

# *Pontifex & Associates Pty Ltd*

MINERALOGY – PETROLOGY · SECTION PREPARATION

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## **MINERALOGICAL REPORT No. 10038**

*by Alan C. Purvis, PhD*

December 6th, 2011

**TO :**

Mr Andrei K. Karpinski  
Korab Resources Ltd  
PO Box 195  
SOUTH PERTH WA 6951

**COPY TO :**

John A Earthrowl  
Consultant to Korab Resources Ltd  
PO Box 219  
BATCHELOR NT 0845

**YOUR REFERENCE :**

J. Earthrowl emails 31/10/11 and 4/11/11

**MATERIAL :  
& IDENTIFICATION :**

Seven drill chip samples:  
KORCH-007, 52-53 to KORCH-008, 115-116

**WORK REQUESTED :**

Polished thin section preparation, description and  
report with comments as specified.

**SAMPLES & SECTIONS :**

Returned to you with hard copy of this report.

**DIGITAL COPY :**

Emailed 12/12/11 to  
<sildol@bigpond.com>  
<akk@korabresources.com.au>

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## **SUMMARY COMMENTS**

This report presents descriptions of seven polished thin sections of drillchip samples from the Rum Jungle Mineral field, N.T., for John Earthrowl on behalf of Korab resources. These are from two drill holes labelled KORCH-007 (two samples) and KORCH-008 (five samples). Selected assay data received for these seven chips are briefly discussed in the following summary and twenty photomicrographs are integrated with the individual petrographic descriptions.

These seven chip samples include mafic lithologies in drillhole KORCH-007, and mostly hyaloclastite or vitric tuff samples in KORCH-008. A summary of the petrology/classification of these is given below by listing the headers from the individual descriptions

**KORCH-007, 52m:** Carbonate-chlorite-quartz-pyrite-rutile-altered mafic rock with minor goethite, low temperature pyrite and chalcopyrite.

**KORCH-007, 109m:** Chlorite-carbonate-quartz-rutile-pyrrhotite-altered, probable dolerite.

**KORC-008, 25m:** Chlorite-carbonate-goethite-rutile-leucoxene-sulphide-altered, hyaloclastite. Probably mafic with low temperature pyrite and rare chalcopyrite.

**KORCH-008, 42m:** Chlorite-carbonate-quartz-leucoxene-rutile-altered hyaloclastite, with goethite, low temperature pyrite and rare chalcopyrite.

**KORCH-008, 59m:** Chlorite-carbonate-quartz-leucoxene-altered hyaloclastite with low temperature pyrite in patches with goethite, rutile and rare chalcopyrite and in fractures. Also rare chalcocite, covellite and bornite.

**KORC-008, 105m:** Carbonate-quartz-chlorite-rutile-pyrrhotite-pyrite-altered, poorly preserved lithology with minor leucoxene.

**KORCH-008, 115m:** Chlorite and quartz-rich areas with minor pyrrhotite, rutile and carbonate, partly derived from hyaloclastite. Possibly in contact with siltstone into which amygdaloidal clasts have been dumped. Trace pentlandite and chalcopyrite.

Samples down to about 60m have low temperature pyrite ex-pyrrhotite, with rutile  $\pm$  goethite, while samples deeper than 100m or more contain fresh pyrrhotite with rutile, indicating low  $fO_2$  values, (depending on the  $fS_2$  value), but this would have originally been in the pyrrhotite field throughout. Minor chalcopyrite occurs throughout, with trace pentlandite only in KORCH-008 at 115m.

## **COMMENT ON ASSAYS PROVIDED FOR THESE SEVEN CHIP SAMPLES**

Assay data were received for the seven chip samples, with 'major' elements including Ti, Fe, Mn, Mg, Ca and S. Aluminium was not reported but this could be useful for discriminating between mafic and ultramafic rocks, and in distributing Mg and Fe between chlorite and carbonate. Minor and trace elements (Ag, As, Co, Cr, Cu, Ni, U, V and Zn) were also reported. The assays suggest that carbonate may be largely ferroan dolomite, but the chemical composition seems to predominantly reflect metasomatism, as there are few significant inter-element correlations.

Correlation coefficients of more than 0.8 however are seen between Fe, Cr, Ni and V, and between Cu, Ni and Cr. There is no correlation between Mg, Cr and Ni, as expected from normal fractional crystallisation models, and the correlation between Fe, Cr and Ni is to some extent counter-intuitive. Although the only chip sample with pentlandite is also the richest in pyrrhotite, the Cr content should correlate with Mg rather than Fe in normal mafic and intermediate igneous suites. The strongest correlation however is between Cr and V ( $R = 0.99$ ).

