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SUBJECT: **LBD001 Drill Hole – Drill Core Observations, Assessment of Geochemistry and Exploration Implications**

INTRODUCTION

This report is based on logging the LBD001 core, an assessment of whole rock and trace element geochemical data from drill-hole samples, and observations from an examination of nine petrographic sections from the core. The report summaries the main geological and geochemical observations and discusses the exploration implications arising from this data.

A brief geological log is given in Appendix I. Significant geological observations, including photographs of the core and comments arising from the logging are given in Appendix II. Results of petrographic examination of thin sections and a report on examination by Scanning Electron Microscopy of one polished thin section are presented in Appendix IIIA and B respectively. Assay data are given in Appendices IV and V and these data are discussed in Appendix VI.

The main focus of the report is on the nature of the mafic rocks intersected in LBD001 with the aim of determining what, if any relationship they have with the Antrim Basalts and to evaluate their exploration potential for magmatic Ni-Cu-PGE sulphide mineralization. Although the mafic rocks are the main focus other geological and geochemical features of significance are also briefly discussed.

DRILL CORE OBSERVATIONS

Two days (30 June-1 July) were spent at the Northern Territory Geological Survey (NTGS) core facility in Darwin logging LBD001 with the assistance of Andrew Jones, Ashley Hood (Proto Resources) and briefly of Dr Linda Glass (NTGS).

Note that the drill hole is vertical throughout so that the core could not be orientated and thus no strike data is obtainable. However structure (i.e. bedding, foliation) to core-axis angles are equivalent to dip.

The drill hole intersected three main geological units:

A. Limbunya Group sedimentary rocks (0-322.8 m) that consist of a diverse series of flat-lying mudrocks, variably silicified carbonate-rich sedimentary rocks and minor sandstones. This sequence unconformably overlies the Inverway Metamorphics.

B. Metasedimentary rocks of the Inverway Metamorphics (322.8-751.0, EOH) consist of a heterogeneous series of moderate-grade metamorphosed carbonate-rich sedimentary rocks including relatively common carbonate breccias, minor mudrock and sandstone. Dips are highly variable (30-90^{o}) with mesoscopic folds recognised in places. The rocks have a foliation or fracture cleavage that is particularly well developed in some carbonate-rich units and in mica-rich lithologies.

C. Mafic sills that intrude the sedimentary rocks of the Inverway Metamorphics. Sills range from 1cm to several metres in thickness and occur throughout the drilled Inverway Metamorphics intersection forming very approximately 50% of the intersection.

Mafic Rocks

The mafic sills are composed of basalt (i.e. fine-grained to very fine-grained with the term basalt referring to grain size not extrusive origin) and very minor fine-grained dolerite. The mafic rocks are metamorphosed (Appendix III) and in places strongly deformed along with their enclosing host rocks (Appendix II/2) and thus on geological grounds they appear to be part of the Inverway Metamorphics lithological/structural package.

This conclusion is supported by the presence of a weathered clay-rich basalt saprock within a deep red-brown, highly ferruginous, clay-rich paleoregolith located at the top of the Inverway Metamorphics immediately below the unconformity (Appendix II/3). This paleoregolith represents a previously exposed land surface that was deeply weathered before deposition of the overlying Limbunya Group. The mafic sills thus must be older than about 1640 Ma, the approximate age of the onset of Limbunya Group deposition (Cutovinos et al. 2002; de Vries et al. 2008).

There is thus compelling geological data that indicates that the mafic sills in LBD001 are very significantly older than Antrim basalts which are dated at 506 Ma (Glass and Phillips 2006; Levins et al. 2009) and are therefore not related to Antrim basaltic magmatism in any way.

No magmatic sulphide was seen in any of the mafic sills although trace amounts of secondary sulphide occurring mostly in veins and on fracture surfaces. The sulphides are mostly too fine-grained to identify in hand specimen but where they could be identified they were pyrite.

All except a few of the mafic sills are highly magnetic (10380 x 10^{-5} SI units; Appendix II/7) being on average three times as magnetic as Antrim basalt (3410 x 10^{-5} SI units). Petrographic examination shows that the magnetite content ranges up to 15%, very significantly higher than in an average basalt or metabasalt. Recent experimental work suggests that the assimilation of carbonate by basaltic magma produces oxidizing conditions (Marziano et al., 2007) which will drive the oxidation of Fe^{2+} to Fe^{3+} and thus favour the formation of magnetite over Fe^{2+}-bearing phases including silicate minerals. There is abundant evidence in the core for interaction between the mafic sills and their enclosing carbonate sedimentary rocks (Appendix II/4; Figure 5) suggesting that the high magnetite content, and thus the strong aeromagnetic anomaly that was a key element in selection of the drill target, may well be the result of carbonate assimilation by the mafic sills.

Marziano et al. (2007) also show that carbonate assimilation by mafic magma induces crystallisation and thus the formation of finer-grained rocks. This may well be the reason for the formation of the basalt sills seen in LBD001 rather than dolerite or gabbro sills.

Sedimentary and Metasedimentary Rocks

The interval 384.2-397.8 m consists of silicified bedded carbonate with numerous stylolites (Appendix I). It contains numerous open vugs lined with quartz and minor pyrite and chalcopyrite. Due to its uneven distribution it is difficult to visually estimate the sulphide content of the interval accurately but it is probably <1%. Similar rocks occur between 398.9-413.3 m below a pale coloured mudrock interval but no sulphides are present in the vugs. Vugs and associated sulphides in the interval 384.2-397.8 m may have formed during silicification of the original carbonate sediments but no feature was observed in the core to constrain the timing of the silicification.

Within the Limbunya Group there are thin layers, mostly <1 m thick, of black carbonaceous shale and dark green mudrock that contain trace amounts of possible sulphide. The possible sulphide was too fine-grained to identify in hand specimen and such intervals were sampled for assay to determine if any elevated metal values are present.

PETROGRAPHY OF MAFIC ROCKS

Observations from the petrography are given in Appendix III. Key findings are:

- All mafic rocks in LBD001 are metamorphosed and are composed of a fine to very fine-grained metamorphic assemblage of plagioclase, biotite, quartz, magnetite, muscovite, hornblende, and chlorite. Equant medium-fine grained magnetite and trace rutile appear to be the only relict igneous phases preserved. The mineral assemblage is very unusual for metabasalt and reflects the influence, via contamination, of the carbonate-rich environment into which the basalt sills were initially emplaced and then later metamorphosed.
- All mafic rocks were originally basalts (defined by grain size, not extrusive origin) and no coarser-grained dolerite or gabbro is present.
- The mafic rocks have an anomalously high magnetite content (up to 15%) for basalt (or metabasalt) as also shown by the magnetic susceptibility data. As discussed above the abundant magnetite and also rutileare thought to have formed during assimilation of carbonate by the basaltic magma, a highly oxidizing process favouring the crystallization of Fe^{3+}-bearing minerals (Marziano et al., 2007) and as a result most Fe is partitioned into magnetite.

- Contamination by the enclosing sedimentary rocks may also account for the high K and wide scatter in Al and within the metabasalts (see next section) and hence the presence of abundant mica in the metamorphic assemblages. Such interaction may also have placed a role in the anomalously low CaO and MnO content of these metabasalts.

Examination by SEM identified the following minerals: plagioclase (andesine An_{35}), Ti-rich and Ti-poor magnetite, quartz, biotite, muscovite, and trace rutile, monazite and possible kaolinite, the latter as an alteration of muscovite (Appendix IIIB).

GEOCHEMISTRY

Drill core samples from LBD001 were divided into two suites: A) mafic rocks to be assayed for major, minor and selected trace elements including rare earth elements (REE) to allow for comparison with Antrim basalts (samples of half NQ core x 20 cm; Appendix IV) and B) samples of sedimentary and mafic rocks collected from throughout the hole including continuous sampling over the chalcopyrite-bearing interval 384.2-397.8 m to be assayed for minor and trace elements to determine if any anomalous metal values are present (samples of half core x 1 m: Appendix V). The assay data are discussed in Appendix VI and the main conclusions reiterated here.

A) Mafic Rocks

The major, minor and trace element composition of LBD001 basalts are significantly different from Antrim basalts and thus they belong to separate magmatic suites. The geochemical comparison between these two mafic suites supports the geological relationships seen in LBD001 core that also shows that they belong to separate, unrelated sequences of very different ages (505 Ma compared to >1640 Ma).

The LBD001 basalts have higher Ti, Fe, K, Cr and lower Ca, Mn, Na, V, Y and Th than Antrim basalts (see geochemical plots, Appendix VI). Alumina shows a wide scatter with many of the basalts having markedly elevated values. The distribution of REE also shows that there are significant consistent differences (e.g. Figure 1) further supporting the conclusion that they are indeed separate suites.

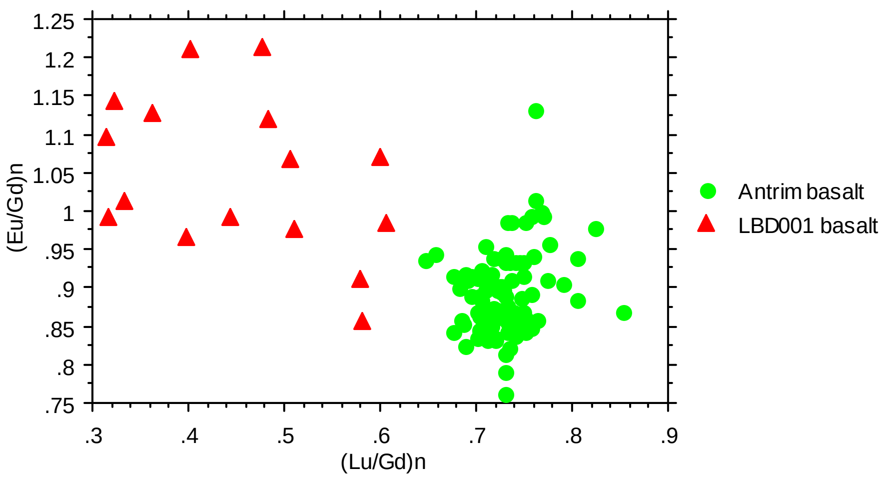

Figure 1. Ratio plot of chrondrite-normalised Eu, Lu and Gd showing that LBD001 and Antrim basalts plot in different fields. Antrim data from Glass (2002).

Notably Ni, Pt and Pd are significantly higher in LBD01 basalt than in Antrim basalt (Figures 2 and 3). Cobalt is also higher in the LBD001 basalts. The Antrim magma was S-saturated prior to the crystallization of the basalts and lost chalcophile-elements (Ni, Co, Cu, PGE) to a sulphide phase that then separated from the basaltic magma. The basalts are thus strongly depleted in chalcophile-elements (Gole and Ashley, 2003). The assay data clearly show that the magma that formed the LBD001 basalts was S-undersaturated and did not undergo a similar sulphide-separation process as did Antrim magma.

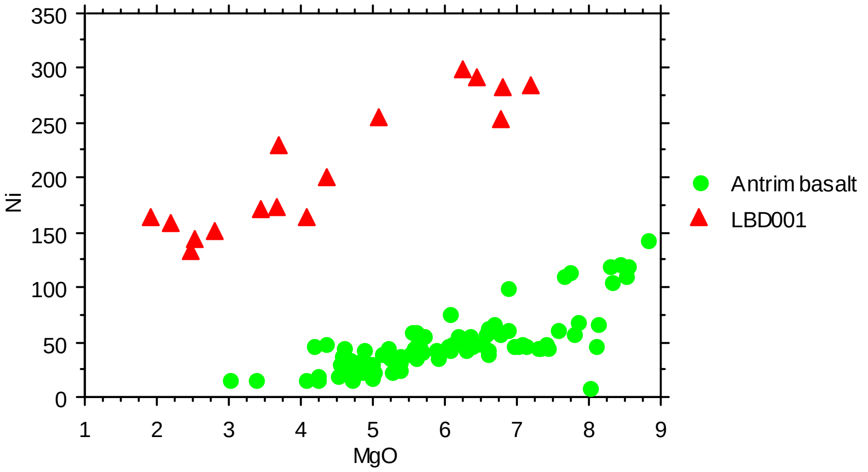

Figure 2. Ni (ppm) and MgO (%) plot showing LBD001 basalts have significantly higher Ni than Antrim basalts for a given MgO value. Antrim data from Glass (2002).

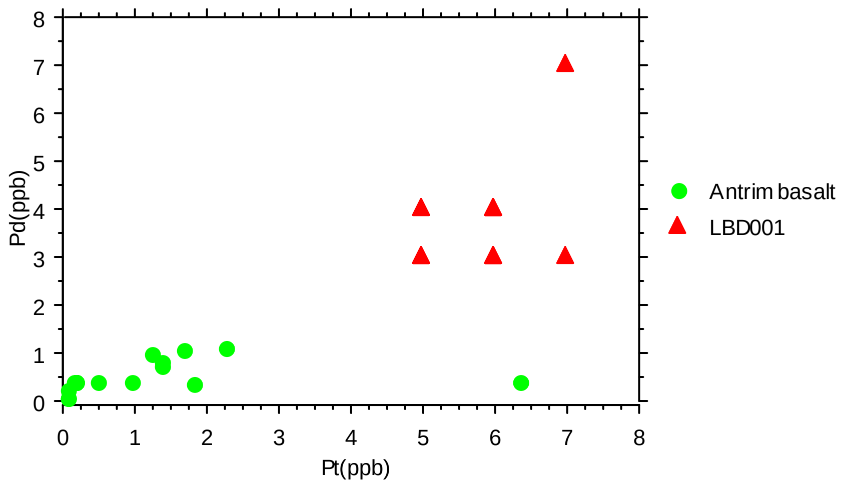

Figure 3. Pt verses Pd plot showing that LBD001 basalts have contents equivalent to other S-undersaturated basalts whereas Antrim basalts are strongly depleted. Antrim data from Glass (2002). Note that different assay techniques have been used for each basalt suite.

The range of Cu values in both LBD001 and Antrim basalts are similar and may reflect alteration/metamorphism related re-distribution and mobility of Cu in the LBD001 basalts such that current values do not reflect original igneous values.

B) Trace element assays

Limbunya Group Sediments: No elevated metal values are present. Sulphur values are in places weakly anomalous (up to 3072 ppm) with one anomalous value (6608 ppm) at the base of the sequence perhaps associated with late-stage fluids moving along the unconformity. No anomalous base metals are associated with the elevated S values.

Inverway Metamorphics: The silicified vuggy carbonate interval containing <1% pyrite and chalcopyrite (384.2 – 397.8 m, see Appendix I and II) contains 12-707 ppm Cu, 284-4555 ppm S and weakly anomalous Co (6-584 ppm).

Au shows weak to moderate anomalism with the most significant values (63-224 ppb) occurring in a 5 m interval (380-385 m) immediately above and at the top of the chalcopyrite-bearing unit mentioned above with two other lower order anomalous values occurring within the interval. It is not known whether the anomalous Cu and Au metals are related or not.

However no other anomalous metal values are present elsewhere within the Inverway Metamorphics interval.

CONCLUSIONS

The main conclusions are:

- Based on both geological and geochemical data the mafic rocks intersected in LBD001 are older and unrelated to the Antrim basalts. These rocks are metamorphosed and deformed and are part of the Inverway Metamorphics. This sequence is older than 1640 Ma and may be 1770 Ma or significantly older (Cawood & Korsch 2008).

- The LBD001 mafic rocks occur as thin basalt sills (<5 cm to several metres thick) intruded into carbonate-rich sediments within the Inverway Metamorphics. No dolerite or gabbro is present. They are unusual rocks both because of their very-fine to fine-grained nature and their mineralogy. They contain highly anomalous magnetite concentrations (up to 15%) and are about three times as magnetic as average basalt. Both these unusual features may be related to assimilation of the carbonate-rich host rocks during intrusion.

- The mafic rocks in LBD001 and contain undepleted Ni, Co, Pt and Pd values indicating that they formed from S-undersaturated magma unlike Antrim (and some Noril'sk) basalts that are highly depleted in these elements. These data suggest that the LBD001 basalt sill sequence is unlikely to be associated with magmatic sulphide mineralization.

- Weakly anomalous Cu (up to 707 ppm) and Co (up to 584 ppm) values are present within a 13.6 m intersection of silicified carbonate unit (384.2-397.8 m) that contains <1% pyrite and chalcopyrite within quartz-rich vugs. The vugs and associated sulphides may have formed during silicification of the original carbonate sediment but the timing of silicification is unknown. Weak to moderate Au values (up to 224 ppb) are spatially associated with this unit but it is not known whether the Cu and Au are related.

EXPLORATION IMPLICATIONS

A. The nature of the mafic rocks in LBD001 being so fine-grained, their undepleted chalcophile-element geochemistry together with the absence of any connection with the Antrim basalts strongly suggests that they have little potential to be associated with a Noril'sk-style magmatic Ni-Cu-PGE sulphide deposit. Further exploration of these mafic rocks for such mineralization is therefore not warranted.

B. Detailed re-logging of the anomalous Au interval (380-385 m) should be undertaken to determine what the Au is likely to be associated with (veins, shears) and evaluate what exploration potential may be associated with these moderately anomalous values. Additional potentially Au-related elements (Ba, Bi, K, Na, Sb, Rb, W) should be assayed from this interval and immediately surrounding units to help evaluate the significance of the anomalous values. As these rocks are deeply buried any realistic potential may be difficult to identify.

