MINERAL RESOURCES TASMANIA

Laboratory Report

LJN2018-074

MINERALOGICAL ANALYSES,

SKILLION HILL, ROKEBY

An unpublished Mineral Resources Report for:

G Cumming

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Mineral Resources Tasmania
Department of State Growth

Tasmanian Government

SUMMARY

These rocks are a range of basaltic rocks with textures ranging from lavas to scoria and pyroclastics. Some show probable welded lapilli, indicating welded basaltic tuffs. The scoria blocks and bombs are sometimes welded into blocky, autoclastic basaltic breccias.

The rock chemistry is strongly peralkaline and indicates a trachybasalt, specifically a hawaiite, assuming the Na/K ratios are reasonably pristine. No nepheline was identified, probably due to the alteration and weathering.

The mineralogy of the basalts was mostly Na-Ca plagioclase - augite - olivine - magnetite - ilmenite, but most olivine is now altered to iddingsite and hematite. Clays (halloysite, smectite and kaolinite, and chalcedony have also formed late. Hematite occurs as a late stage (vapour phase?) mineral with high Ti and Mg contents.

Inclusions in the basalts include orthopyroxene (altering to clinopyroxene), dolerite (slightly altered, with oxidised augites), quartz (altered to tridymite – glass buchites), and aluminous (metasedimentary?) rocks altered to anorthoclase/sanidine – aegirine-augite – tridymite – glass hornfels.

INTRODUCTION

A short visit to a construction site on Skillion Hill, Rokeby, was made by several MRT and UTAS geologists to investigate the exposed geology. Several samples were collected and submitted for petrological, geochemical and mineralogical analysis to help understand their nature. Sample details are shown in Table 1. This site will be the subject of a more complete geological report by G Cumming.

Table 1: Sample details

Reg. #	Location	Sample Description	XRF Trace	XRF Major	C&S	XRD	TS
C112290	Skillion Hill	Hackly basalt	Y	Y	Y		Y
C112291	Skillion Hill	Autoclastic basalt					Y
C112292	Skillion Hill	Spotty basalt	Y	Y	Y		Y
C112293	Skillion Hill	Kaolinised scoria				Y	Y
C112294	Skillion Hill	Siliceous xenolith				Y	
C112295	Skillion Hill	Scoria breccia					
C112296	Skillion Hill	Vugh-filling				Y	
G408822	Skillion Hill	Scoria + microXls				Y	
G408825	Skillion Hill	Silicified basalt?	Y	Y	Y	Y	Y
G408831	Skillion Hill						
G408833	Skillion Hill	Scoria, laminated					
G408835	Skillion Hill	Permian Xens					
G408836	Skillion Hill	Nodular basalt					Y
G408837	Skillion Hill	Spotty basalt	Y	Y	Y		Y
G408840	Skillion Hill	Red ropey scoria					
G408841	Skillion Hill	Volcanic bomb					

METHODS

Some samples were cut and prepared as thin sections, some analysed for chemistry by XRF, and some were subsampled for mineralogy by XRD, especially to describe xenoliths and vugh-fillings.

SAMPLE DESCRIPTIONS

C112290 BASALTIC TUFF

In hand specimen, this rock is a dark greenish-grey, weakly weathered, unfoliated, fine-grained, equigranular mafic rock, with a very hackly fracture and a weakly clastic texture in hand specimen, suggesting a welded tuff, or agglutinate, with basaltic clasts ~5 to 15 mm in diameter (Fig. 1).

Fig. 1. C112290. Hackly, tuffaceous basalt. FOV ~120mm.

In thin section, it is a moderately weathered, holocrystalline, very fine-grained mafic rock comprising plagioclase, clinopyroxene, minor magnetite and clay minerals. The textures indicate an evenly clastic nature to the matrix.

C112291 AUTOCLASTIC BASALTIC BRECCIA

In hand specimen, this rock is a variegated, dark red to dark grey, coarsely brecciated/blocky, basaltic rock. It is probably a basalt-cemented scoria breccia or agglomerate. It has an irregular fracture and a strongly clastic texture, is variably scoriaceous, and has highly vesicular zones interspersed with massive basalt (Fig. 2). There are small xenoliths and phenocrysts to about 20 mm diameter.

Fig. 2. C112291. Autoclastic, scoriaceous basaltic breccia, cut face, showing a variably scoraiceous texture plus small xenoliths and phenocrysts. FOV ~110mm

In thin section, C112291 is similar to C112290, but is much more vesicular and xenolith-rich, and it has a matrix more irregularly clastic in nature. It is a moderately weathered and oxidised, holocrystalline, very fine-grained mafic rock comprising plagioclase, clinopyroxene, minor magnetite and clay minerals, plus some phenocrysts of clinopyroxene. The textures indicate an autoclastic nature to the matrix.

C112292 SPOTTY BASALT

In hand specimen, this rock is a dark greenish-grey, weakly weathered, unfoliated, fine-grained, equigranular mafic rock, with a very hackly fracture and a weakly clastic, suggesting a welded agglomerate with basaltic clasts ~5 to 15 mm in diameter (Fig. 3).

Fig. 3. C112292. Hackly, agglomerate-like basalt. FOV ~140mm.

In thin section, C112292 is similar to C112290, but is fresher. The textures indicate an autoclastic nature to the matrix.

C112293 KAOLINISED SCORIA

This rock is a black, highly vesicular basaltic rock or scoria, with a large amount of off-white clay filling the voids, to ~1cm in diameter.

Fig. 4. C112293. Scoriaceous basaltic breccia, showing abundant white clay infilling vesicles. FOV ~100mm

In thin section, C112293 is similar to C112291, but has much more secondary mineralisation infilling the vesicles (Figs. 5-6). This secondary material appears to include kaolinite, amorphous banded silica, and hematite. The hematite occurs as lustrous, dark red to black platy crystals lining the vesicles (Fig. 6). The rock is highly vesicular (>50% porosity). The textures indicate some of this secondary material may have formed early in the cooling of the basalt, as it was rapidly oxidizing and incorporating molten silica from sedimentary xenoliths? The clay (a mixture of halloysite and montmorillonite) may derive from the weathering of feldspathic xenoliths?

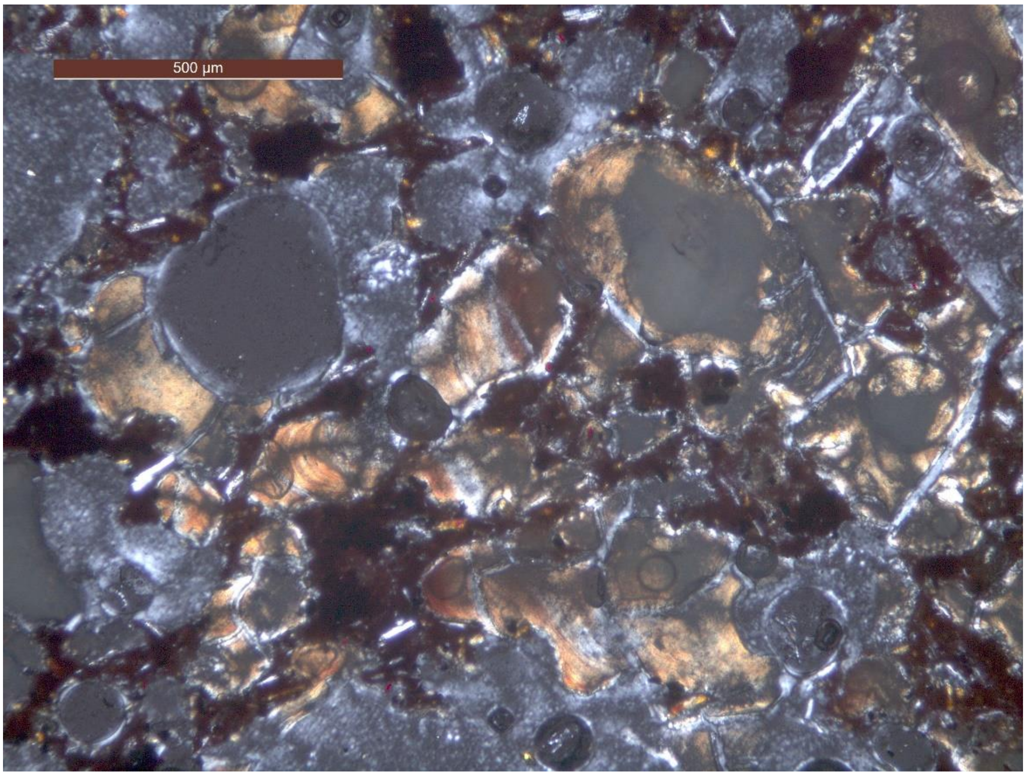

Fig. 5. C112293. Scoriaceous basalt showing very dark, altered basalt with vesicles infilled with near-amorphous but moderately birefringent, banded, glassy material (amorphous silica?). Cross-polarised transmitted light.

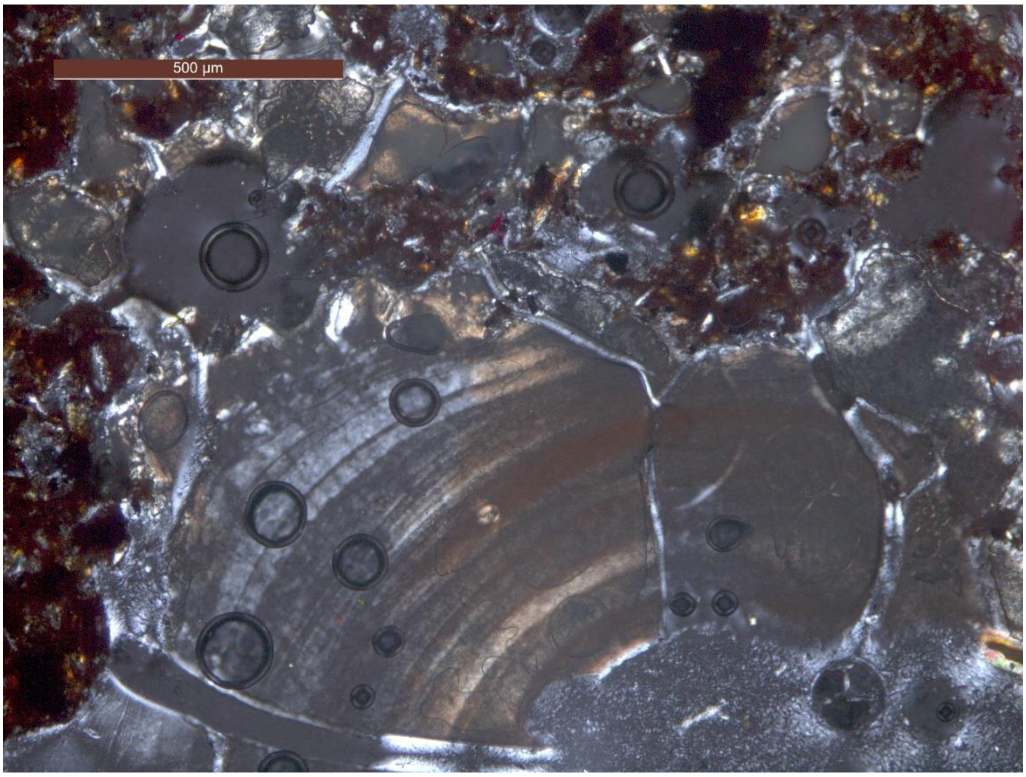

Fig. 6. C112293. Scoriaceous basalt showing very dark, altered basalt with vesicles infilled with near-amorphous but moderately birefringent, banded, glassy material (amorphous silica?). Cross-polarised transmitted light.

C112294 SILICEOUS XENOLITH (BUCHITE)

This rock is a very light-coloured and highly vesicular xenolith in a black, vesicular basalt (Fig. 7). The basalt has an unusual fibrous texture (gas escape structures?). It may have been a carbonate rock which was devolatised by the basalt. Vesicles are up to ~2 cm in diameter. The rock has a variable coating of amorphous silica and tridymite, formed due to melting of the quartz. It is a buchite.

Fig. 7. C112294. Highly vesicular, siliceous buchite xenolith, showing melt textures, in a matrix of basalt. FOV ~140mm

C112295 SCORIACEOUS BASALT BRECCIA

This rock is a variegated, white, grey and black, highly vesicular basaltic rock or agglomerate, with strong blocky breccia texture. The scoria blocks are partly welded, very irregular and up to ~30cm in diameter (Fig. 8).

Fig. 8. C112295. Volcanic breccia containing blocks of partly welded scoriaceous basalt, with some vughs containing white kaolinite. FOV ~1m

C112296 BASALT WITH WHITE VUGH-FILLINGS

This rock is a dark grey/black, moderately vesicular basaltic rock, with a large amount of white clay and siliceous minerals filling the voids, which are up to ~2cm in diameter (Fig. 9). It is hard and appears somewhat silicified.

Fig. 9. C112296. Vesicular basalt, showing white minerals filling vesicles. FOV ~120mm

G408822 SCORIACEOUS BASALT

This rock is a black, highly vesicular basaltic rock or scoria, with a large amount of fine black hematite crystals (<0.5mm) coating the voids, which are up to ~1cm in diameter (Figs. 10-11). There is also some white clay, probably halloysite-smectite mixtures.

