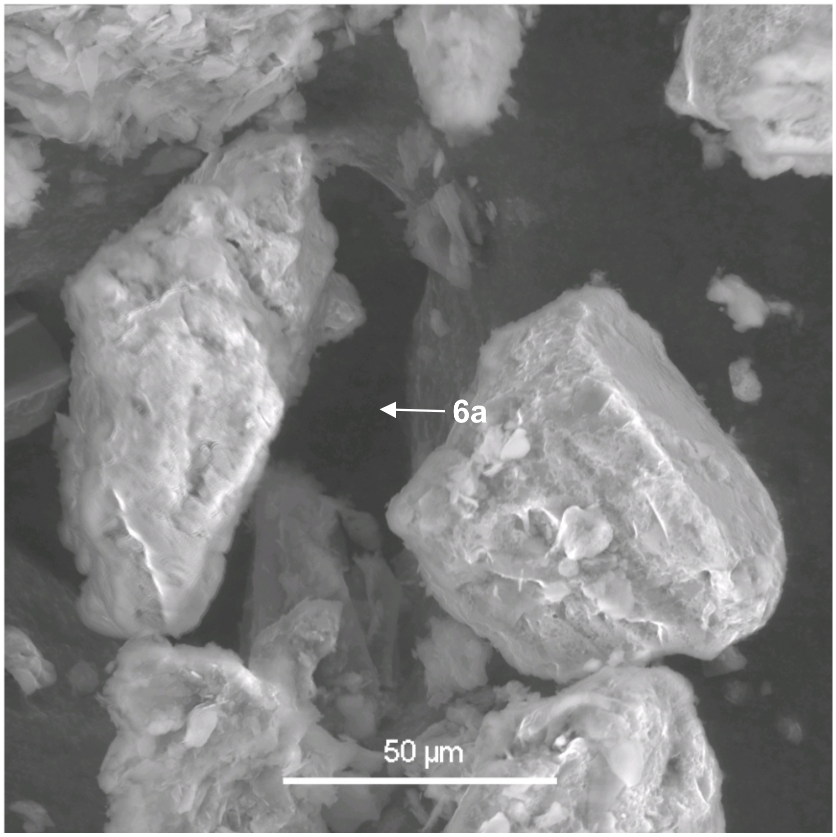
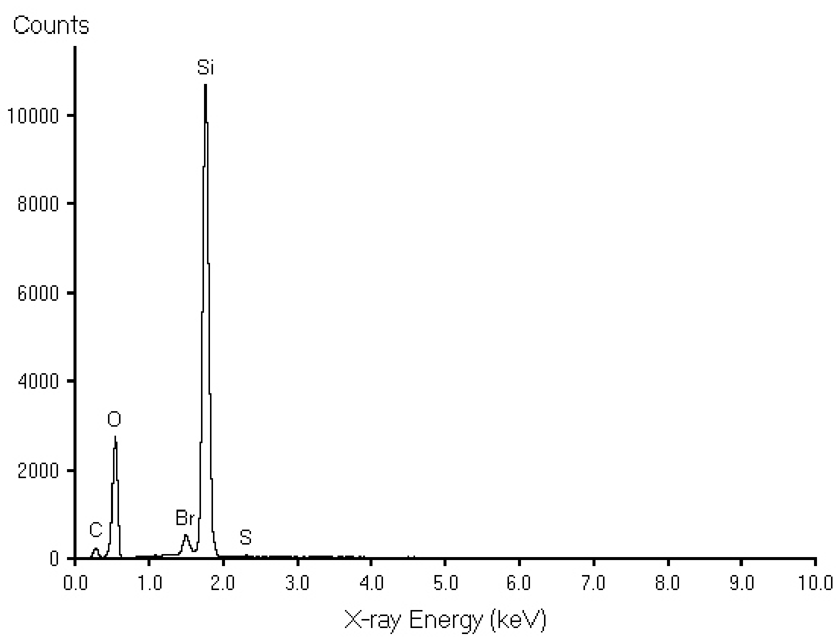


Figure 22: Quartz grain
Borehole CH97-10B 57.69m-57.71m



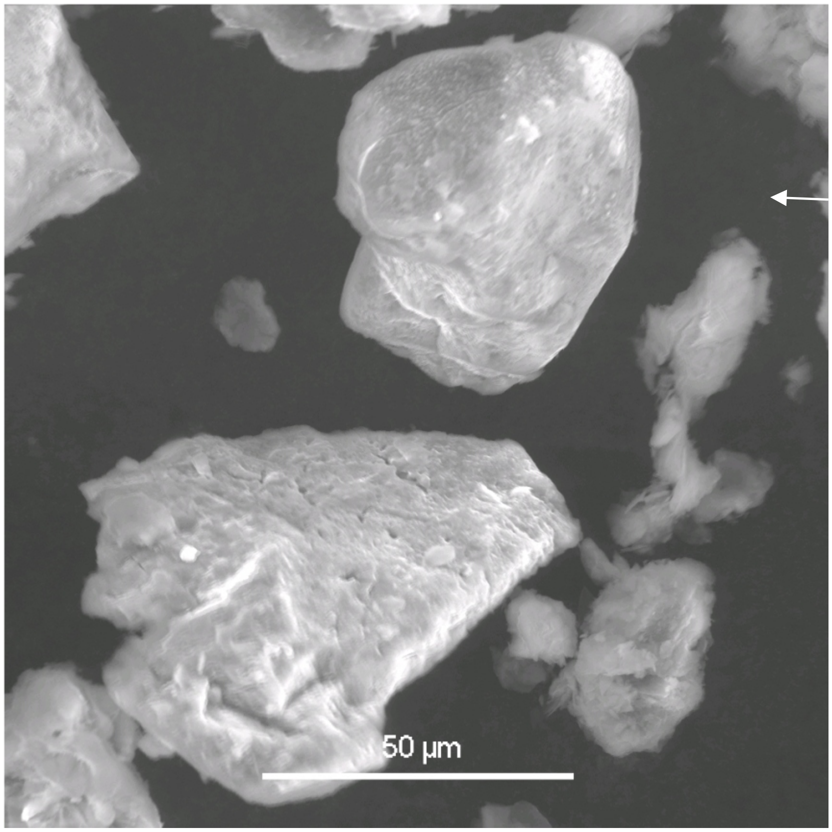
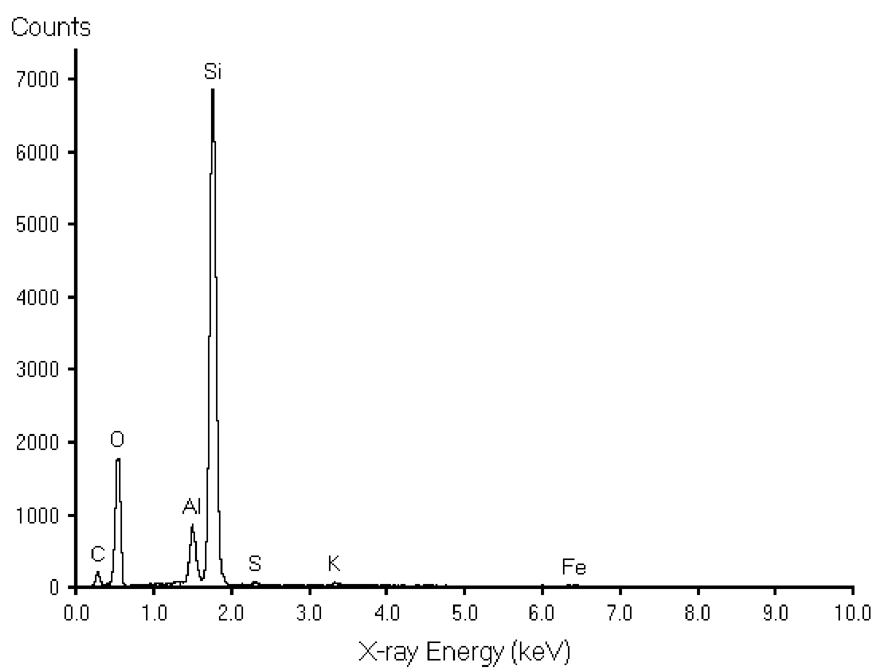


Figure 23: Quartz grain
Borehole CH97-10B 57.69m-57.71m



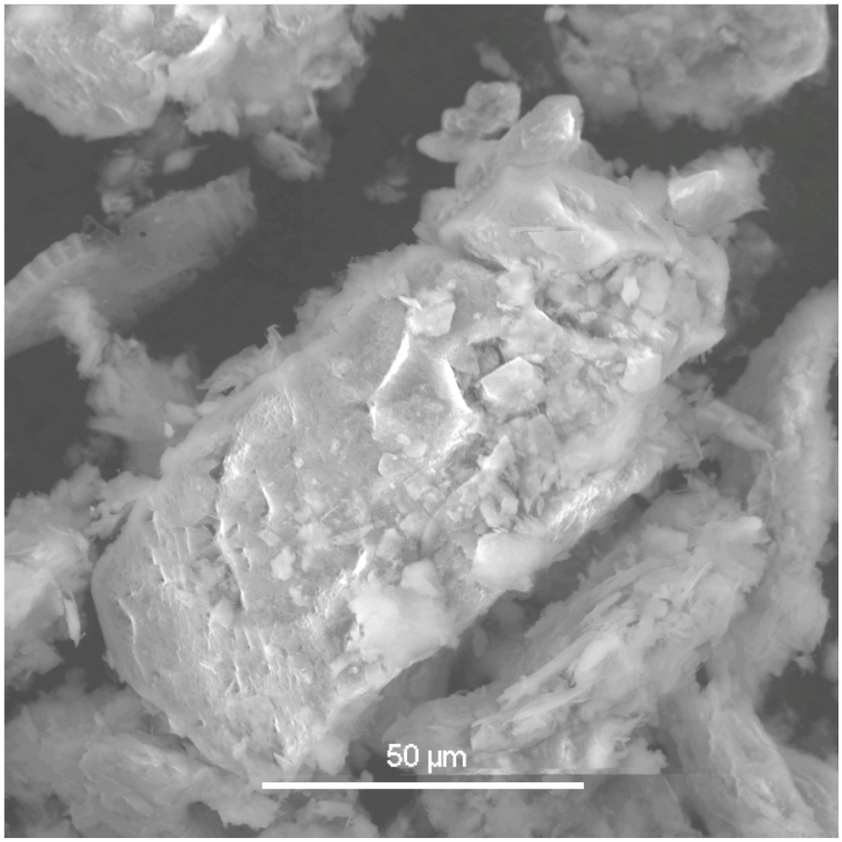
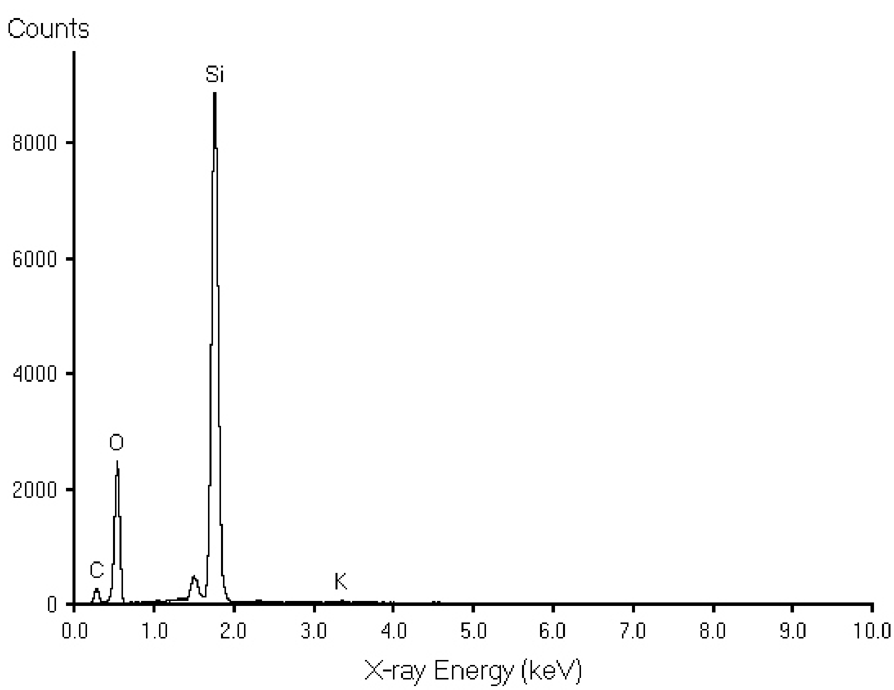


Figure 24: Quartz grain
Borehole CH97-10B 57.69m-57.71m



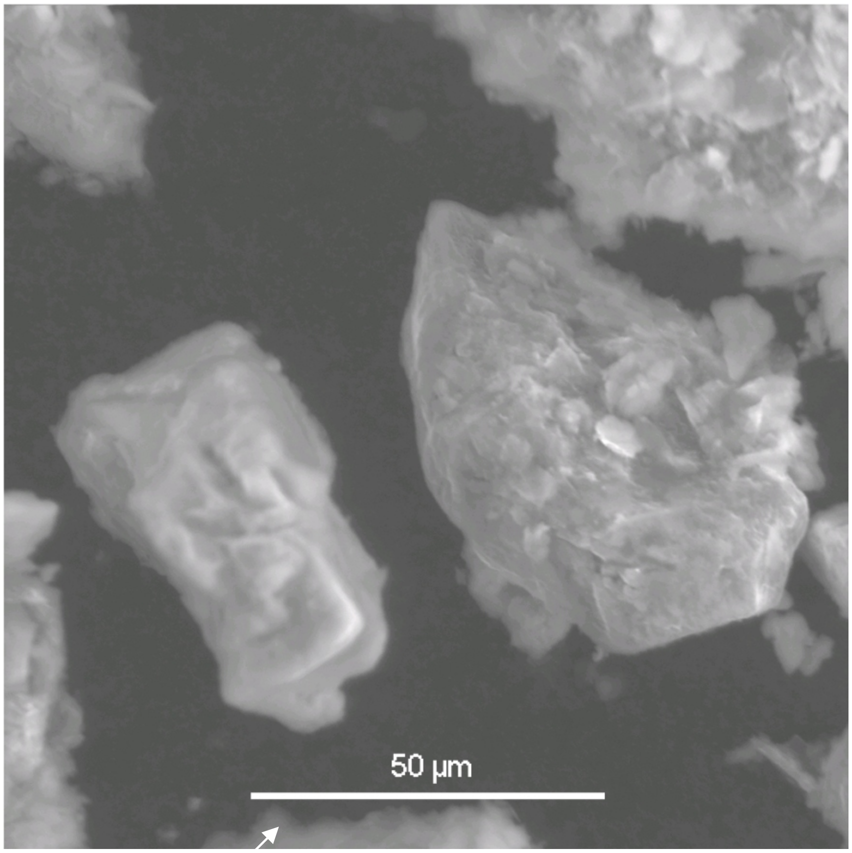
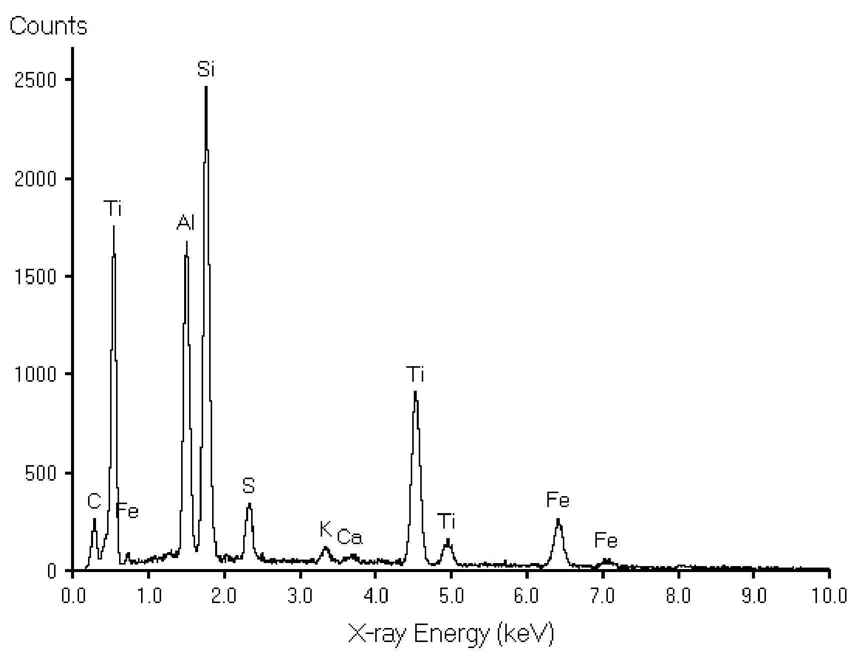


Figure 25:
Borehole CH97-10B 57.69m-57.71m



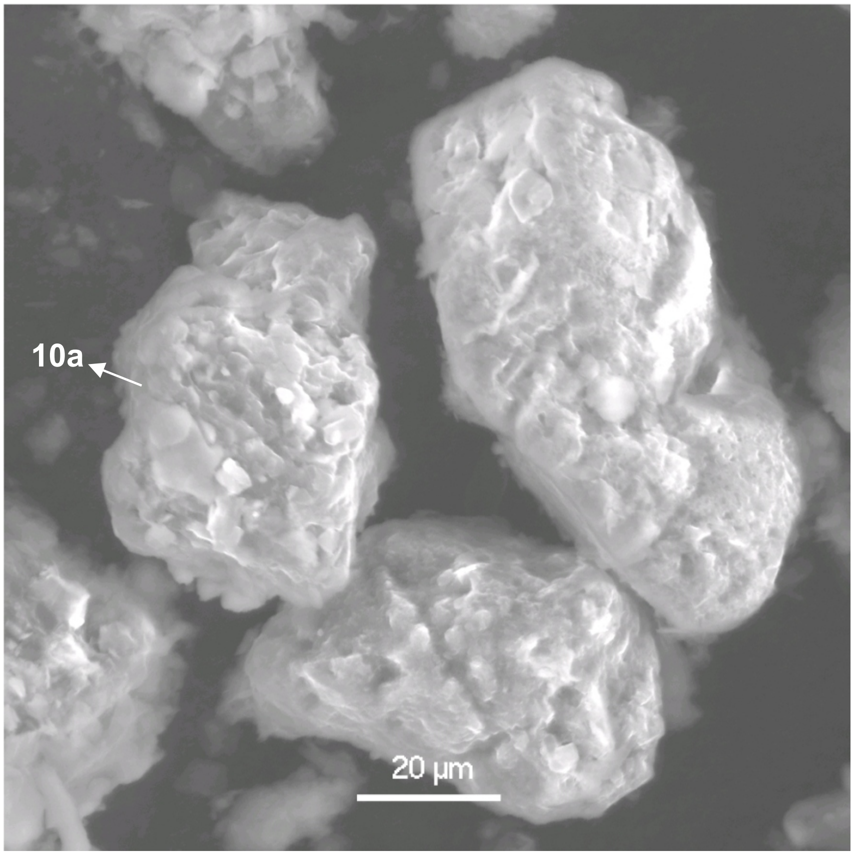
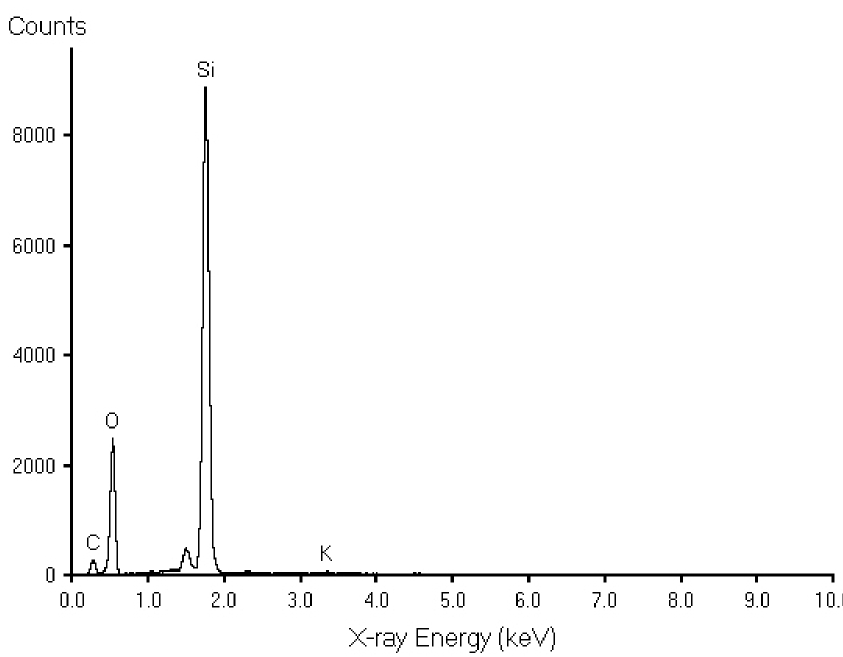


Figure 26: Mineralized quartz
Borehole CH97-10B 57.69m-57.71m



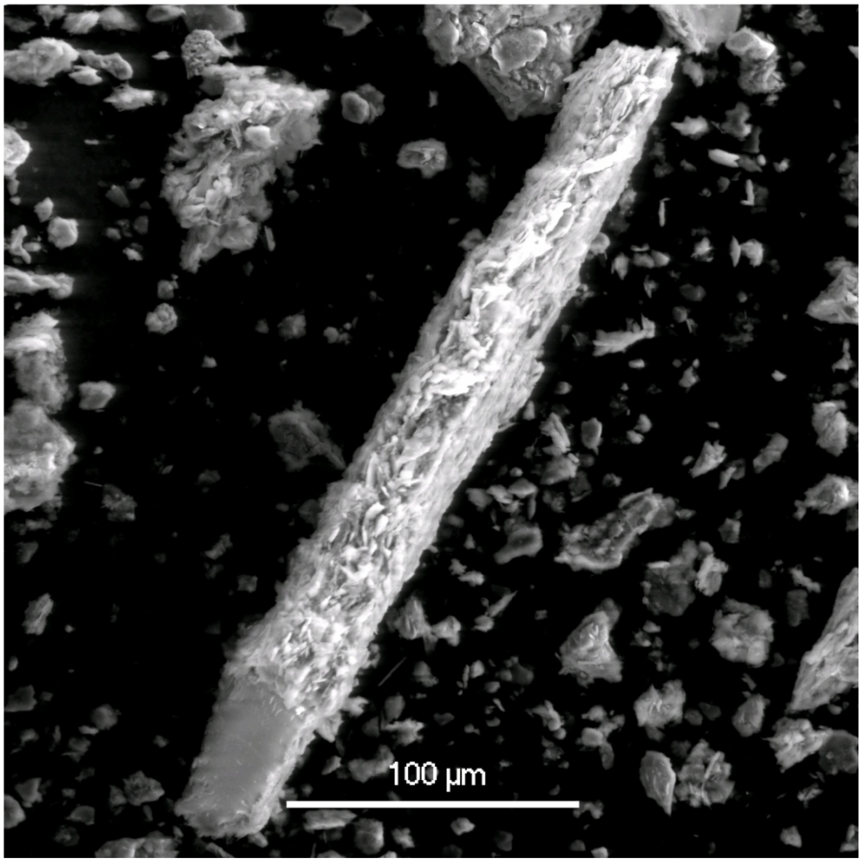
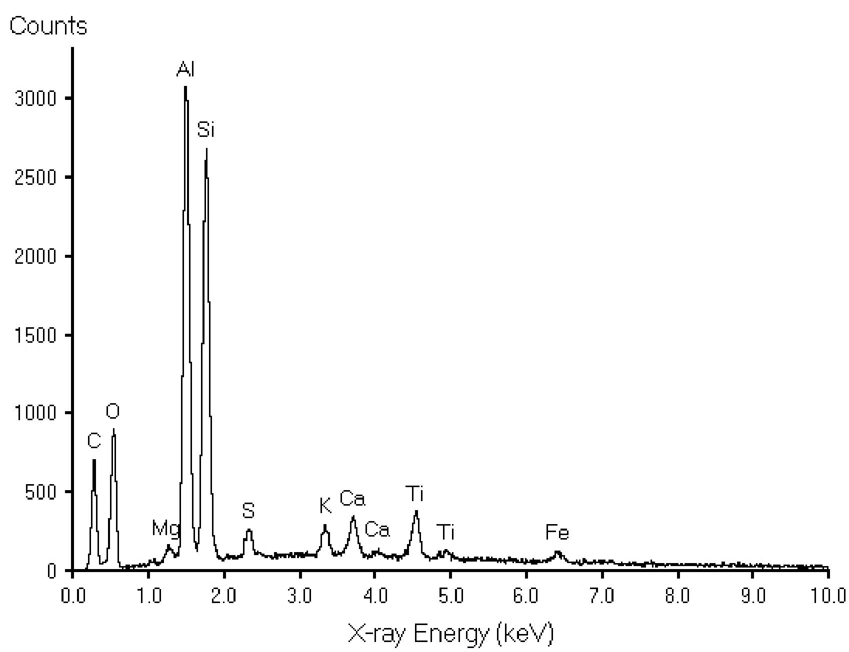


Figure 27: Mineralized wood
Borehole CH97-10B 62.42m-62.49m



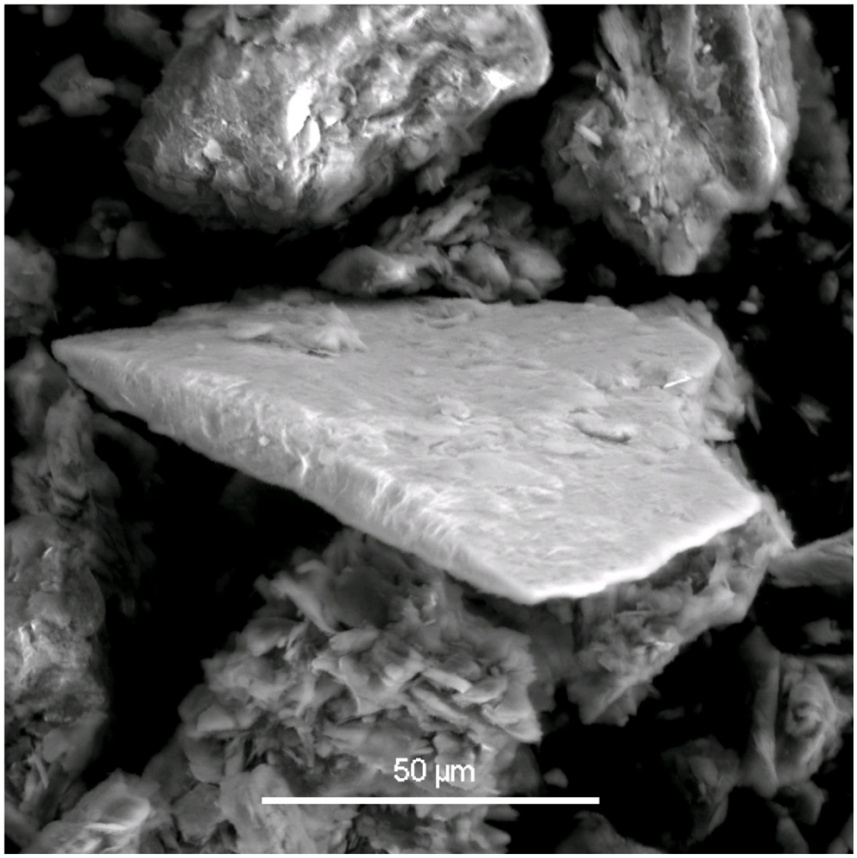
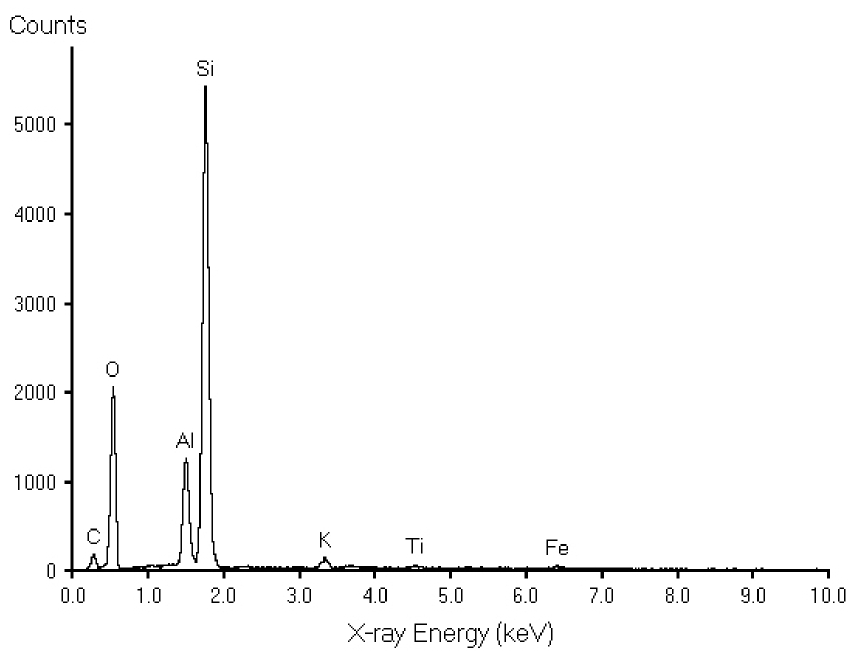


Figure 28: Quartz grain with kaolinite on surface
Borehole CH97-10B 62.42m-62.49m



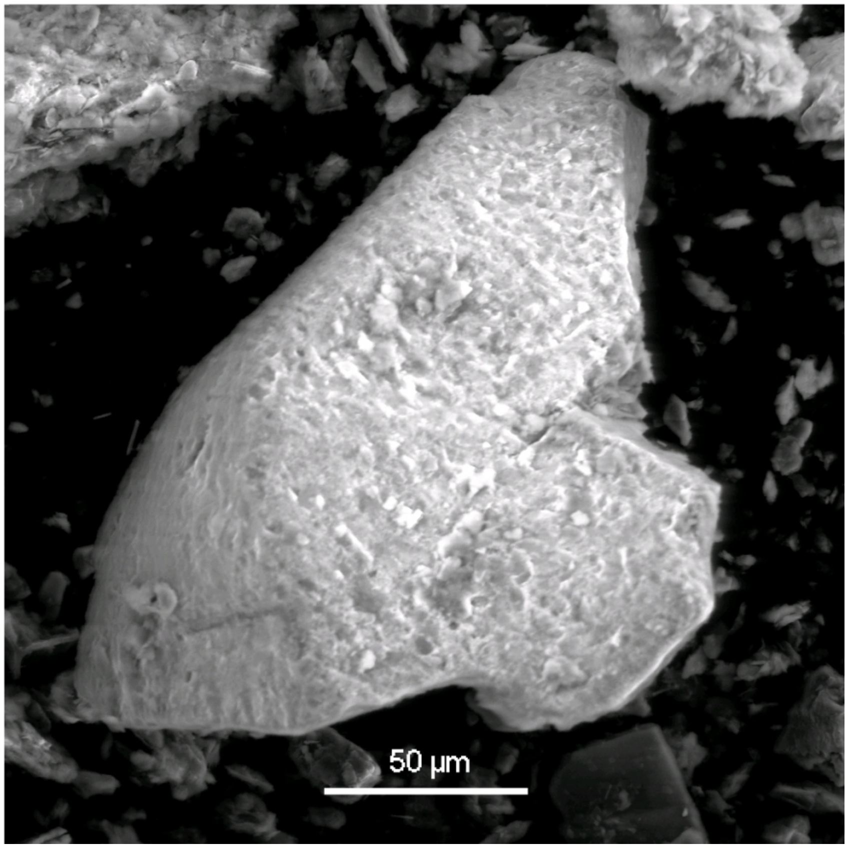
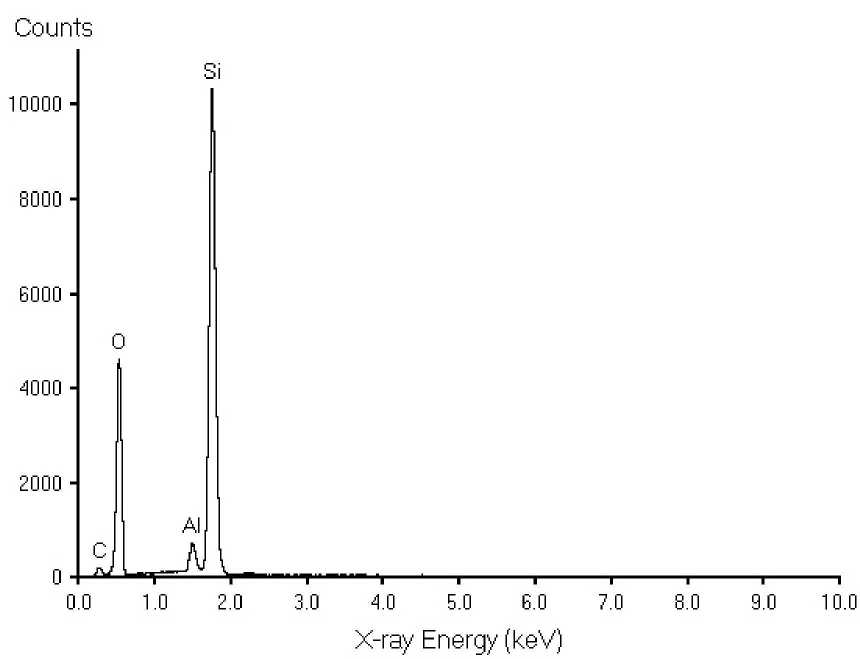


Figure 29: Euhedral quartz
Borehole CH97-10B 62.42m-62.49m



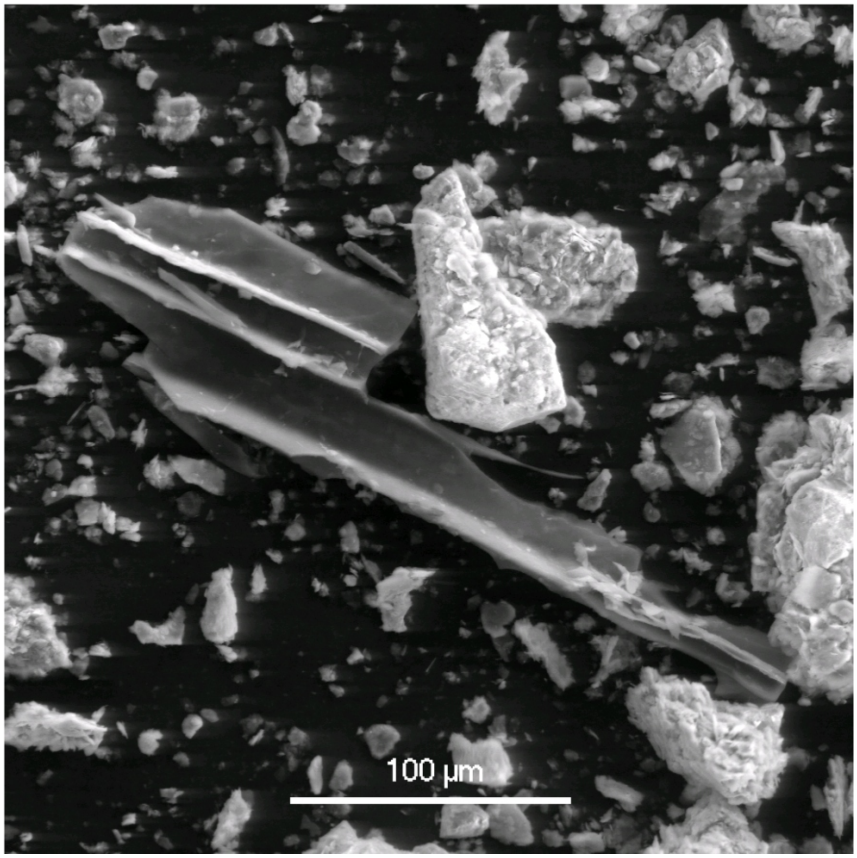
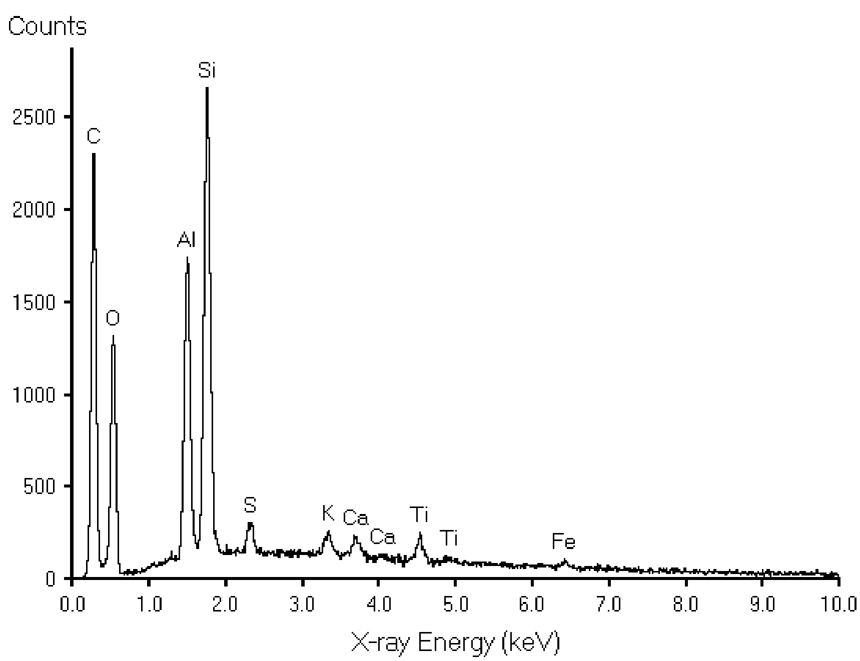


Figure 30: Mineralized wood
Borehole CH97-10B 62.42m-62.49m



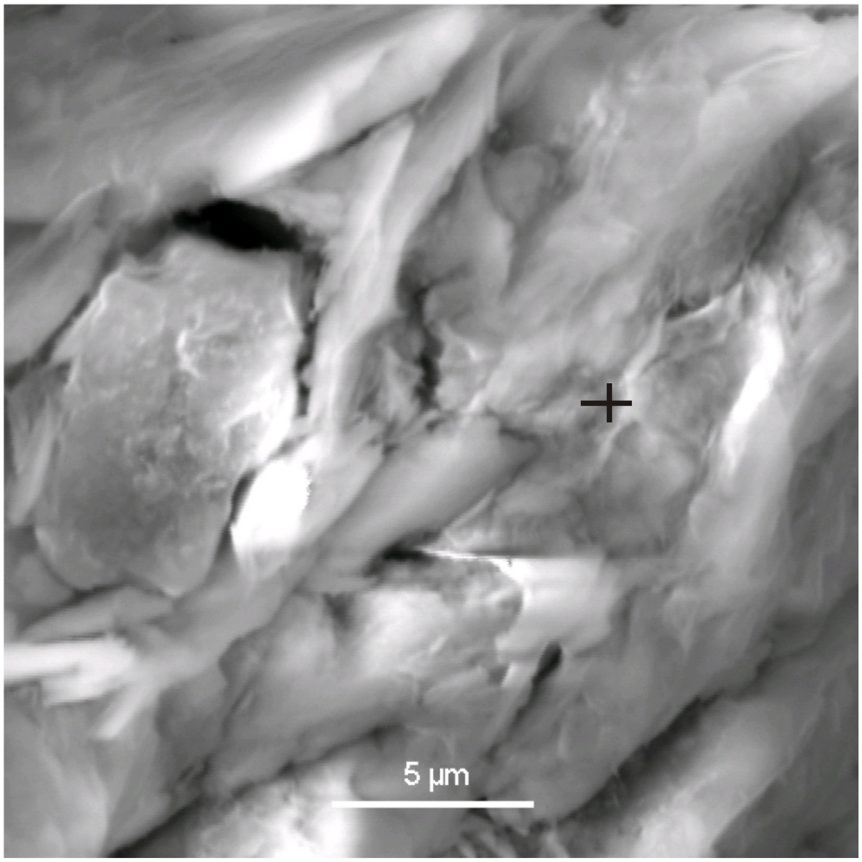
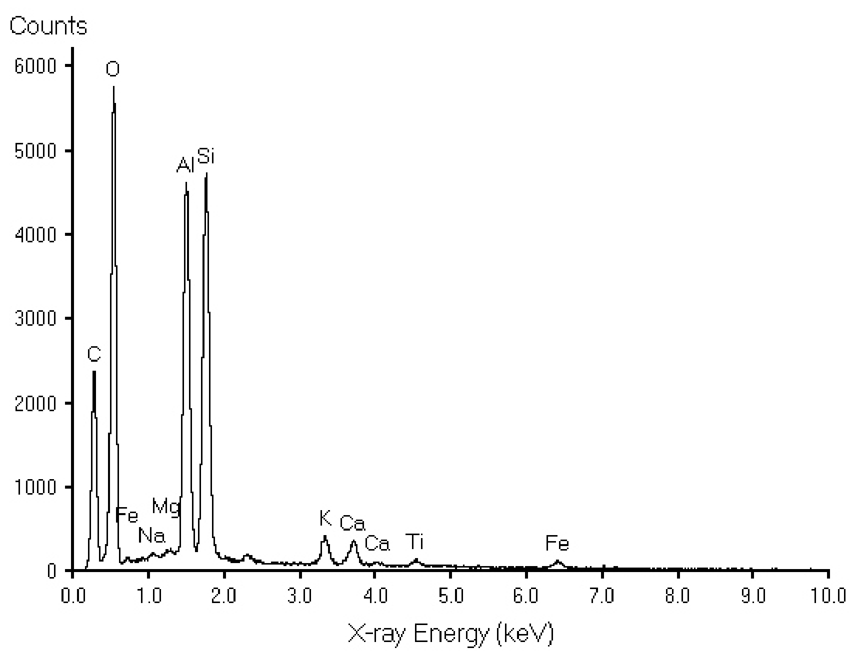


Figure 31: Grain 5a-Mineralized wood
Borehole CH97-10B 62.42m-62.49m



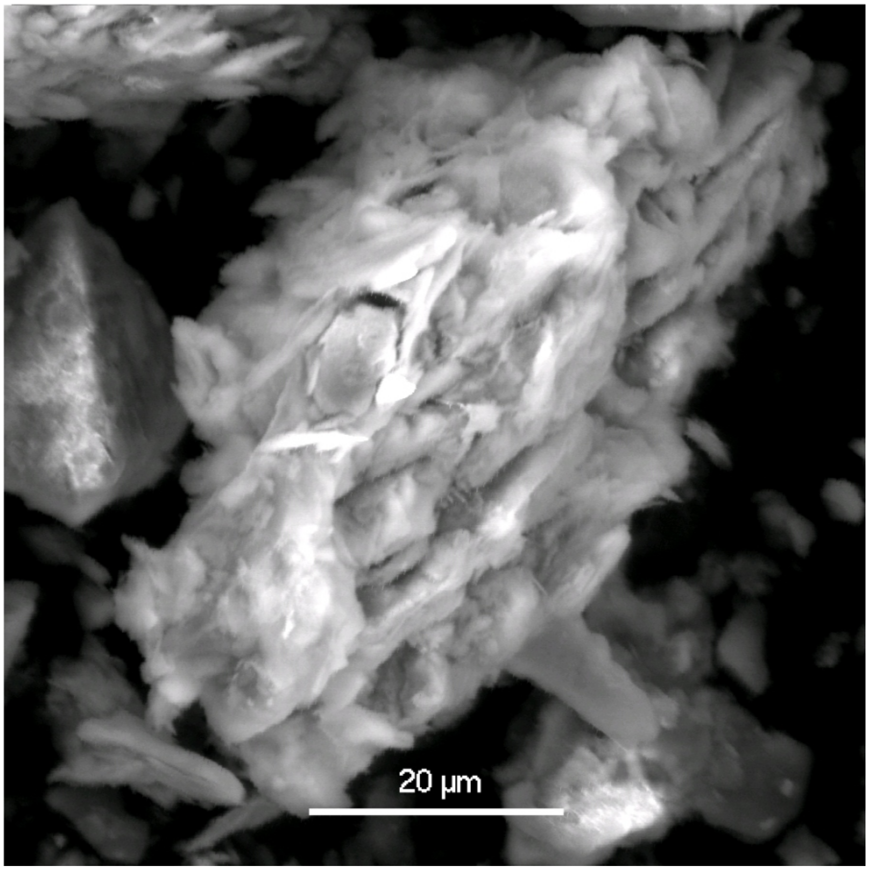


Figure 32: Grain 5b-Mineralized wood, but no obvious clay minera
Borehole CH97-10B 62.42m-62.49m

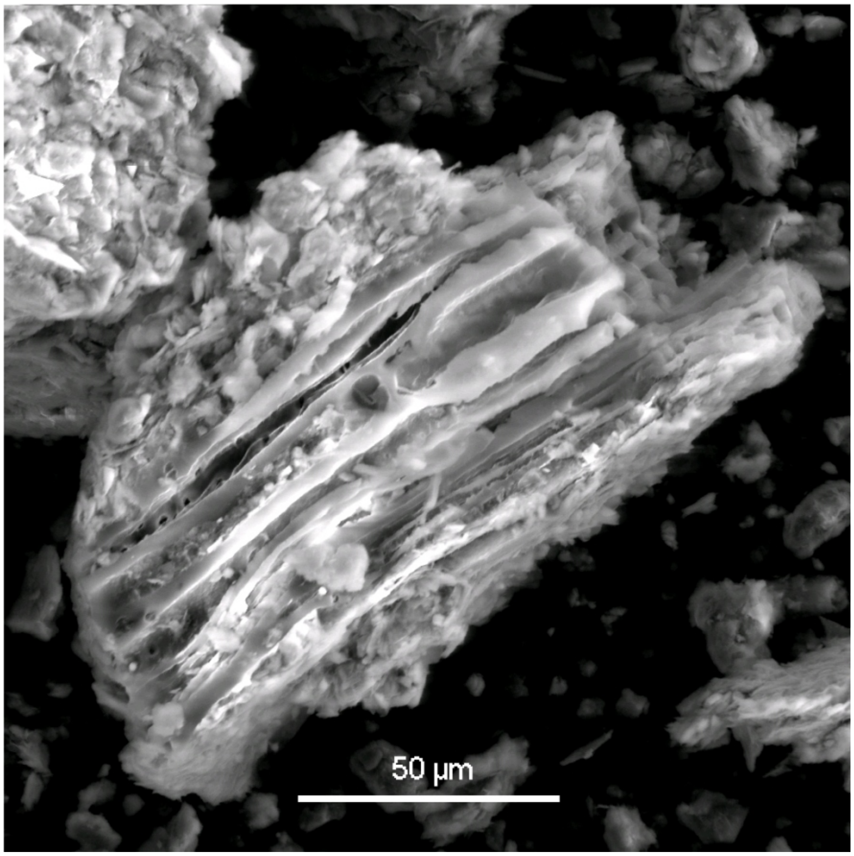
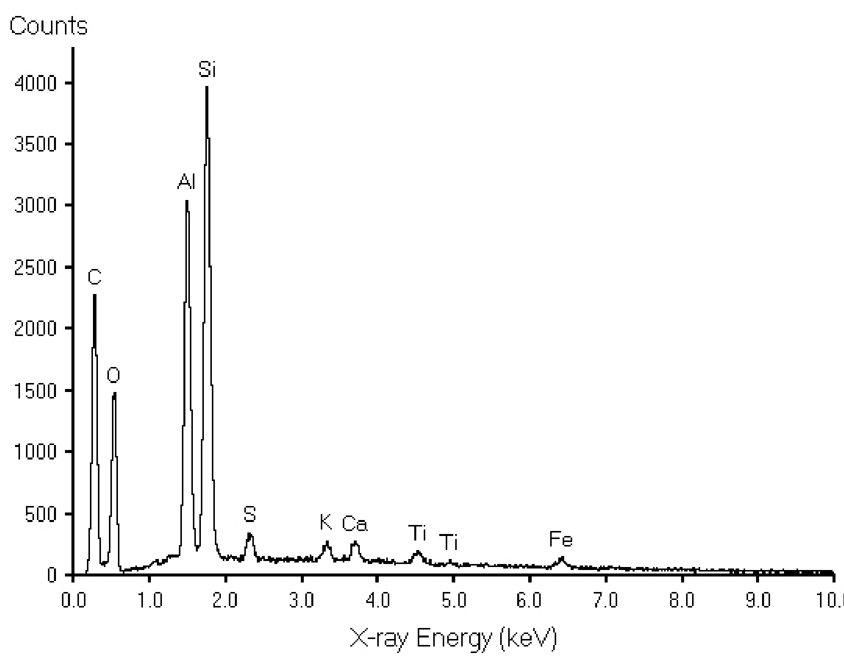


Figure 33: Thick chunk mineralized woody fragment with some clay mineral
Borehole CH97-10B 62.42m-62.49m