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APPENDIX I

Brief Geological Log of LBD001

Hole	Dfrom	Dto	Stratigraphy	Description
LBD01	0.0	8.5	Regolith	Ferruginous red-brown to cream clay-rich saprolite
LBD01	8.5	17.0	Regolith	Cream/pale brown clay-rich saprolite
LBD01	17.0	46.0	Mallaboh Dolostone ?	Saprock. Cherty, angular sedimentary rock fragments in brown clay-rich matrix (after matrix supported sedimentary breccia)
LBD01	46.0	51.6	Mallaboh Dolostone ?	Weathered clay-rich finely laminated mudrock. Pale cream/white
LBD01	51.6	55.7	Mallaboh Dolostone	Cherty convoluted lamination, possibly after stromatolites. Broken core
LBD01	55.7	78.0	Mallaboh Dolostone	Shale, finely laminated, pale gray. Numerous stylolites, originally carbonate-rich, now cherty. Bedding 90^o core axis
LBD01	78.0	79.0	Mallaboh Dolostone	Cherty convoluted lamination, possibly after stromatolites. Chert after carbonate?
LBD01	79.0	96.1	Mallaboh Dolostone	Shale, finely laminated, pale gray. Numerous stylolites, originally carbonate-rich, now cherty. 90.95-91.4 m black carbonaceous shale. Bedding 90^o core axis
LBD01	96.1	141.2	Amos Knob Formation	Interlayered shale and mudrock, finely laminated, pale to dark grey, dark green, maroon layers. Some green altered to maroon. Stylolites present in pale grey layers, originally carbonate-rich, now cherty. Bedding 90^o core axis
LBD01	141.2	146.1	Amos Knob Formation	Massive weakly cherty sediment, former carbonate sediment with numerous stylolites. Medium-grained matrix-supported
LBD01	146.1	162.3	Amos Knob Formation	Interlayered shale and mudrock, finely laminated, pale to dark grey, dark green, maroon layers. Some green altered to maroon. Stylolites present in pale grey layers, originally carbonate-rich, now cherty. Lower contact gradual mix with underlying unit. Bedding 90^o core axis
LBD01	162.3	162.5	Amos Knob Formation	Green-grey medium-grained sandstone. Mixed lithic grains. Some fine-grained layers
LBD01	162.5	178.0	Pear Tree Dolostone	Cherty convoluted laminated sediment, numerous stylolites. Possibly stromatolitic. Former carbonate rich. Weakly weathered to rusty buff. Lower contact gradual
LBD01	178.0	203.4	Margery Formation	Cherty, grey to grey-green convoluted laminated sediment, numerous stylolites. Possibly stromatolitic. Former carbonate rich. Some 10cm wide sandstone layers below 191.8 m. Definite 2-3 cm wide stromatolite at base

LBD01	203.4	211.2	Margery Formation	Fine-grained laminated mudrock and layers of medium-grained sandstone, some 0.5-3 cm angular, flat rip-up clasts in sandstone. Sparse conglomerate/cobbles at sharp base. Bedding 90^o core axis
LBD01	211.2	295.4	Stirling Sandstone	Pink massive quartz sandstone, uniform throughout. Patchy Fe-stained, numerous section of liesegang banding. Poorly displayed bedding 90^o core axis
LBD01	295.4	322.8	Stirling Sandstone	Pink massive quartz sandstone with 0.2-1.5 m thick gritty mudrock layers. Thin conglomerate layer at base. Lower contact irregular, steeply dipping and discordant to fabric in underlying rocks.
LBD01	322.8	334.4	Inverway Metamorphics	Massive deep red-brown strongly ferruginous weathered clay-rich saprock. Protolith metashale or mudrock? Steeply dipping moderately strong foliation. Bedding dips 25-35^o. Protolith textures obscured by weathering and/or foliation development.
LBD01	334.4	351.7	Inverway Metamorphics	Massive deep red-brown strongly ferruginous weathered clay-rich saprock after basalt. In places liquid-immiscible structures are pseudomorphed in saprock. Minor intercalated sediment layers.
LBD01	351.7	368.0	Inverway Metamorphics	Dark red-brown weathered sedimentary breccia composed of convoluted angular mudrock clasts and blocks with interlayered matrix-supported sandstone/conglomerate. Heterogeneous sequence. Moderate cleavage. Bedding 30-40^o to core axis.
LBD01	368.0	384.2	Inverway Metamorphics	Dark red-brown weathered unit of 3->20 cm sized boulders of quartzite in mudrock matrix – possible tilite. Very sharp lower contact.
LBD01	384.2	397.8	Inverway Metamorphics	Light grey laminated silicified carbonate sandstone to mudrock. Numerous stylolites and convoluted lamination (stromatolites?). 10% open vugs lined with quartz, pyrite and chalcopyrite. Sulphide content <1%. Bedding 35^o to core axis.
LBD01	397.8	398.8	Inverway Metamorphics	Very pale light grey mudrock.
LBD01	398.8	413.3	Inverway Metamorphics	Light grey laminated silicified carbonate sandstone to mudrock. Numerous stylolites and convoluted lamination (stromatolites?). 10% open vugs lined with quartz. Bedding 35^o to core axis.
LBD01	413.3	414.2	Inverway Metamorphics	Sedimentary breccia composed of elongate carbonate-rich clasts in grey-green mudrock matrix
LBD01	414.2	415.5	Inverway Metamorphics	Sedimentary breccia composed of elongate carbonate-rich clasts in grey-green mudrock matrix with 5-10 cm thick fine-grained basalt sills. Sills have convoluted contacts with sedimentary rock margins.
LBD01	415.5	437.0	Inverway Metamorphics	Layered dark and light grey laminated mudrock with sandstone layers and fine-grained matrix-supported conglomerate. Numerous 1-15 cm thick basalt sills forming ~10% of interval.
LBD01	437.0	445.1	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior. Complex internal arrangement of glassy and fine-grained basalt probably reflecting presence of several thin sills within interval
LBD01	445.1	448.8	Inverway	Pinkish massive sandstone

			Metamorphics	
LBD01	448.8	449.4	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior.
LBD01	449.4	451.4	Inverway Metamorphics	Pinkish massive sandstone
LBD01	451.4	458.5	Inverway Metamorphics	Mixed basalt sill and laminated grey shale and minor grey-green sandstone. Basalt forms ~50% of interval
LBD01	458.5	461.1	Inverway Metamorphics	Pinkish massive sandstone
LBD01	461.1	471.6	Inverway Metamorphics	Mixed basalt sill and laminated grey shale and minor grey-green sandstone. Basalt forms ~50% of interval
LBD01	471.6	474.3	Inverway Metamorphics	White silicified carbonate, numerous stylolites
LBD01	474.3	508.8	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior. Complex internal arrangement of glassy and fine-grained basalt reflecting presence of many (>10??) thin sills within interval. A few thin metasedimentary rock layers and inclusions present
LBD01	508.8	517.3	Inverway Metamorphics	Sedimentary breccia composed of white silicified carbonate angular and tabular clasts. Interval contains three 20-30 cm thick basalt sills. Middle sill has basalt vein network along contact and disaggregates the sediment close to contact
LBD01	517.3	528.0	Inverway Metamorphics	Two basalt sills separated by white silicified carbonate sediment (524.1-525.0 m). Numerous stylolites
LBD01	528.0	596.0	Inverway Metamorphics	Light to mid-grey strongly foliated carbonate-rich metasedimentary schist. Rock clearly deformed and significantly recrystallised. Generally uniform throughout except several 3 cm thick bands of black carbonaceous shale between 563.5-573.0 m
LBD01	596.0	600.7	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior
LBD01	600.7	618.9	Inverway Metamorphics	Grey weakly carbonaceous carbonate-rich sedimentary rocks, some silicified, strongly veined by carbonate. Sedimentary breccia in places with coarse angular clasts in a mudrock matrix. Variable throughout, some brecciated some laminated. Numerous thin (1-5 cm) glassy basalt sills mostly in lower part of interval
LBD01	618.9	626.9	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior with section of pinkish massive sandstone (626.3-626.8 m)
LBD01	626.9	635.0	Inverway Metamorphics	Fine to medium grained sedimentary breccia composed of angular carbonate-rich fragments in a dark-grey matrix. Minor laminated shale bands. <5% glassy to fine-grained basalt that show clear reaction with enclosing carbonate-rich sedimentary rocks.

LBD01	635.0	645.4	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior
LBD01	645.4	647.3	Inverway Metamorphics	Pink massive sandstone
LBD01	647.3	661.5	Inverway Metamorphics	Basalt sill with glassy (or former glassy) chilled margins and fine-grained interior and minor metasedimentary rock layers and inclusions
LBD01	661.5	669.6	Inverway Metamorphics	Pale grey and white carbonate-rich laminated sedimentary rock, some brecciated layers. 25% of interval composed of glassy to very fine-grained basalt sills
LBD01	669.6	674.0	Inverway Metamorphics	Basalt sill with abundant porphyroblasts
LBD01	674.0	684.6	Inverway Metamorphics	Pale-grey and white carbonate sedimentary rock with abundant (30% of interval) thin (3-10 cm) basalt sills with glassy (or former glassy) chilled margins and fine-grained interior and minor metasedimentary rock layers and inclusions
LBD01	684.6	729.6	Inverway Metamorphics	Abundant (70-80% of interval) thin basalt sills with glassy (or former glassy) chilled margins and fine-grained interior and minor metasedimentary rock layers and inclusions. Some intervals of basalt have abundant porphyroblasts. Basalt in interval 701.0-702.4 m moderately foliated. In places basalt cut by moderate dense network of 1-2 mm carbonate veins filling brittle fractures. Some sedimentary layers contain <1 mm sized ?cordierite porphyroblasts due to recrystallisation from adjacent basalt sills
LBD01	729.6	737.0	Inverway Metamorphics	Grey massive to weakly laminated carbonate-rich and minor carbonaceous sedimentary rock. Some breccia layers with white carbonate clasts in dark grey matrix. .
LBD01	737.0	745.6	Inverway Metamorphics	Three basalt sills with glassy (or former glassy) chilled margins and fine-grained interior with layers of pink sandstone 741.5-741.9 and 742.5-742.8 m
LBD01	745.6	751.0 **EOH**	Inverway Metamorphics	Pink massive sandstone

APPENDIX II

Drill Core Observations and Comments

Drill Core Observations and Comments

1. Limbunya Group sedimentary formations recognised in LBD001 from below the regolith are the Mallabah Dolostone, Amas Knob Formation, Pear Tree Dolostone, Margery Formation and finally the Stirling Sandstone (appendix I). Several of the carbonate-rich units contain stromatolites (Figure 1). Bedding in all these units is flat lying (Figure 2) and the rocks appear to be unmetamorphosed and undeformed.

2. The rocks that underlie the Limbunya Group and extend to the end-of-hole at 571 m are metamorphosed, have a well developed cleavage in mica-rich lithologies and a moderate to strong foliation in some carbonate-rich lithologies and rarely in deformed basalts. Dips are variable, mostly ranging between 30 and 60^{o} with some 90^{o}dips in places (Figure 3). Basalts are composed of plagioclase, biotite, magnetite/ilmenite, muscovite, quartz and minor to trace chlorite and hornblende indicating moderate metamorphic grade (probable greenschist facies). The basalts are commonly cut by chlorite veins and carbonate veins further indicating a degree of metamorphic alteration. Within the interval 528-596 m a medium-grained carbonate-rich metasediment appears to have been significantly recrystallised (it is gneissic in appearance) and contains boudinaged and structurally dismembered thin basalt sills/veins (Figure 4) indicating significant ductile deformation of both the basalt and enclosing sedimentary rock again indicating temperature/pressure conditions of moderate metamorphic grades. It is thus clear that the basalt sills and the enclosing sedimentary rocks have both been deformed and metamorphosed together indicating that are part of the same structural/stratigraphic package of rocks. The basalts should strictly be referred to as metabasalts and the sedimentary rocks should be called metasedimentary rocks. Based on published NTGS descriptions (Cutovinos et al. 2002) this metamorphosed and deformed sequence is likely to be the Inverway Metamorphics. This formation outcrops in small windows in the local area around Lindermans Bore (Cutovinos et al. 2002). The Birindudu Formation, which elsewhere lies between the Limbunya and Inverway Metamorphics is assumed to be missing at this location.

3. The top ~62 m of the Inverway Metamorphics is a weathered, deep red-brown, highly ferruginous, clay-rich paleoregolith. It represents a previously exposed surface (i.e. land surface) that was deeply weathered before deposition of the overlying Limbunya Group. The paleoregolith is thus older than about 1640 Ma, the approximate age of the onset of Stirling Sandstone deposition, the basal unit of the Limbunya Group (Cutovinos et al. 2002; de Vries et al. 2008). Significantly within the weathered zone is a 17 m interval of deeply weathered basalt similar to fresh basalt present throughout the remainder of the drill hole. This strongly indicates that the basalt sills are ~1640 Ma or older.

4. Throughout almost the entire intersection of the Inverway Metamorphics there are probably several hundred basalt sills ranging from <1 cm to at least several metres in thickness. A few probable basalt dykes that cut across the

sedimentary bedding are also present. Within many of the thicker basalt-dominated drill intersections there are 1-10 cm thick sedimentary rock intervals. Some of these appear to be bedding layers with sills on either side whereas others are surrounded by mafic rock and are clearly inclusions within individual sills. The thin sedimentary layers and inclusions are commonly recrystallised due to contact metamorphism caused by the basalt intrusions. Basalts show glassy (or former glassy) chilled margins against the enclosing sedimentary rocks and some of the larger inclusions. In places apparent chilled margins occur within basalt intervals suggesting basalt magma has chilled against earlier-formed sills of basalt. The basaltic rocks are either glassy, very fine-grained or fine-grained (i.e. are basalts) with a few narrow intervals (less than a metre or two thick) that could be described as fine-grained dolerite. No gabbro is present anywhere in the LBD001 core. Contact between sills and enclosing sedimentary rocks are variable ranging from planar to wavy with small (0.5-1 cm) round to irregular protrusions cross cutting the bedding to complex vein networks extending into the sedimentary rock up to 15 cm from the sill margin. The basalt vein networks are best developed in carbonate-rich lithologies where they disaggregate the sediment (Figure 5).

5. Basalts, other than chilled margins, contain variable proportions (30-60%) of 1-3 mm sized round to somewhat spherical to globular structures (Figure 6). The presence of these has resulted in some of the basalts being called gabbro. The structures are green-grey, irregularly rounded, oval to elongate and in places appear to coalesce into almost amoeboid shaped aggregates. In hand specimen some have a thin dark grey rim and occur within a pale grey matrix. It appears that mild metamorphic recrystallisation has made their contacts slightly fuzzy and this has hindered their identification in hand specimen. They could perhaps be metamorphic porphyroblasts or be structures related to liquid immiscibility within the basaltic magma (perhaps associated with carbonate assimilation).

6. No magmatic sulphides were observed in any of the rocks in LBD001. Trace amounts of secondary sulphide are present scattered throughout the mafic rocks. It is probable that these secondary sulphides formed during metamorphism from sulphur introduced with the metamorphic fluid. The sulphides occur in veinlets and most appear to be pyrite although many sulphide grains are too fine grained to identify visually. None were identified in any of the petrographic thin sections which included only one polished thin section.

7. The basalts are highly magnetic with basalts containing liquid immiscibility structures being more magnetic than basalt chilled margins. Magnetic susceptibility measurements on the basalts range from 900 to 19500 x 10^{-5} SI units with an average of 10380 x 10^{-5} SI units (based on 160 readings). This compares with the Antrim basalts which have a range of 600-9000 x 10^{-5} SI units and an average of 3410 x 10^{-5} SI units (based on 228 readings). (Note: the raw magnetic susceptibility measurements on the LBD001 NQ-sized core have been multiplied by 1.6 to correct for curvature of the core).

8. No sills are present in the massive sandstone interval at the bottom-of-hole (745.6-751.0 m). Presumably the lack of bedding partings hinders or does not allow the intrusion of basaltic magma as sills within this interval.

9. The presence of mafic rocks in the form of numerous thin fine-grained sills (as in LBD001) rather than a single thick gabbro sill (as for example at Norilsk) reflect formation in a highly unfavourable geological environment for the accumulation of magmatic Ni-Cu-PGE sulphides from parental mafic magmas. Magmas that form basaltic sill cool and crystallise (i.e. freeze) quickly and do not provide the opportunity to allow any entrained sulphides to separate from the silicate magma and to concentrate into an economic deposit. On the other hand mafic magmas that crystallise into gabbro cool much more slowly and do provide such an opportunity.

10. The mafic sills are all fine grained despite the combined thickness of the sills being greater than 150 m. It is also significant that there are no thick sills (>5-10 m). It might be expected that heat from the total thickness of basaltic magma would have resulted in slow cooling and development of coarser-grained rocks (e.g. dolerites and gabbro). That the rocks are so fine grained could result from either: A) The sills were emplaced near the surface of the sediment pile (perhaps into only partly consolidated sediments) allowing rapid dissipation of heat: B) There was sufficient time between individual sill emplacement to allow for cooling and thus intrusion took place over an extended period: C) Experimental work on the interaction between basaltic magma and carbonate rocks shows that this may induce crystallisation resulting in formation of finer grained rocks than would otherwise form (Marziano et al. 2007).

11. If bedded carbonate-rich sedimentary rocks are present below the massive sandstone unit at the EOH then basalt sills are likely below the EOH. Modelling of magnetic and gravity data with input of magnetic susceptibility and density data gathered from LBD001 core may provide better constrains on the depth and lateral extent of the mafic rocks than currently available.

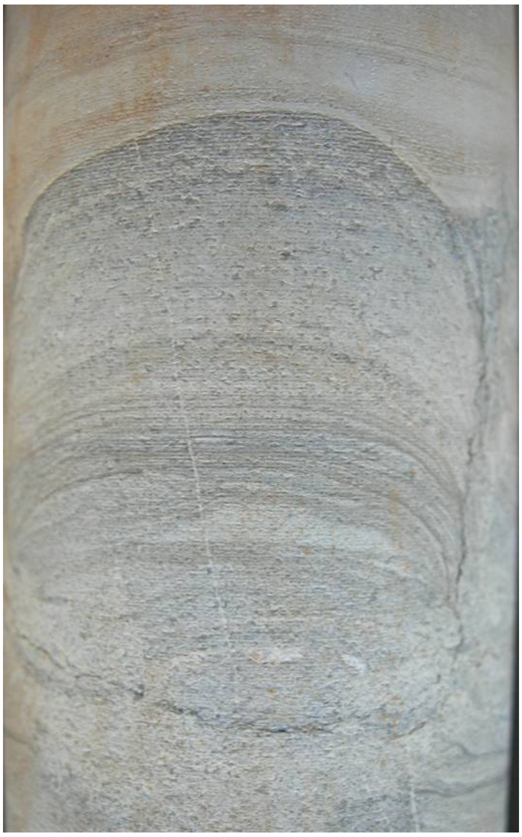

Figure 1. Small dome-shaped stromatolite in carbonate-rich sedementary rock from the Margery Formation. LBD001/203.6 m. Photo is 48 mm wide.