Fig. 10. G408822. Scoriaceous basalt, showing very fine black hematite crystals coating vesicles, plus some white clays. FOV ~120mm

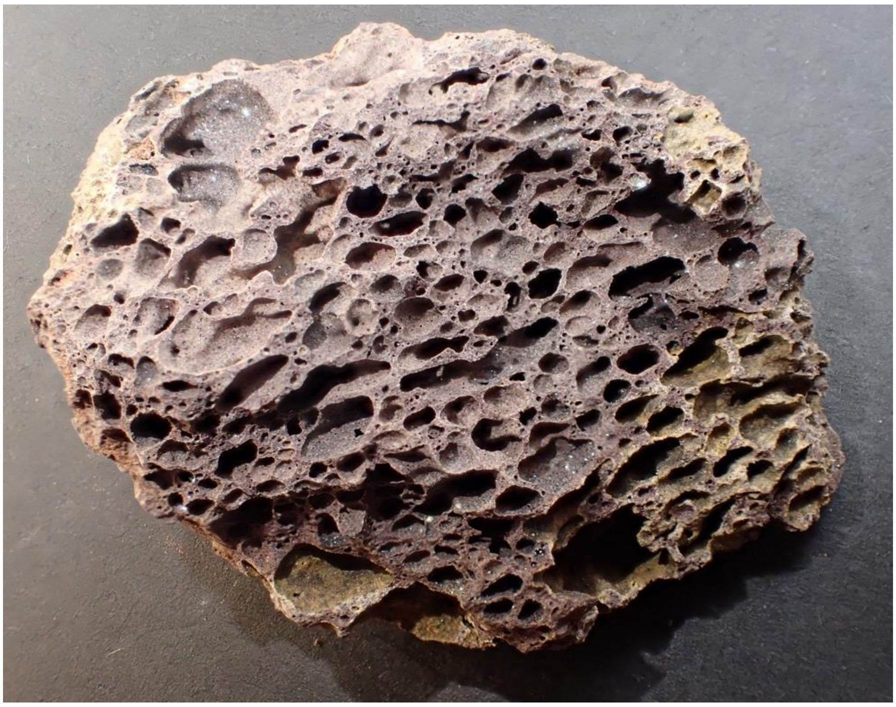

Fig. 11. G408822. Scoriaceous basalt, showing very fine, bright black hematite crystals coating vesicles, plus some white kaolinite. FOV ~120mm

In thin section, it is a moderately weathered, highly vesicular (>50% porosity), microcrystalline, mafic rock comprising plagioclase, clinopyroxene, minor opaques (mostly hematite) and clay minerals (Figs. 12-15). It is porphyritic with partly altered orthopyroxenes to ~1 mm (Fig. 12). Xenoliths are common and include probable Jurassic dolerite (Fig. 13) and probably metasedimentary (Permian?) rocks, altered to yellow clinopyroxene (aegirine-augite?), sanidine/anorthoclase and glass (Figs. 14-15).

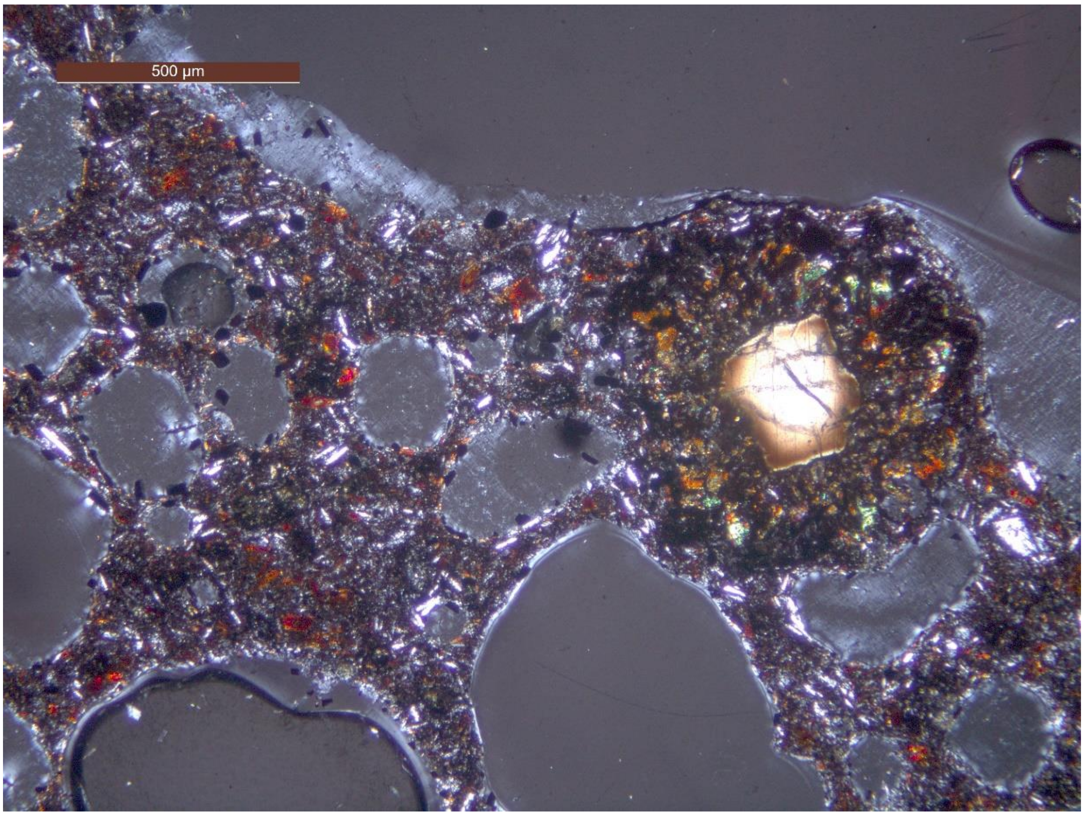

Fig. 12. G408822. Scoriaceous basalt showing altered basalt with vesicles containing some black to red hematite and other opaque crystals. There is an anhedral orthopyroxene (right of centre) with an alteration clinopyroxene halo. Red blebs are probably iddingsite-altered olivine crystals. White to grey laths are plagioclase. Cross-polarised transmitted light.

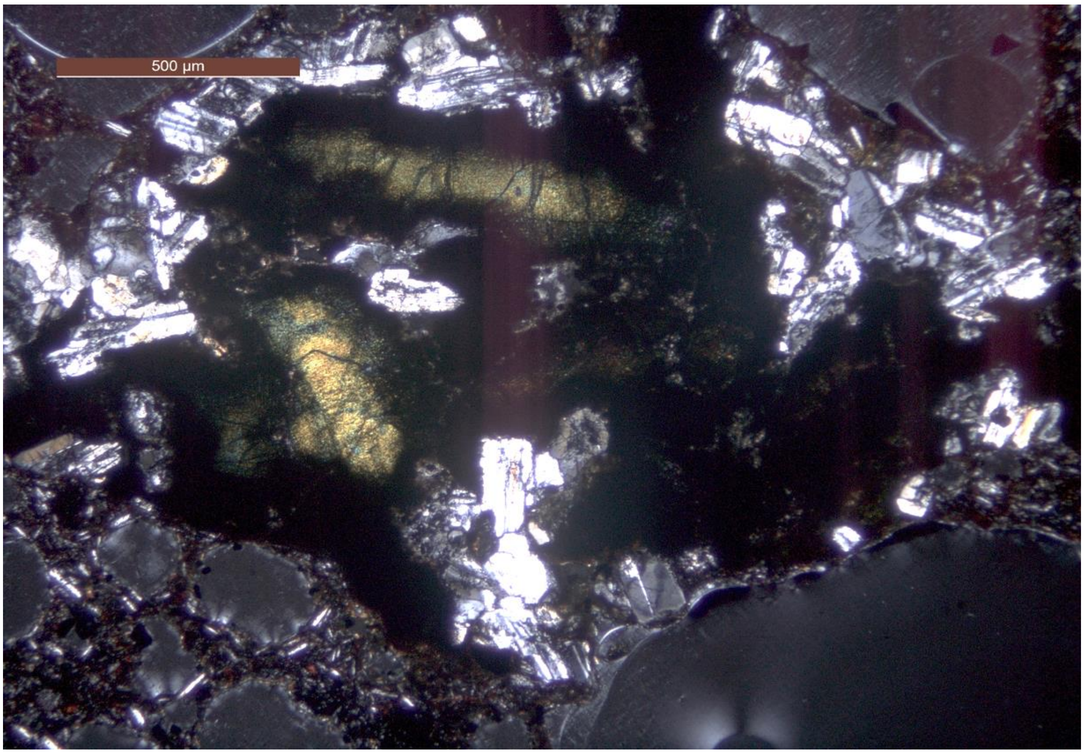

Fig. 13. G408822. A clast of probably Jurassic dolerite, ~2mm across, in basalt, with white-grey plagioclase and pyroxenes partly altered to opaques. Cross-polarised transmitted light.

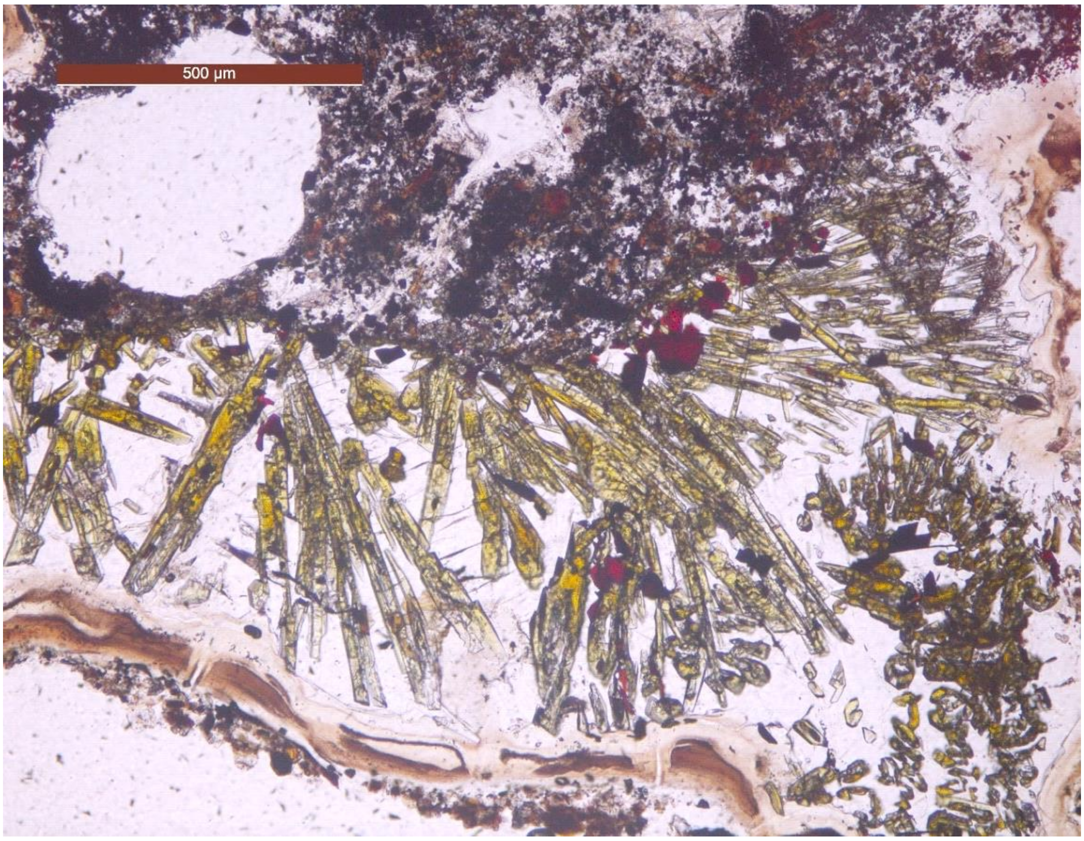

Fig. 14. G408822. A clast of probable hornfelsed metasediment, ~8mm across, in basalt, containing yellow pyroxenes (aegirine-augite?) in white feldspars (sanidine/anorthoclase) with red to black hematite. Plane-polarised transmitted light.

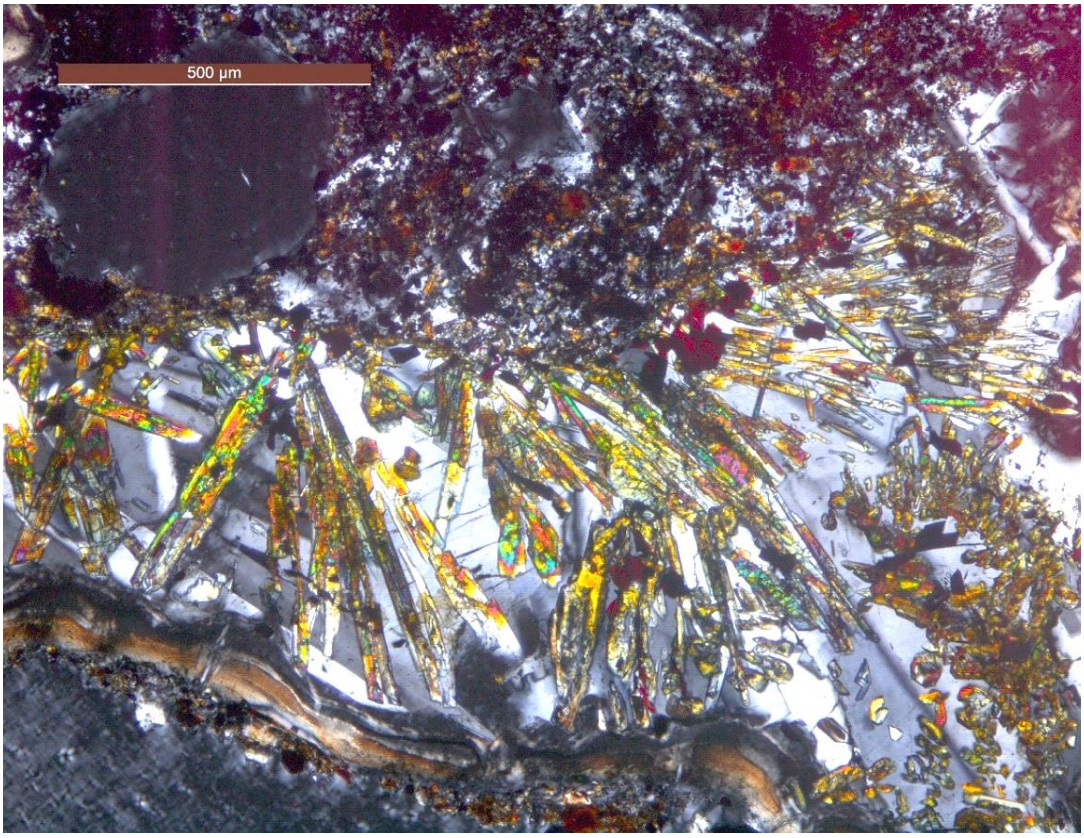

Fig. 15. G408822. A clast of probable hornfelsed metasediment, ~8mm across, in basalt, containing yellow pyroxenes (aegirine-augite?) in white feldspars (sanidine/anorthoclase) with red to black hematite. Cross-polarised transmitted light.

