



PETROGRAPHIC REPORT

3 Rocks from Drillhole FTD038,
W Tasmania

for
Unity Mining (Henty)
(attn. David Evans)

23/5/2013

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Petrographic Summary Report

Background

Three samples from Unity Mining's W Tasmania drillhole FTD038 were submitted for thin section examination to attempt to better characterize the rocks with respect to defining their rock type and comparison with the Lynchford Member of the Tyndall Group.

The three samples were prepared as standard (unpolished) thin sections on the basis of their lacking significant opaque phases. Both the thin section offcuts and thin sections themselves were scanned, and these scanned images are incorporated in the description of each sample to provide visual detail on the rocks examined and complement the representative photomicrographs provided.

Summary and Implications

Samples came from a 158m interval in FTD038 from 320.11m, 426.25m and 479.40m depths. The two shallower samples are essentially identical petrographically, being weakly welded but fiamme-free rhyolitic ignimbrites dominated by vitric ash with well preserved bubble-wall shard shapes and abundant quartz and plagioclase crystal debris, including both entire and broken crystals, and occasional now leucoxene-altered former FeTi oxide phenocrysts and microphenocrysts. An important component of both rock is the common, quite angular and irregular lithic fragments of quartz+plagioclase-phyric rhyolitic lava with devitrified, locally micropoikilitic-textured formerly glassy groundmasses. Importantly perhaps, the sizes, shapes and proportions of the quartz and plagioclase phenocrysts are very similar in both the vitric ash matrix and in the lava fragments.

The deeper sample, from 479.4m depth, is also very close petrographically to the preceding samples, but includes in the sample provided a much larger 3-4cm rhyolitic lava fragment (and the notes provided with this sample suggest fragments may reach 9cm across), which, nevertheless, is identical to the smaller fragments in the two shallower samples, and set in an identical vitroclastic matrix carrying similar proportions of quartz and altered plagioclase phenocryst debris.

The striking similarity between these three rocks is notable, with the coarser fragments in the deeper sample being important. Although no sample carries fiamme, in many places in the better preserved vitroclastic groundmasses of the two shallower samples, it appears that vitric shards have been plastically deformed around quartz and plagioclase phenocrysts, implying that they were plastic during compaction. The rocks are therefore considered to be weakly welded.

It is possible, although more perhaps less likely, that the bent shards and those apparently flattened against neighbouring phenocrysts, were compacted after they were solidified, but it is notable that those shards away from phenocryst margins are typical, undeformed bubble-wall shapes.

Thus the dominance of juvenile pyroclasts (glassy rhyolitic lithic fragments with ragged margins, quartz and plagioclase phenocrysts in similar proportions in both the vitric ash matrix and in the lava fragments, and abundant vitric ash) all, argue that these three rocks represent primary eruption products of significant explosive rhyolitic eruptions, with possible weak, low degree welding compaction. The rocks were probably syn-eruptive, with no extra-basinal or non-juvenile material, and not resedimented from initial deposition.

Although a drill-log of the sampled interval is not available to me, the large thickness of this unit (minimum 158m) seems remarkable if attributable to a single eruption. It is, however, possible that a series of essentially comagmatic eruptions of the same magma package were involved in generating this volcanic sequence, given the consistency in the size, shape and proportions of plagioclase and quartz phenocrysts in these rocks.

Alteration

All three rocks show the same alteration assemblage, with glass having altered devitrified then altered to very fine-grained sericite-carbonate-magnetite intergrowths, with submicroscopic hematite present in the larger lithic fragments groundmass. The deepest sample shows more abundant and more coarsely crystalline, quite dark carbonate, probably an ankeritic composition given the abundance of magnetite in the alteration assemblage (albeit extremely fine-grained).

Comparison With Tyndall Group (Lynchford Member)

As described by White and McPhie (1996, 1997), the Lynchford Member, the lower member of the Comstock Formation, the older of two units constituting the Tyndall Group in W Tasmania. The Lynchford Member comprises four main facies:

- (i) quartz-poor crystal \pm lithic volcanoclastic sandstone;
- (ii) carbonate;
- (iii) laminated mudstone/sandstone; and

(iv) volcanoclastic lithic breccia.

The overlying Mt Julia Member is relatively quartz-rich (rhyolitic to dacitic) and comprises four main facies:

- (i) crystal-rich volcanoclastic sandstone;
- (ii) normally graded volcanoclastic breccia-sandstone units
- (iii) welded ignimbrite; and
- (iv) coherent rhyolite.

The three rocks sampled in FTD038 probably best match units (ii) and (iii) of the Mt Julia Member, in which vitroclastic material is a significant component, and the only occurrence of ignimbrites in the Mt Read Volcanics is recorded (White and McPhie, 1996). Further information on the associated rocks in this drillhole are required to refine this correlation.

References

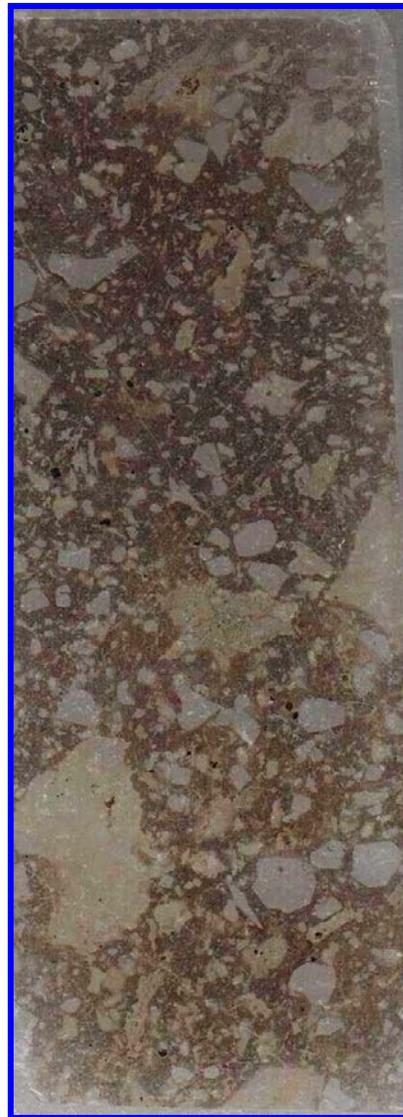
- White M.W. and McPhie, J., 1996. Stratigraphy and palaeovolcanology of the Cambrian Tyndall group, Mt Read Volcanics, western Tasmania. *Australian Journal of Earth Sciences* 43:2, 147-159.
- White M.W. and McPhie, J., 1997. A submarine welded ignimbrite-crystal-rich sandstone facies association in the Cambrian Tyndall Group, western Tasmania, Australia. *Journal of Volcanology and Geothermal Research* 76, 277-295.

SAMPLE NUMBER

FTD038 320.11m

PETROGRAPHIC DESCRIPTION

This is a weakly welded rhyolitic ignimbrite, lacking fiamme but with common cm-sized fragments of rhyolitic glassy lava, and abundant quartz and plagioclase crystal debris, in a matrix dominated by vitric shards, some of which are clearly deformed around adjacent phenocrysts, implying that they were plastic during compaction. Alteration is sericite-carbonate-magnetite, with abundant very fine-grained magnetite restricted to the matrix.



SAMPLE NUMBER

FTD038 320.11m

THIN SECTION DESCRIPTION

This is a hydrothermally altered, medium-grained rhyolitic ignimbrite which contains common, formerly glassy rhyolite lava clasts to 1cm across (10-15modal%), and abundant quartz (8-10modal%) and plagioclase crystals and crystal fragments in a matrix rich in vitric shards. The shards show quite good textural preservation and low-degree welding compaction is preserved in places. Most of the rock consists of a fine-grained quartz-feldspathic intergrowth heavily peppered with tiny alteration-related magnetite grains and turbid, very fine-grained carbonate, in which excellent shard bubble wall shapes are preserved. In a few places, these shard shapes are clearly deformed around quartz or plagioclase phenocrysts, suggesting they were plastic at compaction, and that the rock is at least partly welded. Quartz phenocrysts and crystal fragments to 2mm across vary from almost euhedral, through magmatically rounded and resorbed, to very angular crystal fragments. Plagioclase phenocryst debris is generally finer-grained, and most crystals are intensely sericite+carbonate-altered, with vague preservation of multiple twinning indicating derivation from plagioclase. Occasional small, rather resorbed and partly leucoxene-altered FeTi oxide phenocrysts are scattered through the rock.

The common, rather angular, pale lithic fragments (see scanned images on preceding page) are quartz+plagioclase-phyric rhyolitic lavas with occasional preservation of micropoikilitic (micro-snowflake) textures, and heavy, fine-grained, murky carbonate alteration.

Alteration and Veining

Apart from the moderate sericite-carbonate alteration noted above, the key alteration feature in this rock is the pervasive, very fine-grained magnetite through the vitroclastic matrix. Given the small modal amount of Fe-bearing phases in the primary assemblage (<<<1modal%) FeTi oxides, the Fe in this magnetite is likely to have been introduced during hydrothermal alteration.

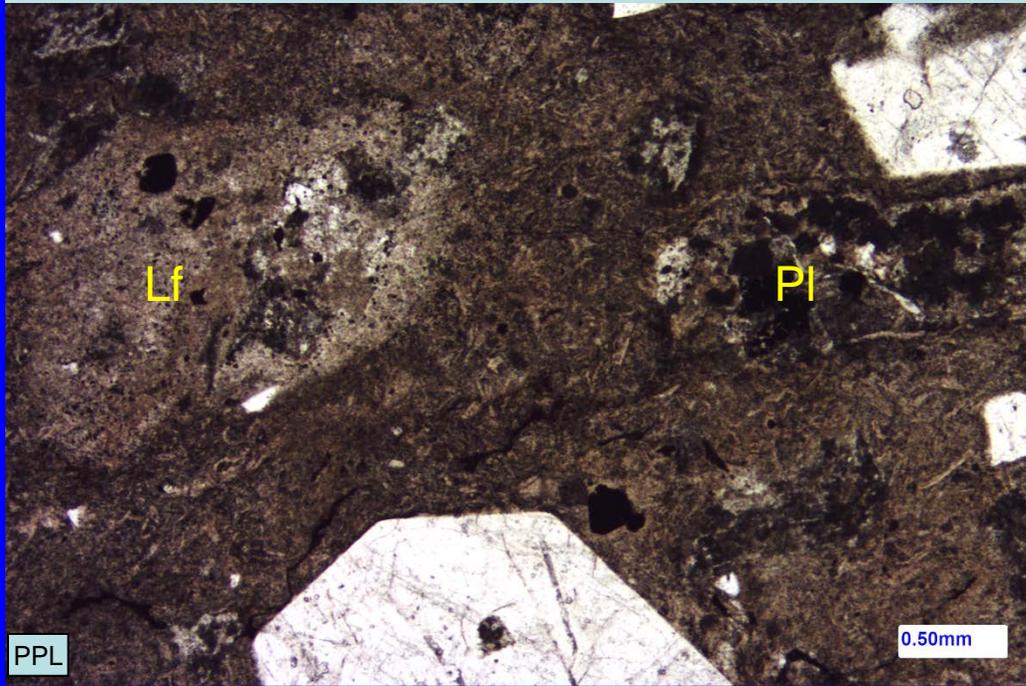
Other Comments

The lack of fiamme and absence of flattening in the rhyolite lithic fragments in this rock but the definite deformation of vitric shards around some phenocryst margins suggest that this is a weakly welded rhyolitic ignimbrite. Its correlations in W Tasmania are discussed in the Summary Report.

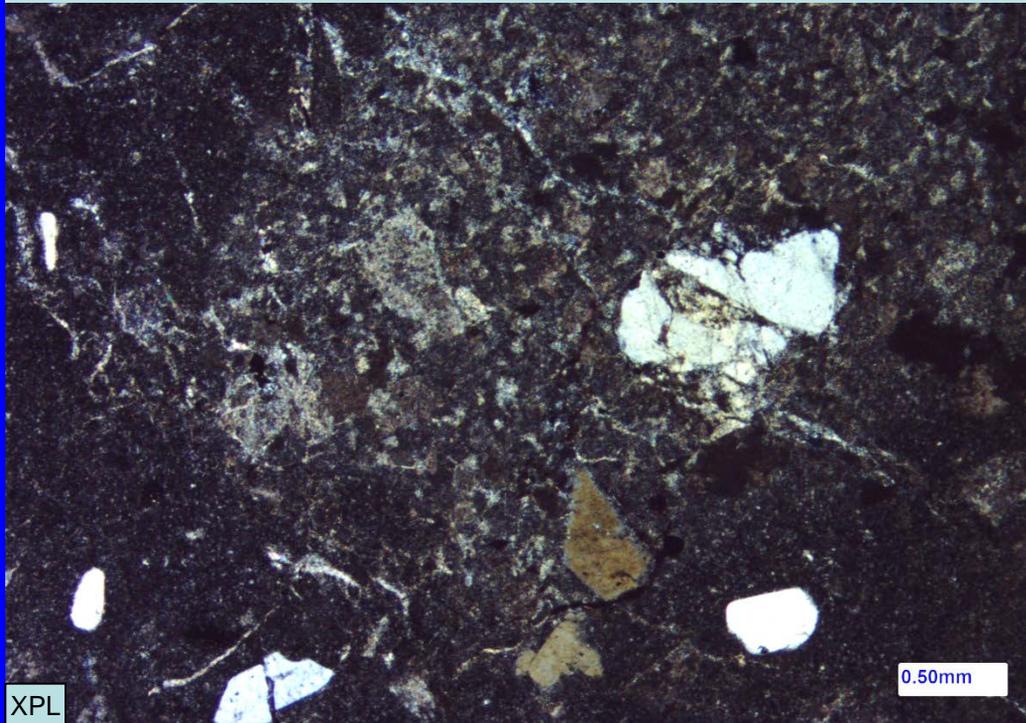
SAMPLE NUMBER

FTD038 320.11m

Quartz and altered plag (PI) phenocryst debris and small altered lithic fragment (Lf) in vitroclastic groundmass



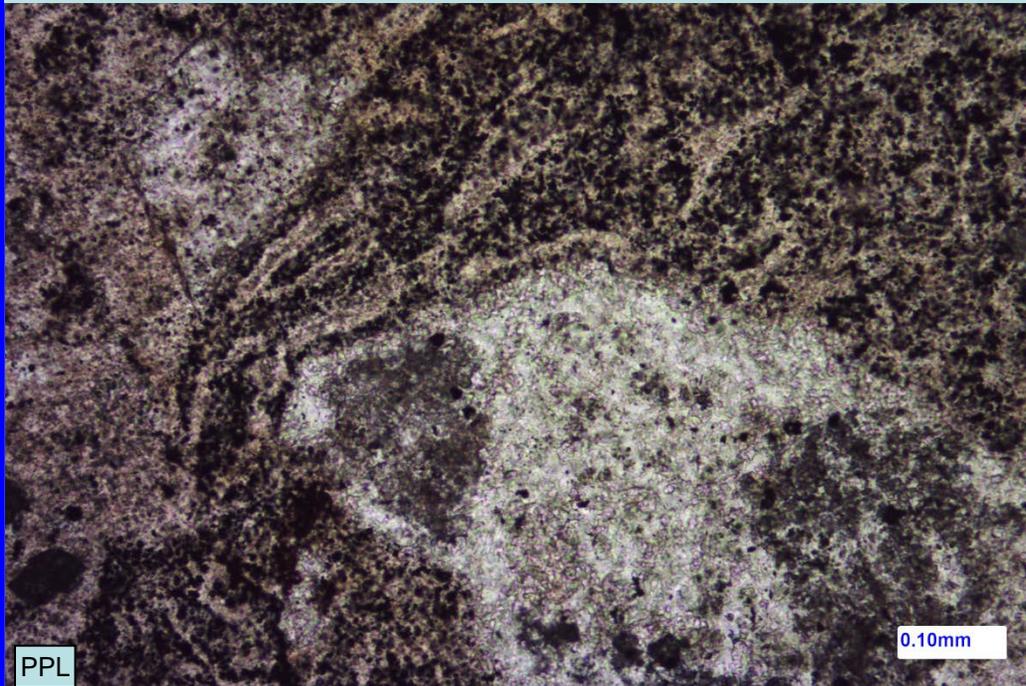
Quartz+plag-phyric rhyolitic lithic fragment with micropoikilitic texture



SAMPLE NUMBER

FTD038 320.11m

Edge of dark, pyritic domain, which was probably a rip-up clast of shale that has been selectively replaced by pyrite.



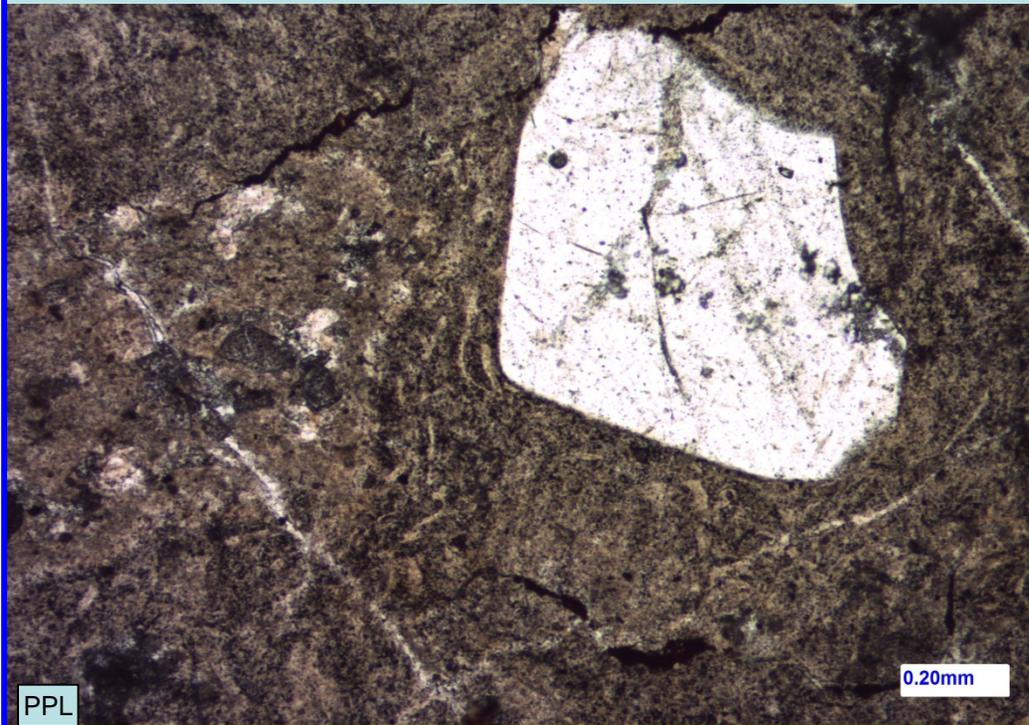
Bubble wall shard textures well preserved in vitroclastic matrix



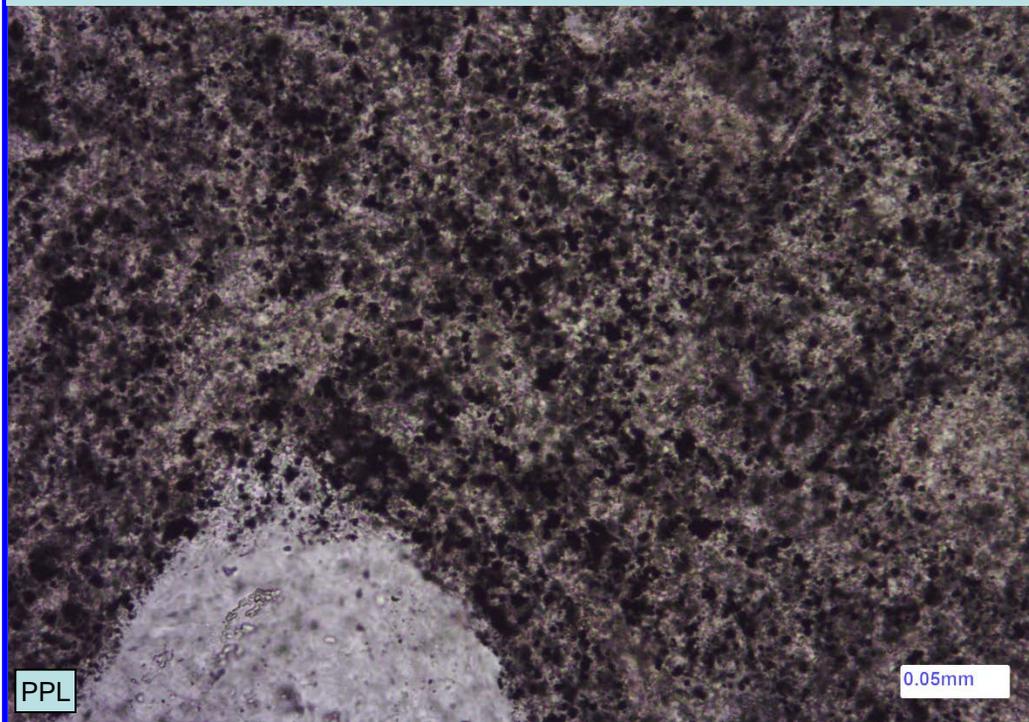
SAMPLE NUMBER

FTD038 320.11m

Now altered vitric shards bent around edge of quartz phenocryst



Fine-grained magnetite through altered matrix



SAMPLE NUMBER

FTD038 426.25m

PETROGRAPHIC DESCRIPTION

This is another weakly welded rhyolitic ignimbrite with no fiamme but common cm-sized fragments of rhyolitic glassy lava, and abundant quartz and plagioclase crystal debris, in a matrix dominated by vitric shards. Alteration is sericite-carbonate-magnetite, with abundant very fine-grained magnetite in both the matrix and in the lithic fragments. This rock is identical petrographically to the preceding sample from 320.11m depth in this drillhole.