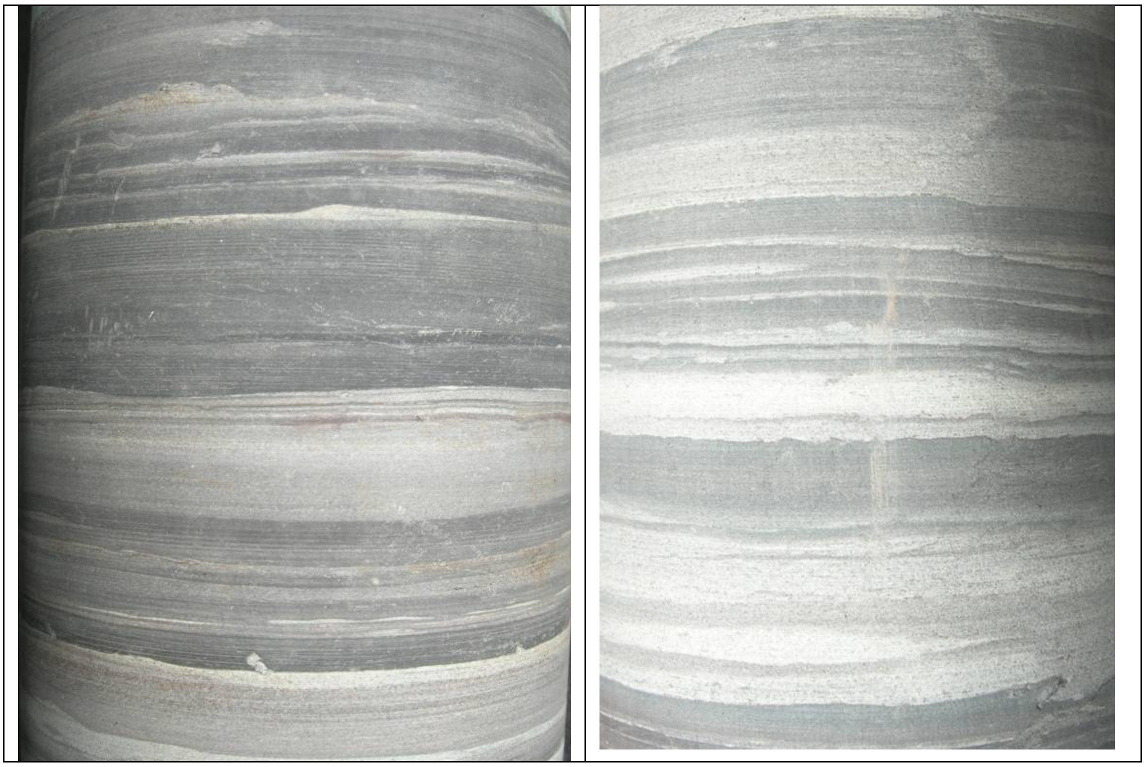

Figure 2. Photos of bedding laminae in carbonate-rich sedimentary rocks from Limbunya Group rocks. Note bedding is at right angles to core axis. Photos are 48 mm wide.

A. B.

Figure 3. A. Weathered former carbonate-rich bedded sedimentary rock showing a 25-30^{o} dip. Sample is from the paleoregolith zone in the upper part of the Inverway Metamorphics LBD001/355.5 m. B. Banded carbonate-rich sedimentary rock showing a 80^{o} dip. LBD001/535.5 m. Photos are 48 mm wide.

A. B.

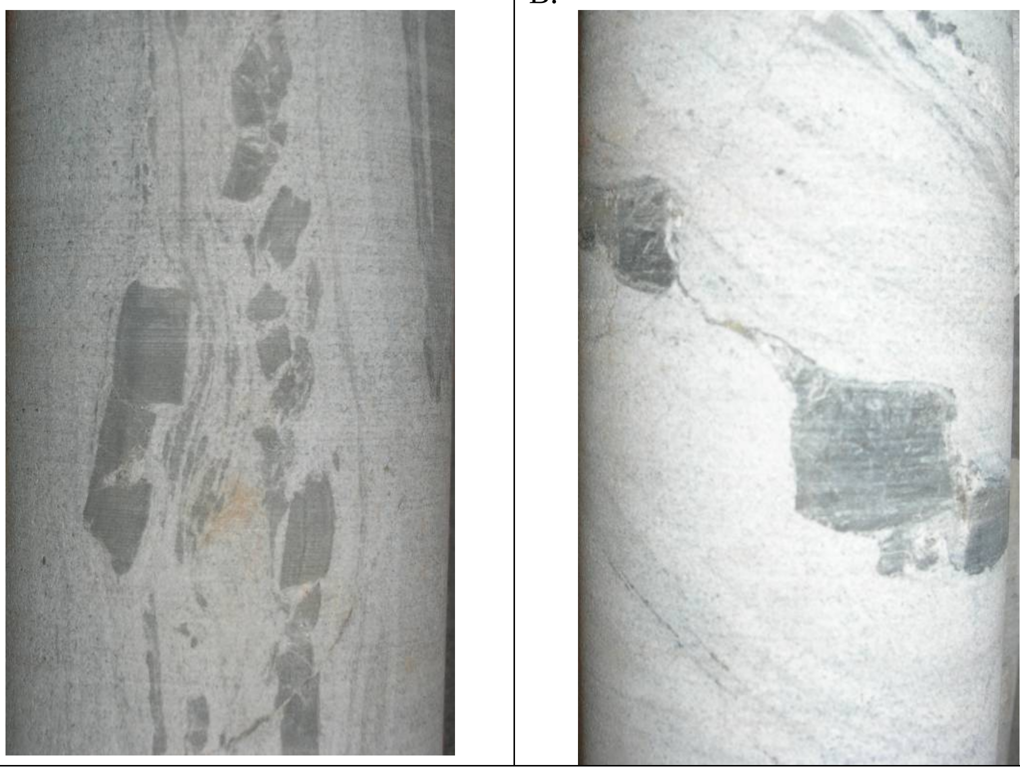

Figure 4. Thin basalt sills dismembered and boudinaged within deformed carbonate-rich sedimentary rocks. A. LBD001/568.5 m, B. LBD001/590.4 m. Photos are 48 mm wide.

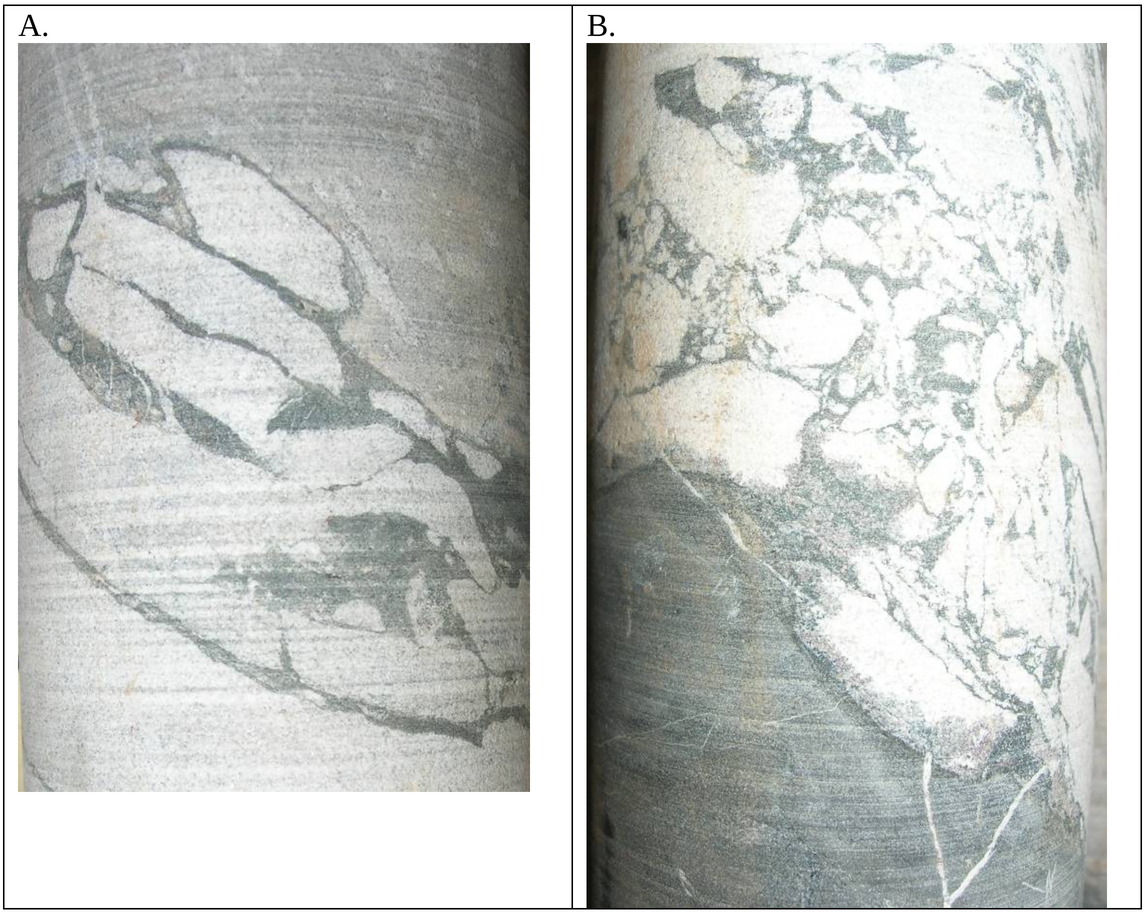

Figure 5. Vein networks of glassy to very fine-grained basalt intruding into and disaggregating carbonate-rich sedimentary rocks. A. LBD001/513.3 m, B. LBD001/595.3 m. Photos are 48 mm wide.

Figure 6. Globular-like structures in metabasalt. Long axis is 6 cm.

APPENDIX III

A. Petrographic Observations of Mafic Rocks and Comments

The samples listed below from LBD001 have been petrographically examined. All are either very-fine or fine-grained with a few medium-grained patches scattered throughout the rocks. Because of the very fine grain size mineral identification in all petrographic sections is difficult and there is a moderate degree of uncertainty as to the constituent minerals despite examination under X40 magnification.

Sample Depth (m)	Type	Description
418.8	TS	Flow-banded basaltic chilled margin in contact with calcite-epidote contact metamorphosed metasedimentary rock
438.0	TS	Fine-medium grained metabasalt
493.6	PTS	Porphyroblastic fine grained metabasalt
503.7	TS	Porphyroblastic fine-medium grained metabasalt
685.2	TS	Flow-banded basaltic chilled margin containing pale brown hornblende in contact with calcite-epidote-chlorite contact metamorphosed metasedimentary rock
692.9	TS	Flow-banded very fine-grained metabasalt with coarse porphyroblastic biotite
702.2	TS	Metabasalt schist containing pale brown hornblende
703.5	TS	Flow banded porphyroblastic fine-grained metabasalt
729.0	TS	Porphyroblastic very fine-grained metabasalt

All the mafic rocks are metamorphosed to the extent that apart from magnetite no other igneous mineral is preserved in the current assemblage. In addition no igneous microtextures are preserved although mesoscopic textures such as flow banding are, in places, moderately well preserved. All the mafic rocks appear to contain a very similar metamorphic mineral assemblage of, in approximate decreasing order of abundance, plagioclase, biotite, magnetite, quartz, muscovite, and chlorite (see Appendix IIIB). Hornblende was identified optically in only two of the rocks and then only in minor amounts. The presence of abundant biotite and muscovite and the near absence of an amphibole (either tremolite/actinolite or hornblende) is most unusual and indeed the mineral assemblage is totally unexpected for such rocks.

Magnetite, which constitutes up to >15% of the mineral assemblage (Figures 7-10), occurs in amounts much higher than present in an average metabasalt. The marked enrichment of magnetite in LBD001 metabasalts is well demonstrated by the X3 higher magnetic susceptibility of these rocks compared to Antrim basalts (see Appendix II/7). Magnetite occurs in two main habits: equant medium to fine grains and fine to very fine somewhat ragged grains distributed throughout the rock. Rutile is associated with the finer grained magnetite (Appendix IIIB). The magnetite and rutile appear to be a relict igneous phases. The very high magnetite content of most metabasalts indicates that much of the Fe in the rock is tied up in this oxide and is thus unavailable to be incorporated into the silicates (i.e. biotite, hornblende).

Pale brown to minor greenish khaki biotite constitutes up to ~25% of the rocks (Figures 7 & 8) and is very significantly more abundant than in an average metabasalt (trace – 3%). The mica is relatively MgO-rich mica (see Appendix IIIB) rather than more Fe-rich biotite that would be normally expected in a tholeiitic metabasalt. This is despite the moderately high Fe content of these metabasalts (see Geochemistry section). Biotite forms strongly poikilitic porphyroblasts that are much larger than all other minerals except, where present, hornblende.

Hornblende was positively identified in only two thin sections as a relatively minor component. It is very light brown in colour and forms medium-grained poikilitic porphyroblasts (Figure 7). Its pale colour suggests that it is pargasite (i.e. a Mg-rich Ca-Al-Na amphibole) rather than a more Fe-rich variety as is present in most metabasalts of the appropriate metamorphic grade.

A thin section across the contact between a mafic sill and enclosing metasedimentary rock shows the contact to be a well preserved igneous intrusive contact with, in places, delicate protrusions of the magma into the sediment (Figure 9) suggesting the magma was progressively assimilating the sediment during intrusion.

Globular-like Structures

Many of the metabasalts in LBD001 contain globular-like structures of uncertain origin (see Appendix II, Figure 6). These structures occur mostly in the middle parts of the sills and appear to be absent from chilled margins. The structures are green-grey with dark coloured rims, irregularly rounded, oval to elongate and in places appear to coalesce into almost amoeboid-shaped aggregates.

The globular structures have a different mineralogy to the matrix (Figure 10, Appendix IIIB). The structures are composed of plagioclase, quartz, magnetite/ilmenite and muscovite (i.e. trace to no biotite) whereas the matrix is contains significant biotite and has a lower plagioclase and quartz content. This indicates that the structures have a different bulk composition to the matrix. This may be caused by either growth of a poikilitic porphyroblast during metamorphism or may perhaps be a result of liquid immiscibility within the basaltic magma. Considerable research may be needed to fully understand the nature and origin of these structures.

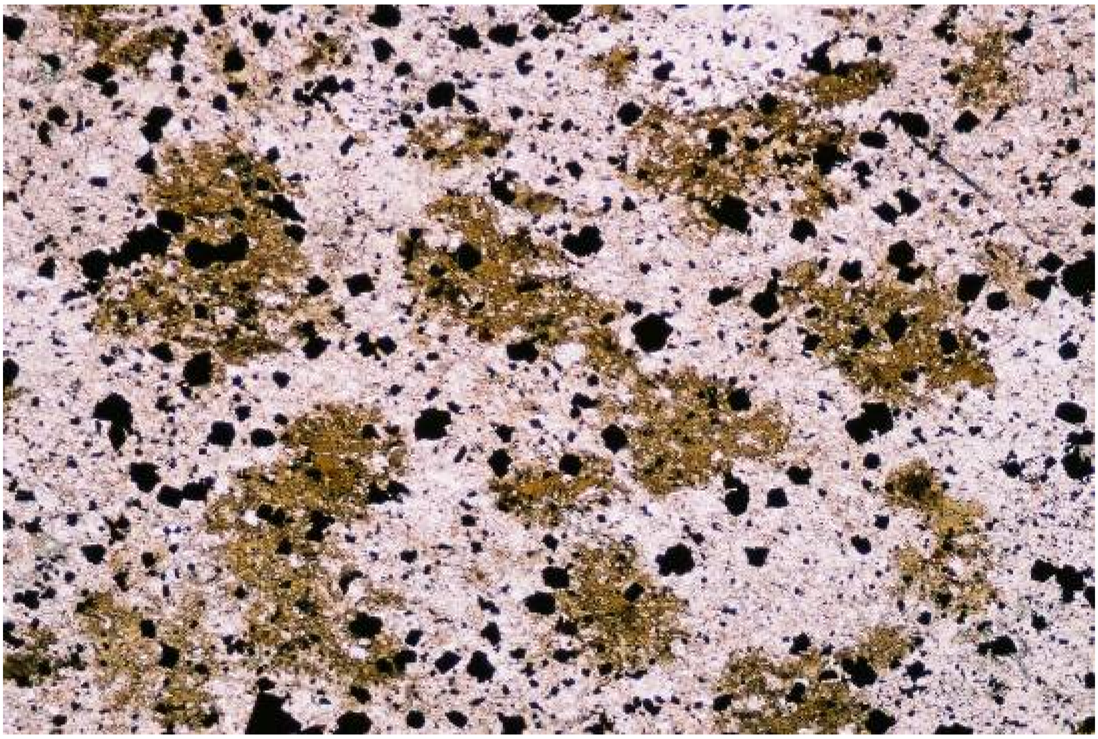

Figure 7. LBD001/503.7 m. Medium-grained poikilitic porphyroblastic biotite (brown) and abundant magnetite (black) in a very fine grained matrix of plagioclase, colourless tremolite, quartz and finer-grained magnetite. Plane light. FOV = 2.6 mm.