G408825 SILICIFIED BASALT

This rock is a reddish black, hard and dense, non-vesicular basaltic rock which appears to have been silicified (Fig. 16).

Fig. 16. G408825. Non-vesicular basaltic rock which appears to have been silicified. FOV ~120mm

In thin section, it is a moderately weathered, very sparsely vesicular (~1% porosity), microcrystalline, mafic rock comprising plagioclase, clinopyroxene, olivine (altered to red iddingsite), minor opaques and clay minerals (Figs. 17-18). It is porphyritic with partly altered orthopyroxenes to ~2 mm. Vesicles (<3 mm) are part-filled with banded chalcedony (agate; Fig. 18).

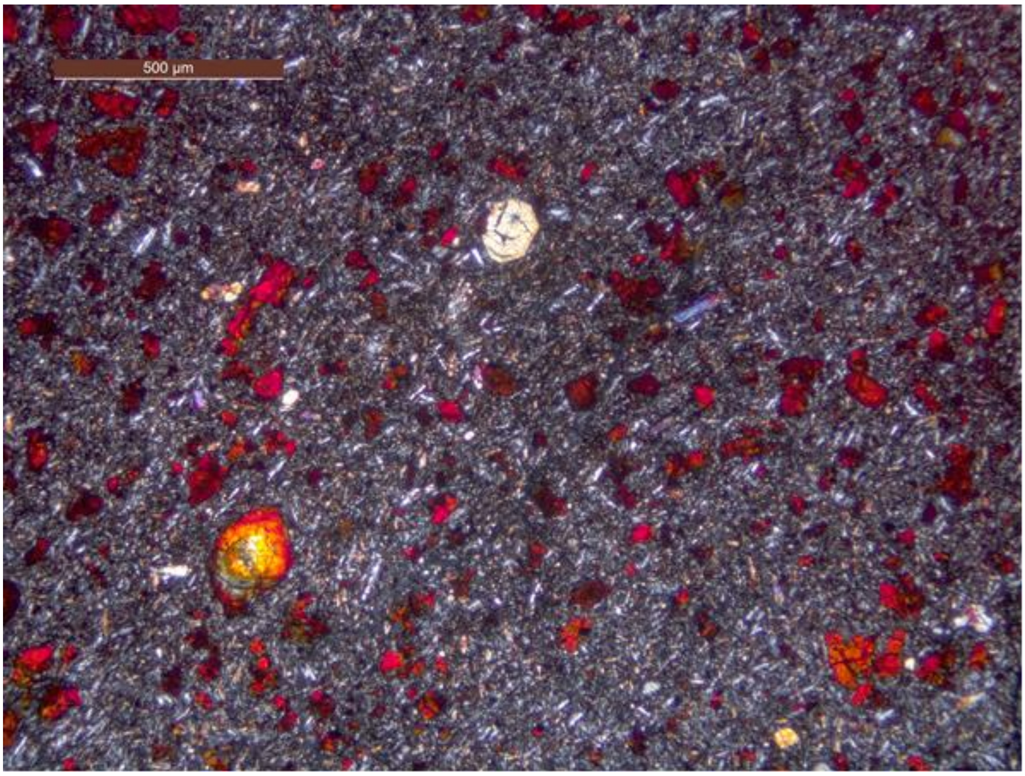

Fig. 17. G408825. Red, finely porphyritic, iddingsitised olivine crystals in fine grained matrix of plagioclase and clinopyroxene. Cross-polarised transmitted light.

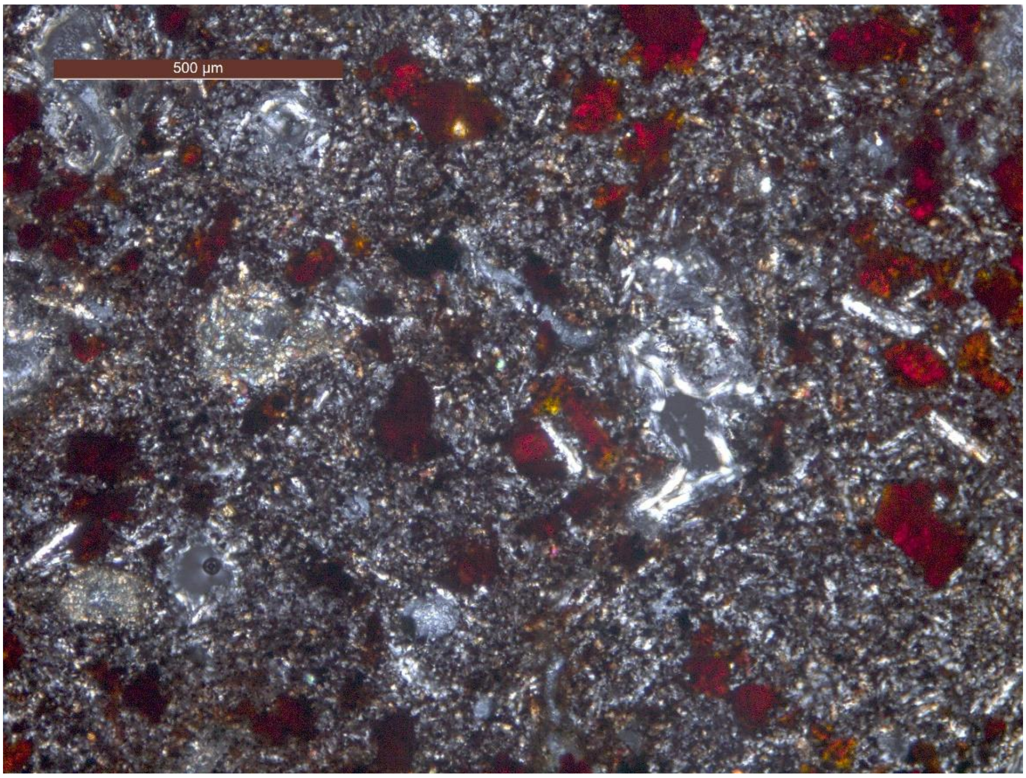

Fig. 18. G408825. White chalcedony (agate) partly filling some vesicles in a basalt matrix containing red, iddingsitised olivine crystals, plagioclase and clinopyroxene. Cross-polarised transmitted light.

G408836 NODULAR BASALT/LAPILLI TUFF

This rock is a reddish brown, hard and weakly vesicular, nodular basaltic rock. The nodules appear to be welded lapilli, ~ 5 to 10mm (Figs. 19-20).

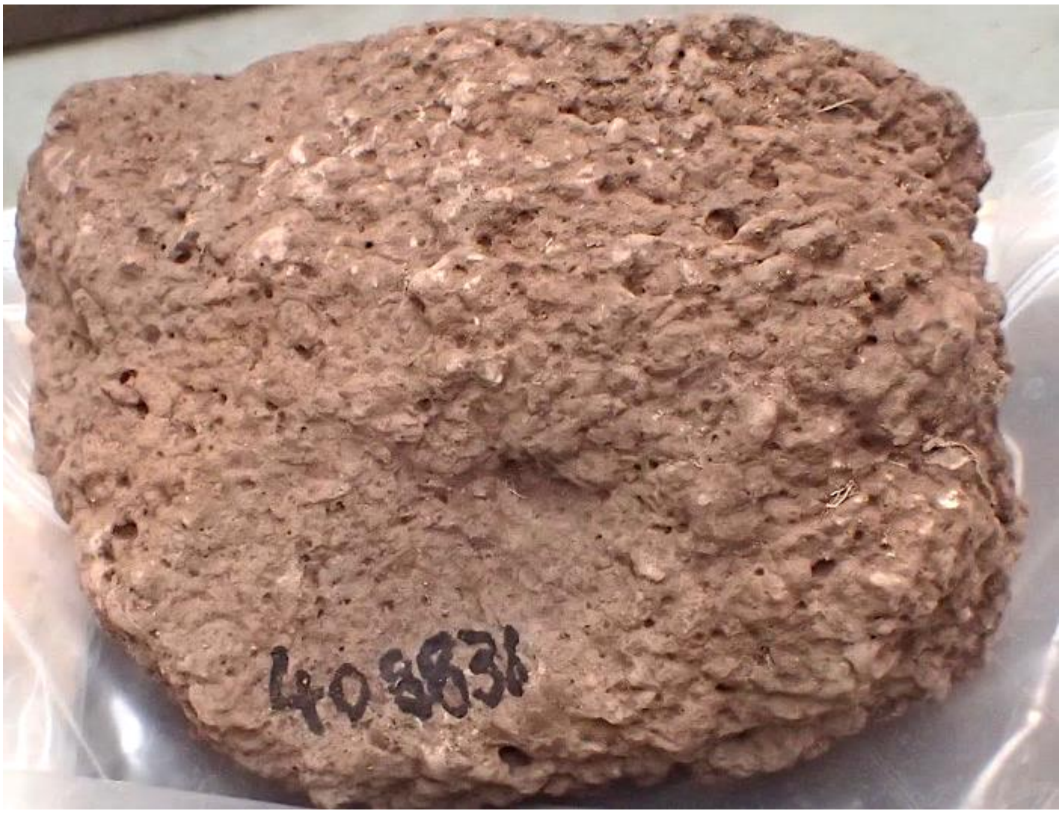

Fig. 19. G408836. Agglutinate texture in basalt, showing small welded lapilli. FOV ~120mm

Fig. 20. G408836. Cut surface showing a spotty agglutinate texture in basalt, composed of small welded lapilli. FOV ~150mm

In thin section, it is a moderately weathered, very sparsely vesicular (~1% porosity), microcrystalline, mafic rock comprising plagioclase, clinopyroxene, olivine (altered to red iddingsite), minor opaques and clay minerals (Figs. 21-22). It is porphyritic with partly altered orthopyroxenes and clinopyroxene phenocrysts (replacing rounded orthopyroxene) to ~2 mm (Fig. 21). Vesicles (<3 mm) are part-filled with banded chalcedony (agate). Metasedimentary xenoliths are altered to mixtures of pyroxene, sanidine/anorthoclase and glass (Fig. 22). There is some swirling and domained flow banding (Figs. 21-22).

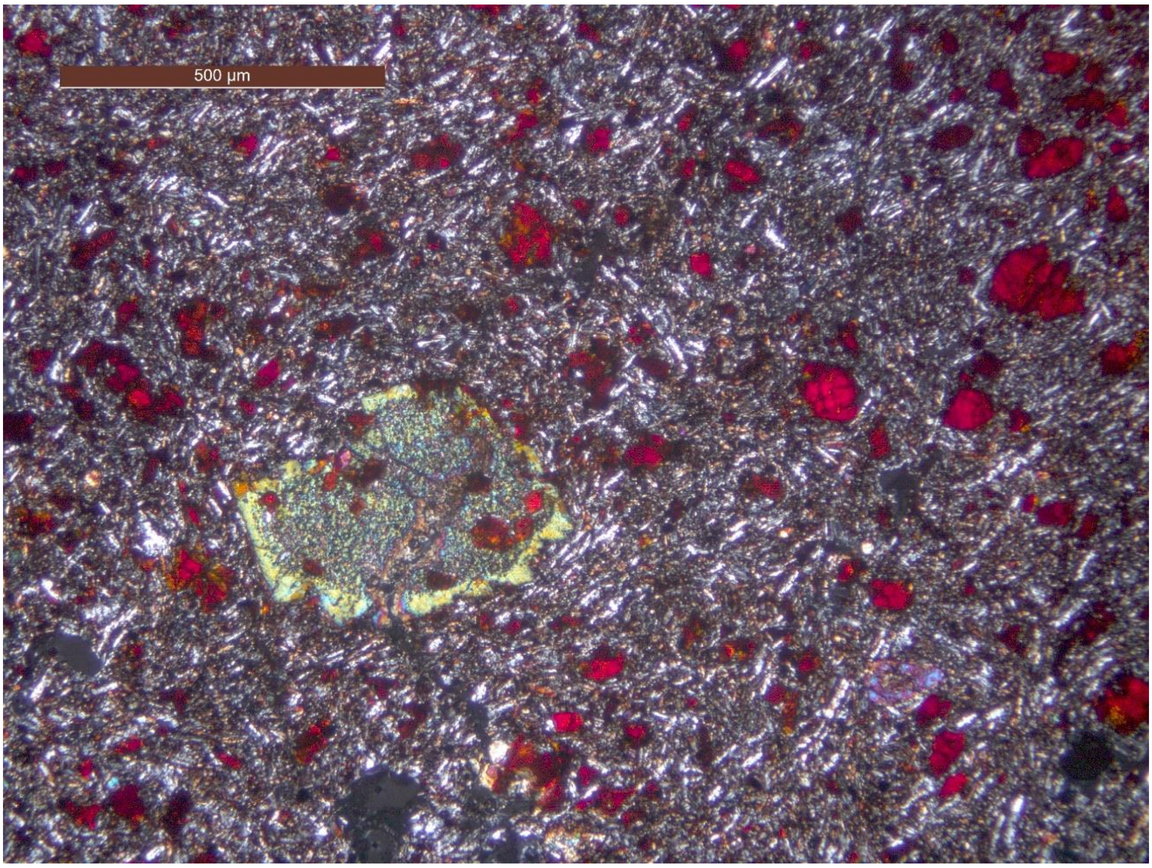

Fig. 21. G408836. Red, finely porphyritic, iddingsitised olivine crystals in fine grained matrix of plagioclase and clinopyroxene. Cross-polarised transmitted light.