SAMPLE NUMBER

FTD038 426.25m

THIN SECTION DESCRIPTION

Despite coming from just over 100m deeper in this drillhole than the preceding sample, this rock is essentially identical to the rock from 320.11m, right down to the pervasive fine-grained magnetite in the matrix. It contains a significant proportion of juvenile pyroclasts, including:

(1) abundant phenocrysts and crystal fragments of quartz and plagioclase, less common FeTi oxides, and

(2) common angular lithic fragments of quartz+plagioclase-phyric, formerly glassy rhyolite with micropoikilitic textures and strong carbonate alteration, and a matrix dominated by texturally quite well preserved glass shards, identical to those in FTD038 320.11m.

Modal proportions and the size range of quartz and plagioclase are broadly similar to those in the rock from 320.11m, with quartz including entire and broken phenocrysts as well as more resorbed grains. The plagioclase phenocrysts (mainly smaller than 1mm long) show the same turbid, fine-grained sericite-carbonate alteration, and small, scattered FeTi oxide phenocrysts are leucoxene-altered.

Matrix areas of this rock preserve good bubble-wall shard shapes over much of the rock. The vitroclastic matrix is now altered to extremely fine-grained and moderately sericite-carbonate-magnetite-altered quartzo-feldspathic intergrowths in which the fine magnetite occurs as a pervasive speckling

Alteration and Veining

As for the preceding sample, alteration is a pervasive, fine-grained sericite-carbonate-magnetite assemblage, with occasional hairline carbonate and quartz veinlets filling brittle fractures.

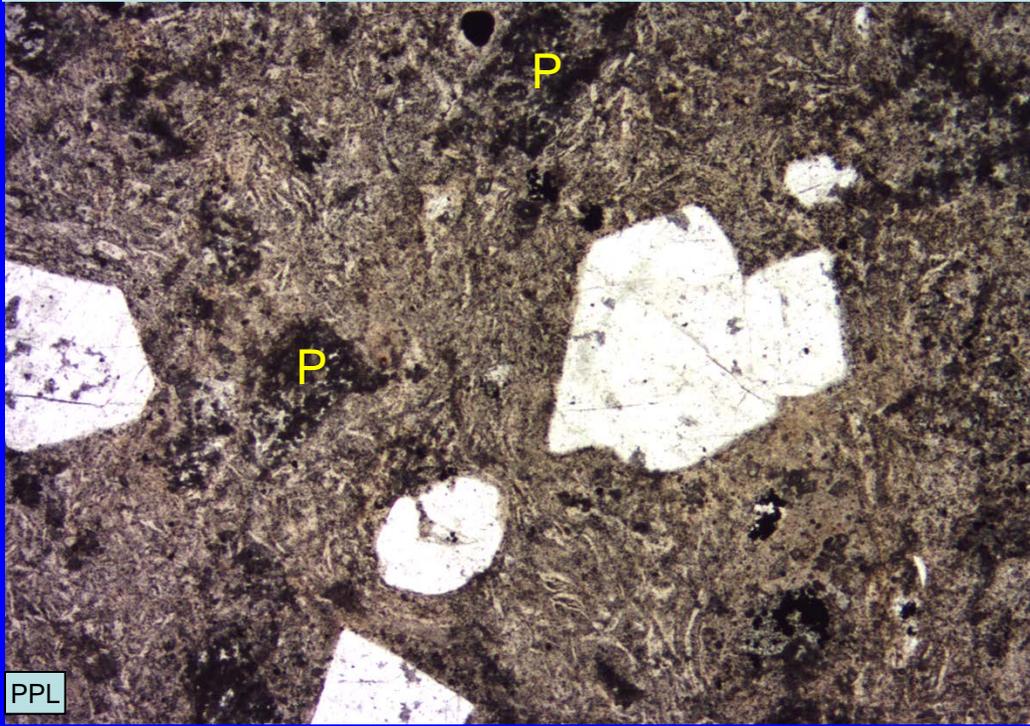
Other Comments

The significance of this sample, and its striking similarity to that from 320.11m in this hole, is discussed in the Summary Report.

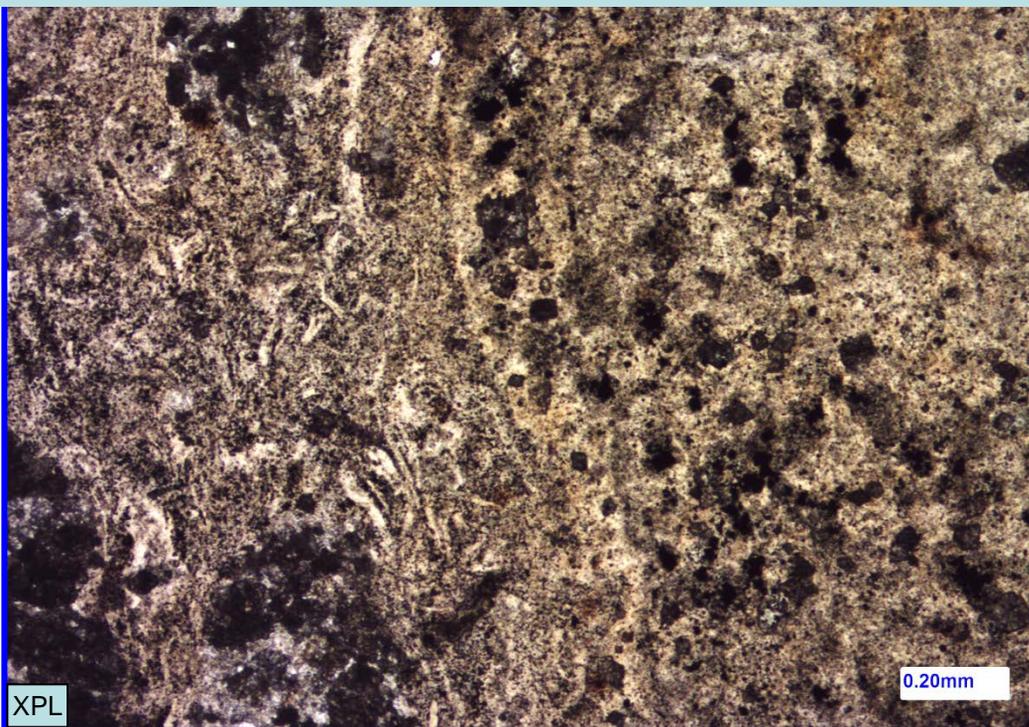
SAMPLE NUMBER

FTD038 426.25m

Quartz and altered plagioclase (P) phenocrysts in vitroclastic matrix



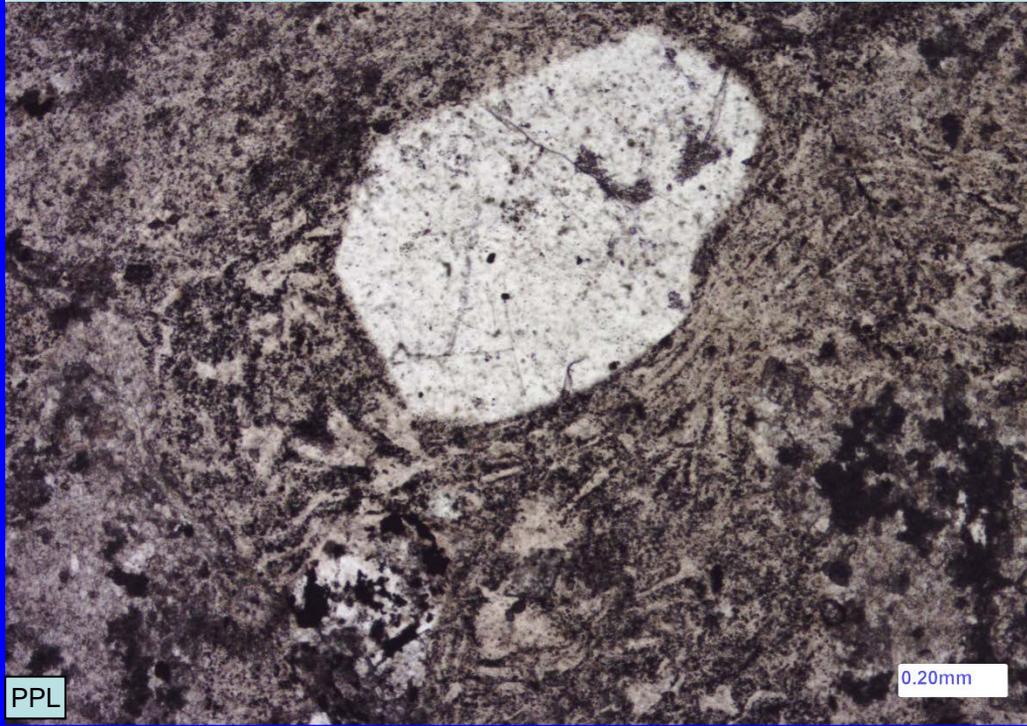
Contact between rhyolitic lithic clast (right) and vitroclastic matrix



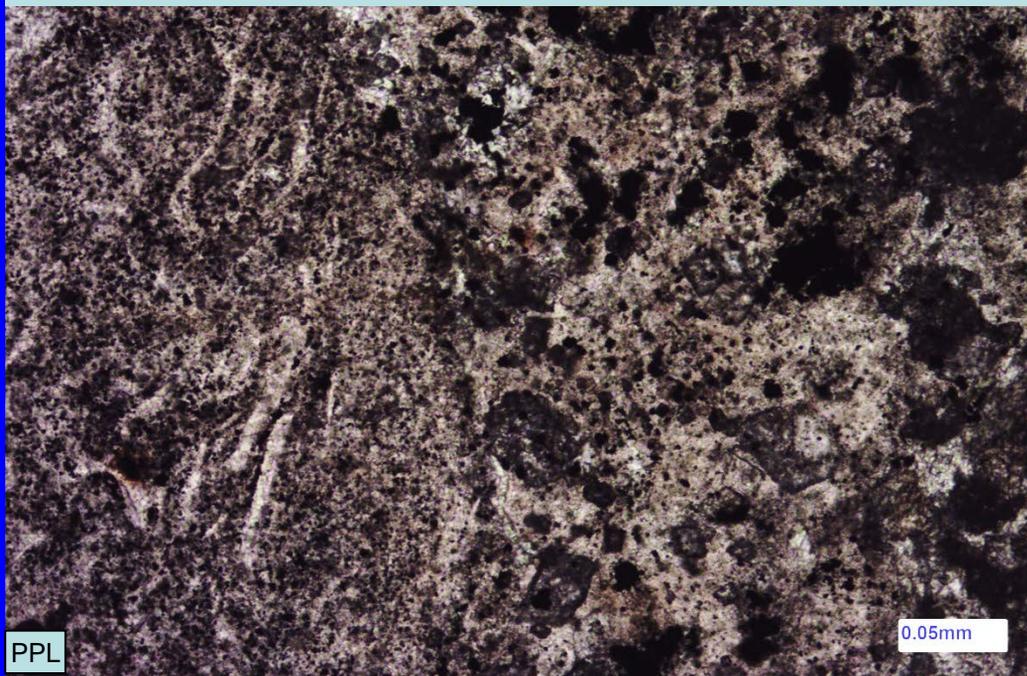
SAMPLE NUMBER

FTD038 426.25m

Flattened shards against edge of quartz phenocryst...low degree welding?



Contact between shard-rich matrix (left) and formerly glassy rhyolitic fragment showing pervasive magnetite in both, but coarser in the lava

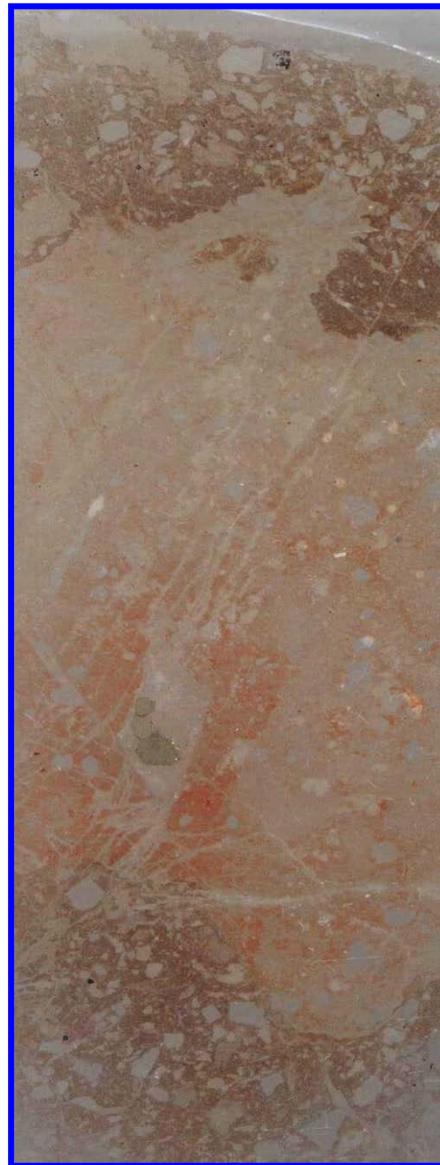
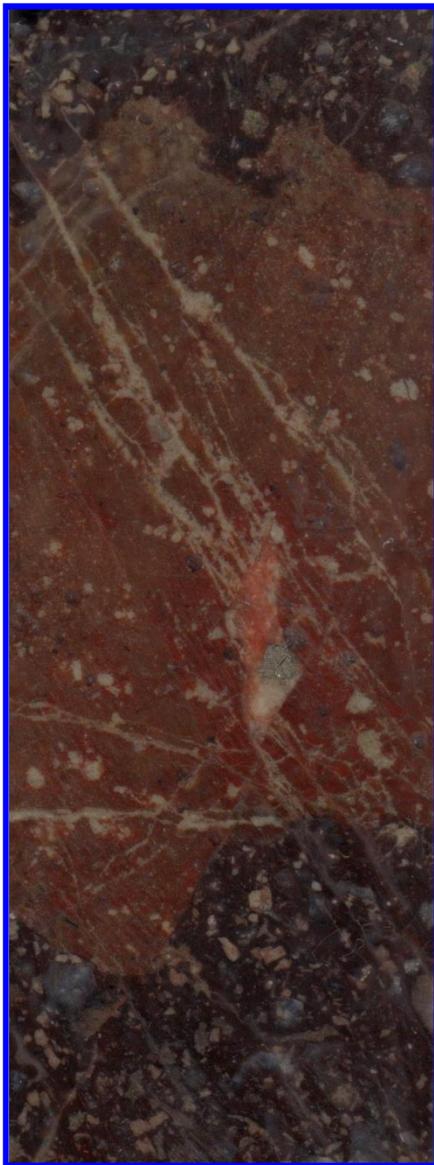


SAMPLE NUMBER

FTD038 479.40m

PETROGRAPHIC DESCRIPTION

This is a another fiamme-free, vitric ash-rich weakly welded ignimbrite very close to the preceding two samples but with much coarser rhyolitic lithic fragments, and abundant quartz and plagioclase crystal debris, in a matrix dominated by vitric shards. Alteration is sericite-carbonate-magnetite, with abundant very fine-grained magnetite in the matrix but far less abundant in the lithic fragments. This rock is again very close petrographically to the preceding sample from 320.11m depth in this drillhole.



SAMPLE NUMBER

FTD038 479.40m

THIN SECTION DESCRIPTION

This is a coarse-grained rhyolite breccia with a single 4-5cm-long lava fragment making up about two thirds of this thin section. The matrix hosting the large rhyolite lava fragment is very close petrographically to the preceding two samples, being a vitroclastic unit dominated by juvenile vitroclasts including lava fragments, common quartz and plagioclase phenocrysts and broken crystals, not uncommon leucoxene-altered former FeTi oxide phenocrysts, and abundant fine-grained vitric shards. All glass in the lava fragments and in the matrix vitric ash is now altered to very fine-grained quartzo-feldspathic intergrowths peppered with extremely fine-grained sericite and minor carbonate. Smaller lithic fragments are identical to the large fragment that dominates this slide, and to those in the preceding samples, being formerly glassy, quartz+plagioclase-phyric rhyolitic lavas in which the glass has devitrified, in places to micropoikilitic textured quartzo-feldspathic intergrowths.

In both the lava fragments and the host rock, the quartz phenocrysts vary from 0.5-3mm across, perfectly euhedral to slightly magmatically resorbed and rounded, and make up about the same amount of each (~10-15modal%), and the slightly elongate former plagioclase phenocrysts are slightly less common, elongate prisms with intense sericite-carbonate alteration. Bubble wall shard-shapes are commonly preserved, although less well preserved than in the preceding samples. It cannot be determined whether welding and plastic deformation of the vitric shards occurred.

An intriguing feature of this rock is that the margins of the large lithic fragment show complex, frilly promontories into the vitroclastic matrix that could not possibly have survived any transport and erosion, suggesting that these are juvenile, and probably related to the same eruptive event as that which formed the host vitric ash.

Alteration and Veining

As noted above, fine-grained sericite-carbonate is the main alteration, with some of the carbonate occurring as quite dark rhombs and patches, and bifurcating veins and veinlets that extend across both lithic fragments and matrix. These transect an earlier vein assemblage dominated by medium-grained Kspar and minor quartz with intergrown 1-2mm-sized pyrite grains and some coarse, late carbonate. Fine-grained magnetite is common through the matrix, but the clasts contain submicroscopic hematite, rendering them quite pinkish-red.

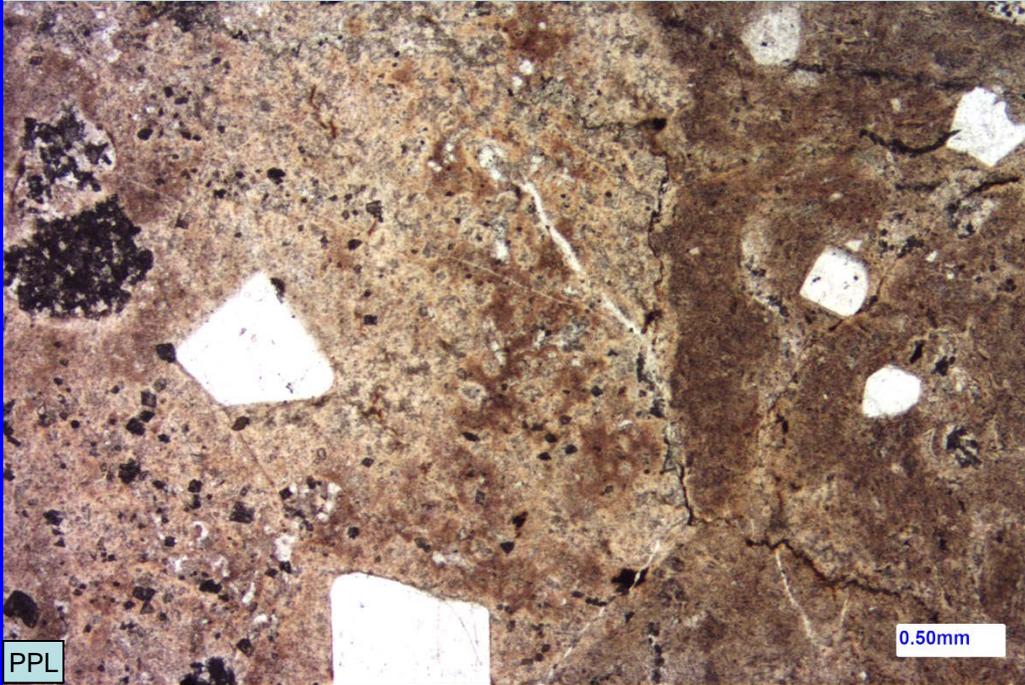
Other Comments

The significance of this rock is discussed in the Summary Report.