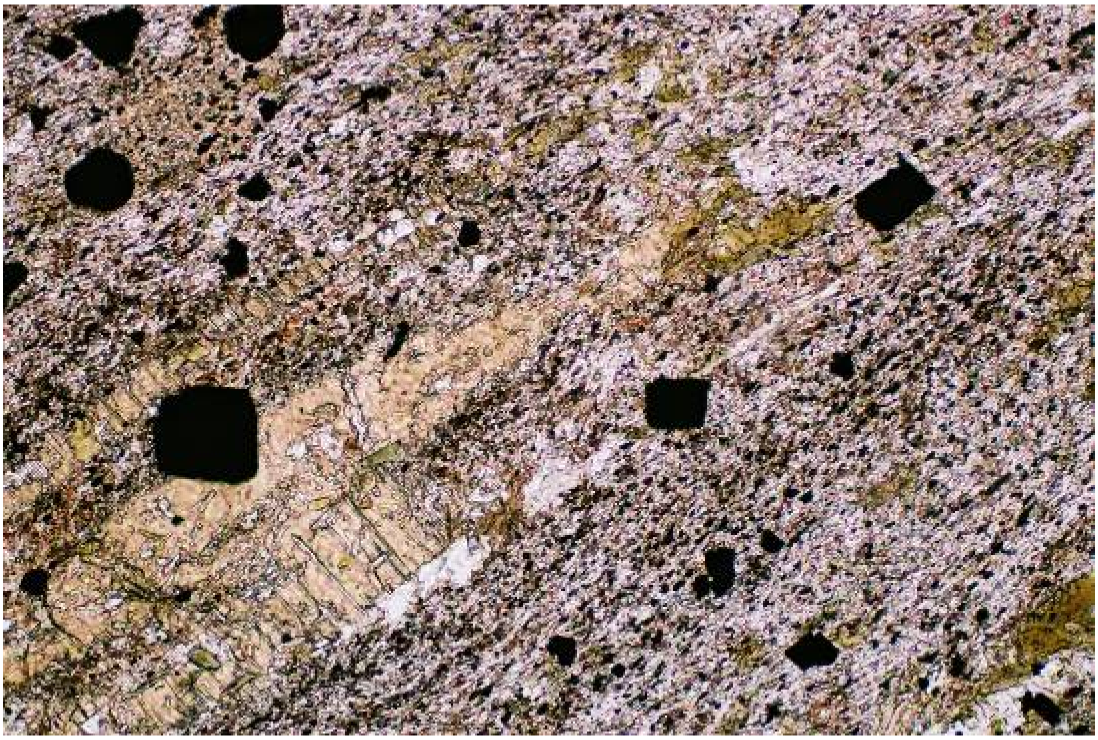

Figure 8. LBD001/702.2 m. Foliated metabasalt containing medium-grained pale brown hornblende (lower left), magnetite (black), biotite (khaki) in a very fine grained matrix of plagioclase, tremolite, quartz and finer-grained magnetite. Plane light. FOV = 1.3 mm.

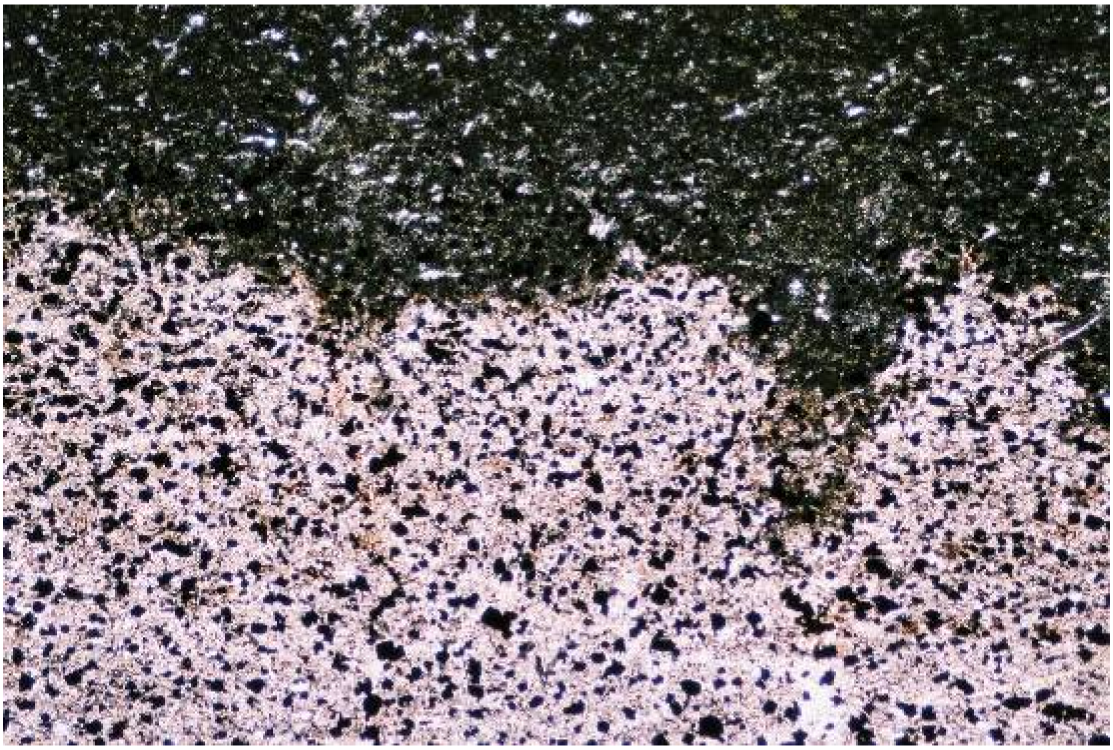

Figure 9. LBD001/685.2 m. Very-well preserved igneous intrusive contact between mafic sill (lower) and metasedimentary rock (upper). Note the high magnetite (black) content of the chilled margin of the sill although biotite is largely absent. Crossed polars. FOV = 2.6 mm.

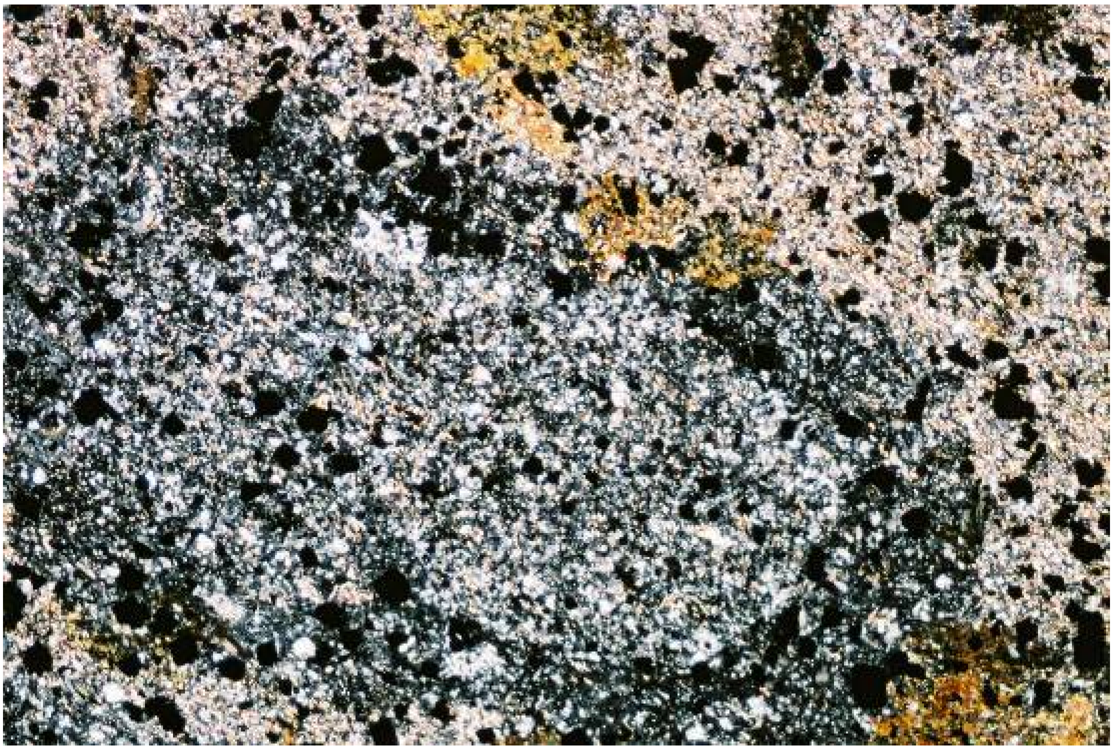

Figure 10. LBD001/503.7 m. Globular-like structure with dark rim. Note marked difference in mineralogy between globule and matrix. Crossed polars. FOV = 2.6 mm.

APPENDIX III

B. SEM Report on sample LBD001 – 493.6 m

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Our ref:
Your ref:

15 August 2009

RE: LBD-1 493.6 m

SEM/EDS examination of Drillcore Sample LBD-1 493.6 m

SCOPE

One polished thin section of diamond drill core sample LBD-1 493.6 m from a fine-grained mafic (basaltic) rock intruding carbonate was submitted by Dr Martin Gole for examination by Scanning Electron Microscopy (SEM) techniques including Backscattered Electron (BSE) imaging and Energy Dispersive X-ray Microanalysis (EDS). The aim of the investigation was to determine the mineralogy of the sample.

METHODS

The polished thin section was coated with carbon to make it conductive and was examined in a JEOL JSM6400 SEM fitted with an Oxford Instruments Link Analytical EDS. The different minerals in the samples were identified by BSE and qualitative EDS, and quantitative EDS analyses of some silicate and oxide minerals were obtained.

MINERALOGY

LBD-1 493.6 m

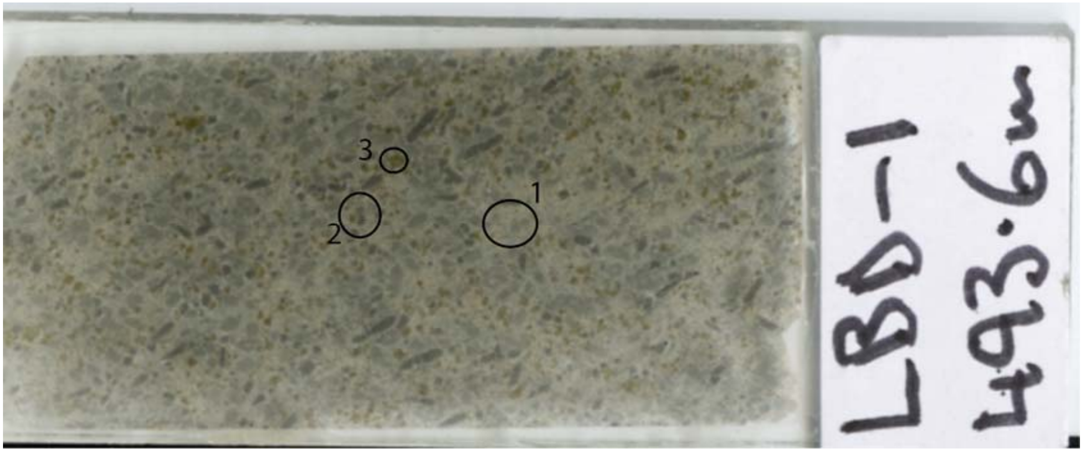


Figure 1. Scan of PTS LBD-1 493.6 m showing the particulate structure and areas analysed.

Mineral analyses were collected from three areas of the section, as shown in Figure 1. Analyses are presented in Table 1.

The rock has a particulate structure comprising cores composed of very fine-grained opaques in colourless, low birefringence minerals, and rims with few very fine opaques in low birefringence minerals, but scattered magnetite octahedra ~50 μm across. The particles are separated by a matrix of very fine-grained white mica with magnetite octahedra. There are also aggregates of fine-grained chlorite and pale brown biotite.

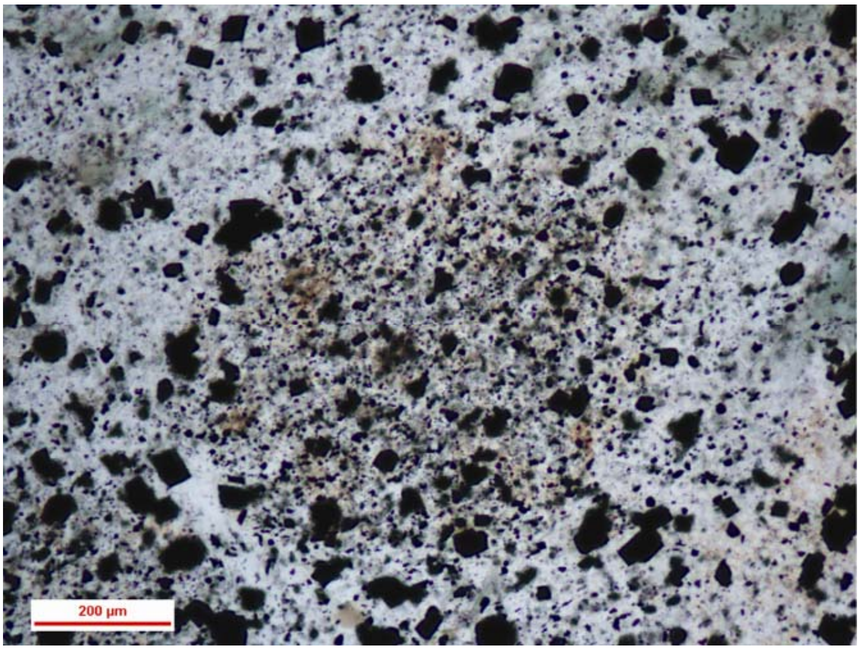


Figure 2. Area 1: central area with very fine opaques surrounded by a light area devoid of fine opaques.

The light coloured minerals within and adjacent to the core in this area have low birefringence and are predominantly quartz and plagioclase (andesine An_{35}). There is also some muscovite and ?kaolinite surrounding the quartz and plagioclase. Magnetite octahedra ~50 µm across are scattered through the area, but the very fine opaques include rutile as well as magnetite. Other minerals include biotite, chlorite, apatite and monazite.

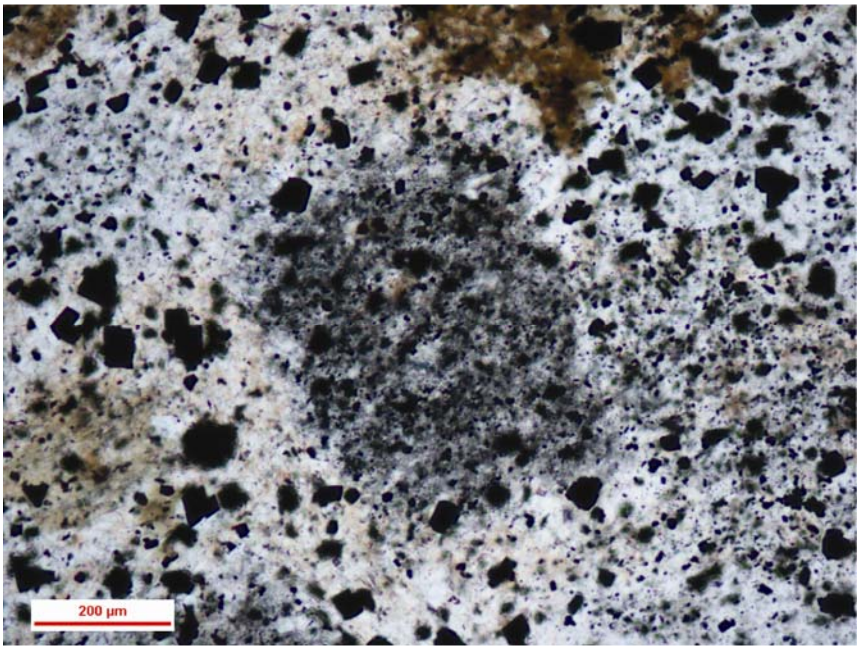


Figure 3. Area 2: central area with very fine opaques surrounded by a light area with few fine opaques.

Within the core and to the right of Figure 3, the light coloured minerals are predominantly quartz and plagioclase (andesine An_{35}). Surrounding the core on the left side is muscovite and ?kaolinite. Again, many of the very fine opaque grains are rutile, and some may be a Ti magnetite or ilmenite but are too fine to analyse. Other minerals in this area are biotite, chlorite and apatite.

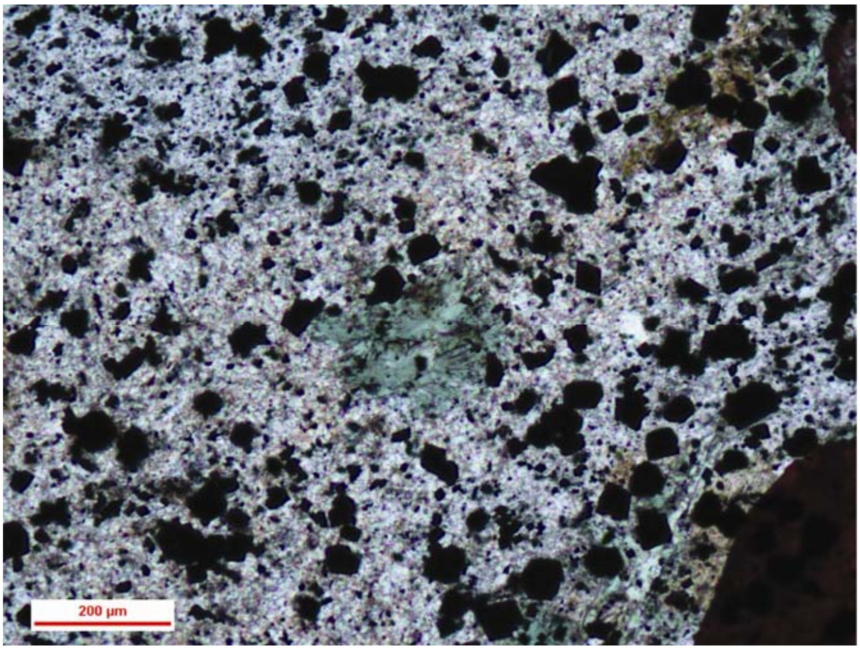


Figure 4. Area 3: Chlorite surrounded by muscovite and magnetite.

This area consists of fine-grained chlorite and biotite surrounded by muscovite, with abundant magnetite octahedra. There are a few grains of chalcopyrite intergrown with the magnetite, and other minerals present are quartz, rutile and monazite.

ANALYSES

Analyses of the major minerals in the sample are presented in Table 1. The coarser magnetite octahedra are almost pure magnetite, with a trace of Cr, but some of the smaller grains have appreciable Ti. Totals for these analyses are low, which may reflect the difficulty of analyzing such small grains. Some of the smaller grains are rutile (no analyses presented), but these differ from the fine Ti-magnetite grains.