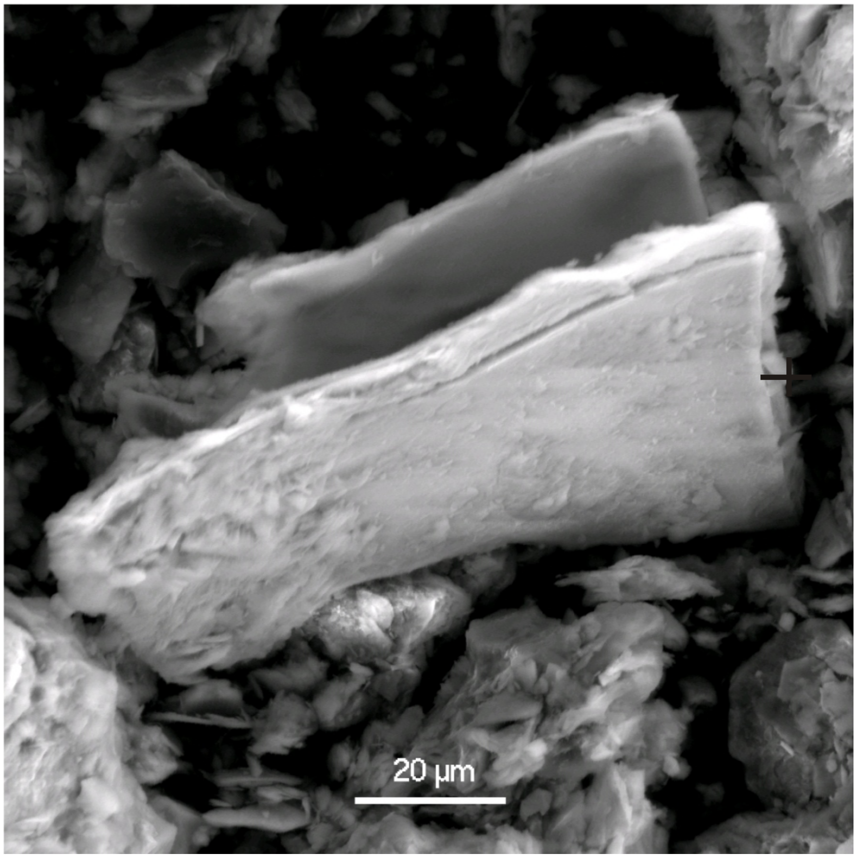
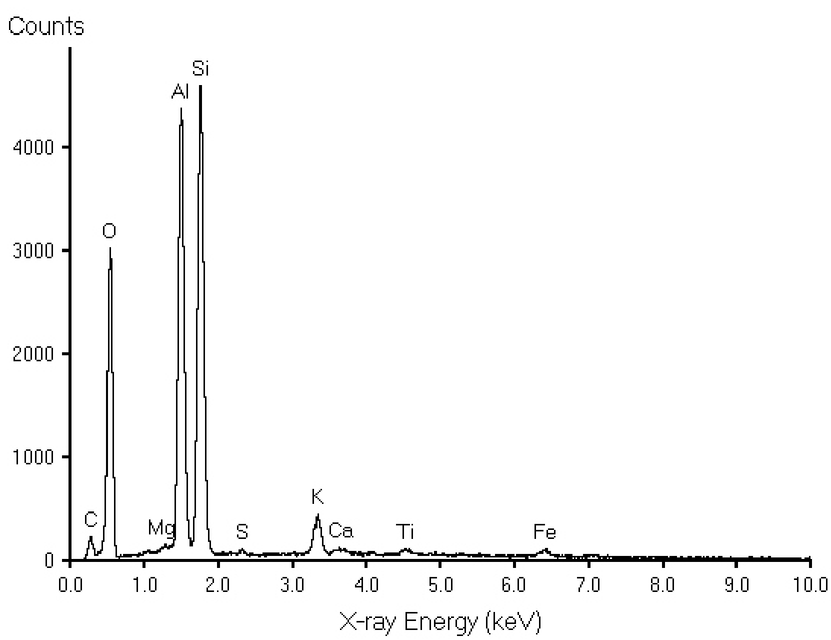


Figure 34: Curved, flat mineral (? muscovite)
Borehole CH97-10B 62.42m-62.49m



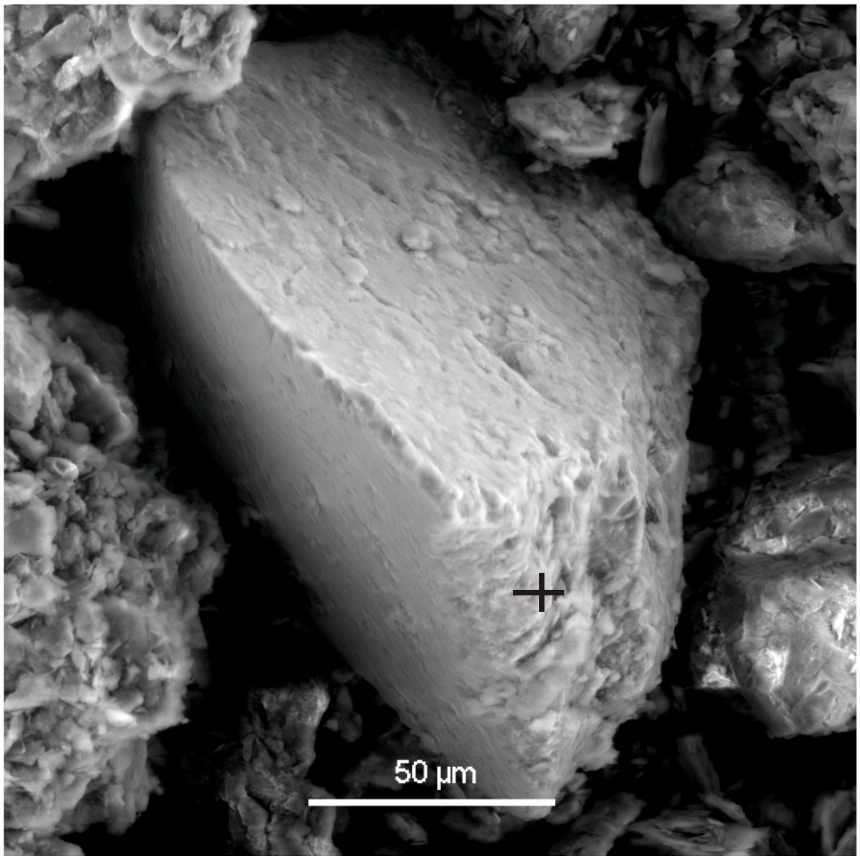
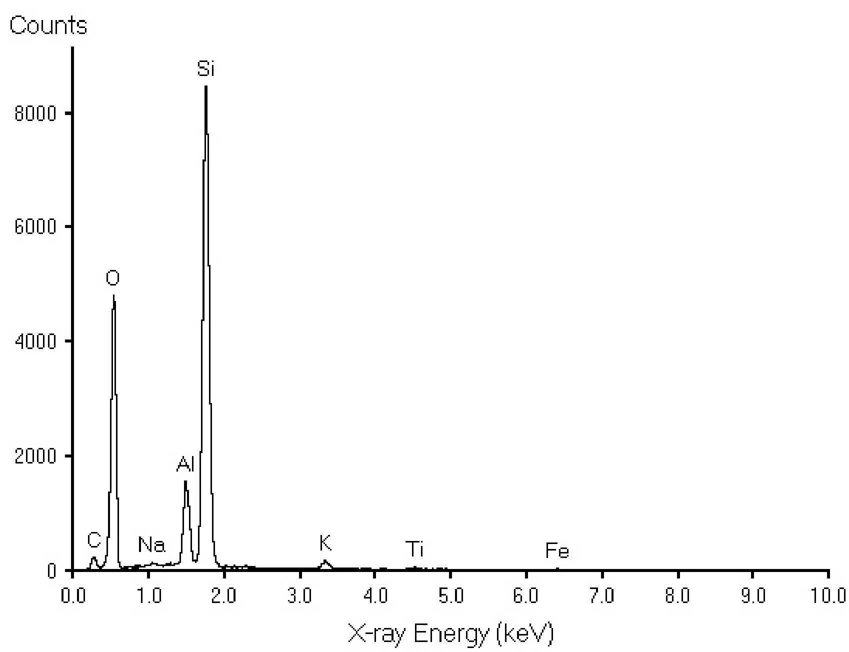


Figure 35: Detrital subhedral quartz
Borehole CH97-10B 62.42m-62.49m



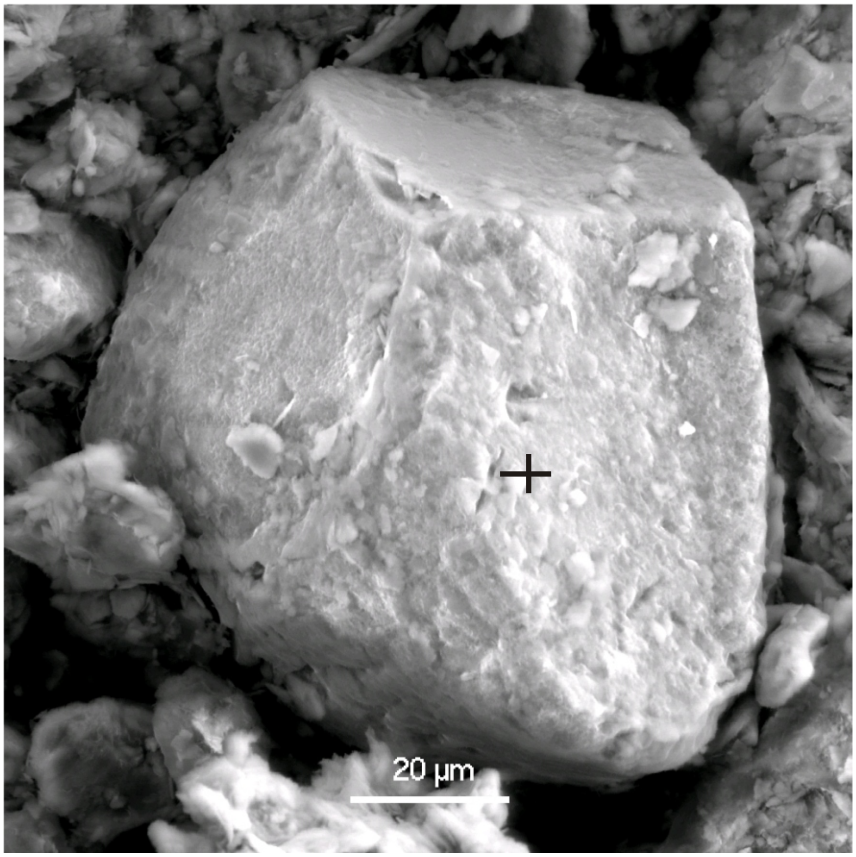
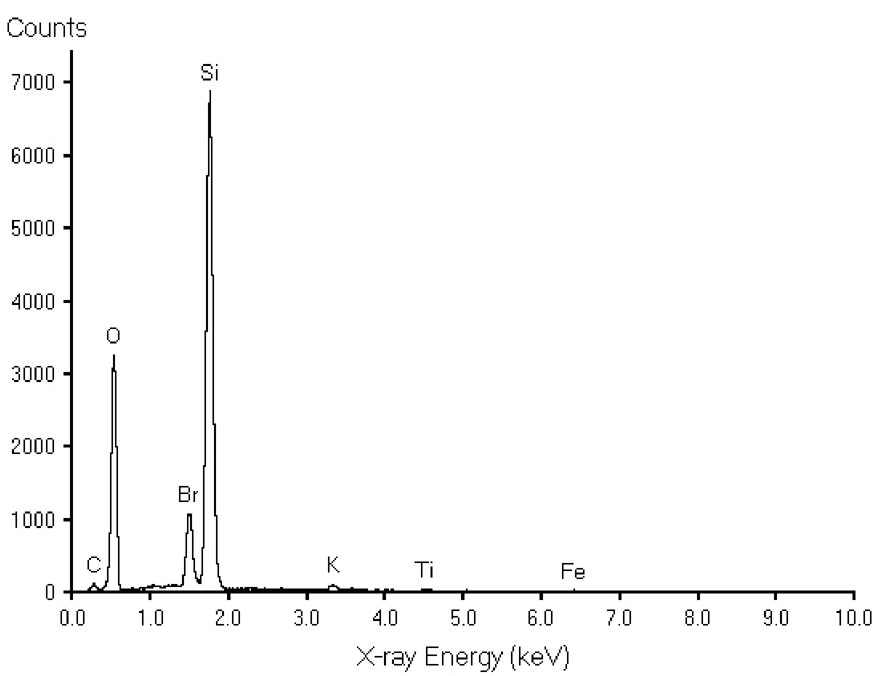


Figure 36:Detrital subhedral quartz
Borehole CH97-10B 62.42m-62.49m



APPENDIX 1
Scanning electron micrographs and electron dispersive system (EDS) spectra analyses of lignite samples

C: Borehole CH-97-9

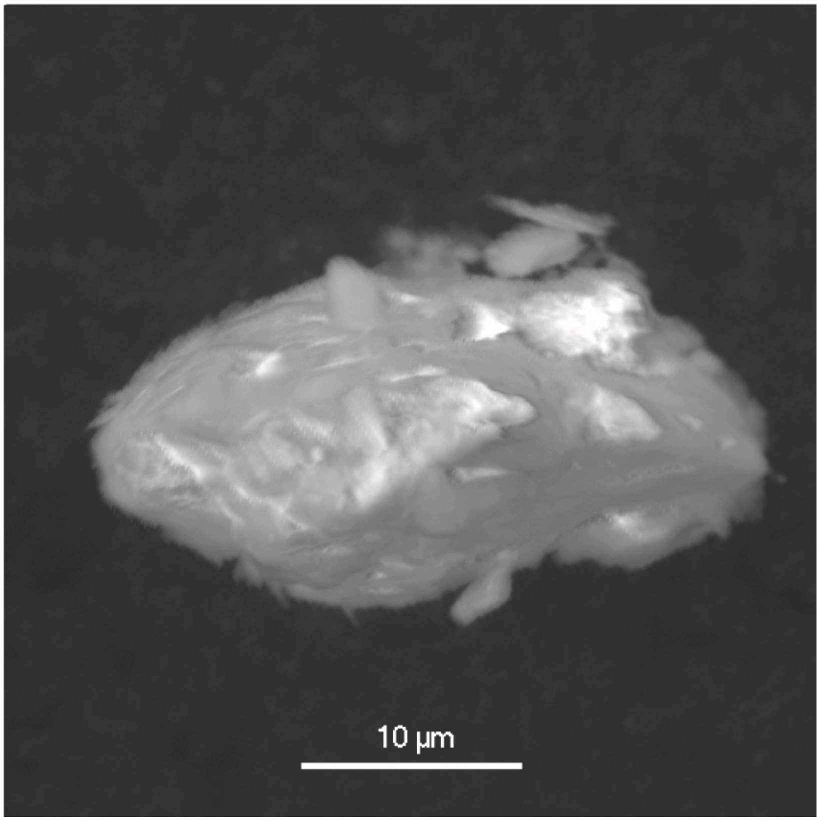
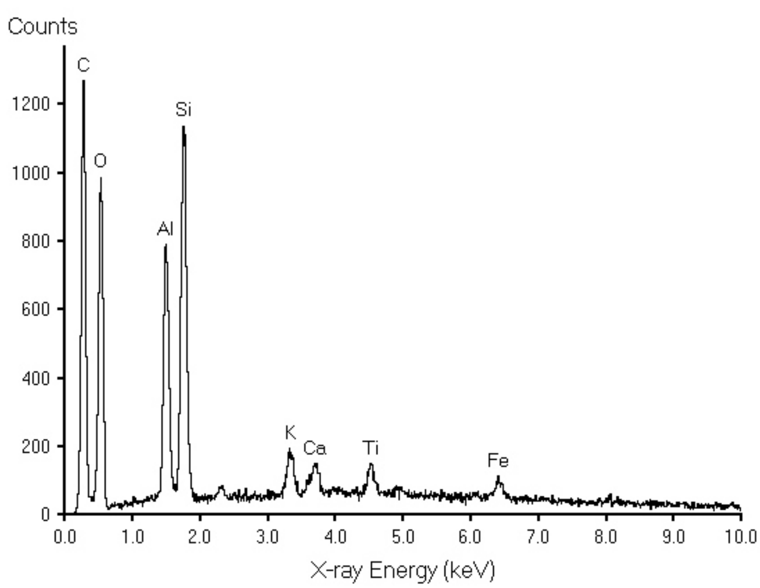


Figure 1: Platey clay mineral (Kaolinite on muscovite(?))
Borehole CH97-9 48.19m-48.23m



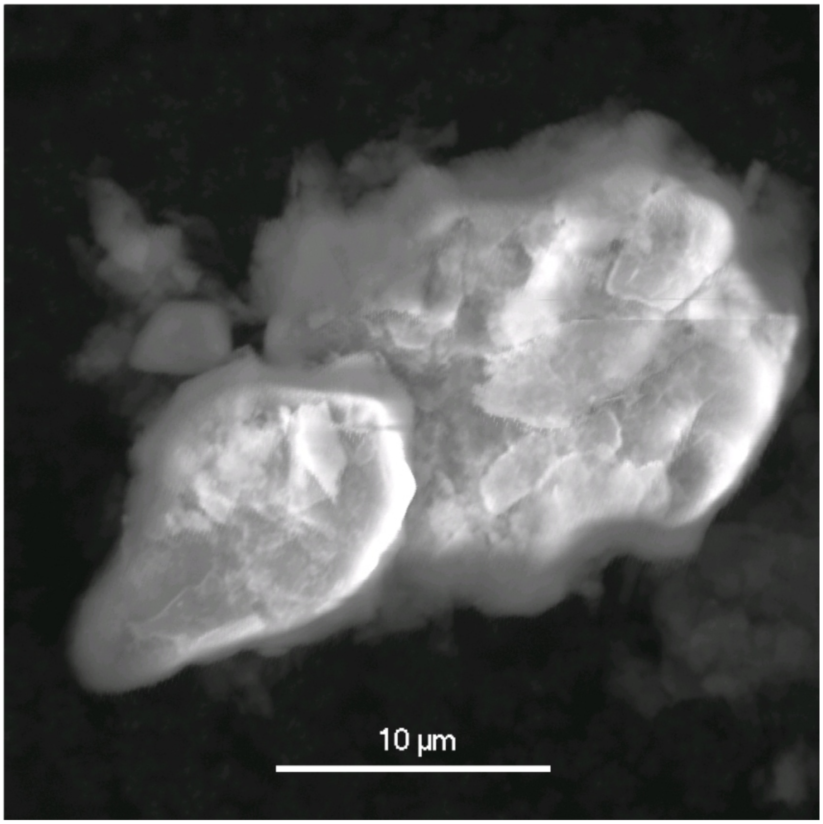
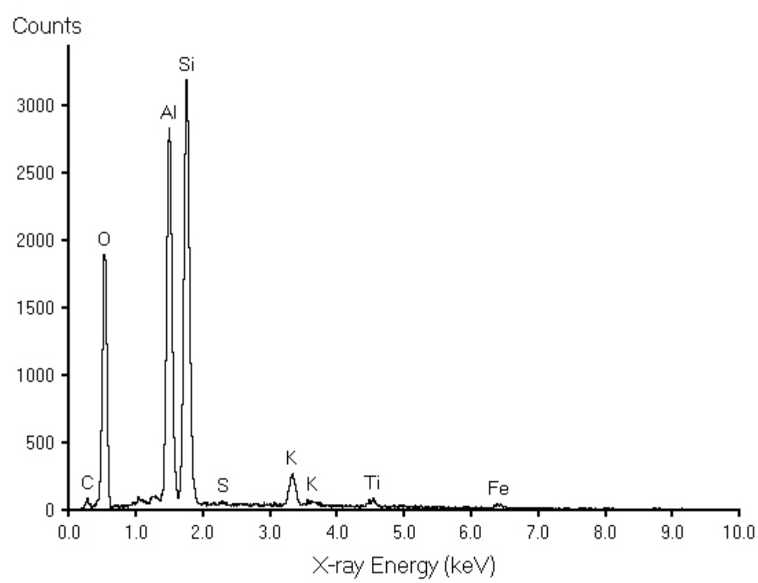


Figure 2: Platey clay mineral (Muscovite + Kaolinite (?))
Borehole CH97-9 48.19m-48.23m



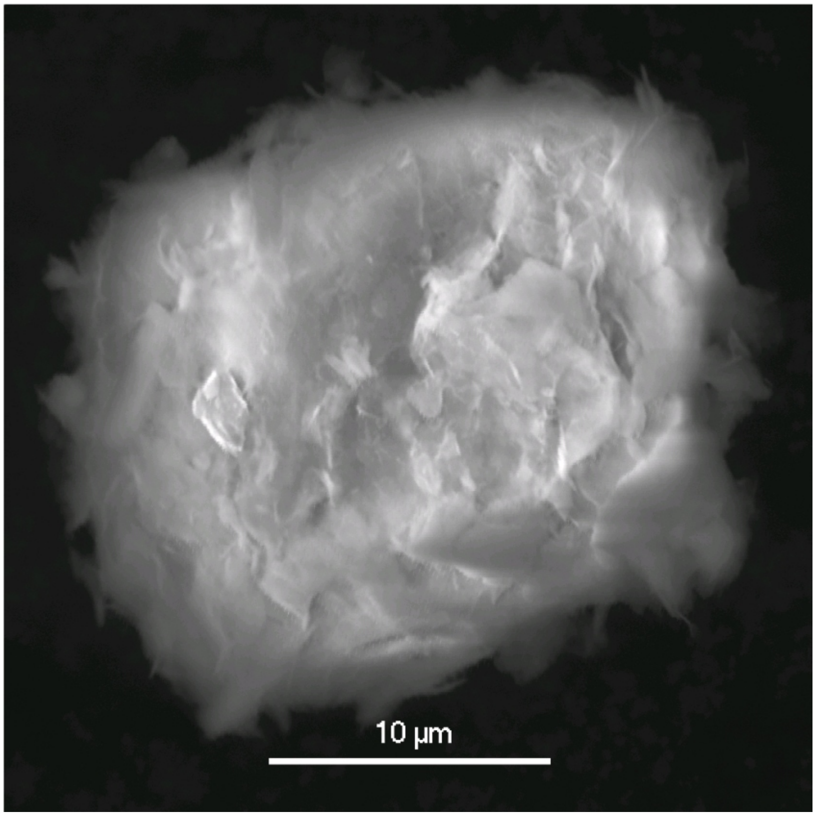
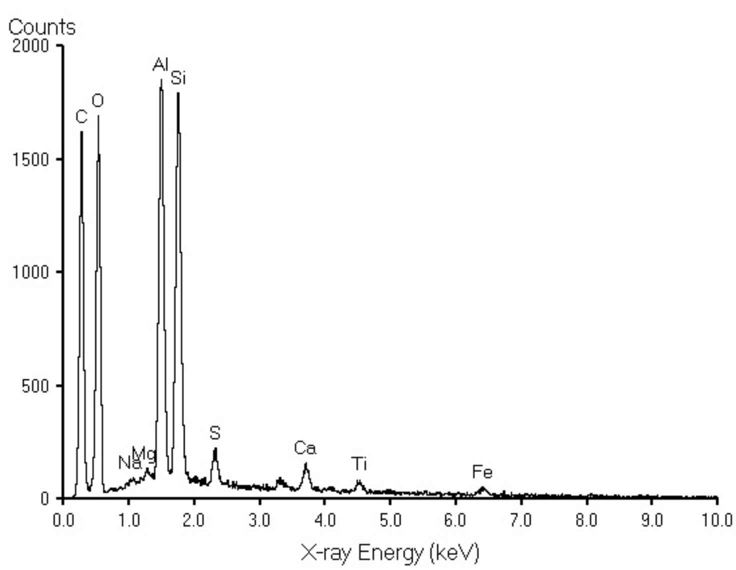


Figure 3: Platey clay mineral, borehole CH97-9 48.19m-48.23m



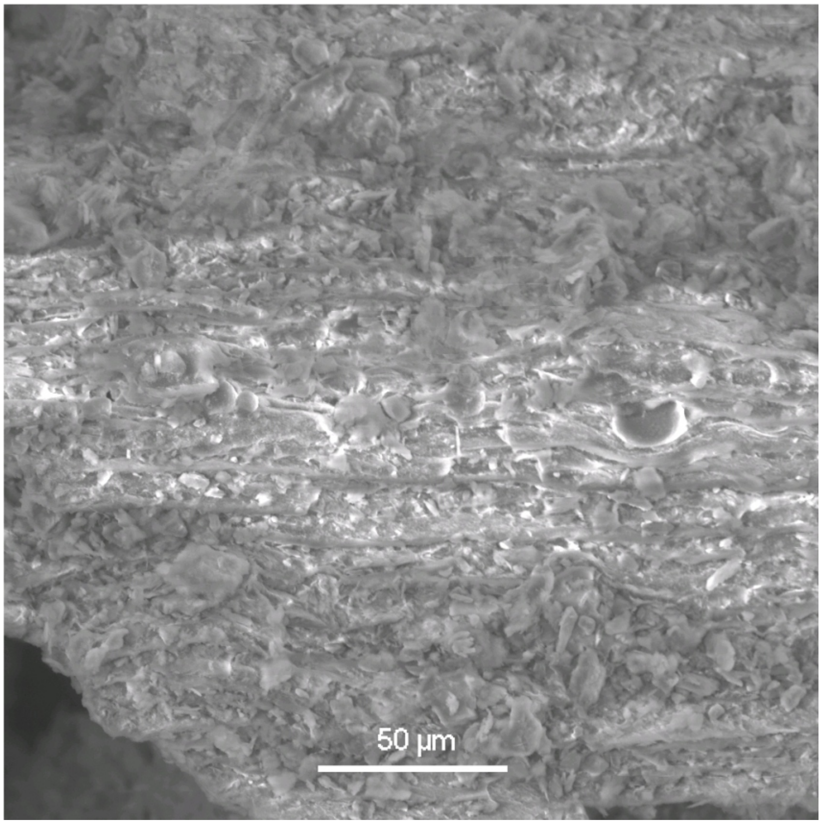
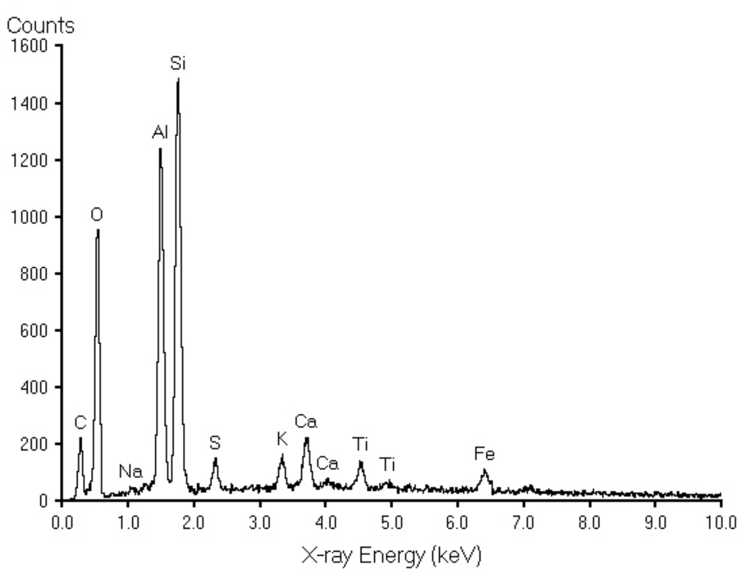


Figure 4: Woody structure mineral (Amphibole (?))
Borehole CH97-9 48.19m-48.23m



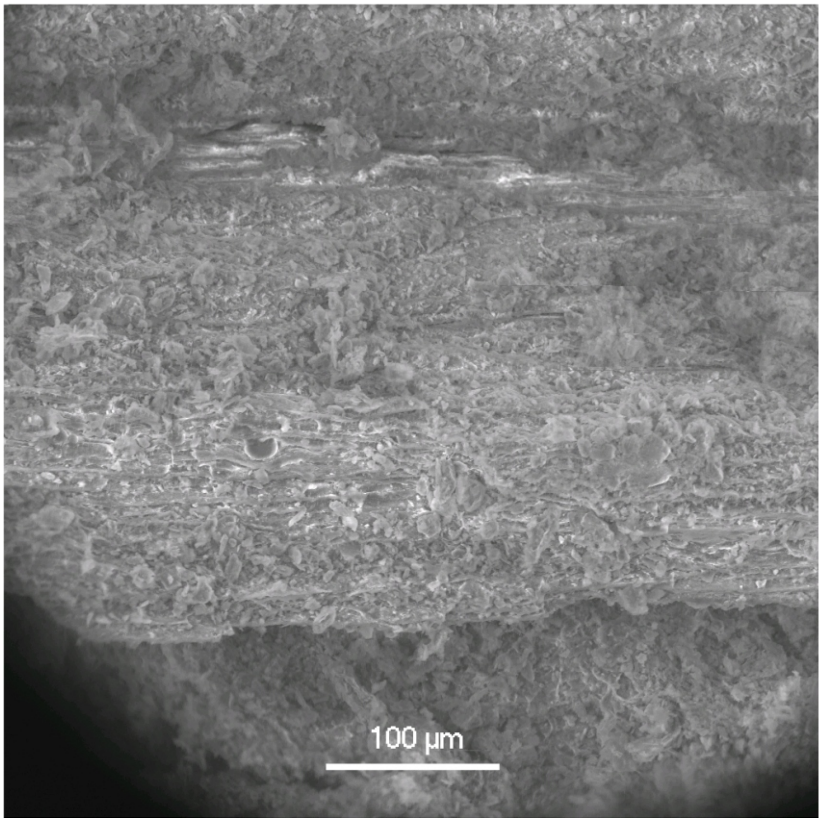
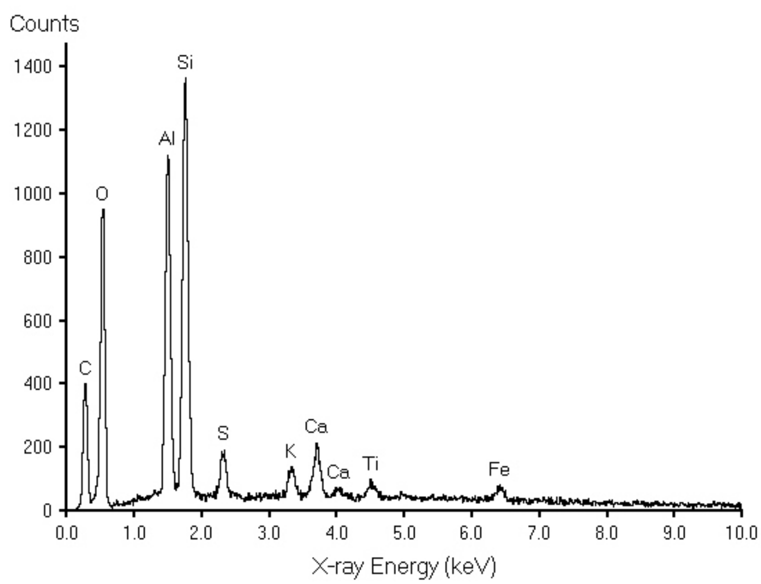


Figure 5: Woody structure mineral (Amphibole + Pyrite (?))
Borehole CH97-9 48.19m-48.23m



APPENDIX 1
Scanning electron micrographs and electron dispersive system (EDS) spectra analyses of lignite samples

D: Borehole SG-98-48

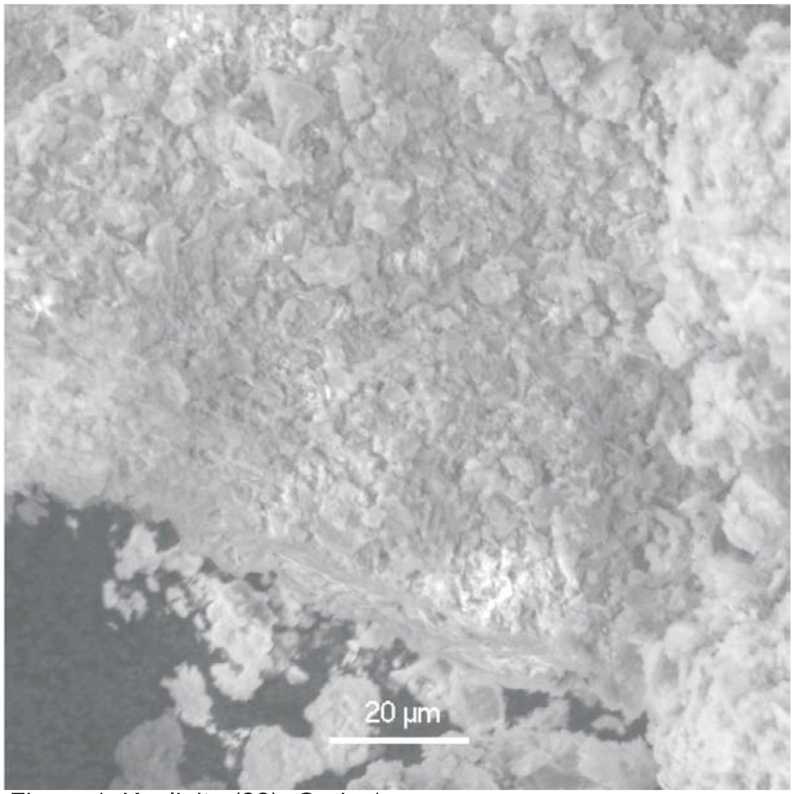
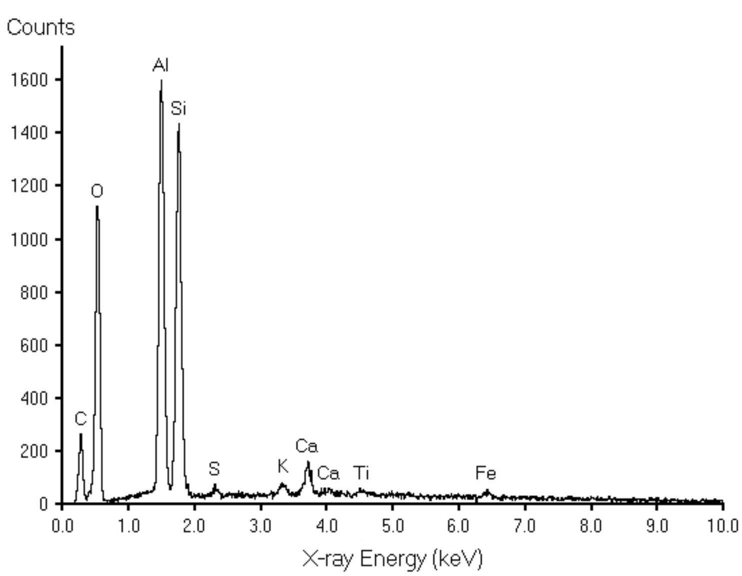


Figure 1: Kaolinite (??)- Grain 1
Borehole SG98-48 31.88m-31.89m



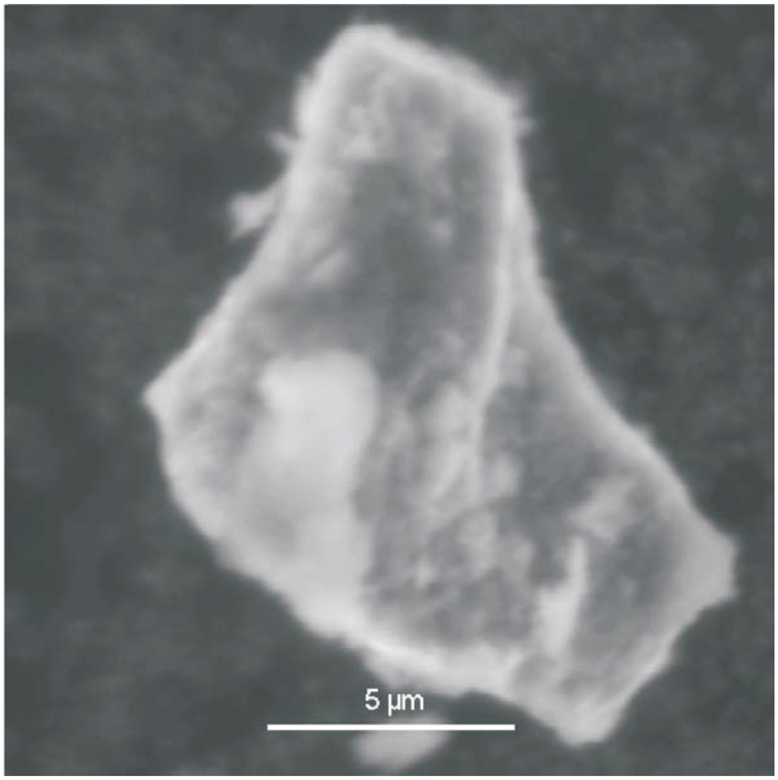
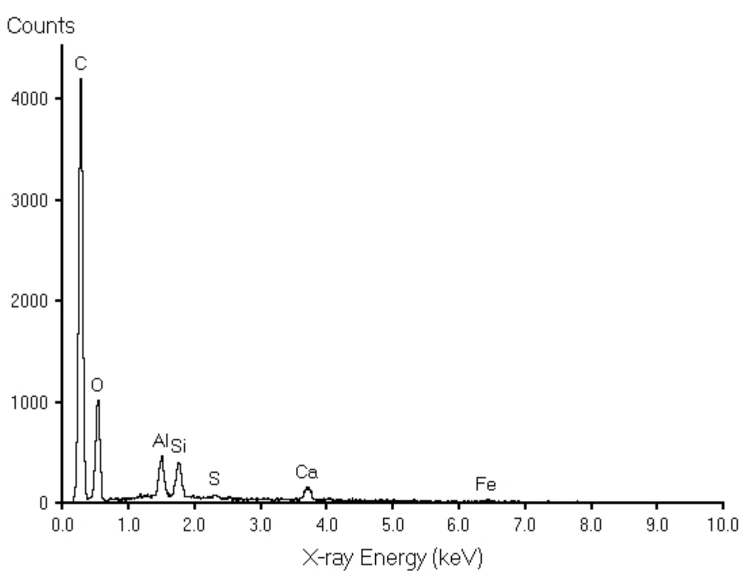


Figure 2: ?? (Grain 5)
Borehole SG98-48 31.88m-31.89m



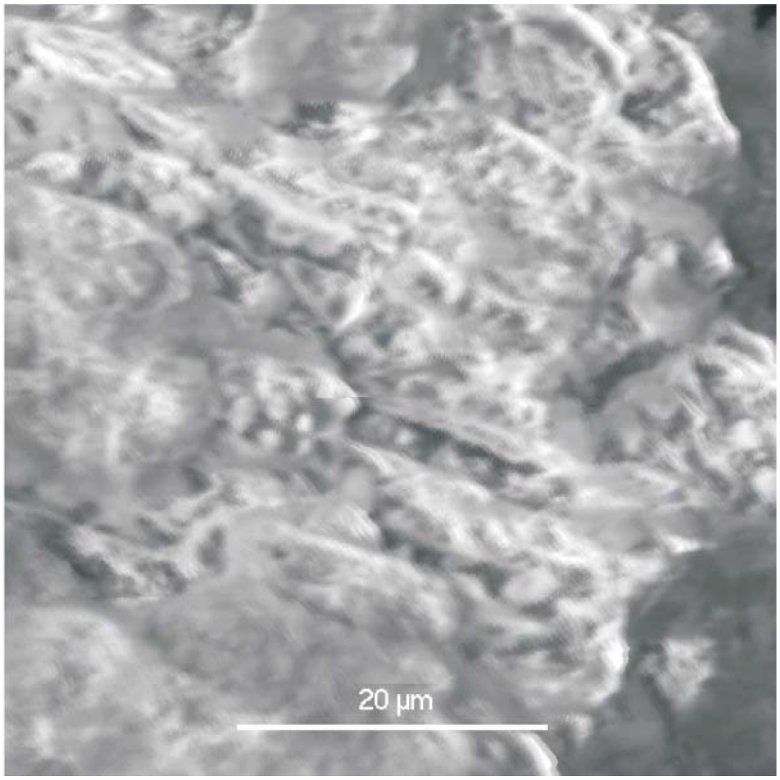
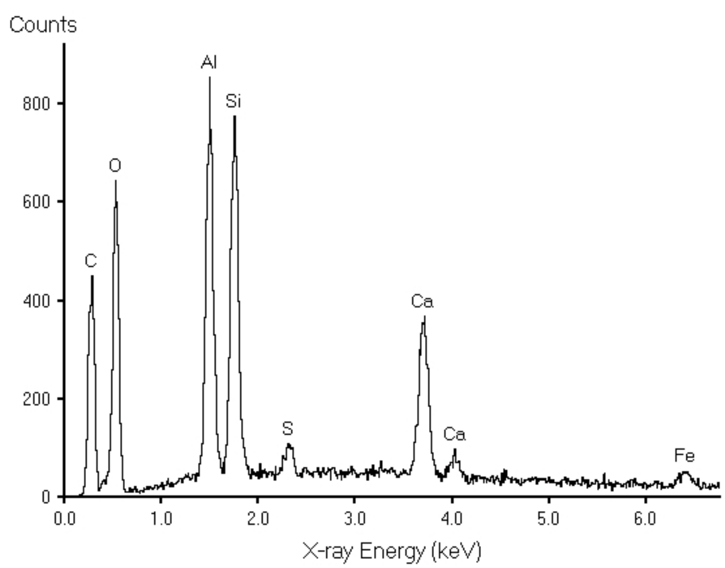


Figure 3: Woody structure (??)-Grain 6
Borehole SG98-48 31.88m-31.89m



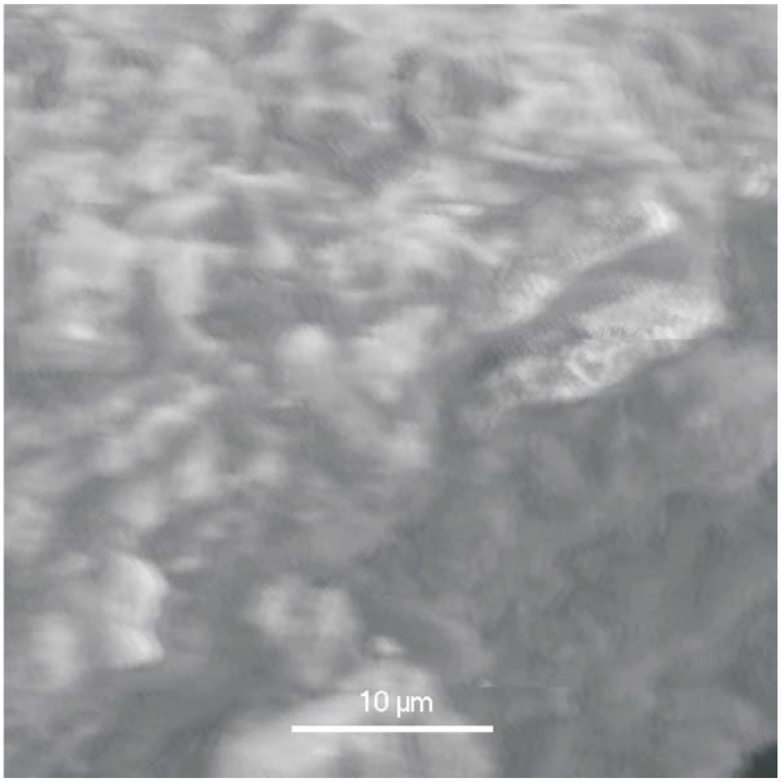
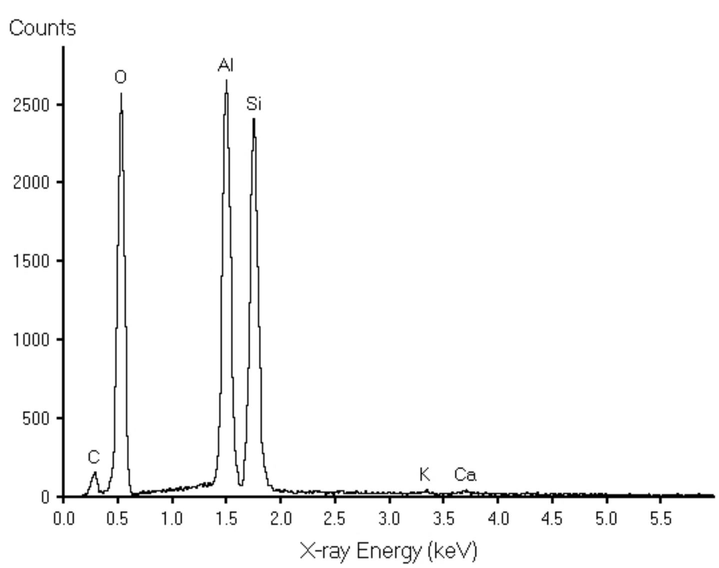


Figure 4: Kaolinite
Borehole SG98-48 31.88m-31.89m



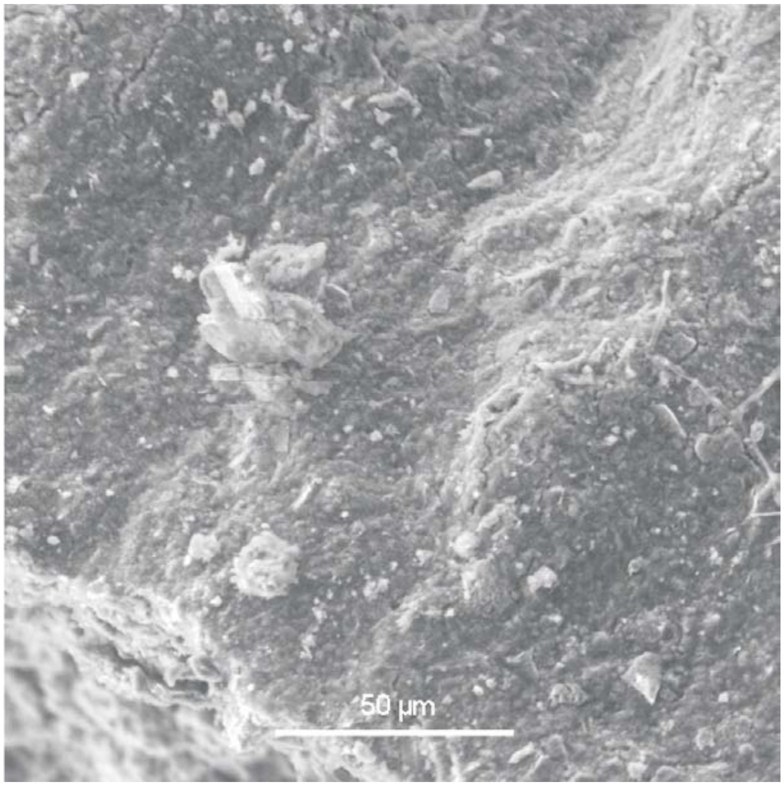
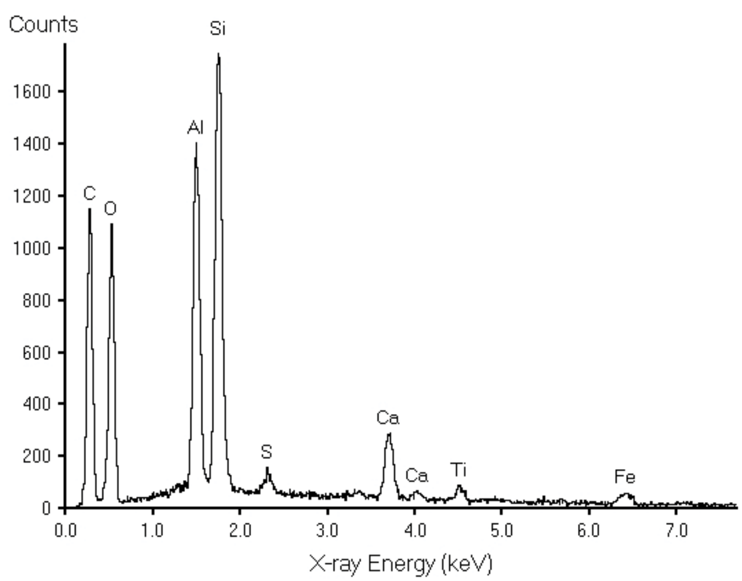


Figure5: Amphibole (??)
Borehole SG98-48 32.20m-32.40m



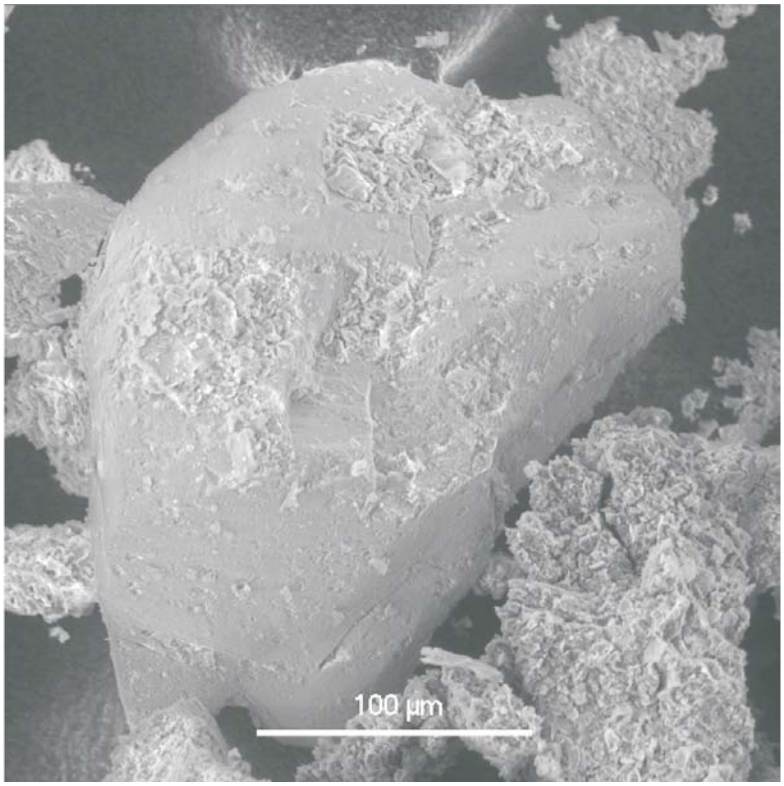
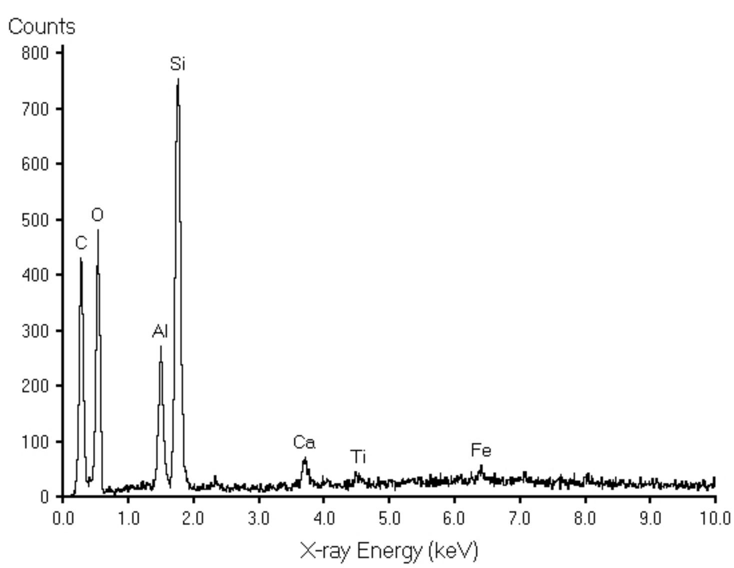