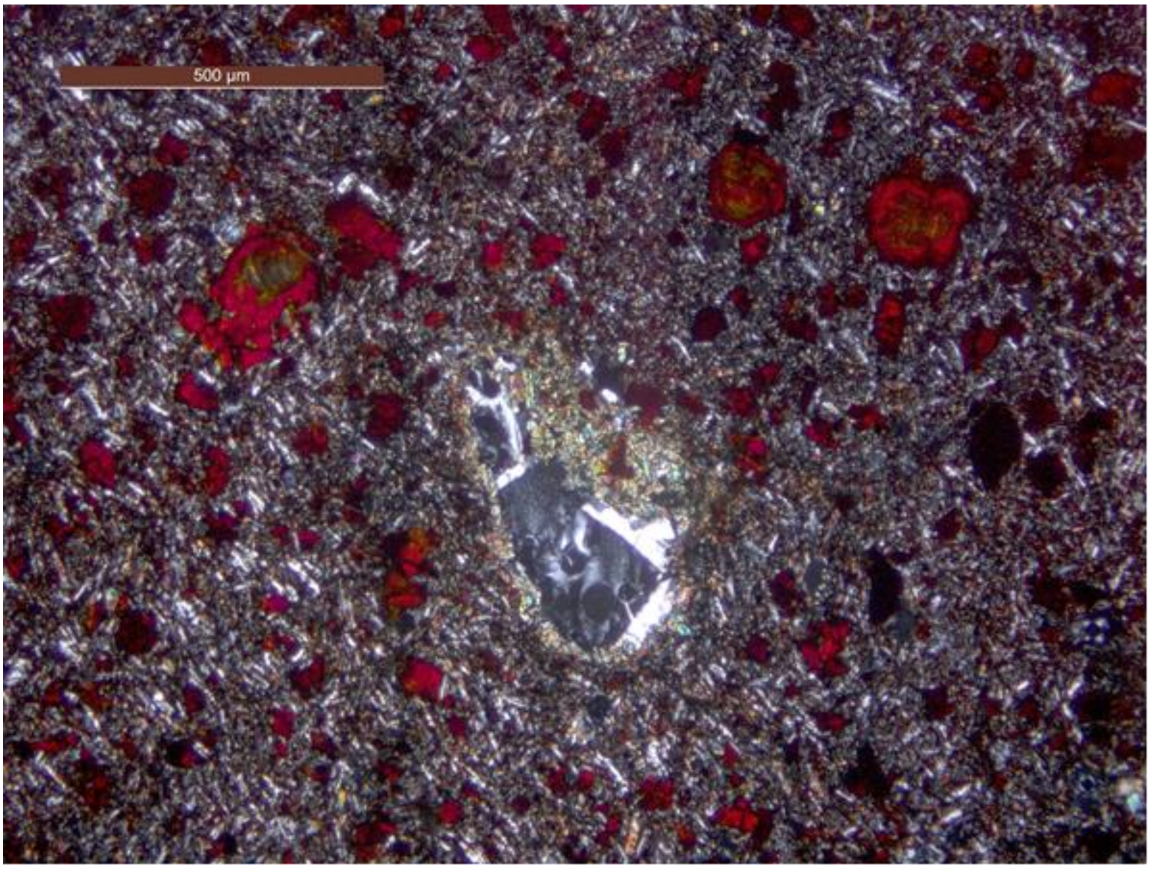

Fig. 22. G408836. Red, finely porphyritic, iddingsite-altered olivine crystals in fine grained matrix of plagioclase and clinopyroxene, with an altered metasedimentary xenolith altered to anorthoclase/sanidine, pyroxene and glass. Note the matrix is distinctly different across a line roughly from the upper left to the lower right, indicating a non-homogeneous matrix. Cross-polarised transmitted light.

G408837 NODULAR BASALT/LAPILLI TUFF?

This rock is a reddish brown, hard and weakly vesicular, nodular basaltic rock, similar to G408836. The nodules appear to be highly welded lapilli, ~ 5 to 10mm (Fig. 23).

Fig. 23. G408837. Cut surface showing a spotty agglutinate texture in basalt, composed of small welded lapilli, plus vesicles. FOV ~150mm

In thin section, it is a moderately weathered, moderately vesicular (~5% porosity), microcrystalline, mafic rock comprising plagioclase, clinopyroxene, olivine (altered to red iddingsite), minor opaques and clay minerals (Figs. 24-25). It is porphyritic with partly altered orthopyroxenes and clinopyroxene phenocrysts to ~2 mm. Vesicles (<3 mm) are part-filled with banded chalcedony (agate) and clays. Metasedimentary xenoliths are altered to mixtures of clinopyroxene (aegirine-augite?), anorthoclase and glass; quartz is partly altered to tridymite (Fig. 25)

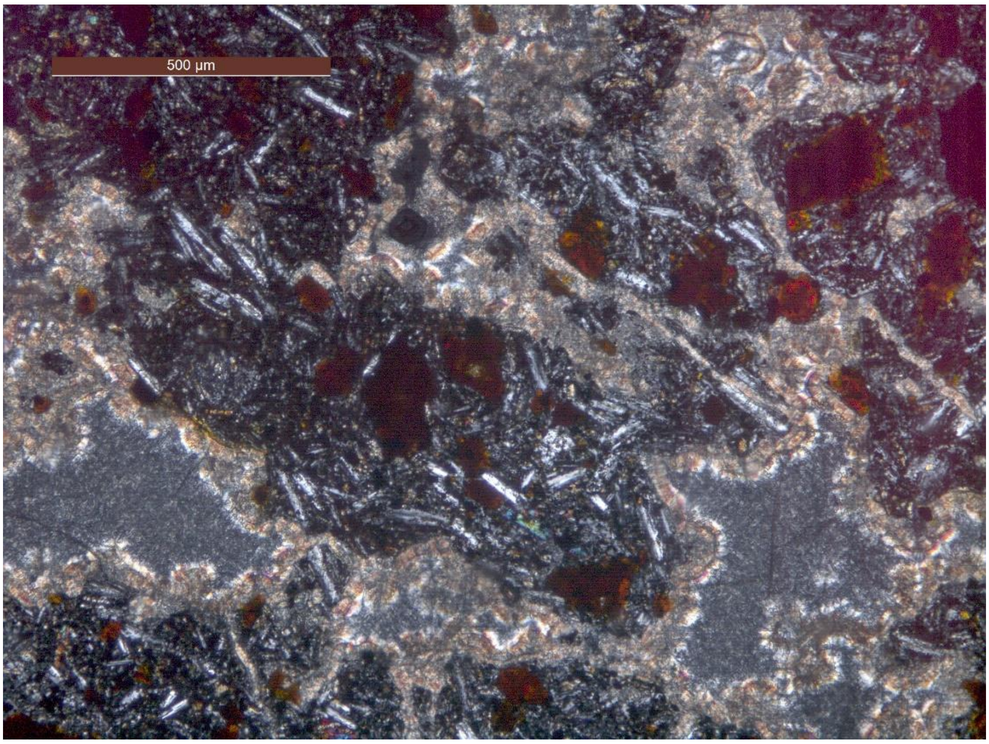

Fig. 24. G408837. Red, finely porphyritic, iddingsitised olivine crystals in fine-grained matrix of plagioclase and clinopyroxene, with vesicles partly filled with secondary minerals (clays?). Cross-polarised transmitted light.

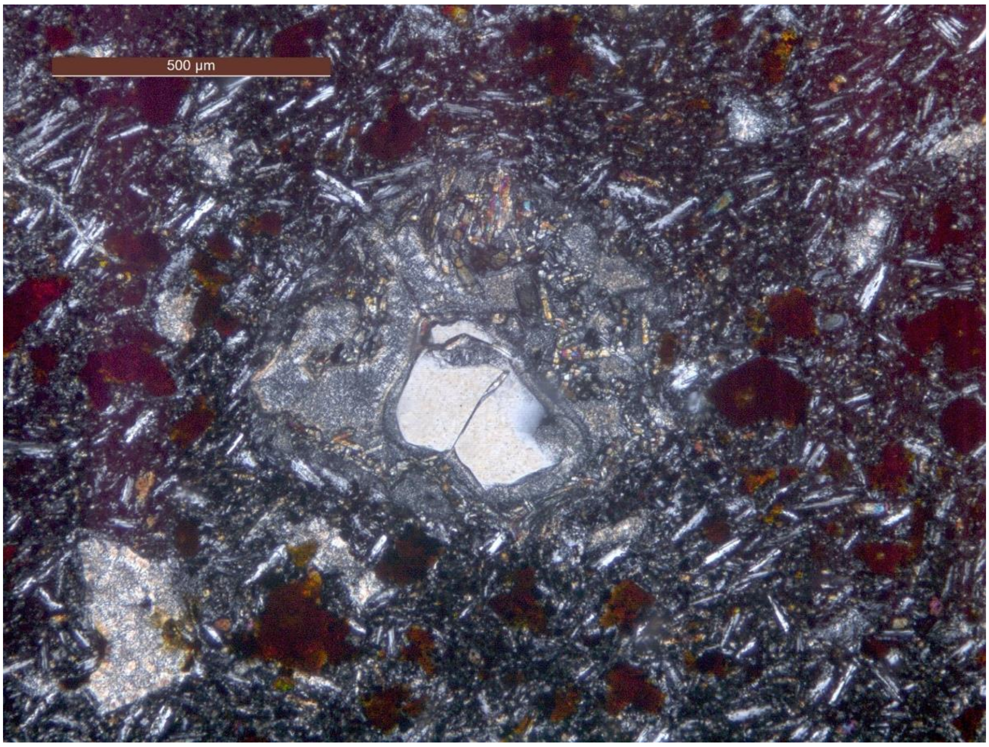

Fig. 25. G408837. A quartz grain being replaced by finely crystalline tridymite? Matrix includes iddingsitised olivine crystals in fine grained matrix of plagioclase and clinopyroxene. Cross-polarised transmitted light.

G408841 VOLCANIC BOMB

This rock is a large tear-drop block of vesicular basalt (Fig. 26).

Fig. 26. G408841. Volcanic bomb with partial tear-drop shape. FOV ~400mm

XRD

The samples were prepared, examined and analysed in the MRT laboratories, Rosny Park, Tasmania. They were run on a Rigaku Miniflex 600 X-Ray Diffractometer system: a 600W generator 150mm goniometer with a Cu tube; 40kV/15mA, sample spinner and a D/teX Ultra High Speed 1D Detector with Be window, -3o to 145o 2Ø scanning range and 2o - 140o 2Ø measuring range, with a scanning speed of 0.01 to 100o/min, A graphite monochromator and a Kß Ni- filter, The analysis software used is the PDXL2 using the ICCD database.

Quantification is largely manual, using a series of prepared standards of the more common minerals to enable some semi-quantitative analysis. Quartz, if present, is used as an internal standard; and if not present, it is often added to the sample for a supplementary scan. Our semi-quantitative results are calculated using single-peak calibration factors derived from scans of known mixtures of minerals.

The results are shown in Appendix 1 and summarised in Table 2. Most of this was confirmed by petrology, except for the presence of amphibole.

Table 1: XRD Summary

Phase Name	C112293	C112294	G408822	G408825
Calcite, magnesian		1(1)		
Quartz		93(10)		9(4)
Tridymite		4(2)		
Augite			15(4)	40(8)
Plagioclase		1(1)	32(8)	42(8)
Enstatite			24(4)	
Anorthoclase			11(4)	
Hematite			8(4)	
Amphibole			4(2)	
Olivine			4(2)	
Kaolinite				1(1)
Halloysite-7A	8(6)			
Montmorillonite	92(6)		3(1)	8(4)

Results are displayed in Wt. % (+/- error)

C112293 (subsampled white clay) is mostly montmorillonite with minor halloysite.

C112294 (a xenolith) is mostly quartz with minor tridymite, plus trace plagioclase and magnesian calcite.

G408822 (scoria) is mostly plagioclase, clinopyroxene, orthopyroxene, anorthoclase, and hematite, with very minor to trace amphibole, olivine and montmorillonite.

G408825 (silicified basalt) contains major augite and plagioclase, minor quartz and some clays (kaolinite and montmorillonite).

XRF

The samples were analysed for major elements on a fused disk, and trace elements on a pressed pellet, in a Bruker ASX58 XRF, with proprietary Bruker software and a series of commercial standards. The results are shown in Appendix 2.

The XRF results on these samples indicate they are mostly dominated by Si-Al-Ca-Mg-Fe-Na. They plot as Trachybasalts on the TAS plot (Fig. 27) but this is affected by alteration and weathering. Some are borderline into basanite and normal basalt. Immobile element plots indicate their chemistry is peralkaline, typical of alkali basalts (Figs. 28-29), probably hawaiites, from their high Na/K ratio. No nepheline (typical of hawaiites) was observed, probably due to weathering and alteration.

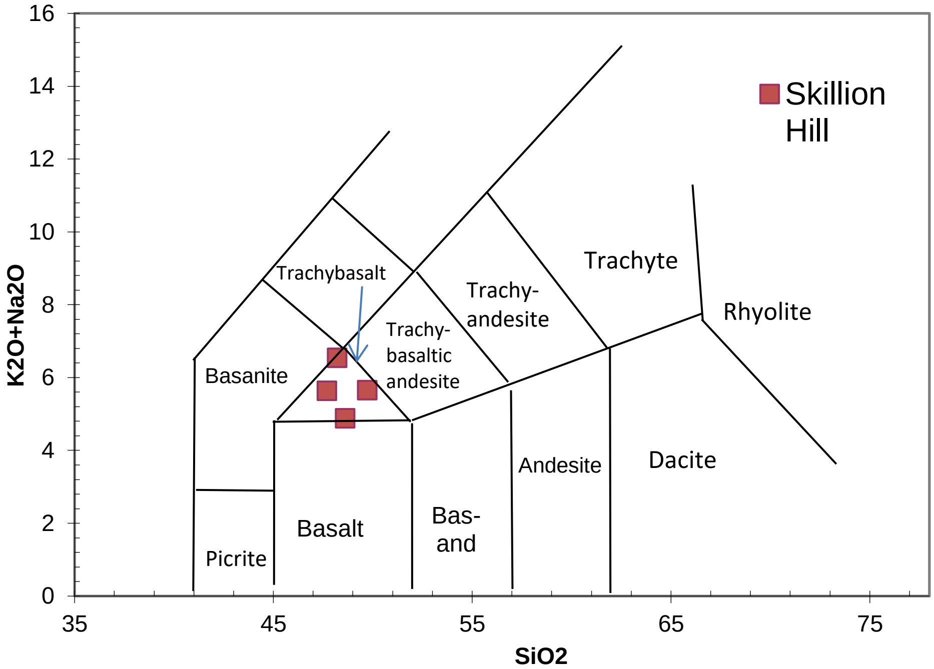

Fig. 27. TAS discrimination plot of alkalis vs SiO2 (Floyd & Winchester, 1975) for the Skillion Hill basalts.