The feldspars analysed have consistent compositions of An_{36}, and are therefore andesine.

The other minerals analysed are sheet silicates. Biotite grains have Mg Nos of 63-65 and ~1.2 wt% TiO_2. White mica is muscovite with ~3 wt% FeO, 1 wt% Na_2O and traces of $TiO_2$and MgO. Chlorite is apparently derived by alteration of biotite, and has K_2O contents ranging from 0-4 wt% and TiO_2 from 0-0.7 wt%. Another mineral has ~41 wt% SiO_2, 37 wt% Al_2O_3, 5 wt% FeO, 3 wt% MgO and traces of CaO, Na_2O and K_2O. This composition fits best with kaolinite, and may be an alteration product of muscovite.

CONCLUSIONS

The origin of the particulate structure is still not apparent.

Table 1. Analyses of minerals from LBD-1 493.6 m

Sample	**lbd11**	**ldb25**	**lbd23**	**Sample**	**lbd12**	**lbd13**	**ldb24**	**Sample**	**lbd21**	**lbd15**	**Sample**	**lbd16**	**lbd17**	
Mineral	magnetite	Ti mag	Ti mag	Mineral	andesine	andesine	andesine	Mineral	chlorite	chlorite	Mineral	kaolinite	kaolinite	
Ox no	4	4	4	Ox no	8	8	8	Ox no	28	28	Ox no	14	14	
TiO2	0.00	12.68	10.79	SiO2	58.24	57.80	59.49	Na2O	0.42	0.31	SiO2	40.81	41.35	
Al2O3	0.00	0.30	0.00	TiO2	0.00	0.00	0.00	MgO	15.15	19.40	TiO2	0.00	0.00	
Cr2O3	0.47	0.34	0.42	Al2O3	25.05	25.48	26.67	Al2O3	19.25	22.76	Al2O3	36.51	36.87	
Fe2O3	0.00	0.00	0.00	Cr2O3	0.00	0.00	0.00	SiO2	31.31	25.24	Cr2O3	0.00	0.00	
V2O3	0.00	0.00	0.00	Fe2O3	0.00	0.00	0.00	P2O5	0.00	0.21	Fe2O3	0.00	0.00	
FeO	92.98	78.64	79.89	FeO	0.50	0.44	0.40	S	0.00	0.00	FeO	5.12	5.16	
MnO	0.00	0.00	0.00	MnO	0.00	0.00	0.00	Cl	0.00	0.00	MnO	0.00	0.00	
MgO	0.00	0.23	0.22	MgO	0.28	0.00	0.00	K2O	4.04	0.00	MgO	2.70	2.90	
ZnO	0.00	0.00	0.00	CaO	7.62	7.54	7.82	CaO	0.15	0.00	CaO	0.42	0.35	
NiO	0.00	0.00	0.00	Na2O	7.05	7.20	7.62	TiO2	0.73	0.00	Na2O	0.47	0.50	
CoO	0.00	0.00	0.00	K2O	0.00	0.00	0.00	Cr2O3	0.00	0.00	K2O	0.99	0.95	
Oxide total	**93.45**	**92.19**	**91.32**	**Oxide total**	**98.74**	**98.46**	**102.00**	MnO	0.00	0.00	**Total**	**87.02**	**88.08**	
Fe2O3*	68.72	41.39	44.95	Si	2.638	2.626	2.611	FeO	17.21	18.34	Si	3.662	3.664	
FeO*	31.14	41.39	39.44	Ti	0.000	0.000	0.000	NiO	0.00	0.00	Ti	0.000	0.000	
Total*	100.33	96.33	95.82	Al	1.338	1.365	1.380	**Oxide total**	**88.26**	**86.26**	Al	3.862	3.851	
Ti	0.000	0.375	0.322	Cr	0.000	0.000	0.000	Na	0.165	0.124	Cr	0.000	0.000	
Al	0.000	0.014	0.000	Fe3+	0.000	0.000	0.000	Mg	4.587	5.966	Fe3+	0.000	0.000	
Cr	0.014	0.011	0.013	Fe2+	0.019	0.017	0.015	Al	4.607	5.535	Fe2+	0.384	0.382	
Fe3+	1.986	1.225	1.343	Mn	0.000	0.000	0.000	Si	6.359	5.207	Mn	0.000	0.000	
V	0.000	0.000	0.000	Mg	0.019	0.000	0.000	P	0.000	0.036	Mg	0.361	0.383	
Fe2+	1.000	1.362	1.309	Ca	0.370	0.367	0.368	S	0.000	0.000	Ca	0.040	0.033	
Mn	0.000	0.000	0.000	Na	0.619	0.634	0.649	Cl-	0.000	0.000	Na	0.082	0.086	
Mg	0.000	0.013	0.013	K	0.000	0.000	0.000	K	1.046	0.000	K	0.113	0.107	
Zn	0.000	0.000	0.000	**Cation total**	**5.003**	**5.009**	**5.023**	Ca	0.033	0.000	**Cation total**	**8.505**	**8.507**	
Ni	0.000	0.000	0.000	Anorthite	36.02	36.06	35.67	Ti	0.112	0.000				
Co	0.000	0.000	0.000	Albite	60.30	62.30	62.90	Cr	0.000	0.000				
Cation total	**3.000**	**3.000**	**3.000**					Mn	0.000	0.000				
Mg No	0.00	0.98	0.98					Fe2+	2.922	3.164				
Ulvospinel	0.00	37.51	32.21					Ni	0.000	0.000				
Spinel	0.00	0.70	0.00					**Cation total**	**19.831**	**20.033**				
Chromite	0.71	0.53	0.66											
Magnetite	99.29	61.27	67.13											
100Cr/(Cr+Al)	100.00	43.20	100.00											
100Fe/(Fe+Mg)	100.00	99.00	99.00											

Table 1. Analyses of minerals from LBD-1 493.6 m

Sample	**ldb26**	**lbd210**	**lbd22**	**lbd18**	**lbd29**	**lbd31**	**lbd32**
Mineral	BI	BI	MV	MV	MV	MV	MV
Ox no	11	11	11	11	11	11	11
SiO2	35.85	34.44	44.38	45.77	45.45	46.89	44.71
TiO2	1.38	1.13	0.50	0.37	0.32	0.62	0.50
Al2O3	18.27	18.40	33.85	34.80	34.63	35.99	33.10
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	14.31	15.93	2.92	3.05	2.94	3.18	3.12
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MgO	14.81	15.44	0.76	0.51	0.53	0.68	0.65
CaO	0.14	0.00	0.00	0.00	0.00	0.00	0.00
Na2O	0.50	0.44	1.11	1.09	0.82	1.06	0.84
K2O	8.64	6.29	9.92	10.11	10.10	10.39	10.28
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oxide total	**93.90**	**92.07**	**93.44**	**95.70**	**94.79**	**98.81**	**93.20**
Si	2.696	2.633	3.044	3.061	3.065	3.040	3.080
Ti	0.078	0.065	0.026	0.019	0.016	0.030	0.026
Al	1.620	1.658	2.738	2.744	2.753	2.751	2.689
Cr	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fe2+	0.900	1.018	0.168	0.171	0.166	0.172	0.180
Mn	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mg	1.660	1.759	0.078	0.051	0.053	0.066	0.067
Ca	0.011	0.000	0.000	0.000	0.000	0.000	0.000
Na	0.073	0.065	0.148	0.141	0.107	0.133	0.112
K	0.829	0.614	0.868	0.863	0.869	0.860	0.904
Cl-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cation total	**7.870**	**7.810**	**7.070**	**7.050**	**7.030**	**7.050**	**7.060**
Mg No	64.84	63.33	31.68	22.96	24.31	27.59	27.07

APPENDIX IV

Whole Rock Analytical Data – Samples L1-L23

Lindeman's Bore LBD 1

Samples for wholerock, trace & platinum group element analysis

SampleID	From	To	MagSus (x10-5)	Comments
L1	426.85	427	95	Fine grained mafic sill. Non Magnetic.
L2	435	435.2	0	Cream coloured medium grained bedded sandstone.
L3	438.6	438.8	15000	Fine grained mafic sill.
L4	444.8	445	9300	Fine grained mafic sill.
L5	448	448.25	0	Red silstone/sandstone.
L6	473.75	474	240	Cream coloured siliceous sandstone. With styolites.
L7	479	479.2	11700	Fine grained mafic sill.
L8	493.65	493.85	13450	Medium grained mafic sill.
L9	513	513.2	0	Cream to brown sedimentary carbonate fragment breccia.
L10	518.5	518.7	12350	Fine grained mafic sill. Minor carbonate veinlets.
L11	523.7	523.95	9350	Fine grained mafic sill. Minor carbonate veinlets.
L12	542	542.25	0	Cream to grey schistose to bedded siliceous sandstones. Metamorphosed.
L13	609	609.2	0	Cream siliceous sandstone. Carbonate replaced.
L14	644	644.25	17200	Fine grained mafic sill. Very minor carbonate veinlets.
L15	648.1	648.38	8864	Fine grained mafic sill. Very minor carbonate veinlets.
L16	654.3	654.6	10800	Fine grained dolerite.
L17	673.15	673.4	12960	Medium grained mafic sill.
L18	693.35	693.55	7020	Medium grained mafic sill.
L19	706	706.3	6500	Medium grained mafic sill.
L20	713.95	714.15	11750	Fine to medium grained mafic sill.
L21	724.25	724.5	4500	Fine grained mafic sill. Fractured with minor carb veinlets along fractures.
L22	726.15	726.45	5300	Medium to coarse grained mafic sill. Brown alteration.
L23	748	748.2	0	Red silstone/sandstone.

ELEMENTS	Au	Al2O3	As	Ba	Ba	CaO	Ce	Cl	Co	Co	Cr	Cr	Cu	Cu	Dy	Er	Eu	Fe2O3	Gd
UNITS	ppb	%	ppm	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm
DETECTION	1	0.01	20	0.1	100	0.01	0.01	0.002	1	100	5	50	1	10	0.01	0.01	0.01	0.01	0.01
METHOD	FA25/MS	Fus/XRFm	Fus/XRFm	A/MS	Fus/XRFm	Fus/XRFm	A/MS	Fus/XRFm	A/OES	Fus/XRFm	A/OES	Fus/XRFm	A/OES	Fus/XRFm	A/MS	A/MS	A/MS	Fus/XRFm	A/MS

COMMENTS: 1049.0/0906564 (13/08/2009) CLIENT O/N: Ashley Hood 1/1

	Au	Al2O3	As	Ba	Ba	CaO	Ce	Cl	Co	Co	Cr	Cr	Cu	Cu	Dy	Er	Eu	Fe2O3	Gd
SAMPLE NUMBERS																			
L1	4	17.05	X	197.4	261	4.53	40.16	0.025	50	X	227	261	231	238	4.79	2.77	1.41	15.52	5.05
L2	5	3.48	X	16	108	42.01	11.75	0.007	16	X	76	73	23	24	1.54	0.94	0.42	4.31	1.59
L3	X	16.96	X	246.8	336	1.45	35.98	0.008	49	X	270	298	68	66	2.06	1.05	1.17	18.14	3.4
L4	X	16.66	X	351.5	464	1.1	35.48	0.011	43	X	264	277	83	68	3.02	1.48	1.5	14	4.37
L5	9	14.2	X	380.7	461	0.95	30.01	0.014	2	X	16	X	6	X	0.56	0.21	0.37	2.3	0.96
L6	2	2.85	X	24.2	131	43.5	10.37	0.017	18	X	78	60	26	X	1.39	0.77	0.37	3.89	1.46
L7	1	17.59	X	292.3	366	2.44	38.9	0.004	44	X	210	280	90	81	2.18	0.93	1.34	15.38	4.13
L8	2	18.68	X	293.8	370	1.48	42.71	0.008	46	X	162	260	81	72	2.41	1.03	1.43	15.06	4.6
L9	4	1.83	X	33.5	X	48.02	15.69	0.023	7	X	54	X	16	X	1.24	0.69	0.41	1.75	1.66
L10	X	12.21	X	108.4	176	1.62	21.29	0.009	54	X	545	674	4	X	3.23	1.77	0.89	16.2	3.21
L11	X	14.74	X	236.5	330	3.23	17.47	0.021	58	X	522	634	17	X	3.65	2.03	0.81	16.72	3.34
L12	1	0.49	20	9.2	113	52.82	2.69	0.009	3	X	35	X	10	13	0.46	0.31	0.11	1	0.49
L13	2	0.93	X	18.4	100	50.01	4.94	0.027	7	X	49	X	30	32	0.68	0.36	0.21	0.85	0.86
L14	X	13.13	X	141.9	237	1.26	22.48	0.013	57	X	574	738	3	X	3.52	1.89	1.08	17.64	3.57
L15	X	13.84	X	197.7	309	1.44	17.46	0.021	57	X	526	649	23	14	3.41	1.89	0.93	17.17	3.06
L16	X	12.92	X	184.6	260	3.17	29.05	0.018	52	X	641	828	23	19	3.56	1.86	1.26	17.52	3.97
L17	X	15.75	X	403.3	439	1.67	30.24	0.017	50	X	330	415	58	58	2.52	1.16	1.17	17.02	3.66
L18	X	17.38	X	323.5	417	1.03	38.65	0.028	46	X	149	251	6	X	3.11	1.4	1.42	15.18	5.05
L19	X	17.14	X	469.6	490	0.31	29.94	0.051	43	X	197	280	45	39	5.38	2.69	1.44	13.9	5.12
L20	1	15.46	X	379.3	493	0.68	31.04	0.025	60	X	366	480	68	58	4.51	2.19	1.66	16.01	5.78
L21	1	15.54	X	248.7	367	2.68	31.69	0.02	50	X	270	514	6	X	3.8	2.09	1.28	16.46	4.67
L22	X	16.8	X	353.1	402	1.07	22.04	0.02	35	X	214	304	104	106	4.12	2.3	1.01	14.15	3.91
L23	X	14.34	X	379.7	455	1.25	33.61	0.029	1	X	16	X	9	X	0.54	0.2	0.4	1.94	1.02
CHECKS																			
L10	1	12.19	X	113	190	1.62	21.67	0.011	55	X	525	687	5	11	3.3	1.84	0.89	16.12	3.24
STANDARDS																			
AMIS0076				95.9			80.15		120		462		88		15.93	8.5	1.62		12.5
GenFe-3																			
OREAS13P	43																		
Quartz-1																			
SARM45		26.46	38		907	0.76		0.01		X		221		X				12.68	
BLANKS																			
Control Bla	X	X	X	X	X	X	0.02	0.003	X	X	6	X	X	X	X	X	X	X	X
Control Blank				0.1			0.02		X		7		X		0.03	0.04	X		0.02
Acid Blank				X			X		X		X		X		X	X	X		X

Hf	Ho	K2O	LOI	La	Lu	MgO	MnO	Na2O	Nb	Nd	Ni	Ni	P2O5	Pb	Pb	Pd	Pr	Pt	Rb	S
ppm	ppm	%	%	ppm	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppb	ppm	ppm
0.01	0.01	0.01	0.01	0.01	0.005	0.01	0.005	0.01	0.05	0.01	1	50	0.002	5	50	1	0.005	1	0.05	50
A/MS	A/MS	Fus/XRFm	/TGA	A/MS	A/MS	Fus/XRFm	Fus/XRFm	Fus/XRFm	A/MS	A/MS	A/OES	Fus/XRFm	Fus/XRFm	A/OES	Fus/XRFm	FA25/MS	A/MS	FA25/MS	A/MS	A/OES
5.58	0.98	3.94	2.13	19.52	0.382	4.1	0.048	2.37	14.9	21.34	162	181	0.133	X	X	7	5.107	7	147.74	934
0.98	0.32	0.15	32.93	5.97	0.121	2.11	0.106	0.35	2.36	6.39	46	X	0.074	10	X	2	1.506	2	3.77	2416
3.72	0.37	1.99	1.41	16.81	0.203	2.82	0.037	1.62	7.49	18.5	150	164	0.084	X	X	3	4.387	7	74.38	2025
3.03	0.54	3.2	2.7	16.66	0.22	2.56	0.028	1.02	5.61	18.99	143	161	0.107	X	X	3	4.475	6	63.42	307
1.69	0.09	2.95	1.24	16.25	0.024	0.38	0.031	4.28	2.81	10.02	9	X	0.035	X	X	X	3.053	X	65.19	111
0.77	0.28	0.47	35.26	5.46	0.09	1.73	0.183	0.13	1.24	5.66	50	X	0.041	X	X	2	1.33	2	10.1	1451
2.89	0.35	1.44	1.52	18.41	0.167	2.23	0.039	1.6	2.9	21.92	157	163	0.112	X	X	3	5.066	6	50.86	101
2.62	0.38	2.09	2.52	19.96	0.181	1.94	0.013	1.33	0.71	23.43	162	170	0.124	X	X	3	5.566	6	63.22	135
0.48	0.26	0.27	38.75	11.31	0.07	1.29	0.13	0.03	0.56	8.42	26	X	0.106	8	X	2	1.973	2	8.98	2127
2	0.63	1.77	4.65	9.83	0.205	6.27	0.049	0.64	0.92	12.27	297	331	0.095	X	X	3	2.747	5	44.5	163
2.6	0.74	2.77	6.5	7.27	0.243	6.48	0.034	0.67	4.28	10.53	290	343	0.103	X	X	3	2.358	5	87.55	53
0.16	0.11	0.03	42.34	2	0.031	0.78	0.038	0.02	0.28	1.89	19	X	0.072	13	X	2	0.427	X	1.48	825
0.2	0.13	0.43	39.12	3.03	0.035	0.43	0.117	0.03	0.29	2.96	24	X	0.032	X	X	2	0.674	1	6.84	5747
2.26	0.7	1.28	3.34	10.36	0.226	6.84	0.037	2.26	1.98	12.76	281	329	0.09	X	X	4	2.921	5	33.49	X
2.78	0.69	1.39	3.75	7.91	0.229	7.23	0.053	2.21	1.98	9.79	282	345	0.099	X	X	4	2.28	5	39.11	X
2.34	0.69	1.63	3.98	12.83	0.24	6.81	0.047	1.41	2.95	15.46	251	319	0.092	X	X	3	3.586	5	47.84	57
2.35	0.44	3.4	1.49	14.34	0.166	4.38	0.167	1.46	4.6	16.86	198	258	0.103	5	X	4	3.884	6	89.28	94
2.55	0.54	3.58	2.65	19.3	0.201	3.47	0.047	1.42	2.78	20.84	170	182	0.126	X	X	4	4.986	6	62.07	X
2.01	1.04	4.31	3.38	14.47	0.284	3.69	0.043	0.39	3.18	17.48	172	193	0.138	X	X	4	4.056	6	89.61	1438
2.75	0.85	3.66	3.38	15.42	0.241	5.11	0.073	0.38	6.66	18.67	254	297	0.117	X	X	4	4.17	6	55.9	80
1.89	0.75	2.66	5.07	16.47	0.233	3.72	0.085	1.15	0.76	19.06	227	250	0.118	X	X	4	4.367	6	74.95	X
3.12	0.84	3.01	3.62	10.89	0.283	2.49	0.032	1.24	2.77	12.93	132	159	0.111	X	X	3	2.903	6	92.63	107
1.82	0.09	1.35	1.23	19.33	0.023	0.23	0.03	5.21	3.56	10.98	8	X	0.037	6	X	X	3.359	X	44.9	X
2.28	0.66	1.76	4.64	9.93	0.225	6.26	0.044	0.63	1.28	12.58	298	354	0.095	X	X	3	2.822	5	44.1	161
2.18	3.05			40.29	0.823				5.8	33.99	195			687			8.78		16.96	20856
			4.36																	
																67		46		
		3.13				3.42	0.097	0.76				65	0.075		X					
X	X	X	0.05	0.02	X	X	X	X	X	0.01	X	X	X	X	X	X	X	X	0.06	X
0.03	0.02			0.02	X				X	0.09	X			X			0.007		0.05	X
X	X			0.02	X				X	0.02	X			X			X		X	X