Figure 6: Plagioclase (?)
Borehole SG98-48 32.20m-32.40m



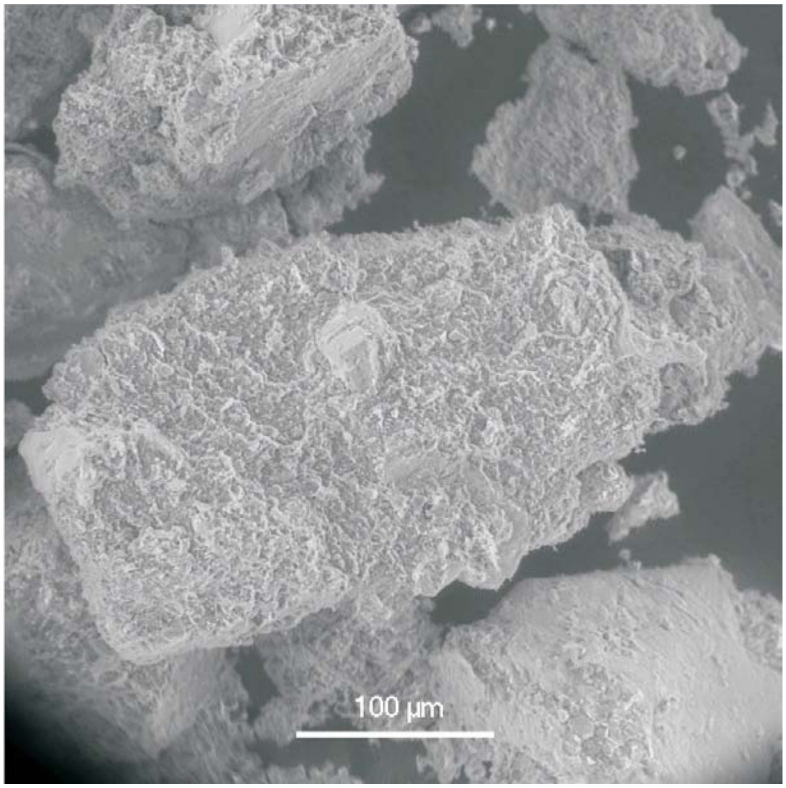
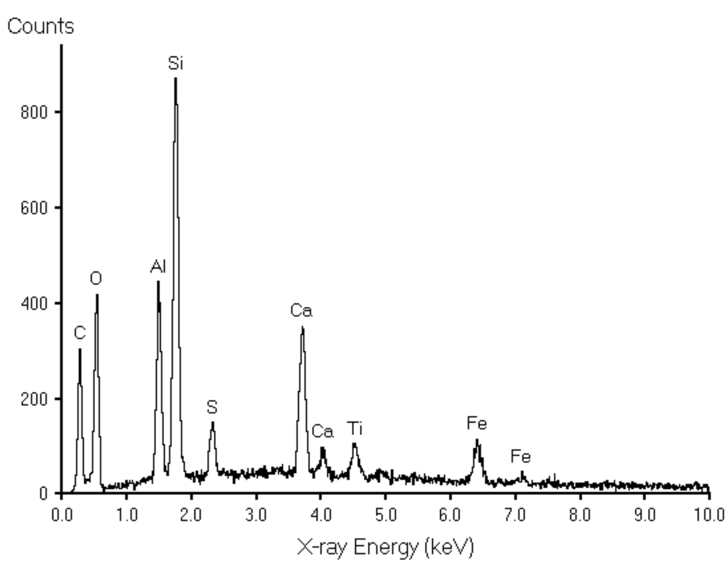


Figure 7: Grain 3
Borehole SG98-48 32.20m-32.40m



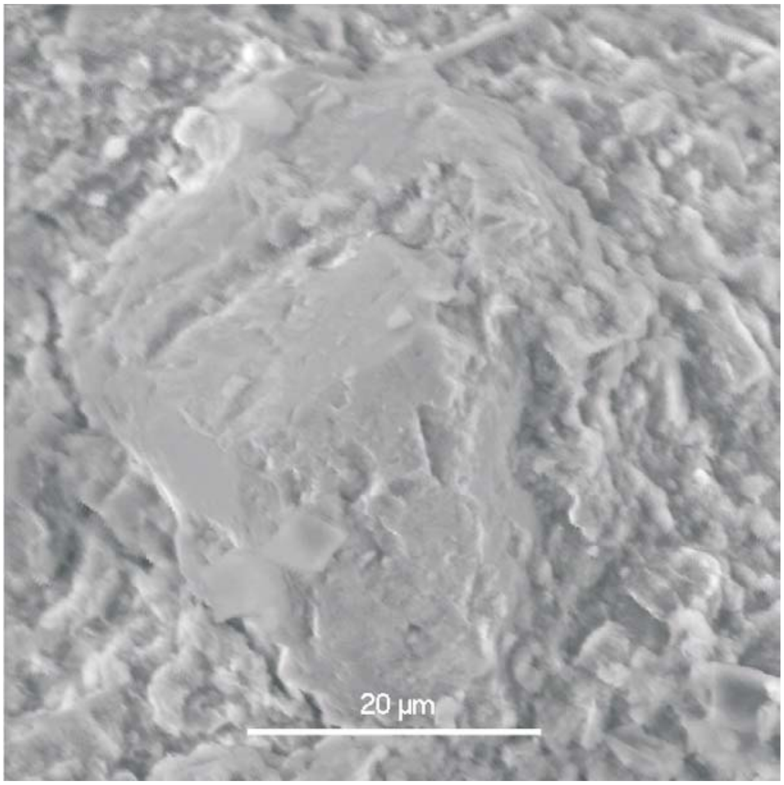
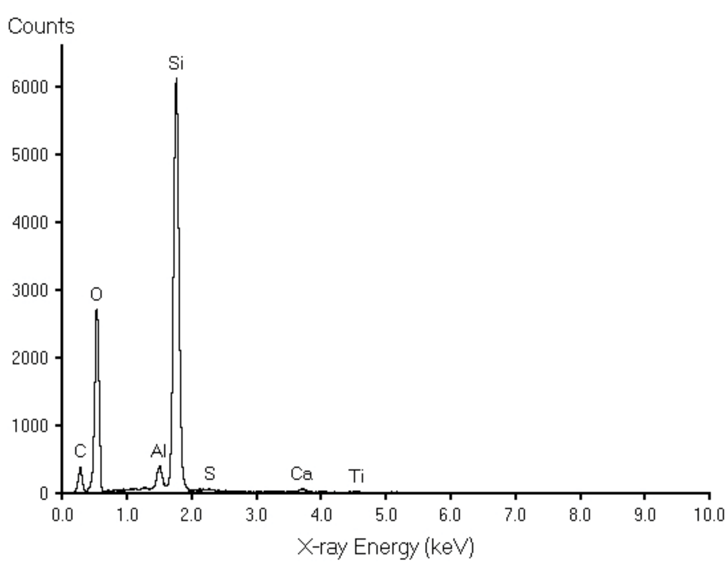


Figure 8: Angular quartz (subhedral) with etching and dissolution features
Borehole SG98-48 32.20m-32.40m



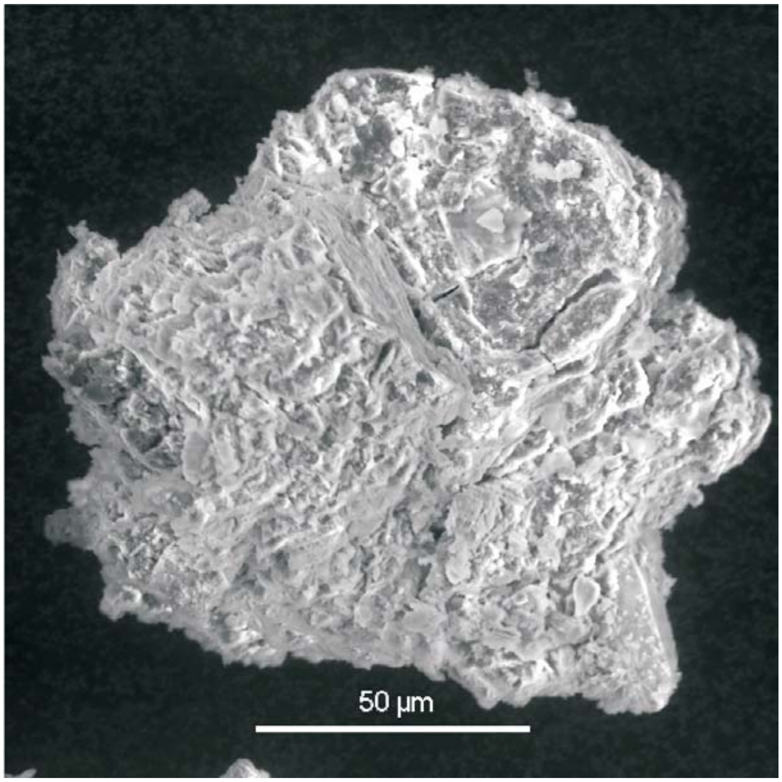
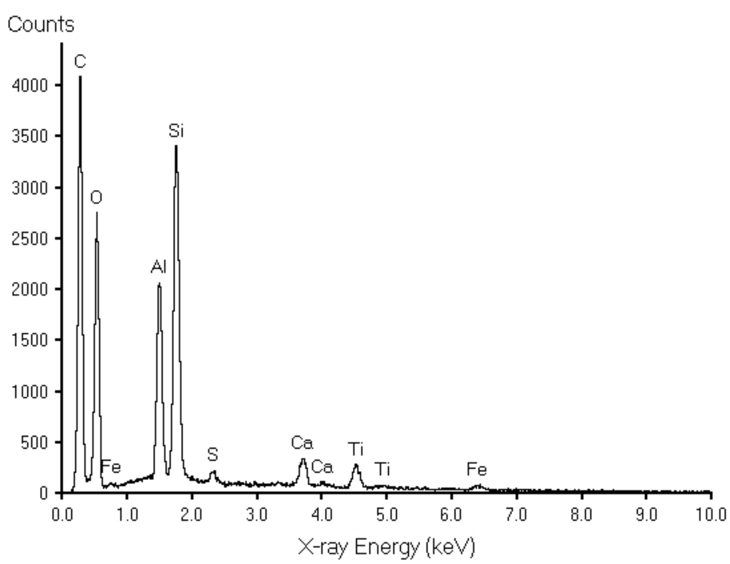


Figure 9: ??
Borehole SG98-48 32.20m-32.40m



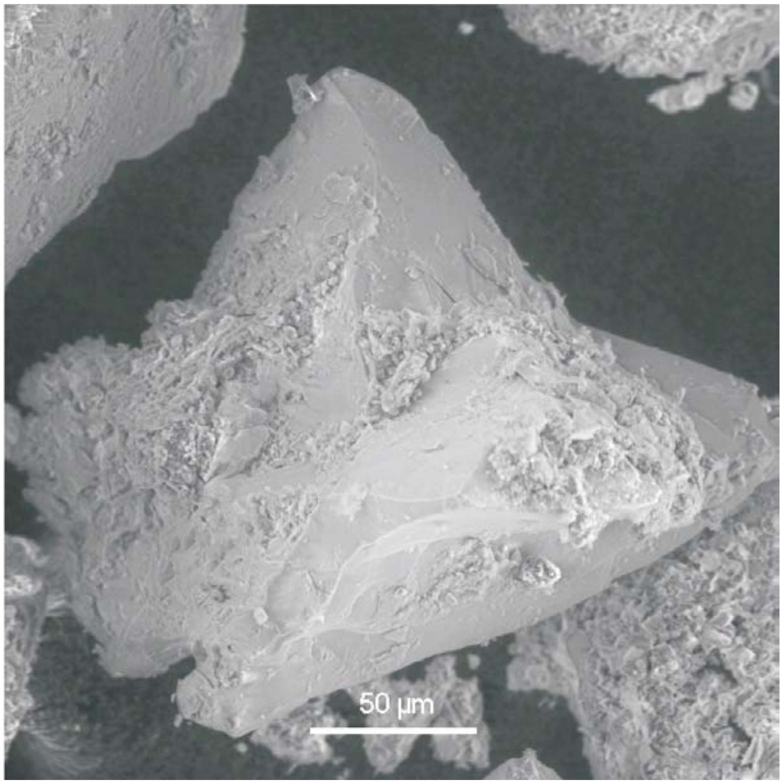
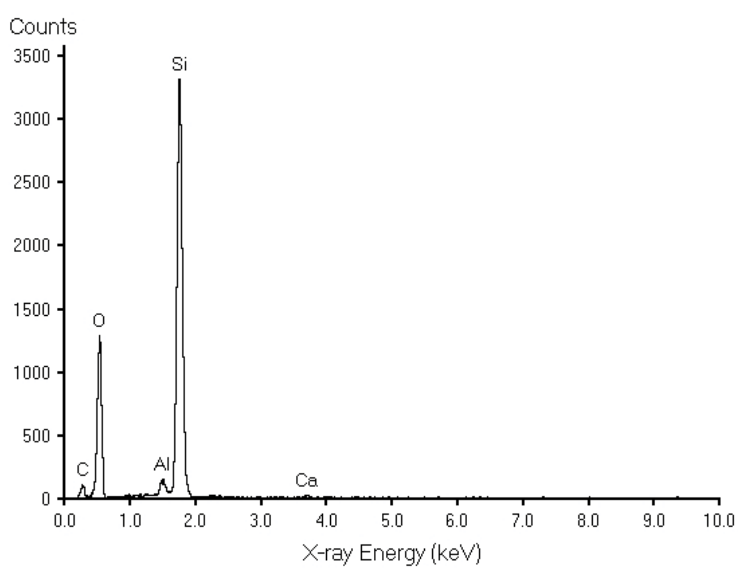


Figure 10: Quartz (twinned) Mineral
Borehole SG98-48 32.20m-32.40m



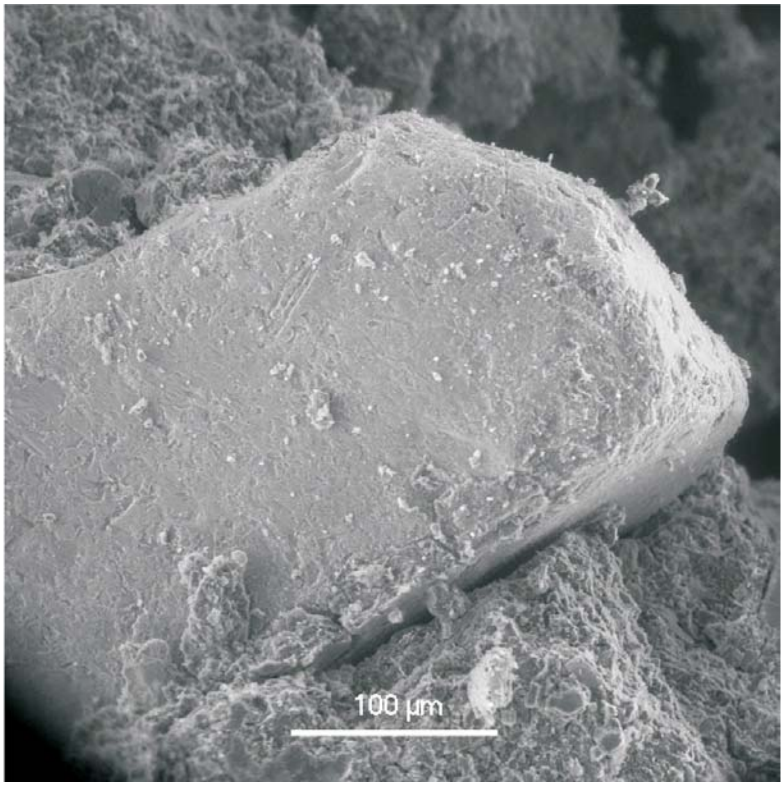
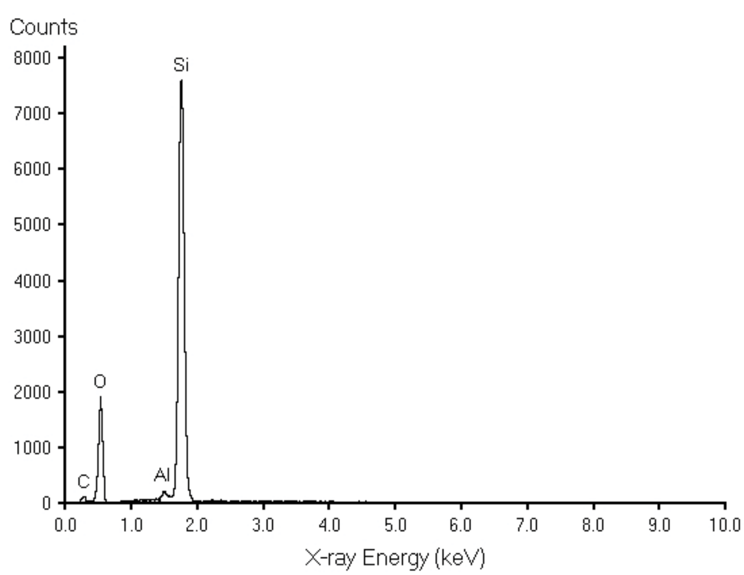


Figure 11: Quartz (subhedral) mineral
Borehole SG98-48 32.20m-32.40m



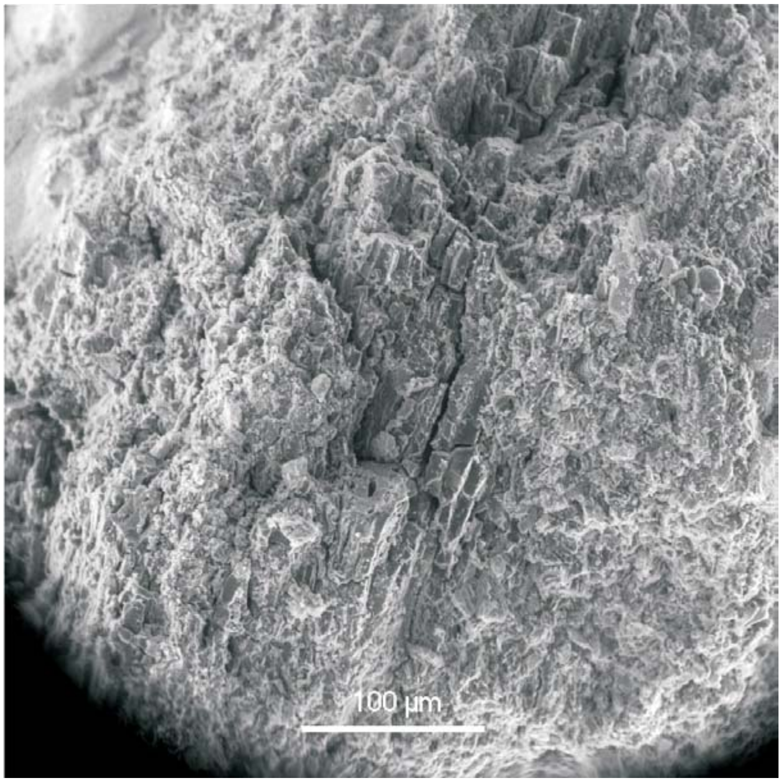
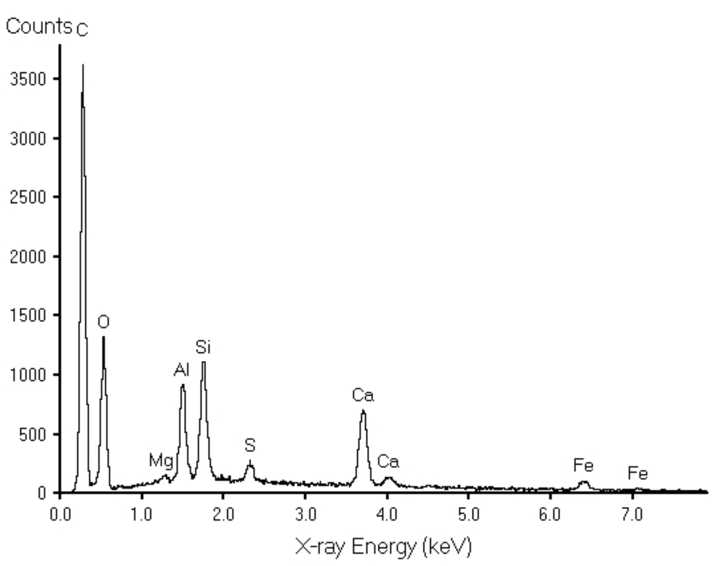


Figure 12: Kaolinite (?) + Calcite + ??
Borehole SG98-48 32.20m-32.40m



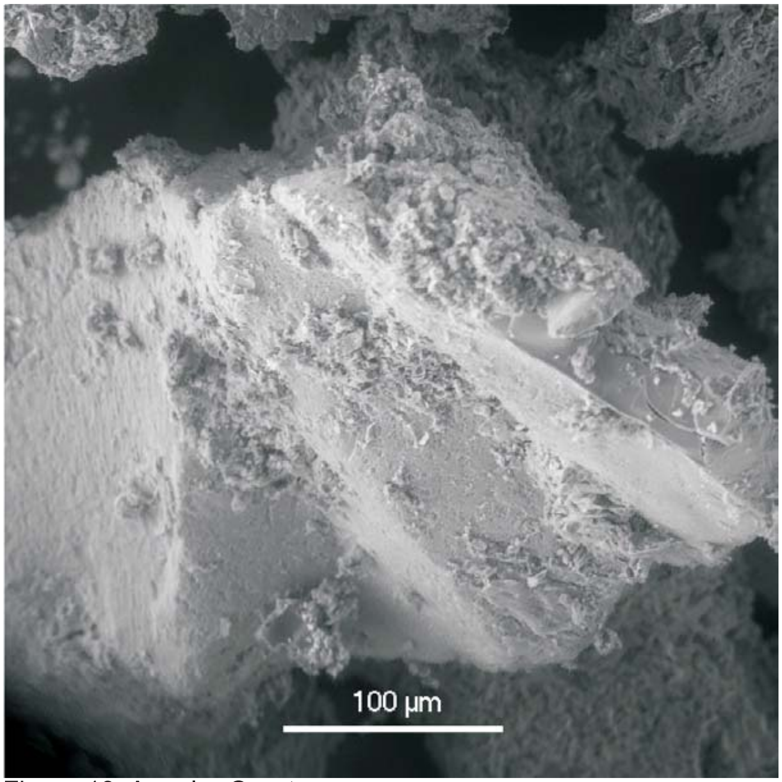
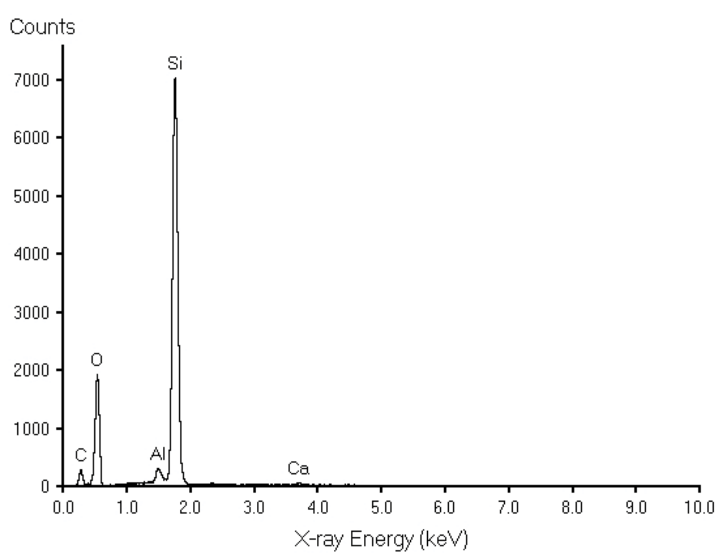


Figure 13: Angular Quartz
Borehole SG98-48 32.20m-32.40m



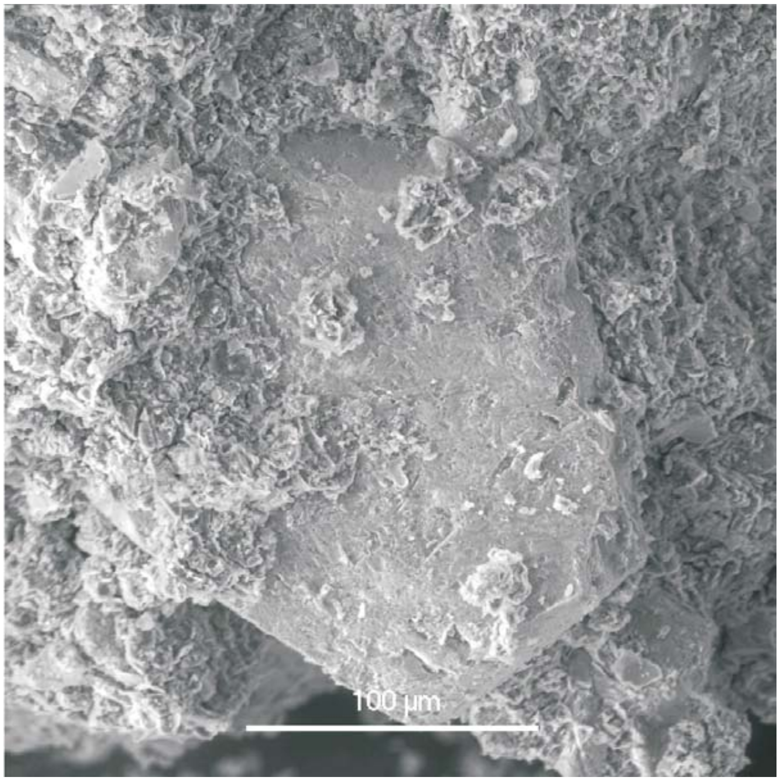
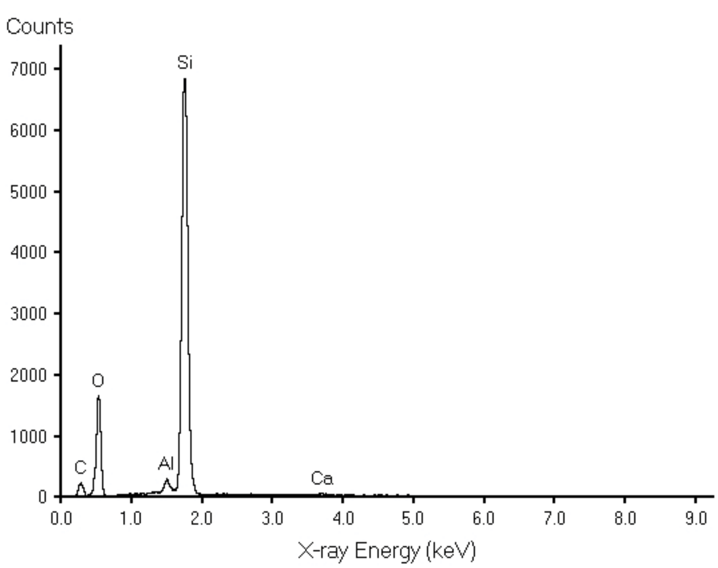


Figure 14: Quartz (Subhedral) Mineral
Borehole SG98-48 32.20m-32.40m



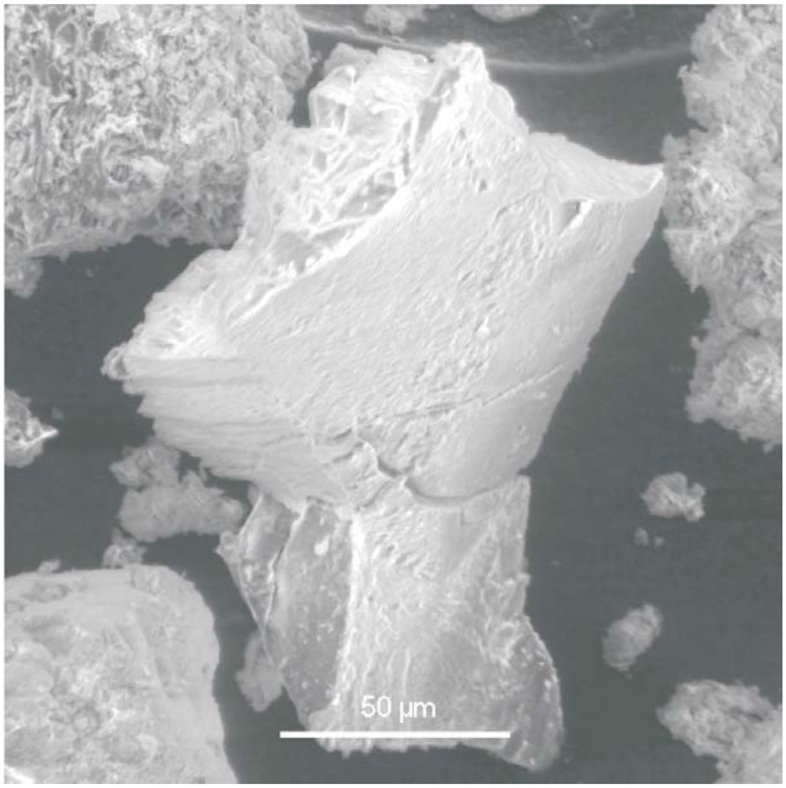
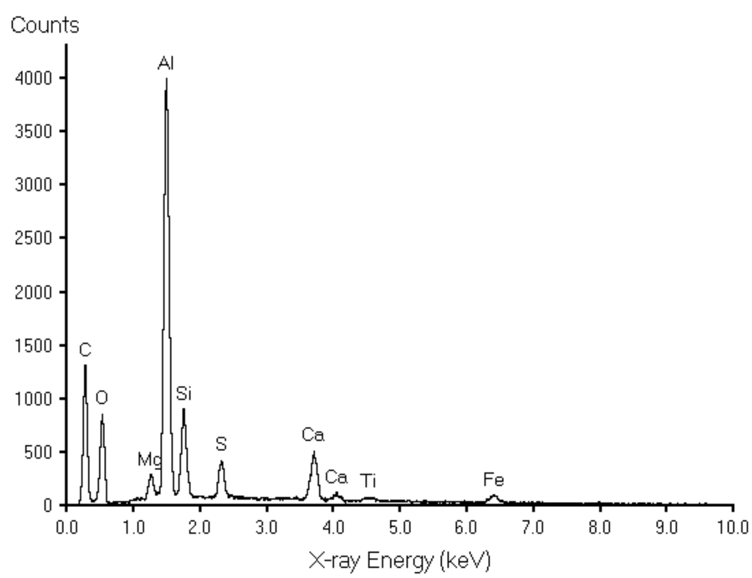


Figure 15: Mineral with high aluminum
Borehole SG98-48 32.40m-32.44m



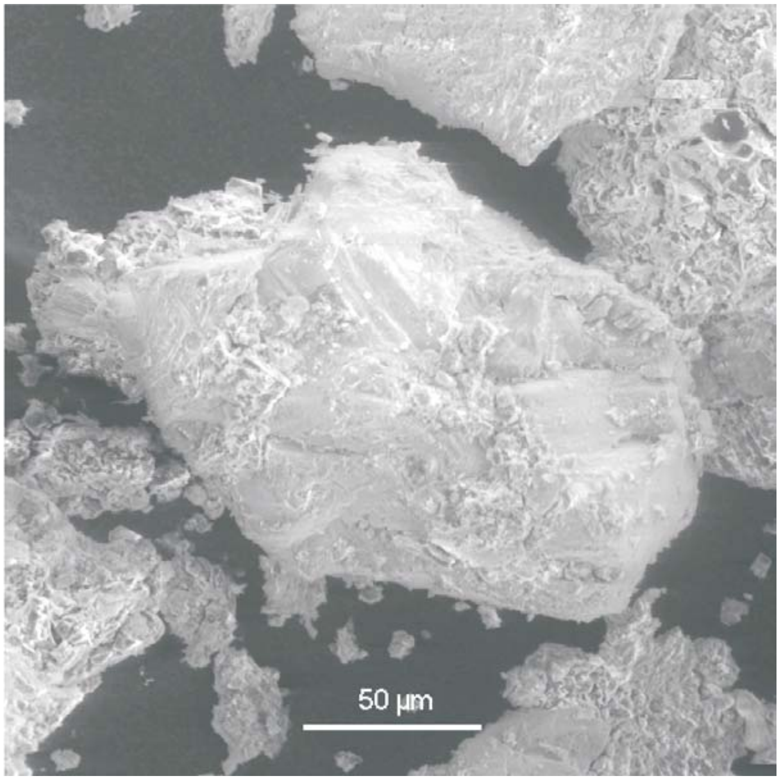
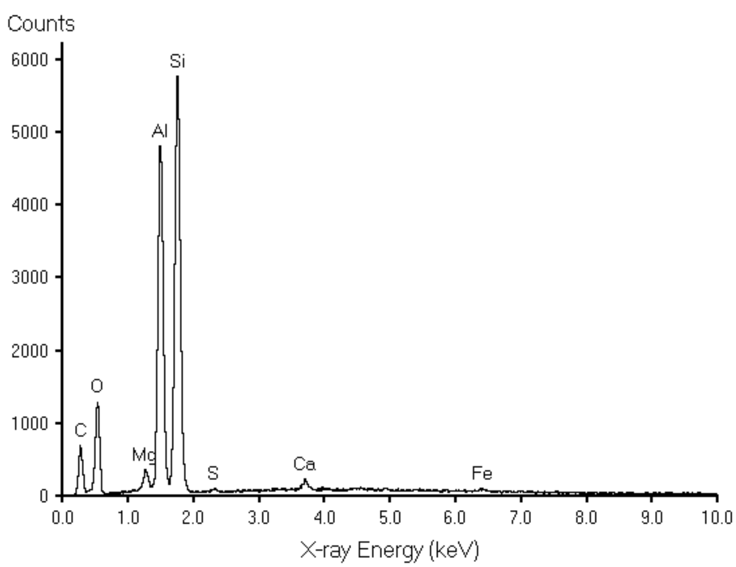


Figure 16: Blocky aggregate of kaolinite, possible pseudomorph after feldspar
Borehole SG98-48 32.40m-32.44m



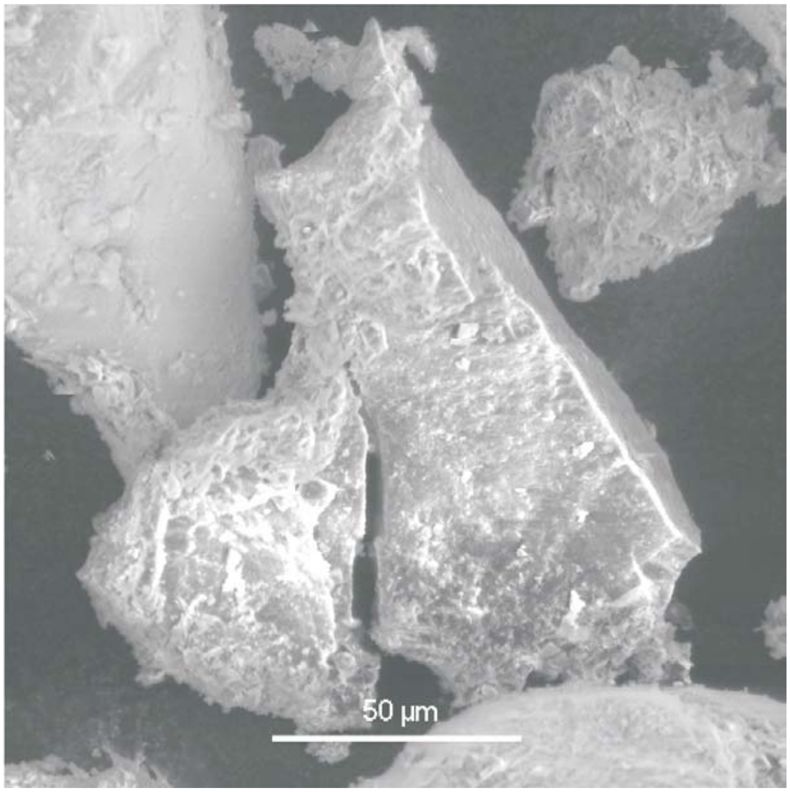
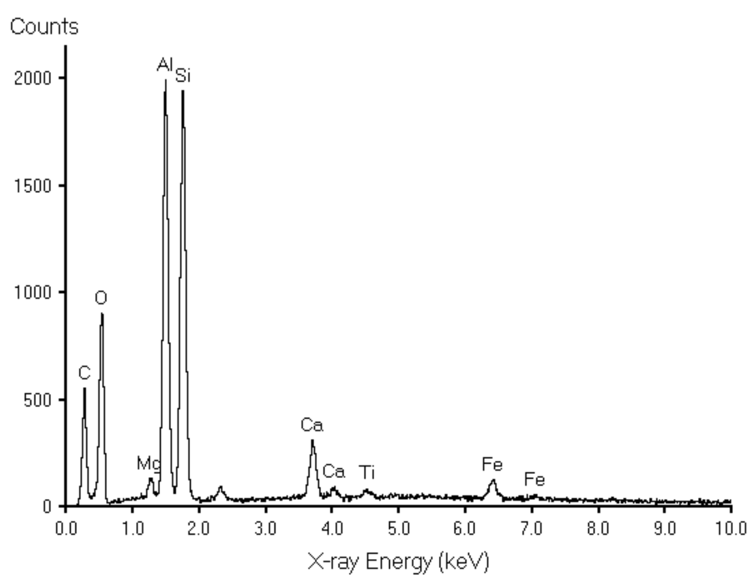


Figure 17: Possible augite crystal
Borehole SG98-48 32.40m-32.44m



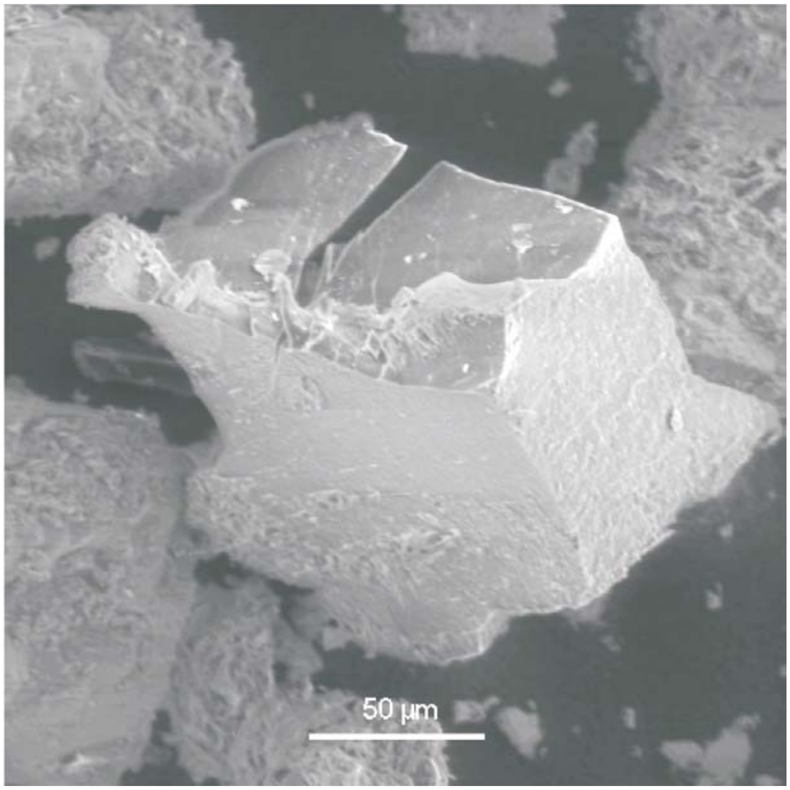
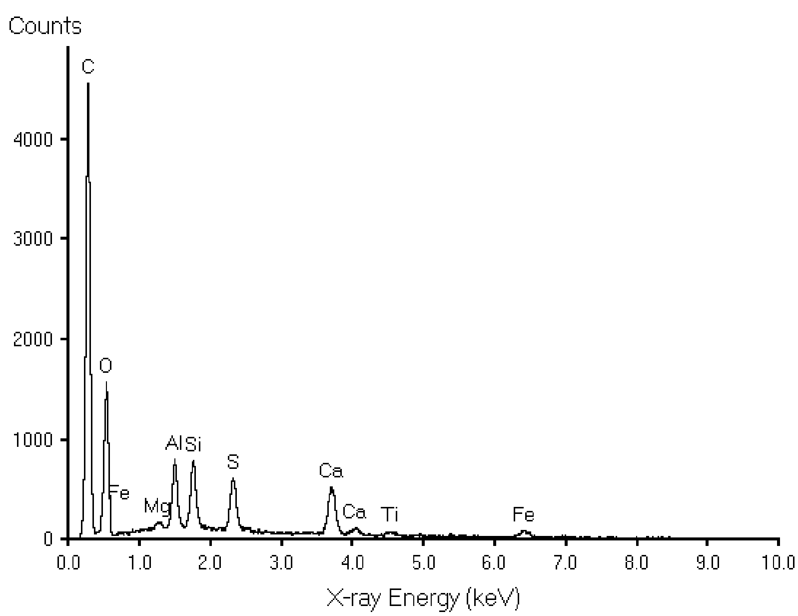


Figure 18: Mostly carbon, possible resinous plant material
Borehole SG98-48 32.40m-32.44m



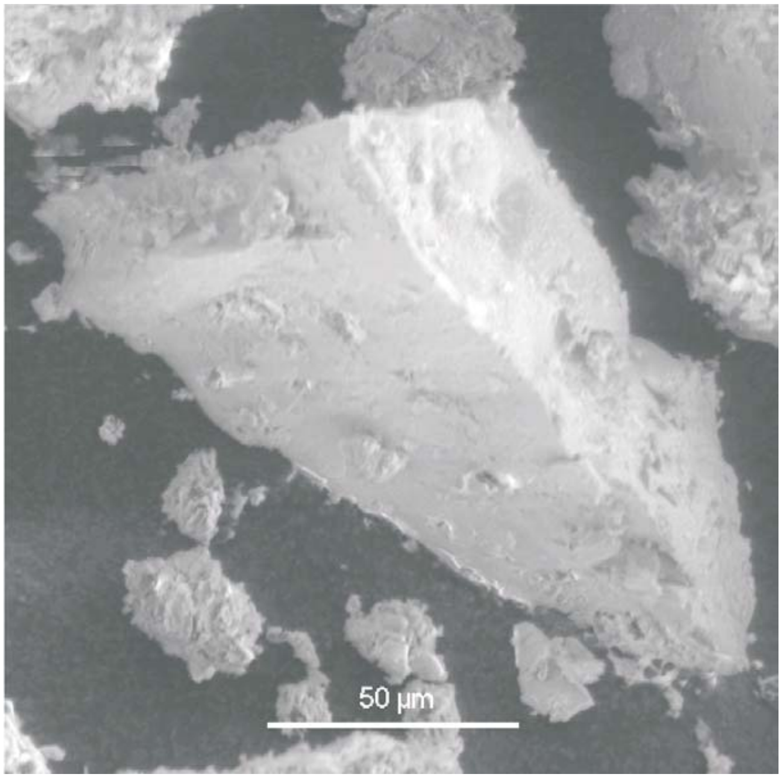
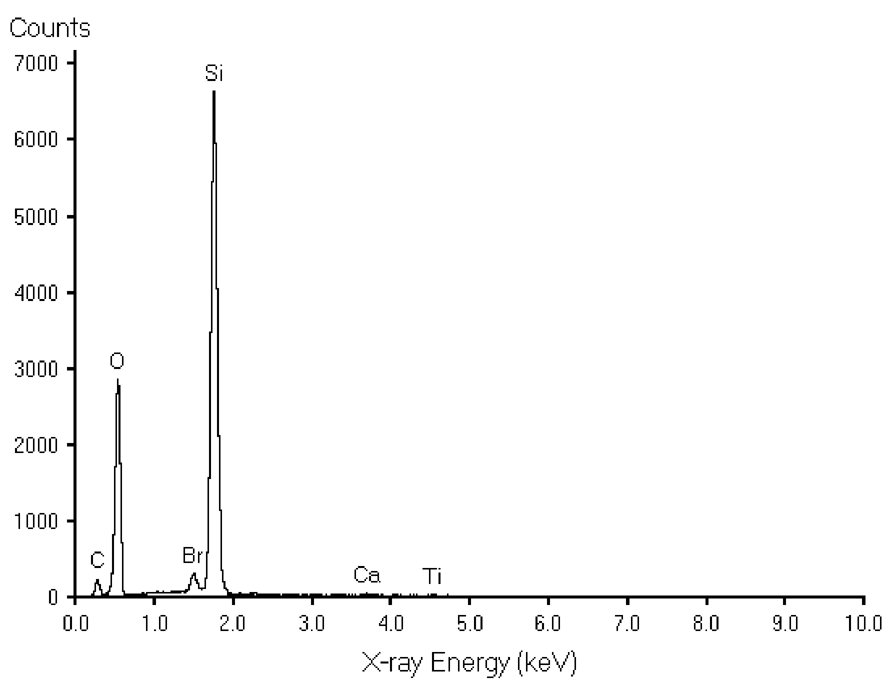


Figure 19: Blocky quartz grain
Borehole SG98-48 32.40m-32.44m



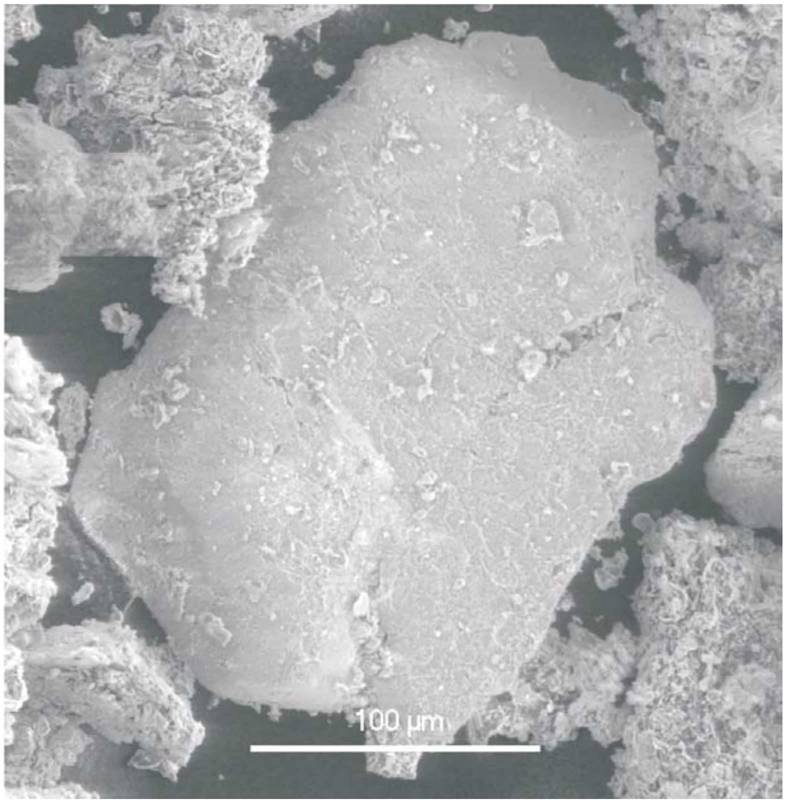
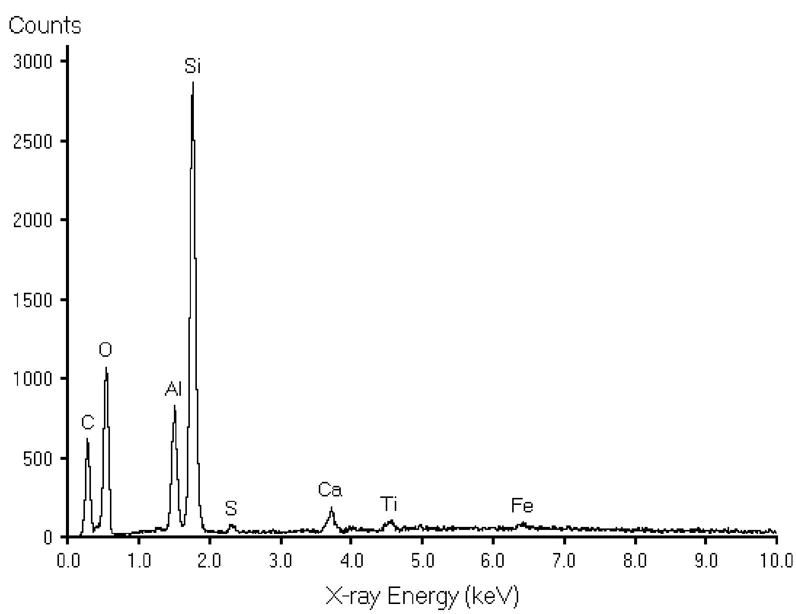