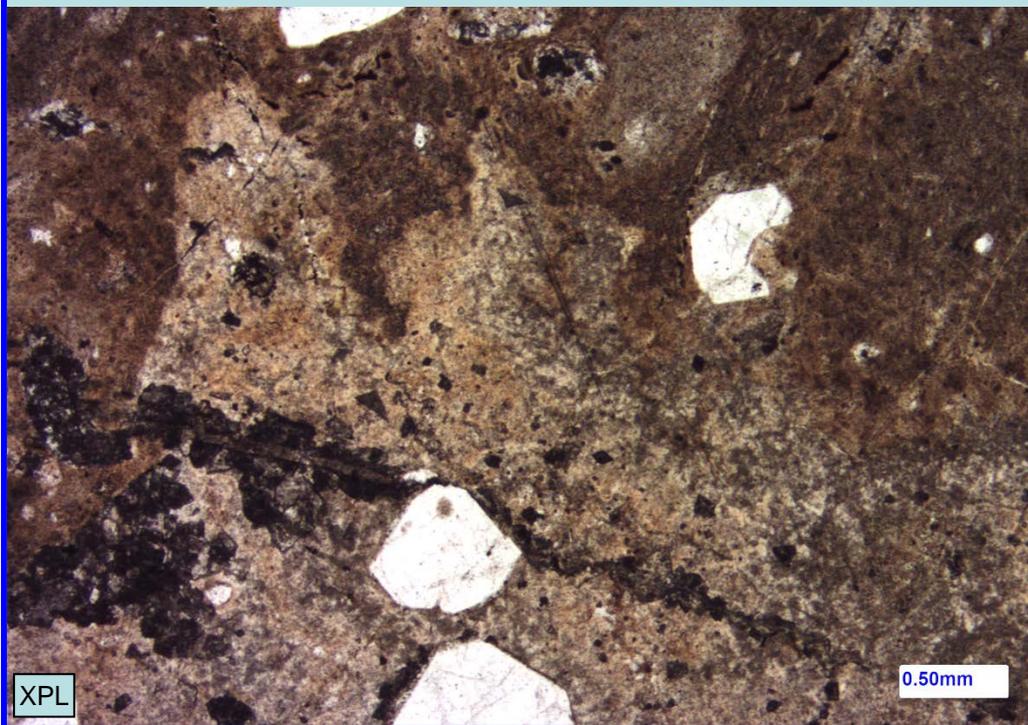
SAMPLE NUMBER

FTD038 479.40m

Contact between formerly glassy rhyolitic lava fragment (right) and vitric ash host



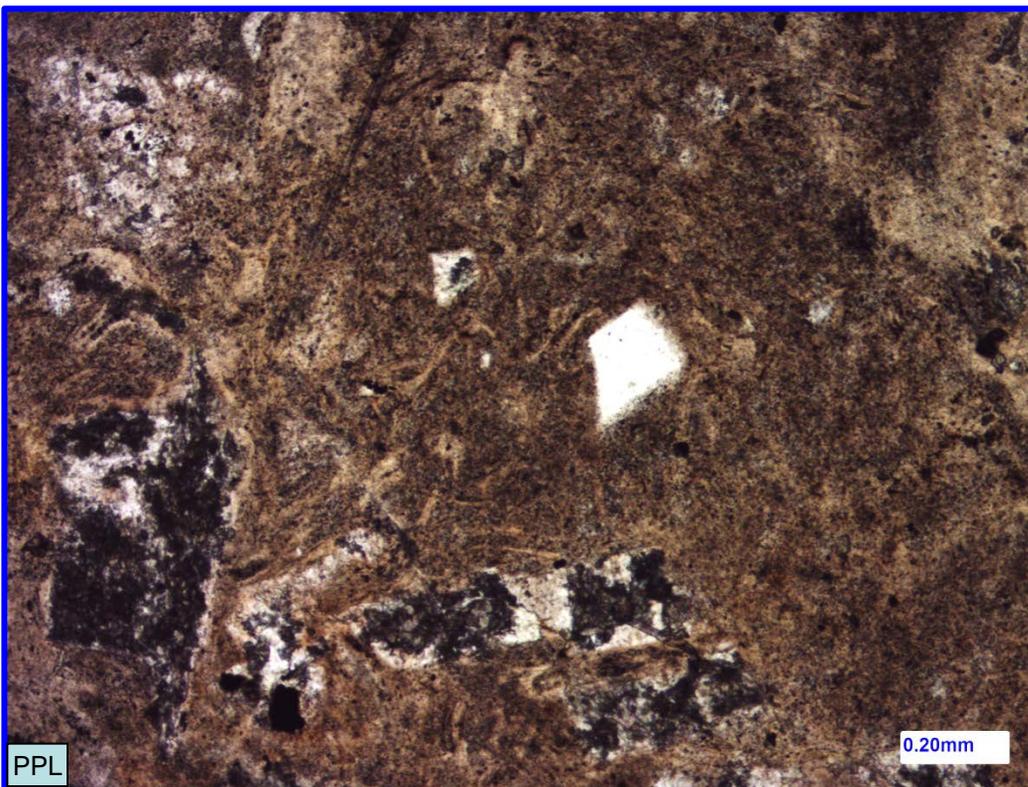
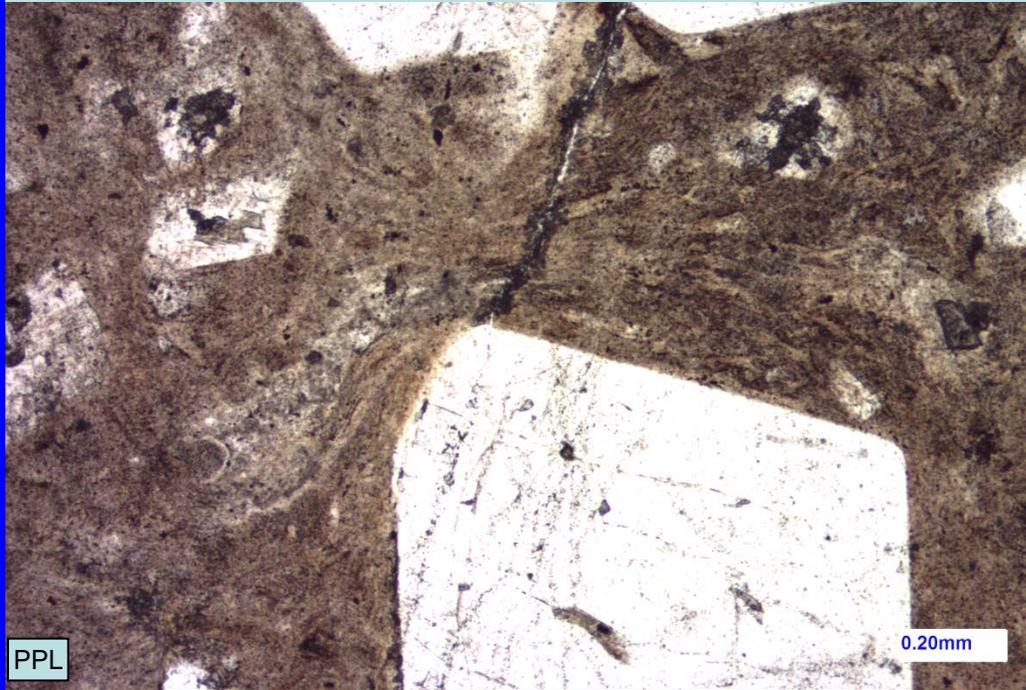
Complex, delicate promontories of rhyolite lava extending into vitric ash host



SAMPLE NUMBER

FTD038 479.40m

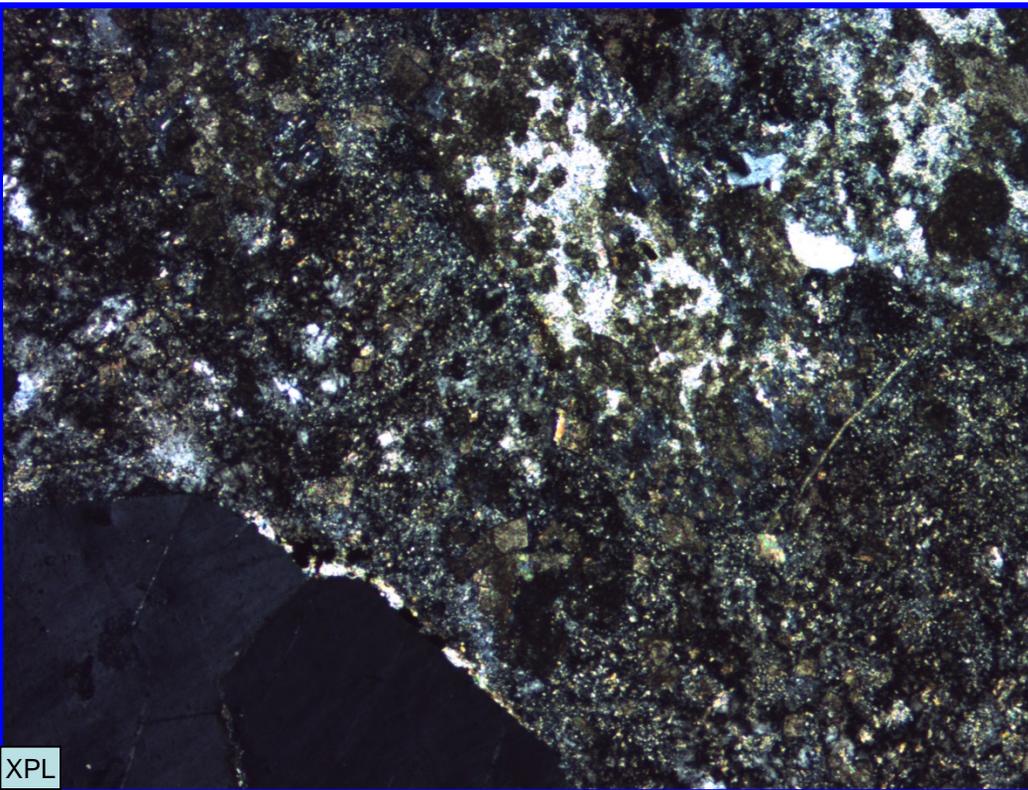
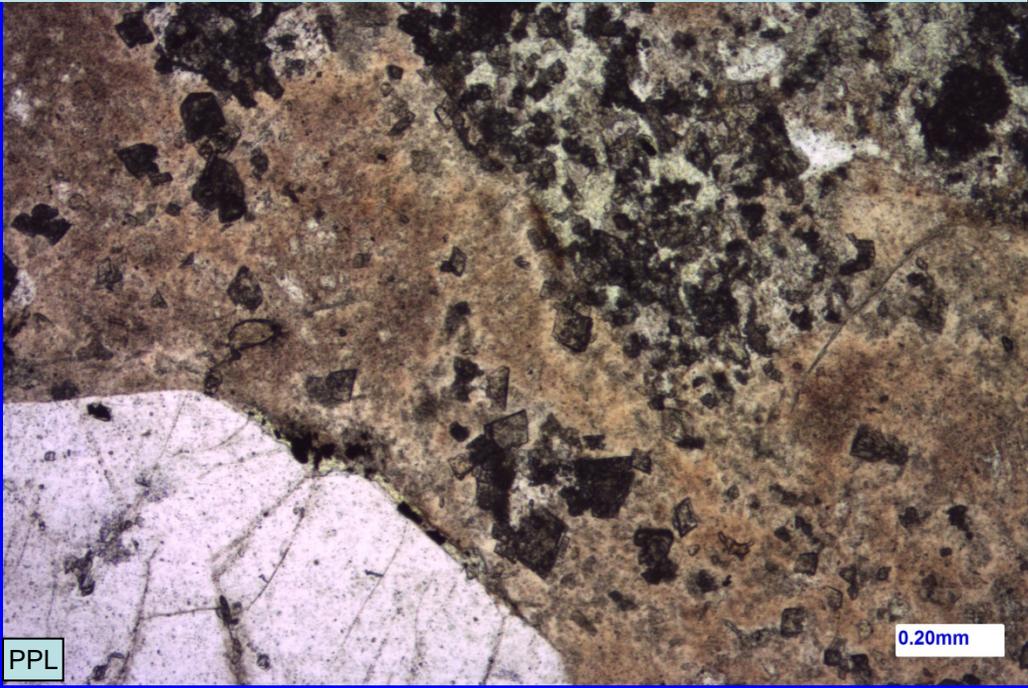
Vitric ash shards in matrix host with quartz (top image) and carbonate-altered plagioclase (lower) phenocryst debris



SAMPLE NUMBER

FTD038 479.40m

Devitrified glassy groundmass with quartz and carbonate-sericite-altered plagioclase phenocrysts in rhyolitic lithic fragment



PETROGRAPHIC REPORT
8 Rocks from Unity's
W Tasmania Prospects,
(HC1227.5550)



for

Unity Mining Ltd
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10/7/2013

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Petrographic Summary Report

This report includes petrographic descriptions of 8 rocks from tenements held by Unity Mining Ltd. In western Tasmania, with six being from drillhole FTD038 and two from FTD040 in the Firetower Prospect, near Gog Range. Four of the eight samples were prepared as standard, unpolished thin sections, and four were prepared as a polished thin sections to allow diagnosis of the sulfide and oxide minerals. Thin sections and offcuts of all samples were scanned, to provide some visual context beyond the 2-4 photomicrographs provided for each thin section. No background geological information or maps were provided for this exercise, so the thin section descriptions are essentially 'stand alone'.

Petrographic Summary

FTD038

Protoliths

Three samples had been examined previously from the lower section of this hole, with all three being felsic volcanoclastic rocks drilled from 320.11m, 426.25m and 479.40m depths. The two shallower samples were petrographically identical, weakly welded but fiamme-free rhyolitic ignimbrites dominated by vitric ash, with well preserved bubble-wall shard shapes and abundant quartz and plagioclase crystal debris. The deeper sample, from 479.4m depth, was also very close petrographically to the preceding two samples, but included a much larger 3-4cm rhyolitic lava fragment, which, nevertheless, is identical to the smaller fragments in the two shallower samples, and set in an identical vitroclastic matrix carrying similar proportions of quartz and altered plagioclase phenocryst debris.

The six samples examined in this set from FTD038 include a felsic volcanoclastic sandstone from 169.04m depth, dominated by quartz phenocryst debris and altered vitric ash. The abundant quartz suggests that this is a unit from the Tyndall Group or its correlates..

The five other samples are assigned to two discrete units, both mafic to intermediate in composition. The two samples from 195.41m and 201.0m depth are intensely hydrothermally altered probably shallow intrusive doleritic rocks with near-total textural destruction, and only occasional clusters of intergrown former plagioclase crystals defining a holocrystalline intrusive texture preserved to inform about the protolith. The three subsequent samples, from 250.0m, 253.85m and 263.93m depths are petrographically very similar and judged to be from the same plagioclase+hornblende+FeTi oxide+apatite-phyric flow unit, which was probably of broadly andesitic to basaltic andesite composition. The hornblende phenocrysts (chloritized) and ubiquitous and common apatite microphenocrysts are strongly reminiscent of the high-K calc-alkaline to shoshonitic (Suite 2) Anthony Rd-type andesites which occur stratigraphically between the top of the Central Volcanic Complex and the base of the Tyndall Group.

Petrographic Summary Report

A feature of two of the three plagioclase+hornblende andesites is the very variable groundmass textures, attributed in this case to cracking of the top of a flow, and intrusion of fresh lava into the cracks, leading to quenching and thus fine-grained groundmass textures in the latter. Although difficult to judge with certainty, it appears that the indicated top of sample #4 from 250.0m depth is 'way-up', although this may conflict with evidence that Tyndall-type lithologies are deeper in this same drillhole.

Alteration

Both the intrusive dolerite unit represented by the samples from 195.41m and 201.0m depth, and the andesite lava(s?) sampled at 250.0m, 253.85m and 263.93m depths, show a complex and strong hydrothermal overprint, with an earlier potassic alteration assemblage overprinted by a more typical phyllic assemblage. The potassic alteration is recorded in narrow Kspar veinlets, and by even distributed, fairly fine-grained magnetite, along with occasional patches of green biotite intergrown with chlorite. Kspar may have replaced groundmass feldspars, but the subsequent phyllic overprint rules against making a confident prognosis on this point.

The phyllic overprint in these mafic to intermediate rocks has produced widespread fine-grained quartz-sericite-chlorite-carbonate alteration, along with minor disseminated pyrite. Importantly, it has not destroyed the earlier disseminated magnetite, nor Kspar veinlets.

FTD040

Protoliths

Two samples from this drillhole, at 121.62m and 144.34m depth, are both matrix-supported volcanoclastic sandstones, originally with a high proportion of comminuted felsic vitric ash (textures obliterated by devitrification-crystallization-alteration), and common broken and strained quartz phenocryst detritus, particularly in the shallower sample.

Alteration

Both samples show pervasive quartz-sericite-carbonate alteration with little or no chlorite, but the deeper rock also carries common fine-grained green tourmaline, and scattered, tiny arsenopyrite crystals. A local tension gash with strained ribbon quartz, sericite and mainly sub-mm pyrite crystals occurs in the shallower sample.

SAMPLE NUMBER

FTD038 169.04m

SUMMARY

This is a poorly sorted, matrix-supported volcanoclastic coarse sandstone dominated by detrital quartz grains and lithic clasts of quartz+feldspar-phyric formerly glassy felsic lavas in a matrix that was probably composed largely of vitric ash. Alteration includes a weak early sericite wash that is overprinted by a more pervasive, moderately developed fine-grained carbonate alteration



SAMPLE NUMBER**FTD038 169.04m****THIN SECTION DESCRIPTION**

This is a massive, matrix-supported volcanoclastic sandstone dominant by two main detrital components, quartz phenocrysts and small lithic clasts. Most of the latter are smaller than about 5mm across, and they are subrounded to subangular lithic clasts of quartz-phyric and quartz+feldspar-phyric felsic lavas, most of which had originally glassy groundmasses now crystallized to extremely fine-grained quartzo-feldspathic intergrowths. Occasional clasts with well developed micropoikilitic-textured groundmasses, and several in which the devitrified glass has recrystallized to a rather coarse quartzose intergrowth, are also present, but no clasts with unambiguous pumice textures were sampled in this thin section. The plagioclase phenocrysts in these lithic clasts, and the occasional detrital feldspars phenocrysts, appear to have included both plagioclase and Kspar, with the latter showing patchy fine clay alteration, and the plagioclase being typically overprinted by murky microcrystalline epidote and carbonate alteration. About 20modal% of this rock consists of often broken and angular detrital quartz phenocrysts, with occasional well preserved euhedral crystals, all rarely coarser than 2mm across, and generally smaller than 1mm across. The sample also contains occasional chunky detrital zircon grains.

The matrix of this sandstone is a very fine-grained quartzo-feldspathic intergrowth that has presumably developed from an original vitric ash-rich silt matrix in which all the vitric ash component has devitrified then recrystallized to a fairly uniform quartzo-feldspathic intergrowth.

VEINING and ALTERATION

A very patchy fine-grained and rather turbid carbonate alteration overprints parts of the groundmass, apparently overprinting an earlier sericite-dominated alteration that is also very irregular in its distribution, affecting both lithic clasts and matrix. Narrow veinlets are mainly composed of either Kspar, or quartz, and one quartz veinlets also carries amorphous black opaques material that may be either a Mn-oxide/hydroxide, or less likely perhaps, hematite.