S	SG	SiO2	Sm	Sn	Sr	Sr	Ta	Tb	Th	Ti	TiO2	U	V	V	Y	Yb	Zn	Zn	Zr
%	NONE	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
0.002	0.01	0.01	0.01	50	1	0.05	0.01	0.005	0.01	5	0.01	0.01	2	20	0.05	0.01	1	10	0.1
Fus/XRFm	/GRAV	Fus/XRFm	A/MS	Fus/XRFm	A/OES	A/MS	A/MS	A/MS	A/MS	A/OES	Fus/XRFm	A/MS	A/OES	Fus/XRFm	A/MS	A/MS	A/OES	Fus/XRFm	A/MS
0.09	2.9	48.2	4.9	X	258	288.56	1.26	0.784	5.02	9825	1.8	1.25	199	209	23.26	2.87	151	175	191
0.221	2.76	13.16	1.46	X	543	617.64	0.15	0.247	0.83	2361	0.45	1.41	50	55	8.92	0.87	57	106	32.9
0.208	2.92	53.69	3.96	X	302	331.74	0.65	0.429	3.39	9000	1.88	0.49	226	217	8.61	1.57	129	178	128.8
0.023	2.86	56.27	4.48	X	190	210.52	0.47	0.602	3.59	5812	1.8	0.48	194	180	14.19	1.47	93	88	108.5
0.004	2.66	73.38	1.44	X	155	172.48	0.28	0.114	6.42	232	0.05	2.71	X	X	2.98	0.18	12	32	46
0.118	2.75	11.03	1.21	X	436	500.48	0.05	0.224	0.63	1262	0.33	1.23	36	33	9.12	0.64	23	100	26.7
0.003	2.88	55.79	4.89	X	300	329.99	0.31	0.489	4.02	5642	1.75	0.5	196	184	8.59	1.01	105	155	99.7
0.003	2.89	54.4	5.34	X	318	341.86	0.15	0.555	4.44	2163	1.69	0.46	152	186	9.26	1.12	93	137	92.6
0.194	2.73	7.02	1.55	X	242	275.26	0.02	0.208	0.6	434	0.16	1.85	18	23	10.11	0.54	14	71	17.1
0.009	2.86	54.92	2.95	X	16	18.43	0.09	0.531	2.43	1191	1.55	0.37	169	198	15.3	1.52	115	163	68.4
X	2.85	46.11	2.77	X	57	63.86	0.34	0.58	3.11	4063	1.57	0.77	196	200	18.12	1.79	115	125	85.9
0.047	2.72	1.94	0.4	X	464	529.87	0.01	0.071	0.18	151	0.03	1.22	6	25	4.2	0.24	33	68	5.5
0.592	2.71	6.07	0.68	X	555	632.61	X	0.12	0.19	227	0.1	1.04	10	X	5.07	0.27	12	68	7.3
X	2.88	52.14	3.19	X	65	73.91	0.24	0.596	3.39	3427	1.71	4.49	225	245	16.96	1.69	105	127	77.4
X	2.88	50.83	2.48	X	78	88.18	0.17	0.54	3.08	3459	1.72	0.67	220	233	15.79	1.65	116	117	92
X	2.91	50.51	3.72	X	55	62.25	0.18	0.621	2.66	4968	1.79	0.51	216	224	17.82	1.6	106	151	77.4
X	2.91	52.45	4.04	X	78	89.09	0.35	0.505	3.45	7215	1.72	0.54	225	223	11.55	1.07	116	150	81.5
X	2.88	53.1	4.88	X	90	100.76	0.24	0.634	4.45	2681	1.47	0.59	138	178	13.66	1.37	116	142	91.6
0.156	2.82	54.19	4.42	X	27	29.08	0.23	0.882	4.26	3391	1.52	0.52	182	191	24.82	2.05	104	127	69.5
X	2.9	52.78	4.91	X	57	63.12	0.45	0.843	2.69	7867	1.85	0.43	235	245	23.71	1.69	135	173	97.7
X	2.9	50.11	4.52	X	33	36.49	0.08	0.667	2.65	2164	1.91	0.28	153	266	18.46	1.72	121	126	66.9
0.005	2.87	56.05	3.21	X	95	104.94	0.36	0.673	3.94	3620	1.79	0.49	184	206	21.04	2.01	92	70	110.6
X	2.67	74.04	1.54	X	273	298.32	0.33	0.122	6.53	323	0.07	2.77	X	X	2.81	0.17	15	43	47.7
0.007		54.77	3.06	X	16	17.46	0.09	0.527	2.51	1812	1.54	0.43	171	180	15.18	1.6	117	181	82.1
			10.41		31	31.37	1.37	2.519	142.7	527		1503.1	17		61.36	7.14	445		71.5
	2.63																		
0.04		49.19		X							1.86			260				82	
X		100.62	X	X	X	0.11	X	X	0.02	X	X	0.15	X	X	X	0.02	2	X	0.3
			0.06		X	0.32	X	0.013	1.12	X		7.81	X		0.3	0.05	X		1
			X		X	0.75	X	X	0.14	X		0.49	X		X	0.02	X		0.2

APPENDIX V

1 m Sample Analytical Data – Samples L24-L170

APPENDIX VI

Geochemical Plots of Whole Rock Analytical Data

ELEMENTS	Dfrom	Dto	Au	Au-Rp1	Ag	As	Ca	Cd	Co	Cr	Cu	Fe	Mg	Mn	Mo	Ni	Pb	Rb	S	Sn	Sr	U	V	Zn
UNITS	m	m	ppb	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
DETECTION			1	1	0.2	2	50	0.1	0.1	5	1	0.01	20	1	0.1	1	2	0.05	50	0.1	0.05	0.01	2	1
METHOD			FA25/SA/	FA25/SA/	A/MS	A/MS	A/OES	A/MS	A/MS	A/OES	A/OES	A/OES	A/OES	A/OES	A/MS	A/OES	A/MS	A/MS	A/OES	A/MS	A/MS	A/MS	A/OE	A/OES

COMMENTS: 1049.0/0906565 (13/08/2009) CLIENT O/N: Ashley Hood 1/1

SAMPLE NUMBERS	Dfrom	Dto	Au	Au-Rp1	Ag	As	Ca	Cd	Co	Cr	Cu	Fe	Mg	Mn	Mo	Ni	Pb	Rb	S	Sn	Sr	U	V	Zn
L24	13	14	3		X	X	58	0.1	13.4	57	11	1.95	768	6	0.3	2	4	1.86	88	4.9	1.33	1.99	59	8
L25	18	19	3		X	7	132	0.1	9.3	80	32	6.77	936	34	0.5	12	13	11.47	156	3.2	4.81	2.36	165	15
L26	27	28	X		X	16	183	0.1	11.4	48	19	3.35	3663	198	0.6	13	11	88.57	69	3.1	10.74	2.01	60	35
L27	64	65	3		X	7	86385	0.1	8.2	40	81	1.82	65925	417	0.9	12	21	116.75	2597	2	58.03	2.48	39	28
L28	90.95	91.25	2		0.2	4	58735	X	6.1	42	5	2.97	64624	295	0.3	11	6	263.66	140	2	145.32	1.99	38	34
L29	98	99	2		X	4	55065	X	5.2	47	4	3.55	51519	419	0.3	11	5	198.64	383	2.4	77.99	2.21	46	28
L30	107.5	108.5	2		0.4	6	80265	X	8.2	40	11	2.24	59407	588	0.5	11	11	159.26	1123	2.2	60.32	2.64	36	26
L31	122	123	1		X	4	82137	X	7	40	4	2.79	55933	646	0.3	11	6	145	364	2.2	82.31	2.48	38	27
L32	136	137	2		X	5	80200	X	7	43	6	3.05	53380	689	0.5	13	7	154.2	283	2.2	62.79	2.82	43	28
L33	144	145	2		0.3	5	99303	0.1	6.5	17	32	0.73	49091	800	1.4	5	8	21.88	605	0.6	39.58	2.16	6	5
L34	170	171	3		X	3	102061	X	2.8	16	16	1.22	56183	1122	1.4	1	X	15.26	144	0.5	58.12	1.52	11	7
L35	182	183	2		X	21	79934	0.1	11.4	21	25	1.17	42611	937	2.2	6	18	30.14	1174	0.8	75.63	1.29	15	20
L36	183	184	2		0.2	68	92880	X	39.5	17	109	1.24	51088	1022	3.7	16	43	18.91	1304	0.6	126.15	1.26	12	11
L37	184	185	2		0.4	96	78699	X	52.5	21	90	1.29	42283	928	3.2	19	62	28.91	2149	0.7	89.9	2.57	14	13
L38	185	186	2		0.3	50	48314	X	26.6	26	77	0.98	25765	622	2.1	13	14	52.91	2090	1.2	65.94	1.87	17	11
L39	186	187	2		0.3	66	65107	0.2	36.1	29	126	1.23	33923	833	6.2	14	34	38.79	2600	1	62.23	1.36	15	85
L40	187	188	2		0.3	25	99452	X	15.3	16	44	1.43	54964	1245	1.7	5	14	18.04	1058	0.5	102.16	0.69	9	4
L41	188	189	2		X	35	96041	X	19.2	22	60	1.45	52201	1191	2.6	7	19	26	1604	0.7	130.45	1.02	11	10
L42	189	190	2		0.2	31	64399	X	16.5	19	58	1.14	33658	846	2.1	8	18	27.54	1854	0.8	91.08	1.84	11	11
L43	190	191	2		0.3	46	62892	X	26.3	22	50	1.2	32377	837	3.2	11	53	29.97	2010	0.8	73.85	2.34	18	11
L44	191	192	2		X	21	105544	X	10.9	15	27	1.25	54854	959	2.4	X	39	10.72	1634	0.4	234.86	2.48	9	14
L45	192	193	3		0.2	30	63133	X	14.7	22	29	1.16	32853	798	3.5	6	18	15.51	3072	0.6	223.33	3.6	10	19
L46	193	194	2		0.2	23	58616	0.1	13.9	30	31	1.39	31449	991	2.1	8	22	49.35	3220	1.1	208.9	3.54	19	23
L47	198	199	2		X	5	17756	X	3.7	44	214	1.27	11007	288	1.5	8	7	134.2	1708	2	81.05	1.42	31	16
L48	217	218	2		X	X	1247	X	0.5	6	6	0.22	459	37	1	3	X	6.17	234	0.3	26.39	0.64	3	4
L49	240	241	2		X	X	2558	X	0.6	19	4	0.45	341	65	2.5	3	X	5.14	X	0.5	11.65	0.76	3	4
L50	270	271	2		X	X	951	X	5.7	15	29	2.62	3309	888	1.4	6	3	4.87	X	0.6	12.86	0.82	3	12
L51	304	305	2		X	5	511	0.5	0.6	18	4	1.76	595	81	1.8	3	17	16.49	172	1.7	154.29	3.07	12	5
L52	321	322	2		X	4	9796	0.1	0.7	17	32	2.69	570	31	1.6	4	12	20.38	6608	1.4	205.23	6.71	9	3
L53	326	327	3		X	39	851	0.2	2.2	33	6	5	1177	351	1.9	13	26	42.35	403	7.4	540.04	5.44	45	9
L54	337	338	2		X	139	7003	0.2	6.5	29	7	49.64	1561	1412	3.2	6	30	34	2512	1.9	980.57	10.93	275	20
L55	342	343	2		X	33	707	X	3.5	112	9	10.58	1479	156	0.9	12	7	72.15	161	1.5	88.47	1.87	75	8
L56	343	344	2		X	29	983	0.1	4.6	133	9	10.94	2015	215	0.4	14	6	82.91	272	1.6	140.33	2.1	66	9
L57	344	345	2		X	38	711	0.1	5	150	12	10.8	1795	216	2.5	21	7	81.99	147	1.8	152.54	2.41	84	13
L58	347	348	2		0.5	30	795	0.1	6.7	119	9	11.19	1787	707	0.3	16	7	64.1	232	1.5	163.92	2.19	61	11
L59	357	358	19		X	146	1780	0.1	2.4	142	9	10.2	2032	75	1.6	10	25	81.99	1186	1.4	1622.4	7.14	215	12
L60	374	375	3		X	86	1114	0.1	4.8	91	5	10.55	2673	533	0.5	25	36	81.31	193	1.5	575.28	6.7	90	30
L61	375	376	2		X	21	12101	0.4	3.3	39	4	2.75	3542	120	0.4	27	10	113.34	139	1.7	250.37	3.21	24	48
L62	376	377	2		X	16	7228	0.2	4.4	14	3	2.21	3241	37	0.3	27	4	131.96	X	1.4	34.66	1.64	8	12
L63	377	378	5		X	16	20454	0.5	3.4	67	4	2.1	4257	57	0.4	32	4	134.96	74	1.5	88.61	3.63	33	51
L64	378	379	3		X	11	2624	0.2	4.4	39	5	2.97	4316	61	0.2	4	3	129.95	X	1.5	16.33	3.57	40	15