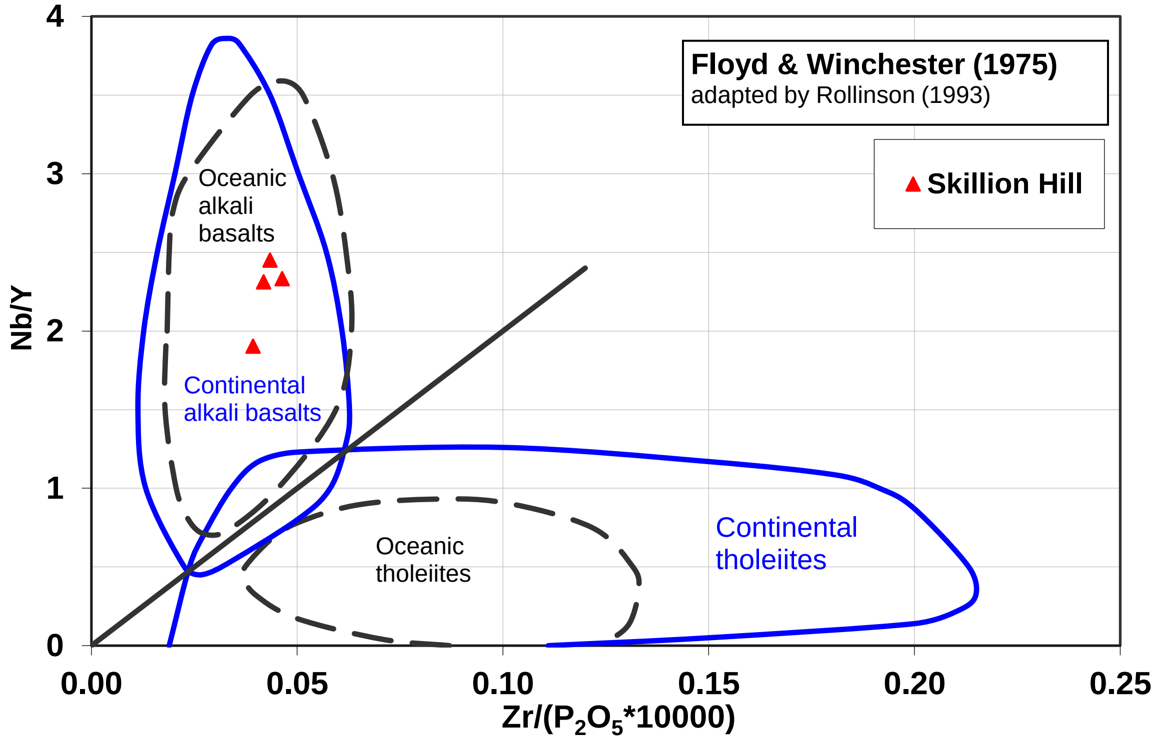

Fig. 28. Nb/Y vs Zr/P discrimination plot of Floyd and Winchester (1975) for the Skillion Hill basalts.

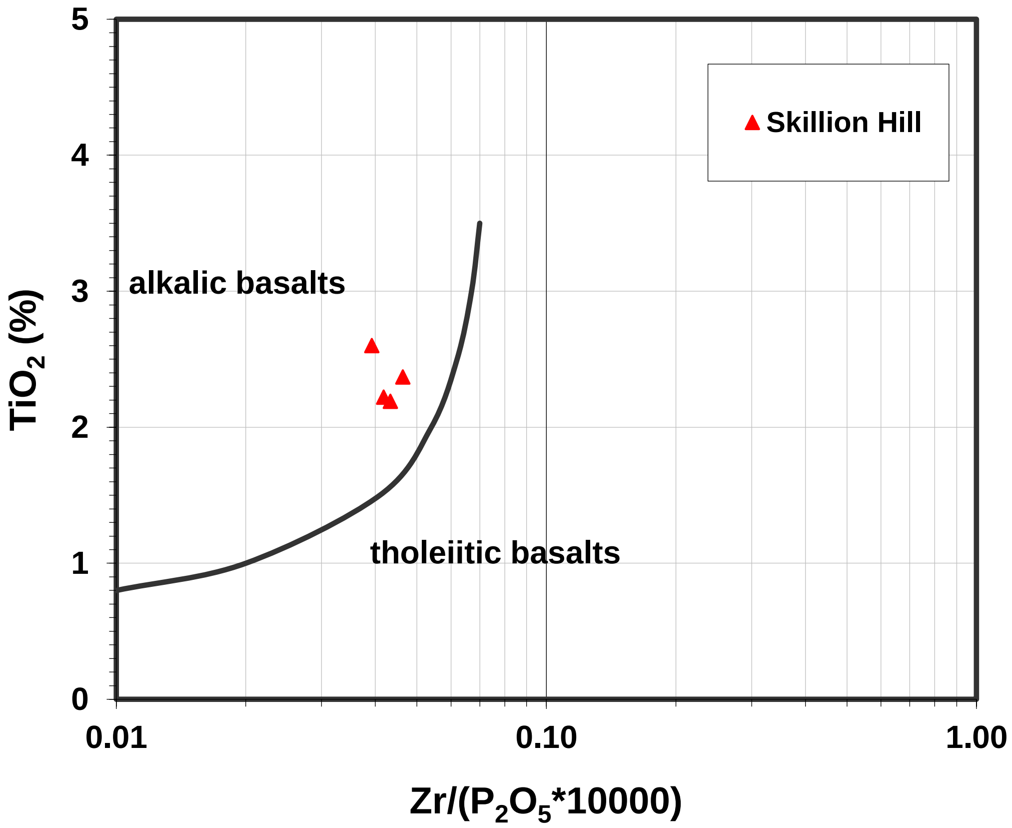

Fig. 29. Ti-Zr discrimination plot of Floyd and Winchester (1975) for the Skillion Hill basalts.

NDIR

The carbon and sulphur contents of these samples were determined by Non-dispersive infrared (NDIR) analysis using a Bruker G4 Icarus analyser, in the MRT laboratories, Rosny Park.

The results have been included in Appendix 2, and show low C (<0.1 wt.%) and low sulphur values (<0.2 wt.%).

SEM ANALYSES

The sample G408822 was micro-analysed by SEM-EDS to determine the mineral composition, and results given in Appendix 1. The analytical conditions are shown in Appendix 2 and images of areas analysed (Figs. 30–36).

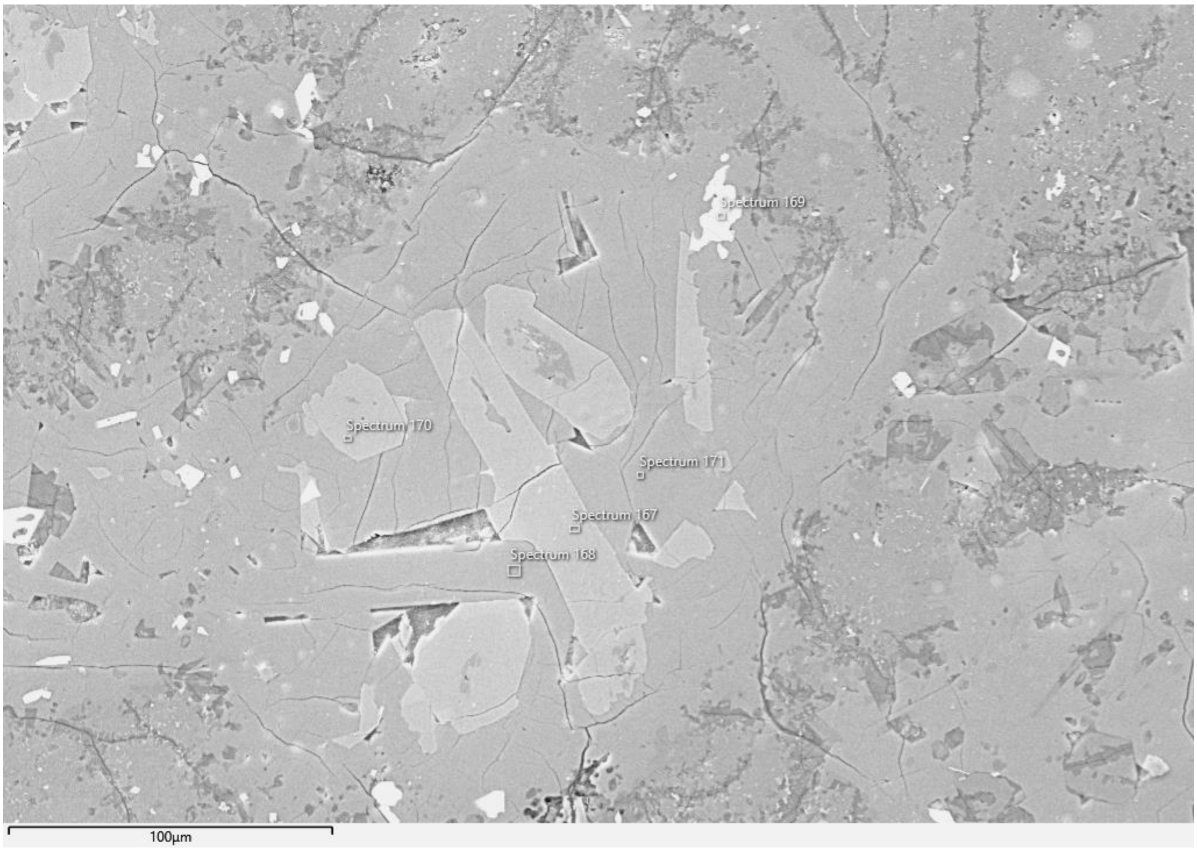

Fig. 30. SEM image showing analysis spots of a probable recrystallised xenolith in basalt, containing skeletal aegirine-augite plus sanidine/anorthoclase and some skeletal ilmenite.

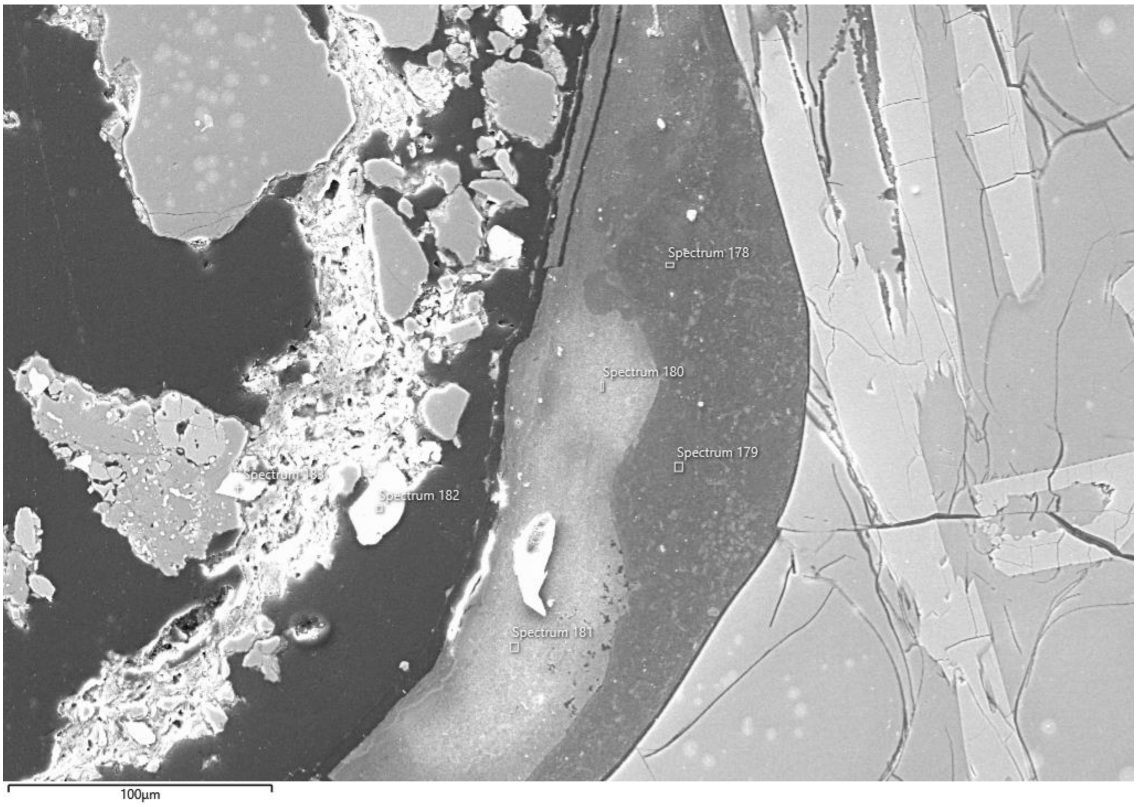

Fig. 31. SEM image showing analysis spots of a glassy rim, plus montmorillonite and hematite, on a probable recrystallised xenolith in basalt containing prismatic-skeletal aegirine-augite plus sanidine/anorthoclase.