Figure 20: Corroded, dirty quartz grain
Borehole SG98-48 32.40m-32.44m



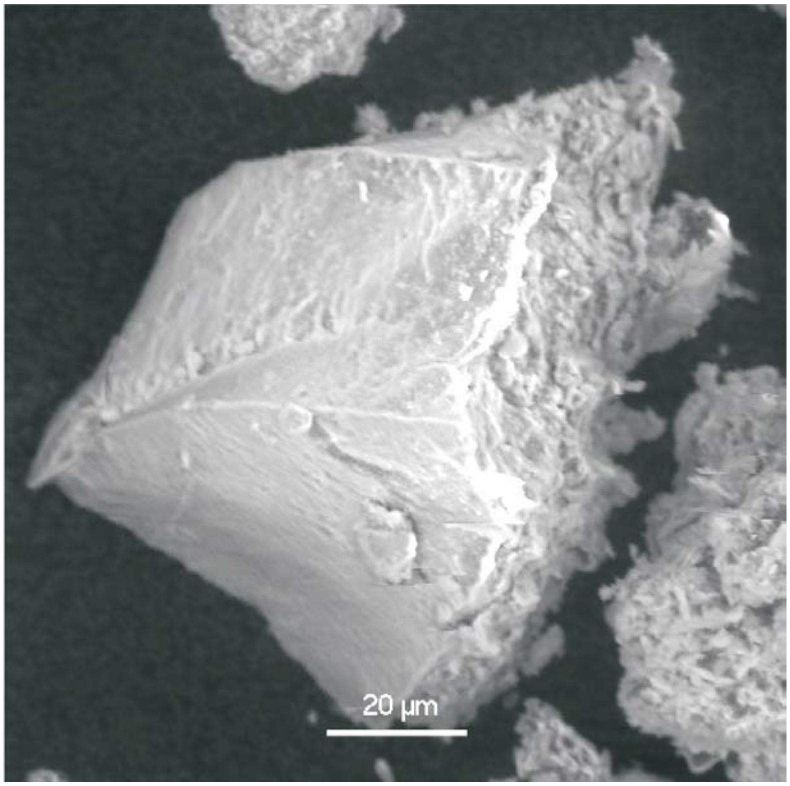
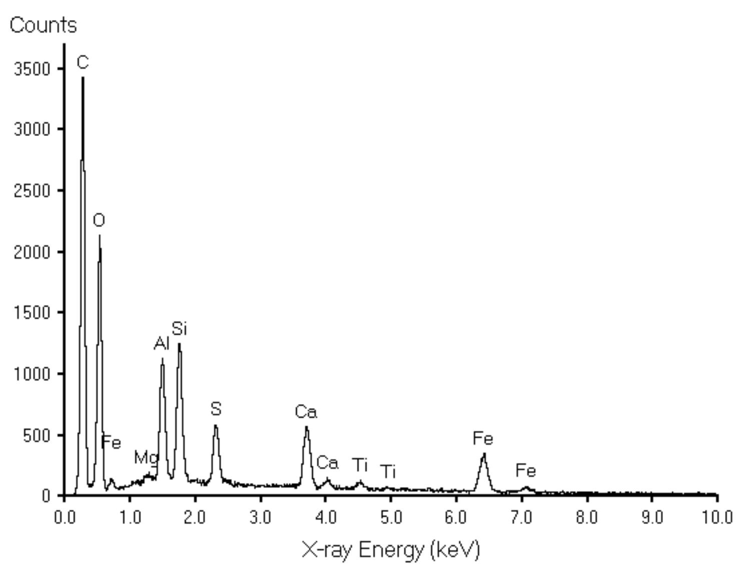


Figure 21: Mostly carbon, possible resinous plant material
Borehole SG98-48 32.40m-32.44m



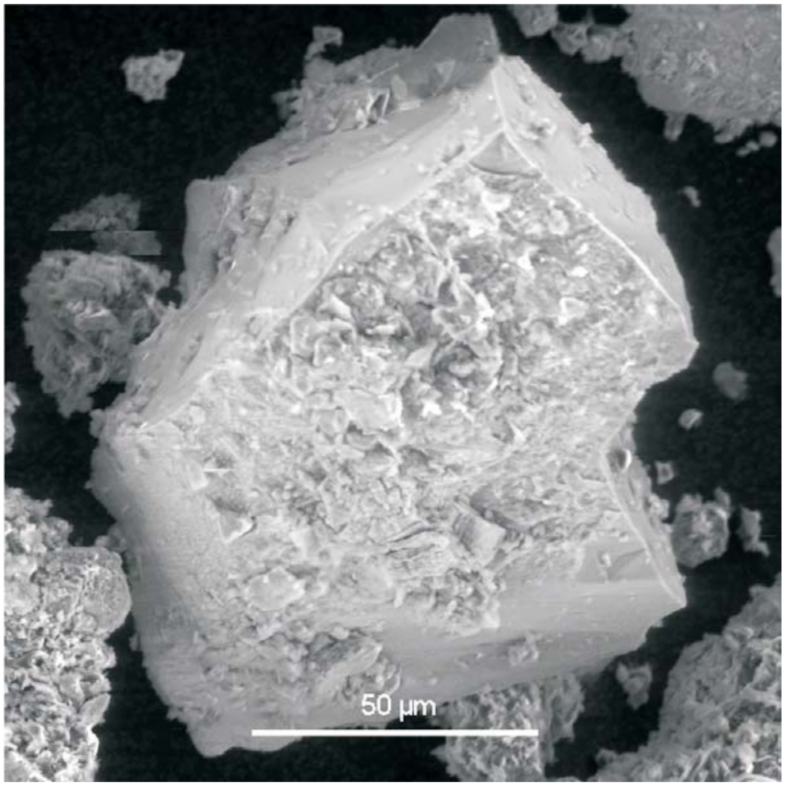
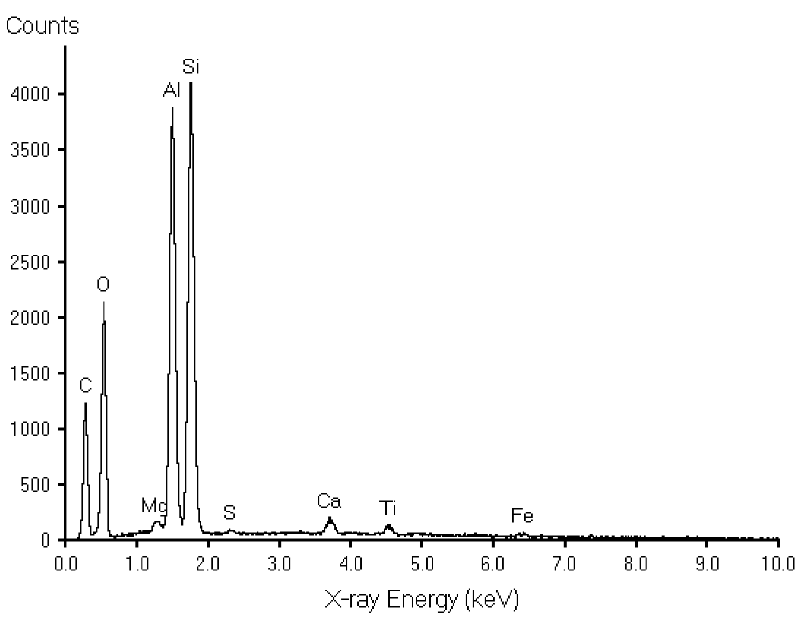


Figure 22: Blocky kaolinite (?kaolinite after feldspar)
Borehole SG98-48 32.40m-32.44m



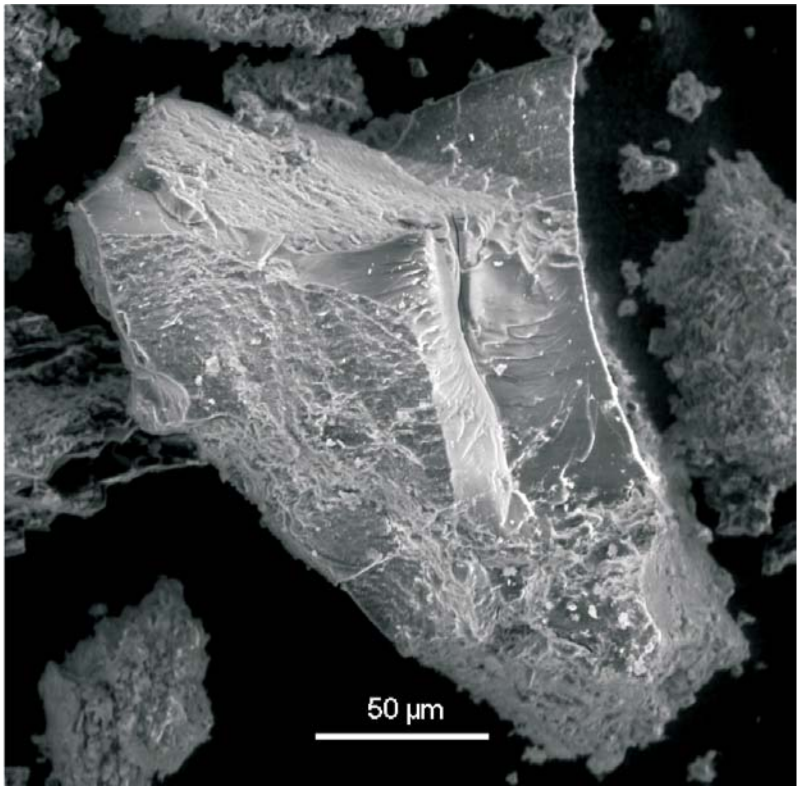
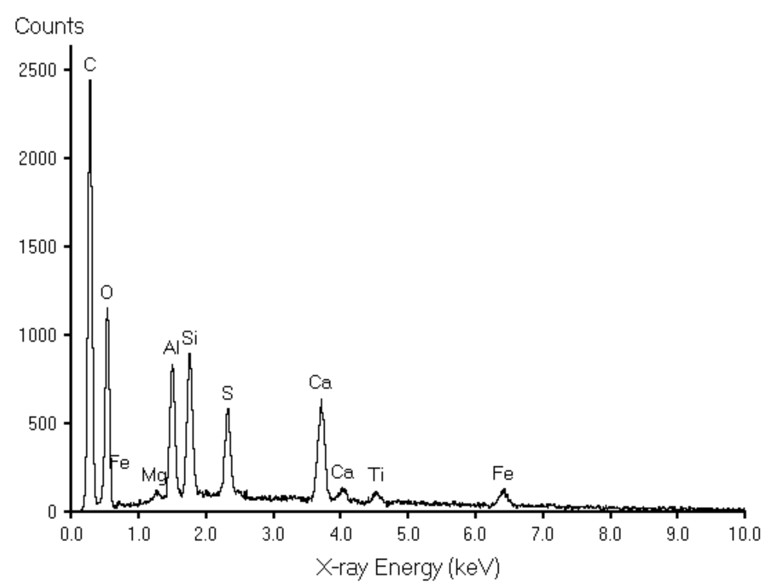


Figure 23: Blocky high carbon grain with curved face
Borehole SG98-48 32.40m-32.44m



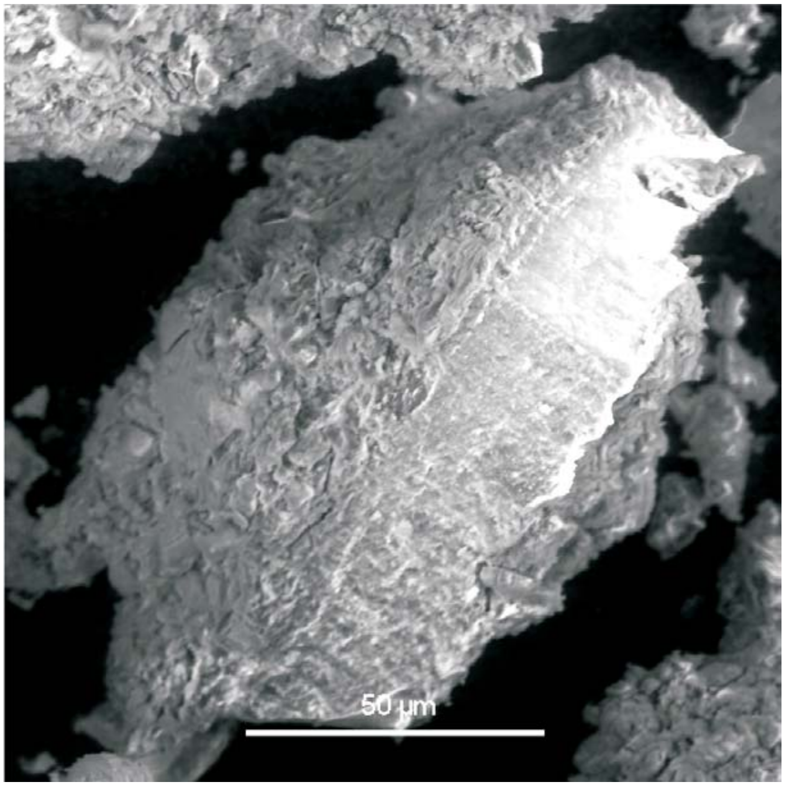
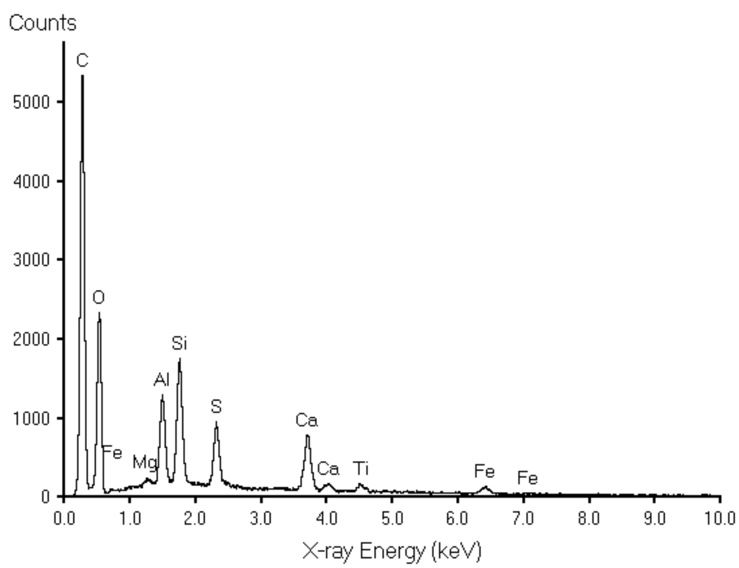


Figure 24: Blocky high carbon grain with curved face, geological contact with clayey aggregate.
Borehole SG98-48 32.40m-32.44m



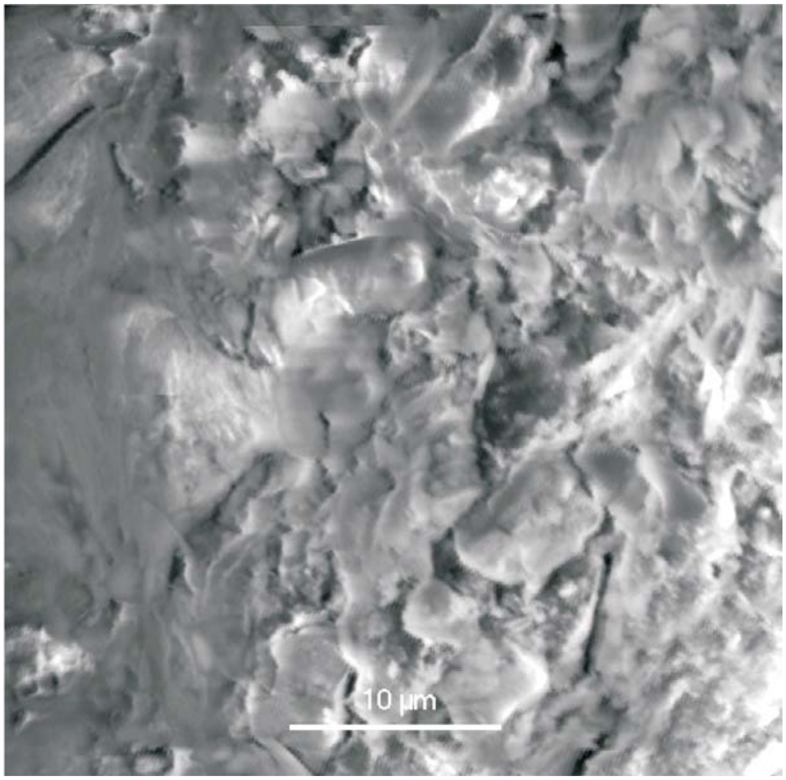
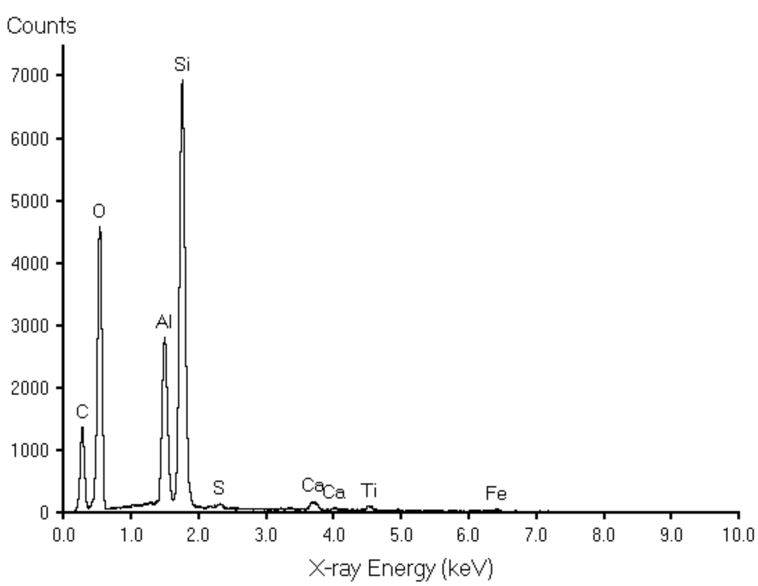


Figure 25: Corroded quartz grain with adhering kaolinite
Borehole SG98-48 32.40m-32.44m



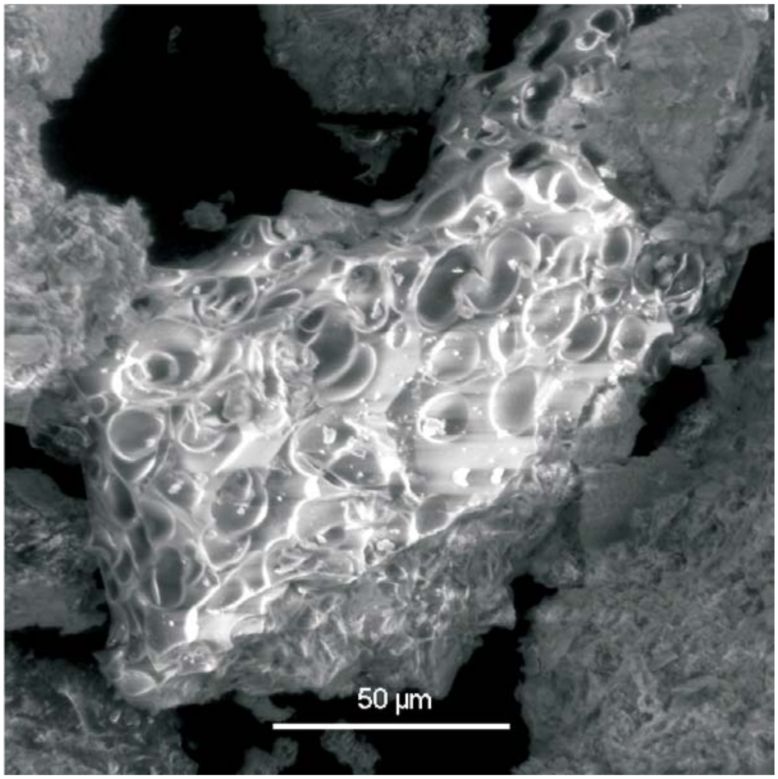
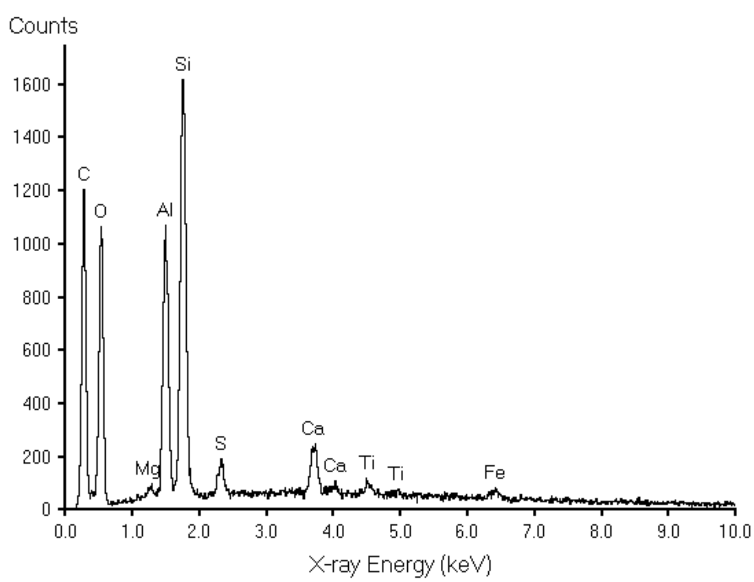


Figure 26: Grain with high carbon, silicon and aluminum: might be bubbly resin with kaolinite in pores, or pumice with calcite alteration
Borehole SG98-48 32.40m-32.44m



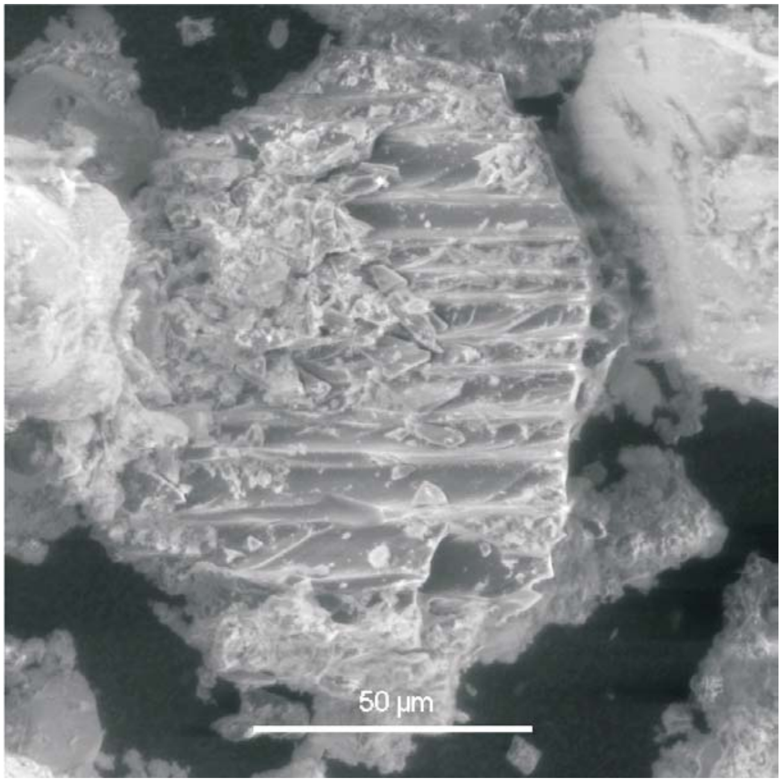
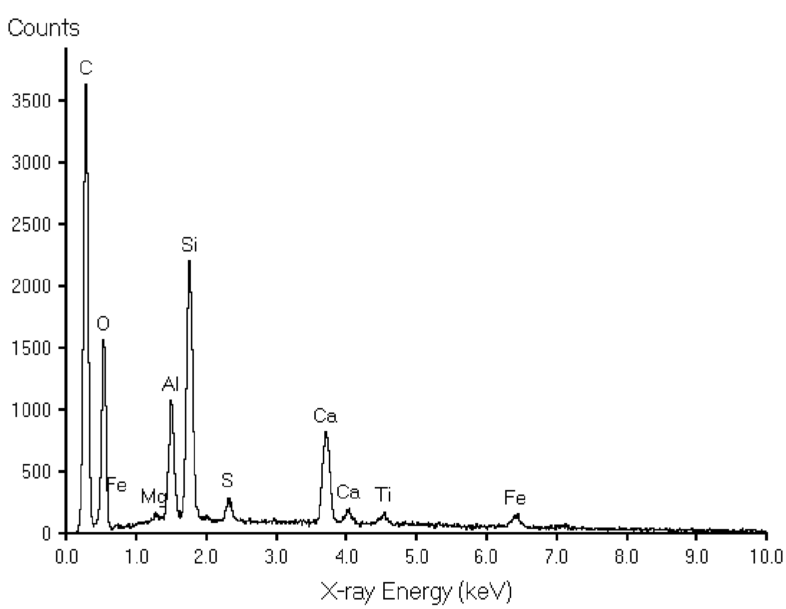


Figure 27: Woody material
Borehole SG98-48 32.40m-32.44m



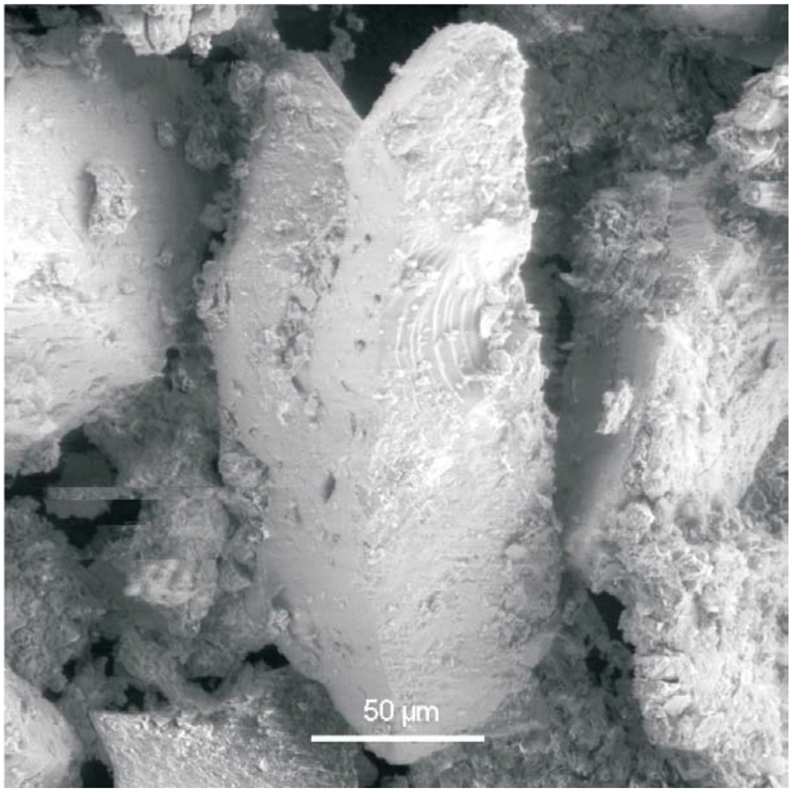
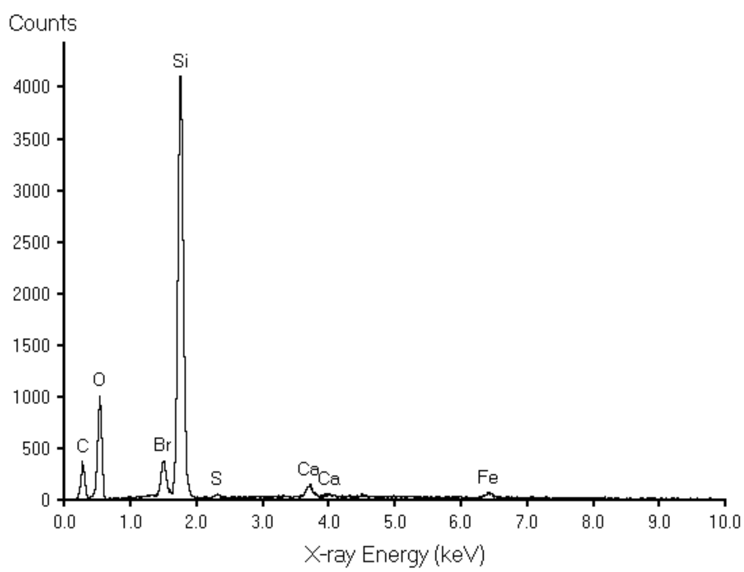
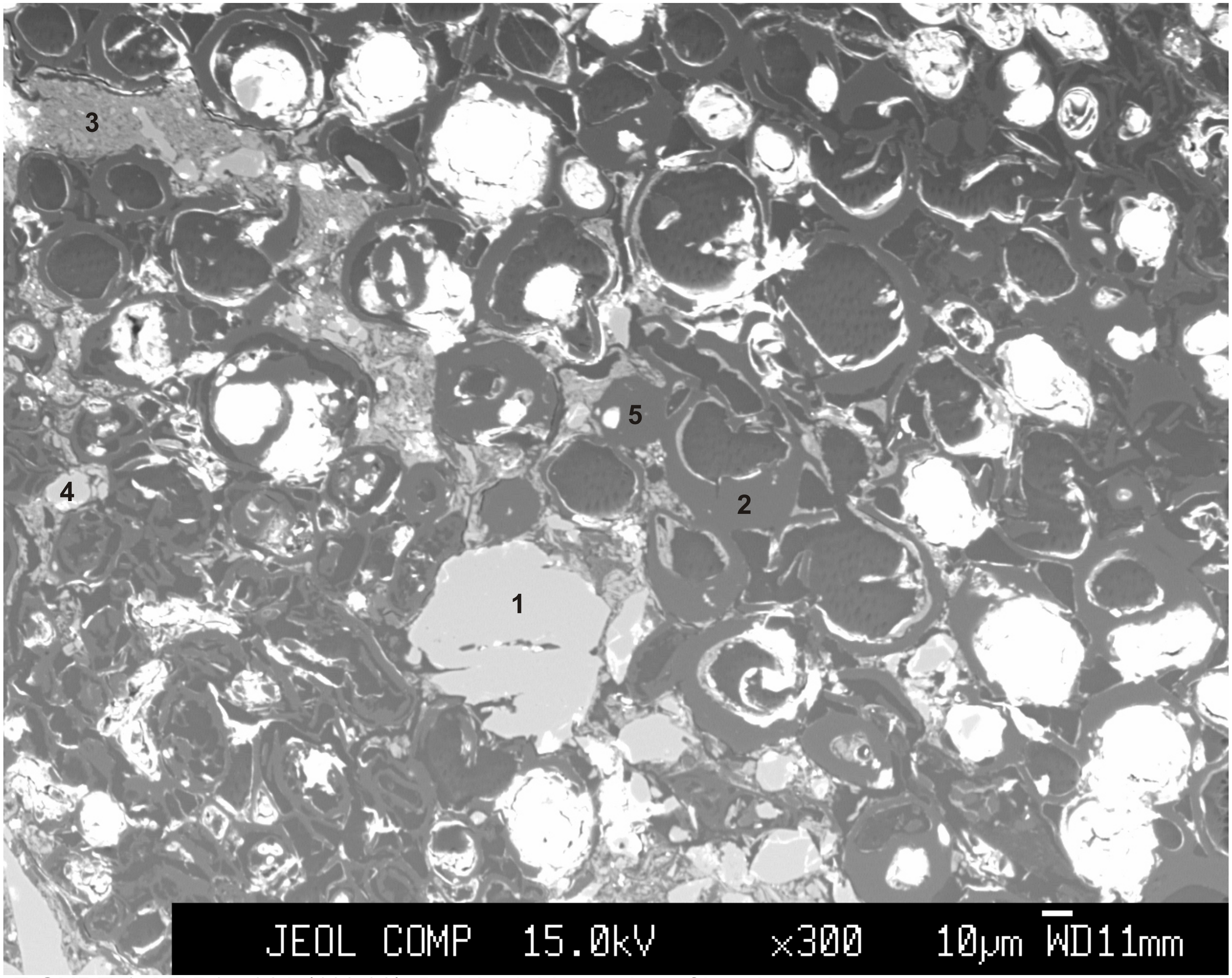


Figure 28: Twinned quartz with euhedral terminations and a conchodal fracture
Borehole SG98-48 32.40m-32.44m

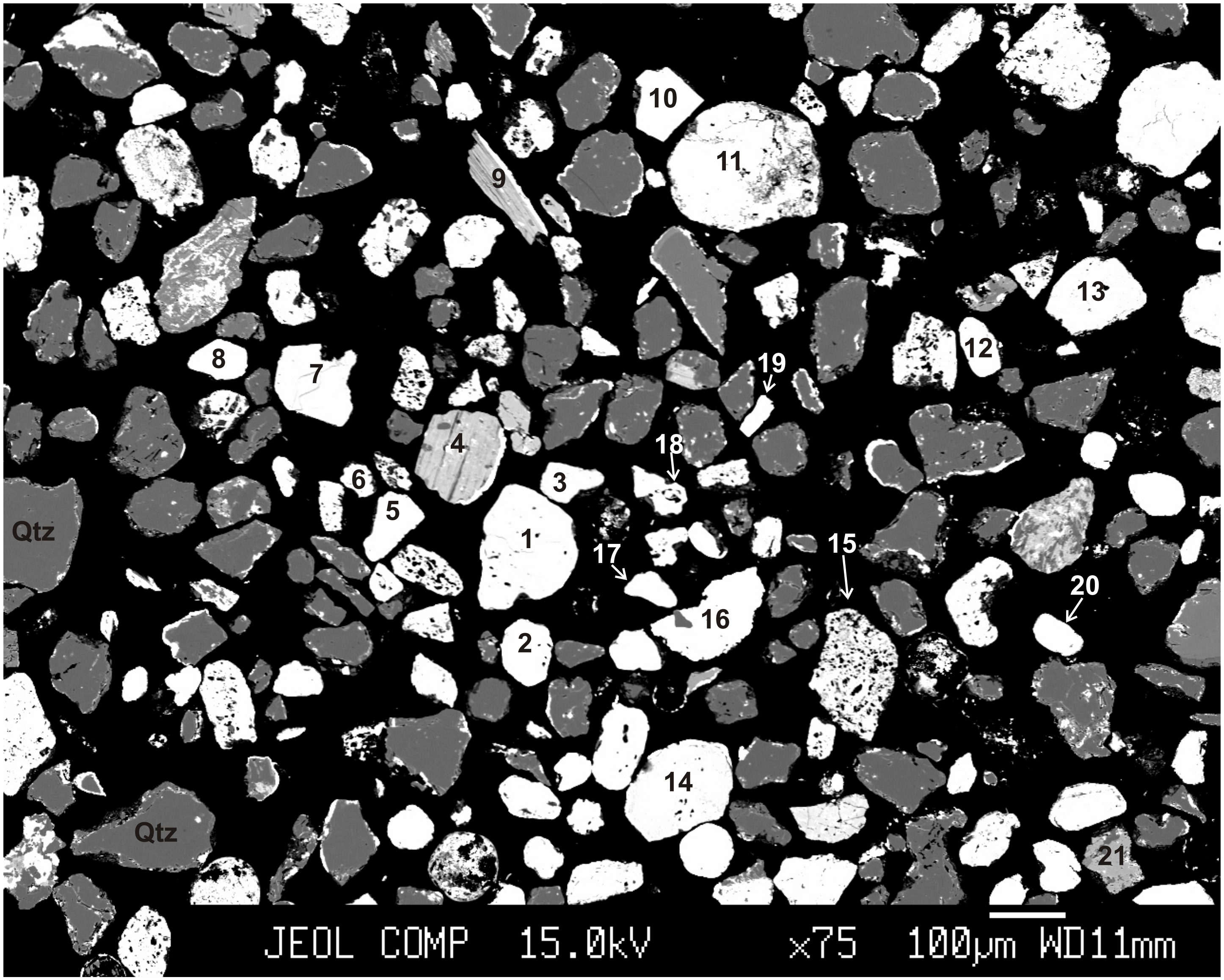


APPENDIX 2
Back-scattered electron (BSE) images and mineral identification from lignite and associated mudstone samples



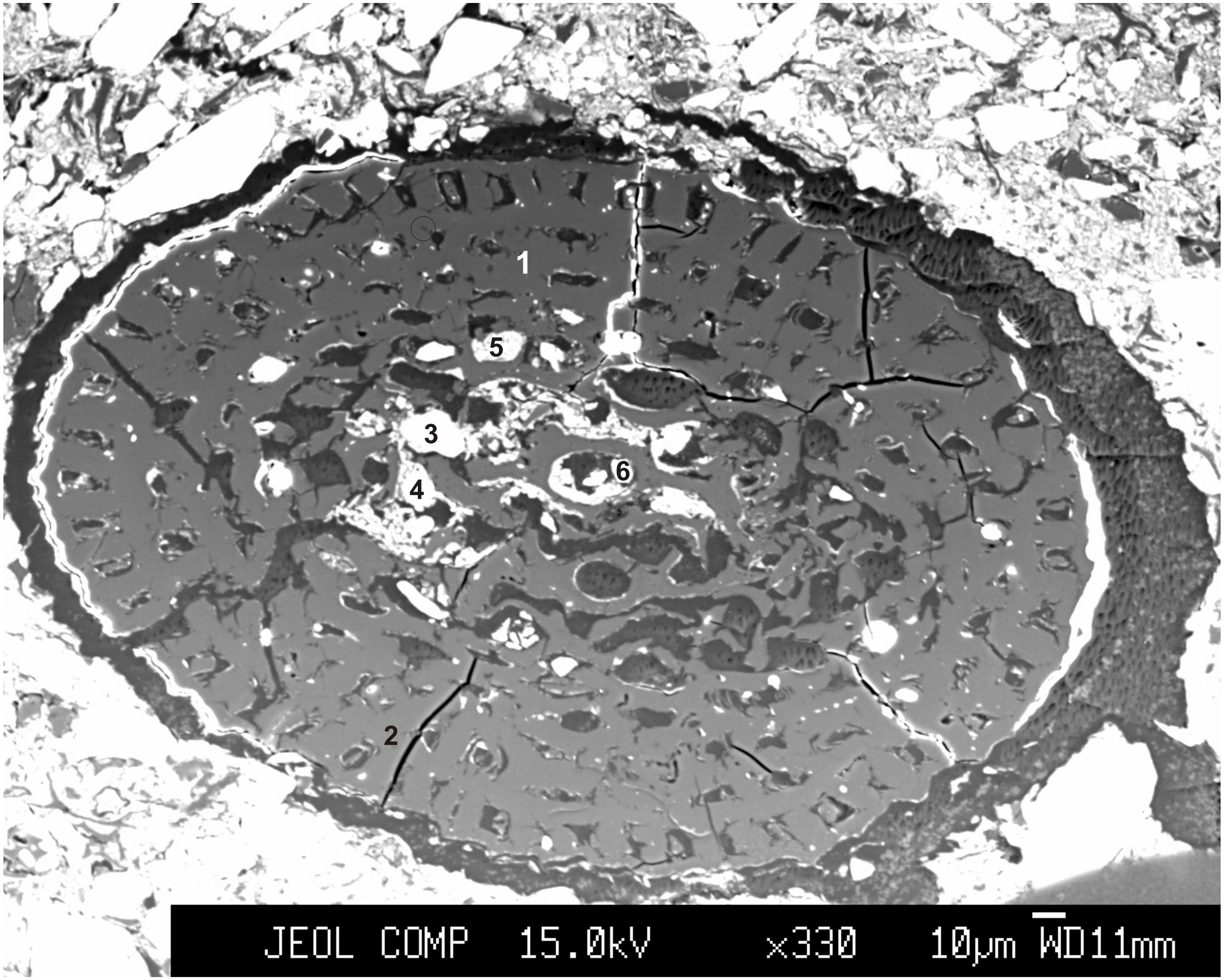
1. Quartz
2. ? Wood
3. ? Kaolinite + TiO_2
4. Quartz
5. ? Wood

FIGURE 1: MBR97-32A (116.80). Polished thin section of hand specimen



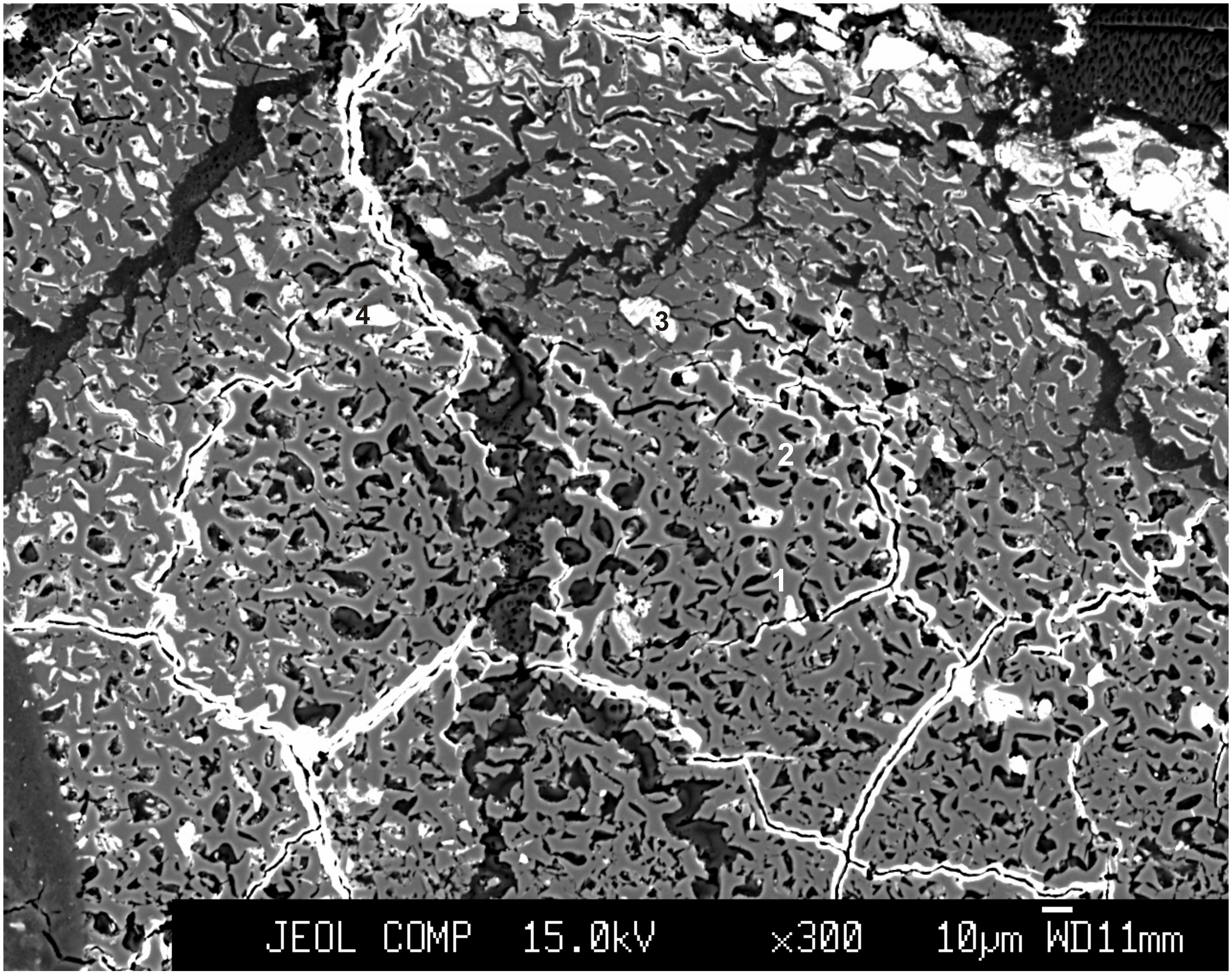
1. Ilmenite
2. Zircon
3. Ilmenite
4. Biotite
5. Ilmenite
6. Ilmenite
7. Ilmenite
8. Zircon
9. Biotite
10. Ilmenite
11. Pyrite
12. Ilmenite
13. Ilmenite
14. Ilmenite
15. Ilmenite
16. Pyrite
17. Zircon
18. Ilmenite
19. Zircon
20. Ilmenite
21. Ankerite

FIGURE 2: MRB97-32A (121.17m). Polished thin section of heavy mineral separate



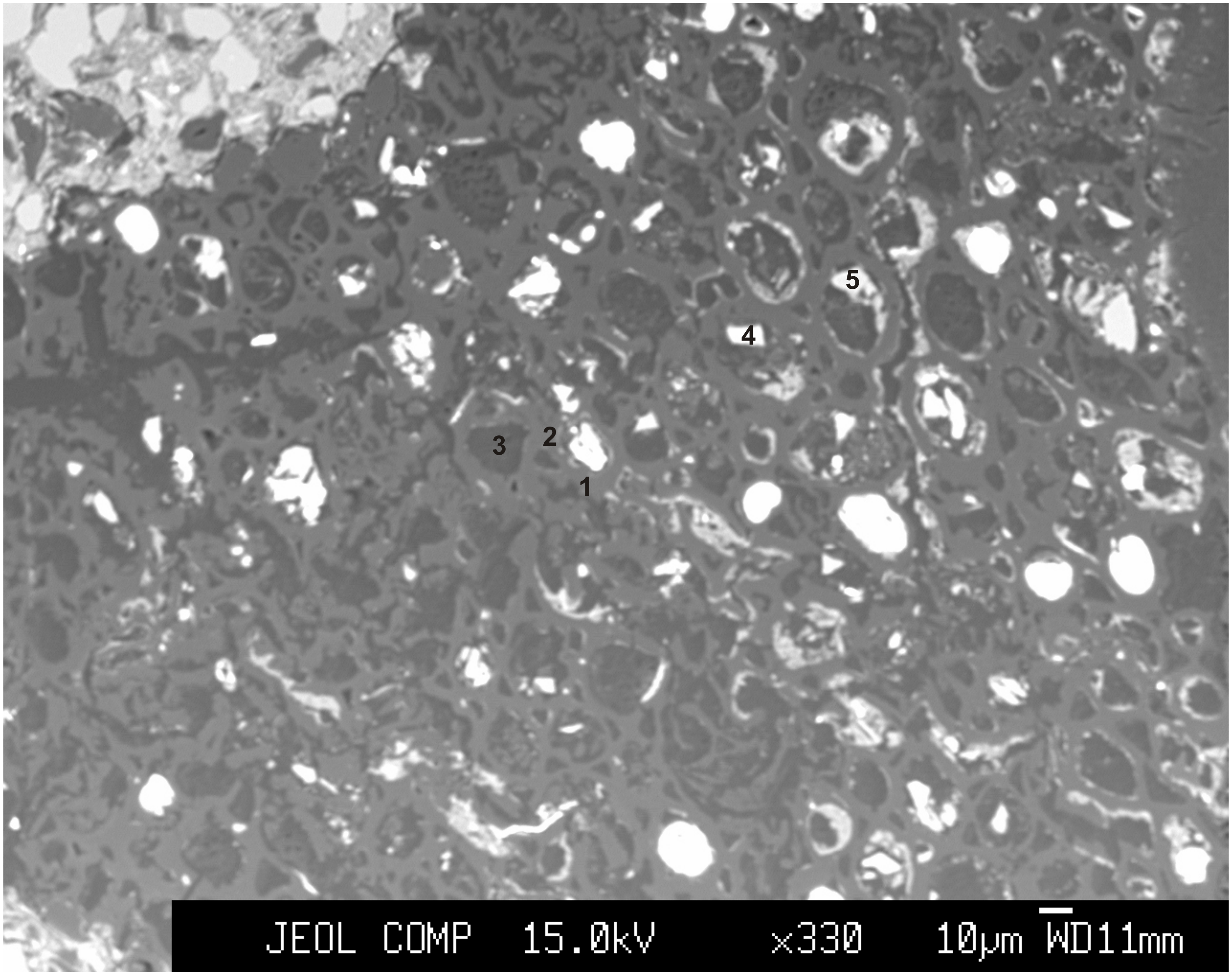
1. Wood
2. Wood
3. Quartz
4. Quartz
5. ? Kaolinite
6. Si chip from polishing