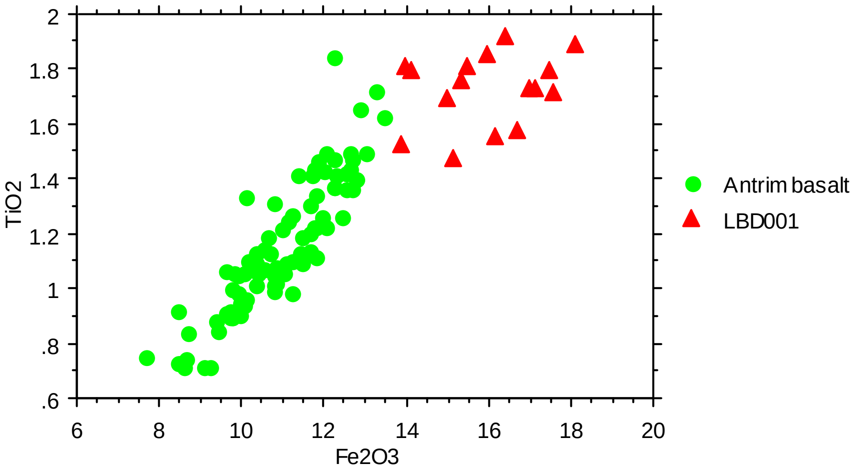
L65	379	380	2		X			26	2268		0.2	8.2	34	5	3.21	5769	47		1	47	3	162.31	52	1.3	15.24	3.34	34		14
L66	380	381	140	150	X			29	2416		0.1	8.7	33	4	3.38	5968	33		0.8	54	3	164.8	81	1.4	22.73	5.77	33		15
L67	381	382	224	211	X			49	2434		0.1	18.4	27	4	2.37	5406	23		0.4	64	3	144.59	327	1.3	30.39	4.72	30		10
L68	382	383	79	78	X			10	2462		0.1	5.3	26	4	2.96	5647	27		0.1	52	3	147	94	1.6	28.45	3.58	30		12
L69	383	384	63	81	X			6	2718		0.1	4.5	39	10	5.73	6325	25		0.5	50	3	138.24	202	3.4	17.91	4.86	32		11
L70	384	385	167	140	X			17	152054	X		72.7	32	30	4.17	86671	1582		0.4	37	6	34.28	3411	0.7	147.3	4.68	19		7
L71	385	386	5		X			3	199487	X		325.1	25	293	1.22	112027	2655		0.3	133	4	10.81	1791	0.3	22.66	3.1	13		4
L72	386	387	5		X			20	195064	X		266.4	24	281	1.39	108603	2296		0.1	111	3	14.61	3718	0.3	18.76	3.61	15		1
L73	387	388	5		X			5	207147	X		201	18	707	1.34	118553	2262		0.2	97	5	6.42	2150	0.3	12.47	1.83	11		4
L74	388	389	5		X			4	201051	X		311.1	21	566	1.09	112067	8181		0.2	153	10	8.44	1311	0.3	14.29	1.72	15		4
L75	389	390	4		X			5	201140	X		583.9	20	428	1.13	113060	6143		0.4	302	5	7.25	2141	0.3	16.36	1.99	12		9
L76	390	391	5		X			2	203709	X		178.5	16	501	1	113978	6175		0.2	86	5	5.7	1786	0.2	12.84	2.11	9		4
L77	391	392	4		X		X		207232	X		25.1	18	50	1.16	116881	5563		0.2	18	2	4.27	985	0.2	11.95	0.94	9		4
L78	392	393	100	104	X			2	206684	X		5.8	19	12	0.95	116314	1798	X		6	2	5.55	800	0.2	11.58	1.53	9	X	
L79	393	394	3		X			2	203020	X		19.3	16	154	0.95	115831	3187		0.1	12	2	5.1	670	0.2	12.11	1.53	10		2
L80	394	395	3		X			4	197324	X		32.2	18	161	1.16	111594	4105		0.2	24	3	6.8	1742	0.3	15.23	2.07	11		1
L81	395	396	2			0.5		5	185658	X		28.1	30	173	1.73	101286	3390		0.3	24	10	16.31	4137	0.4	14.43	2.82	20		2
L82	396	397	13			0.3		5	194441	X		84.2	27	66	1.44	108115	2816		0.3	51	6	15.69	4555	0.3	15.38	2.86	18		14
L83	397	398	135	147	X			3	165621	X		14.3	21	44	1.39	93222	2748		0.1	20	5	39.34	284	0.6	24.55	2.71	17		24
L84	398	399	4		X			3	38305		0.2	8.6	15	13	1.95	26804	654		0.1	4	3	171.55	221	1.6	25.21	9.82	27		32
L85	399	400	9		X			47	179804		0.3	27.4	24	46	4.26	100059	3243		0.7	36	13	25.67	2135	0.5	37.11	4.66	33		135
L86	400	401	13		X			57	160430		0.1	27.1	23	47	9.37	89642	3009		1.7	32	24	16.26	1449	0.4	30.04	7.75	48		60
L87	401	402	11		X			14	188645		0.2	22.2	22	30	3.48	103101	3424		0.5	30	11	17.83	339	0.4	25.07	4.27	18		125
L88	402	403	12		X			30	182776		0.3	34.9	24	19	7.91	102988	5652		1.2	33	8	10.23	213	0.3	19.28	3.62	30		127
L89	403	404	9		X			45	155028		0.3	22.5	29	19	12.1	87736	3578		2	29	17	21.66	339	0.4	43.41	4.59	49		145
L90	404	405	23		X			19	152346		0.4	38.4	40	10	6.03	85278	5600		1	38	6	43.96	156	0.6	30.27	4.08	55		210
L91	405	406	17		X			20	130498		0.4	23.8	39	23	3.49	70516	3240		0.7	29	7	23.02	228	0.5	62.48	2	35		146
L92	406	407	22		X			16	132324	X		20	44	28	2.9	73210	1903		0.2	27	9	42.28	559	0.7	85.95	4.26	34		19
L93	407	408	6		X			18	188940	X		15.5	32	38	3.85	103347	2795		0.3	20	9	15.74	431	0.3	48.16	2.05	33		12
L94	408	409	39		X			7	172498		0.1	41.2	29	20	2.39	96790	5752		0.2	31	4	26.36	336	0.5	45.99	2.32	40		87
L95	409	410	14		X			8	188292		0.2	28.6	26	23	2.31	104160	3919		0.2	35	3	17.23	104	0.3	20.94	1.77	24		179
L96	410	411	48		X			3	189873	X		29.2	21	14	1.68	105887	3903		0.4	22	7	15.14	623	0.3	17.05	1.86	19		44
L97	411	412	9		X			6	193726	X		28.5	21	27	1.33	108084	3751		0.5	21	4	13.46	1246	0.3	12.07	2.75	18		5
L98	412	413	23		X			4	196572	X		33.8	19	44	1.26	109005	3797		0.4	17	5	9.3	444	0.4	12.21	2.58	15		7
L99	413	414	34			0.9		9	125579	X		57.3	61	48	3.98	66230	3138		1.6	65	19	86.99	11265	1.2	28.5	2.53	82		11
L100	414	415	35			0.7		7	75834	X		45.5	87	35	6.75	44317	1654		0.2	68	14	126.74	9975	1.7	51.99	1.72	94		27
L101	415	416	10			0.6		10	74950		0.2	36.9	101	63	6.04	47109	2248		0.5	65	16	94.85	3681	2.2	24.94	1.5	101		22
L102	416	417	4		X			6	85543		0.1	28.5	119	79	6.78	30089	1113		0.3	60	7	81.59	1417	1.8	108.7	1.44	105		44
L103	417	418	2		X			7	63923		0.1	36.5	122	92	5.81	42473	1575		0.7	69	4	120.06	1447	1.7	28.42	1.46	125		33
L104	474	475	3		X		X		158052	X		50.1	157	76	6.56	17403	750		1.2	9	4	41.42	602	1.1	330.78	1.19	117		56
L105	475	476	3		X			3	25426	X		50.2	236	119	9.28	18234	315		1	130	7	80.55	275	1.6	232.19	0.7	169		79
L106	476	477	2		X		X		6875		0.1	44.9	208	69	8.38	18207	147		0.7	134	6	111.4	149	1.6	128.09	0.91	146		93
L107	477	478	2		X		X		9147		0.1	40.2	245	74	10.16	14602	112	X		145	8	99.31	128	1.5	210.81	0.69	182		81
L108	478	479	3		X		X		21602		0.1	48.4	277	97	10.53	16232	294		0.4	148	10	57.46	139	1.1	327.25	0.69	185		110
L109	479	480	3		X		X		23385		0.1	46.5	224	78	8.87	17150	276		0.2	137	9	92.91	160	1.4	241.52	0.68	160		103
L110	480	481	4		X			2	12264		0.1	40.7	220	90	8.96	17494	187		0.5	131	6	121.41	180	1.3	119.98	1.12	165		85
L111	481	482	2		X		X		3982	X		41	125	23	6.1	17499	146		0.2	124	4	110.03	67	0.9	120.53	0.49	103		102
L112	482	483	2		X			4	15469	X		53.8	210	105	9.55	16667	214		0.5	139	7	61.8	611	1.1	310.15	0.48	167		93

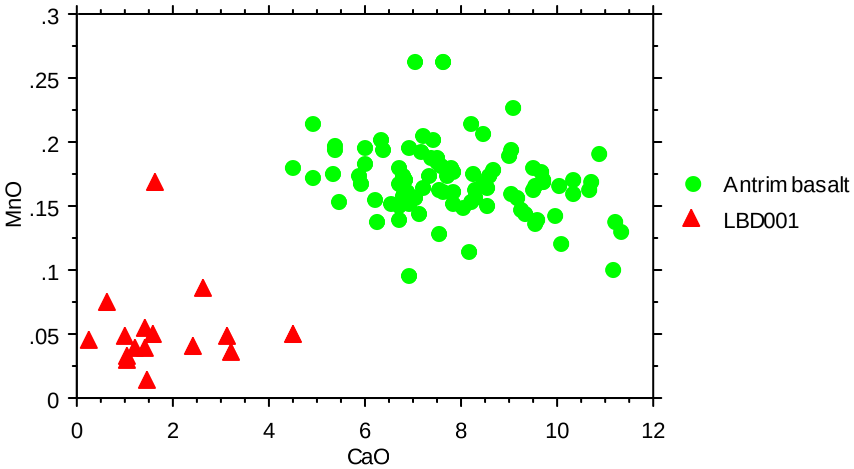
L113	483	484		3	X			2	6126		0.1	47.8	236	99	10.18	18936	147	X			144	6	107.42		174	1.3	153.46	0.61	183	94
L114	484	485		2	X			2	11191	X		44.6	203	78	9.74	16477	138		0.1		138	6	93.88		83	1.2	203.18	0.5	164	81
L115	485	486		2	X			2	4840		0.1	45	162	22	7.32	16032	157		0.2		126	5	99.56	X		1	175.31	0.57	126	89
L116	486	487		3	X			2	4231		0.1	47.1	160	27	7.56	18910	197		0.4		128	4	105.43		100	1	151.67	0.71	128	112
L117	487	488		2	X		X		11511		0.1	52.3	224	110	10.13	15753	165	X			138	8	67.77		184	1.4	311.14	0.63	176	104
L118	488	489		2	X			2	9138		0.1	48.5	216	79	10.08	15037	138		0.3		146	8	79.4		151	1.2	291.71	0.61	167	106
L119	489	490		3	X			2	5132		0.1	43.1	190	52	7.81	13552	85		0.1		122	6	102.46		101	1.2	196.09	0.63	137	83
L120	490	491		2	X			3	3930		0.1	42.6	178	17	7.85	16033	100		0.4		12	5	119.24		59	1.5	108.31	0.89	145	82
L121	491	492		2	X			3	13902	X		42.6	211	63	8.84	12315	125		0.1		14	8	84.5		117	1.3	272.34	0.63	154	80
L122	492	493		2	X		X		11998		0.1	48.9	206	103	9.31	13299	133		0.6		14	9	66.61		163	1.3	328.18	0.57	154	95
L123	493	494		2	X			2	8311		0.1	42.8	189	54	8.43	13683	100		0.1		8	7	96.67	X		1.3	231.53	0.65	144	49
L124	494	495		2	X			2	7574	X		44.9	182	84	8.85	14456	99		0.1		13	6	80.27		134	1	205.39	0.42	139	82
L125	495	496		2	X		X		7879		0.1	48.2	202	106	9.92	15560	122		0.2		15	8	85.91		129	1.4	241.3	0.58	171	101
L126	496	497		3	X		X		5035		0.1	47.7	188	73	9.59	17524	176		0.2		15	6	87.15		75	1.3	196.07	0.57	159	122
L127	497	498		2	X		X		3947	X		45.6	174	42	8.76	18284	177		0.2		14	5	91.86		91	1.3	177.27	0.56	151	123
L128	498	499		18	X			3	4661		0.1	45	140	41	7.51	20493	214		0.2		13	3	96.35		163	1.5	122.84	0.68	126	114
L129	499	500		3	X			3	4377		0.1	41.5	152	44	6.91	17748	109		0.2		12	5	122.55		176	2.1	73.14	1.08	131	91
L130	500	501		2	X			2	6806		0.1	42.1	163	63	7.68	16501	102		0.3		12	6	106.58		271	2	157.45	0.79	143	80
L131	501	502		2	X			3	5019		0.1	39.9	179	81	8.1	15088	69	X			12	6	104.02		157	2.3	152.86	0.9	152	80
L132	502	503		2	X			2	5806		0.1	40.4	191	69	8.22	17674	128		0.2		13	4	103.47		157	1.5	80.72	0.67	155	93
L133	503	504		2	X		X		5715	X		45.4	205	64	8.15	20136	163		0.2		13	4	96.7		242	1.4	104	0.66	144	110
L134	504	505		2	X		X		6930		0.1	41.8	231	71	8.92	17501	117		0.2		13	5	100.97		120	1.5	116.19	0.65	165	95
L135	505	506		8		0.2		5	9377		0.1	40.9	184	51	7.88	19574	216		0.3		12	3	99.48		1670	1.3	49.81	0.68	148	91
L136	506	507		2		0.2	X		3387	X		39.7	205	63	8.12	19897	143		0.6		13	4	104.03		182	1.6	61.74	0.74	162	83
L137	507	508		4	X			3	19272		0.1	38.9	187	113	7.96	22990	225		0.7		12	4	93.72		789	1.8	73.85	1.1	162	91
L138	508	509		2	X			5	319954		0.1	10.7	18	24	1.35	6245	729		3.7		1	15	7.43		1095	0.4	463.11	1.63	18	42
L139	528	529		3	X			12	301466	X		11.3	26	82	1.09	5646	642		0.3		2	6	14.73		2060	0.3	514.53	1.87	25	17
L140	541	542		2	X			4	363124		0.2	2.4	8	6	0.68	4616	283		0.2	X		27	1.22		844	0.2	495.6	1.32	5	91
L141	559	560		2	X			3	368013		0.3	4.1	11	8	0.88	2459	280		0.2		1	36	5.13		3963	0.3	321.21	2.38	6	121
L142	566	567		2	X		X		361198	X		3.7	15	8	0.85	3729	234	X			1	10	9.34		1545	0.3	527.64	1.47	11	43
L143	584	585		2	X			7	315082		0.2	10.9	32	26	1.83	3552	481		0.4		2	30	23.8		5641	0.4	197.18	2.71	25	102
L144	604	605		3	X			2	204710	X		19.7	79	34	4.82	15567	1122		0.1		5	2	45.29		688	1	165.39	1.28	71	53
L145	609	610		3	X			3	347071	X		5.8	25	47	0.55	2468	694		1.2		2	5	6.52		2675	0.2	673.69	1.42	12	24
L146	632	633		2	X		X		261591	X		19.9	102	42	3.38	14541	844		0.3		6	4	26.32		667	0.6	373.74	1.54	63	45
L147	646	647		3	X		X		12225	X		1.3	7	24	0.98	1977	145		0.5	X		7	68.94		400	0.9	231.52	2.67	3	20
L148	675	676		4	X			2	83394		0.1	51.1	144	133	8.25	29071	1190		0.7		11	5	55.57		180	1.6	164.18	0.83	157	98
L149	676	677		6	X		X		45214	X		50.8	221	603	8.08	30210	887		0.2		15	5	82.52		1494	1.4	93.88	1.19	166	98
L150	677	678		2	X			2	26586	X		51.7	207	10	9.08	27105	613		0.4		15	4	95.96		95	1.3	64.76	0.59	151	99
L151	678	679		2	X			2	83053	X		41.9	126	38	7.79	19151	1053		0.2		10	5	82.1		490	1.4	103.66	0.73	147	80
L152	679	680		3	X			2	82214	X		45.1	128	50	7.94	24153	1162		0.3		10	5	76.57		904	1.6	136.66	0.82	135	83
L153	680	681		3	X		X		98679	X		38	126	35	7.75	30166	1169		0.4		9	3	32.73		340	1.3	143.95	0.78	113	82
L154	681	682		2	X			3	73671	X		48.6	156	121	8.16	26146	1107		0.3		13	6	70.89		223	1.6	170.25	0.94	143	91
L155	682	683		2	X		X		96005	X		44.1	136	6	7.31	24102	1219		0.4		11	5	58.65	X		1.3	166.77	0.81	121	84
L156	683	684		2	X			3	74378	X		47.2	145	7	8.09	26559	1022		0.3		13	6	72.74		69	1.6	141.5	0.91	138	91
L157	684	685		2	X			3	86246	X		44	129	11	7.28	24697	1073		0.5		12	6	67.58	X		1.5	154.31	0.84	126	89
L158	685	686		2	X		X		29085	X		51.1	188	12	8.86	27034	655		0.3		15	5	98.73	X		1.6	97.45	0.9	159	105
L159	686	687	X		X		X		41268		0.1	48.1	164	6	8.56	28276	925		0.4		12	5	72.35	X		1.5	91.4	0.82	153	102
L160	687	688		2	X			3	19927		0.1	54.9	208	6	9.15	28043	710		0.2		14	10	62.91	X		1.6	84.36	0.88	175	114

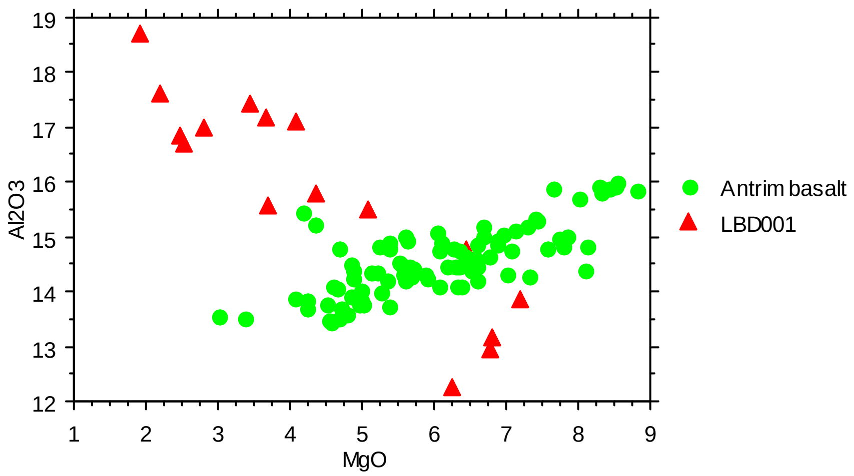
L161	688	689	2		X	3	31239	0.1	50.6	181	6	8.69	27305	820	0.5	13	4	66.03	X	1.6	85.14	0.86	166	105
L162	689	690	4		X	2	20696	X	54.1	163	42	8.23	26234	652	0.1	14	3	83.49	X	1.1	52.16	0.67	158	106
L163	720	721	3		X	X	132946	0.1	35.1	105	66	5.33	22675	2094	0.5	9	3	48.58	50	1	70.55	0.62	102	84
L164	721	722	5		X	X	123394	0.1	31.9	100	19	5.93	15961	1807	0.2	8	4	52.2	52	1.1	76.13	0.62	104	74
L165	722	723	2		X	X	125400	0.1	35.8	113	7	5.93	17391	1770	0.4	10	3	49.69	134	0.9	62.37	0.51	92	79
L166	723	724	3		X	3	134444	0.1	33.2	107	6	6.12	15919	1974	0.2	9	4	66.21	68	1.2	73.66	0.67	108	75
L167	724	725	2		X	X	33662	X	48.2	193	8	6.77	21628	635	0.2	17	2	88.62	X	0.9	36.43	0.46	134	98
L168	725	726.15	2		X	X	38144	X	48.2	218	53	9.21	22470	603	0.1	14	3	86.22	60	1.3	67.91	0.57	164	97
L169	749	750	1		X	2	8968	X	1.2	9	30	1.06	1418	191	2.7	X	5	53.03	116	1	285.55	2.76	2	13
L170	750	751	1		X	3	5043	X	2.5	7	43	1.2	2244	214	0.7	X	5	51.16	135	1.2	256.83	2.42	3	30
L171			773	789	2	9	15887	0.3	15.2	33	6242	5.04	12475	377	3.6	3	16	56.67	7014	8.1	418.38	1.87	105	69
L172			58	62	0.3	11	2884	0.2	119.7	986	680	17.93	2148	1231	2.1	35	21	23.97	270	2.4	32.94	1.98	246	121
L173			902	882	2.1	8	16031	0.2	15.4	34	6277	5.06	12178	372	4.4	3	17	58.92	6947	7.7	420.55	1.91	104	68
L174			804	790	2	9	15628	0.2	15.4	27	6211	5.04	12220	373	3	3	22	74.72	6952	7.9	425.69	1.94	104	65
CHECKS																								
L24			3		X	2	X	0.2	13.7	51	11	1.87	729	5	0.4	2	4	2.07	65	5	2.06	2.14	60	7
L44			2		X	22	105065	X	11.3	7	26	1.16	55793	899	1.9	X	35	10.59	1579	0.4	234.96	2.55	9	14
L64			3		X	9	2545	0.2	4.5	23	5	2.92	4281	60	0.2	4	3	78.56	X	1.6	17.99	3.6	40	21
L84			4		X	4	37201	0.2	7.9	9	13	1.83	25496	597	0.1	4	3	80.08	222	1.7	23.48	9.36	26	31
L104			2		X	X	159926	0.1	51.5	113	79	6.4	17242	726	1.4	9	4	41.47	640	1.3	334.08	1.2	113	60
L124			2		X	2	7544	0.1	48.8	170	84	9.35	14648	120	0.2	14	7	69.21	121	1.4	230.25	0.68	157	90
L144			2		X	X	205365	X	20.3	58	39	4.8	15446	1088	0.1	5	2	44.2	667	1.1	167.87	1.32	71	53
L164			4		X	X	119055	0.1	31.5	78	17	5.82	15611	1759	0.2	8	3	51.36	X	1	75.84	0.63	102	74
STANDARDS																								
OREAS 45P					0.3	12	3142	0.2	116.3	1016	706	18.62	2303	1295	2	370	20	24.17	293	2.3	31.31	1.94	253	129
OREAS 5Pb			98																					
OxE56			598																					
SARM1					X	16	5450	0.3	0.4	17	11	1.33	204	128	3.5	X	36	321.61	93	4	9.44	16.46	X	48
OxG70			1079																					
SARM4					X	2	83054	X	58	35	11	6.08	45670	1445	0.9	101	2	3.89	96	0.3	252.55	0.33	193	48
OREAS 5Pb			98																					
SARM48					0.2	8	65857	0.3	0.7	7	11	0.42	446	101	0.4	X	160	254.6	104	4	30.07	25.4	X	51
OxE56			610																					
SY-4					X	X	58068	X	2.3	12	5	4.05	2971	767	0.2	X	9	56.13	139	7	1172.2	0.68	4	76
OxG70			1054																					
WGB-1					X	3	114818	X	27.7	153	93	4.31	56571	956	0.7	6	8	18.56	180	4	112.12	0.63	196	27
BLANKS																								
Control Blank			1		X	X	X	X	X	8	X	X	X	X	X	X	X	X	X	0.2	0.18	X	X	2
Acid Blank					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