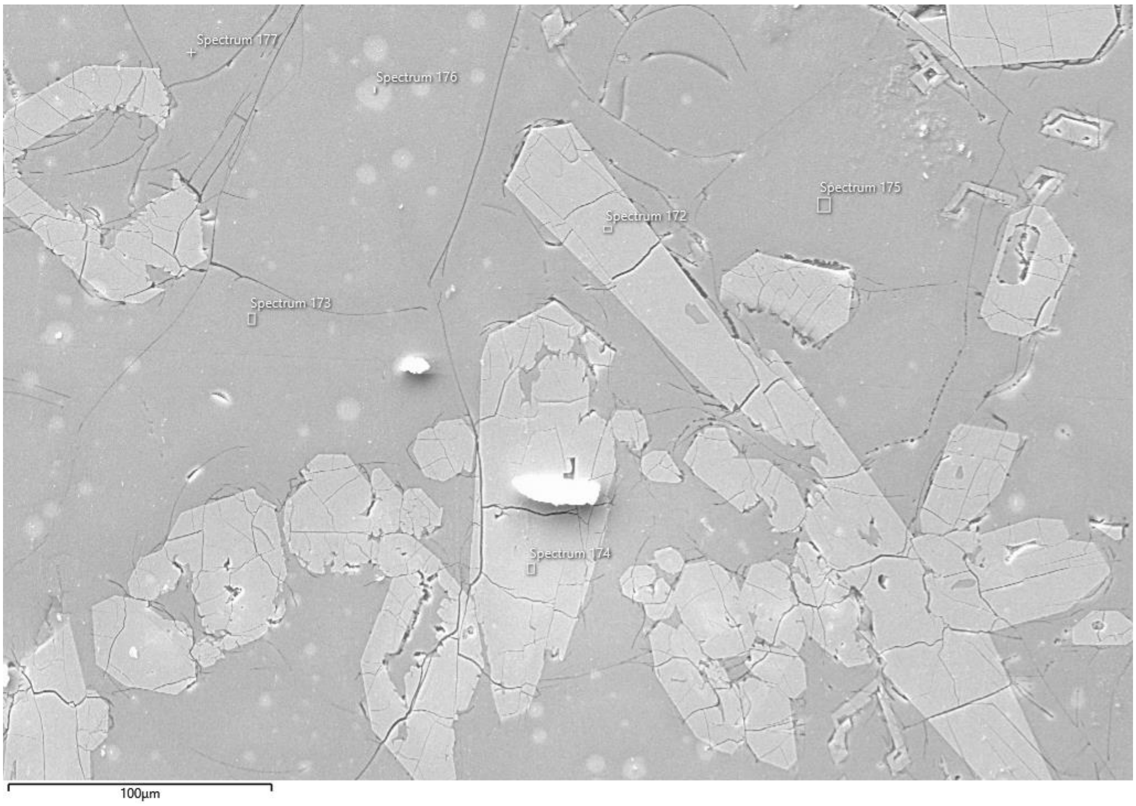

Fig. 32. SEM image showing analysis spots of an aegirine-augite and sanidine/anorthoclase xenolith in basalt.

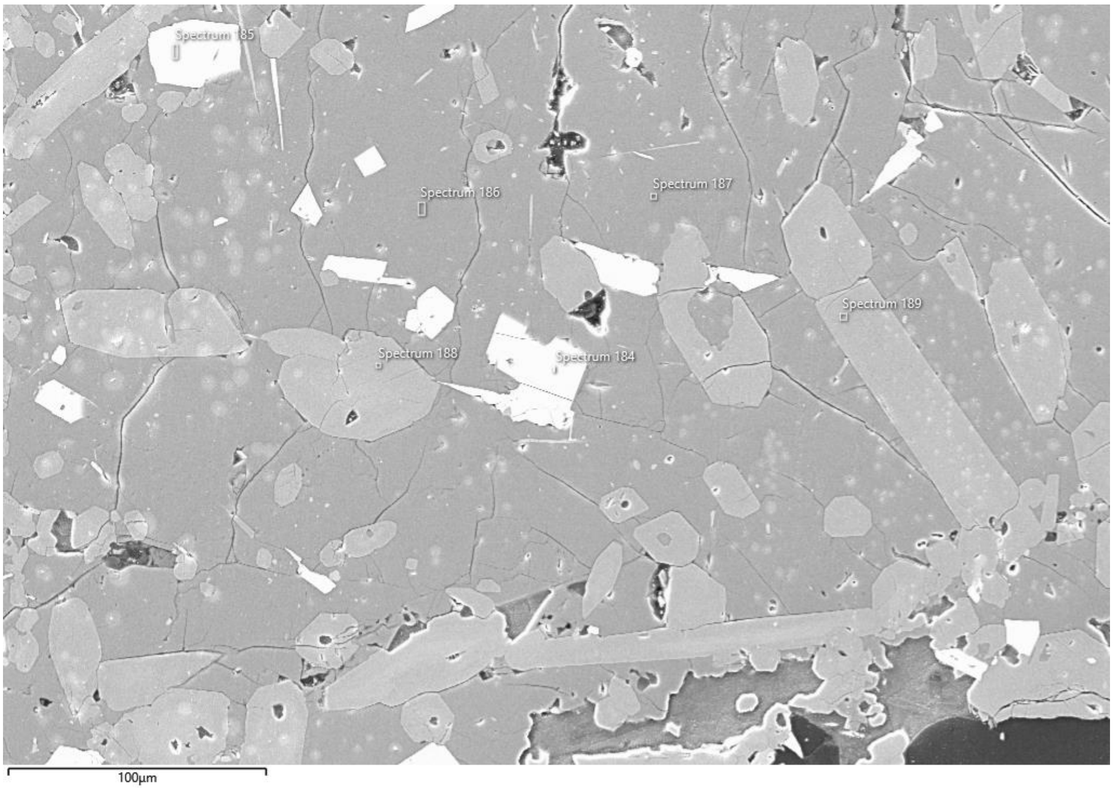

Fig. 33. SEM image showing analysis spots of an aegirine-augite and sanidine/anorthoclase plus hematite-bearing xenolith in basalt.

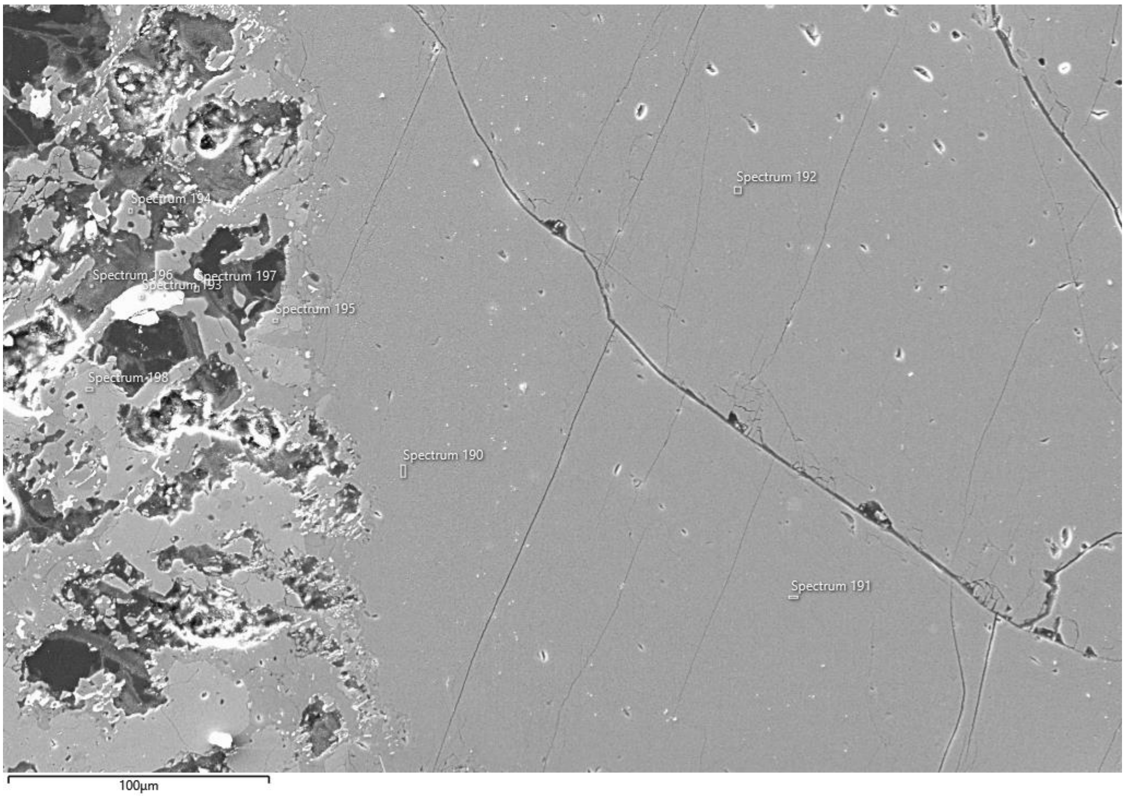

Fig. 34. SEM image showing analysis spots of an enstatite xenocryst in basalt (LHS).

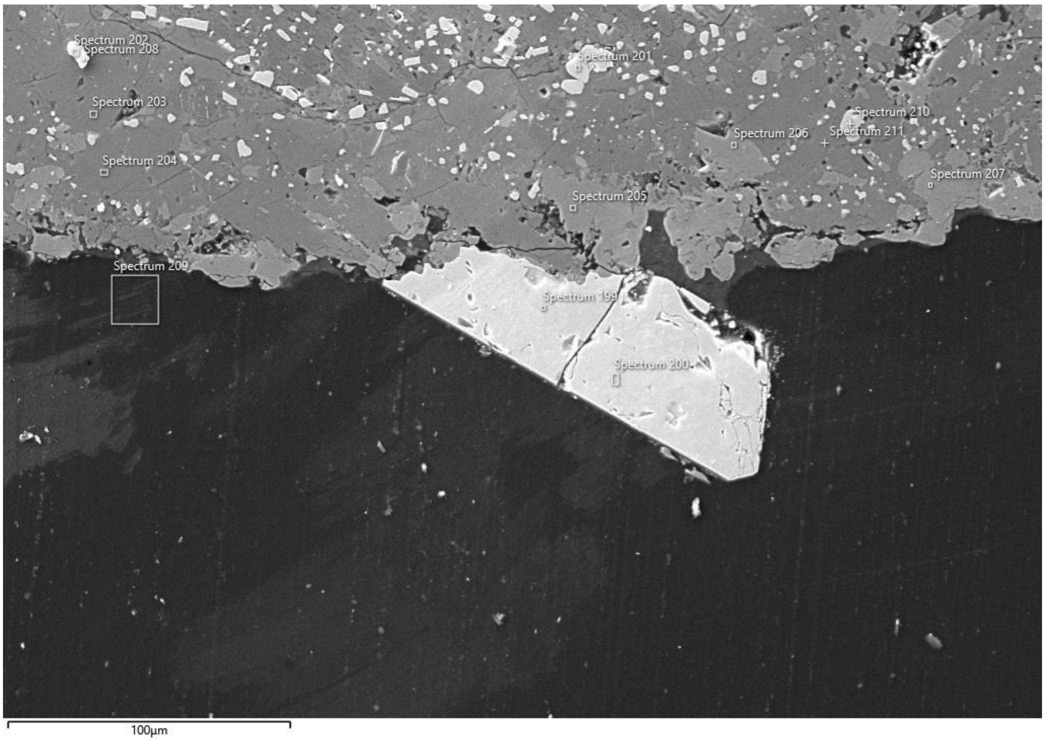

Fig. 35. SEM image showing analysis spots of a hematite crystal on the surface of a vesicle in basalt.

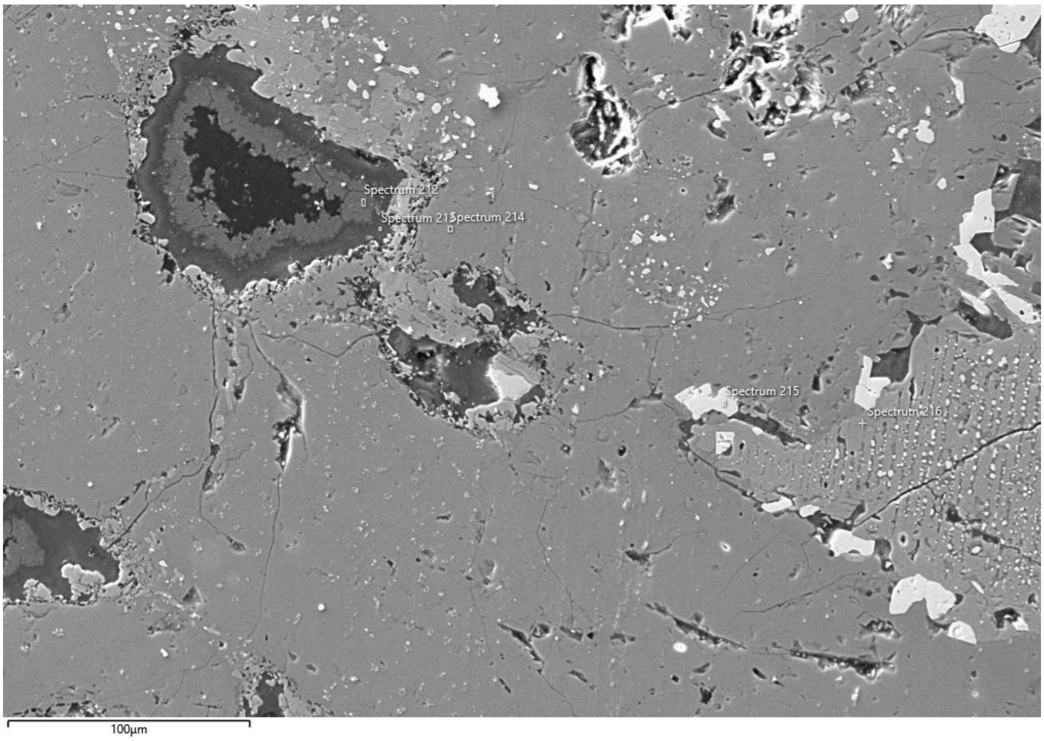

Fig. 36. SEM image showing analysis spots of a dolerite xenolith in basalt, with coarse plagioclase, augite exsolving Fe-Ti oxides (centre right), and a vesicle containing clays.

Clinopyroxenes were found to be in two groups (Appendix 3, Tables 2 & 3): aegirine-augite (in xenoliths) and augite (in the basalt matrix and in dolerite xenoliths). The aegirine-augite has an average composition: (Na0.2 Ca0.7)(Mg0.7 Fe3+0.2)Si2O6 with a range (Na0.2-0.3 Ca0.7)(Mg0.6-0.8 Fe3+0.2-0.4)Si2O6. The augite has an average composition: (Na0.1 Ca0.8 Mg0.1)(Mg0.8 Fe2+0.2)(Si1.9 Al0.1)O6 with a range (Na0.1-0.2 Ca0.7-0.9 Mg0.0-0.2)(Mg0.7-1.0 Fe2+0.1-0.3)(Si1.7-2.0 Al0.0-0.3)O6. The augite in the dolerite xenoliths has a similar composition to that in the basalt matrix, despite having abundant magnetite exsolution, possibly due to oxidation?

The orthopyroxene in the buchite xenoliths is compositionally close to pure Enstatite (Appendix 3, Table 4): (Mg0.8 Fe2+0.1)(Si0.9 Al0.1)O3.