FIGURE 3: MRB97-32A (121.17m). Polished thin section of hand specimen



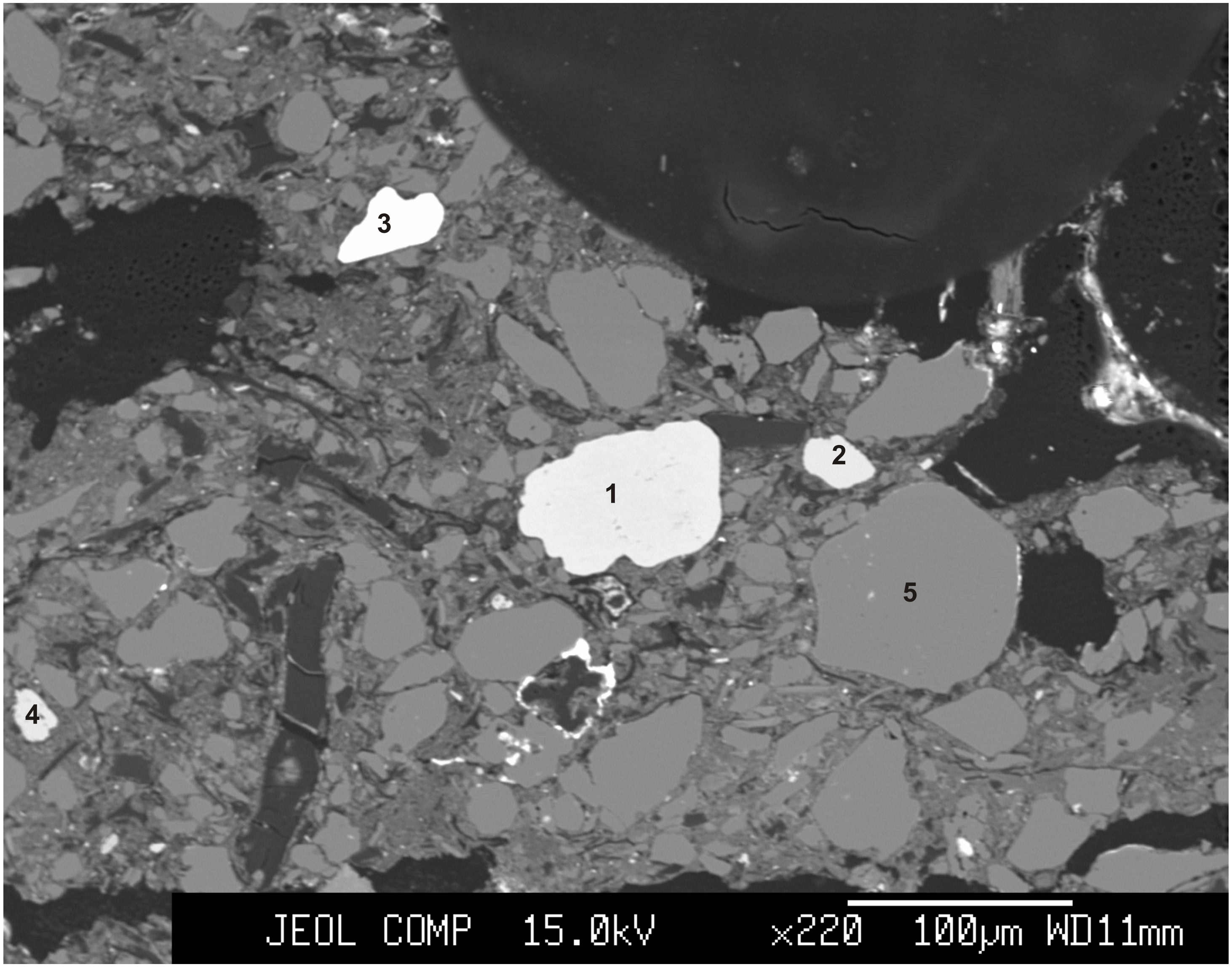
1. ? Wood
2. ? Wood
3. Kaolinite
4. Quartz

FIGURE 4: MBR97-32A (121.17m). Polished thin section of hand specimen



1. Wood
2. Wood
3. Wood
4. Quartz
5. Quartz

FIGURE 5: MBR97-32A (121.17m). Polished thin section of hand specimen



1. Rutile
2. Rutile
3. Zircon
4. Rutile
5. Quartz

FIGURE 6: MBR97-32A (121.17). Polished thin section of hand specimen

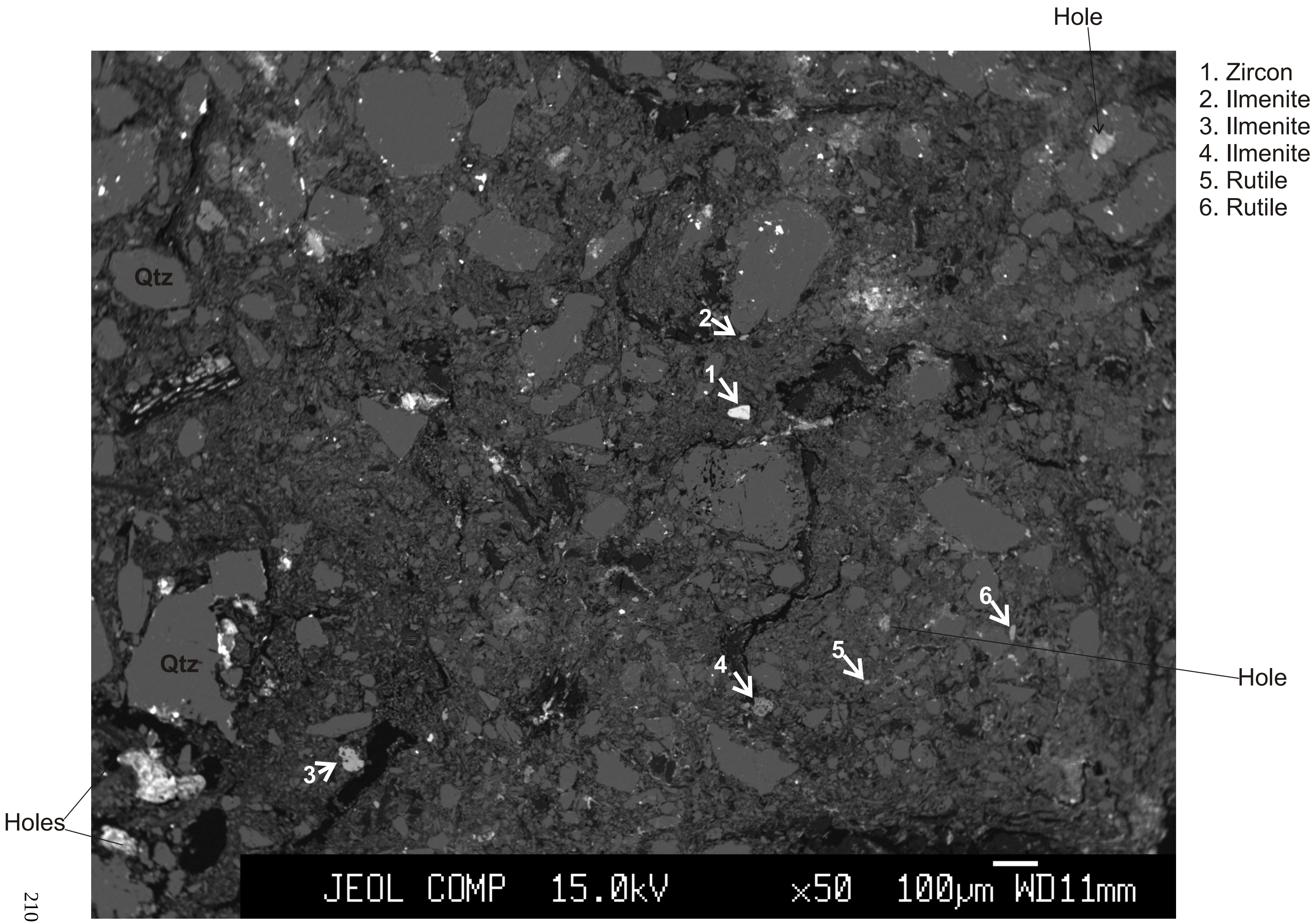
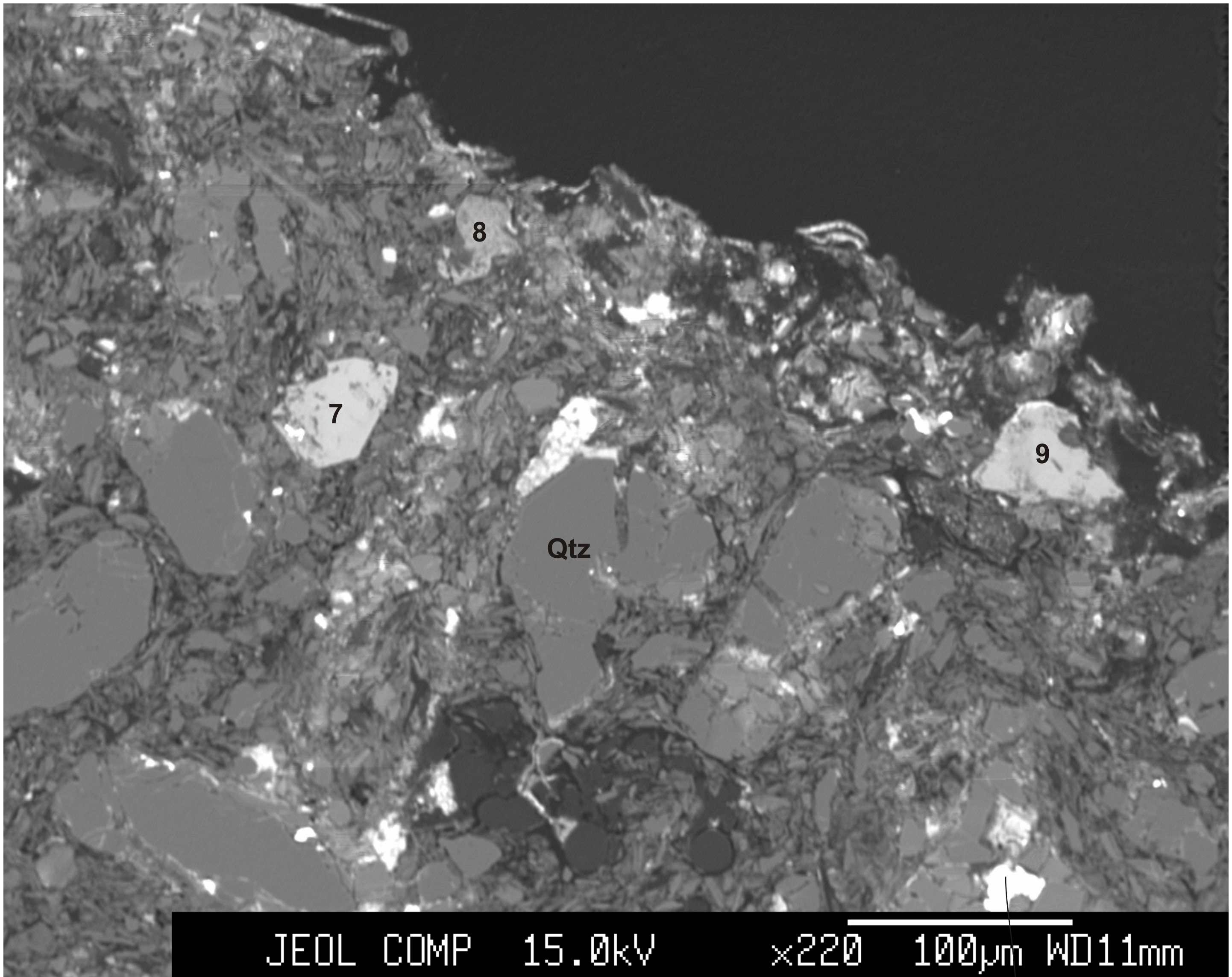
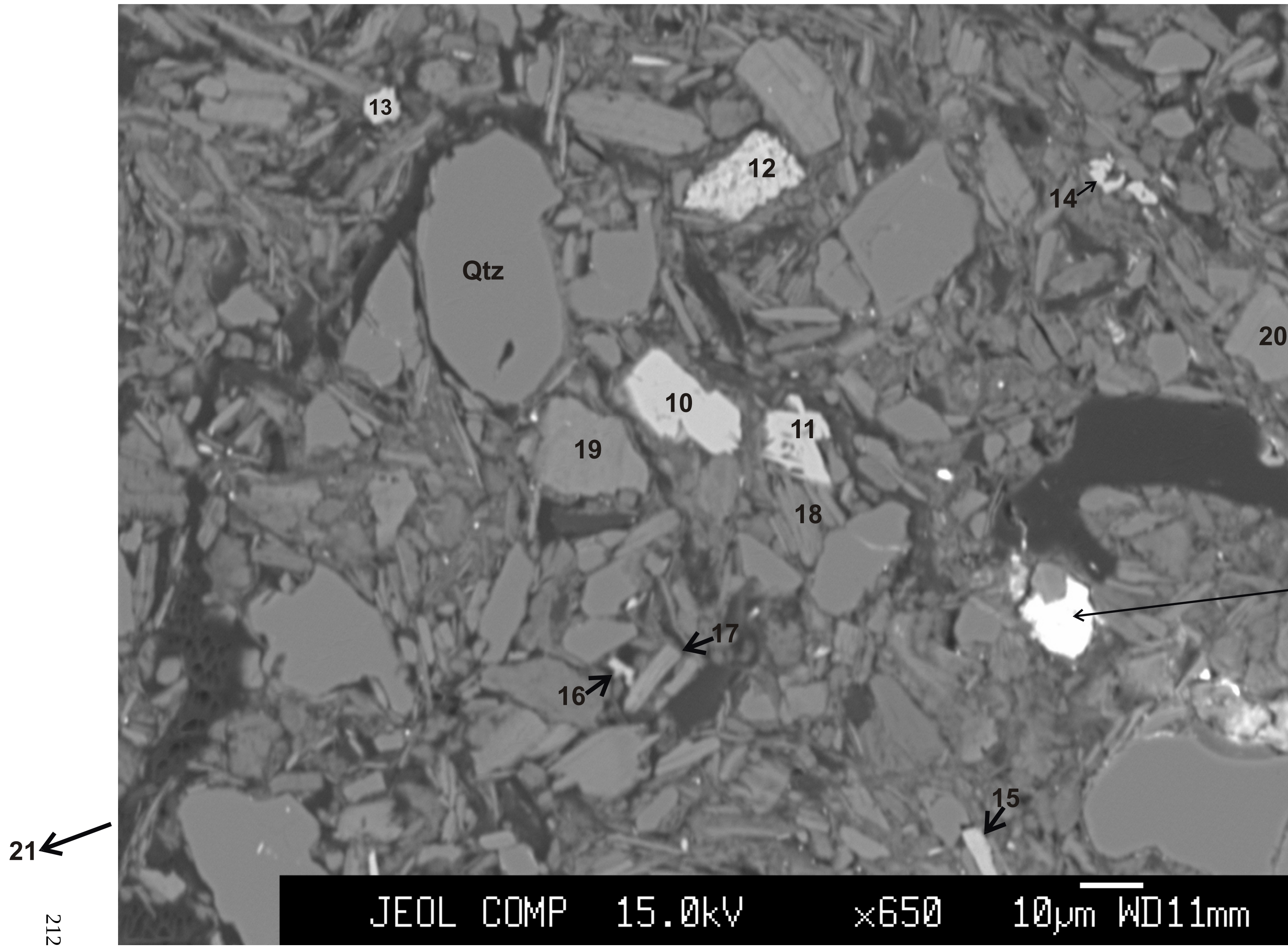


FIGURE 7: CH97-10B (62.42-62.49m). Polished thin section of hand specimen



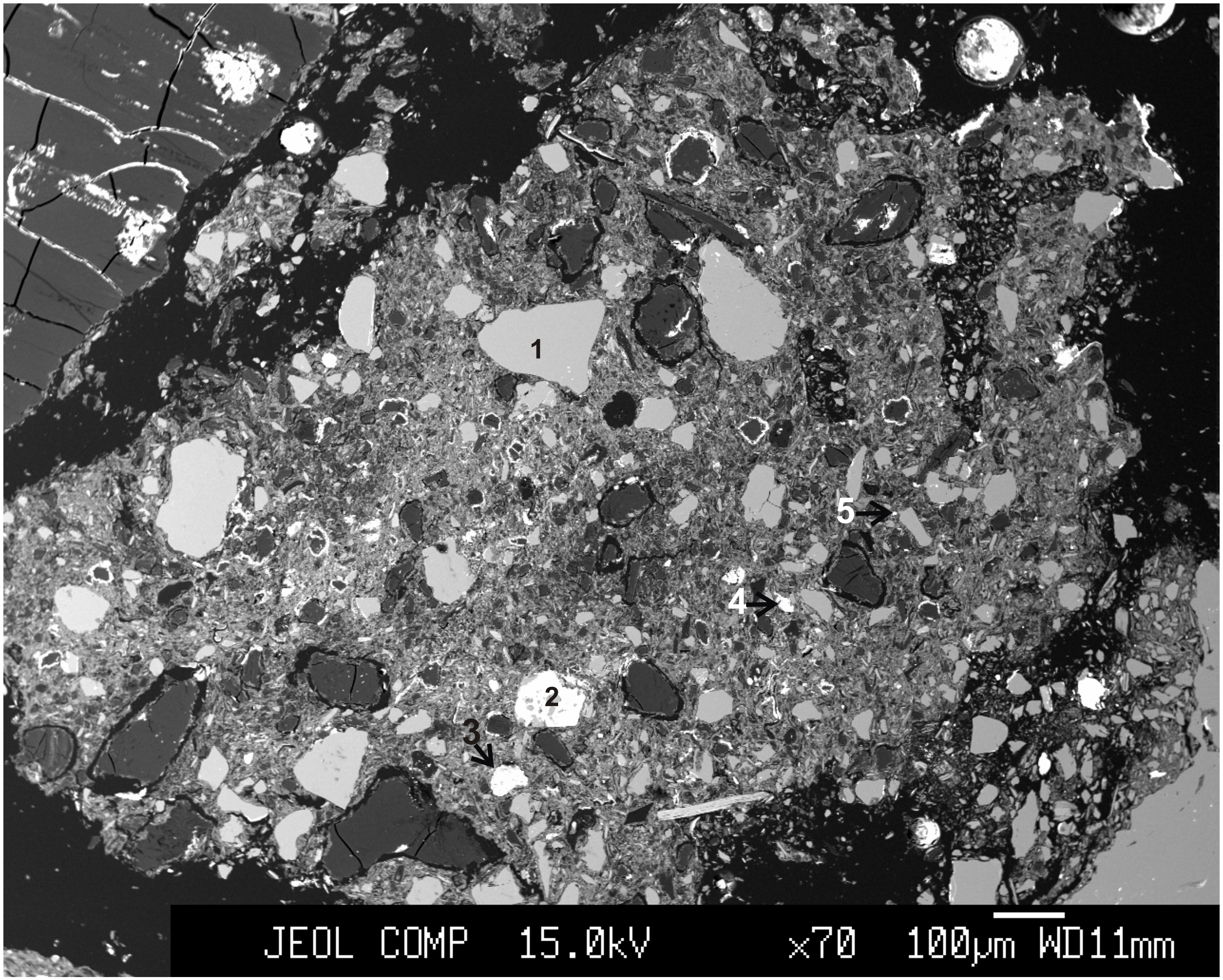
7. Ilmenite
8. Ilmenite
9. Ilmenite

FIGURE 8: CH97-10B (62.42-62.49m). Polished thin section of hand specimen



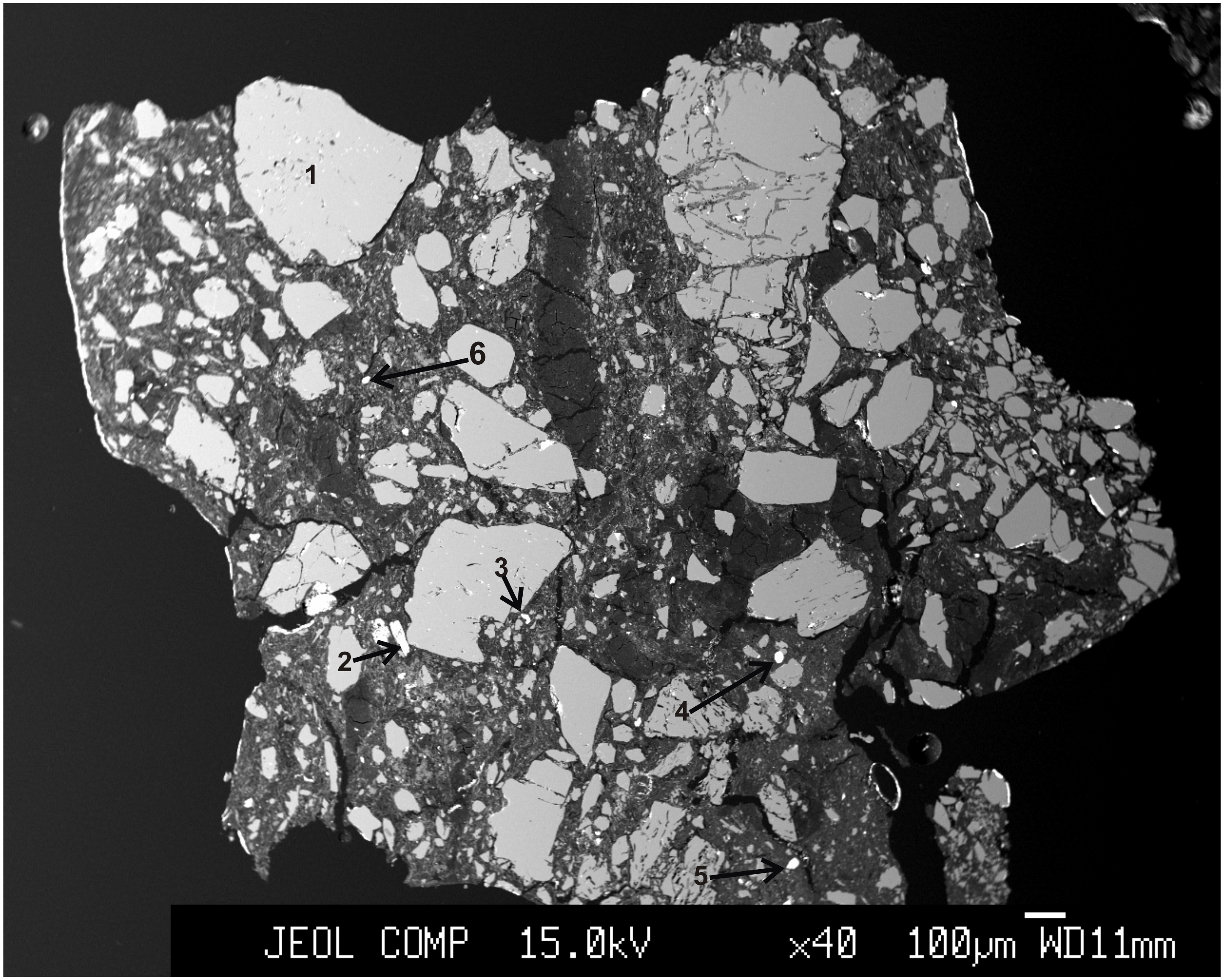
10. Rutile
11. Rutile
12. Ilmenite
13. Rutile
14. Ilmenite
15. Ilmenite
16. ?
17. Muscovite lillite
18. Muscovite lillite
19. Muscovite
20. Muscovite
21. Muscovite

FIGURE9: CH97-10B (62.42-62.49m). Polished thin section of hand specimen



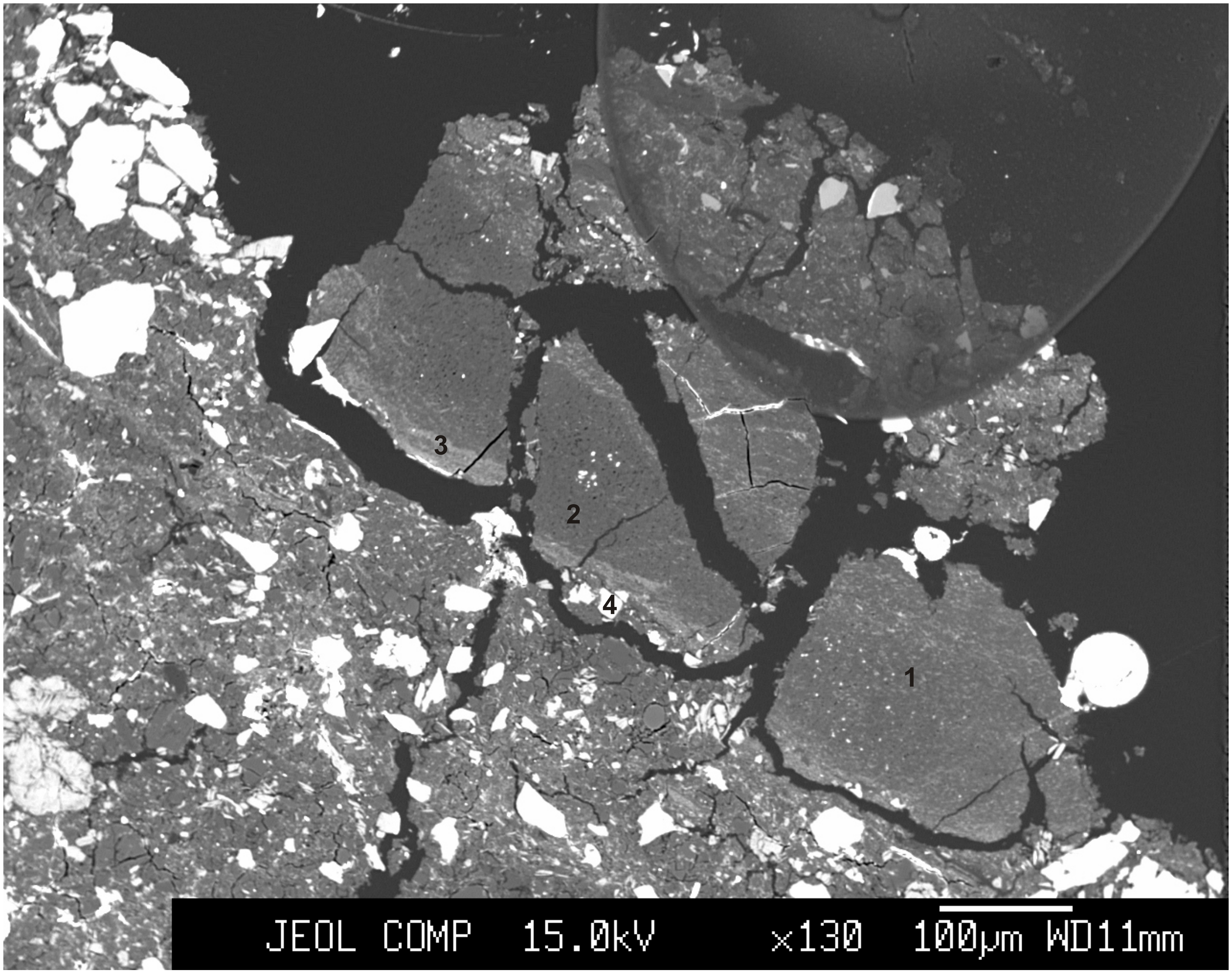
1. Quartz
2. Rutile
3. Ilmenite
4. Rutile
5. Rutile

FIGURE 10: CH97-9 (48.19-48.23m). Polished thin section of hand specimen



1. Quartz
2. Rutile
3. Ilmenite
4. Zircon
5. Ilmenite
6. Rutile

FIGURE 11: SG98-48 (32.40-32.44m). Polished thin section of hand specimen



1. ? Wood
2. Wood
3. ?? Kaolinite
4. Quartz

FIGURE 12: SG98-48 (32.40-32.44m). Polished thin section of hand specimen

APPENDIX 3
Peak areas of minerals measured by X-ray diffraction (XRD)

A: XRD PEAK AREAS FOR UNASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
UNASHED LIG.	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 103.30UA	31.544	32.286	4.56	5.6	31.842	3.2608	Rutile	59.1	54.1	0.153	31.857	0.213	31.815	3.26356	15.24	11.53
MBR-97-32A 103.30UA	35.917	36.546	12.4	6.57	36.181	2.88064	Alunite	42.1	32.1	0.096	36.169	0.069	36.282	2.87287	8.132	2.216
MBR-97-32A 103.30RR	6.565	7.602	0	0	7.043	14.56178	Vermiculite	97.5	97.5	0.717	7.042	0.65	7.059	14.52899	62.87	63.37
MBR-97-32A 103.30RR	13.162	14.827	0	0	14.104	7.28599	Kaolinite	357	357	0.671	14.052	0.801	14.002	7.33865	285.1	286.1
MBR-97-32A 107.42UA	23.678	24.23	98.7	60	23.935	4.31367	Quartz	298	218	0.216	23.926	0.212	23.931	4.31447	90.08	46.14
MBR-97-32A 107.42UA	33.473	34.198	26	2.73	33.748	3.08158	Jarosite	171	154	0.237	33.751	0.257	33.765	3.08005	50.1	39.6
MBR-97-32A 107.42UA	35.796	36.75	-2	3.73	36.081	2.88835	Alunite	126	126	0.158	36.126	0.195	36.109	2.88613	25.3	24.58
MBR-97-32A 107.42UA	41.581	42.138	14.4	17.4	41.883	2.50264	Hematite	63.1	47.1	0.29	41.859	0.285	41.881	2.50279	22.52	13.43
MBR-97-32A 107.42UA	38.563	39.177	12.2	8.63	38.813	2.69204	Marcasite	63.7	52.9	0.195	38.803	0.207	38.783	2.69408	17.47	10.98
MBR-97-32A 107.42RR	5.029	5.408	0	0	5.075	20.20234	Vermiculite	16.2	16.2	0.196	5.138	0.216	5.197	19.72926	3.448	3.494
MBR-97-32A 107.42RR	5.747	6.126	0	1.36	5.924	17.30887	Expandable	19.2	18.5	0.159	5.921	0.17	5.92	17.32123	3.486	3.159
MBR-97-32A 107.42RR	12.881	13.543	0	0	13.317	7.71419	Gypsum	260	260	0.241	13.304	0.284	13.284	7.73322	72.98	73.68
MBR-97-32A 107.42RR	13.643	14.666	0	0	14.117	7.27933	Kaolinite	279	279	0.461	14.121	0.527	14.114	7.28087	145.9	146.9
MBR-97-32A 108.66UA	23.639	24.428	44.1	8.05	23.998	4.30264	Quartz	237	209	0.233	24	0.262	23.992	4.30363	75.5	54.77
MBR-97-32A 108.66UA	33.493	34.299	39.7	7.05	33.807	3.07639	Jarosite	207	180	0.25	33.814	0.237	33.808	3.07623	61.91	42.79
MBR-97-32A 108.66UA	38.624	39.095	75	8.83	38.829	2.69101	Marcasite	111	64.8	0.273	38.815	0.256	38.819	2.69166	36.01	16.6
MBR-97-32A 108.66UA	42.759	43.692	22.1	17.7	43.296	2.42472	Pyrite	166	146	0.257	43.242	0.24	43.294	2.42482	54.03	35.19
MBR-97-32A 108.66RR	13.142	13.623	0	0	13.367	7.68586	Gypsum	169	169	0.27	13.365	0.274	13.367	7.68534	45.67	46.25
MBR-97-32A 108.66RR	13.864	14.546	0	0	14.245	7.21422	Kaolinite	93.8	93.8	0.515	14.162	0.49	14.182	7.24617	45.43	45.97
MBR-97-32A 108.87UA	24.112	25.316	105	17.8	24.576	4.20293	Quartz	145	73	0.581	24.728	0.597	24.73	4.17719	117.8	43.55
MBR-97-32A 108.87UA	31.564	32.045	8.38	4.24	31.868	3.25822	Rutile	43.1	37.3	0.215	31.845	0.206	31.838	3.26124	10.57	7.696
MBR-97-32A 108.87RR	6.904	7.303	0	0	7.027	14.59608	Vermiculite	16	16	0.368	7.105	0.288	7.105	14.43658	4.557	4.594
MBR-97-32A 108.87RR	13.362	14.927	0	0	14.152	7.2613	Kaolinite	698	698	0.503	14.134	0.621	14.112	7.28177	432.3	433.3
MBR-97-32A 109.24RR	6.505	7.602	0	0	6.958	14.74001	Vermiculite	62	62	0.486	6.969	0.53	7.008	14.63454	32.72	32.89
MBR-97-32A 109.24RR	9.939	10.319	0	0	10.055	10.20701	illite	25.3	25.3	0.172	10.086	0.192	10.125	10.13636	4.96	4.87
MBR-97-32A 109.24RR	13.302	14.907	0	0	14.126	7.27461	Kaolinite	571	571	0.563	14.1	0.693	14.078	7.29945	394.2	395.5
MBR-97-32A 110.78UA	31.644	32.206	15.4	11.5	31.797	3.26538	Rutile	58.3	44	0.137	31.835	0.198	31.893	3.2558	16.29	8.689
MBR-97-32A 110.78UA	38.073	38.951	18.4	12.5	38.378	2.72144	Marcasite	187	171	0.202	38.396	0.275	38.443	2.71697	60.43	46.96
MBR-97-32A 110.78UA	47.331	47.964	13.4	-0.91	47.499	2.22102	Pyrite	77	67.3	0.122	47.524	0.235	47.587	2.21713	19.62	15.79
MBR-97-32A 110.78RR	4.85	5.388	0	0	5.086	20.16095	Mixed layer	18.9	18.9	0.269	5.099	0.252	5.083	20.17217	4.774	4.765
MBR-97-32A 110.78RR	5.727	5.907	0	0	5.853	17.521	Expandable	11.7	11.7	0.085	5.835	0.092	5.804	17.66853	1.104	1.072
MBR-97-32A 110.78RR	13.683	14.566	0	0	14.113	7.28115	Kaolinite	256	256	0.577	14.086	0.55	14.103	7.28632	139.4	140.6
MBR-97-32A 111.10UA	38.481	39.033	21.6	5.54	38.718	2.69843	Hematite	47.2	32.5	0.173	38.724	0.195	38.733	2.69739	13.79	6.359
MBR-97-32A 111.10RR	5.747	6.086	0	0	5.905	17.36621	Expandable	11.6	11.6	0.097	5.921	0.118	5.9	17.37925	1.408	1.375
MBR-97-32A 111.10RR	7.163	7.562	0	0	7.266	14.11726	Vermiculite	24.9	24.9	0.069	7.278	0.13	7.324	14.0054	3.124	3.226
MBR-97-32A 111.10RR	13.643	14.907	0	0	14.211	7.23143	Kaolinite	212	212	0.631	14.174	0.664	14.195	7.23934	140.1	140.8
MBR-97-32A 111.36RR	5.249	5.807	0	0	5.543	18.4986	Expandable	16.1	16.1	0.259	5.563	0.282	5.545	18.49093	4.518	4.541
MBR-97-32A 111.36RR	7.203	7.363	0	0	7.274	14.10046	Vermiculite	17.3	17.3	0.065	7.28	0.058	7.275	14.09809	1.099	1.005
MBR-97-32A 111.36RR	13.282	14.807	0	0	14.118	7.27871	Kaolinite	316	316	0.637	14.083	0.797	14.04	7.31903	251	251.9
MBR-97-32A 111.66UA	29.086	29.585	154	28.6	29.213	3.54701	Anatase	179	57	0.263	29.306	0.298	29.303	3.53637	62.28	16.97
MBR-97-32A 111.66UA	31.604	32.166	8.47	4.44	31.865	3.25856	Rutile	55.4	48.8	0.198	31.796	0.192	31.799	3.26515	13.07	9.398
MBR-97-32A 111.66UA	12.34	15.289	0	0	14.08	7.29798	Kaolinite	328	328	0.66	14.03	0.897	13.92	7.38153	293.6	293.8
MBR-97-32A 112.06UA	31.564	32.166	5.04	-1.11	31.878	3.25722	Rutile	40.9	39.1	0.145	31.863	0.169	31.835	3.26153	7.879	6.627
MBR-97-32A 112.06RR	4.83	5.288	0	0	5.152	19.90134	Mixed layer	17.5	17.5	0.115	5.126	0.174	5.066	20.23937	3.049	3.046
MBR-97-32A 112.06RR	5.747	5.946	0	0	5.846	17.54077	Expandable	13.6	13.6	0.105	5.849	0.1	5.841	17.55647	1.376	1.362
MBR-97-32A 112.06RR	13.563	15.068	0	0	14.155	7.25992	Kaolinite	386	386	0.598	14.144	0.686	14.16	7.25732	263.8	265

A: XRD PEAK AREAS FOR UNASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
UNASHED LIG.	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 114.31UA	23.523	24.529	94.3	19.1	23.921	4.31624	Quartz	960	895	0.197	23.924	0.226	23.906	4.31883	259.8	202.7
MBR-97-32A 114.31UA	33.318	34.064	6.84	-4.43	33.661	3.0893	Jarosite	77.3	75.7	0.102	33.628	0.185	33.64	3.09119	14.98	14
MBR-97-32A 114.31UA	35.783	36.391	9.48	-4.56	35.928	2.90022	Alunite	44	37.9	0.192	35.971	0.28	36.059	2.89007	12.14	10.61
MBR-97-32A 114.31RR	5.807	6.006	0	0	5.885	17.42584	Expandable	16	16	0.083	5.887	0.097	5.896	17.3925	1.54	1.554
MBR-97-32A 114.31RR	13.041	13.583	0	0	13.355	7.69265	Gypsum	115	115	0.343	13.359	0.326	13.341	7.70062	36.79	37.41
MBR-97-32A 114.31RR	13.723	14.626	0	0	14.132	7.27149	Kaolinite	154	154	n.a.	n.a.	0.598	14.138	7.26864	91.13	92.19
MBR-97-32A 121.15UA	31.544	32.226	13.7	3.23	31.865	3.25856	Rutile	66.3	57.5	0.267	31.904	0.267	31.891	3.25598	21.35	15.37
MBR-97-32A 121.15RR	5.687	6.345	0	0	6.039	16.98224	Expandable	18.6	18.6	0.38	6.042	0.335	6.011	17.06083	6.229	6.235
MBR-97-32A 121.15RR	13.563	14.706	0	0	14.245	7.21422	Kaolinite	202	202	0.738	14.1	0.727	14.108	7.28365	145.9	146.9
MBR-97-32A 121.17UA	23.737	24.408	69.4	51.1	24.116	4.28192	Quartz	778	719	0.205	24.113	0.228	24.1	4.2847	204.4	163.8
MBR-97-32A 121.17UA	31.564	32.126	13.9	5.74	31.836	3.26148	Rutile	90.4	80.5	0.199	31.826	0.219	31.839	3.26109	23.16	17.6
MBR-97-32A 121.17RR	5.388	6.345	0	0	5.827	17.59893	Expandable	21.8	21.8	0.767	5.851	0.696	5.854	17.51827	15.14	15.19
MBR-97-32A 121.17RR	13.523	14.526	0	0	14.044	7.31677	Kaolinite	251	251	0.704	14.058	0.675	14.038	7.32017	168.2	169.8
MBR-97-32A 121.66UA	23.797	24.526	70.6	33.5	24.13	4.2794	Quartz	795	741	0.194	24.129	0.217	24.121	4.28088	198.3	160.5
MBR-97-32A 121.66UA	31.584	32.146	18.4	8.66	31.842	3.2608	Rutile	118	104	0.191	31.841	0.2	31.84	3.26106	28.38	20.84
MBR-97-32A 121.66RR	5.787	6.305	0	0	5.964	17.19357	Expandable	17.6	17.6	0.289	6.028	0.247	6.004	17.08075	4.356	4.34
MBR-97-32A 121.66RR	13.322	15.008	0	0	14.113	7.28099	Kaolinite	235	235	0.653	14.059	0.779	14.077	7.29958	182.3	183
MBR-97-32A 121.66RR	9.939	10.119	0	0	10.054	10.20819	illite	24.3	24.3	n.a.	n.a.	0.109	10.029	10.23378	2.49	2.649
MBR-97-32A 137.25UA	23.816	24.664	14.9	6.7	24.138	4.27798	Quartz	488	476	0.21	24.14	0.24	24.124	4.28037	123.6	114.6
MBR-97-32A 137.25UA	32.065	32.547	4.07	0.92	32.327	3.21314	? Rutile	43	40.6	0.146	32.314	0.181	32.326	3.21332	8.612	7.369
MBR-97-32A 137.25UA	32.748	33.654	8.97	8.97	33.191	3.13183	Jarosite	48	39	n.a.	n.a.	0.287	33.353	3.117	19.24	11.19
MBR-97-32A 137.25UA	34.4	35.209	14.4	3	34.764	2.99421	Alunite	47.8	38.5	0.287	34.711	0.337	34.788	2.99219	20.01	12.99
MBR-97-32A 137.25UA	37.93	38.972	5.98	2.99	38.451	2.71642	Marcasite	102	97.1	0.21	38.455	0.22	38.475	2.71479	26.03	21.36
MBR-97-32A 137.25RR	9.559	10.519	0	0	10.138	10.1237	illite	109	109	0.38	10.117	0.46	10.062	10.20025	49.93	50.37
MBR-97-32A 137.25RR	13.803	14.747	0	0	14.222	7.2255	Kaolinite	54.7	54.7	n.a.	n.a.	0.574	14.217	7.22833	31.08	31.39
MBR-97-32A 137.25RR	5.867	6.265	0	0	6.106	16.79368	Expandable	21.5	21.5	0.075	6.107	0.121	6.066	16.90485	2.689	2.61
CH-97-10B 40.95UA	23.974	24.467	107	51.3	24.09	4.28643	Quartz	162	67.8	0.186	24.109	0.179	24.121	4.28105	51.26	12.17
CH-97-10B 40.95UA	34.461	35.229	15.2	1.86	34.755	2.99495	Augite	36	25.9	0.167	34.758	0.257	34.781	2.99276	13.11	6.645
CH-97-10B 40.95RR	5.827	6.305	0	0	5.888	17.41458	Expandable	24.7	24.7	0.174	5.95	0.153	6.043	16.9711	3.791	3.774
CH-97-10B 40.95RR	9.879	10.379	0	0	10.079	10.18233	illite	72.6	72.6	0.304	10.099	0.301	10.106	10.15606	21.61	21.86
CH-97-10B 40.95RR	13.503	14.747	0	0	14.143	7.2661	Kaolinite	360	360	0.575	14.114	0.677	14.107	7.28456	242.3	243.7
CH-97-10B 57.54UA	23.659	24.309	80.8	38	24.14	4.27761	Quartz	404	355	0.221	24.138	0.222	24.139	4.2778	117	78.59
CH-97-10B 57.54UA	34.198	35.047	23.3	1.9	34.824	2.98916	Augite	47.9	40.3	0.403	34.739	0.349	34.835	2.98827	24.73	14.07
CH-97-10B 57.54UA	36.912	37.482	0.48	-0.15	37.383	2.79116	Siderite	24.8	24.8	n.a.	n.a.	0.196	37.332	2.79481	4.766	4.871
CH-97-10B 57.54RR	5.747	6.246	0	0	6.018	17.03978	Expandable	19.4	19.4	0.162	5.991	0.161	5.966	17.18904	3.2	3.129
CH-97-10B 57.54RR	9.839	10.319	0	0	10.116	10.14565	illite	123	123	0.333	10.096	0.319	10.088	10.17365	38.94	39.32
CH-97-10B 57.54RR	13.523	14.666	0	0	14.161	7.25665	Kaolinite	428	428	0.497	14.133	0.558	14.116	7.27986	237.6	238.8
CH-97-10B 57.69UA	23.836	24.408	68.1	35.7	24.12	4.28114	Quartz	410	358	0.193	24.121	0.209	24.12	4.28111	104.6	74.77
CH-97-10B 57.69UA	34.38	35.067	8.03	14.6	34.701	2.99946	Augite	50.1	39	0.209	34.764	0.203	34.749	2.99546	15.7	7.939
CH-97-10B 57.69RR	5.607	6.086	0	0	5.705	17.9728	Expandable	16.8	16.8	0.315	5.774	0.264	5.793	17.70073	4.444	4.45
CH-97-10B 57.69RR	9.719	10.419	0	0	10.113	10.14914	illite	107	107	0.344	10.093	0.372	10.09	10.17214	39.32	39.7
CH-97-10B 57.69RR	13.503	14.787	0	0	14.178	7.24777	Kaolinite	302	302	0.526	14.145	0.605	14.127	7.27392	181.8	182.6
CH-97-10B 57.71UA	23.718	24.625	52.4	29.4	24.136	4.2784	Quartz	306	264	0.213	24.133	0.243	24.109	4.28304	101.3	64.26
CH-97-10B 57.71UA	34.42	35.128	14.6	3.51	34.776	2.99317	Augite	61.7	52.7	0.279	34.789	0.307	34.78	2.99288	22.56	16.19
CH-97-10B 57.71UA	5.887	6.325	0	0	6.071	16.89126	Expandable	18.7	18.7	0.139	6.036	0.187	6.065	16.9073	3.473	3.486
CH-97-10B 57.71UA	9.719	10.499	0	0	10.155	10.10703	illite	164	164	0.303	10.121	0.37	10.115	10.14687	60.27	60.55
CH-97-10B 57.71UA	13.362	15.008	0	0	14.168	7.25298	Kaolinite	447	447	0.54	14.143	0.676	14.122	7.27641	301.2	302.1

A: XRD PEAK AREAS FOR UNASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
UNASHED LIG.	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-10B 58.12UA	23.816	24.408	74.4	43	24.137	4.27821	Quartz	640	583	0.219	24.135	0.235	24.127	4.27985	171.6	136.9
CH-97-10B 58.12UA	34.521	35.087	2.12	4.64	34.78	2.99287	Augite	40.7	37.4	0.256	34.777	0.249	34.788	2.99219	11.17	9.337
CH-97-10B 58.12RR	5.488	6.365	7.18	3.86	5.715	17.94152	Expandable	38.3	32	0.616	5.919	0.525	5.937	17.27339	21.66	16.8
CH-97-10B 58.12RR	9.719	10.579	11.4	7.42	10.133	10.12853	illite	75.5	66	0.307	10.12	0.371	10.138	10.12392	32.32	24.52
CH-97-10B 58.12RR	13.422	14.727	61.6	50.8	14.185	7.24468	Kaolinite	271	215	0.537	14.102	0.564	14.084	7.29636	194.9	121.6
CH-97-10B 62.42UA	23.678	24.526	38.6	16.3	24.124	4.28042	Quartz	749	722	0.196	24.122	0.234	24.107	4.28345	192.5	169.1
CH-97-10B 62.42UA	31.724	32.166	23.7	13.6	31.863	3.25869	Rutile	46.7	26.1	0.096	31.866	0.022	31.184	3.32787	8.854	0.572
CH-97-10B 62.42UA	34.42	35.107	10.7	3.86	34.845	2.98748	Augite	45.3	38.8	0.346	34.739	0.311	34.763	2.99429	17.22	12.09
CH-97-10B 62.42UA	36.994	37.645	1.81	1.26	37.282	2.79843	Siderite	43.7	42.1	0.105	37.297	0.164	37.276	2.79887	7.884	6.917
CH-97-10B 62.42RR	5.587	6.206	2.08	1.56	6.022	17.0297	Expandable	26.4	24.6	0.346	5.98	0.328	5.912	17.34581	9.148	8.075
CH-97-10B 62.42RR	9.779	10.419	27.5	22.4	10.133	10.12836	illite	167	142	0.231	10.118	0.243	10.11	10.15217	50.29	34.45
CH-97-10B 62.42RR	13.603	14.887	81.1	25	14.205	7.2345	Kaolinite	374	319	0.457	14.159	0.508	14.166	7.25431	230.2	162.2
CH-97-10B 63.01UA	23.698	24.645	41.3	10.6	24.151	4.27578	Quartz	667	640	0.241	24.147	0.271	24.143	4.27713	197.7	173.1
CH-97-10B 63.01UA	31.684	32.166	11.9	8.44	31.886	3.25642	Rutile	50.9	40.4	0.194	31.856	0.182	31.877	3.25732	12.2	7.336
CH-97-10B 63.01UA	34.501	35.107	14.5	6.11	34.825	2.98908	Augite	59.9	49.9	0.199	34.799	0.206	34.814	2.99002	16.4	10.27
CH-97-10B 63.01RR	5.488	6.265	0	0	5.967	17.18472	Expandable	31.9	31.9	0.642	5.918	0.528	5.9	17.37934	16.68	16.87
CH-97-10B 63.01RR	9.839	10.439	0	0	10.175	10.08747	illite	112	112	0.274	10.165	0.322	10.144	10.11781	35.63	36.01
CH-97-10B 63.01RR	13.703	14.827	0	0	14.245	7.21422	Kaolinite	316	316	0.498	14.182	0.564	14.194	7.24009	177.1	178
CH-97-10B 113.05RR	5.687	6.026	0	0	5.767	17.78145	Expandable	12.8	12.8	0.13	5.81	0.096	5.871	17.46613	1.21	1.222
CH-97-10B 113.05RR	5.986	6.285	0	0	6.125	16.74398	Expandable	15.2	15.2	0.124	6.138	0.169	6.163	16.63921	2.56	2.58
CH-97-10B 113.05RR	9.739	10.419	0	0	10.099	10.16222	illite	110	110	0.371	10.043	0.366	10.062	10.2003	39.94	40.39
CH-97-10B 113.05RR	13.061	13.523	0	0	13.317	7.71448	Gypsum	81.3	81.3	0.198	13.328	0.226	13.313	7.71676	18.15	18.35
CH-97-10B 113.05RR	14.405	15.008	0	0	14.811	6.93995	? Kaolinite	80.5	80.5	0.292	14.821	0.324	14.774	6.95718	25.75	26.05
CH-97-10B 114.42UA	23.836	24.566	24.9	8.37	24.233	4.26154	Quartz	323	307	0.225	24.225	0.249	24.208	4.26585	88.53	76.36
CH-97-10B 114.42UA	33.432	34.239	20.2	-2.11	33.916	3.06677	Jarosite	69.6	62.7	0.297	33.846	0.324	33.84	3.07343	27.52	20.3
CH-97-10B 114.42UA	34.36	35.188	5.92	9.7	34.82	2.98948	Augite	77.6	69.6	0.251	34.837	0.28	34.845	2.98747	26.04	19.49
CH-97-10B 114.42UA	37.034	37.767	10.6	5.3	37.378	2.79153	Siderite	80.3	72.2	0.113	37.379	0.168	37.351	2.79342	17.84	12.1
CH-97-10B 114.42UA	38.257	38.972	10.4	11.7	38.502	2.71299	Marcasite	125	114	0.207	38.556	0.248	38.562	2.70893	36.19	28.16
CH-97-10B 114.42RR	7.063	7.502	0	0	7.269	14.11128	Vermiculite	26.7	26.7	n.a.	n.a.	0.2	7.252	14.14321	5.08	5.344
CH-97-10B 114.42RR	9.459	10.679	0	0	10.299	9.966	illite	236	236	0.372	10.209	0.531	10.122	10.13948	125	125.5
CH-97-10B 114.42RR	5.946	6.405	0	0	6.04	16.97821	Expandable	13.9	13.9	0.13	6.081	0.148	6.154	16.66476	2.037	2.068
CH-97-10B 114.42RR	14.024	14.807	0	0	14.519	7.0786	Kaolinite	55.7	55.7	0.477	14.408	0.427	14.441	7.11667	23.63	23.82
CH-97-10B 114.42RR	13.222	13.783	0	0	13.504	7.6081	Gypsum	49.1	49.1	0.214	13.483	0.256	13.496	7.61242	12.42	12.59
CH-97-9 46.22UA	23.994	24.388	72.1	46.2	24.116	4.28182	Quartz	140	75.7	0.154	24.132	0.131	24.119	4.28124	33.36	9.939
CH-97-9 46.22UA	28.31	29.365	43.1	68.8	28.768	3.60073	Anatase	250	196	0.497	28.825	0.501	28.828	3.59338	157.2	98.15
CH-97-9 46.22RR	9.799	10.379	0	0	10.053	10.20932	illite	50.4	50.4	0.341	10.089	0.354	10.074	10.18772	17.63	17.85
CH-97-9 46.22RR	13.422	15.028	0	0	14.125	7.27521	Kaolinite	418	418	0.602	14.083	0.707	14.097	7.28922	294.6	295.6
CH-97-9 46.22RR	4.969	5.269	-1.41	-2.71	5.176	19.81134	Mixed layer	16.3	18.6	0.061	5.174	0.078	5.12	20.02545	0.845	1.45
CH-97-9 46.22RR	5.647	5.887	0	0	5.804	17.66938	Expandable	13.7	13.7	0.089	5.781	0.065	5.725	17.91053	0.864	0.884
CH-97-9 46.22RR	7.083	7.323	0.25	0	7.208	14.23027	Vermiculite	14.7	14.6	n.a.	n.a.	0.098	7.175	14.29491	1.355	1.424
CH-97-9 46.49UA	24.033	24.586	83.8	54.6	24.202	4.2669	Quartz	153	77.9	0.221	24.214	0.223	24.229	4.26211	55.38	17.35
CH-97-9 46.49UA	34.622	35.168	12	-1.97	34.851	2.98692	Augite	51	44.9	0.27	34.887	0.234	34.87	2.98532	13.06	10.5
CH-97-9 46.49UA	41.622	42.2	55.6	40.1	41.894	2.50203	Hematite	91.6	43.2	0.346	41.955	0.284	41.974	2.49748	39.94	12.27
CH-97-9 46.49RR	5.767	6.146	0	0	6.094	16.82666	Expandable	12	12	0.164	6.038	0.219	5.951	17.23195	2.677	2.631
CH-97-9 46.49RR	9.979	10.479	0	0	10.228	10.035	illite	75.6	75.6	0.34	10.233	0.321	10.216	10.04672	23.82	24.23
CH-97-9 46.49RR	13.362	14.887	0	0	14.238	7.21759	Kaolinite	470	470	0.676	14.182	0.763	14.156	7.25906	357.4	358.8
CH-97-9 47.20UA	23.777	24.546	71.4	27.2	24.13	4.27939	Quartz	301	250	0.188	24.125	0.219	24.13	4.27934	92.65	54.56
CH-97-9 47.20UA	34.481	35.087	13.6	12.7	34.646	3.00403	Augite	51.6	38.2	0.235	34.679	0.232	34.721	2.99779	16.99	8.852