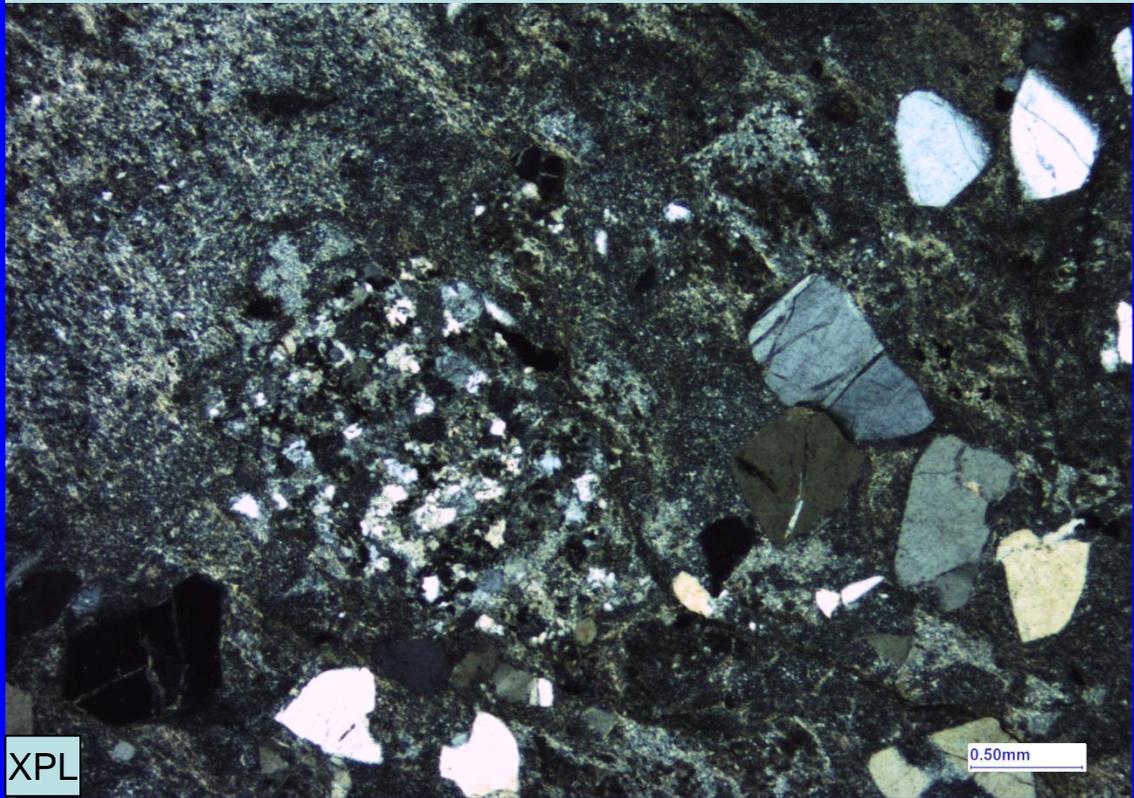
OTHER COMMENTS

There is no size grading obvious in this sample that would allow determination of stratigraphic 'way-up'. This sandstone is obviously derived from a proximal quartz+feldspar-phyric felsic volcanic provenance.

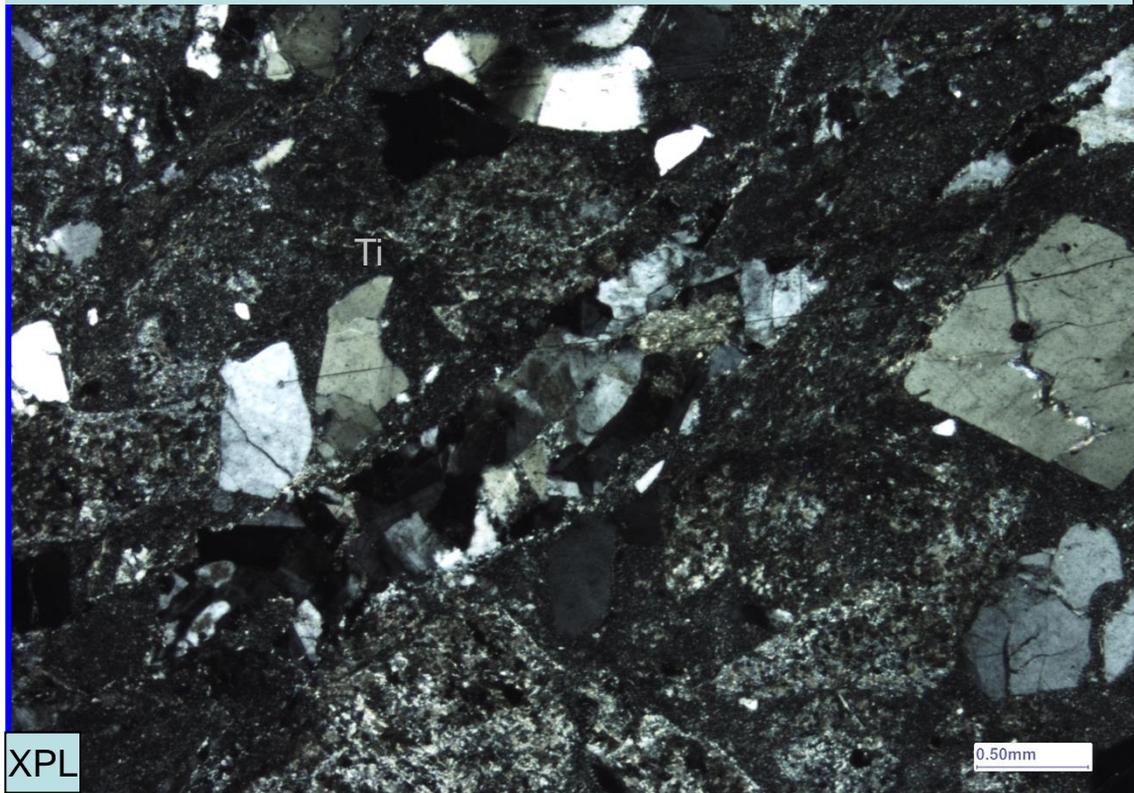
SAMPLE NUMBER

FTD038 169.04m

Angular detrital quartz phenocrysts debris and small lithic clast of formerly glassy rhyolite



Vein of well formed Kspar crystals; note both euhedral and broken quartz phenocrysts

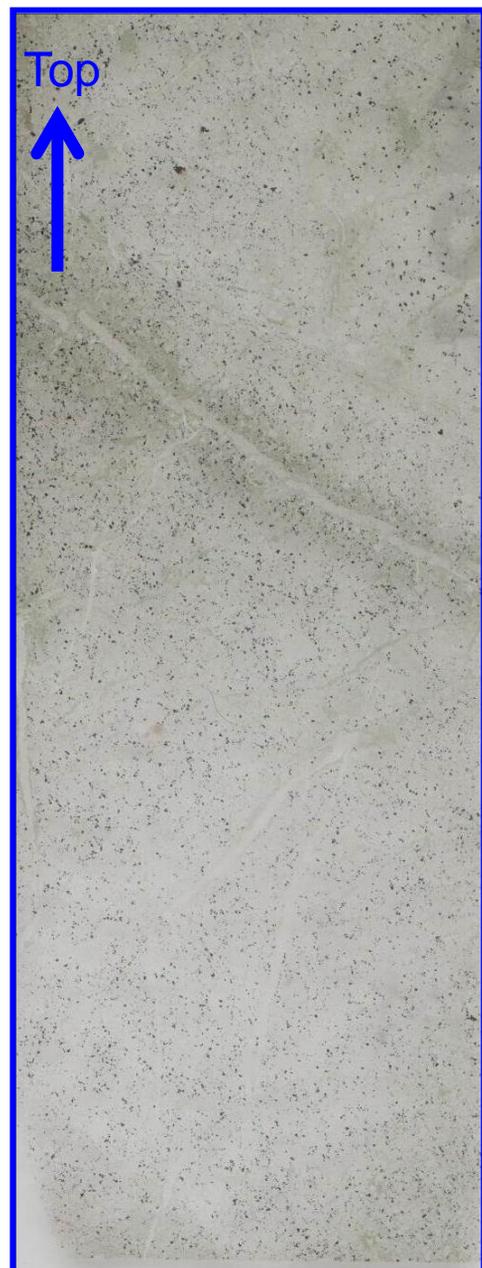


SAMPLE NUMBER

FTD038 195.46m

SUMMARY

This is an aphyric, former andesitic to mafic dyke or sill, with early pervasive magnetite and vein-dominated Kspar alteration overprinted by a phyllic (quartz-sericite-carbonate-minor pyrite) alteration event which did not affect the abundant hydrothermal magnetite.



SAMPLE NUMBER**FTD038 195.46m****THIN SECTION DESCRIPTION**

This sample is rather difficult to diagnose with confidence, as it has been strongly hydrothermally altered, probably in at least two events. The absence of detrital grains, coupled with the uniformity of the texture, suggest that this was either a lava or intrusive rock. The vague textural details preserved (and comparison with petrographically similar but better preserved #3 from 201.0m depth, further suggests that this was likely to have been an aphyric intrusive andesitic or mafic rock. Vague traces of totally sericitized former plagioclase crystals are present, mostly as blocky 0.5-1mm long grains, but the former mafic silicates in this rock are obliterated by the intense alteration. Widely dispersed quartz grains around 0.5mm long are anhedral, and unlikely to be primary. Spotty fine-grained chlorite and widespread magnetite are subordinate phases distributed fairly evenly through this rock, mainly intergrown with the sericite.

VEINING and ALTERATION

Veining is common in this rock, with a single well developed, sub-mm-wide Kspar-chlorite-brownish carbonate veinlet with a distinct selvage, being transected by narrow, discontinuous quartz veinlets with carbonate-rich margins. The Kspar veinlet shows a 3-5mm-wide selvage on either side dominated by chlorite, and lacking feldspar, this did not develop sericite during the subsequent phyllic alteration, and is obvious on the scanned image of the thin section.

In reflected light, the pervasive magnetite grains are seen to be mainly 0.1-0.2mm across, and make up about 5modal% of the rock. They show tatty grain shapes unlike typically equant, octahedral grains of primary magmatic Ti-magnetite, with occasional crystal faces, and no exsolution, and they often occur in clots or trails of 4 or 5 crystals, unlike magmatic FeTi oxides. The magnetite grains are perfectly fresh and show no alteration to hematite. This sample also contains sparse, disseminated, small pyrite grains with no associated base metal sulfides.

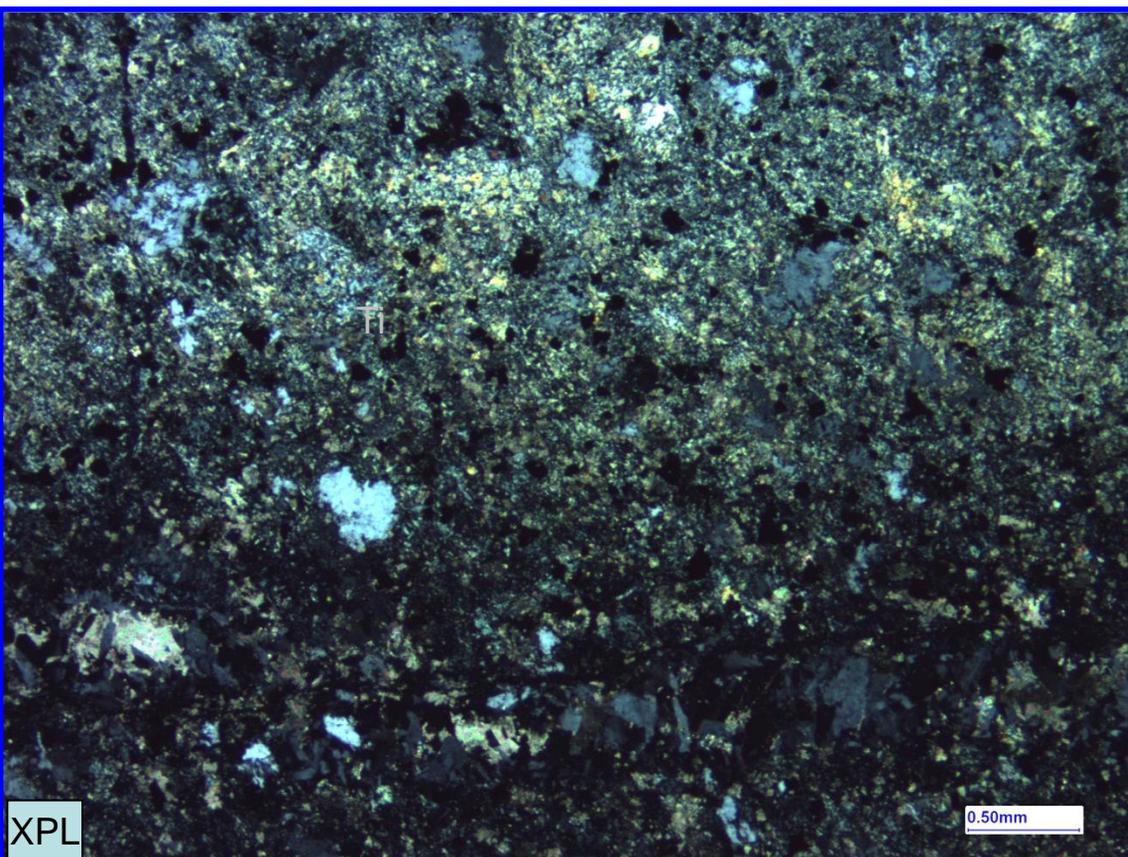
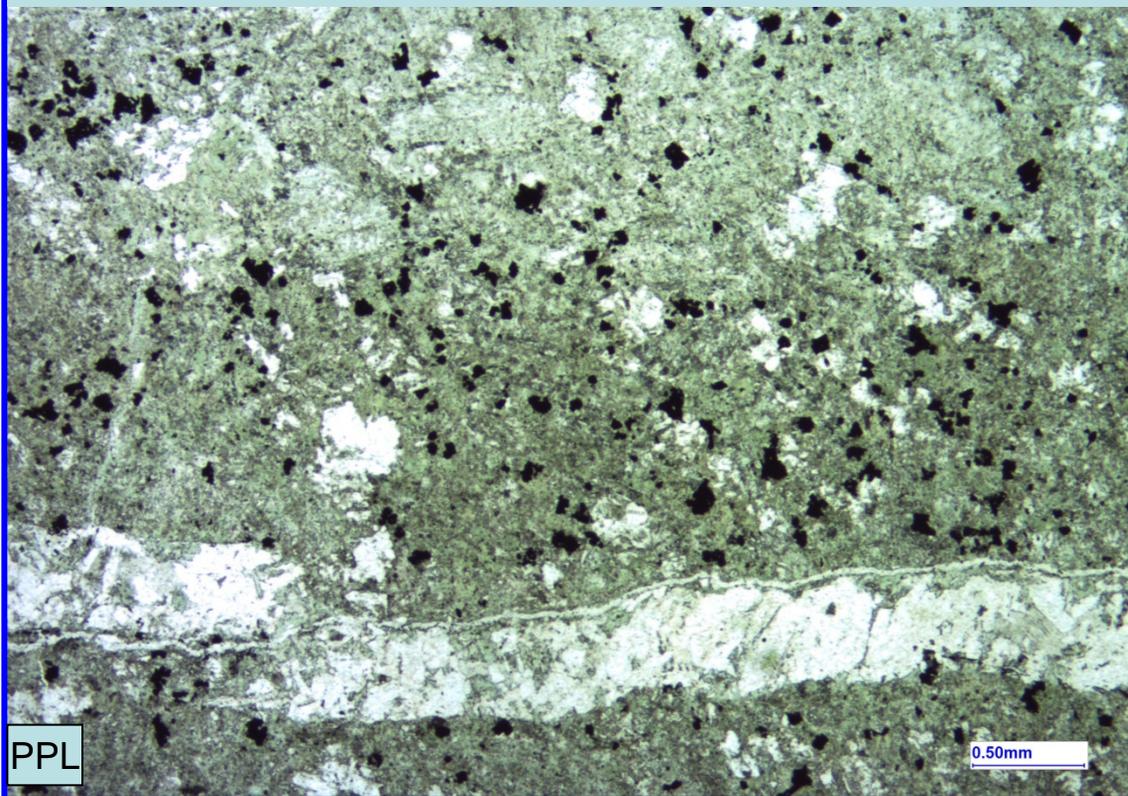
OTHER COMMENTS

This rock was probably an aphyric andesitic to basaltic shallow intrusive unit. It appears to have undergone a magnetite-Kspar alteration and veining episode prior to a pervasive phyllic alteration (quartz-sericite-carbonate-minor pyrite which did not affect the magnetite. Major and trace element geochemistry should be useful in tracking the ancestry of this rock, which I am fairly sure was not a felsic lava or intrusive unit.

SAMPLE NUMBER

FTD038 195.46m

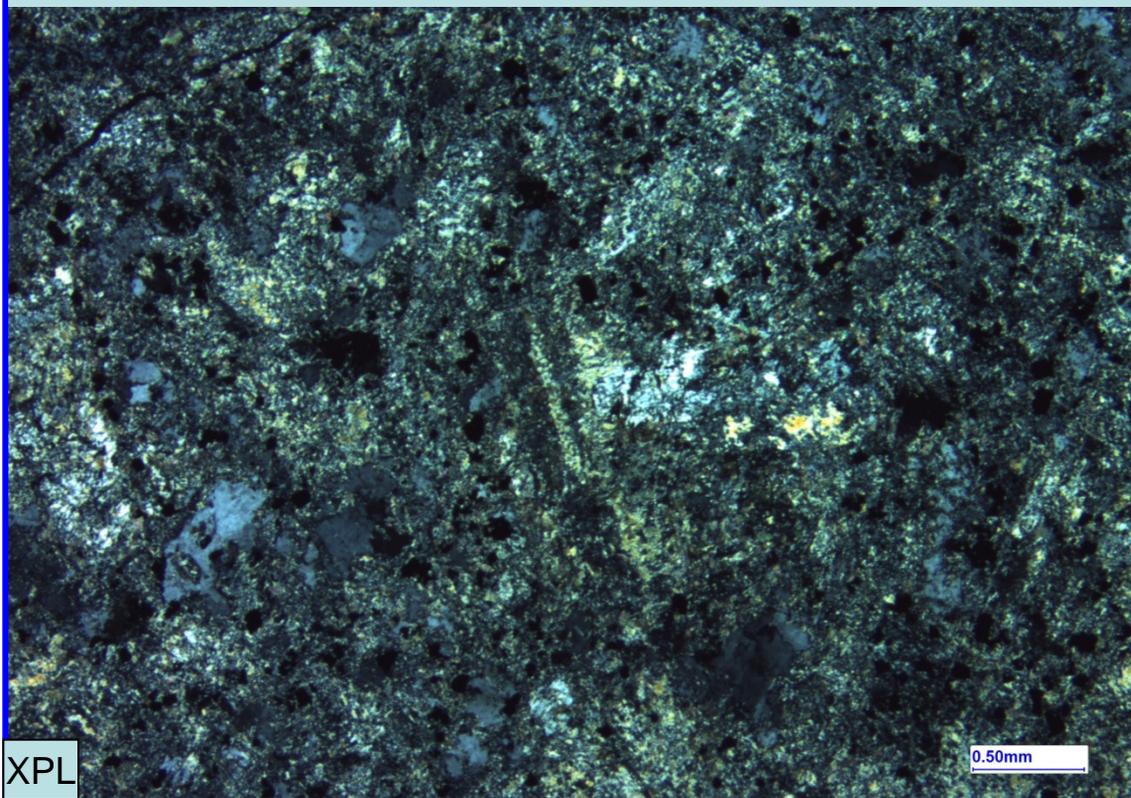
Kspar vein with chloritic selvage; note the evenly distributed fine-grained magnetite



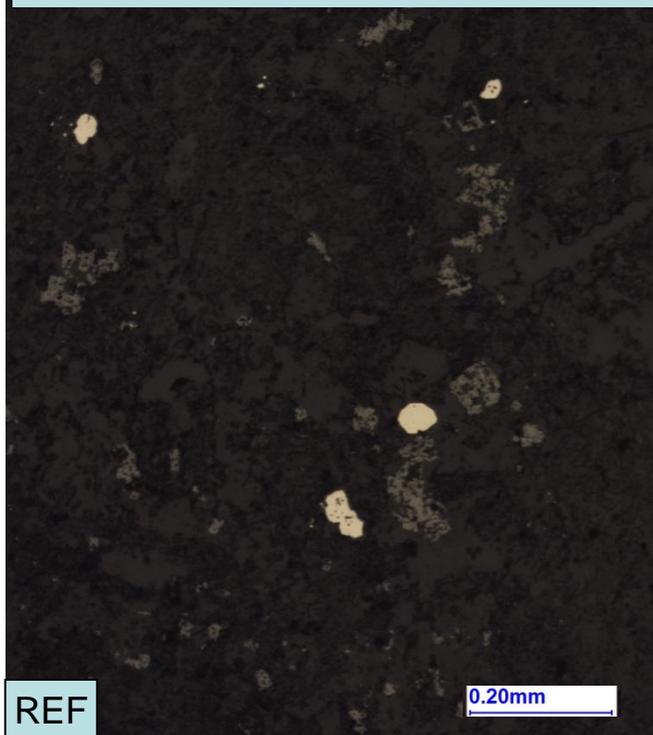
SAMPLE NUMBER

FTD038 195.46m

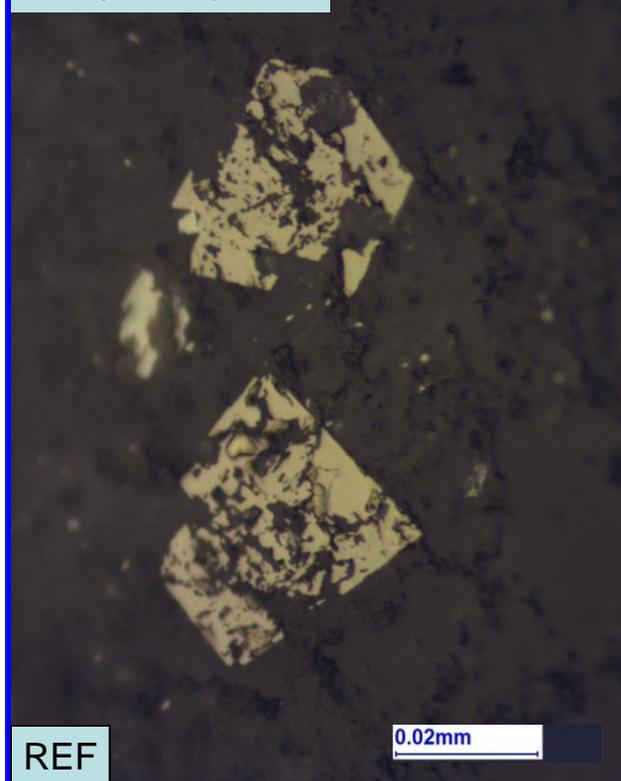
Typical texturally destructive sericite-quartz and minor carbonate phyllic overprint



Typical distribution of pyrite (white) and Ti-magnetite (paler grey)



Ti-magnetite crystals



SAMPLE NUMBER

FTD038 201.00m

SUMMARY

This rock is almost certainly from the same unit as the preceding sample from 195.41m depth in this hole, being a strongly hydrothermally altered doleritic intrusive rock. The alteration assemblage in this rock is an early magnetite-Kspar(?) alteration overprinted by a phyllic assemblage (quartz-chlorite-carbonate-minor pyrite).