The feldspar in the buchites is an iron-rich sanidine: (K0.5 Na0.5)(Al1.0 Fe0.1)Si3O8, (Appendix 3, Table 5). The range is (K0.4-0.6 Na0.4-0.6)(Al1.0 Fe0.1)Si2.9-3O8. Some analyses are very close to anorthoclase but all have >36% Kspar component.

The feldspar in both the basalt matrix and the dolerite xenoliths is an intermediate plagioclase, andesine to labradorite (Appendix 3, Table 6): average composition: (Ca0.4 Na0.5) (Al1.5 Si2.5)O8. The range is (Ca0.3-0.6 Na0.4-0.7) (Al1.3-1.6 Si2.4-2.7)O8.

The oxides analysed appear to be mostly coarse, late stage hematite, with some fine primary ilmenite and magnetite. The ilmenite is Mg-rich “picroilmenite” and the analysis (Appendix 3, Table 7) gives: (Fe0.7 Mg0.3)TiO3. The magnetite is weakly Ti and Mg-rich and the analysis (Appendix 3, Table 8) gives: (Fe0.8 Mg0.1 Ti0.1)Fe2O3. The main Fe-Ti oxide found is probably a Mg-Ti rich hematite based on its tabular morphology and bright red transmitted light colour, plus chemistry, and was confirmed by XRD analysis. It is similar in chemistry and appearance to pseudobrookite, but is deficient in Ti, and these are more bladed to prismatic. Magnetite and ulvospinel can have similar compositions but they are more opaque and form equant, octahedral crystals with dark brown internal reflections. It has a compositional range (Fe1.4-1.7 Mg0.1-0.3 Ti0.1-0.3)2O3 and averages (Fe1.6 Mg0.2 Ti0.2)2O3 (Appendix 3, Table 9). Hematite typically contains very little Mg, but in this case it probably balances the high Ti content, and may relate to high temperature (vapour phase deposition)? The maximum values of Mg and Ti found here are about 4% and 8% respectively.

The clay is an Al-rich smectite (Appendix 3, Table 10), with a compositional range (Na0.1)(Al1.2-1.8 Mg0.1-0.5 Fe0-0.2)(Si3.2-3.9 Al0.1-0.8)O10(OH)10.nH2O and averaging: (Na0.1)(Al1.5 Mg0.3 Fe0.2)(Si3.5 Al0.5)O10(OH)10. nH2O. By definition the more Si-rich compositions (Si >3.75) are montmorillonite and the more Si-poor ones (Si <3.75) are beidellite. The compositions of some zones are unusually Al-rich (Si<3.4), suggesting some interlayering or intermixing with kaolinite and/or halloysite.

The glass is silica-rich (67-71% SiO2), with moderate Ti, Al, Fe, Mg, Na, Al and K contents (Appendix 3, Tables 11, 12). The composition is clearly too high in Si and too low in Al, Fe and Mg to be a basaltic glass, and it has a high K/Na ratio. It is suggested that this glass is largely formed from the partial melting and preferential remobilisation of silica and alkalis from the siliceous metasedimentary xenoliths.

CONCLUSIONS AND DISCUSSION

These rocks comprise a range of basaltic rocks with textures ranging from lavas to scoria and pyroclastics. Some show probable welded lapilli, indicating welded basaltic tuffs. The scorias blocks and bombs are sometimes welded into blocky, autoclastic basaltic breccias.

The rock chemistry is strongly peralkaline and indicates a trachybasalt, specifically a hawaiite assuming the Na/K ratios are reasonably pristine. No nepheline was identified, probably due to the alteration and weathering.

The mineralogy of the basalts was mostly Na-Ca plagioclase - augite - olivine - magnetite - ilmenite, but most olivine is now altered to iddingsite and hematite. Clays (halloysite, smectite and kaolinite), and chalcedony have also formed late. Hematite occurs as a late stage (vapour phase?) mineral with high Ti and Mg contents.

Inclusions in the basalts include orthopyroxene (altering to clinopyroxene), dolerite (slightly altered, with oxidised augites), quartz (altered to tridymite – glass buchites), and aluminous (metasedimentary?) rocks altered to anorthoclase/sanidine – aegirine-augite – tridymite – glass hornfels.

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L Unwin
TECHNICAL OFFICER

Mineral Resources Tasmania

Appendix 1: pXRF Report

Client: R. Bottrill
Sample Source: Stoney Ford
MRT Job Number: LJN2020-070
Analysis: Geochemistry
Analyse: R Bottrill
Methods: pXRF

Sample ID	DL	c111677	c111677
Date	-	12/08/2020	12/08/2020
Time	-	2:03:27 PM	2:04:12 PM
Method	-	Geochem(2)	Geochem(2)
SiO2 (%)	9	53.1	55.4
TiO2 (%)	0.2	(0.1)	0.2
Al2O3 (%)	5	19.2	19.5
Fe2O3 (%)	1.0	8.9	5.8
MnO (%)	0.1	1.4	1.2
CaO (%)	1.0	(0)	(0)
MgO (%)	1.5	(0)	(0)
K2O5 (%)	2.0	15.7	18.1
P2O5 (%)	0.5	(0)	(0)
S (%)	1.0	(0)	(0)
As (ppm)	100	(0)	(0)
Bi (ppm)	200	(0)	(0)
Cr (ppm)	50	(0)	(0)
Cu (ppm)	50	(11)	(16)
Mo (ppm)	100	(0)	(0)
Nb (ppm)	30	(8)	(14)
Ni (ppm)	30	(0)	(0)
Pb (ppm)	10	(0)	(0)
Rb (ppm)	10	461	489
Sb (ppm)	100	(0)	(0)
Sn (ppm)	100	484	472
Sr (ppm)	10	234	282
Th (ppm)	100	(0)	(0)
U (ppm)	50	(0)	(0)
V (ppm)	100	(76)	150
Y (ppm)	20	(12)	(12)
Zn (ppm)	20	1208	1067
Zr (ppm)	50	(19)	80
LE (%)	-	0	0

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Appendix 2: Whole Rock Analysis Report

Client: R. Bottrill
Sample Source: Stoney Ford
MRT Job Number: LJN2020-070
Analysis: Geochemistry
Analyst: J. Renaud
Methods: XRF, NDIR

Reg. #	DL	C111677	C111678	C111679
SiO2 %	0.10	56.13	66.29	73.80
TiO2 %	0.01	0.06	0.31	0.21
Al2O3 %	0.20	19.23	16.75	13.27
Fe2O3 %	0.10	7.99	3.10	2.37
MnO %	0.01	1.80	0.07	0.04
MgO %	0.02	0.35	1.06	0.80
CaO %	0.01	0.37	1.77	1.78
Na2O %	0.10	0.57	7.38	2.55
K2O %	0.01	10.81	2.43	4.56
P2O5 %	0.01	<0.01	0.02	0.04
LOI %		2.47	0.81	0.59
TOTAL %		100.43	100.13	100.14
C wt %	0.05	<0.05	<0.05	0.08
S wt %	0.04	0.05	<0.04	<0.04
As ppm	5	<5	<5	<5
Ba ppm	5	1772	453	421
Bi ppm	2	5	<2	<2
Ce ppm	6	39	11	31
Co ppm	4	<4	6	5
Cr ppm	4	5	34	23
Cs ppm	4	14	4	10
Cu ppm	5	19	11	8
Ga ppm	1	18	14	12
La ppm	5	18	<5	13
Mo ppm	2	<2	3	3
Nb ppm	2	9	9	6
Nd ppm	5	8	<5	9
Ni ppm	7	<7	<7	<7
Pb ppm	3	551	46	34
Rb ppm	3	455	104	214
Sb ppm	2	<2	4	2
Sc ppm	2	<2	9	6
Sn ppm	2	1823	17	2
Sr ppm	4	228	172	174
Th ppm	2	24	31	23
U ppm	1	15	14	5
V ppm	2	2	39	33
W ppm	3	<3	<3	<3
Y ppm	2	25	13	13
Zn ppm	6	1265	69	44
Zr ppm	6	99	116	99

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Appendix 1: XRD Laboratory Report

MRT Job Number: LJN2018-074
Client: R. Bottrill
Sample Source: Skillion Hill
Analysis: Approximate Mineralogy
Method: X-Ray Diffraction
Analyst: L Unwin
Lab Manager: R Bottrill
Date: 22/12/2017

Analysis Results – C112293 – White clay

Analysis date	2018/07/23 11:21:53		
Sample name	LJN2018-074-Basalts	Measurement date	2018/07/20 08:02:02
File name	C112293.ras	Operator	lunwin
Comment	White clay like material		

Phase name	Content (%)	Formula
Montmorillonite	92(6)	Ca0.5 (Al2 Si4 O11 (O H))
Halloysite-7	8(6)	Si2 Al2 O5 (O H)4

Analysis Results – C112294 – White Xenolith

Analysis date	2018/07/23 16:01:11		
Sample name	LJN2018-074-White Mat.	Measurement date	2018/07/23 08:54:57
File name	C112294.ras	Operator	lunwin

Phase name	Content (%)	Formula
Quartz	93.4(11)	Si O2
Tridymite	4.2(6)	Si O2
Calcite, magnesian	1.4(4)	Ca0.9 Mg0.1 (C O3)
Albite	1.0(8)	(Na0.7 K0.3) (Al1.02 Si2.98 O8)

Analysis Results – G408822

Analysis date	2018/09/17 14:13:07		
Sample name	LJN2018-074-Basalts	Measurement date	2018/07/20 11:17:14
File name	G408822.ras	Operator	lunwin

Phase name	Content(%)	Formula
Albite	32(2)	Na Al Si3 O8
Enstatite	24(2)	Mg (Si O3)
Augite	15(3)	(Ca0.774 Na0.226) (Mg0.901 Fe0.099) Fe0.011 (Si2 O6)
Anorthoclase	11.4(12)	K0.224 Na0.710 Ca0.069 Al1.036 Si2.952 O8
Hematite	7.7(10)	Fe2 O3
Magnesio-hornblende	4.0(17)	Na0.46 Ca1.7 Mg3.44 Fe1.72 Al1.1 Si6.9 O23 (O H)
Forsterite	3.7(18)	(Mg0.879 Fe0.121) (Mg0.881 Fe0.119) (Si O4)
Montmorillonite	2.8(15)	Ca0.5 (Al2 Si4 O11 (O H))

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Analysis Results – G408825

Analysis date	2018/07/20 12:25:26		
Sample name	LJN2018-074-Basalts	Measurement date	2018/07/17 11:47:49
File name	G408825.ras	Operator	lunwin
Comment	Shifted 0.1		

Phase name	Content (%)	Formula
Albite	42(2)	Na Al Si3 O8
Augite	39.9(16)	K0.23 Ca0.75 Mg0.75 Al0.30 Si1.97 O6.00
Quartz	8.5(4)	Si O2
Montmorillonite	7.8(4)	Ca1.2 Al4 (Si8 O20 (O H)2) O2.2 (H2 O)3.1
Kaolinite	1.4(13)	Al2 (Si2 O5) (O H)4

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Appendix 2: XRF Laboratory Report

Job Number: LJN2018-091
Client: R. Bottrill
Sample Source: Rokeby
MRT Job Number: LJN2018-074
Analysis: Geochemistry
Method: X-Ray Fluorescence – Major elements
Analyst: L Unwin
Lab Manager: R Bottrill
Date: 22/12/2017

Results (wt.%):

Reg. #	C112290	C112292	G408825	G408837
Sample Description	Hackly basalt	Spotty basalt	silicified basalt?	spotty basalt
Locality	Skillion Hill	Skillion Hill	Skillion Hill	Skillion Hill
TOTAL %	100.1	100.24	100.07	100.14
SiO2 %	48.2	47.68	49.71	48.6
TiO2 %	2.19	2.6	2.37	2.22
Al2O3 %	13.19	13.1	14.21	13.27
Fe2O3 %	12.77	13.62	13.43	12.82
MnO %	0.17	0.16	0.16	0.12
MgO %	7.83	7.82	4.09	5.59
CaO %	7.52	7.81	6.94	7.48
Na2O %	4.87	4.33	3.86	3.61
K2O %	1.67	1.31	1.8	1.27
P2O5 %	1.01	0.93	1.01	1
LOI %	0.28	0.52	2.08	3.76
C wt %	0	0	0	0
S wt %	0	0.12	0.05	0.19

Mineral Resources Tasmania

Client: R. Bottrill
Sample Source: Rokeby
MRT Job Number: LJN2018-074
Analysis: Geochemistry
Method: X-Ray Fluorescence – Trace elements

Results:

Reg. #	C112290	C112292	G408825	G408837	Detection Limit	Units
As ppm	8	7	6	6	3	ppm
Ba ppm	697	606	705	700	5	ppm
Bi ppm	2	0	2	1	1	ppm
Ce ppm	132	111	141	122	5	ppm
Co ppm	75	74	63	52	2	ppm
Cr ppm	249	269	223	265	1	ppm
Cs ppm	0	0	0	0	3	ppm
Cu ppm	51	55	90	98	2	ppm
Ga ppm	25	24	27	25	1	ppm
La ppm	59	56	68	63	6	ppm
Mo ppm	7	6	3	6	1	ppm
Nb ppm	76	59	77	74	1	ppm
Nd ppm	55	56	68	57	7	ppm
Ni ppm	370	377	504	584	2	ppm
Pb ppm	9	7	11	8	2	ppm
Rb ppm	14	18	13	11	1	ppm
Sb ppm	0	0	0	0	2	ppm
Sc ppm	16	17	15	14	2	ppm
Sn ppm	0	2	0	2	2	ppm
Sr ppm	1165	947	1190	1150	1	ppm
Th ppm	11	9	11	11	2	ppm
U ppm	3	2	3	2	1	ppm
V ppm	134	169	115	151	2	ppm
W ppm	93	96	28	25	2	ppm
Y ppm	31	31	33	32	1	ppm
Zn ppm	147	141	174	148	1	ppm
Zr ppm	438	365	468	418	2	ppm

Mineral Resources Tasmania

Appendix 3: Laboratory Report – SEM Analyses

Client: R Bottrill, G Cumming
Sample Location: Skillion Hill
Job Number: LJN2018-074
Analyses: Mineral chemistry
Methods: SEM-EDS
Analyst: R Bottrill, J Renaud
Lab Manager: R Bottrill
Date: 30/9/20