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UNASHED LIG.	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-9 47.20RR	5.249	5.647	0	0	5.561	18.43864	Expandable	19.6	19.6	0.102	5.549	0.117	5.482	18.70401	2.364	2.296
CH-97-9 47.20RR	5.747	6.106	0	0	5.886	17.42179	Expandable	15.9	15.9	n.a.	n.a.	0.174	5.872	17.46275	2.71	2.772
CH-97-9 47.20RR	7.263	7.582	0	0	7.329	13.99493	Vermiculite	13.3	13.3	0.119	7.336	0.107	7.35	13.9549	1.375	1.419
CH-97-9 47.20RR	9.759	10.399	0	0	10.119	10.14276	illite	96.9	96.9	0.263	10.099	0.332	10.089	10.17279	32.04	32.21
CH-97-9 47.20RR	13.162	15.088	0	0	14.119	7.27796	Kaolinite	506	506	0.681	14.072	0.829	14.055	7.31094	418.4	419.6
CH-97-9 47.64UA	23.816	24.546	91.9	47.4	24.157	4.27466	Quartz	232	161	0.193	24.156	0.2	24.149	4.27603	82.83	32.3
CH-97-9 47.64UA	34.541	35.067	15.2	18.7	34.802	2.99098	Augite	47.6	30.6	0.198	34.76	0.175	34.744	2.99584	14.17	5.35
CH-97-9 47.64UA	37.197	37.706	1.44	5.16	37.34	2.79422	Siderite	41.4	38.9	0.107	37.333	0.113	37.355	2.79314	6.096	4.376
CH-97-9 47.64RR	6.066	6.445	0	0	6.18	16.59488	Expandable	20.3	20.3	0.148	6.227	0.15	6.251	16.4044	3.08	3.046
CH-97-9 47.64RR	9.939	10.439	0	0	10.187	10.07507	illite	81.8	81.8	0.28	10.165	0.288	10.165	10.09688	23.06	23.54
CH-97-9 47.64RR	13.222	15.048	0	0	14.183	7.24532	Kaolinite	387	387	0.635	14.147	0.801	14.107	7.28423	309.6	310.5
CH-97-9 47.64RR	4.85	5.109	-2.36	-2.39	5.01	20.46392	Mixed layer	5.03	7.4	0.224	4.976	0.188	4.982	20.57938	0.797	1.392
CH-97-9 47.81UA	23.678	24.428	67	21.3	24.069	4.29013	Quartz	252	209	0.229	24.077	0.274	24.067	4.29045	90.07	57.24
CH-97-9 47.81UA	34.34	35.128	12.3	7.27	34.658	3.0031	Augite	42.4	32.2	0.173	34.653	0.206	34.645	3.00413	14.22	6.632
CH-97-9 47.81UA	36.932	37.38	2.13	9.44	37.151	2.80796	Siderite	36.3	30.6	0.097	37.169	0.099	37.113	2.81073	5.768	3.044
CH-97-9 47.81UA	41.539	42.262	24.4	10.6	41.87	2.50342	Hematite	42.2	24.1	0.439	41.851	0.27	41.793	2.50779	19.35	6.502
CH-97-9 47.81RR	4.651	5.129	0	0	4.95	20.71388	Mixed layer	16.5	16.5	0.161	4.95	0.153	4.931	20.79413	2.517	2.519
CH-97-9 47.81RR	5.787	6.006	0	0	5.87	17.46856	Expandable	16.9	16.9	0.089	5.881	0.08	5.892	17.40435	1.407	1.342
CH-97-9 47.81RR	9.819	10.259	0	0	10.048	10.2144	illite	94	94	0.266	10.037	0.259	10.037	10.22522	23.96	24.3
CH-97-9 47.81RR	13.362	14.787	0	0	14.144	7.26514	Kaolinite	403	403	0.602	14.039	0.695	14.036	7.32076	278.4	279.6
CH-97-9 48.00UA	23.58	24.586	70.9	26.4	24.095	4.28546	Quartz	393	345	0.203	24.096	0.246	24.077	4.28872	133.6	85
CH-97-9 48.00UA	34.38	35.067	15.5	5.93	34.713	2.99843	Augite	61.7	50.9	0.246	34.652	0.241	34.702	2.99933	19.56	12.25
CH-97-9 48.00UA	37.014	37.584	11.7	5.63	37.36	2.79278	Siderite	38.1	30.1	0.169	37.306	0.11	37.21	2.80366	8.305	3.32
CH-97-9 48.00RR	5.129	5.448	0	0	5.376	19.07381	Mixed layer	18.7	18.7	0.149	5.329	0.131	5.291	19.38122	2.45	2.446
CH-97-9 48.00RR	5.707	6.066	0	0	5.989	17.12398	Expandable	21	21	0.182	5.926	0.158	5.879	17.44284	3.262	3.31
CH-97-9 48.00RR	9.879	10.339	0	0	10.094	10.16751	illite	91.4	91.4	0.304	10.096	0.29	10.1	10.16126	26.18	26.49
CH-97-9 48.00RR	13.302	15.008	0	0	14.122	7.27651	Kaolinite	393	393	0.661	14.087	0.762	14.07	7.30317	298.3	299.1
CH-97-9 48.19UA	23.757	24.586	64.4	9.2	24.186	4.26969	Quartz	486	451	0.226	24.188	0.27	24.187	4.26947	152.1	121.8
CH-97-9 48.19UA	34.4	35.229	1.85	6.13	34.844	2.98748	Augite	54.4	50.2	0.324	34.775	0.273	34.799	2.99129	17.12	13.71
CH-97-9 48.19UA	36.994	37.726	5	4.68	37.319	2.79574	Siderite	38.3	33.5	0.179	37.321	0.157	37.334	2.79466	8.757	5.256
CH-97-9 48.19RR	5.229	5.568	0	0	5.301	19.34236	Mixed layer	12.3	12.3	0.165	5.336	0.196	5.39	19.02517	2.381	2.41
CH-97-9 48.19RR	5.667	6.485	0	0	6.138	16.70811	Expandable	24.4	24.4	0.419	5.971	0.413	6.017	17.04202	10.01	10.08
CH-97-9 48.19RR	7.223	7.443	0	0	7.398	13.86392	Vermiculite	15	15	0.022	7.398	0.028	7.342	13.96966	0.55	0.418
CH-97-9 48.19RR	9.919	10.479	0	0	10.194	10.06816	illite	137	137	0.219	10.194	0.261	10.187	10.07487	35.32	35.64
CH-97-9 48.19RR	13.442	14.887	0	0	14.216	7.22855	Kaolinite	399	399	0.608	14.193	0.723	14.157	7.25859	286.9	288.2
SG-98-48 31.24UA*	13.668	14.737	34.4	16.2	14.17	7.25189	Kaolinite	203	177	0.289	14.194	0.318	14.171	7.25147	83.11	56.27
SG-98-48 3124UA	23.816	24.507	19.8	19.2	24.131	4.27924	Quartz	114	94.4	0.162	24.134	0.132	24.088	4.28673	25.92	12.51
SG-98-48 31.24UA*	4.245	7.702	43.6	-6.98	6.253	16.40061	Smectite	739	725	1.571	6.28	1.571	6.145	16.68942	1202.8	1139.5
SG-98-48 31.24UA*							Mixed layer									
SG-98-48 31.24UA*							Expandable									
SG-98-48 31.64UA	34.34	35.026	0.2	-0.86	34.642	3.00438	Augite	46.6	46.9	0.229	34.629	0.192	34.635	3.00503	8.752	9.007
SG-98-48 31.64UA	38.155	38.931	6.05	9.07	38.462	2.71567	Marcasite	67.3	60	0.107	38.451	0.24	38.517	2.71194	20.1	14.41
SG-98-48 31.64RR	5.687	6.126	0	0	5.844	17.54807	Expandable	23	23	0.158	5.838	0.198	5.852	17.52195	4.532	4.546
SG-98-48 31.64RR	4.85	5.129	0	0	5.022	20.41652	Mixed layer	11.4	11.4	0.244	4.985	0.217	4.988	20.55667	2.452	2.474
SG-98-48 31.64RR	13.503	15.148	0	0	14.212	7.23082	Kaolinite	611	611	0.357	14.208	0.464	14.211	7.23136	283.2	283.6
SG-98-48 31.98UA	23.816	24.507	73.8	35.3	24.071	4.28977	Quartz	234	174	0.169	24.075	0.2	24.08	4.28824	72.65	34.79
SG-98-48 31.98RR	5.288	5.627	0	0	5.444	18.8367	Expandable	17.8	17.8	0.133	5.477	0.155	5.472	18.73995	2.768	2.758
SG-98-48 31.98RR	13.462	14.767	0	0	14.119	7.27829	Kaolinite	379	379	0.408	14.108	0.524	14.099	7.28842	198.1	198.7

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UNASHED LIG.	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
SG-98-48 32.20UA	23.836	24.467	106	72.6	24.094	4.28563	Quartz	532	440	0.206	24.102	0.226	24.098	4.28498	155.5	99.33
SG-98-48 32.20UA	31.524	32.146	15.5	15.9	31.829	3.26211	Rutile	71.2	55.4	0.227	31.792	0.25	31.804	3.26468	23.65	13.89
SG-98-48 32.20UA	41.663	42.18	51.5	25.6	41.892	2.50214	Hematite	92.9	52.9	0.343	41.929	0.292	41.929	2.50001	35.42	15.44
SG-98-48 32.20RR	5.488	5.986	0	0	5.598	18.31737	Expandable	21.8	21.8	0.211	5.641	0.22	5.685	18.03686	4.839	4.794
SG-98-48 32.20RR	13.703	14.626	0	0	14.175	7.24968	Kaolinite	265	265	0.345	14.179	0.421	14.166	7.254	111.1	111.7
SG-98-48 32.40UA	23.698	24.368	45.9	46.8	24.099	4.28485	Quartz	771	725	0.192	24.097	0.209	24.083	4.28765	182.8	151.6
SG-98-48 32.40UA	31.664	32.025	-4.68	7.72	31.821	3.26291	Rutile	33.4	32.7	0.141	31.838	0.143	31.825	3.26258	5.193	4.683
SG-98-48 32.40RR	5.448	6.086	3.78	0.81	5.789	17.71208	Expandable	23.3	21.2	0.348	5.78	0.327	5.78	17.73998	8.419	6.916
SG-98-48 32.40RR	13.643	14.787	0	0	14.105	7.2853	Kaolinite	348	348	0.4	14.104	0.498	14.123	7.27601	172.9	173.4
SH-94-3 30.70UA	23.875	24.428	176	90.6	24.067	4.29042	Quartz	274	128	0.287	24.099	0.278	24.086	4.28716	109.1	35.6
SH-94-3 30.70UA	33.493	34.097	26.5	9.72	33.815	3.07569	Jarosite	140	122	0.22	33.814	0.246	33.805	3.07655	40.85	29.98
SH-94-3 30.70UA	34.501	35.006	-0.98	18.9	34.734	2.99669	Augite	50.2	42	0.181	34.722	0.13	34.703	2.99928	10.12	5.45
SH-94-3 30.70RR	6.864	7.343	0	0	6.974	14.70653	Vermiculite	29.3	29.3	0.227	7.058	0.253	7.107	14.43166	7.319	7.422
SH-94-3 30.70RR	9.919	10.419	0	0	9.999	10.26368	illite	38.4	38.4	n.a.	n.a.	0.288	10.156	10.10612	10.82	11.06
SH-94-3 30.70RR	13.182	14.847	0	0	14.203	7.23551	Kaolinite	324	324	0.522	14.178	0.677	14.07	7.30335	219.1	219.6
SH-94-4 78.91UA	23.718	24.467	20.3	14.8	24.082	4.28786	Quartz	131	114	0.224	24.07	0.237	24.036	4.29581	40.03	26.95
SH-94-4 78.91UA	31.424	32.146	0.56	1.5	31.804	3.26467	Rutile	52.5	51.4	0.091	31.821	0.111	31.829	3.26218	6.376	5.681
SH-94-4 78.91UA	41.539	42.2	-0.02	-2.89	41.891	2.50221	Hematite	34.9	36.4	0.279	41.914	0.272	41.873	2.50322	8.843	9.924
SH94-4 78.91RR	9.739	10.439	0	0	10.103	10.15907	illite	89.2	89.2	0.228	10.094	0.281	10.07	10.19153	24.83	25.11
SH94-4 78.91RR	13.202	14.827	0	0	14.114	7.28086	Kaolinite	513	513	0.572	14.09	0.696	14.047	7.31507	356	357

*: This are samples that reruns have not been done for.

B: XRD PEAK AREAS FOR ASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
ASHED LIG	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 103.80	31.724	32.206	8.72	1.26	31.847	3.26036	Rutile	37.3	30.4	0.143	31.85	0.178	31.886	3.25645	7.802	5.415
MBR-97-32A 103.30RR	5.568	5.986	0	0	5.914	17.33896	Expandable	17.4	17.4	0.203	5.841	0.243	5.766	17.78543	4.185	4.221
MBR-97-32A 103.30RR	6.186	6.485	0	0	6.354	16.14113	Expandable	23.7	23.7	0.118	6.363	0.129	6.347	16.15676	3.085	3.075
MBR-97-32A 103.30RR	13.503	14.666	0	0	14.156	7.25935	Kaolinite	256	256	0.639	14.128	0.705	14.102	7.28671	179.4	180.7
MBR-97-32A 107.42	29.047	29.924	101	24.5	29.439	3.52039	Anatase	310	243	0.301	29.437	0.313	29.442	3.52003	131.1	76.01
MBR-97-32A 107.42	34.017	34.885	6.68	-2.71	34.34	3.03004	Calcite	43.8	40.7	0.195	34.418	0.202	34.494	3.01693	9.835	8.205
MBR-97-32A 107.42	36.1	36.79	13.5	18.8	36.353	2.86746	Dolomite	87.7	72.2	0.222	36.4	0.212	36.393	2.8644	26.49	15.32
MBR-97-32A 107.42RR	5.667	5.946	0	0	5.771	17.76751	Expandable	11.7	11.7	0.153	5.767	0.118	5.763	17.79458	1.395	1.386
MBR-97-32A 107.42RR	6.844	7.163	0	0	6.93	14.80046	Vermiculite	19.5	19.5	0.13	6.928	0.155	6.973	14.70914	3.04	3.026
MBR-97-32A 107.42RR	13.202	13.543	0	0	13.362	7.68837	Gypsum	31.3	31.3	n.a.	n.a.	0.288	13.392	7.67132	8.645	9.035
MBR-97-32A 107.42RR	16.616	17.2	0	0	16.938	6.07368	?	31.9	31.9	0.239	16.92	0.21	16.88	6.09435	6.793	6.694
MBR-97-32A 108.66	38.318	38.686	3.28	31.3	38.564	2.70875	Marcasite	66.4	44.3	0.122	38.544	0.139	38.529	2.71112	12.51	6.161
MBR-97-32A 108.66RR	5.368	5.887	0	0	5.477	18.72347	?	18.6	18.6	0.299	5.551	0.258	5.598	18.31803	4.827	4.808
MBR-97-32A 108.66RR	7.423	7.782	0	0	7.627	13.44943	?	19	19	0.178	7.597	0.19	7.597	13.50283	3.51	3.622
MBR-97-32A 108.66RR	13.503	13.723	0	0	13.648	7.52781	Halloysite	25.5	25.5	0.132	13.615	0.131	13.623	7.54165	3.304	3.349
MBR-97-32A 108.66RR	13.944	14.787	0	0	14.312	7.18053	Kaolinite	119	119	0.537	14.279	0.504	14.316	7.17845	59.27	59.82
MBR-97-32A 108.87	34.259	34.743	3.16	12.1	34.361	3.02826	Calcite	30.1	25	0.121	34.407	0.102	34.399	3.02494	6.136	2.545
MBR-97-32A 108.87RR	4.989	5.308	0	0	5.214	19.66485	Mixed layer	20.3	20.3	0.141	5.175	0.116	5.168	19.83941	2.359	2.355
MBR-97-32A 108.87RR	6.166	6.485	0	0	6.385	16.06041	Expandable	18.1	18.1	0.136	6.342	0.132	6.3	16.27814	2.393	2.394
MBR-97-32A 108.87RR	9.899	10.119	0	0	10.059	10.20344	illite	35.6	35.6	n.a.	n.a.	0.148	10.011	10.25156	4.974	5.278
MBR-97-32A 108.87RR	13.422	14.847	0	0	14.119	7.27828	Kaolinite	719	719	0.491	14.105	0.596	14.093	7.29133	427.8	428.9
MBR-97-32A 109.27	34.239	34.642	-1.33	5.32	34.382	3.02646	Calcite	37.8	36.8	0.197	34.448	0.069	34.448	3.02079	3.177	2.544
MBR-97-32A 109.27RR	9.799	10.379	0	0	10.258	10.00513	illite	34.7	34.7	0.32	10.166	0.295	10.097	10.16433	10.23	10.22
MBR-97-32A 109.27RR	13.482	14.907	0	0	14.205	7.23423	Kaolinite	558	558	0.558	14.18	0.656	14.179	7.24755	364.5	366
MBR-97-32A 110.78	29.126	29.724	145	84.8	29.356	3.53014	Anatse	177	55	0.308	29.39	0.33	29.412	3.52356	87.21	18.15
MBR-97-32A 110.78	31.704	32.186	9.26	4.66	31.845	3.26055	Rutile	25.8	17.9	0.3	31.926	0.288	31.883	3.25677	8.419	5.143
MBR-97-32A 110.78	35.958	36.607	12.2	15.8	36.1	2.88684	Dolomite	54.7	41.7	0.271	36.227	0.138	36.298	2.87165	14.73	5.759
MBR-97-32A 110.78	38.134	38.87	7.31	3.34	38.393	2.72039	Marcasite	37.2	31.3	0.248	38.456	0.192	38.54	2.71037	9.964	5.998
MBR-97-32A 110.78RR	5.946	6.246	0	0	6.156	16.65774	Expandable	20	20	0.059	6.157	0.082	6.102	16.80543	1.69	1.634
MBR-97-32A 110.78RR	13.603	15.068	0	0	14.185	7.24468	Kaolinite	225	225	0.613	14.114	0.668	14.168	7.25321	150	150.6
MBR-97-32A 111.10	29.106	29.585	124	58.9	29.326	3.5337	Anatase	133	39	0.214	29.363	0.219	29.355	3.53028	52.41	8.535
MBR-97-32A 111.10	31.704	32.106	4.71	4.29	31.823	3.26278	Rutile	41.8	37.2	0.126	31.837	0.127	31.848	3.2602	6.511	4.711
MBR-97-32A 111.10	34.097	34.905	1.43	6.01	34.481	3.01803	Calcite	53.1	49.5	0.219	34.488	0.272	34.479	3.01817	16.49	13.46
MBR-97-32A 111.10RR	5.587	5.867	0	0	5.72	17.9274	Expandable	13.7	13.7	0.128	5.746	0.123	5.723	17.91665	1.68	1.685
MBR-97-32A 111.10RR	6.166	6.405	0	0	6.254	16.39679	Expandable	16	16	0.118	6.281	0.102	6.277	16.33643	1.652	1.629
MBR-97-32A 111.10RR	13.242	13.422	0	0	13.314	7.71599	Gypsum	60.6	60.6	n.a.	n.a.	0.17	13.334	7.70443	9.312	10.28
MBR-97-32A 111.10RR	13.643	14.706	3	0	14.205	7.2345	Kaolinite	217	216	0.668	14.124	0.675	14.136	7.26939	145.9	145.5
MBR-97-32A 111.36	31.684	32.266	3	1.86	31.966	3.24851	Rutile	25.4	23	0.198	31.934	0.171	31.926	3.25252	5.363	3.936
MBR-97-32A 111.36RR	13.282	14.887	0	0	14.265	7.20412	Kaolinite	254	254	0.666	14.176	0.795	14.124	7.27541	201.5	202.2
MBR-97-32A 111.66	31.684	32.206	20.1	2.76	31.851	3.25989	Rutile	41.7	27.1	0.182	31.87	0.174	31.802	3.26482	10.57	4.724
MBR-97-32A 111.66	29.166	29.565	144	72.2	29.405	3.52433	Anatase	139	37.8	0.12	29.392	0.167	29.361	3.52952	49.43	6.324
MBR-97-32A 111.66RR	13.021	15.108	0	0	14.157	7.25863	Kaolinite	250	250	0.624	14.115	0.848	14.041	7.31818	211.6	212.1
MBR-97-32A 111.66RR	7.223	7.482	0	0	7.382	13.89392	Vermiculite	20.2	20.2	n.a.	n.a.	0.146	7.38	13.89911	2.89	2.949
MBR-97-32A 112.06	23.974	24.368	111	54.7	24.23	4.26194	Quartz	125	50.8	0.245	24.152	0.238	24.165	4.27328	44.77	12.09
MBR-97-32A 112.06	29.306	29.545	150	54.7	29.505	3.51268	Anatase	102	31.3	0.15	29.468	0.156	29.458	3.51821	29.14	4.869
MBR-97-32A 112.06	31.684	32.065	9.37	3.12	31.875	3.25758	Rutile	28.6	22.3	0.172	31.867	0.207	31.85	3.26002	6.913	4.625

B: XRD PEAK AREAS FOR ASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
ASHED LIG	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 112.06RR	5.328	5.747	0	0	5.572	18.4033	?	16	16	n.a.	n.a.	0.263	5.536	18.52411	4.047	4.191
MBR-97-32A 112.06RR	5.926	6.126	0	0	6.001	17.08945	Expandable	11.3	11.3	n.a.	n.a.	0.104	5.971	17.17317	1.194	1.18
MBR-97-32A 112.06RR	13.462	14.847	0	0	14.168	7.25317	Kaolinite	364	364	0.604	14.143	0.704	14.129	7.27303	255.1	256.3
MBR-97-32A 114.31	23.678	24.566	39.6	27.4	24.071	4.28975	Quartz	571	537	0.207	24.068	0.235	24.057	4.29216	155.9	126.3
MBR-97-32A 114.31	34.34	35.026	5.3	1.9	34.656	3.00324	Alunite	32.5	28.8	0.142	34.613	0.14	34.58	3.00961	6.35	4.024
MBR-97-32A 114.31RR	5.667	6.046	0	0	5.975	17.16125	Expandable	27.7	27.7	0.288	5.868	0.228	5.87	17.46827	6.175	6.313
MBR-97-32A 114.31RR	9.819	10.179	0	0	10.101	10.1604	illite	34.2	34.2	0.161	10.046	0.171	10.025	10.23741	5.749	5.861
MBR-97-32A 114.31RR	13.803	14.486	0	0	14.089	7.29378	Kaolinite	200	200	0.564	14.109	0.504	14.121	7.27689	98.97	100.8
MBR-97-32A 121.15	23.58	24.625	34.2	7.84	24.118	4.2815	Quartz	773	752	0.236	24.115	0.276	24.097	4.28517	229.8	207.9
MBR-97-32A 121.15	31.604	32.126	13.9	7.2	31.838	3.26123	Rutile	58.4	47.5	0.235	31.811	0.253	31.845	3.26056	17.39	11.99
MBR-97-32A 121.15RR	5.348	6.146	0	0	5.741	17.86182	Expandable	47.5	47.5	0.553	5.68	0.541	5.723	17.91708	25.5	25.69
MBR-97-32A 121.15RR	13.543	14.386	0	0	13.894	7.39523	Kaolinite	125	125	0.675	13.906	0.586	13.93	7.37621	72.17	73.11
MBR-97-32A 121.17	23.777	24.526	77.6	12.1	24.107	4.28349	Quartz	712	663	0.207	24.109	0.233	24.109	4.28312	188.4	154.7
MBR-97-32A 121.17	29.086	29.705	63.3	-3.06	29.267	3.54057	Chlorite	84.3	40.4	0.312	29.328	0.322	29.365	3.52911	31.65	13.01
MBR-97-32A 121.17	31.564	32.065	5.54	11.5	31.902	3.25491	Rutile	73.5	64	0.193	31.849	0.197	31.817	3.2633	16.76	12.59
MBR-97-32A 121.17RR	5.488	6.465	0	0	5.887	17.42024	Expandable	24	24	n.a.	n.a.	0.568	5.943	17.25486	13.51	13.67
MBR-97-32A 121.17RR	13.603	14.686	3	0	14.096	7.28994	Kaolinite	164	162	0.736	14.083	0.704	14.098	7.28887	114.8	114.1
MBR-97-32A 121.66	23.757	24.546	68.7	29.8	24.095	4.28556	Quartz	518	466	0.19	24.092	0.227	24.091	4.28619	144.7	105.7
MRB97-32A 121.66	27.575	28.29	8.93	9.13	27.885	3.7124	Muscovite	73.5	64.5	0.123	27.881	0.147	27.84	3.7182	15.98	9.459
MRB97-32A 121.66	31.664	32.086	23.5	5.4	31.828	3.26225	Rutile	78.9	62.4	0.139	31.83	0.15	31.84	3.26103	15.37	9.371
MBR-97-32A 121.66RR	5.827	6.186	0	0	5.963	17.19617	Expandable	17.1	17.1	0.136	6	0.175	6.017	17.04292	2.944	2.999
MBR-97-32A 121.66RR	7.203	7.403	0	0	7.265	14.11885	Vermiculite	15.5	15.5	0.057	7.28	0.07	7.31	14.03051	1.146	1.083
MBR-97-32A 121.66RR	13.041	13.563	0	0	13.362	7.68837	Gypsum	92.4	92.4	n.a.	n.a.	0.423	13.337	7.70259	37.98	39.06
MBR-97-32A 121.66RR	13.583	14.827	0	0	14.124	7.27583	Kaolinite	243	243	0.655	14.056	0.701	14.112	7.28197	169.4	170.7
MBR-97-32A 137.25	23.836	24.605	22.8	3.76	24.195	4.26812	Quartz	374	360	0.257	24.187	0.286	24.188	4.26926	113.2	103
MBR-97-32A 137.25	29.346	29.824	24.8	7.35	29.524	3.51052	Anatase	53.5	35.2	0.244	29.558	0.247	29.568	3.50536	16.46	8.703
MBR-97-32A 137.25	31.564	32.126	61.7	52	31.752	3.2698	Rutile	87.8	29.4	0.117	31.768	0.089	31.547	3.29058	34.59	2.615
MBR-97-32A 137.25	34.541	35.188	16.8	10.4	34.755	2.99493	Alunite	62.3	47.6	0.243	34.814	0.218	34.836	2.98815	19.2	10.38
MBR-97-32A 137.25	36.262	36.75	14.6	-3	36.453	2.85986	Dolomite	53.7	46	0.102	36.46	0.169	36.492	2.85688	10.66	7.799
MBR-97-32A 137.25RR	5.308	6.724	4.25	-0.16	6.024	17.02315	Expandable	23.5	21.4	0.691	5.99	0.714	5.955	17.21925	18.15	15.31
MBR-97-32A 137.25RR	7.004	7.742	0	0	7.392	13.876	Vermiculite	17.2	17.2	0.246	7.399	0.161	7.405	13.85152	2.786	2.77
MBR-97-32A 137.25RR	9.419	10.799	0	0	10.213	10.05003	illite	121	121	0.379	10.167	0.486	10.126	10.13604	58.64	58.63
MBR-97-32A 137.25RR	13.663	14.968	0	0	14.294	7.18935	Kaolinite	58.7	58.7	0.669	14.231	0.673	14.268	7.20252	39.21	39.54
CH-97-10B 40.95	34.461	35.026	10.9	7.35	34.795	2.99162	Calcite	49.1	40.3	0.227	34.715	0.16	34.734	2.99669	11.59	6.463
CH-97-10B 40.95	36.039	36.831	13.4	16.3	36.349	2.86772	Dolomite	49.7	35.2	0.207	36.323	0.236	36.362	2.86674	20.28	8.291
CH-97-10B 40.95	37.014	37.686	14.6	11.2	37.299	2.79717	Siderite	43.4	30.3	0.095	37.296	0.194	37.29	2.79782	14.34	5.871
CH-97-10B 40.95	23.954	24.408	65.3	43.1	24.13	4.2794	Quartz	118	61	0.207	24.154	0.188	24.152	4.27563	36.05	11.45
CH-97-10B 40.95RR	9.859	10.319	8.24	0.55	10.121	10.1402	illite	62.7	58.8	0.33	10.138	0.289	10.118	10.14367	19.02	17.03
CH-97-10B 40.95RR	12.961	15.088	7.14	1.65	14.171	7.25139	Kaolinite	248	244	0.567	14.166	0.734	14.126	7.27458	188.1	178.8
CH-97-10B 57.54	23.659	24.428	37.6	12.3	24.05	4.29342	Quartz	334	310	0.197	24.051	0.234	24.049	4.29358	91.79	72.5
CH-97-10B 57.54	31.985	32.708	15.6	11.1	32.222	3.22341	? Rutile	50.9	36.7	0.202	32.28	0.233	32.302	3.21562	18.23	8.565
CH-97-10B 57.54	33.452	34.097	3.27	3.13	33.774	3.07931	Jarosite	24.2	21	0.227	33.773	0.221	33.736	3.08264	6.658	4.631
CH-97-10B 57.54	34.42	35.006	7.2	2.73	34.767	2.9939	Calcite	41.2	36.6	n.a.	n.a.	0.259	34.671	3.00193	12.27	9.479
CH-97-10B 57.54	36.059	36.689	7.97	6.06	36.262	2.8744	Dolomite	45.4	38.1	0.221	36.284	0.151	36.336	2.86871	10.06	5.763
CH-97-10B 57.54	37.055	37.706	7.95	4.23	37.442	2.78691	Siderite	41.2	35.4	0.073	37.419	0.168	37.378	2.79152	10.11	5.957
CH-97-10B 57.54	40.366	41.189	9.88	7.79	40.845	2.56344	? Hematite	53.7	45	0.298	40.744	0.254	40.712	2.57143	18.81	11.42
CH-97-10B 57.54RR	6.106	6.465	0	0	6.186	16.57732	Expandable	10.3	10.3	n.a.	n.a.	0.145	6.205	16.52578	1.478	1.492
CH-97-10B 57.54RR	9.439	10.519	0	0	10.095	10.16686	illite	135	135	0.352	10.07	0.436	10.035	10.22701	58.6	59.03

B: XRD PEAK AREAS FOR ASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
ASHED LIG	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-10B 57.54RR	13.543	15.269	0	0	14.143	7.26607	Kaolinite	472	472	0.482	14.132	0.604	14.169	7.25263	284.5	285.3
CH-97-10B 57.69	23.836	24.526	48.9	20.5	24.112	4.28252	Quartz	335	297	0.208	24.115	0.222	24.109	4.28305	89.65	65.93
CH-97-10B 57.69	32.166	32.728	11.5	0.23	32.344	3.21158	? Rutile	30	22.1	0.25	32.369	0.22	32.391	3.20705	8.244	4.857
CH-97-10B 57.69	34.4	35.087	10.4	-1.59	34.694	3.00005	Calcite	52.2	46.9	0.231	34.769	0.227	34.757	2.99473	13.64	10.66
CH-97-10B 57.69	36.161	36.77	19.6	10.9	36.312	2.87059	Dolomite	57.8	40.4	0.229	36.37	0.236	36.393	2.86437	18.79	9.532
CH-97-10B 57.69RR	5.727	6.325	0	0	5.943	17.25502	Expandable	27.3	27.3	0.342	5.976	0.301	5.977	17.15769	8.248	8.224
CH-97-10B 57.69RR	9.599	10.519	0	0	10.14	10.12213	illite	119	119	0.33	10.092	0.422	10.086	10.1757	50.13	50.39
CH-97-10B 57.69RR	13.262	15.329	0	0	14.177	7.24843	Kaolinite	258	258	0.474	14.172	0.641	14.171	7.25144	164.8	165.2
CH-97-10B 57.71	23.678	24.349	55.7	31.9	24.057	4.29224	Quartz	257	215	0.191	24.06	0.215	24.048	4.29383	75.47	46.16
CH-97-10B 57.71	31.985	32.608	27.2	8.63	32.288	3.21693	? Rutile	57.6	39.4	0.241	32.287	0.262	32.261	3.21957	21.54	10.3
CH-97-10B 57.71	34.299	34.986	-0.11	-5.36	34.618	3.00646	Calcite	46.9	49.5	n.a.	n.a.	0.269	34.639	3.00464	11.15	13.3
CH-97-10B 57.71	35.998	36.689	14.9	13.8	36.404	2.86356	Dolomite	47.8	33.5	0.244	36.322	0.202	36.345	2.86802	16.77	6.77
CH-97-10B 57.71RR	9.539	10.579	8.1	0.41	10.119	10.14281	illite	152	148	0.334	10.114	0.411	10.097	10.16447	65.2	60.77
CH-97-10B 57.71RR	12.921	15.329	13.8	11.6	14.177	7.24845	Kaolinite	426	414	0.483	14.142	0.63	14.112	7.28159	291.1	260.4
CH-97-10B 58.12	23.659	24.447	47.8	29	24.121	4.28093	Quartz	463	426	0.201	24.117	0.229	24.104	4.28392	128.1	97.61
CH-97-10B 58.12	32.045	32.608	7	2.68	32.326	3.21331	? Rutile	36.2	31.4	0.258	32.367	0.248	32.332	3.21272	10.66	7.785
CH-97-10B 58.12	34.34	35.107	1.24	-1.37	34.648	3.00392	Calcite	36.8	36.6	0.289	34.696	0.297	34.738	2.99638	10.74	10.87
CH-97-10B 58.12	35.978	36.587	11.2	9.16	36.321	2.86988	Dolomite	45.1	35.1	0.165	36.256	0.116	36.244	2.87578	10.23	4.058
CH-97-10B 58.12	37.075	37.767	7.73	8.44	37.48	2.78414	Siderite	34	25.9	0.146	37.421	0.146	37.288	2.79799	9.27	3.778
CH-97-10B 58.12RR	9.739	10.419	0	0	10.134	10.12764	illite	102	102	0.302	10.092	0.337	10.076	10.18629	33.92	34.3
CH-97-10B 58.12RR	13.503	14.646	63.4	70.7	14.117	7.27931	Kaolinite	347	279	0.53	14.078	0.57	14.075	7.30062	235.5	159.2
CH-97-10B 62.42	23.678	24.625	35.6	20.3	24.097	4.28511	Quartz	400	371	0.195	24.097	0.249	24.072	4.28964	118.8	92.35
CH-97-10B 62.42	32.086	32.567	12.1	3.26	32.367	3.20936	? Rutile	39.9	33	0.301	32.34	0.282	32.345	3.21149	13.12	9.308
CH-97-10B 62.42	34.4	35.107	11	0.46	34.709	2.99876	Alunite	51.4	45	0.32	34.725	0.285	34.738	2.99634	16.86	12.84
CH-97-10B 62.42	36.08	36.668	17.5	4.82	36.425	2.862	Dolomite	47.4	37.3	0.332	36.333	0.222	36.362	2.86674	14.91	8.304
CH-97-10B 62.42	37.075	37.604	6.22	8.22	37.419	2.78859	Siderite	54.2	46.7	0.156	37.355	0.12	37.279	2.79867	9.414	5.598
CH-97-10B 62.42RR	5.827	6.166	0	0	5.885	17.42589	Expandable	29.5	29.5	0.15	5.921	0.139	5.989	17.1221	4.136	4.106
CH-97-10B 62.42RR	9.699	10.579	0	0	10.19	10.07196	illite	156	156	0.339	10.14	0.355	10.147	10.1143	54.95	55.34
CH-97-10B 62.42RR	13.182	15.088	0	0	14.229	7.22234	Kaolinite	477	477	0.495	14.196	0.662	14.151	7.26161	315.6	316
CH-97-10B 63.01	23.678	24.467	52.9	29.1	24.095	4.28554	Quartz	435	395	0.2	24.095	0.233	24.081	4.28803	124	91.76
CH-97-10B 63.01	31.604	32.206	7.65	19.1	31.785	3.26649	Rutile	49.9	38.8	0.167	31.782	0.112	31.685	3.27659	12.46	4.339
CH-97-10B 63.01	34.218	35.047	-1.91	3.78	34.686	3.00074	Calcite	46.7	45.4	0.298	34.656	0.305	34.64	3.00458	14.71	13.85
CH-97-10B 63.01	36.019	36.587	16.7	3.09	36.337	2.86869	Dolomite	39	29.9	0.227	36.34	0.225	36.331	2.86915	12.35	6.724
CH-97-10B 63.01	37.116	37.767	10	9.27	37.385	2.79103	Siderite	41	31.3	0.094	37.358	0.131	37.352	2.79339	10.33	4.087
CH-97-10B 63.01RR	5.707	6.186	0	0	6.118	16.76232	Expandable	29.3	29.3	n.a.	n.a.	0.282	5.967	17.18439	8.029	8.259
CH-97-10B 63.01RR	9.599	10.439	0	0	10.076	10.18629	illite	124	124	0.307	10.075	0.398	10.047	10.21502	49.25	49.42
CH-97-10B 63.01RR	13.322	14.706	0	0	14.14	7.26734	Kaolinite	503	503	0.468	14.121	0.6	14.081	7.29746	300.4	301.6
CH-97-10B 113.05	23.659	24.546	8.15	9.78	24.124	4.28039	Quartz	306	297	0.208	24.12	0.224	24.105	4.28382	74.57	66.46
CH-97-10B 113.05	29.146	29.964	10.6	1.86	29.484	3.51509	Anatase	98.5	91.5	0.289	29.496	0.24	29.471	3.51664	27.04	21.96
CH-97-10B 113.05	34.319	35.006	4.89	6.94	34.625	3.0058	Calcite	42.3	36.5	0.236	34.629	0.22	34.659	3.00297	12.2	8.013
CH-97-10B 113.05	35.958	36.75	-3.63	8.38	36.139	2.88382	Dolomite	42.8	43.7	0.2	36.181	0.288	36.309	2.8708	14.33	12.56
CH-97-10B 113.05	38.134	38.992	6.52	11.4	38.46	2.71583	Marcasite	88.7	80.4	0.069	38.452	0.141	38.475	2.71483	19.21	11.33
CH-97-10B 113.05RR	5.368	5.966	0	0	5.496	18.65631	?	17.6	17.6	n.a.	n.a.	0.366	5.621	18.24286	6.324	6.45
CH-97-10B 113.05RR	5.946	6.405	0	0	6.04	16.97766	Expandable	31.2	31.2	0.128	6.066	0.196	6.151	16.67235	6.039	6.116
CH-97-10B 113.05RR	7.004	7.243	0	0	7.103	14.4403	Vermiculite	14.6	14.6	n.a.	n.a.	0.182	7.133	14.37987	2.478	2.655
CH-97-10B 113.05RR	9.699	10.459	0	0	10.116	10.14541	illite	232	232	0.341	10.09	0.386	10.069	10.19253	88.61	89.42
CH-97-10B 113.05RR	14.124	14.586	0	0	14.206	7.23405	Kaolinite	37.4	37.4	0.286	14.278	0.266	14.304	7.18432	9.798	9.954
CH-97-10B 114.42	23.659	24.447	28.3	12.6	24.128	4.27978	Quartz	311	292	0.207	24.121	0.233	24.109	4.28307	84.27	68.19

B: XRD PEAK AREAS FOR ASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
ASHED LIG	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-10B 114.42	29.385	29.824	53.2	15.8	29.53	3.50973	Anatase	107	66.7	0.232	29.56	0.206	29.556	3.50675	28.88	13.71
CH-97-10B 114.42	34.36	35.148	7.82	6.45	34.754	2.99504	Calcite	70	62.9	0.29	34.702	0.295	34.682	3.00101	24.18	18.52
CH-97-10B 114.42	35.917	36.831	-0.99	6.55	36.282	2.8729	Dolomite	61.9	59.9	0.267	36.347	0.323	36.328	2.86932	21.75	19.36
CH-97-10B 114.42	38.175	38.788	5.39	16.5	38.44	2.71719	Marcasite	121	110	0.172	38.475	0.188	38.473	2.71491	27.5	20.7
CH-97-10B 114.42RR	6.006	6.345	0	0.34	6.059	16.92488	Expandable	22.4	22.3	n.a.	n.a.	0.228	6.155	16.6599	5.013	5.087
CH-97-10B 114.42RR	5.468	5.687	0	0	5.602	18.30408	Expandable	21.9	21.9	0.119	5.607	0.131	5.595	18.32849	2.818	2.876
CH-97-10B 114.42RR	9.08	10.699	7.45	1.35	10.136	10.12526	illite	258	255	0.339	10.098	0.507	9.997	10.26648	136.5	129.3
CH-97-10B 114.42RR	14.044	14.586	6.44	1.35	14.445	7.1145	Kaolinite	49.8	47.2	0.373	14.35	0.359	14.328	7.17248	18.89	16.94
CH-97-9 46.22	23.974	24.447	67.3	31.5	24.172	4.27199	Quartz	94.1	41.9	0.176	24.187	0.14	24.143	4.27718	29.18	5.878
CH-97-9 46.22	29.186	29.824	102	33.7	29.485	3.515	Anatase	129	58.8	0.324	29.549	0.343	29.529	3.50986	63.45	20.16
CH-97-9 46.22	34.34	34.885	-0.24	11.5	34.56	3.01132	Alunite	29.2	24.7	0.159	34.558	0.163	34.625	3.00586	7.022	4.014
CH-97-9 46.22	38.379	39.033	7.57	2.39	38.623	2.70482	Marcasite	29.6	23.9	n.a.	n.a.	0.227	38.679	2.70105	8.634	5.439
CH-97-9 46.22	36.161	36.729	10.6	6.7	36.374	2.86586	Dolomite	42.5	33.4	0.187	36.406	0.233	36.455	2.85968	12.63	7.788
CH-97-9 46.22RR	9.799	10.339	0	0	10.122	10.13966	illite	61.6	61.6	0.231	10.096	0.278	10.072	10.18986	16.75	17.15
CH-97-9 46.22RR	13.623	14.767	0	0	14.164	7.25511	Kaolinite	206	206	0.671	14.14	0.66	14.167	7.25356	135.4	136.3
CH-97-9 46.49	23.718	24.309	12.1	14.8	24.13	4.27946	Quartz	47.3	33.3	0.165	24.09	0.167	24.065	4.29084	13.53	5.563
CH-97-9 47.49RR	5.488	6.006	0.37	0.86	5.686	18.0329	?	19.6	19	0.177	5.743	0.173	5.76	17.8035	3.705	3.291
CH-97-9 47.49RR	6.066	6.405	0	0	6.09	16.83767	Expandable	21.3	21.3	n.a.	n.a.	0.18	6.203	16.53292	3.627	3.832
CH-97-9 47.49RR	9.699	10.339	0	0	10.099	10.16279	illite	117	117	0.305	10.098	0.352	10.052	10.21038	40.78	41.16
CH-97-9 47.49RR	13.482	14.626	0	0	14.13	7.27229	Kaolinite	395	395	0.624	14.102	0.663	14.082	7.29724	260.4	262
CH-97-9 47.20	23.777	24.467	63.1	31.9	24.113	4.2824	Quartz	229	181	0.23	24.108	0.233	24.097	4.28522	75.2	42.23
CH-97-9 47.20	31.704	32.106	1.81	6.91	31.875	3.2575	Rutile	33.7	29.7	0.131	31.866	0.136	31.905	3.2546	5.863	4.031
CH-97-9 47.20	34.44	34.925	6.38	7.83	34.643	3.00435	Calcite	44.3	37.3	0.134	34.627	0.149	34.69	3.00034	8.99	5.562
CH-97-9 47.20	36.08	36.811	4.77	4.94	36.312	2.87057	Dolomite	37.7	32.8	0.274	36.342	0.237	36.342	2.86829	11.2	7.786
CH-97-9 47.20RR	5.727	5.986	0	0	5.796	17.69323	Expandable	14.7	14.7	0.092	5.813	0.112	5.833	17.58033	1.723	1.653
CH-97-9 47.20RR	9.799	10.479	0	0	10.088	10.17417	illite	92.3	92.3	0.318	10.075	0.359	10.1	10.16211	32.72	33.14
CH-97-9 47.20RR	13.362	14.927	63.2	37	14.119	7.27791	Kaolinite	321	271	0.592	14.08	0.64	14.098	7.28911	251.8	173.3
CH-97-9 47.64	23.915	24.388	34.1	3.02	24.013	4.29986	Quartz	82	54.4	0.242	24.103	0.222	24.098	4.28503	20.85	12.08
CH-97-9 47.64RR	5.966	6.385	0	0	6.288	16.30952	Expandable	16.6	16.6	0.199	6.228	0.188	6.17	16.62123	3.141	3.112
CH-97-9 47.64RR	6.445	6.764	0	0	6.672	15.3724	Expandable	16.8	16.8	n.a.	n.a.	0.173	6.589	15.56445	2.872	2.92
CH-97-9 47.64RR	9.739	10.319	0	0	10.082	10.17976	illite	128	128	0.282	10.07	0.3	10.048	10.21464	38.27	38.57
CH-97-9 47.64RR	13.142	13.603	0	0	13.338	7.70249	Gypsum	205	205	0.214	13.342	0.245	13.362	7.68852	49.5	50.24
CH-97-9 47.64RR	13.643	14.727	0	0	14.155	7.2596	Kaolinite	150	150	0.525	14.103	0.6	14.127	7.2743	89.53	90.24
CH-97-9 47.81	23.836	24.586	50.7	33.2	24.154	4.27523	Quartz	185	142	0.234	24.159	0.258	24.163	4.27361	68.01	36.68
CH-97-9 47.81	36.12	36.77	11.9	8.21	36.353	2.86747	Dolomite	40.4	29.9	0.224	36.386	0.21	36.441	2.86072	12.92	6.284
CH-97-9 47.81	5.693	5.886	458	541	5.85	17.52797	Expandable	558	32.1	0.03	5.846	-0.077	5.735	17.88004	94.16	-2.455
CH-97-9 47.81RR	5.887	6.166	0	0	5.966	17.18734	Expandable	19.6	19.6	n.a.	n.a.	0.16	6.024	17.02435	2.958	3.144
CH-97-9 47.81RR	9.739	10.479	0	0	10.161	10.1009	illite	83.7	83.7	0.364	10.123	0.408	10.119	10.14309	33.73	34.2
CH-97-9 47.81RR	13.102	15.108	0	0	14.197	7.23849	Kaolinite	275	275	0.594	14.178	0.755	14.138	7.26817	206.9	207.6
CH-97-9 48.00	23.836	24.467	61.9	24.8	24.146	4.27662	Quartz	242	198	0.224	24.146	0.228	24.146	4.27656	72.74	45.22
CH-97-9 48.00	34.622	35.148	14.7	4.43	34.68	3.00123	Alunite	38.7	25.1	0.087	34.707	0.164	34.776	2.9932	9.167	4.113
CH-97-9 48.00	36.12	36.607	6.94	8.13	36.373	2.86588	Dolomite	30.7	23.1	0.226	36.315	0.144	36.398	2.86404	7.164	3.329
CH-97-9 48.00RR	9.819	10.359	0	0	10.094	10.16791	illite	73.2	73.2	0.369	10.078	0.349	10.08	10.18232	25.17	25.57
CH-97-9 48.00RR	13.282	14.988	0	0	14.185	7.24468	Kaolinite	251	251	0.642	14.116	0.785	14.107	7.28427	196.3	197
CH-97-9 48.19	23.974	24.645	63.7	17.5	24.227	4.2626	Quartz	201	155	0.201	24.227	0.212	24.225	4.26282	60.18	32.92
CH-97-9 48.19	31.785	32.226	10.9	18.8	31.909	3.25416	Rutile	36.8	23.6	0.061	31.919	0.042	31.869	3.25813	7.515	1.004
CH-97-9 48.19	34.501	35.188	9.57	1.96	34.861	2.98611	Alunite	52	46.4	0.175	34.833	0.282	34.802	2.991	17.03	13.11