SAMPLE NUMBER**FTD038 201.00m****THIN SECTION DESCRIPTION**

Although this is another very difficult sample to diagnose due to intense hydrothermal alteration, in many key respects, it appears to be derived from an identical or very similar protolith to that of the preceding sample, and retain some evidence that the protolith was a doleritic intrusive rock. It shows the same even distribution of small, hydrothermal magnetite grains, often in small clusters in a very 'un-magmatic' disposition throughout the rock, and vague traces of blocky prismatic (former) plagioclase crystals are evident. In a few places, clear, holocrystalline doleritic textures are present, with former mafic silicate (augite) crystals replaced by almost colourless chlorite.

VEINING and ALTERATION

As in the preceding sample, narrow veinlets of quartz and carbonate are common through this rock, and less common veinlets composed almost entirely of intergrown Kspar crystals are also present, with more chlorite in the selvages than in the rest of the sample.

Compared with the preceding sample, although sericite is common, along with widespread chlorite, this sample shows less sericite and far more fine-grained carbonate alteration dominating the phyllic overprint

In reflected light, the evenly distributed, small magnetite grains are identical in shape (tatty subhedral prisms) and disposition to those in the preceding sample, but they show strong and patchy hematite replacing the magnetite. Occasional, mainly sub-mm crystals of pyrite are present, and most include relic magnetite grains., indicating the pyrite is part of the later, phyllic alteration assemblage. A few tiny patches of chalcopyrite are also present.

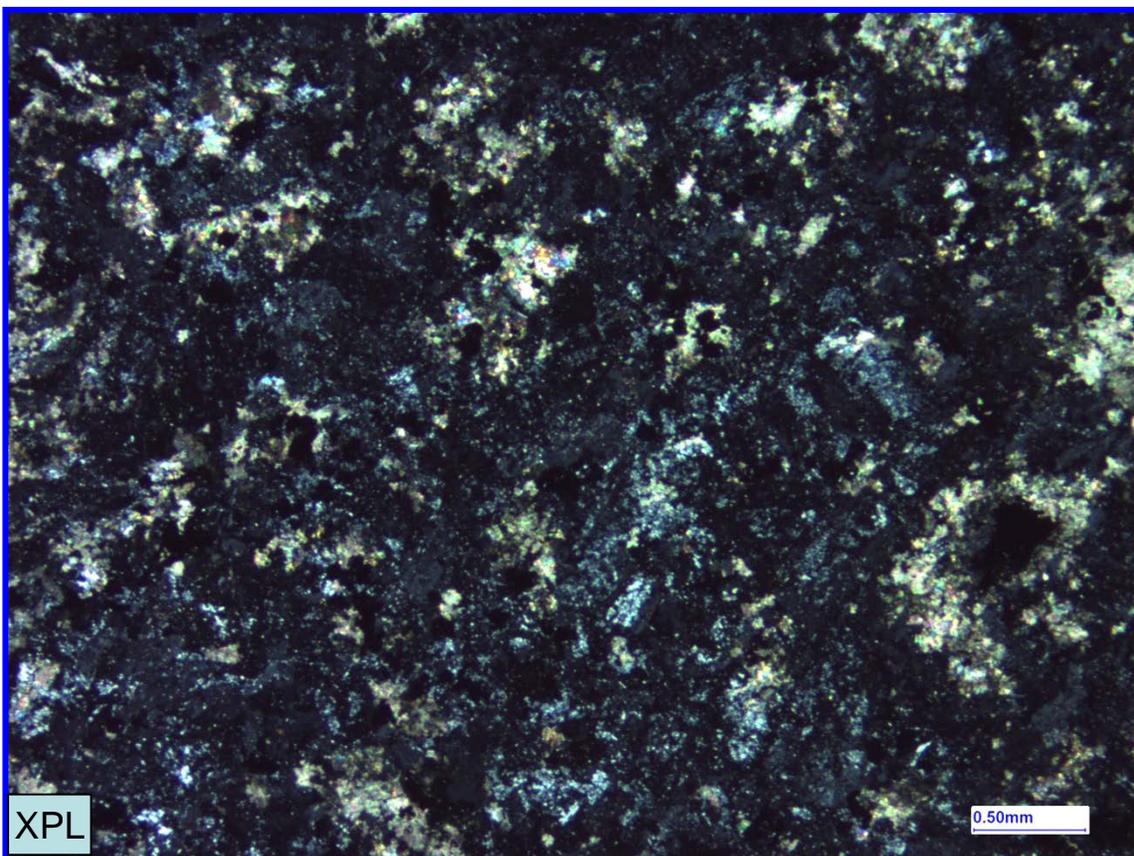
OTHER COMMENTS

I am confident that this sample is from the same lithological unit as the preceding sample, and that the protolith was a dolerite, possibly of evolved basaltic to basaltic andesite composition. It shows the same early potassic (Kspar-magnetite) hydrothermal alteration assemblage overprinted by a later phyllic event, with abundant late carbonate. The intense hydrothermal alteration of both samples is notable. Lithogeochemistry using immobile element abundances and ratios should easily confirm the comagmatic nature of these two samples.

SAMPLE NUMBER

FTD038 201.00m

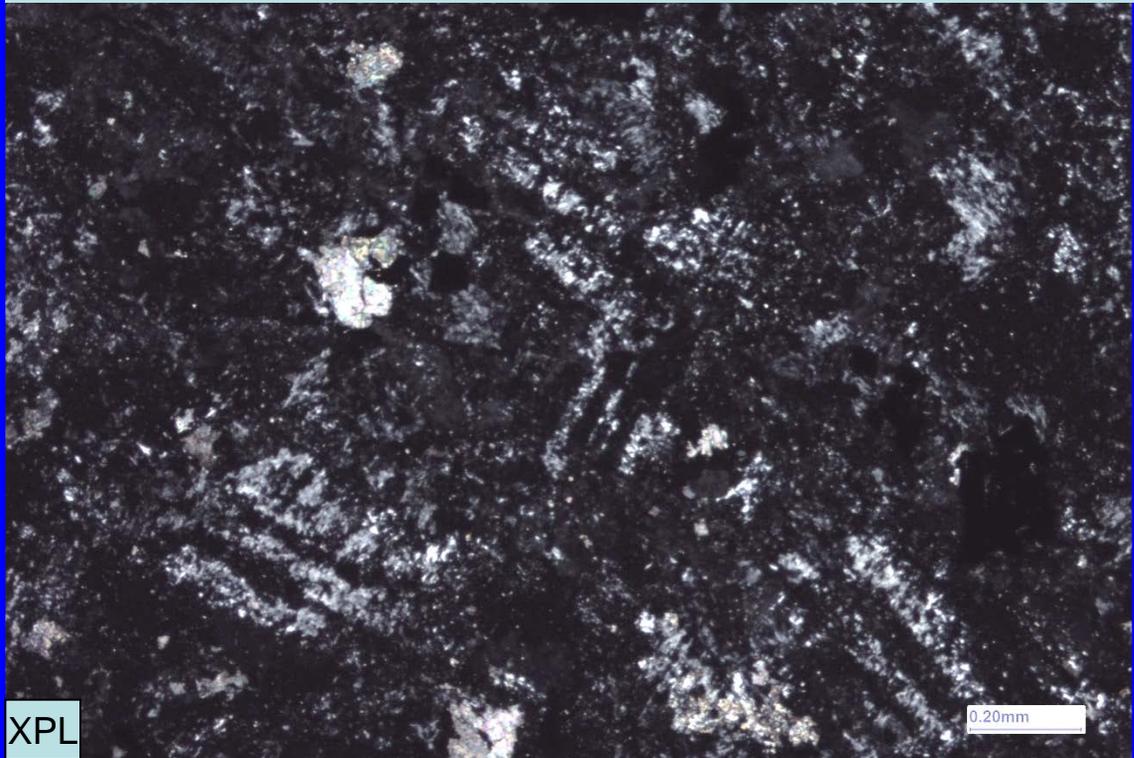
Fine-grained, evenly distributed magnetite in a sericite-chlorite-carbonate intergrowth that occasionally preserves shapes of former plagioclase crystals.



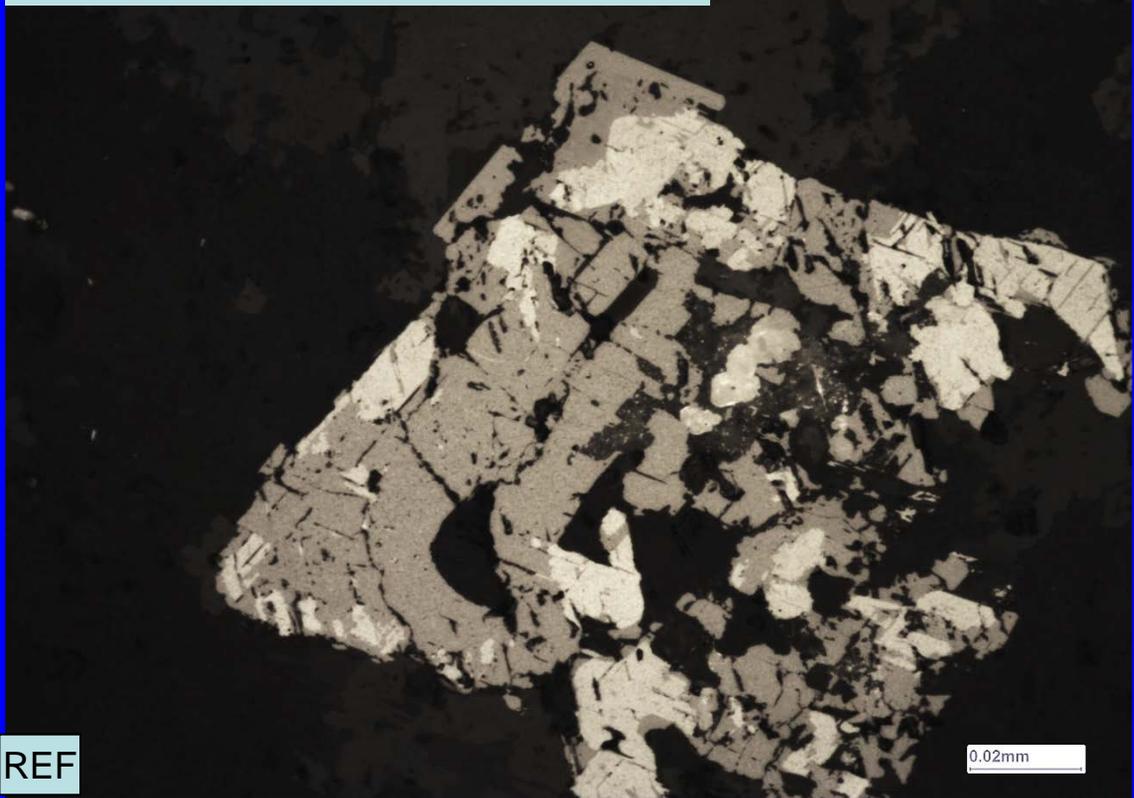
SAMPLE NUMBER

FTD038 201.00m

Ghost relics of former plagioclase crystals preserved in chlorite, carbonate and minor sericite



Ti-magnetite crystal being replaced by pale hematite



SAMPLE NUMBER

FTD038 250.00m

SUMMARY

This is the margin of a sparsely plagioclase+hornblende+FeTi oxide-phyric andesite or basaltic andesite lava flow with a quenched top, and pervasive sericite-carbonate-minor pyrite hydrothermal alteration overprinting a potassic alteration assemblage marked by abundant fine-grained magnetite and occasional Kspar veinlets with pink selvages lacking sericite. The flow appears to be 'right-way-up'.



SAMPLE NUMBER**FTD038 250.00m****THIN SECTION DESCRIPTION**

This is a texturally quite well preserved, sparsely plagioclase+augite-phyric andesitic or basaltic andesite lava, with around 2-4modal% of blocky prismatic plagioclase phenocrysts that are intensely replaced by fine-grained sericite, and 0.5-1modal% of former mafic phenocrysts now replaced by chlorite and fine-grained magnetite, with crystals shapes generally indicative of hornblende precursors. Also present are ~1-2modal% of small, equant FeTi oxide phenocrysts that are partly replaced by leucoxenitic aggregates. Small apatite microphenocrysts, which commonly occur as inclusions within the hornblende are also notable. These phenocrysts are set in a groundmass that shows significant grainsize variation across the slide, evident in the scanned images on the preceding page. Much of the groundmass (paler grey on the scanned offcut image) consists of an intergrowth of tiny plagioclase laths replaced by brown microcrystalline carbonate, with interstitial chlorite and abundant tiny magnetite grains. However, towards the top of the slide, the darker groundmass areas are much finer-grained, devitrified glass, suggesting this was at or close to the flowtop. Near-flowtop lava was clearly cracked and breached by flow interior melt that quenched, producing locally complex textural relationships.

VEINING and ALTERATION

This sample shows pervasive moderate hydrothermal alteration, with two main hydrothermal events recorded – an earlier potassic alteration marked by the widespread fine-grained magnetite and Kspar veins, and a more obvious, overprinting phyllic assemblage dominated by sericite-carbonate and minor pyrite. A few cracks and gashes are filled by intergrown green chlorite and radiating aggregates of green biotite crystals, possibly associated with the potassic alteration event. Kspar-dominated veinlets with some carbonate and fine-grained pyrite are present and the main one shows a 3-5mm-wide pinkish selvage with extremely fine-grained quartzo-feldspathic intergrowth lacking the carbonate replacement of plagioclase laths that is present elsewhere throughout the rock.

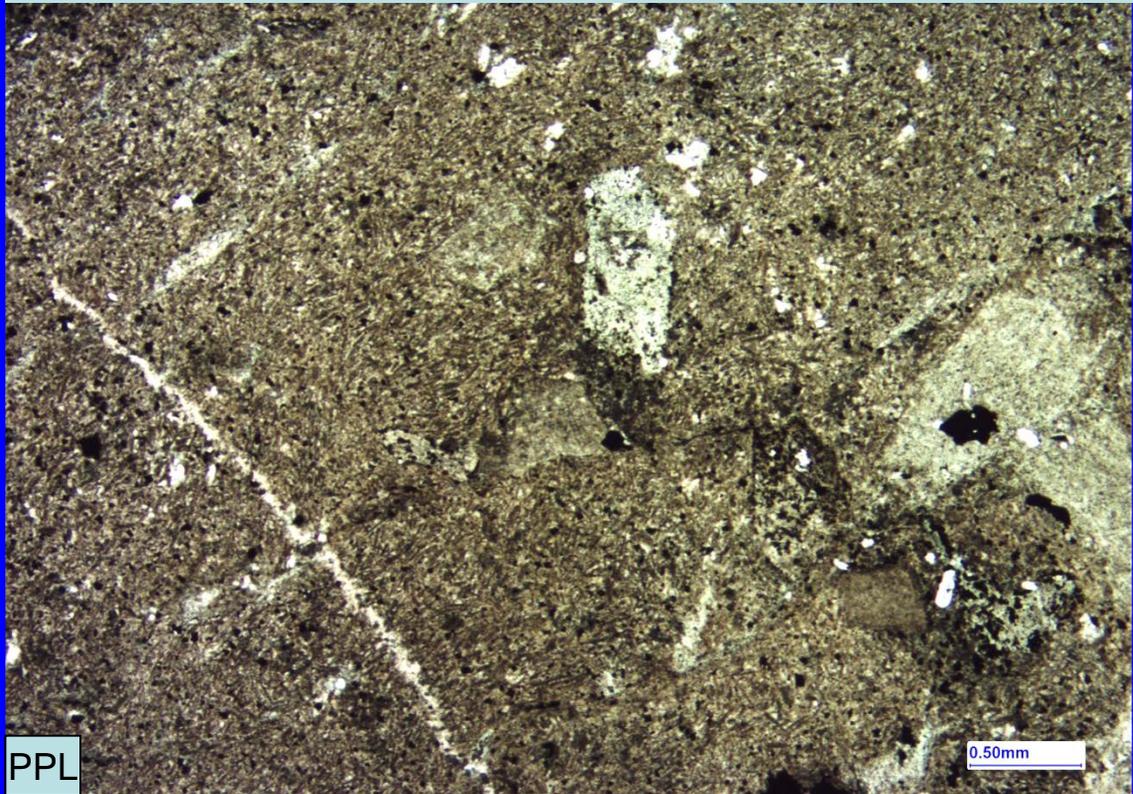
OTHER COMMENTS

The protolith of this rock was a basaltic andesite to andesite lava flow. If the up-arrow points up-hole, then the flow is 'right-way-up'. The alteration is discussed in more detail in the Summary Report.