Table 1: Analyses (Wt.% elements) G408822

Spectrum	Mineral	O	Na	Mg	Al	Si	Cl	K	Ca	Ti	Cr	Mn	Fe	Zr	Total
167	aug	43.77	1.57	10.26	0.36	24.91			13.74	0.73		0.39	3.87		99.61
168	San	47.23	3.75		9.37	30.51		7.33		0.19			1.45		99.83
169	Ilm	38.07		5.04	0.61	0.44				31.47	0.22	0.68	24.05	0.27	100.85
170	aug	44.48	1.59	10.07	0.34	25.07			13.91	0.76		0.22	4.12		100.55
171	San	47.56	3.95		9.52	30.67		7.14		0.21			1.33		100.39
172	aeg-aug	43.73	2.33	8.65	0.16	25.19			13.45	0.27		0.3	5.91		100
173	glass?	50.47	3.43	0.84	3.88	32.11		4.31		0.25			3.85		99.15
174	aeg-aug	42.14	3.46	6.2	0.34	23.84			11.66	0.5		0.2	10.96		99.29
175	glass?	49.42	3.9	0.76	4.29	31.44		4.58		0.21			3.84		98.45
176	glass?	51.4	2.64	0.82	3.89	32.98		3.95		0.29		0.17	3.85		99.99
177	glass?	52.11	1.92	0.83	3.66	33.7		3.41		0.22			4.09		99.93
178	mont	16.23	0.15	1.07	3.41	10.65	0.37	0.19	0.19	0.11			1.29		33.68
179	mont	15.94	0.18	0.97	3.75	10.43	0.25		0.2				1.08		32.79
180	mont	36.22	0.39	0.9	13.31	20.98	0.19		0.23	0.21			2.08		74.51
181	mont	35.9	0.35	0.92	13	20.62	0.19	0.13	0.38	0.19			1.86		73.53
182	hem	32.65		3.96	0.29					7.77		0.71	54.66		100.04
183	hem	30.98		2.95	0.3	0.09				5.91		0.52	57.29		98.04
184	hem	31.75		3.41	0.17	0.09				7.3		0.85	55.29		98.86
185	hem	31.95		3.73		0.1				7.78		0.88	54.23		98.67
186	San	47.65	4.31		9.79	30.69		6.53					1.32		100.29
187	San	47.16	4.16		9.55	30.51		6.64					1.57		99.58
188	aeg-aug	43.89	2.92	6.97	0.45	24.14			12.58	0.54			8.68		100.18
189	aeg-aug	43.74	2.71	7.61	0.29	24.72			13.13	0.39			7.77		100.37
190	opx	46.09		19.15	2.94	25.2			0.65		0.31		5.11		99.44
191	opx	45.66		18.86	2.91	24.97			0.69		0.26		5.22		98.56
192	opx	45.8		19.31	2.92	25.18			0.64	0.12	0.3		5.27		99.53
193	mgt	30.05								0.68	0.89		67.03		98.65
194	San	48.89	5.02		10.54	30.62	0.17	5.09	0.89				1.31		102.53
195	aug	44.16	0.63	10.61	0.88	24.83			14.95	0.37	0.84		3.24		100.52
196	mont	28.93		0.89	10.6	16.69	0.43	0.17	0.29				1.21		59.22
198	aug	44.48	0.58	11.36	0.89	24.97			13.01	0.24	0.9		3.96		100.39
199	hem	30.62		2.59	0.48					5.29		0.6	58.93		98.5
200	hem	30.19		2.58	0.41					5.21		0.59	58.68		97.66
201	mgt	30.35		1.9						4		0.28	61.34		97.87
203	pl	47.64	4.58		14.26	26.4		0.4	6.2	0.17			0.7		100.35
204	pl	46.68	5.26		13	27.82		0.84	4.06	0.15			0.68		98.48
205	aug	42.91	1.34	7.76	3.1	21.78			15.04	1.31	0.47		5.96		99.68
206	aug	43.8	0.9	8.88	1.5	23.51			15.52	0.76			5.65		100.53
207	aug	43.57	1.4	7.04	3.22	21.11			14.99	1.94			7.08		100.35
210	mgt	31.3		4.4	0.48	0.14			0.18	8.96		0.56	51.15		97.17
211	pl	49.36	4.62		14.24	26.7		0.38	6.17				0.49		101.96
212	mont	39.44	0.35	0.59	14.75	18.45	0.26	0.27	0.37				0.61		75.09
214	pl	47.63	2.97		15.89	23.98		0.22	9.1				0.72		100.51
215	mgt	29.48		0.66						1.64			65.93		97.7
216	aug	43.24	1	9.99	0.36	24.77			15.15			0.25	4.08		98.84

Table 2: Aegirine-Augite Analyses (relative atomic proportions to 4 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe	Ca/(Ca+Na)
172	aeg-aug	0.22	0.79	0.01	1.98	0.00	0.74	0.01	0.00	0.01	0.23	0.77
174	aeg-aug	0.34	0.58	0.03	1.92	0.00	0.66	0.02	0.00	0.01	0.44	0.66
188	aeg-aug	0.29	0.65	0.04	1.94	0.00	0.71	0.03	0.00	0.00	0.35	0.71
189	aeg-aug	0.26	0.70	0.02	1.96	0.00	0.73	0.02	0.00	0.00	0.31	0.73
average		0.28	0.68	0.03	1.95	0.00	0.71	0.02	0.00	0.01	0.33	0.72

Table 3: Augite Analyses (relative atomic proportions to 4 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe	Ca/(Ca+Na)
167	aug	0.15	0.93	0.03	1.94	0.00	0.75	0.03	0.00	0.01	0.15	0.83
170	aug	0.15	0.91	0.03	1.95	0.00	0.76	0.03	0.00	0.01	0.16	0.83
195	aug	0.06	0.95	0.07	1.93	0.00	0.81	0.02	0.04	0.00	0.13	0.93
198	aug	0.06	1.02	0.07	1.94	0.00	0.71	0.01	0.04	0.00	0.16	0.93
205	aug	0.13	0.72	0.26	1.74	0.00	0.84	0.06	0.02	0.00	0.24	0.87
206	aug	0.09	0.81	0.12	1.86	0.00	0.86	0.04	0.00	0.00	0.22	0.91
207	aug	0.14	0.66	0.27	1.71	0.00	0.85	0.09	0.00	0.00	0.29	0.86
216	aug	0.10	0.91	0.03	1.95	0.00	0.84	0.00	0.00	0.01	0.16	0.90
average		0.11	0.86	0.11	1.88	0.00	0.80	0.04	0.01	0.00	0.19	0.88

Table 4: Orthopyroxene (Enstatite) Analyses (relative atomic proportions to 2 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
192	opx	0.00	0.83	0.11	0.94	0.00	0.02	0.00	0.01	0.00	0.10
190	opx	0.00	0.83	0.11	0.94	0.00	0.02	0.00	0.01	0.00	0.10
191	opx	0.00	0.82	0.11	0.94	0.00	0.02	0.00	0.01	0.00	0.10
average		0.00	0.83	0.11	0.94	0.00	0.02	0.00	0.01	0.00	0.10

Table 5: Feldspar Analyses (relative atomic proportions to 5 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
168	San	0.45	0	0.96	3.00	0.52	0	0.01	0	0	0.07
171	San	0.47	0	0.97	2.99	0.50	0	0.01	0	0	0.07
186	San	0.51	0	0.99	2.98	0.46	0	0	0	0	0.06
187	San	0.50	0	0.97	2.99	0.47	0	0	0	0	0.08
194	San	0.58	0	1.04	2.91	0.35	0.06	0	0	0	0.06
average		0.50	0.00	0.99	2.97	0.46	0.01	0.00	0.00	0.00	0.07

Table 6: Plagioclase Analyses (relative atomic proportions to 5 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
203	plag	0.35	0	1.62	2.35	0.02	0.62	0	0	0	0.04
204	plag	0.54	0	1.43	2.54	0.03	0.42	0.01	0	0	0.03
211	plag	0.62	0	1.31	2.69	0.06	0.28	0.01	0	0	0.03
214	plag	0.54	0	1.42	2.57	0.03	0.42	0	0	0	0.02
average		0.51	0.00	1.45	2.54	0.04	0.44	0.01	0.00	0.00	0.03

Table 7: Ilmenite Analyses (relative atomic proportions to 2 cations) G408822

Spectrum	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
169	0	0.31	0.03	0.02	0	0	0.97	0.01	0.02	0.64

Table 8: Magnetite Analyses (relative atomic proportions to 3 cations) G408822

Spectrum	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
169	0	0.07	0.00	0.00	0.00	0.00	0.08	0.00	0.00	2.85

Table 9: Hematite Analyses (relative atomic proportions to 2 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
182	hem	0.00	0.25	0.02	0.00	0.00	0.00	0.24	0.00	0.02	1.47
183	hem	0.00	0.19	0.02	0.01	0.00	0.00	0.19	0.00	0.01	1.59
184	hem	0.00	0.21	0.01	0.01	0.00	0.00	0.23	0.00	0.03	1.51
185	hem	0.00	0.23	0.00	0.01	0.00	0.00	0.25	0.00	0.03	1.49
199	hem	0.00	0.17	0.03	0.00	0.00	0.00	0.17	0.00	0.02	1.62
200	hem	0.00	0.17	0.03	0.00	0.00	0.00	0.17	0.00	0.02	1.63
201	hem	0.00	0.13	0.00	0.00	0.00	0.00	0.13	0.00	0.01	1.73
210	hem	0.00	0.27	0.03	0.01	0.00	0.01	0.28	0.00	0.01	1.39
average		0.00	0.20	0.02	0.00	0.00	0.00	0.21	0.00	0.02	1.55

Table 10: Montmorillonite Analyses (relative atomic proportions to 6 cations excluding alkalis) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe
178	mont	0.07	0.46	1.30	3.92	0.05	0.05	0.03	0.00	0.00	0.24
179	mont	0.08	0.42	1.46	3.92	0.00	0.05	0.00	0.00	0.00	0.20
180	mont	0.08	0.16	2.25	3.40	0.00	0.03	0.02	0.00	0.00	0.16
181	mont	0.07	0.17	2.23	3.40	0.02	0.04	0.02	0.00	0.00	0.16
196	mont	0.00	0.21	2.24	3.39	0.03	0.04	0.00	0.00	0.00	0.12
212	mont	0.07	0.12	2.63	3.17	0.04	0.05	0.00	0.00	0.00	0.05
average		0.06	0.26	2.02	3.53	0.02	0.04	0.01	0.00	0.00	0.16

Table 11: Glass Analyses (relative atomic proportions to 10 cations) G408822

Spectrum	Min	Na	Mg	Al	Si	K	Ca	Ti	Cr	Mn	Fe	SiO2 wt%
173	glass?	0.45	0.1	0.43	3.45	0.33	0	0.02	0	0	0.21	68.7
175	glass?	0.51	0.09	0.48	3.35	0.35	0	0.01	0	0	0.21	67.2
176	glass?	0.35	0.1	0.44	3.56	0.31	0	0.02	0	0.01	0.21	70.5
177	glass?	0.26	0.11	0.42	3.71	0.27	0	0.01	0	0	0.23	72.1
average		0.39	0.10	0.44	3.52	0.32	0.00	0.02	0.00	0.00	0.22	69.63

Table 12: Glass Analyses (wt.% oxides) G408822

Spectrum	SiO2	TiO2	Al2O3	Fe2O3	MgO	Na2O	K2O
173	68.7	0.4	7.3	5.5	1.4	4.6	5.2
175	67.2	0.4	8.1	5.5	1.3	5.3	5.5
176	70.5	0.5	7.4	5.5	1.4	3.6	4.8
177	72.1	0.4	6.9	5.8	1.4	2.6	4.1
average	68.7	0.4	7.3	5.5	1.4	4.6	5.2

Table 13: Abbreviations

Abb	Mineral
aeg-aug	Aegirine-augite
aug	Augite
cpx	Clinopyroxene
hem	hematite
Ilm	Ilmenite
mgt	Magnetite
mont	Montmorillonite
opx	Orthopyroxene
plag	plagioclase
San	Sanidine/anorthoclase
usp	Ulvospinel

Mineral Resources Tasmania

Appendix 4: Laboratory Report –SEM analytical conditions

Hitachi SU-70 analytical field emission SEM

- Installed February 2011
- Schottky thermal field emission source
- ultra-high resolution (1.0 nm @ 15kV, 1.6 nm @ 1kV for SE imaging)
- high vacuum operation only (i.e. no variable pressure in chamber)
- Hitachi in-chamber and in-lens scintillation detectors, Super ExB filter, beam deceleration
- Hitachi in-chamber 5-segment solid state BSE detector, retractable
- in-column Faraday cup with picoammeter for beam current measurement
- anticontamination cold plate, liquid nitrogen cooled
- 5 axis motorised fully eucentric stage, XYZ range 110x110x40mm
- Oxford AZtec EDS/EBSD system with
    - X-Max 80 SDD EDS, MnKa 125 eV resolution, elements B-U, large area hyperspectral mapping, standardless and standards-based quantification, feature analysis
    - HKL NordlysNano EBSD camera & forescatter detector system, HKL & Channel 5 software packages, Synergy EDS/EBSD integration, HKL, ICSD & American Mineralogist phase databases
- NEW June 2017: Gatan ChromaCL2 colour cathodoluminescence imaging system with integrated BSE detector, Digital Micrograph 3 software, automated mosaic acquisition, simultaneous acquisition of SE, iBSE and colour CL images.

Label:	am 179
Element List Type:	Current Spectrum
Processing Option:	All Elements
Specimen Coating:	On
Beam Calibration Element Coating:	Off
Coating Element:	Carbon
Coating Thickness:	20 nm
Coating Density:	2.25 g/cm³
Automatic Line Selection:	Disabled
Normalization:	Enabled
Thresholding:	Sigma level = 1
Detector Window Correction:	Enabled
Deconvolution Elements:	None
Selected Standards:	Minerals_15kV_2017-10-20 [User]
Pulse Pile Up Correction:	Succeeded
Detector file:	X-Max 3
Efficiency:	File based