B: XRD PEAK AREAS FOR ASHED "LIGNITE" SAMPLES

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ASHED LIG	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-9 48.19	37.217	37.604	18.2	8.9	37.372	2.79197	Siderite	42.4	27.9	0.188	37.386	0.097	37.384	2.7911	7.936	2.71
CH-97-9 48.19	38.338	38.706	8.44	7.2	38.54	2.71043	Marcasite	33	25.3	0.06	38.522	0.031	38.606	2.70594	3.658	0.78
CH-97-9 48.19RR	4.85	5.129	1.89	-0.3	5.007	20.47943	Mixed layer	17.5	16.8	0.082	5.004	0.11	4.989	20.55346	2.063	1.852
CH-97-9 48.19RR	6.644	6.844	0	0	6.779	15.12852	Expandable	12.2	12.2	0.107	6.744	0.091	6.719	15.26404	1.086	1.105
CH-97-9 48.19RR	9.799	10.479	3	0	10.127	10.13515	illite	127	126	0.298	10.111	0.347	10.114	10.14754	44.35	43.61
CH-97-9 48.19RR	13.442	14.907	0	0	14.17	7.25202	Kaolinite	431	431	0.581	14.127	0.691	14.129	7.27318	296.7	297.8
SG-98-48 31.24	23.757	24.566	30	9.19	24.146	4.27654	Quartz	222	202	0.218	24.137	0.244	24.129	4.27964	65.16	49.42
SG-98-48 31.24	29.126	30.184	74.4	5.38	29.365	3.52901	Anatase	128	69.6	0.472	29.5	0.459	29.53	3.50976	74.19	31.92
SG-98-48 31.24	31.644	32.166	-4.73	-5.03	31.836	3.26138	Rutile	44.3	49.1	0.169	31.884	0.179	31.885	3.25651	6.263	8.802
SG-98-48 31.24	33.513	34.663	17.9	8.93	34.238	3.03875	Calcite	57.1	44.9	0.453	34.142	0.378	34.132	3.04796	32.47	16.98
SG-98-48 31.24	36.059	36.668	13.2	15.1	36.159	2.88231	Dolomite	45.1	31.5	0.22	36.213	0.22	36.331	2.86915	15.51	6.929
SG-98-48 31.24RR	5.528	6.126	0	0	5.87	17.46955	Expandable	22.7	22.7	0.37	5.849	0.357	5.809	17.65155	8.082	8.112
SG-98-48 31.24RR	10.019	10.259	0	0	10.106	10.15611	illite	21.1	21.1	n.a.	n.a.	0.121	10.134	10.12805	2.31	2.559
SG-98-48 31.24RR	13.924	14.666	0	0	14.209	7.23237	Kaolinite	105	105	0.381	14.17	0.401	14.224	7.22482	41.9	42.33
SG-98-48 31.84	23.974	24.408	41.2	36.3	24.159	4.27434	Quartz	93.2	54.1	0.108	24.155	0.109	24.132	4.27898	22.66	5.877
SG98-48 31.84	29.186	29.984	108	37.8	29.481	3.51547	Anatase	196	114	0.317	29.502	0.358	29.531	3.50962	98.95	40.88
SG98-48 31.84	35.816	36.222	-1.5	5.35	35.999	2.89468	Dolomite	40.8	39.2	n.a.	n.a.	0.177	36.063	2.88972	7.286	6.942
SG98-48 31.84	34.017	34.925	8.03	-1.03	34.483	3.01785	Calcite	40.5	37.2	0.089	34.499	0.004	39.152	2.66963	3.368	0.154
SG98-48 31.84	38.216	38.992	6.69	9.46	38.558	2.70916	Marcasite	41	33.1	0.259	38.572	0.284	38.563	2.70883	15.57	9.386
SG-98-48 31.84RR	13.482	14.968	0	0	14.205	7.23434	Kaolinite	287	287	0.338	14.188	0.437	14.183	7.2453	125.5	125.6
SG-98-48 31.98	23.718	24.388	39.6	14.3	24.103	4.28408	Quartz	302	277	0.21	24.097	0.233	24.087	4.2869	82.45	64.65
SG-98-48 31.98	31.644	32.045	1.84	0.92	31.785	3.26652	Rutile	40.8	39.3	0.162	31.81	0.133	31.812	3.26384	5.73	5.213
SG-98-48 31.98RR	5.109	5.428	0	0	5.347	19.17698	Mixed layer	9.69	9.69	n.a.	n.a.	0.106	5.332	19.23057	1.013	1.024
SG-98-48 31.98RR	5.607	6.166	0	0	6.071	16.89253	Expandable	26.9	26.9	0.132	6.037	0.179	5.936	17.27446	4.818	4.821
SG-98-48 31.98RR	7.143	7.243	0	0	7.19	14.2649	Vermiculite	18.3	18.3	0.049	7.19	0.052	7.187	14.27219	0.912	0.95
SG-98-48 31.98RR	9.799	9.999	0	0	9.921	10.34456	illite	28.3	28.3	0.038	9.922	0.062	9.895	10.37211	1.62	1.76
SG-98-48 31.98RR	13.884	14.445	0	0	14.135	7.27004	Kaolinite	85.1	85.1	0.417	14.147	0.412	14.156	7.25901	34.46	35.09
SG-98-48 31.98RR	13.543	13.783	0	0	13.592	7.55876	Halloysite	30.9	30.9	0.218	13.664	0.18	13.662	7.52029	5.401	5.554
SG-98-48 32.20	23.659	24.467	24.2	22	24.091	4.28615	Quartz	304	281	0.211	24.086	0.238	24.07	4.28985	85.46	66.82
SG-98-48 32.20	29.086	29.665	33	23.8	29.308	3.53583	Anatase	84.9	55.5	0.214	29.292	0.192	29.302	3.5365	26.87	10.65
SG-98-48 32.20	31.724	32.045	18.5	-0.36	31.806	3.26441	Rutile	40	26.3	0.128	31.812	0.156	31.83	3.26207	6.972	4.106
SG-98-48 32.20RR	6.385	6.744	0	0	6.513	15.7456	?	30.2	30.2	0.307	6.562	0.252	6.56	15.63265	7.423	7.618
SG-98-48 32.20RR	7.283	7.443	0	0	7.333	13.9879	Vermiculite	18.3	18.3	0.082	7.346	0.087	7.349	13.95801	1.583	1.599
SG-98-48 32.20RR	13.081	13.402	0	0	13.19	7.78842	Gypsum	23.4	23.4	n.a.	n.a.	0.222	13.24	7.759	5.012	5.194
SG-98-48 32.20RR	13.783	14.626	0	0	14.143	7.26598	Kaolinite	142	142	0.427	14.128	0.459	14.153	7.26101	64.67	65.27
SG-98-48 32.40	23.659	24.507	28.7	18.9	24.1	4.2846	Quartz	552	528	0.195	24.098	0.225	24.089	4.28654	139.1	119
SG-98-48 32.40	29.126	29.665	36.2	11.1	29.365	3.52901	Anatase	56.6	31.5	0.13	29.334	0.187	29.345	3.53137	18.65	5.898
SG-98-48 32.40	31.644	32.005	6.04	4.21	31.799	3.26517	Rutile	53.6	48.3	0.107	31.788	0.149	31.795	3.26549	8.972	7.224
SG-98-48 32.40RR	5.887	5.986	0	0	5.921	17.31812	Expandable	21	21	0.056	5.924	0.059	5.929	17.29502	1.199	1.246
SG-98-48 32.40RR	6.006	6.265	0	0	6.136	16.71284	Expandable	24.6	24.6	0.146	6.144	0.151	6.128	16.73504	3.605	3.726
SG-98-48 32.40RR	13.603	13.763	0	0	13.692	7.50412	Halloysite	36.7	36.7	n.a.	n.a.	0.141	13.684	7.5085	4.662	5.165
SG-98-48 32.40RR	13.843	14.486	0	0	14.152	7.2614	Kaolinite	149	149	0.441	14.136	0.433	14.156	7.25913	63.76	64.55
SH-94-3 30.70	23.954	24.546	67.6	24.4	24.143	4.27704	Quartz	150	96.5	0.148	24.15	0.172	24.166	4.27319	43.7	16.6
SH-94-3 30.70	29.246	29.984	56.1	1.19	29.502	3.51304	Anatase	137	100	0.228	29.506	0.227	29.513	3.51173	43.88	22.7
SH-94-3 30.70	34.501	35.148	7.95	3.04	34.706	2.999	Alunite	32.9	26.5	0.254	34.735	0.205	34.757	2.99479	8.895	5.43
SH-94-3 30.70	36.14	36.709	17.3	-2.61	36.364	2.86663	Dolomite	29.1	19.6	0.336	36.393	0.288	36.389	2.86471	9.801	5.644
SH-94-3 30.70RR	7.203	7.323	0	0	7.228	14.19101	Vermiculite	13.2	13.2	0.056	7.242	0.05	7.259	14.12997	0.636	0.66
SH-94-3 30.70RR	10.039	10.319	0	0	10.077	10.18526	illite	53.5	53.5	n.a.	n.a.	0.164	10.141	10.12043	8.526	8.78
SH-94-3 30.70RR	13.543	13.723	0	0	13.669	7.51635	Halloysite	47.7	47.7	n.a.	n.a.	0.124	13.644	7.53004	5.516	5.933

B: XRD PEAK AREAS FOR ASHED "LIGNITE" SAMPLES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
ASHED LIG	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
SH-94-3 30.70RR	13.743	14.646	0	0	14.178	7.24813	Kaolinite	138	138	0.498	14.204	0.526	14.184	7.24521	71.75	72.4
SH-94-4 78.91	23.678	24.368	71.9	54	24.059	4.29175	Quartz	201	139	0.179	24.057	0.205	24.027	4.2975	72.03	28.57
SH-94-4 78.91RR	5.009	5.348	0	0	5.087	20.15574	Mixed layer	11.2	11.2	0.183	5.131	0.203	5.179	19.79745	2.3	2.27
SH-94-4 78.91RR	5.986	6.305	0	0	6.028	17.01116	Expandable	16.9	16.9	0.05	6.029	0.116	6.123	16.74839	1.961	1.96
SH-94-4 78.91RR	9.799	10.259	0	0	10.064	10.19754	illite	52.7	52.7	n.a.	n.a.	0.257	10.052	10.21023	13.18	13.58
SH-94-4 78.91RR	13.202	13.362	0	0	13.311	7.71801	Gypsum	53	53	n.a.	n.a.	0.149	13.29	7.73	7.229	7.916
SH-94-4 78.91RR	13.462	14.586	0	0	14.098	7.28903	Kaolinite	266	266	0.632	14.079	0.639	14.053	7.31218	169.1	170.3

C: XRD PEAK AREAS FOR MUDSTONE ASSOCIATED WITH LIGNITES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
MUDSTONE	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 50.78	23.954	24.546	143	48.5	24.21	4.26549	Quartz	581	478	0.214	24.209	0.232	24.215	4.26467	167.8	110.8
MBR-97-32A 50.78	37.177	37.747	13.5	-1.43	37.347	2.79371	Siderite	49.4	40.4	0.155	37.375	0.157	37.435	2.78738	9.792	6.352
MBR-97-32A 50.78	38.277	38.992	12.8	2.65	38.481	2.71437	Marcasite	48.8	38.9	0.455	38.638	0.42	38.631	2.70425	21.84	16.32
MBR-97-32A 50.78RR	5.308	6.305	1.22	0.84	5.867	17.4794	Expanded	30.3	29.3	0.692	5.923	0.644	5.854	17.51728	19.9	18.84
MBR-97-32A 50.78RR	10.019	10.399	0	0	10.198	10.06385	illite	90.1	90.1	0.251	10.216	0.247	10.206	10.05596	21.84	22.27
MBR-97-32A 50.78RR	13.703	15.008	0	0	14.237	7.21804	Kaolinite	462	462	0.595	14.206	0.663	14.246	7.21363	304.8	306.3
MBR-97-32A 53.62	23.974	24.526	156	44.5	24.139	4.27781	Quartz	768	645	0.199	24.14	0.211	24.144	4.27695	190.5	136.2
MBR-97-32A 53.62	37.116	37.543	10.6	5.96	37.337	2.79444	Siderite	67.6	59.4	0.078	37.353	0.119	37.332	2.79483	10.64	7.054
MBR-97-32A 53.62RR	5.488	6.325	0	0	5.774	17.75845	Expanded	35.8	35.8	0.472	5.815	0.456	5.88	17.44115	16.21	16.3
MBR-97-32A 53.62RR	7.143	7.622	0	0	7.366	13.9244	Vermiculite	23.1	23.1	n.a.	n.a.	0.334	7.362	13.93257	7.546	7.714
MBR-97-32A 53.62RR	9.939	10.359	0	0	10.169	10.0934	illite	126	126	0.312	10.125	0.281	10.142	10.11947	34.77	35.47
MBR-97-32A 53.62RR	13.663	14.847	0	0	14.171	7.25162	Kaolinite	350	350	0.617	14.137	0.674	14.178	7.24807	234.1	235.9
MBR-97-32A 55.42	23.915	24.467	130	45.2	24.139	4.27775	Quartz	308	212	0.218	24.151	0.221	24.146	4.27662	95.51	46.89
MBR-97-32A 55.42	31.644	32.045	12.7	7.37	31.856	3.25941	Rutile	52.7	42.8	0.191	31.848	0.205	31.839	3.2611	12.81	8.769
MBR-97-32A 55.42RR	9.939	10.419	0	0	10.104	10.15771	illite	77.6	77.6	0.33	10.128	0.321	10.154	10.10797	24.43	24.91
MBR-97-32A 55.42RR	5.627	6.226	0	0	5.701	17.9864	Expanded	23.8	23.8	0.325	5.808	0.367	5.892	17.40467	8.692	8.744
MBR-97-32A 55.42RR	13.442	15.369	0	0	14.166	7.25426	Kaolinite	781	781	0.598	14.132	0.727	14.171	7.25144	566.6	567.9
MBR-97-32A 61.72	23.915	24.605	167	17.3	24.15	4.27585	Quartz	819	704	0.201	24.148	0.215	24.152	4.27562	214.6	151
MBR-97-32A 61.72	31.624	32.146	2.45	4.88	31.87	3.258	Rutile	44.2	40.6	0.207	31.865	0.213	31.847	3.26029	10.62	8.63
MBR-97-32A 61.72RR	5.607	6.345	0	0	6.027	17.01596	Expanded	41.9	41.9	0.591	5.915	0.516	5.944	17.25332	21.51	21.64
MBR-97-32A 61.72RR	9.839	10.379	0	0	10.219	10.04379	illite	71.7	71.7	0.333	10.121	0.328	10.127	10.13515	23.14	23.51
MBR-97-32A 61.72RR	13.643	14.706	0	0	14.166	7.2539	Kaolinite	368	368	0.605	14.119	0.635	14.139	7.26816	231.8	233.7
MBR-97-32A 62.20	23.895	24.428	139	89.2	24.148	4.27623	Quartz	531	416	0.213	24.148	0.222	24.141	4.27746	153.1	92.29
MBR-97-32A 62.20	37.075	37.523	16.2	12.3	37.304	2.79688	Siderite	72	57.8	0.184	37.279	0.196	37.291	2.79779	17.84	11.35
MBR-97-32A 62.20RR	5.448	6.325	0	0	5.525	18.56054	Expanded	22.7	22.7	0.476	5.711	0.607	5.853	17.52151	13.7	13.77
MBR-97-32A 62.20RR	7.063	7.482	0	0	7.164	14.31733	Vermiculite	17.8	17.8	0.151	7.227	0.163	7.262	14.1234	2.935	2.904
MBR-97-32A 62.20RR	9.859	10.479	0	0	10.159	10.10314	illite	251	251	0.265	10.15	0.314	10.146	10.11605	78.2	78.91
MBR-97-32A 62.20RR	13.503	15.128	0	0	14.177	7.24829	Kaolinite	684	684	0.536	14.16	0.637	14.164	7.25518	434.4	435.5
MBR-97-32A 68.55	23.915	24.487	95.7	82.4	24.189	4.2692	Quartz	512	423	0.231	24.186	0.234	24.178	4.27105	150.3	99.18
MBR-97-32A 68.55	31.684	32.086	3.74	22.3	31.924	3.25266	Rutile	73.9	59	0.129	31.886	0.143	31.885	3.25657	13.51	8.422
MBR-97-32A 68.55	37.156	37.625	4.45	6.65	37.397	2.79017	Siderite	57.1	51.5	0.102	37.38	0.168	37.369	2.79214	11.28	8.647
MBR-97-32A 68.55RR	5.368	5.787	0	0	5.604	18.29773	Expanded	20.8	20.8	0.198	5.586	0.199	5.591	18.34006	4.127	4.14
MBR-97-32A 68.55RR	5.807	6.246	0	0	5.855	17.51538	Expanded	24.2	24.2	0.234	5.939	0.221	6.008	17.06718	5.348	5.35
MBR-97-32A 68.55RR	7.043	7.462	0	0	7.223	14.20062	Vermiculite	28.7	28.7	0.223	7.252	0.258	7.228	14.19034	7.283	7.396
MBR-97-32A 68.55RR	9.939	10.519	0	0	10.196	10.06614	illite	127	127	0.3	10.173	0.331	10.198	10.06384	41.45	42.07
MBR-97-32A 68.55RR	13.402	14.907	0	0	14.196	7.239	Kaolinite	333	333	0.685	14.141	0.774	14.133	7.27107	256.2	257.6
MBR-97-32A 71.42	23.856	24.507	108	84.7	24.139	4.27775	Quartz	497	399	0.204	24.14	0.23	24.139	4.27791	154.5	91.84
MBR-97-32A 71.42	31.644	32.106	6.64	16.1	31.857	3.2593	Rutile	59.7	48.7	0.155	31.835	0.14	31.834	3.26162	11.93	6.818
MBR-97-32A 71.42	37.116	37.645	9.41	4.25	37.387	2.79085	Siderite	52.8	46	0.206	37.33	0.204	37.349	2.79361	13.03	9.401
MBR-97-32A 71.42RR	5.787	6.345	0	0	6.177	16.60098	Expanded	26.1	26.1	0.17	6.122	0.263	6.063	16.91405	6.682	6.876
MBR-97-32A 71.42RR	7.143	7.283	0	0	7.215	14.21662	Vermiculite	27.2	27.2	0.093	7.203	0.091	7.211	14.22365	2.329	2.482
MBR-97-32A 71.42RR	9.759	10.399	0	0	10.155	10.10686	illite	143	143	0.304	10.131	0.332	10.107	10.15462	46.82	47.29
MBR-97-32A 71.42RR	13.382	14.706	0	0	14.159	7.25783	Kaolinite	336	336	0.615	14.115	0.706	14.075	7.30054	236	237.2
MBR-97-32A 75.20	23.954	24.388	178	96	24.11	4.28293	Quartz	342	193	0.177	24.116	0.183	24.123	4.28055	94.79	35.37
MBR-97-32A 75.20	31.724	32.086	34.8	9.47	31.888	3.25628	Rutile	72.8	49.4	0.094	31.889	0.079	31.912	3.25391	11.8	3.899
MBR-97-32A 75.20	34.461	35.107	20.1	12.3	34.729	2.9971	Alunite	66.9	50	0.178	34.742	0.178	34.723	2.99757	19.37	8.913
MBR-97-32A 75.20RR	6.844	7.403	0	0	7.003	14.6463	Vermiculite	36.7	36.7	0.284	7.022	0.277	7.097	14.45102	9.972	10.16
MBR-97-32A 75.20RR	9.819	10.279	0	0	10.08	10.18163	illite	44.9	44.9	0.23	10.075	0.264	10.069	10.19266	11.79	11.86

C: XRD PEAK AREAS FOR MUDSTONE ASSOCIATED WITH LIGNITES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
MUDSTONE	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 75.20RR	13.302	14.968	0	0	14.084	7.29602	Kaolinite	420	420	0.732	14.036	0.82	14.054	7.31144	343.1	344.2
MBR-97-32A 76.22	31.644	32.065	-5.01	1.06	31.859	3.25911	Rutile	49.2	51.1	0.185	31.842	0.177	31.837	3.26133	8.367	9.051
MBR-97-32A 76.22	34.319	35.229	5.01	0.13	34.734	2.99666	Alunite	54.1	51.3	0.333	34.664	0.309	34.782	2.99272	18.17	15.84
MBR-97-32A 76.22	30.723	31.083	49	81.6	30.933	3.35417	Quartz	351	283	0.19	30.921	0.191	30.918	3.3558	77.36	54.12
MBR-97-32A 76.22RR	5.587	5.946	0	0	5.825	17.6032	Expanded	15.6	15.6	0.169	5.794	0.207	5.746	17.84499	3.255	3.218
MBR-97-32A 76.22RR	6.605	6.944	0	0	6.869	14.93097	Vermiculite	19.5	19.5	0.168	6.813	0.132	6.786	15.11261	2.614	2.566
MBR-97-32A 76.22RR	9.819	10.439	0	0	10.069	10.19319	illite	33.4	33.4	0.282	10.083	0.329	10.112	10.14938	11.01	11
MBR-97-32A 76.22RR	13.021	15.369	0	0	14.131	7.27183	Kaolinite	672	672	0.677	14.099	0.85	14.093	7.29128	570.7	571.5
MBR-97-32A 79.50	23.777	24.605	55.9	52.1	24.189	4.26904	Quartz	680	626	0.246	24.186	0.263	24.17	4.27244	209.6	164.5
MBR-97-32A 79.50	37.075	37.726	5.56	1.23	37.419	2.78854	Siderite	69.9	66.6	0.262	37.38	0.291	37.376	2.79167	21.53	19.41
MBR-97-32A 79.50RR	5.448	6.465	0	0	6.054	16.94003	Expanded	35.9	35.9	0.571	5.92	0.529	5.915	17.3375	19.05	18.98
MBR-97-32A 79.50RR	9.719	10.519	0	0	10.186	10.0757	illite	165	165	0.358	10.168	0.401	10.152	10.10967	65.51	66.07
MBR-97-32A 79.50RR	13.603	14.947	0	0	14.211	7.23116	Kaolinite	307	307	0.626	14.185	0.693	14.201	7.23621	211.5	212.6
MBR-97-32A 80.40	23.836	24.467	86.8	64.2	24.17	4.27239	Quartz	475	400	0.21	24.157	0.22	24.152	4.27555	135.8	88.26
MBR-97-32A 80.40	31.604	32.186	13.7	44.2	31.884	3.2567	Rutile	120	91.9	0.189	31.873	0.178	31.865	3.25858	33.11	16.38
MBR-97-32A 80.40	37.055	37.767	5.64	9.66	37.279	2.79864	Siderite	52.1	45.2	0.153	37.322	0.237	37.356	2.79309	15.87	10.73
MBR-97-32A 80.40	38.338	38.951	11.2	16.5	38.602	2.70618	Marcasite	44.4	31	0.217	38.561	0.193	38.611	2.70557	14.38	5.98
MBR-97-32A 80.40RR	6.664	7.742	0	0	6.954	14.74917	Vermiculite	34.6	34.6	0.67	7.206	0.605	7.182	14.28126	20.86	20.95
MBR-97-32A 80.40RR	9.619	10.779	0	0	10.219	10.04379	illite	85	85	0.431	10.131	0.46	10.138	10.12376	39.17	39.15
MBR-97-32A 80.40RR	13.202	15.108	0	0	14.225	7.22435	Kaolinite	377	377	0.692	14.134	0.837	14.098	7.28891	314.4	315.6
MBR-97-32A 84.34	23.875	24.546	72.2	19.8	24.202	4.26682	Quartz	502	456	0.231	24.202	0.248	24.199	4.26735	144	113.2
MBR-97-32A 84.34	36.994	37.788	9.88	-1.3	37.389	2.79073	Siderite	104	99.2	0.282	37.389	0.294	37.392	2.79048	32.49	29.13
MBR-97-32A 84.34RR	5.428	6.485	0	0	6.086	16.84996	Expanded	31.1	31.1	0.737	5.898	0.702	5.922	17.31479	21.8	21.8
MBR-97-32A 84.34RR	9.759	10.759	0	0	10.205	10.05736	illite	207	207	0.379	10.183	0.432	10.206	10.05634	88.94	89.38
MBR-97-32A 84.34RR	13.282	14.947	0	0	14.245	7.21389	Kaolinite	499	499	0.541	14.22	0.666	14.185	7.24461	332	332.7
MBR-97-32A 94.27	38.24	39.36	31	11.8	38.56	2.70904	Marcasite	135	109	0.484	38.663	0.534	38.708	2.69905	82.12	58.39
MBR-97-32A 94.27	34.64	35.16	6.86	-0.16	34.948	2.97891	Alunite	45	42.3	0.21	34.919	0.238	34.87	2.98534	11.77	10.05
MBR-97-32A 94.27RR	5.54	5.98	0	0	5.697	17.99809	Expanded	15.4	15.4	0.166	5.699	0.169	5.719	17.93136	2.568	2.595
MBR-97-32A 94.27RR	9.9	10.38	0	0	10.202	10.06046	illite	32.4	32.4	n.a.	n.a.	0.28	10.123	10.13912	8.829	9.069
MBR-97-32A 94.27RR	13.32	14.98	0	0	14.215	7.22905	Kaolinite	449	449	0.595	14.183	0.736	14.162	7.25605	329.4	330.2
MBR-97-32A 94.93	35.775	36.323	6.25	20.9	36.008	2.89397	Dolomite	43.4	30.9	0.102	36.037	0.08	36.068	2.88936	9.833	2.475
MBR-97-32A 94.93RR	6.744	7.223	0	0	7.064	14.52045	Vermiculite	18.3	18.3	0.153	7.013	0.174	6.966	14.72262	3.258	3.183
MBR-97-32A 94.93RR	5.129	5.847	0	0	5.489	18.68188	Expanded	19.8	19.8	0.402	5.466	0.41	5.481	18.70916	8.103	8.116
MBR-97-32A 94.93RR	9.899	10.419	0	0	10.174	10.08844	illite	52.8	52.8	0.337	10.15	0.322	10.152	10.10956	16.72	17.02
MBR-97-32A 94.93RR	13.302	14.787	0	0	14.183	7.24525	Kaolinite	620	620	0.546	14.176	0.671	14.116	7.2799	414.7	415.9
MBR-97-32A 96.13RR	5.288	6.006	0	0	5.733	17.88793	Expanded	23	23	0.262	5.717	0.324	5.655	18.13342	7.47	7.439
MBR-97-32A 96.13RR	9.759	10.439	0	0	10.131	10.13071	illite	61	61	0.344	10.098	0.36	10.101	10.16028	21.71	21.96
MBR-97-32A 96.13RR	13.142	15.008	0	0	14.157	7.25872	Kaolnite	841	841	0.551	14.129	0.685	14.096	7.28981	575.1	576.2
MBR-97-32A 101.17	23.935	24.566	117	63.6	24.236	4.26101	Quartz	443	351	0.237	24.235	0.259	24.229	4.26222	147.9	90.85
MBR-97-32A 101.17	37.116	37.625	11.1	21.5	37.341	2.79418	Siderite	56.8	41.1	0.161	37.363	0.169	37.331	2.79492	15.45	6.962
MBR97-32A 101.17RR	5.787	6.146	0	0	6.048	16.95527	Expanded	25.6	25.6	0.317	5.957	0.273	5.963	17.19806	6.803	6.989
MBR97-32A 101.17RR	7.143	7.443	0	0	7.21	14.22505	Vermiculite	21.5	21.5	n.a.	n.a.	0.212	7.275	14.09947	4.388	4.549
MBR97-32A 101.17RR	10.079	10.419	0	0	10.242	10.02151	illite	76.5	76.5	0.297	10.247	0.255	10.247	10.01638	19.13	19.5
MBR97-32A 101.17RR	13.803	14.807	0	0	14.28	7.1964	Kaolinite	508	508	0.552	14.258	0.57	14.273	7.19993	287.4	289.4
MBR-97-32A 105.16	24.112	24.408	139	95.5	24.309	4.24831	Quartz	197	86.5	0.216	24.25	0.212	24.263	4.25637	52.63	18.29
MBR-97-32A 105.16	31.745	32.266	12.7	8.28	31.997	3.24542	Rutile	73.8	63.3	0.246	32.005	0.254	31.99	3.24612	21.41	16.08

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Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
MUDSTONE	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
MBR-97-32A 105.16RR	6.784	7.662	0	0	7.243	14.16114	Vermiculite	47.9	47.9	0.67	7.198	0.612	7.236	14.1748	29.13	29.31
MBR-97-32A 105.16RR	13.623	14.988	0	0	14.286	7.19372	Kaolinite	272	272	0.629	14.248	0.72	14.249	7.21184	194.5	195.5
MBR-97-32A 108.15	31.604	32.166	2.23	8.51	31.835	3.26153	Rutile	52.6	47.8	0.216	31.826	0.225	31.886	3.25641	13.89	10.74
MBR-97-32A 108.15RR	6.884	7.522	0	0	7.202	14.2423	Vermiculite	54.6	54.6	0.584	7.199	0.45	7.196	14.25363	24.25	24.59
MBR-97-32A 108.15RR	13.442	14.827	0	0	14.18	7.24676	Kaolinite	494	494	0.63	14.149	0.703	14.128	7.27364	345.4	346.9
MBR-97-32A 109.96RR	7.163	7.363	8.51	3.04	7.223	14.19943	Vermiculite	24.4	17.5	0.08	7.233	0.082	7.239	14.16926	2.647	1.442
MBR-97-32A 109.96RR	5.667	6.066	0	0	5.751	17.83153	Expanded	11.1	11.1	0.21	5.793	0.189	5.81	17.65054	2.154	2.101
MBR-97-32A 109.96RR	9.939	10.379	0	0	10.082	10.18025	illite	55.6	55.6	0.145	10.099	0.246	10.152	10.10979	13.27	13.66
MBR-97-32A 109.96RR	13.162	13.543	49.7	108	13.39	7.67254	Gypsum	133	48	0.142	13.372	0.182	13.347	7.69694	38.73	8.745
MBR-97-32A 109.96RR	13.543	15.108	0	0	14.225	7.22435	Kaolinite	439	439	0.593	14.15	0.696	14.171	7.2516	303.9	305.2
MBR-97-32A 109.96RR	8.061	8.321	0	0	8.102	12.66223	Expanded	17.1	17.1	n.a.	n.a.	0.152	8.187	12.53008	2.44	2.613
MBR-97-32A 110.57	31.704	32.186	11	12.1	31.865	3.25856	Rutile	42.4	31	0.22	31.885	0.161	31.877	3.25733	10.65	4.982
MBR-97-32A 110.57RR	6.944	7.243	0	0	7.012	14.62644	Vermiculite	35.8	35.8	0.228	7.079	0.191	7.081	14.48388	6.628	6.828
MBR-97-32A 110.57RR	13.282	15.148	0	0	14.185	7.24453	Kaolinite	409	409	0.633	14.149	0.767	14.123	7.27621	312.8	313.5
MBR-97-32A 113.76	23.915	24.388	166	116	24.154	4.27515	Quartz	601	461	0.201	24.159	0.216	24.152	4.27561	166.3	99.49
MBR-97-32A 113.76	34.319	34.885	22	21.6	34.428	3.02254	Calcite	70	48.1	0.128	34.469	0.175	34.562	3.0111	20.86	8.407
MBR-97-32A 113.76	31.624	32.086	-5.55	7.16	31.837	3.26128	Rutile	61.9	61.5	0.178	31.859	0.192	31.849	3.26013	12.12	11.79
MBR-97-32A 113.60RR	13.603	14.807	0	0	14.157	7.25891	Kaolinite	267	267	0.576	14.144	0.659	14.145	7.26463	175.2	176.1
MBR-97-32A 113.60RR	8.041	8.321	0	0	8.259	12.42103	Expanded	25.2	25.2	0.116	8.232	0.098	8.214	12.48939	2.457	2.464
MBR-97-32A 113.60RR	5.607	6.265	0	0	5.758	17.80828	Expanded	25.1	25.1	0.286	5.818	0.361	5.899	17.38451	8.979	9.068
MBR-97-32A 129.08	23.816	24.625	78.1	49.3	24.242	4.25984	Quartz	1268	1205	0.25	24.234	0.276	24.229	4.26217	383.9	332.2
MBR-97-32A 129.08	27.734	28.469	11.2	2.28	28.03	3.69356	Muscovite	162	155	0.225	28.022	0.241	28.018	3.69515	42.22	37.29
MBR-97-32A 129.07RR	5.368	6.385	0	0	5.946	17.24514	Expanded	70.7	70.7	0.647	5.946	0.616	5.899	17.38221	43.43	43.53
MBR-97-32A 129.07RR	9.899	10.279	0	0	10.219	10.04356	illite	29.7	29.7	0.183	10.158	0.196	10.111	10.15081	5.754	5.826
MBR-97-32A 129.07RR	13.924	14.807	0	0	14.153	7.2606	Kaolinite	88	88	n.a.	n.a.	0.586	14.269	7.20197	50.86	51.6
MBR-97-32A 138.55	23.935	24.526	105	32.8	24.213	4.26486	Quartz	735	664	0.225	24.215	0.237	24.214	4.26474	198.6	157.4
MBR-97-32A 138.55	29.346	29.884	27	18.6	29.627	3.49849	Anatase	87.1	64.4	0.302	29.659	0.286	29.615	3.49989	30.75	18.41
MBR-97-32A 138.55	33.05	33.614	17.1	41.5	33.219	3.12923	Jarosite	66.9	42.5	0.283	33.28	0.224	33.274	3.12423	25.94	9.505
MBR-97-32A 138.55	37.014	37.706	7.48	9.89	37.37	2.79206	Siderite	83.6	74.9	0.15	37.323	0.211	37.332	2.79481	21.85	15.84
MBR-97-32A 138.55	38.216	38.87	12.4	12.4	38.532	2.71091	Marcasite	178	165	0.193	38.535	0.213	38.535	2.71074	43.31	35.16
MBR-97-32A 138.55RR	5.587	6.385	0	0	5.839	17.56215	Expanded	25.6	25.6	0.421	5.88	0.426	5.93	17.29224	10.96	10.92
MBR-97-32A 138.55RR	9.879	10.399	0	0	10.14	10.12218	illite	192	192	0.337	10.104	0.325	10.121	10.1407	61.21	62.54
MBR-97-32A 138.55RR	13.924	14.466	0	0	14.104	7.2857	Kaolinite	47.2	47.2	n.a.	n.a.	0.481	14.181	7.24667	22.03	22.69
CH-97-10B 35.98	23.777	24.447	73.3	43	24.149	4.27608	Quartz	501	445	0.235	24.14	0.254	24.135	4.27858	151.9	112.9
CH-97-10B 35.98	31.644	32.126	20.4	37.8	31.861	3.25896	Rutile	102	73.4	0.19	31.881	0.169	31.868	3.25824	26.27	12.42
CH-97-10B 35.98	36.994	37.686	9.19	11	37.409	2.78925	Siderite	78.5	68.2	0.197	37.34	0.245	37.328	2.79512	23.63	16.7
CH-97-10B 35.98RR	5.348	6.206	0	0	6.007	17.07129	Expandable	33.3	33.3	0.621	5.801	0.55	5.804	17.66638	18.24	18.3
CH-97-10B 35.98RR	9.779	10.539	0	0	10.179	10.08314	illite	210	210	0.369	10.122	0.419	10.13	10.13197	87.13	88.09
CH-97-10B 35.98RR	13.462	14.706	0	0	14.161	7.25675	Kaolinite	473	473	0.601	14.114	0.675	14.094	7.2912	317.6	319.4
CH-97-10B 38.59	23.875	24.487	119	49.2	24.098	4.28491	Quartz	527	434	0.191	24.098	0.204	24.103	4.28411	140.2	88.36
CH-97-10B 38.59	36.973	37.543	21	18.2	37.261	2.79994	Siderite	71.9	52.3	0.222	37.301	0.186	37.285	2.79822	20.9	9.718
CH-97-10B 38.59	31.604	32.005	17.9	22.5	31.817	3.26329	Rutile	95.3	74.9	0.145	31.822	0.151	31.818	3.26327	19.4	11.32
CH-97-10B 38.59RR	9.919	10.439	0	0	10.154	10.10768	illite	186	186	0.287	10.15	0.315	10.157	10.10509	57.29	58.56
CH-97-10B 38.59RR	13.442	14.927	0	0	14.19	7.24205	Kaolinite	592	592	0.517	14.168	0.648	14.148	7.2634	382.7	383.9
CH-97-10B 38.59RR	5.807	6.246	0	0	5.939	17.26542	Expandable	23.4	23.4	n.a.	n.a.	0.244	5.987	17.12783	5.553	5.7
CH-97-10B 40.08	23.757	24.507	83.8	37.8	24.115	4.28199	Quartz	628	566	0.211	24.113	0.237	24.105	4.2837	179.5	134

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MUDSTONE	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-10B 40.08	31.604	32.045	-0.87	12.3	31.804	3.26459	Rutile	62.8	57.7	0.153	31.829	0.152	31.794	3.26561	11.22	8.752
CH-97-10B 40.08	37.055	37.625	10.8	9.36	37.401	2.78987	Siderite	56.8	46.8	0.083	37.376	0.104	37.307	2.7966	10.51	4.847
CH-97-10B 40.03RR	5.707	6.226	0	0	5.791	17.7067	Expandable	20.3	20.3	0.227	5.866	0.287	5.936	17.2754	5.705	5.828
CH-97-10B 40.03RR	9.779	10.419	0	0	10.065	10.19663	illite	144	144	0.261	10.083	0.321	10.068	10.19403	45.84	46.21
CH-97-10B 40.03RR	13.523	14.686	0	0	14.103	7.28643	Kaolinite	452	452	0.559	14.063	0.637	14.063	7.30681	285.6	287.6
CH-97-10B 41.84	23.856	24.368	127	105	24.144	4.277	Quartz	506	391	0.23	24.151	0.245	24.137	4.27823	155.6	95.85
CH-97-10B 41.84	36.039	36.607	8.32	9.88	36.37	2.86617	Dolomite	36.5	27.2	0.191	36.338	0.194	36.341	2.86834	10.48	5.276
CH-97-10B 41.84	37.197	37.726	15.8	1.26	37.399	2.79002	Siderite	57.9	47.7	0.108	37.395	0.129	37.414	2.78894	10.6	6.168
CH-97-10B 41.89RR	5.587	6.046	0	0	5.945	17.24791	Expandable	23.3	23.3	n.a.	n.a.	0.318	5.823	17.6108	7.249	7.41
CH-97-10B 41.89RR	6.944	7.323	0	0	7.079	14.48813	Vermiculite	18.3	18.3	0.128	7.098	0.156	7.133	14.37861	2.845	2.858
CH-97-10B 41.89RR	9.959	10.399	0	0	10.217	10.04599	illite	63.1	63.1	0.222	10.156	0.218	10.157	10.10489	13.35	13.75
CH-97-10B 41.89RR	13.503	15.088	0	0	14.178	7.24782	Kaolinite	304	304	0.671	14.11	0.75	14.166	7.25411	227.1	228.2
CH-97-10B 46.65	23.875	24.428	75.7	54.1	24.226	4.26274	Quartz	466	404	0.221	24.231	0.237	24.221	4.26351	131.5	95.73
CH-97-10B 46.65	31.684	32.206	22.2	55.9	31.948	3.25031	Rutile	120	80.6	0.165	31.94	0.145	31.917	3.25334	32.13	11.69
CH-97-10B 46.65	37.156	37.991	11.5	-2.76	37.401	2.78984	Siderite	113	105	0.197	37.433	0.229	37.471	2.78483	27.81	24.14
CH9710B46.65RR	5.627	6.305	0	0	5.673	18.07472	Expanded	32.1	32.1	n.a.	n.a.	0.44	5.933	17.28417	13.9	14.13
CH9710B46.65RR	8.041	8.481	0	0	8.26	12.42058	Expanded	26.3	26.3	n.a.	n.a.	0.227	8.249	12.43718	5.733	5.964
CH9710B46.65RR	9.739	10.719	0	0	10.186	10.07633	illite	254	254	0.295	10.18	0.38	10.179	10.08315	96.16	96.58
CH9710B46.65RR	13.442	14.947	0	0	14.22	7.22689	Kaolinite	511	511	0.515	14.197	0.655	14.172	7.25099	333.8	334.9
CH-97-10B 47.40	23.895	24.526	151	59.8	24.134	4.27865	Quartz	410	294	0.201	24.141	0.228	24.139	4.27776	133.6	67.06
CH-97-10B 47.40	31.624	32.106	5.31	3.01	31.847	3.26036	Rutile	58.7	54.4	0.189	31.882	0.212	31.862	3.25885	13.32	11.56
CH-97-10B 47.40	37.095	37.665	11.4	8.75	37.307	2.79664	Siderite	49.4	39	0.195	37.33	0.213	37.325	2.79532	14.04	8.305
CH-97-10B 47.40RR	5.687	6.106	0	0	5.766	17.78379	Expanded	18.4	18.4	0.229	5.818	0.25	5.873	17.45957	4.548	4.593
CH-97-10B 47.40RR	9.999	10.419	0	0	10.161	10.10136	illite	111	111	0.277	10.154	0.256	10.179	10.08322	28.03	28.47
CH-97-10B 47.40RR	13.282	13.523	0	0	13.429	7.65016	?	96.1	96.1	n.a.	n.a.	0.223	13.409	7.66144	20.15	21.49
CH-97-10B 47.40RR	13.643	14.807	0	0	14.188	7.24312	Kaolinite	421	421	0.583	14.166	0.632	14.172	7.25108	264.5	266.2
CH-97-10B 48.64	23.797	24.507	101	42	24.134	4.27879	Quartz	766	693	0.211	24.136	0.237	24.126	4.28018	214.8	164
CH-97-10B 48.64	31.564	32.106	-0.9	34.8	31.88	3.25701	Rutile	102	81.6	0.175	31.828	0.168	31.834	3.26158	22.87	13.7
CH-97-10B 48.64	37.075	37.726	19.4	9.22	37.366	2.79238	Siderite	74.8	59.9	0.192	37.329	0.2	37.324	2.79542	21.32	11.97
CH-97-10B 48.64RR	5.428	6.485	0	0	5.934	17.2817	Expanded	36.7	36.7	0.728	5.897	0.638	5.913	17.34174	23.41	23.44
CH-97-10B 48.64RR	9.919	10.459	0	0	10.203	10.05975	illite	232	232	0.284	10.191	0.304	10.185	10.07723	69.96	70.67
CH-97-10B 48.64RR	13.683	14.927	0	0	14.227	7.22332	Kaolinite	391	391	0.515	14.206	0.609	14.215	7.22939	237.3	238.5
CH-97-10B 55.05	23.875	24.586	97.6	37.7	24.216	4.26446	Quartz	626	557	0.238	24.204	0.25	24.206	4.26621	187.5	139.4
CH-97-10B 55.05	31.684	32.206	14.1	35.4	31.927	3.25241	Rutile	65.6	41.6	0.137	31.889	0.09	31.789	3.2661	16.74	3.763
CH-97-10B 55.05RR	5.568	6.405	0	0	5.961	17.20355	Expanded	39.6	39.6	0.653	5.933	0.592	5.954	17.22418	23.36	23.44
CH-97-10B 55.05RR	9.879	10.519	0	0	10.248	10.01541	illite	99.4	99.4	0.284	10.228	0.338	10.213	10.04977	33.14	33.65
CH-97-10B 55.05RR	13.603	14.968	0	0	14.266	7.2035	Kaolinite	389	389	0.555	14.242	0.657	14.242	7.21562	254.5	255.6
CH-97-10B 59.00	23.895	24.526	93.4	48.4	24.129	4.27951	Quartz	215	139	0.239	24.143	0.216	24.148	4.27618	74.77	29.93
CH-97-10B 59.00	31.624	32.146	5.31	34.8	31.844	3.26066	Rutile	99.4	81.7	0.163	31.864	0.147	31.835	3.26153	22.5	12.03
CH-97-10B 59.00	37.075	37.726	14.1	5.94	37.3	2.79711	Siderite	107	95.4	0.147	37.348	0.173	37.356	2.79309	23.06	16.48
CH-97-10B 59.00	38.236	38.808	11.5	2.63	38.475	2.71477	Marcasite	136	128	0.2	38.468	0.228	38.481	2.71436	33.38	29.22
CH-97-10B 59.00	42.987	43.485	3.6	3.32	43.243	2.42753	Pyrite	100	96.9	0.217	43.259	0.22	43.242	2.42758	22.94	21.28
CH-97-10B 59.00RR	5.667	5.966	0	0	5.816	17.63074	Expanded	20.5	20.5	0.162	5.816	0.163	5.8	17.6812	3.277	3.341
CH-97-10B 59.00RR	9.659	10.639	0	0	10.161	10.10082	illite	292	292	0.281	10.153	0.369	10.141	10.1204	107.3	107.7
CH-97-10B 59.00RR	13.242	15.048	0	0	14.193	7.24041	Kaolinite	1212	1212	0.478	14.179	0.597	14.152	7.26148	722.7	723.7
CH-97-10B 60.54	23.935	24.447	95.4	73.9	24.158	4.27447	Quartz	174	88	0.24	24.181	0.223	24.154	4.27513	62.88	19.59
CH-97-10B 60.54	31.664	32.186	0.99	28.3	31.955	3.2496	Rutile	74.9	58.7	0.176	31.917	0.159	31.896	3.25547	16.94	9.317
CH-97-10B 60.54	37.136	37.767	4.54	-1.33	37.317	2.79594	Siderite	66.6	63.8	0.242	37.374	0.252	37.38	2.79135	17	16.04