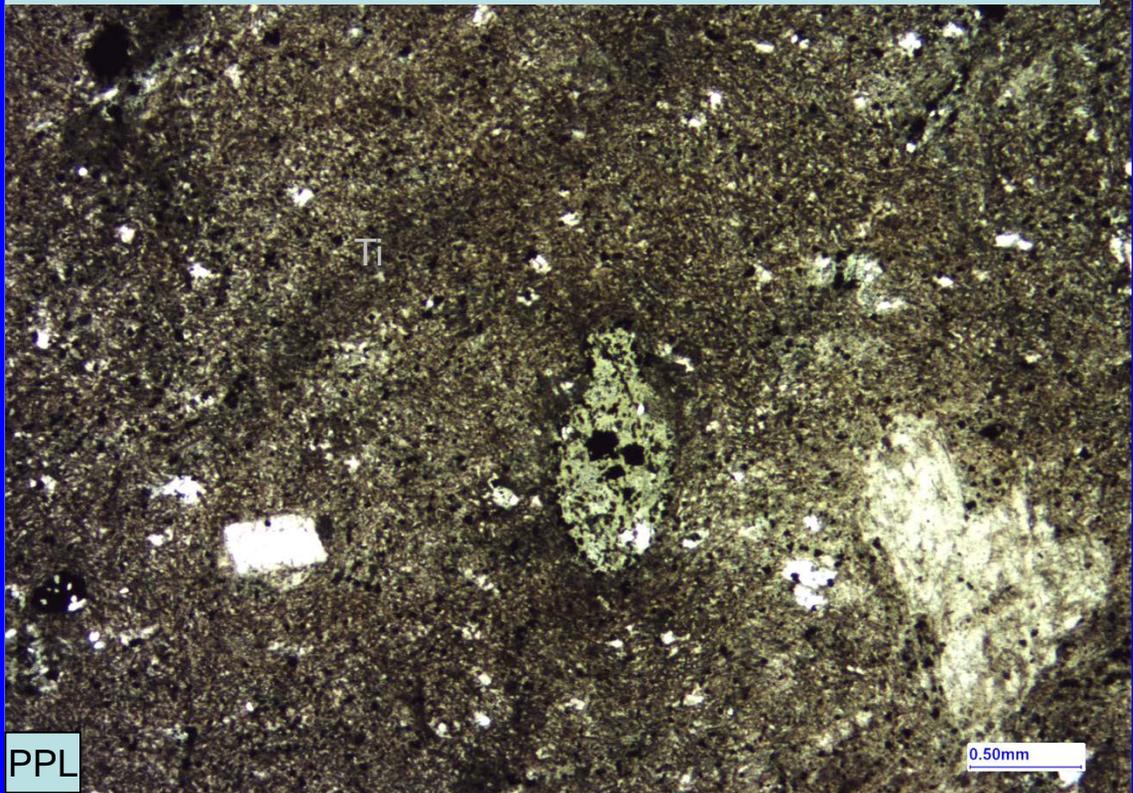
SAMPLE NUMBER

FTD038 250.00m

Sericitized plagioclase phenocrysts (right) and chlorite-altered former hornblende (centre)



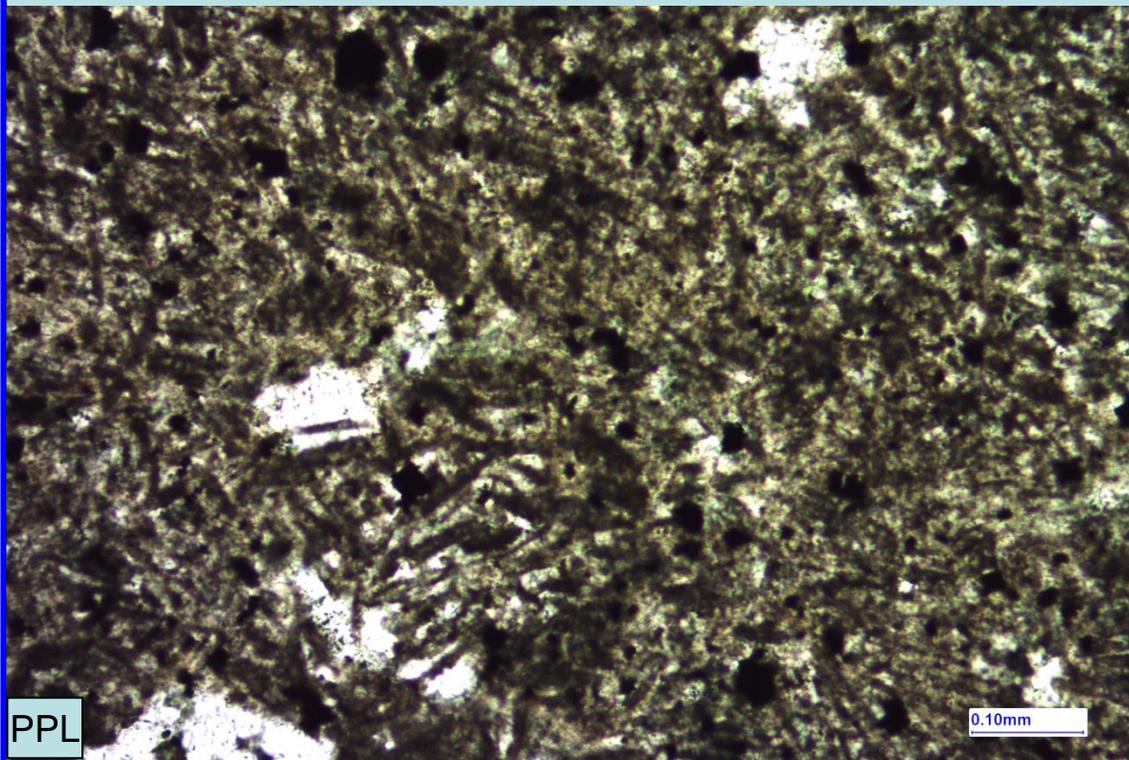
Chlorite-magnetite-altered former hornblende phenocryst



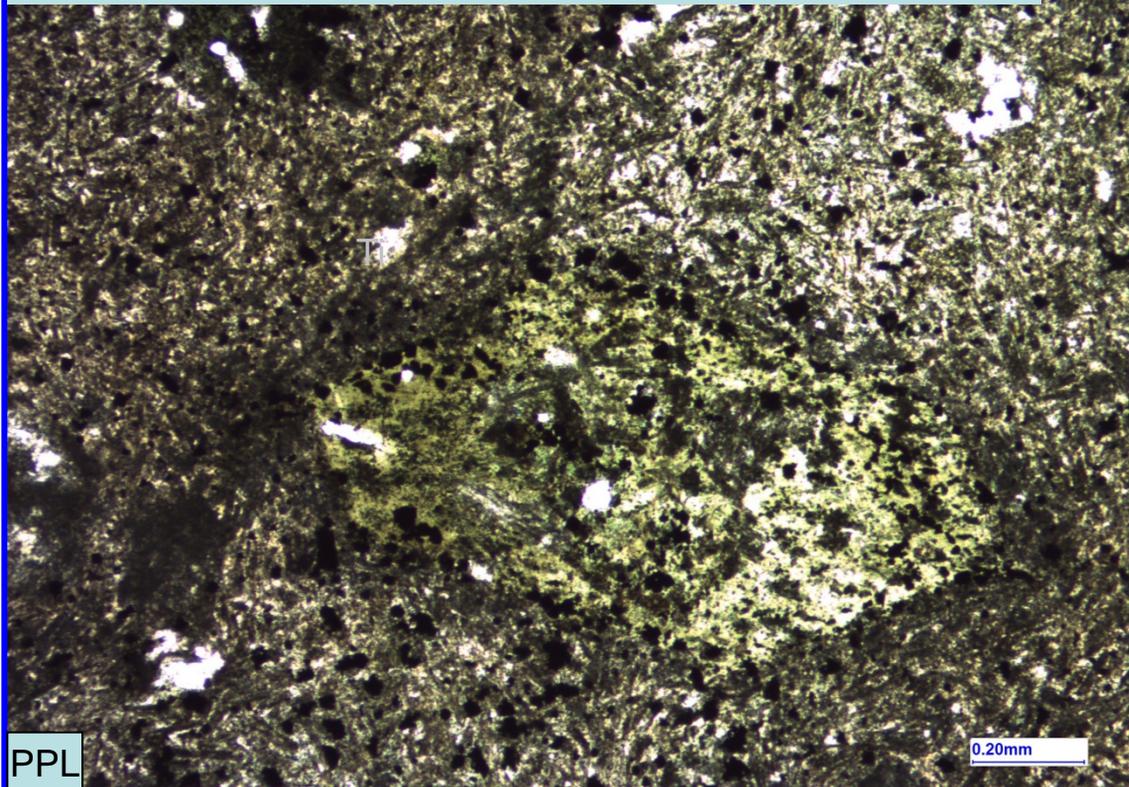
SAMPLE NUMBER

FTD038 250.00m

Small plagioclase-lath-riddled groundmass with plagioclase replaced by turbid fine-grained carbonate and microcrystalline epidote, with anhedral, blebby secondary quartz patches



Chlorite+magnetite-altered former hornblende phenocryst

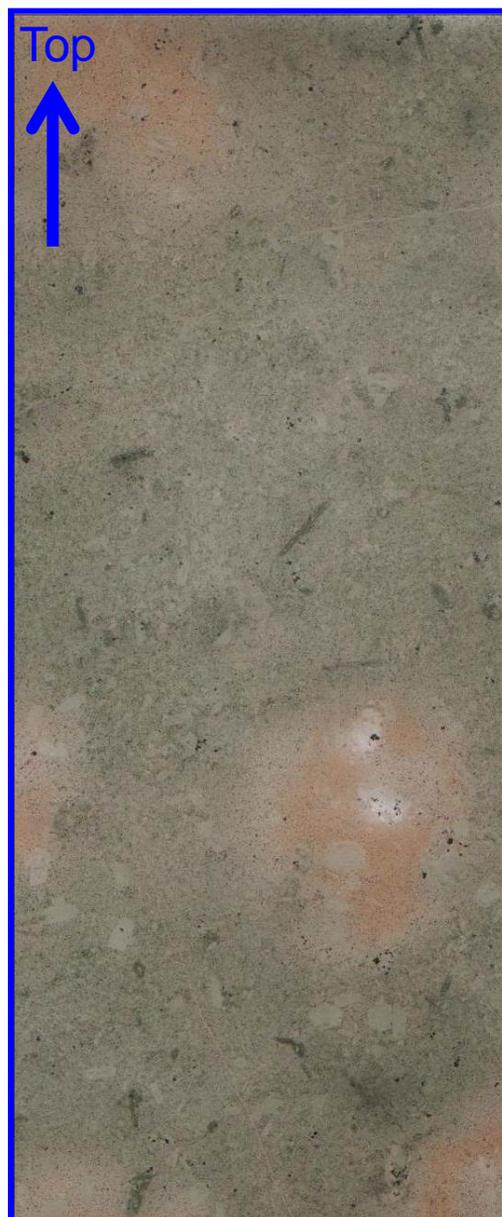
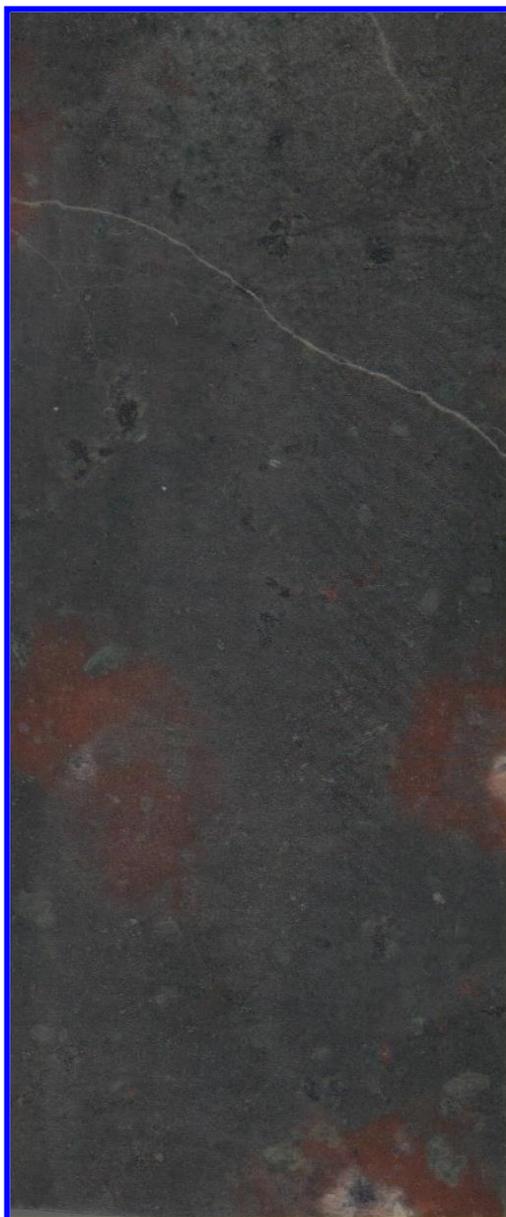


SAMPLE NUMBER

FTD038 253.85m

SUMMARY

This is a weakly plagioclase+hornblende+FeTi oxide-phyric andesite or basaltic andesite lava, from the same flow unit as the preceding rock from 250.0m depth in this hole. It shows diffuse, relic areas of potassic alteration as pinkish spotting within the rock that has been otherwise overprinted by phyllic (sericite-carbonate-chlorite-minor pyrite) alteration.



SAMPLE NUMBER**FTD038 253.85m****THIN SECTION DESCRIPTION**

This rock is very similar petrographically to the preceding sample from 250.0m depth in this hole, and is almost certainly from the same lithostratigraphic flow unit (protolith). It is a weakly plagioclase+hornblende-phyric andesitic or basaltic andesite lava with around 4-5 modal% of thoroughly sericitized former plagioclase phenocrysts mainly smaller than 2mm long, and somewhat less former hornblende phenocrysts now replaced by chlorite and fine-grained magnetite. Small apatite prisms are common as microphenocrysts .

The groundmass consists of an intergrowth of small plagioclase laths in an ultrafine-grained pinkish quartzo-feldspathic intergrowth after devitrified glass.

VEINING and ALTERATION

Obvious in the scanned images of both the offcut and thin section of this rock are cm-sized pinkish patches immersed in the more typical darker, turbid groundmass. In thin section, these pink domains show identical grain size and texture to the darker typical groundmass, but compared to the darker domains, they show less sericite and chlorite overprint and preservation of pink Kspar as the groundmass feldspar. Both pinkish and darker domains show weak carbonate overprinting. A key feature of both domains is the pervasive fine-grained magnetite present throughout the rock as individual sub-0.1mm-sized grains and common grains aggregates and short trails.

The simplest explanation of this blotchy texture is that the rock suffered pervasive potassic alteration that was partly, but not entirely, later overprinted by strong phyllic alteration (sericite-carbonate-chlorite-minor pyrite), leaving the pinkish patches relatively unaffected by the phyllic overprint.

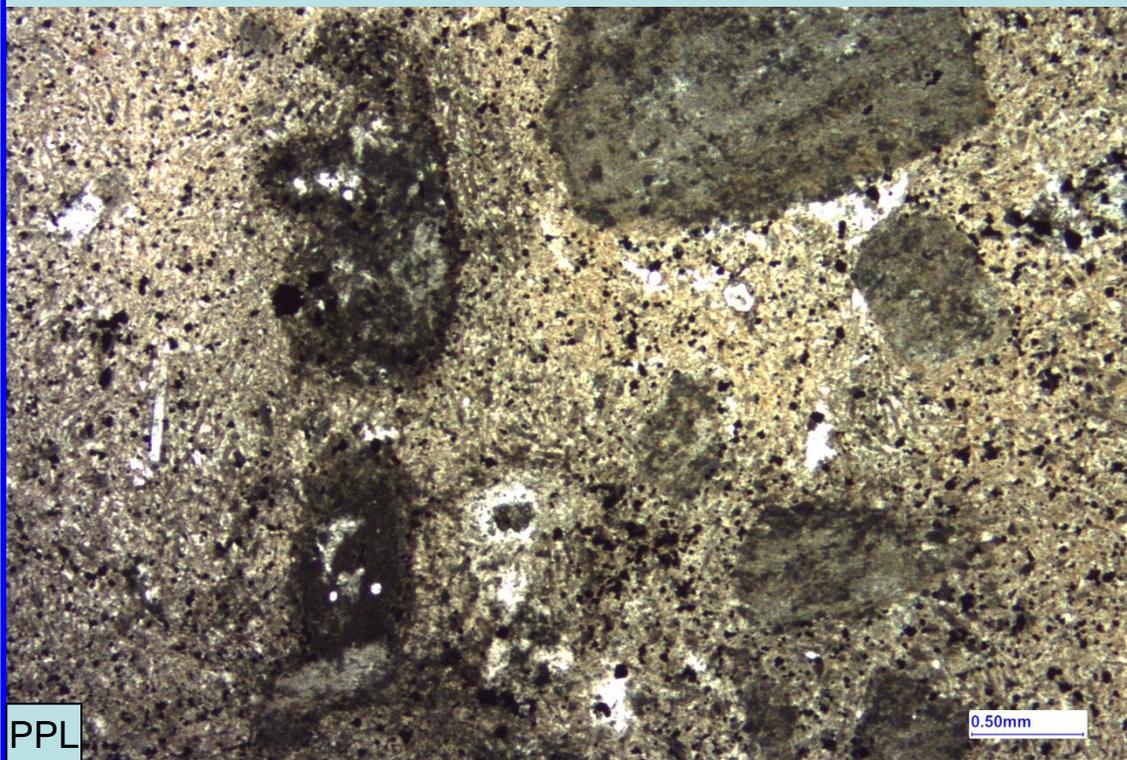
OTHER COMMENTS

This sample is from the same unit as the preceding andesite or basaltic andesite lava. The common apatite microphenocrysts are notable and suggest affinities with the Group 2 hornblende andesites above the CVC and in the base of the Tyndall Group (Anthony Rd Andesite correlates?). Alteration is discussed further in the Summary Report.

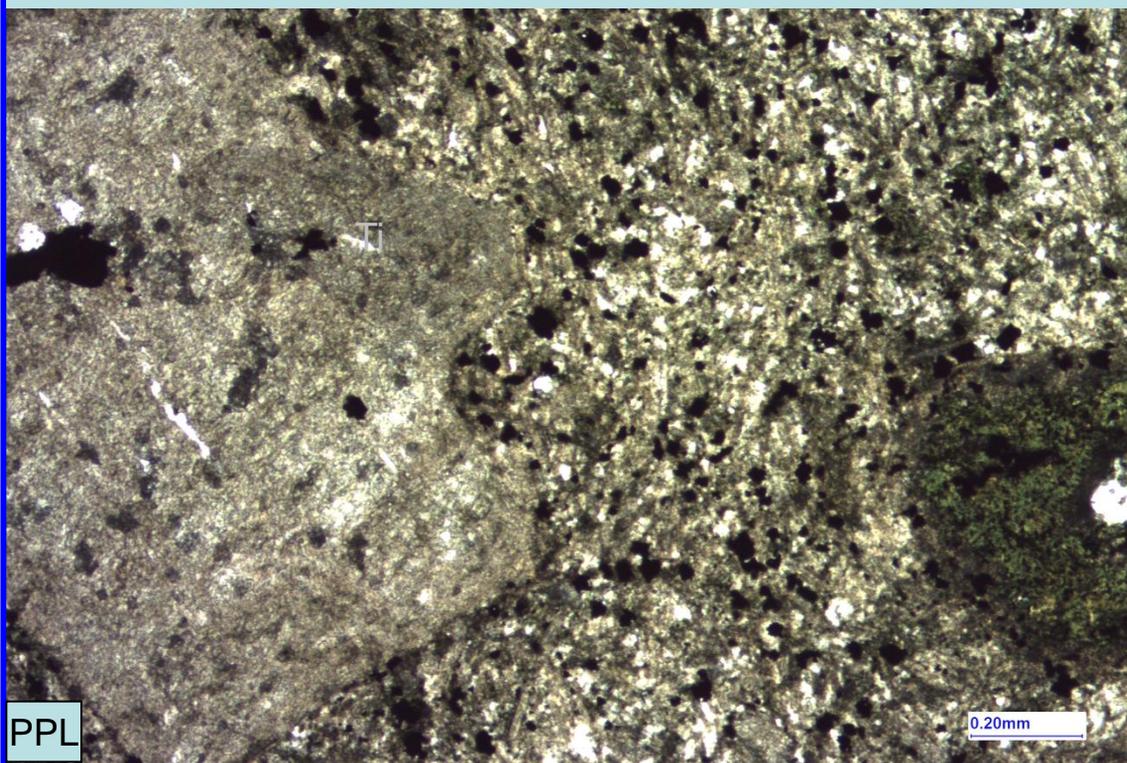
SAMPLE NUMBER

FTD038 253.85m

Sericite-altered plagioclase and darker former hornblende phenocrysts replaced by chlorite and carbonate – note abundant groundmass alteration-related magnetite