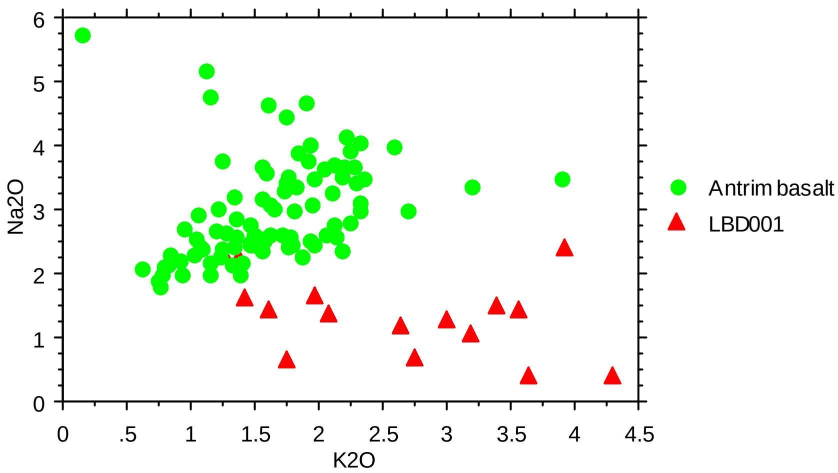
PLOTS OF WHOLE ROCK ANALYSES

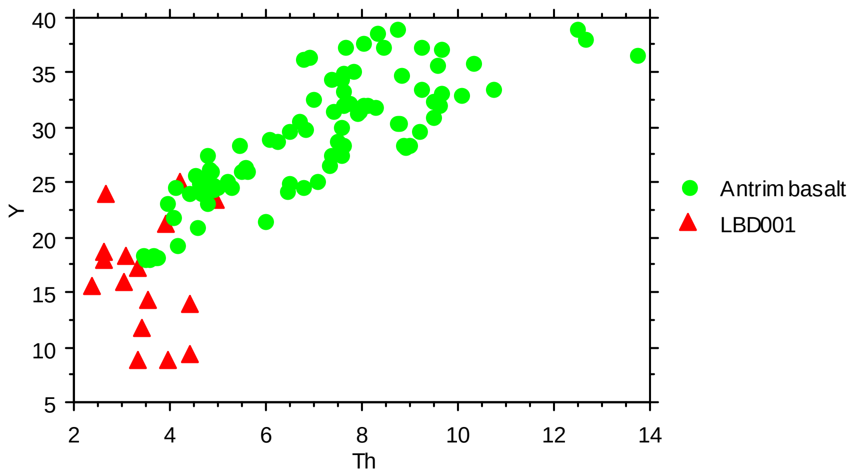
MAJOR, MINOR AND SELECTED TRACE ELEMENT PLOTS








Na2O
K2O
Antrim basalt
LBD001


Y
Th
Antrim basalt
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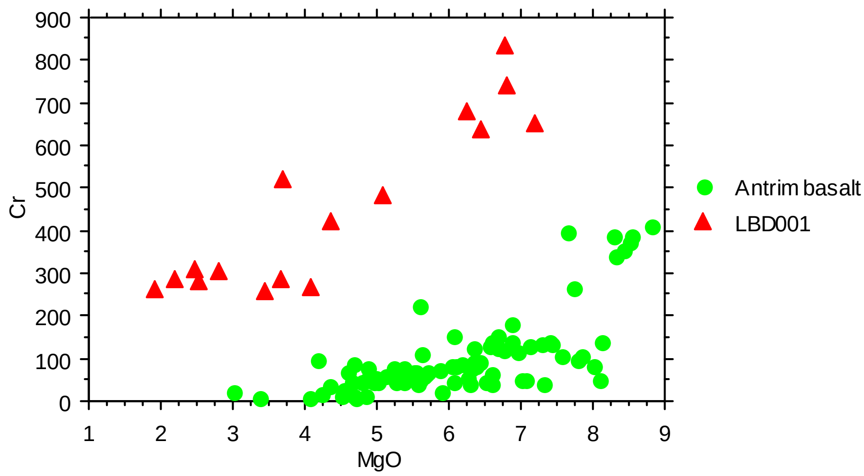
Cr
MgO
Antrim basalt
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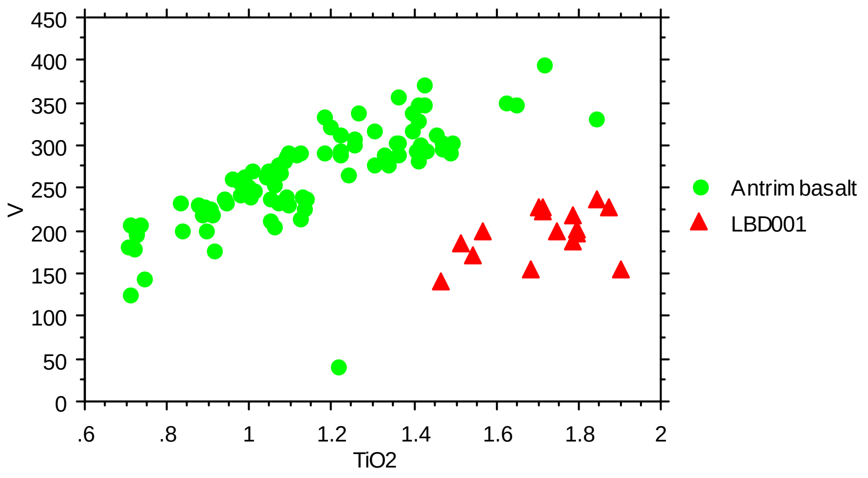
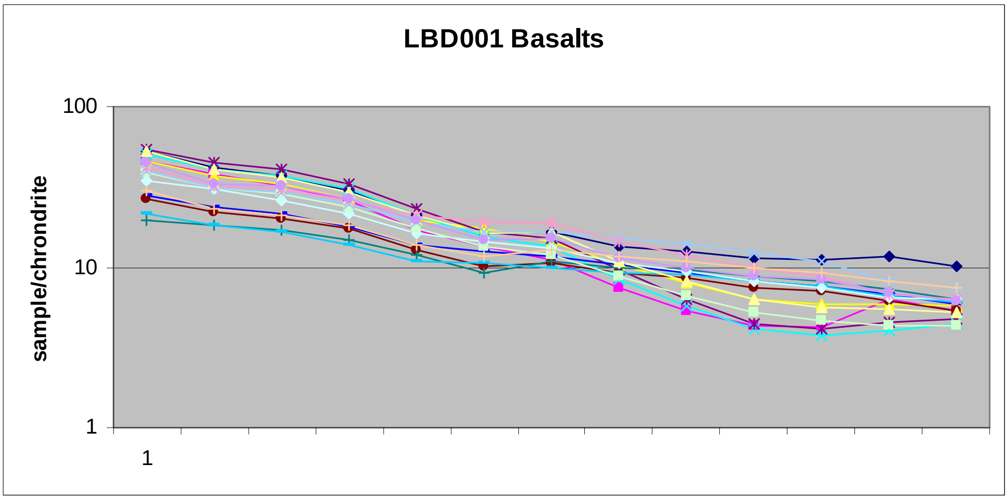
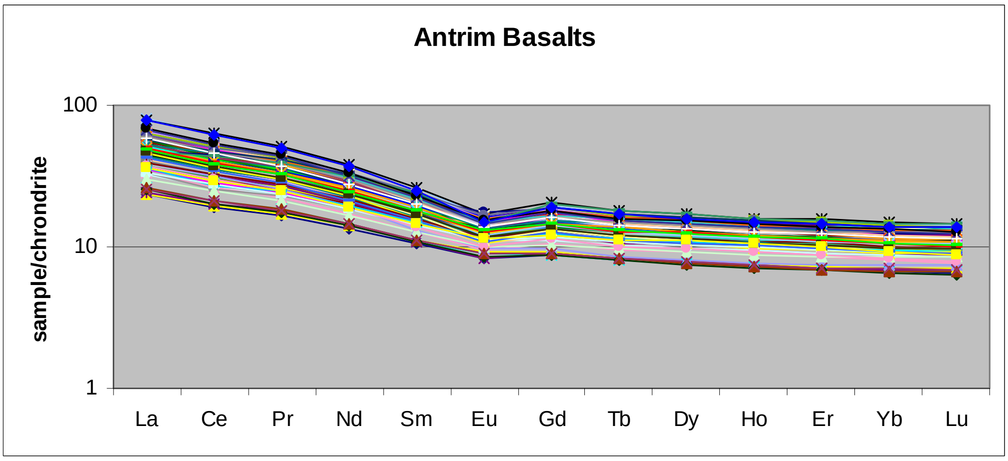
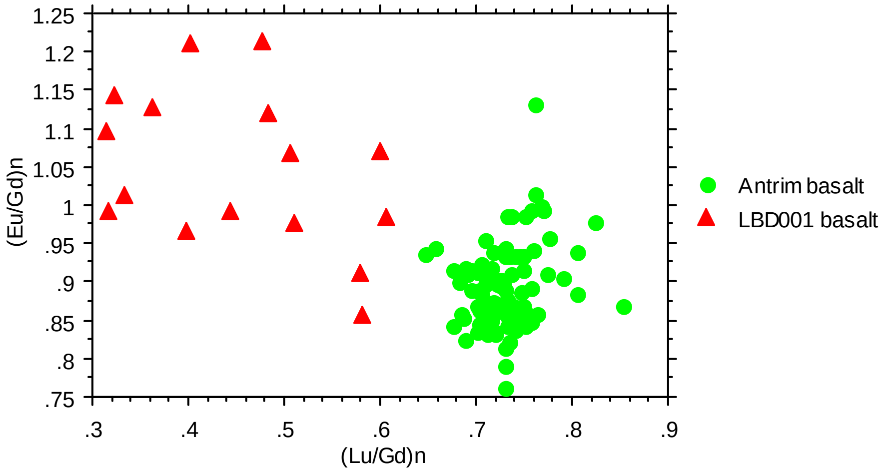


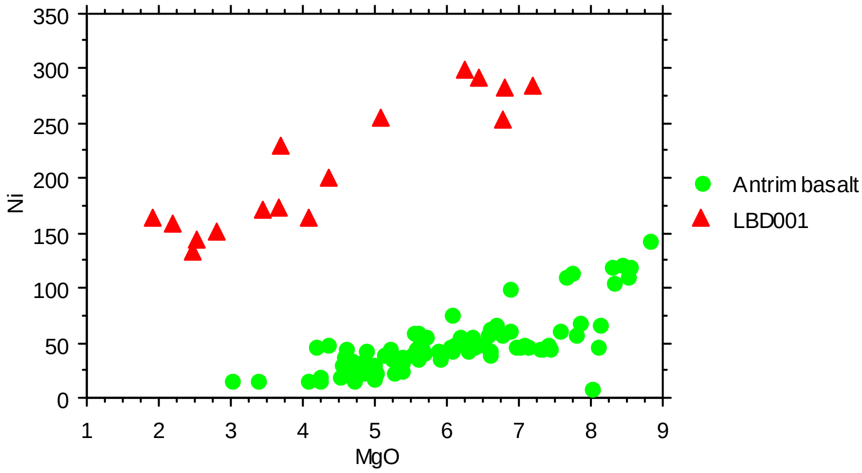
RARE EARTH ELEMENT PLOTS
Sample data normalised using chrondrite values of Talyor and McLennan (1984).

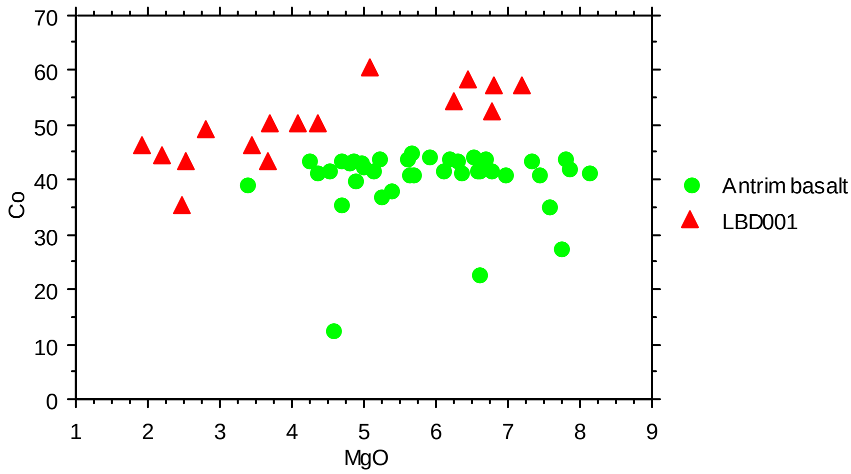


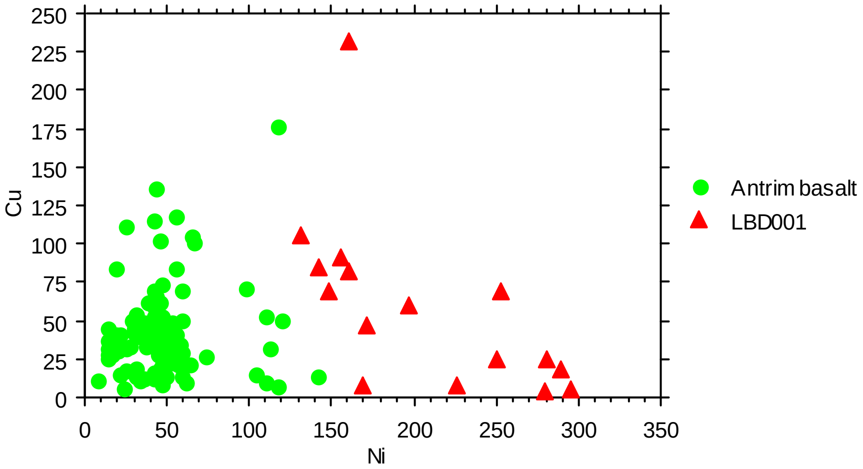


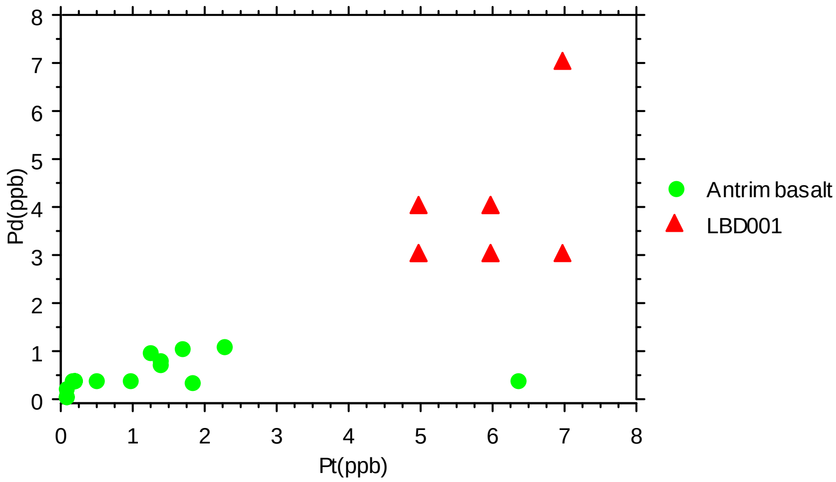


CHALCOPHILE-ELEMENT PLOTS









(Note that different Pt and Pd assaying techniques were used for Antrim compared to LBD001 samples)