C: XRD PEAK AREAS FOR MUDSTONE ASSOCIATED WITH LIGNITES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
MUDSTONE	2-Theta °	2-Theta °	Cps	Cps	2-Theta °	Angstrom		Cps	Cps	2-Theta °	2-Theta °	2-Theta °	2-Theta °	Angstrom	Cps x 2-Theta °	Cps x 2-Theta °
CH-97-10B 60.54RR	4.95	5.368	0	0	5.331	19.23318	Mixed layer	13.4	13.4	n.a.	n.a.	0.268	5.187	19.76866	3.437	3.595
CH-97-10B 60.54RR	5.647	5.946	0	0	5.802	17.67539	Expanded	23.1	23.1	n.a.	n.a.	0.24	5.785	17.72585	5.332	5.536
CH-97-10B 60.54RR	9.859	10.539	0	0	10.2	10.06227	illite	174	174	0.329	10.178	0.352	10.182	10.08007	60.55	61.03
CH-97-10B 60.54RR	13.322	15.048	0	0	14.239	7.21718	Kaolinite	1222	1222	0.48	14.22	0.596	14.207	7.23328	727.1	728.2
CH-97-10B 85.57	23.757	24.526	49.7	25	24.183	4.2702	Quartz	878	842	0.228	24.176	0.257	24.165	4.2733	245.6	216.6
CH-97-10B 85.57	31.704	32.106	23.2	40.9	31.893	3.25576	Rutile	114	82.3	0.156	31.885	0.162	31.894	3.25561	26.31	13.34
CH-97-10B 85.57	37.055	37.706	9.08	-1.39	37.334	2.79469	Siderite	61	56.4	0.18	37.359	0.252	37.407	2.78939	16.81	14.21
CH-97-10B 85.57RR	5.428	6.425	0	0	5.827	17.59893	Expanded	49.2	49.2	0.605	5.949	0.648	5.895	17.39438	31.82	31.92
CH-97-10B 85.57RR	9.759	10.519	0	0	10.197	10.06497	illite	165	165	0.303	10.162	0.349	10.152	10.10992	57.45	57.74
CH-97-10B 85.57RR	13.603	14.867	0	0	14.203	7.23544	Kaolinite	282	282	0.625	14.168	0.67	14.178	7.24788	188	188.9
CH-97-10B 104.26	23.816	24.645	114	71.1	24.174	4.27166	Quartz	1001	905	0.211	24.176	0.23	24.166	4.27305	285.4	208.7
CH-97-10B 104.26	38.114	39.177	13.6	6.55	38.6	2.70638	Marcasite	155	144	0.466	38.623	0.436	38.608	2.70582	73.63	62.88
CH-97-10B 104.26RR	5.229	6.305	0	0	5.754	17.82108	Expanded	43.3	43.3	0.744	5.828	0.644	5.793	17.70036	28.01	27.88
CH-97-10B 104.26RR	9.839	10.359	0	0	10.179	10.08314	illite	121	121	0.302	10.097	0.319	10.1	10.16132	38.14	38.58
CH-97-10B 104.26RR	13.583	14.747	0	0	14.194	7.23979	Kaolinite	1101	1101	0.319	14.185	0.388	14.169	7.25243	426.9	427.5
CH-97-10B 108.14	23.777	24.526	45.7	24.9	24.196	4.2679	Quartz	782	748	0.214	24.196	0.248	24.175	4.27151	212.1	185.4
CH-97-10B 108.14	37.116	37.747	11.7	8.34	37.458	2.78572	Siderite	60.5	50.6	0.096	37.427	0.165	37.382	2.79119	14.84	8.368
CH-97-10B 108.14	33.332	34.158	25	5.77	33.684	3.08725	Jarosite	58.1	41.3	0.289	33.725	0.326	33.739	3.08236	26.44	13.47
CH-97-10B 108.14RR	5.328	6.465	0	0	6.077	16.87543	Expanded	41.3	41.3	0.734	5.886	0.666	5.917	17.33193	27.47	27.48
CH-97-10B 108.14RR	9.739	10.559	0	0	10.242	10.02157	illite	198	198	0.457	10.174	0.478	10.163	10.0984	93.48	94.53
CH-97-10B 108.14RR	14.024	14.666	0	0	14.32	7.17632	Kaolinite	281	281	0.328	14.316	0.354	14.323	7.17526	98.55	99.47
CH-97-10B 109.55	23.816	24.546	50.7	13.6	24.184	4.27004	Quartz	804	771	0.228	24.18	0.252	24.172	4.27199	217.9	194.5
CH-97-10B 109.55	33.412	34.239	4.66	2.17	33.751	3.08133	Jarosite	58.7	55.1	0.241	33.77	0.332	33.782	3.07857	21.21	18.28
CH-97-10B 109.55RR	5.887	6.465	0	0	6.108	16.78805	Expanded	27.8	27.8	0.42	6.136	0.373	6.154	16.66404	10.21	10.37
CH-97-10B 109.55RR	7.004	7.482	0	0	7.263	14.12142	Vermiculite	18	18	0.216	7.243	0.185	7.246	14.15456	3.41	3.33
CH-97-10B 109.55RR	9.759	9.939	0	0	9.876	10.39194	illite	71.8	71.8	n.a.	n.a.	0.172	9.853	10.41604	11.2	12.37
CH-97-10B 109.55RR	14.004	14.847	3	3	14.401	7.13612	Kaolinite	324	321	0.343	14.394	0.4	14.398	7.1376	130.4	128.6
CH-97-10B 112.04	23.718	24.526	59.2	19.7	24.148	4.27632	Quartz	736	698	0.217	24.146	0.23	24.15	4.27587	192.7	160.2
CH-97-10B 112.04	36.912	37.706	9.87	6.6	37.234	2.8019	Siderite	65.4	56.8	0.199	37.291	0.321	37.297	2.79732	24.7	18.23
CH-97-10B 112.04RR	6.844	7.363	0	0	7.123	14.40022	Vermiculite	31.5	31.5	0.253	7.124	0.257	7.133	14.37886	8.072	8.116
CH-97-10B 112.04RR	5.747	6.126	0	0	5.946	17.24707	Expanded	20.5	20.5	n.a.	n.a.	0.249	5.932	17.28579	4.936	5.11
CH-97-10B 112.04RR	9.839	10.559	0	0	10.188	10.07385	illite	239	239	0.432	10.15	0.434	10.167	10.09469	102.5	103.7
CH-97-10B 112.04RR	13.924	14.988	0	0	14.332	7.17046	Kaolinite	198	198	0.435	14.331	0.501	14.359	7.15694	98.83	99.34
GR-97-19 87.20	23.836	24.428	7.94	12.6	24.113	4.28237	Quartz	116	106	0.204	24.118	0.218	24.114	4.28215	29.2	23.02
GR-97-19 87.20	35.31	36.465	30.7	24.7	35.969	2.89706	Dolomite	4798	4771	0.238	35.968	0.284	35.962	2.89755	1385.3	1353.5
GR-97-19 87.20	38.727	39.299	26.8	30.9	39.027	2.67784	Hematite	320	291	0.231	39.021	0.25	39.026	2.67796	89.22	72.71
GR-97-19 87.20RR	6.724	7.243	0	0	6.927	14.80518	Vermiculite	32.7	32.7	n.a.	n.a.	0.38	6.963	14.73037	12.1	12.41
GR-97-19 87.20RR	9.939	10.299	0	0	10.136	10.12523	illite	40.3	40.3	0.278	10.146	0.242	10.126	10.1355	9.521	9.741
GR-97-19 88.25	23.856	24.428	23.6	2.39	24.125	4.28029	Quartz	178	164	0.228	24.107	0.226	24.113	4.28233	44.68	37.14
GR-97-19 88.25	35.289	36.689	12.9	4.33	35.967	2.89722	Dolomite	4187	4179	0.239	35.965	0.287	35.961	2.89762	1213.2	1201.2
GR-97-19 88.25	38.788	39.381	45.1	7.99	39.023	2.67815	Hematite	253	223	0.218	39.025	0.239	39.039	2.6771	69.17	53.33
GR-97-19 88.25RR	6.285	7.582	0	0	6.747	15.2007	Expanded	35	35	0.733	6.945	0.687	6.904	14.85524	24.05	24.07
GR-97-19 88.25RR	9.659	10.519	0	0	10.189	10.07361	illite	66.2	66.2	0.252	10.162	0.279	10.145	10.1165	18.57	18.48
GR-97-19 88.25RR	14.084	14.827	0	0	14.394	7.14	Kaolinite	35.9	35.9	0.626	14.419	0.491	14.424	7.1248	17.47	17.63
GR-97-19 90.00	23.915	24.507	76.3	6.32	24.147	4.27636	Quartz	443	394	0.216	24.149	0.23	24.157	4.27475	115.1	90.56
GR-97-19 90.00	31.724	32.146	21.6	-1.77	31.927	3.25235	Rutile	57.9	47.5	0.201	31.948	0.183	31.926	3.2525	12.71	8.672
GR-97-19 90.00	38.257	38.829	17.7	31.6	38.46	2.71584	Marcasite	106	83.8	0.19	38.462	0.178	38.434	2.71761	29.07	14.91

C: XRD PEAK AREAS FOR MUDSTONE ASSOCIATED WITH LIGNITES

Sample Name	Left Angle	Right Angle	Left Int.	Right Int.	Obs. Max	d (Obs. Max)	Minerals	Max Int.	Net Height	FWHM	Chord Mid.	I. Breadth	Gravity C.	d (Gravity C.)	Raw Area	Net Area
MUDSTONE	**2-Theta °**	**2-Theta °**	**Cps**	**Cps**	**2-Theta °**	**Angstrom**		**Cps**	**Cps**	**2-Theta °**	**2-Theta °**	**2-Theta °**	**2-Theta °**	**Angstrom**	**Cps x 2-Theta °**	**Cps x 2-Theta °**
GR-97-19 90.00	35.512	36.506	43.8	21	35.997	2.89481	Dolomite	2372	2339	0.238	35.995	0.284	35.996	2.89495	695.9	663.6
GR-97-19 90.00	38.829	39.361	31.6	-0.29	39.043	2.6768	Hematite	145	127	0.247	39.049	0.256	39.058	2.67583	40.88	32.45
GR-97-19 90.00RR	5.687	6.305	0	0	6.046	16.96101	Expanded	30.1	30.1	0.514	6.01	0.452	5.994	17.10804	13.61	13.62
GR-97-19 90.00RR	7.043	7.363	0	0	7.127	14.3917	Vermiculite	34	34	0.148	7.15	0.17	7.173	14.29865	5.731	5.783
GR-97-19 90.00RR	9.999	10.419	0	0	10.147	10.11465	illite	108	108	0.305	10.158	0.273	10.178	10.08422	28.87	29.51
GR-97-19 90.00RR	13.843	14.787	0	0	14.385	7.14413	Kaolinite	86	86	0.539	14.289	0.583	14.302	7.18571	49.83	50.18
GR-97-19 93.74	23.737	24.566	44.8	8.48	24.177	4.27117	Quartz	437	411	0.236	24.185	0.266	24.176	4.27145	131.2	109.3
GR-97-19 93.74	31.684	32.306	59	43.1	31.865	3.25856	Rutile	139	84.3	0.212	31.912	0.202	31.886	3.25647	48.67	17.04
GR-97-19 93.74	37.095	37.502	9.28	19.1	37.274	2.79905	Siderite	53.7	40.2	0.139	37.309	0.123	37.301	2.79705	10.62	4.959
GR-97-19 93.74RR	5.647	5.926	0	0	5.782	17.73447	Expanded	27.1	27.1	0.116	5.785	0.154	5.79	17.7107	4.012	4.171
GR-97-19 93.74RR	7.043	7.303	0	0	7.106	14.43371	Vermiculite	19.8	19.8	0.105	7.125	0.116	7.14	14.36533	2.28	2.297
GR-97-19 93.74RR	9.719	10.459	0	0	10.059	10.20306	illite	151	151	0.588	10.037	0.519	10.074	10.18817	77.5	78.31
GR-97-19 93.74RR	13.924	14.706	0	0	14.358	7.15774	Kaolinite	95.6	95.6	0.492	14.291	0.466	14.303	7.18505	44.18	44.57

APPENDIX 4
Chemical analyses of Lower Cretaceous igneous rocks from the southeastern Canadian continental margin offshore

Appendix 4: Chemical analyses of Lower Cretaceous igneous rocks from the southeastern Canadian continental margin offshore.

Wells	Samples	File	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	L.O.I	Total	Ba	Rb	Sr	Y
Hercules J-15	2540-2550 ft	1 (676)	47.16	3.46	14.64	0	14.7	0.22	5.66	8.69	3.21	1.32	0.65	0	99.71	987	21	711	31
Hercules J-15	2590-2600 ft	1 (677)	47.79	3.29	15.09	0	14.16	0.24	5.51	8.48	3.36	1.38	0.61	0	99.91	0	0	0	0
Jason C-20	4520-4530 ft	1 (678)	47.23	3.68	15.67	0	13.54	0.18	5.24	9.4	3.2	1.43	0.67	0	100.24	0	0	0	0
Hesper I-52	9000-9010 ft	1 (679)	47.17	3.34	14.95	0	14	0.23	5.66	9.27	3.68	1.16	0.6	0	100.06	890	19	735	30
Hesper I-52	8960-8970a	1 (680)	42.79	4.23	17.75	0	14.25	0.19	3.01	11.66	4.15	1.32	0.08	0	99.43	0	0	0	0
Hesper I-52	8960-8970b	1 (681)	42.05	3.95	17.45	0	13.67	0.29	2.77	13.29	3.7	1.38	0.72	0	99.27	0	0	0	0
Scotian Shelf	AV	3 (325)	47.3	3.4	15.1	0	14.1	0.22	5.4	9	3.4	1.3	0.63	0	99.85	0	0	0	0
Scattarie Bank	13-23	3 (217)	46.21	3.28	14.41	13.74	0	0.2	5.87	9.11	2.94	1.37	0.64	2	99.77	926	17	763	28
Scattarie Bank	54-64	3 (218)	46.45	3.3	14.61	13.48	0	0.2	4.83	9.22	3.03	1.37	0.66	2	99.15	937	15	772	32
Scattarie Bank	88-95	3 (219)	46.4	3.25	14.37	13.79	0	0.2	5.33	9.01	3.4	1.37	0.65	1.4	99.17	922	19	766	30
Scattarie Bank	124-131	3 (220)	44.62	3.38	14.7	13.87	0	0.2	4.17	9.18	3.3	1.41	0.66	4.9	100.39	1003	22	738	31
Scattarie Bank	159-162	3 (221)	44.41	3.36	14.46	14.55	0	0.23	3.89	9.56	3.21	1.42	0.68	4.3	100.07	1036	19	745	30
Scattarie Bank	162-166	3 (222)	44.05	3.3	14.42	14.49	0	0.24	3.86	9.67	3.06	1.39	0.67	4.8	99.95	1043	20	749	29
Scattarie Bank	AV	3 (324)	47	3.4	15	0	13.1	0.22	4.8	9.6	3.3	1.4	0.68	0	98.5	718	0	0	0
Fogo Smts	1	6 (214)	48.26	1.18	19.2	9.16	0	0.2	6.19	8.25	2.57	2.17	0.19	2.23	99.6	491	85	363	20
Fogo Smts	2	6 (215)	43.9	2.24	17.5	13.1	0	0.24	6.81	9.08	2.28	1.66	0.12	1.85	98.78	463	62	447	22
Fogo Smts	3	6 (216)	42.09	1.6	17.03	11.44	0	0.24	7.16	9.33	1.43	1.52	0.24	8.23	0.31	488	81	261	23
Norwhal F-99	4550A	3 (601)	51.09	3.63	15.91	0	13.02	0.15	4.11	7.67	3.59	0.84	0	0	0.01	275	8	340	33
Norwhal F-99	4550B	3 (602)	52.1	3.27	14.73	0	13.09	0.19	3.68	8.47	3.39	1.07	0	0	99.99	781	17	333	33
Norwhal F-99	4515A	3 (603)	51.03	3.76	15.97	0	12.8	0.17	3.77	8.68	2.78	1.02	0	0	99.98	0	0	0	0
Norwhal F-99	4515B	3 (604)	52.27	3.49	14.72	0	13.07	0.14	3.47	8.96	2.63	1.25	0	0	100	0	0	0	0
Norwhal F-99	4570A	3 (605)	49.56	3.76	16.45	0	12.93	0.18	4.36	8.45	3.45	0.85	0	0	99.99	0	0	0	0
Norwhal F-99	4570B	3 (606)	50.75	3.51	16.01	0	12.76	0.16	4.09	8.13	3.37	1.23	0	0	100.01	0	0	0	0
Norwhal F-99	4540A	3 (607)	50.91	3.61	16.65	0	12.7	0.18	3.71	7.47	3.92	0.84	0	0	99.99	272	11	341	35
Norwhal F-99	4540B	3 (608)	52.21	3.41	15.44	0	13.37	0.14	3.38	7.27	3.69	1.08	0	0	99.99	3405	17	350	33
Norwhal F-99	4775A	3 (609)	50.17	3.67	16.7	0	12.11	0.18	4.48	8.41	3.33	0.96	0	0	100.01	0	0	0	0
Norwhal F-99	4575B	3 (610)	51.66	3.51	15.93	0	12.27	0.15	3.78	7.96	3.25	1.32	0	0	99.83	0	0	0	0
Norwhal F-99	4535A	3 (611)	50.91	3.55	16.08	0	12.92	0.18	3.63	8.51	3.44	0.77	0	0	99.99	0	0	0	0
Norwhal F-99	4535B	3 (612)	51.88	3.56	16.08	0	13.04	0.16	3.3	6.88	3.93	1.18	0	0	100.01	0	0	0	0
Norwhal F-99	4585A	3 (613)	50.58	3.66	16.15	0	12.59	0.2	3.88	8.78	3.25	0.89	0	0	99.98	0	0	0	0
Norwhal F-99	44585B	3 (614)	50.37	3.53	15.65	0	13.33	0.18	3.68	9.63	2.6	1.02	0	0	99.99	0	0	0	0
Brant P-87	3569-3572	1 (647)	47.16	4.46	14.99	0	12.05	0.27	4.72	9.78	3.77	1.18	0.77	0	99.15	0	0	0	0
Brant P-87	3566-3569	1 (648)	47.29	4.49	14.7	0	12.62	0.18	5.1	9.5	3.69	1.11	0.77	0	99.45	0	0	0	0
Brant P-87	3547.8-3551	1 (649)	47.45	4.43	14.81	0	12.81	0.18	5.1	9.38	3.72	1.11	0.81	0	99.8	0	0	0	0
Brant P-87	3544.8-3551	1 (650)	47.37	4.35	14.62	0	13.34	0.22	5.17	9.4	3.61	1.08	0.84	0	100	0	0	0	0
Brant P-87	3541.7-3544.8	1 (651)	47.58	4.21	14.5	0	13.3	0.21	5.12	9.22	3.52	1.11	0.78	0	99.55	380	17	619	37
Brant P-87	3538.7-3541.7	1 (652)	47.6	4.12	14.53	0	13.26	0.2	4.93	9.3	3.52	1.08	0.7	0	99.24	389	17	626	36
Brant P-87	3508-3511	1 (653)	48.05	3.95	14.71	0	12.8	0.27	4.69	9.34	3.65	1.11	0.86	0	99.43	0	0	0	0
Brant P-87	3499-3502	1 (654)	48.26	4.28	14.91	0	12.62	0.19	4.52	9.42	3.66	1.13	0.92	0	99.91	0	0	0	0
Brant P-87	3496-3499	1 (655)	47.92	4.08	14.86	0	12.71	0.22	4.35	9.34	3.74	1.17	0.97	0	99.36	0	0	0	0
Brant P-87	2856-2859	1 (656)	50.38	2.68	17.36	0	11.88	0.01	6.27	6.99	3.62	0.76	0.03	0	99.98	0	0	0	0
Brant P-87	11070	3 (615)	70.29	0.73	16.12	0	3.62	0	0.48	0.89	4.45	3.42	0	0	100	553	112	445	45
Brant P-87	10050	3 (616)	70.02	0.74	15.87	0	3.22	0.05	0.42	0.84	4.8	4.04	0	0	100	0	0	0	0
Brant P-87	11080	3 (617)	69.85	0.73	16.65	0	4.01	0	0.46	0.85	4.47	2.95	0	0	99.97	0	0	0	0
Brant P-87	11060	3 (618)	71.17	0.72	16.31	0	3.15	0	0.39	0.83	4.21	3.22	0	0	100	0	0	0	0
Brant P-87	10280	3 (619)	69.93	0.53	15.89	0	2.52	0.02	0.03	0.65	8.02	2.41	0	0	100	0	0	0	0
Brant P-87	11050	3 (620)	70.22	0.5	15.03	0	2.67	0.02	0.04	0.67	6.79	4.02	0.06	0	100.02	900	99	391	39
Brant P-87	10310	3 (621)	63.1	1.23	18.41	0	5.72	0.09	0.4	0.56	8.33	2.08	0.09	0	100.01	0	0	0	0
Brant P-87	10310	1 (699)	63.1	1.23	18.41	0	5.72	0.09	0.4	0.56	8.33	2.08	0.09	0	100.01	0	0	0	0
Brant P-87	1028	1 (700)	69.93	0.53	15.89	0	2.52	0.02	0.03	0.65	8.02	2.41	0	0	100	0	0	0	0
Brant P-87	11050A	1 (701)	70.22	0.5	15.03	0	2.67	0.02	0.04	0.67	6.79	4.02	0.06	0	100.02	900	99	391	39
Brant P-87	B11070	6 (220)	75.69	0.24	11.07	2.45	0	0.04	0.97	0.98	1.19	5.61	0.09	1.69	100.02	362	158	45	75
Brant P-87	B11080	6 (221)	65.34	0.77	17.23	5.28	0	0.09	2.37	0.92	2.7	4.57	0.18	1.46	100.91	682	174	128	33
Twillick G-49	1301.4 (core)	1 (657)	54.25	2.82	15.68	0	10.33	0.11	3.66	5.93	4.53	2.35	0.37	0	100.03	529	53	608	33
Twillick G-49	1298.4-1301.4	1 (658)	51.76	2.9	16.04	0	11.18	0.17	4.41	5.86	4.2	2.24	0.59	0	99.35	498	47	542	33
Twillick G-49	1295.4-1298.4	1 (659)	53.47	2.72	16.3	0	9.95	0.18	3.97	5.85	4.24	1.94	0.54	0	99.16	0	0	0	0
Twillick G-49	1292.3-1295.4	1 (660)	50.69	3.31	15.62	0	11.6	0.14	4.58	6.47	3.87	1.96	0.47	0	98.71	416	35	525	38
Twillick G-49	1289.3-1292.3	1 (661)	49.03	3.94	16.38	0	12.16	0.12	4.52	7.05	3.33	2.14	0.64	0	99.31	0	0	0	0
Emerilon C-56	2999-3002	1 (662)	53.31	2.8	17.94	0	7	0.05	4.66	5.26	5.81	2.6	0.69	0	100.12	0	0	0	0
Emerilon C-56	2990-2993	1 (663)	53.67	2.71	18.19	0	6.66	0.05	1.23	9.3	4.58	3.43	0.48	0	100.3	0	0	0	0
Emerilon C-56	2981-2984	1 (664)	52.85	2.64	17.82	0	8.15	0.02	2.87	6.21	5.08	3.71	0.65	0	100	0	0	0	0
Mallard M-45	8310	6 (217)	48.1	1.5	16.5	10.8	0	0.27	7.36	8.4	2.98	0.61	0.21	2.85	99.58	294	28	317	28
Mallard M-45	8550	6 (218)	46.86	1.72	17.73	10.51	0	0.21	7.63	9.92	2	0.51	0.28	1.85	99.22	211	30	351	27
Mallard M-45	8660	6 (219)	52	1.3	19.07	9.57	0	0.22	4.18	6.6	3.39	1.87	0.26	1.31	99.77	619	64	434	30
Mallard M-45	9930	6 (294)	44.6	2.61	14.5	14.4	0	0.12	6.52	9.17	1.83	2.9	0.35	1.77	98.77	231	193	267	32
Mallard M-45	9530	6 (295)	49.4	2.18	17.5	11.2	0	0.19	4.14	5.64	4.52	1.56	0.56	2.31	99.2	613	52	699	34
Mallard M-45	9110	6 (296)	45.5	1.98	15.3	13.4	0	0.26	6.85	8.99	2.38	0.67	0.23	3.39	98.95	342	29	300	29
Mallard M-45	7770	6 (297)	75.7	0.15	12	1.42	0	0.01	0.31	0.32	2.32	6.08	0.03	0.85	99.19	324	194	77	67
Mallard M-45	8370	6 (298)	75.3	0.08	12.8	0.95	0	0.01	0.11	0.57	3.03	6.05	0.02	0.62	99.54	339	113	104	13
Mallard M-45	10050	6 (299)	63.9	0.54	16.3	5.08	0	0.13	1.87	4.46	4.34	1.64	0.17	1.16	99.59	615	45	372	20
Grand Banks (Lower)	AV	3 (326)	47.6	4.3	14.7	0	12.8	0.22	4.9	9.4	3.7	1.1	0.82	0	99.54	385	0	0	0
Grand Banks (Upper)	AV	3 (327)	50.4	2.7	17.4	0	11.9	0.01	6.3	7	3.6	0.8	0.03	0	100.14	0	0	0	0
Newfoundland Smts.	SCR2	1 (712)	61.16	0.54	19.28	2.43	0.46	0.08	1.21	1.06	6.78	2.37	0.08	4.59	100.12	1178	19	209	50
Newfoundland Smts.	SCR3	1 (713)	61.23	0.55	18.46	2.88	0	0.14	1.12	1.01	6.52	2.41	0.09	4.96	99.37	1180	20	185	0
Newfoundland Smts.	SCR9	1 (714)	49.53	3.11	16.55	9.81	0.58	0.29	1.62	3.84	3.34	3.55	1.09	6.31	99.66	370	36	346	102
Newfoundland Smts.	SCR32	1 (715)	45.84	3.35	14.57	12.47	0.84	0.1	2.46	3.17	1.97	4.52	1.06	9.77	100.17	193	71	288	64
Newfoundland Smts.	DIP2	1 (716)	50.1	3.43	18.7	7.24	1.05	0.19	1.19	3.97	3.79	3.87	0.96	4.94	99.53	410	50	330	49
Georges Bank (Exxon 133-1)	4111-4112	1 (665)	47.02	3.97	14.16	0	10.22	0	8.7	7.85	4.89	1.71	1.5	0	100.02	653	16	1240	50
Georges Bank (Exxon 133-1)	4115-4124	1 (666)	47.55	4.3	14.39	0	9.72	0.01	8.3	8.35	4.28	1.67	1.45	0	100.02	686	18	1316	50
Georges Bank (Exxon 133-1)	4105.6-4115	1 (667)	47.37	3.97	14.42	0	10.21	0.03	8.34	8.1	4.76	1.59	1.22	0	100.01	0	0	0	0
Georges Bank (Exxon 133-1)	4096.5-4105.6	1 (668)	47.45	4.41	14.46	0	9.69	0.04	8.19	8.24	4.46	1.72	1.34	0	100	0	0	0	0
Baltimore Canyon Trough (Mobil 544.1)	3240-3246	1 (669)	46.45	3.06	16.14	0	11.98	0.18	4.88	9.43	3.54	3.43	0.84	0	99.93	0	0	0	0
Baltimore Canyon Trough (Mobil 544.1)	3193.7	1 (670)	48.21	2.99	17.13	0	10.1	0.1	3.35	8.86	3.32	4.78	1.16	0	100	2174	97	1880	46
Baltimore Canyon Trough (Mobil 544.1)	4093.7-3160.7	1 (671)	53.47	1.64	19	0	7.45	0	1.42	6.92	6.38	3.35	0.31	0	99.94	0	0	0	0
Baltimore Canyon Trough (Mobil 544.1)	3154.7-3160.7	1 (672)	46.32	3.2	16.64	0	11.6	0.2	4.41	9.71	3.89	2.87	1.08	0	99.92	0	0	0	0
Baltimore Canyon Trough (Mobil 544.1)	3069-3075.4	1 (673)	46.6	2.99	16.88	0	11.26	0.2	4.31	9.88	5.42	1.29	1.11	0	99.94	0	0	0	0
Baltimore Canyon Trough (Mobil 544.1)	2978-2984	1 (674)	45.88	3.33	15.11	0	12.41	0.13	5.27	10.23	1.77	5.22	0.57	0	99.92	0	0	0	0
Baltimore Canyon Trough (Mobil 544.1)	2911-2917	1 (675)	49.21	2.95	15.69	0	11.26	0.24	4.74	8.72	2.99	3.68	0.43	0	99.91	0	0	0	0
DSDP 382 (WR)	25-2105	1 (82)	41.86	3.57	13.8	1.69	9.58	0	8.75	16.47	2.34	1.32	0.79	0	100.17	0	0	0	0
DSDP 382 (WR)	25-2107	1 (83)	43.16	3.66	14.28	1.78	10.11	0.04	8.79	14.06	2.3	1.29	0.72	0	100.19	0	0	0	0
DSDP 382 (WR)	23-07-9	1 (84)	41.44	4.3	14.12	1.86	10.53	0.03	2.11	17.71	2.55	4.37	1.19	0	100.21	309	48	434	27
DSDP 382 (WR)	23-1148	1 (85)	43.99	4.44	13.9	2.13	12.05	0.02	3.11	12.5	1.72	5.78	0.58	0	100.22	459	0	0	0
DSDP 382 (Glass)	25-2105	1 (86)	43.84	4.6	14.71	0	10.93	0.02	6.04	13.28	2.8	2.1	0.53	0	98.85	0	0	0	0
DSDP 382 (Glass)	25-2107	1 (87)	43.81	4.34	15.13	1.6	9.06	0	5.73	12.84	3.42	2.08	0.46	0	98.47	0	0	0	0

Appendix 4: Chemical analyses of Lower Cretaceous igneous rocks from the southeastern Canadian continental margin offshore.

Wells	Samples	File	Zr	Nb	Th	Pb	Ga	Zn	Cu	Ni	V	Cr	La	Ce	Pr	Nd	Sm	Eu	Gd
Hercules J-15	2540-2550 ft	1 (676)	222	30	0	11	27	132	38	28	331	31	n.d.	75.54	n.d.	45.13	n.d.	3.33	8.24
Hercules J-15	2590-2600 ft	1 (677)	0	0	0	0	0	0	0	0	0	0	n.d.	73.6	n.d.	44.7	n.d.	3.35	8.47
Jason C-20	4520-4530 ft	1 (678)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Hesper I-52	9000-9010 ft	1 (679)	211	29	0	2	31	120	40	24	357	23	n.d.	70.53	n.d.	42.19	n.d.	3.2	7.85
Hesper I-52	8960-8970a	1 (680)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Hesper I-52	8960-8970b	1 (681)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scotian Shelf	AV	3 (325)	0	0	0	0	0	0	0	0	0	0	n.d.	73.2	n.d.	44	n.d.	3.3	n.d.
Scattarie Bank	13-23	3 (217)	223	29	0	0	26	124	52	80	325	18	36.34	69.5	n.d.	40.23	8.58	3.03	n.d.
Scattarie Bank	54-64	3 (218)	224	27	0	0	28	113	58	16	312	23	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	88-95	3 (219)	223	27	27	0	27	115	54	22	308	31	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	124-131	3 (220)	221	28	2	0	27	150	54	23	379	25	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	159-162	3 (221)	223	29	0	0	24	119	15	24	363	22	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	162-166	3 (222)	219	28	0	0	28	125	48	30	347	26	34.5	69.65	n.d.	40.62	8.32	2.95	n.d.
Scattarie Bank	AV	3 (324)	0	0	0	0	0	0	0	0	0	0	35.4	69.6	n.d.	40.4	8.5	3	n.d.
Fogo Smts	1	6 (214)	78	9	1	40	18	243	38	23	266	32	11.5	27	n.d.	15	2.93	0.97	n.d.
Fogo Smts	2	6 (215)	60	7	1	8	18	89	82	18	477	2	8.3	20	n.d.	15	3.54	1.36	n.d.
Fogo Smts	3	6 (216)	101	7	0	9	24	113	7	90	254	84	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4550A	3 (601)	237	43	0	26	22	125	43	38	342	37	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4550B	3 (602)	229	38	0	46	23	121	50	41	321	36	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4515A	3 (603)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4515B	3 (604)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4570A	3 (605)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4570B	3 (606)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4540A	3 (607)	238	43	0	26	22	123	38	34	343	25	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4540B	3 (608)	234	41	0	61	22	121	43	37	320	44	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4775A	3 (609)	0	0	0	0	0	0	0	0	0	0	28.93	62.47	n.d.	37.37	8.15	2.67	n.d.
Norwhal F-99	4575B	3 (610)	0	0	0	0	0	0	0	0	0	0	28.09	65.61	n.d.	36.54	7.8	2.65	n.d.
Norwhal F-99	4535A	3 (611)	0	0	0	0	0	0	0	0	0	0	29.63	67.68	n.d.	37.79	8.12	2.72	n.d.
Norwhal F-99	4535B	3 (612)	0	0	0	0	0	0	0	0	0	0	29.71	70.13	n.d.	38.97	8.23	2.73	n.d.
Norwhal F-99	4585A	3 (613)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	44585B	3 (614)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3569-3572	1 (647)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3566-3569	1 (648)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3547.8-3551	1 (649)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3544.8-3551	1 (650)	0	0	0	0	0	0	0	0	0	0	32.4	75.9	n.d.	44.14	8.95	3.14	n.d.
Brant P-87	3541.7-3544.8	1 (651)	258	45	2	21	27	264	38	26	325	16	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3538.7-3541.7	1 (652)	258	45	4	13	26	173	38	25	319	16	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3508-3511	1 (653)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3499-3502	1 (654)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3496-3499	1 (655)	0	0	0	0	0	0	0	0	0	0	37.79	90.2	n.d.	51.25	10.9	1.01	n.d.
Brant P-87	2856-2859	1 (656)	0	0	0	0	0	0	0	0	0	0	19.9	36	n.d.	20.2	4.89	1.65	n.d.
Brant P-87	11070	3 (615)	723	100	0	0	25	92	14	0	5	16	78.7	133	n.d.	60	11.5	3.04	n.d.
Brant P-87	10050	3 (616)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	11080	3 (617)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	11060	3 (618)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	10280	3 (619)	0	0	0	0	0	0	0	0	0	0	64.93	134	n.d.	56.85	10.63	3.2	n.d.
Brant P-87	11050	3 (620)	533	68	8	12	20	50	2	17	5	7	71.5	116	n.d.	39	10.2	2.25	n.d.
Brant P-87	10310	3 (621)	0	0	0	0	0	0	0	0	0	0	61.55	131	n.d.	56.99	11.16	2.16	n.d.
Brant P-87	10310	1 (699)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	1028	1 (700)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	11050A	1 (701)	533	68	8	12	20	50	2	17	5	7	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	B11070	6 (220)	482	33	16	15	14	60	14	19	34	14	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	B11080	6 (221)	204	17	12	19	22	81	0	24	102	51	39.2	79	n.d.	31	6.67	1.52	n.d.
Twillick G-49	1301.4 (core)	1 (657)	256	41	6	10	24	116	17	15	239	30	36.42	83.3	n.d.	41.68	6.99	2.7	n.d.
Twillick G-49	1298.4-1301.4	1 (658)	269	41	4	9	21	119	20	12	266	14	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Twillick G-49	1295.4-1298.4	1 (659)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Twillick G-49	1292.3-1295.4	1 (660)	290	45	0	7	25	127	18	15	299	17	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Twillick G-49	1289.3-1292.3	1 (661)	0	0	0	0	0	0	0	0	0	0	38.08	90.8	n.d.	48.1	9.63	3.38	n.d.
Emerilon C-56	2999-3002	1 (662)	0	0	0	0	0	0	0	0	0	0	17.43	38.51	n.d.	24.3	6.59	2.08	n.d.
Emerilon C-56	2990-2993	1 (663)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Emerilon C-56	2981-2984	1 (664)	0	0	0	0	0	0	0	0	0	0	66.55	107	n.d.	60.5	10.5	3.38	n.d.
Mallard M-45	8310	6 (217)	142	11	0	7	22	109	48	83	223	62	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	8550	6 (218)	125	10	0	11	20	100	54	78	217	65	14.3	32	n.d.	13	4.47	1.43	n.d.
Mallard M-45	8660	6 (219)	120	12	0	6	20	96	30	9	232	11	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	9930	6 (294)	181	11	2	15	23	57	28	74	327	133	16	36	n.d.	24	5.66	1.99	n.d.
Mallard M-45	9530	6 (295)	380	28	0	11	21	119	33	29	177	39	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	9110	6 (296)	119	6	0	8	21	82	75	77	284	105	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	7770	6 (297)	247	42	20	18	20	30	5	21	6	35	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	8370	6 (298)	131	7	78	19	11	14	12	6	4	43	16.9	46	n.d.	10	1.98	0.33	n.d.
Mallard M-45	10050	6 (299)	126	8	5	8	15	44	6	9	69	34	18	40	n.d.	15	4.31	1.59	n.d.
Grand Banks (Lower)	AV	3 (326)	0	0	0	0	0	0	0	0	0	0	35.2	83.1	n.d.	47.7	9.9	2.1	n.d.
Grand Banks (Upper)	AV	3 (327)	0	0	0	0	0	0	0	0	0	0	19.9	36	n.d.	20.2	4.89	1.65	n.d.
Newfoundland Smts.	SCR2	1 (712)	586	121	0	0	0	229	36	36	0	5	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Newfoundland Smts.	SCR3	1 (713)	503	122	0	0	0	228	28	38	0	2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Newfoundland Smts.	SCR9	1 (714)	237	59	0	0	0	169	30	39	0	11	43	n.d.	n.d.	n.d.	11	3	n.d.
Newfoundland Smts.	SCR32	1 (715)	139	35	0	0	0	179	106	55	0	17	41	n.d.	n.d.	n.d.	8	2	n.d.
Newfoundland Smts.	DIP2	1 (716)	230	50	0	0	0	152	97	55	0	29	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Georges Bank (Exxon 133-1)	4111-4112	1 (665)	618	81	0	0	24	117	67	188	161	232	53.36	122	n.d.	71.17	12.14	4.59	n.d.
Georges Bank (Exxon 133-1)	4115-4124	1 (666)	632	80	0	4	29	129	60	175	158	233	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Georges Bank (Exxon 133-1)	4105.6-4115	1 (667)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Georges Bank (Exxon 133-1)	4096.5-4105.6	1 (668)	0	0	0	0	0	0	0	0	0	0	71.2	139	n.d.	84.2	17	4.94	n.d.
Baltimore Canyon Trough (Mobil 544.1)	3240-3246	1 (669)	0	0	0	0	0	0	0	0	0	0	71.03	151	n.d.	67.22	10.31	3.16	n.d.
Baltimore Canyon Trough (Mobil 544.1)	3193.7	1 (670)	461	127	2	15	27	147	31	12	375	0	102	201	n.d.	101	15.13	4.17	n.d.
Baltimore Canyon Trough (Mobil 544.1)	4093.7-3160.7	1 (671)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	3154.7-3160.7	1 (672)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	3069-3075.4	1 (673)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	2978-2984	1 (674)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	2911-2917	1 (675)	0	0	0	0	0	0	0	0	0	0	61.24	111	n.d.	53.51	9.18	2.51	n.d.
DSDP 382 (WR)	25-2105	1 (82)	0	0	0	0	0	0	0	0	0	0	56.5	91.4	n.d.	44.6	8.77	2.61	n.d.
DSDP 382 (WR)	25-2107	1 (83)	0	0	0	0	0	0	0	0	0	0	59.6	101	n.d.	48.2	9.33	2.75	n.d.
DSDP 382 (WR)	23-07-9	1 (84)	346	74	2	4	17	105	29	34	184	26	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
DSDP 382 (WR)	23-1148	1 (85)	0	0	5	0	0	0	0	0	0	287	57.7	111	n.d.	53.3	10.3	3.05	n.d.
DSDP 382 (Glass)	25-2105	1 (86)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
DSDP 382 (Glass)	25-2107	1 (87)	0	0	0	0	0	0	0	0	0	0	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

Appendix 4: Chemical analyses of Lower Cretaceous igneous rocks from the southeastern Canadian continental margin offshore.

Wells	Samples	File	Tb	Dy	Ho	Er	Tm	Yb	Lu	Co	Cs	Hf	Sb	Sc	Ta	Th	U
Hercules J-15	2540-2550 ft	1 (676)	1.15	n.d.	n.d.	n.d.	0.32	2.39	n.d.	n.d.	n.d.	5.02	n.d.	n.d.	2.04	2.46	n.d.
Hercules J-15	2590-2600 ft	1 (677)	1.15	n.d.	n.d.	n.d.	0.31	2.35	n.d.	n.d.	n.d.	5.03	n.d.	n.d.	2.02	2.53	n.d.
Jason C-20	4520-4530 ft	1 (678)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Hesper I-52	9000-9010 ft	1 (679)	1.11	n.d.	n.d.	n.d.	0.3	2.29	n.d.	n.d.	n.d.	4.82	n.d.	n.d.	1.93	2.35	n.d.
Hesper I-52	8960-8970a	1 (680)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Hesper I-52	8960-8970b	1 (681)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scotian Shelf	AV	3 (325)	1.13	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	13-23	3 (217)	1.09	n.d.	n.d.	n.d.	n.d.	2.59	0.33	56.4	0.17	4.68	0.09	21.4	1.87	2.3	0.64
Scattarie Bank	54-64	3 (218)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	88-95	3 (219)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	124-131	3 (220)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	159-162	3 (221)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Scattarie Bank	162-166	3 (222)	1.1	n.d.	n.d.	n.d.	n.d.	2.45	0.34	90	0.07	4.33	0.29	20.6	2.22	2.18	0.69
Scattarie Bank	AV	3 (324)	1.09	n.d.	n.d.	n.d.	n.d.	2.5	0.33	n.d.	n.d.	4.5	n.d.	21	2	2.2	n.d.
Fogo Smts	1	6 (214)	0.5	n.d.	n.d.	n.d.	n.d.	1.56	0.27	41	2.2	2.5	0.5	28.6	0.8	2.7	0.6
Fogo Smts	2	6 (215)	0.5	n.d.	n.d.	n.d.	n.d.	1.63	0.28	45	2.2	2	0.5	59.5	0.6	1.2	0.4
Fogo Smts	3	6 (216)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4550A	3 (601)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4550B	3 (602)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4515A	3 (603)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4515B	3 (604)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4570A	3 (605)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4570B	3 (606)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4540A	3 (607)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4540B	3 (608)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	4775A	3 (609)	1.12	n.d.	n.d.	n.d.	n.d.	2.13	0.29	43.1	n.d.	5.72	n.d.	24.36	2.46	2.14	n.d.
Norwhal F-99	4575B	3 (610)	1.18	n.d.	n.d.	n.d.	n.d.	2.38	0.31	37.79	n.d.	5.62	n.d.	23.5	2.4	2.36	0.3
Norwhal F-99	4535A	3 (611)	1.11	n.d.	n.d.	n.d.	n.d.	2.18	0.33	41.1	n.d.	5.5	n.d.	24.58	2.32	2.15	n.d.
Norwhal F-99	4535B	3 (612)	1.33	n.d.	n.d.	n.d.	n.d.	2.4	0.35	41.71	n.d.	5.7	n.d.	22.85	2.69	2.36	0.32
Norwhal F-99	4585A	3 (613)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Norwhal F-99	44585B	3 (614)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3569-3572	1 (647)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3566-3569	1 (648)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3547.8-3551	1 (649)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3544.8-3551	1 (650)	1.33	n.d.	n.d.	n.d.	n.d.	2.78	0.36	38.6	0.22	7.54	0.22	24.5	2.85	2.58	1.08
Brant P-87	3541.7-3544.8	1 (651)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3538.7-3541.7	1 (652)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3508-3511	1 (653)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3499-3502	1 (654)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	3496-3499	1 (655)	1.5	n.d.	n.d.	n.d.	n.d.	2.62	0.45	34.7	0.05	8.65	0.15	24.9	3.23	3.23	1.04
Brant P-87	2856-2859	1 (656)	0.8	n.d.	n.d.	n.d.	n.d.	1.71	0.26	70.9	0.18	3.01	n.d.	23.5	1.88	2.53	0.42
Brant P-87	11070	3 (615)	2.2	n.d.	n.d.	n.d.	n.d.	5.04	0.7	64	n.d.	24	0.3	7.65	5.3	13	4.1
Brant P-87	10050	3 (616)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	11080	3 (617)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	11060	3 (618)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	10280	3 (619)	1.41	n.d.	n.d.	n.d.	n.d.	3.88	0.5	29.94	0.2	14.34	n.d.	3.71	6.25	10.51	2
Brant P-87	11050	3 (620)	2.1	n.d.	n.d.	n.d.	n.d.	4.27	0.64	67	1	22	n.d.	6.37	4.8	9.9	3
Brant P-87	10310	3 (621)	1.58	n.d.	n.d.	n.d.	n.d.	5.31	0.75	8.76	0.33	18.12	n.d.	7.35	6.45	10.93	2.39
Brant P-87	10310	1 (699)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	1028	1 (700)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	11050A	1 (701)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	B11070	6 (220)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Brant P-87	B11080	6 (221)	1.1	n.d.	n.d.	n.d.	n.d.	3.65	0.61	37	10.3	6.5	0.6	17.3	1.6	12	2.5
Twillick G-49	1301.4 (core)	1 (657)	1.11	n.d.	n.d.	n.d.	n.d.	2.33	0.35	62.4	0.62	8.31	0.2	18.45	3.2	4.93	1.32
Twillick G-49	1298.4-1301.4	1 (658)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Twillick G-49	1295.4-1298.4	1 (659)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Twillick G-49	1292.3-1295.4	1 (660)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Twillick G-49	1289.3-1292.3	1 (661)	1.41	n.d.	n.d.	n.d.	n.d.	3.28	0.48	36	1.32	9.86	0.24	24.9	3.1	3.38	1.26
Emerilon C-56	2999-3002	1 (662)	0.98	n.d.	n.d.	n.d.	n.d.	2.36	0.58	44.1	4.52	5.67	0.23	13.77	3.8	7.16	3.51
Emerilon C-56	2990-2993	1 (663)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Emerilon C-56	2981-2984	1 (664)	1.13	n.d.	n.d.	n.d.	n.d.	2.67	0.41	150	10.73	5.39	0.19	12.75	5.81	7.01	2.41
Mallard M-45	8310	6 (217)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	8550	6 (218)	0.5	n.d.	n.d.	n.d.	n.d.	2.64	0.39	53	11.2	4	0.3	38.2	1.1	1.3	0.2
Mallard M-45	8660	6 (219)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	9930	6 (294)	0.9	n.d.	n.d.	n.d.	n.d.	2.86	0.49	44	19.9	5.4	1.2	41	1.1	0.5	0.4
Mallard M-45	9530	6 (295)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	9110	6 (296)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	7770	6 (297)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Mallard M-45	8370	6 (298)	0.3	n.d.	n.d.	n.d.	n.d.	2.07	0.54	1.4	1.3	5.3	0.2	1.12	1.4	73	8.1
Mallard M-45	10050	6 (299)	0.6	n.d.	n.d.	n.d.	n.d.	2.4	0.45	23	1.8	2.6	0.2	17.7	1.2	8.6	1.7
Grand Banks (Lower)	AV	3 (326)	1.4	n.d.	n.d.	n.d.	n.d.	2.7	0.41	n.d.	n.d.	8.1	n.d.	25	3	2.9	n.d.
Grand Banks (Upper)	AV	3 (327)	0.8	n.d.	n.d.	n.d.	n.d.	1.71	0.26	n.d.	n.d.	3.01	n.d.	23	1.88	2.53	n.d.
Newfoundland Smts.	SCR2	1 (712)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Newfoundland Smts.	SCR3	1 (713)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Newfoundland Smts.	SCR9	1 (714)	2	n.d.	n.d.	n.d.	n.d.	4	0.6	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Newfoundland Smts.	SCR32	1 (715)	1	n.d.	n.d.	n.d.	n.d.	3	0.3	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Newfoundland Smts.	DIP2	1 (716)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Georges Bank (Exxon 133-1)	4111-4112	1 (665)	1.44	n.d.	n.d.	n.d.	n.d.	2.59	0.4	156	1.38	9.99	0.31	16.54	6.66	4.92	1.11
Georges Bank (Exxon 133-1)	4115-4124	1 (666)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Georges Bank (Exxon 133-1)	4105.6-4115	1 (667)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Georges Bank (Exxon 133-1)	4096.5-4105.6	1 (668)	1.96	n.d.	n.d.	n.d.	n.d.	3.23	0.43	44.3	1.85	10.5	n.d.	19.4	4.62	5.56	1.32
Baltimore Canyon Trough (Mobil 544.1)	3240-3246	1 (669)	1.21	n.d.	n.d.	n.d.	n.d.	2.38	0.4	46.4	1.99	7.21	0.8	18.59	6.28	9.57	2.96
Baltimore Canyon Trough (Mobil 544.1)	3193.7	1 (670)	1.58	n.d.	n.d.	n.d.	n.d.	3.63	0.48	45	2.56	8.98	0.45	10.94	9.11	12.23	4.8
Baltimore Canyon Trough (Mobil 544.1)	4093.7-3160.7	1 (671)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	3154.7-3160.7	1 (672)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	3069-3075.4	1 (673)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	2978-2984	1 (674)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
Baltimore Canyon Trough (Mobil 544.1)	2911-2917	1 (675)	0.98	n.d.	n.d.	n.d.	n.d.	2.24	0.4	47.5	4.1	5.74	0.49	22.48	4.58	7.97	3.28
DSDP 382 (WR)	25-2105	1 (82)	1.04	n.d.	n.d.	n.d.	n.d.	2.07	0.31	55.6	0.52	5.3	n.d.	28.2	5	5.57	1.18
DSDP 382 (WR)	25-2107	1 (83)	1.15	n.d.	n.d.	n.d.	n.d.	2.13	0.36	68.1	0.79	5.65	n.d.	30	5.84	6.07	1.23
DSDP 382 (WR)	23-07-9	1 (84)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
DSDP 382 (WR)	23-1148	1 (85)	1.06	n.d.	n.d.	n.d.	n.d.	2.04	0.28	60.1	0.62	7.54	n.d.	27.1	4.71	5.03	1.33
DSDP 382 (Glass)	25-2105	1 (86)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
DSDP 382 (Glass)	25-2107	1 (87)	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.