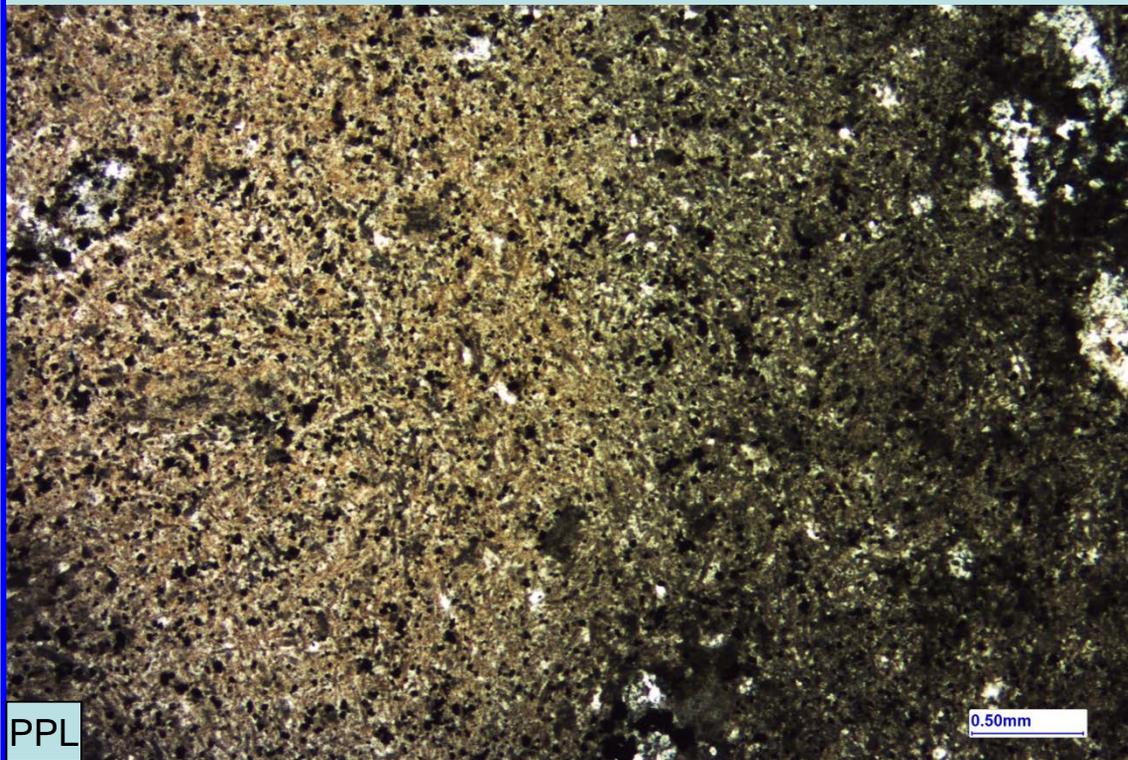
Groundmass detail between a large sericitized plagioclase phenocryst (left) and chlorite-altered former hornblende phenocryst (right)



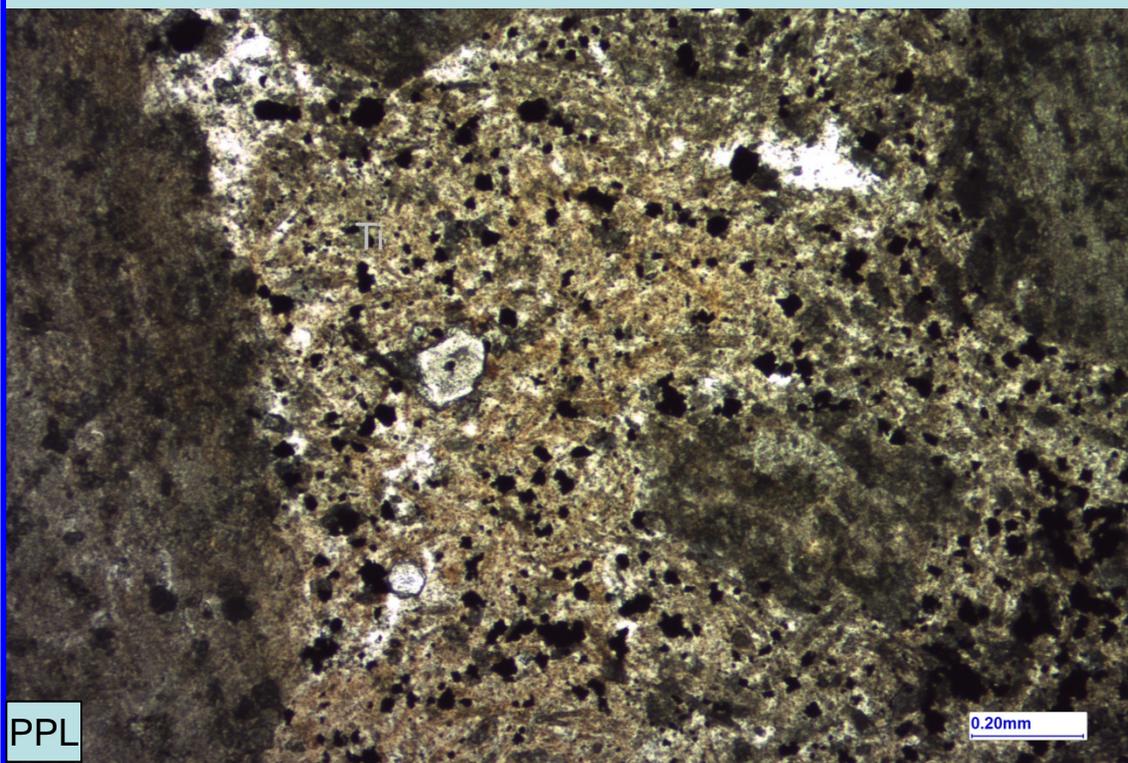
SAMPLE NUMBER

FTD038 253.85m

Transition from texturally similar dark domain (right) and pink domain (left) with colour difference due to weak to absent sericite –carbonate-chlorite alteration in the pink domain.



Apatite microphenocryst (clear) in groundmass between sericite-altered plagioclase phenocrysts



SAMPLE NUMBER

FTD038 263.93m

SUMMARY

This is another weakly plagioclase+hornblende-phyric andesitic to basaltic andesite lava probably from the same flow unit as the two preceding samples, from 250.0 and 253.85m depth in this hole. Alteration is a poorly preserved early potassic event (Kspar veinlets, disseminated fine magnetite) overprinted by a phyllic (moderate sericite-quartz- late carbonate alteration.



SAMPLE NUMBER**FTD038 263.93m****THIN SECTION DESCRIPTION**

This is another weakly plagioclase+hornblende+FeTi oxide-phyric andesite or basaltic andesite lava that could very well be from the same flow unit as the preceding two rocks (from 250.0 and 253.85m depths), because it has the same phenocryst assemblage in the same modal amounts, with very similar hydrothermal alteration, and a groundmass texture that resembles the more rapidly quenched parts of that in the preceding two samples. In particular, the common stout to elongate apatite microphenocrysts are unusual, and match those in the rocks from 250.0m and 253.85m.

The mainly 1-2mm-sized blocky, prismatic plagioclase phenocrysts make up about 3-5 modal% of this rock and are heavily sericitized, with many also overprinted by messy brown carbonate. Former hornblende phenocrysts, mainly 0.5-2mm long and almost always well formed crystals, are replaced by chlorite and fine-grained magnetite. The groundmass texture varies across the slide, recording cracking of the original lava crust and intrusion of hot lava from deeper in the cooling flow. Most of the groundmass consists of small plagioclase laths and tiny equant FeTi oxides in former glass that shows variable devitrification-recrystallization textures, including almost microspherulitic textures in places that show light sericite development, and spotty late carbonate overprinting.

VEINING and ALTERATION

Narrow brittle fractures filled by Kspar aggregates are the main vein type in this rock, but they are not common, and are locally offset along microfaults. They also lack the sericite-free selvages of the Kspar veinlets in the two preceding samples. Although fine-grained magnetite is abundant through the groundmass of this rock, much of it appears to be well formed equant octahedral grains that are typically magmatic, so it is difficult to determine the intensity of the potassic alteration well recorded in the preceding four samples. Narrow quartz and quartz-carbonate veinlets are present through the rock, and the main alteration assemblage is moderate sericite-quartz and late carbonate.

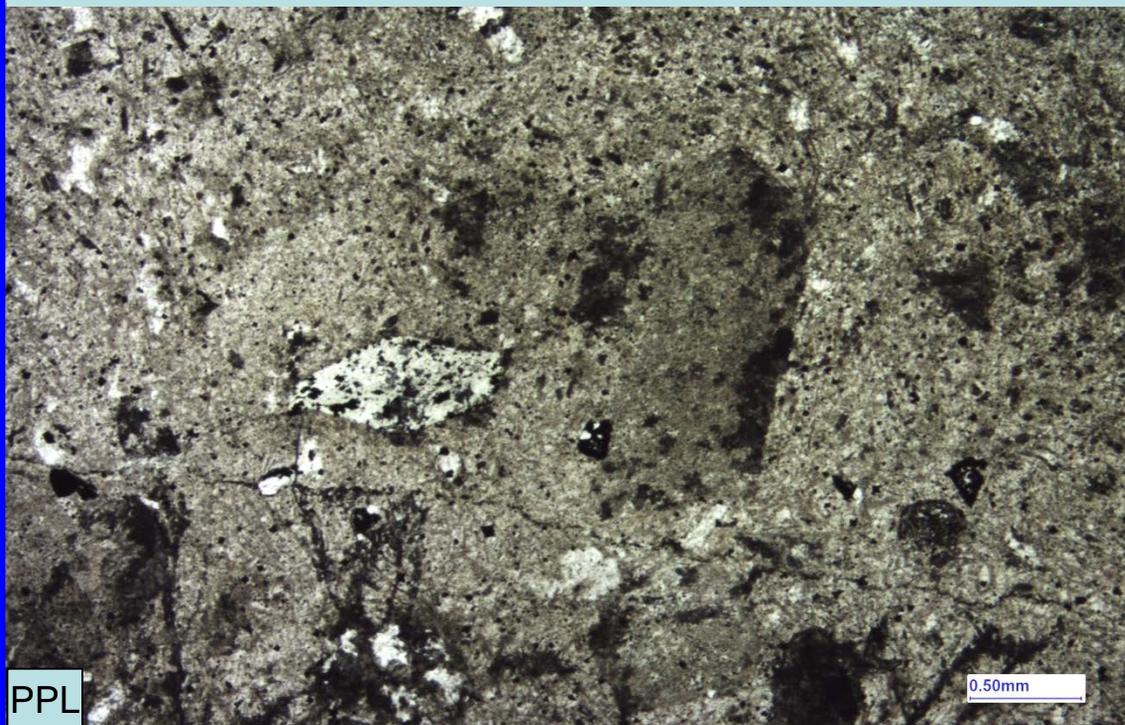
OTHER COMMENTS

This rock is clearly from the same flow unit, or series of petrographically identical units, as the preceding two rocks. The sharp textural changes are more likely to be seen in flowtop than a quenched margin of an intrusive unit in my opinion, although it is impossible to preclude that the samples come from a shallow intrusive unit of andesitic to basaltic andesite composition. This is discussed in the Summary Report.

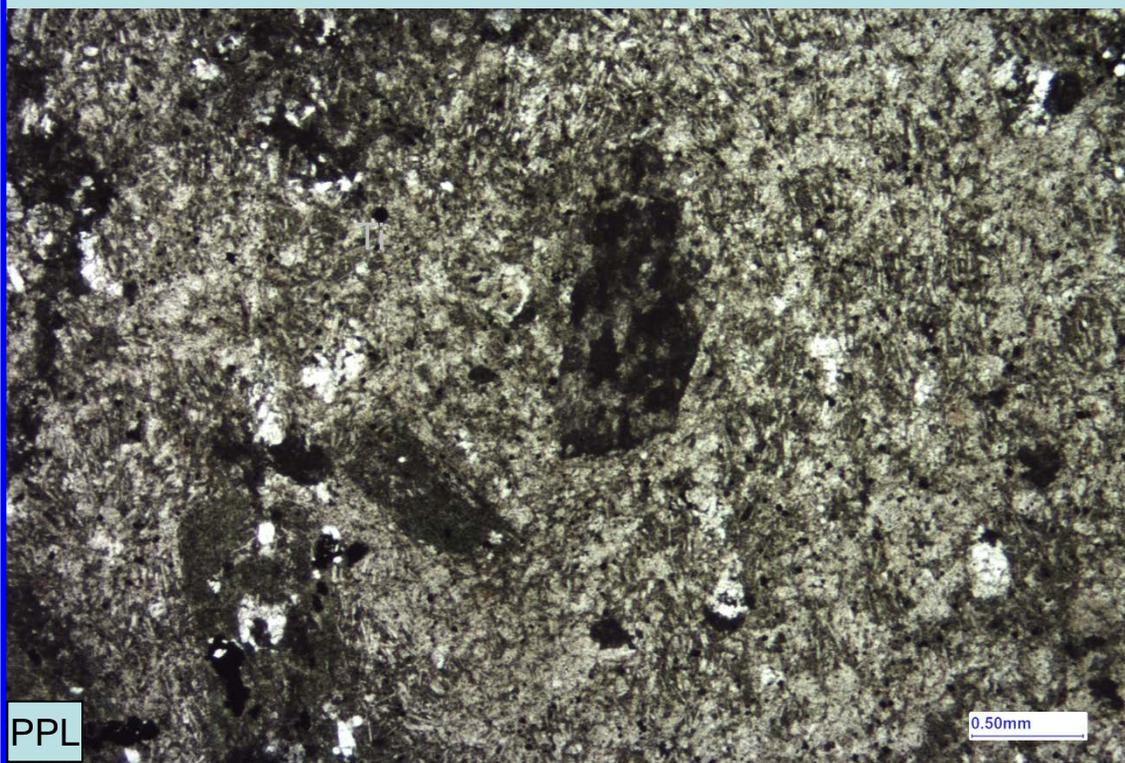
SAMPLE NUMBER

FTD038 263.93m

Blocky, sericite+carbonate-altered plagioclase phenocryst and euhedral diamond-shaped hornblende phenocryst replaced by chlorite and magnetite – note texturally variable groundmass



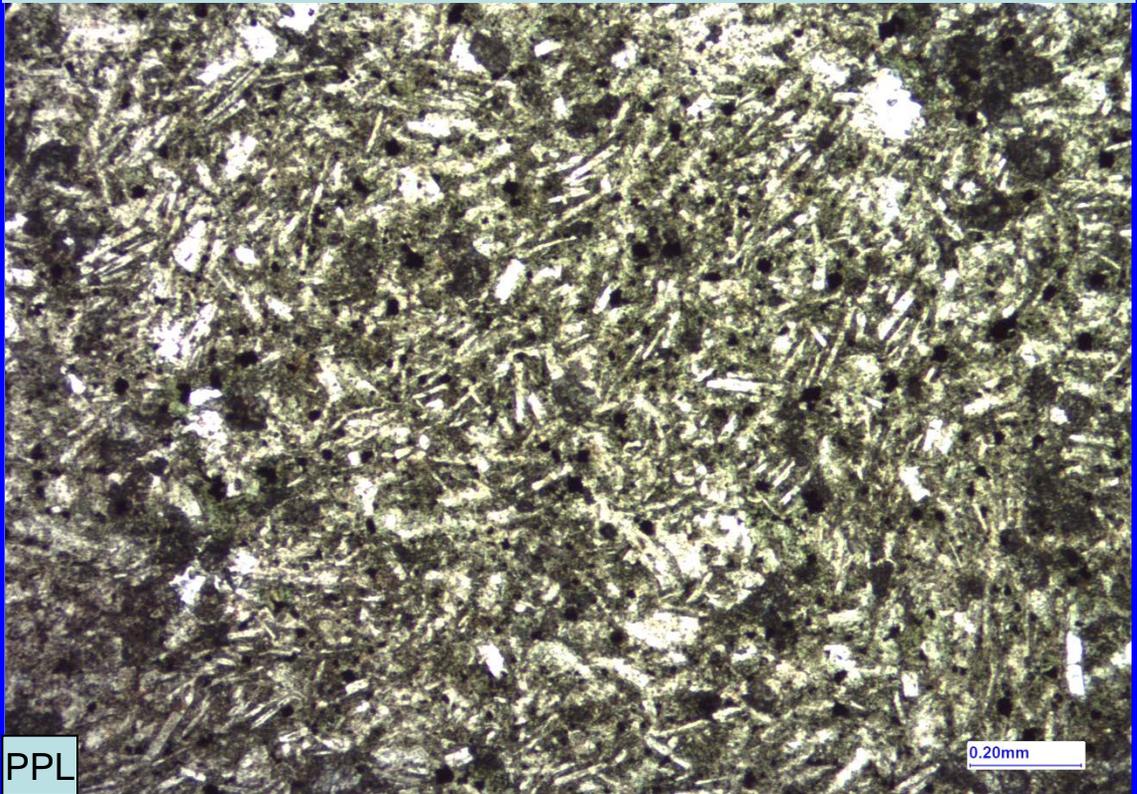
Phenocrysts of plagioclase replaced by sericite and carbonate in an almost micropoikilitic-textured groundmass domain



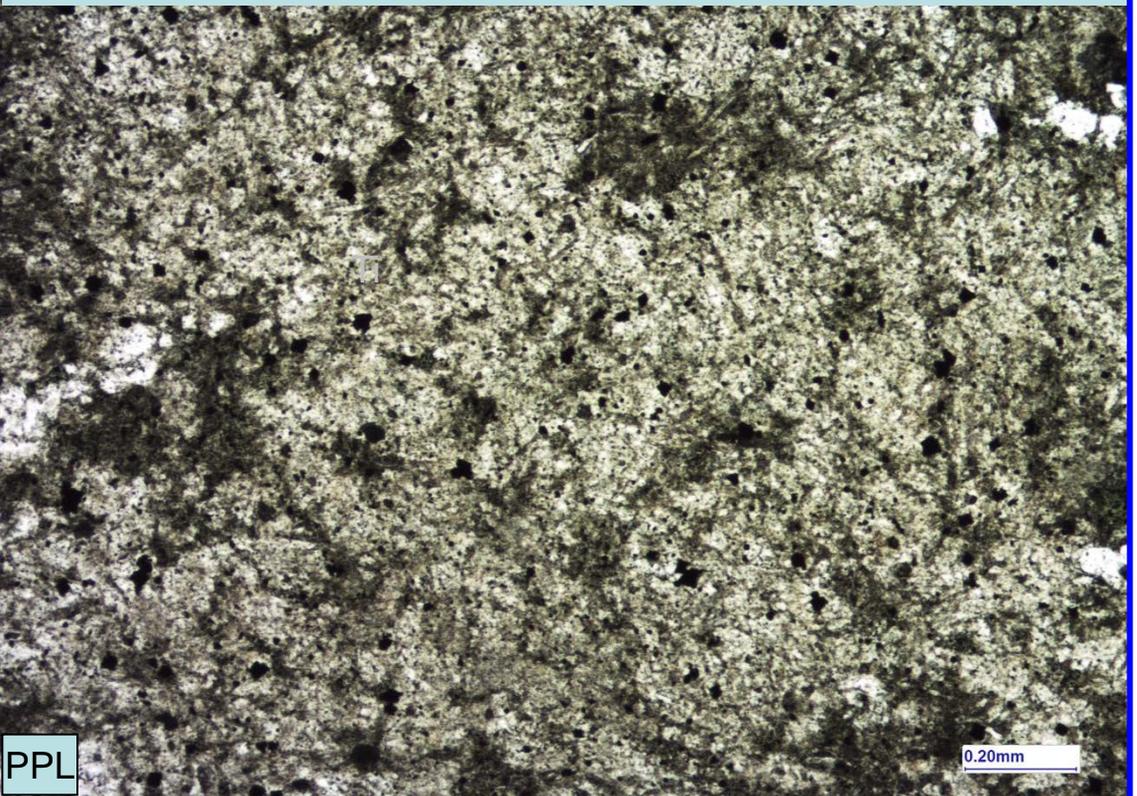
SAMPLE NUMBER

FTD038 263.93m

Coarser groundmass variant with plagioclase laths and tiny equant FeTi oxides



Finer-grained, more quenched groundmass variant with less and smaller plagioclase laths



SAMPLE NUMBER

FTD040 121.62m

SUMMARY

This is strongly fractured, poorly sorted, matrix supported fine volcanoclastic sandstone in which the dominant clast population (~10modal%) is broken and strained quartz phenocryst debris. The matrix was probably comminuted felsic vitric ash. The pervasive alteration is quartz-sericite-late carbonate.



SAMPLE NUMBER**FTD040 121.62m****THIN SECTION DESCRIPTION**

This is a strongly fractured, moderately veined siliceous, matrix-supported volcanoclastic sandstone that shows very poor sorting. Angular and broken quartz phenocrysts form most of the detrital grains in the rock, but these make up only about 10modal% of the rock, and vary from 2mm to <0.2mm in size. Many have been locally fragmented and disrupted during alteration/deformation, and numerous crystals, even those with clear euhedral phenocryst shapes, show strong internal strain features. Lithic clasts are absent, and former feldspar phenocrysts are quite rare and heavily sericitized. Also present in this rock are quite common often well formed zircons, presumably derived from the rhyolitic parent rock of the quartz detritus.

The matrix of this rock was probably originally dominated by comminuted felsic vitric ash although no convincing shard shapes are preserved, and the vitric ash has crystallized to mainly fine-grained, variably textured quartzo-feldspathic intergrowths.

VEINING and ALTERATION

A network of hairline and sometimes more robust fractures pervades this rock, locally producing weakly brecciated textures with sericite defining the fractures. Finely streaky, rather dark fine-grained carbonate overprints the sericite-quartz-dominant earlier alteration.

At the top of this slide, a clot of strong and coarse carbonate-ribbon quartz-sericite-pyrite alteration is present, with the larger pyrite crystals (in this unpolished slide) to almost 2mm across.

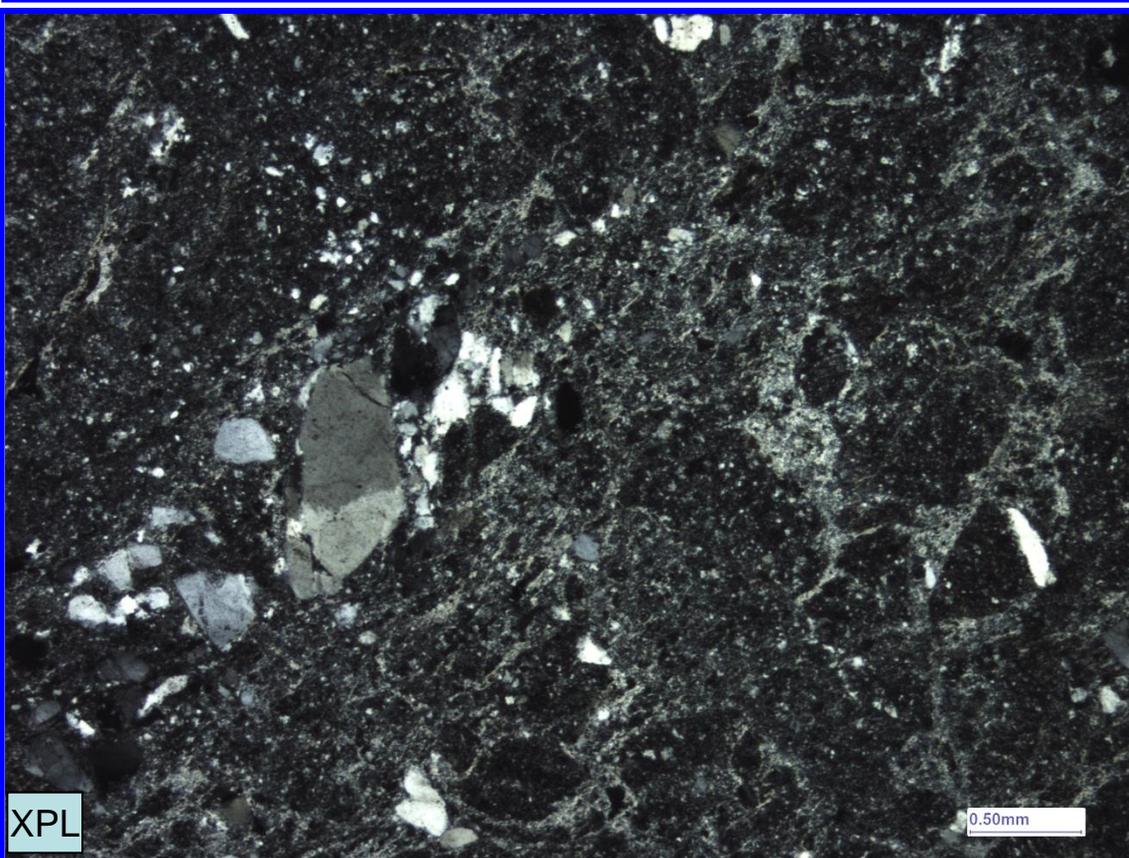
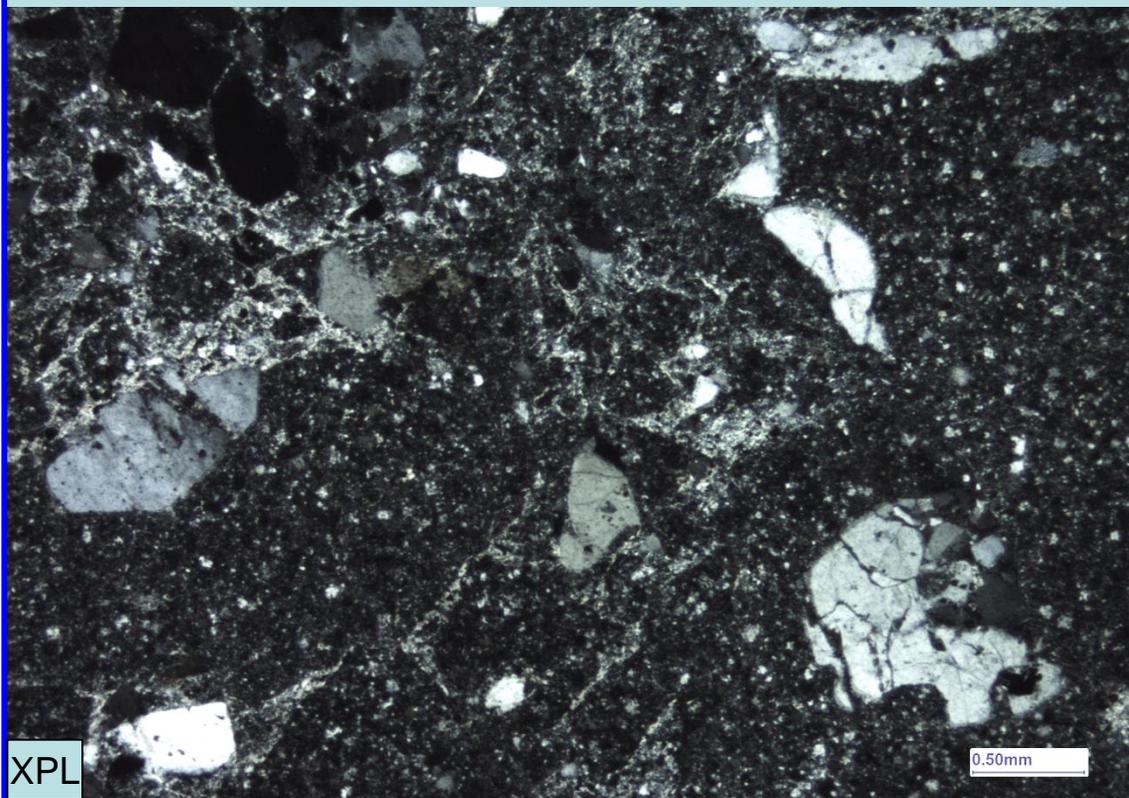
OTHER COMMENTS

This paucity of lithic clasts and detrital feldspar crystals characterize this sample, which was obviously derived from an explosive, quartz-phyric rhyolitic lava provenance. Alteration is sericite-quartz and late carbonate, and linked to the fracturing. Despite 'way-up' being indicated on the sample provided, the poor sorting of this rock shows no textural indication that an up-direction is obtainable from this thin section.

SAMPLE NUMBER

FTD040 121.62m

Broken quartz phenocryst detritus and a network of fine, sericite-defined fractures



SAMPLE NUMBER

FTD040 144.34m

SUMMARY

This is a volcanoclastic siltstone with occasional, detrital, angular quartz grains in a very fine-grained quartzo-feldspathic intergrowth that is probably derived from crystallization of devitrified finely comminuted vitric ash. The pervasive alteration is quartz-sericite-tourmaline-arsenopyrite and late carbonate.



SAMPLE NUMBER**FTD040 144.34m****THIN SECTION DESCRIPTION**

This is a volcanoclastic siltstone which probably had a dominant vitric ash component, although the thorough devitrification – crystallization of the vitric ash has obliterated any shard textures. Occasional small (<0.1mm), angular, detrital quartz grains are present, set in a mainly quite fine-grained quartzo-feldspathic intergrowth after vitric ash, that is now peppered with fine sericite and more blebby and patchy carbonate.

VEINING and ALTERATION

Although the hydrothermal alteration of this sample is pervasive, it is not intense, and mainly restricted to a fairly even distribution of four major alteration phases, quartz, pale carbonate, sericite and tourmaline. The latter occurs as small (to ~0.1mm long) prisms, commonly more concentrated in some bands than others, whereas the quartz occurs as narrow, very irregular and often branching veinlets usually carrying some relatively coarsely crystalline pale carbonate. A single, discontinuous, 1-2mm-wide vein composed mainly of Kspar cuts the rock, and small spots of rather coarse Kspar aggregates are scattered through the sample. Fine meshes of sericite are variably developed overprinting the quartzo-feldspathic aggregates that dominate this rock, and abundant, messy to well crystallized carbonate overprints the other alteration phases.

In reflected light, the rock is seen to contain occasional patches of limonite-goethite possibly replacing some former detrital FeTi oxide grains, and a small amount of disseminated sulfides. The latter are mainly tiny crystals (<0.01mm across) of perfectly euhedral arsenopyrite, along with less common, often more reacted-looking pyrite grains, (the two together making up <<0.1modal% of the rock) often occurring in small clots and trails..

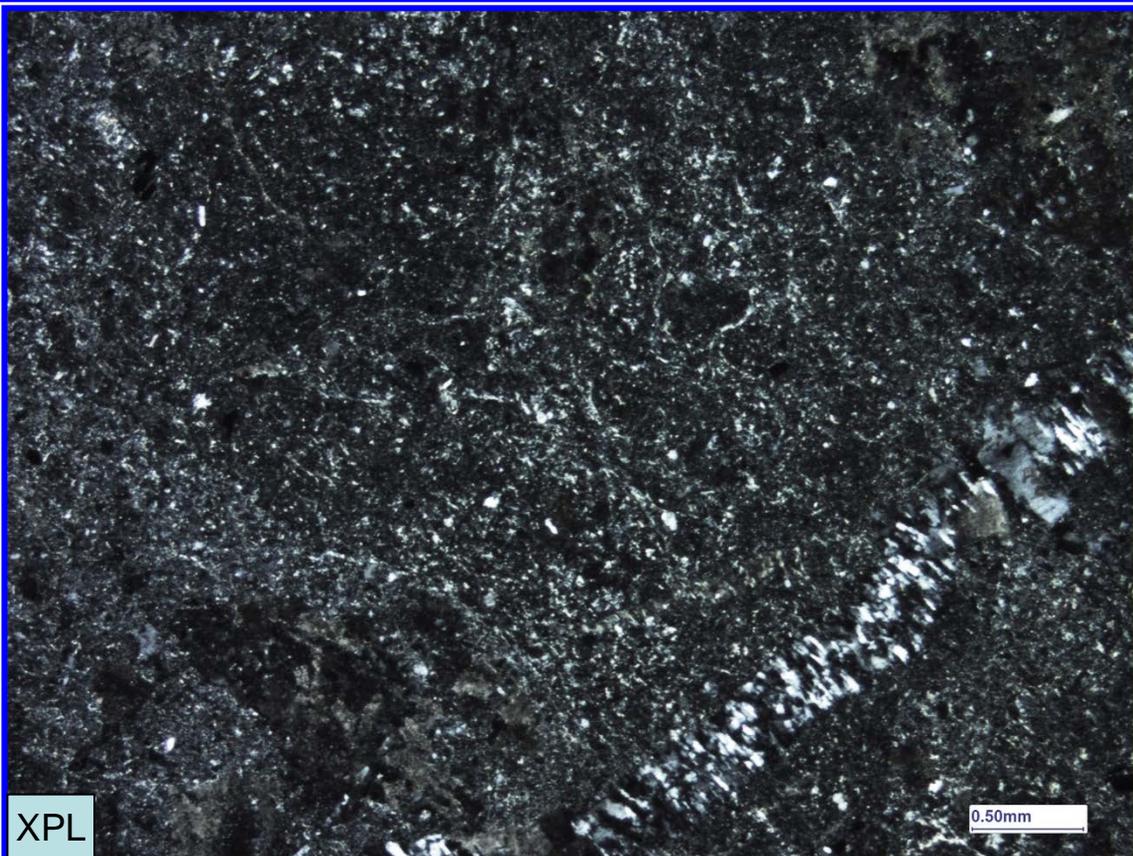
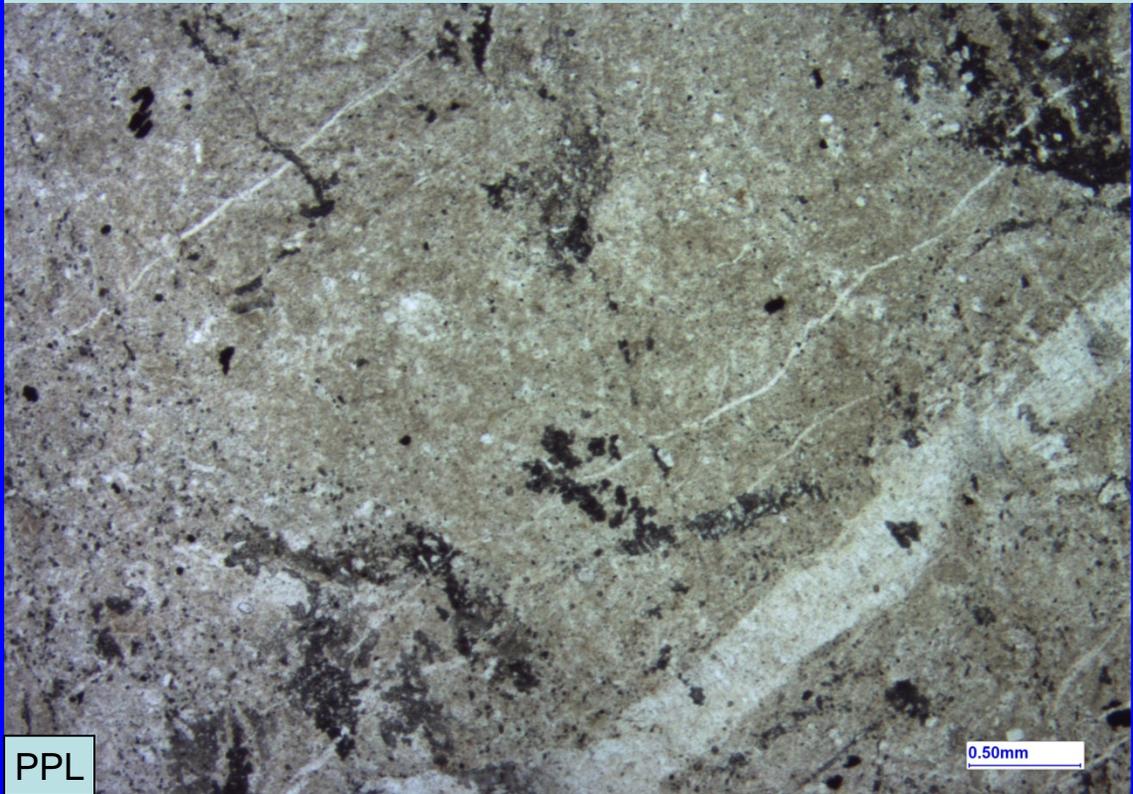
OTHER COMMENTS

The small amount of arsenopyrite in this rock is enough to account for the 1015ppm As assayed in this sample. The widespread, fine-grained tourmaline, normally linked to a granite-associated hydrothermal system, is not present in the compositionally similar rock from only 20m shallower in this drillhole.

SAMPLE NUMBER

FTD040 144.34m

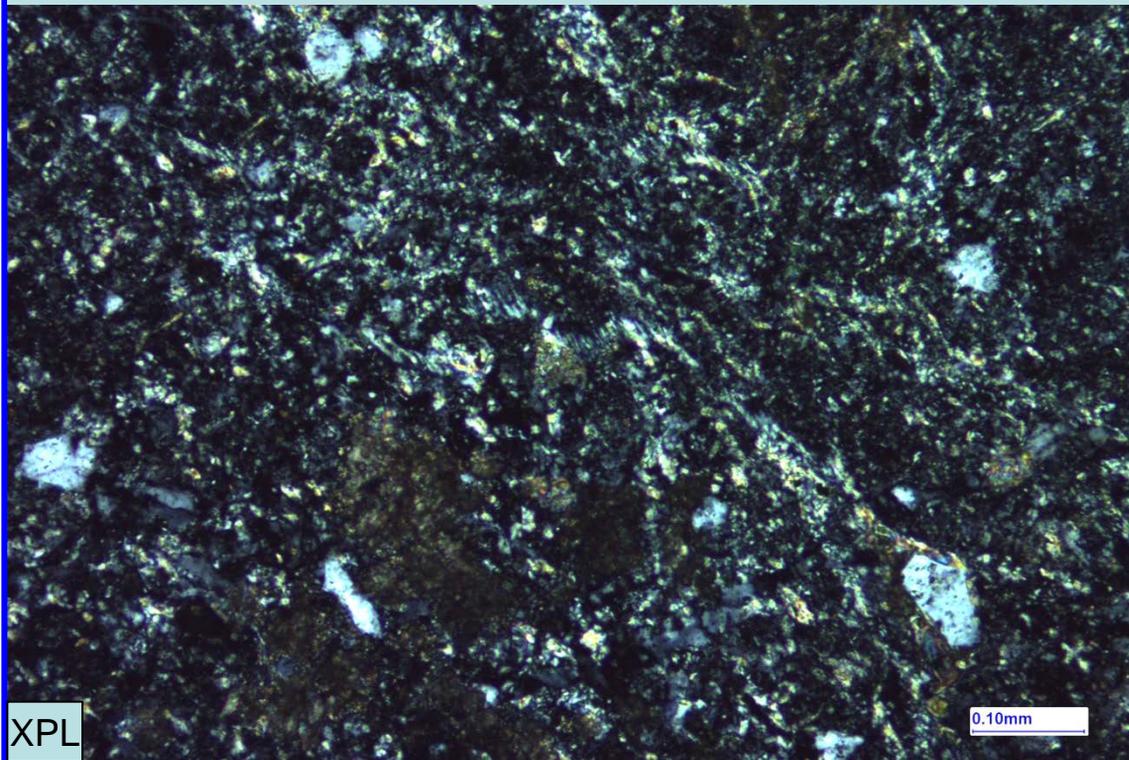
Quartz veining and dark carbonate patches in altered vitric ash-rich volcanoclastic siltstone



SAMPLE NUMBER

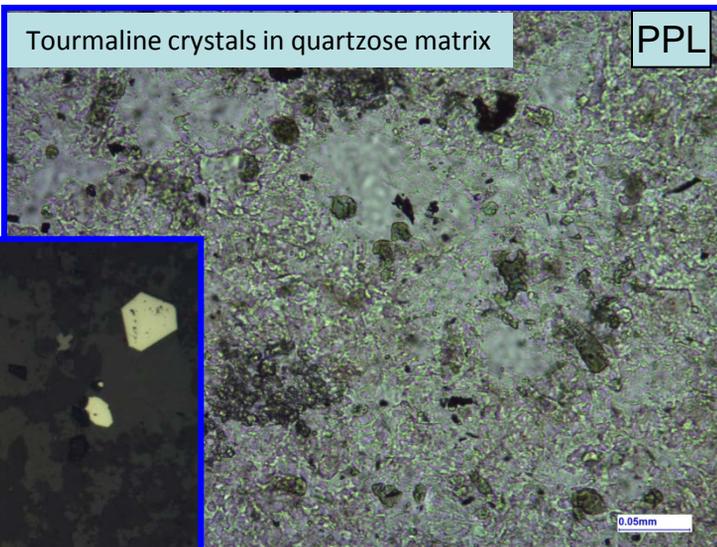
FTD040 144.34m

Detrital quartz grains in a recrystallized quartzo-feldspathic matrix after devitrified glass, with a fine sericite mesh and some patchy late carbonate



Tourmaline crystals in quartzose matrix

PPL



Arsenopyrite crystals