These elements correlate in komatiites, albeit less strongly, but the samples from these drillholes are more probably mafic to intermediate rather than komatiitic. Low Ti/V ratios of 18-28 suggest similarities with arc or back-arc volcanism, but further geochemical data may be useful, including Al, Zr and Nb, for example.

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## **INDIVIDUAL DESCRIPTIONS**

**KORCH-007, 52m**      **Carbonate-chlorite-quartz-pyrite-rutile-altered, mafic rock with minor goethite low temperature pyrite and chalcopyrite.**

### **Hand Specimen**

This sample has small dark patches in a paler matrix.

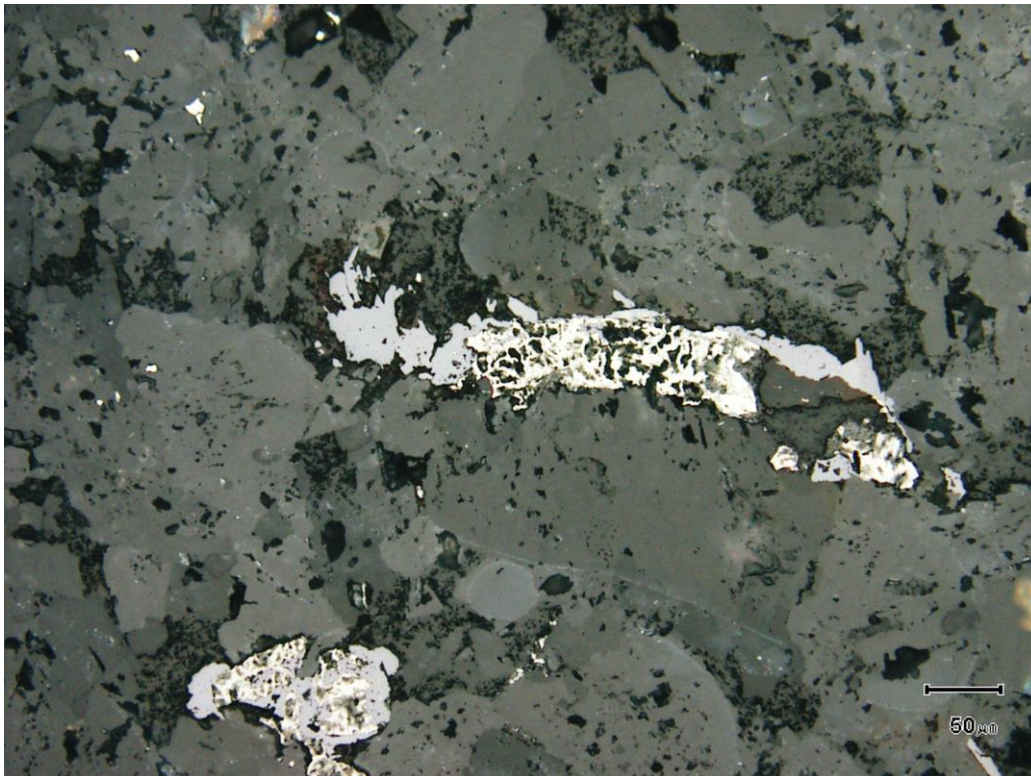
### **Thin Section**

Partly zoned granular or rhombohedral carbonate dominates this sample, with 15-20% interstitial chlorite and sparse pyrite as crystals and aggregates to 2mm in diameter, commonly composite with rutile. Separate low temperature pyrite (melnikovite) and goethite patches occur and rare chalcopyrite occurs within low temperature pyrite. Some chlorite patches contain goethite outlining elliptical shapes (olivine?), but this sample has poor textural preservation and entirely metasomatic mineralogy. Rare quartz is present, partly as pressure shadows on pyrite.

This sample appears to represent original relatively melanocratic mafic rock. The assay is inconsistent with the thin section and suggests 25% ferroan dolomite. Some Mg-Fe carbonate may be present, however.



**Fig 1** **KORCH-007, 52m** 100 μm  
TS. PPL. (x100). Zoned rhombohedral carbonate crystals with interstitial chlorite in massive altered mafic material.



**Fig 2** **KORCH-007, 52m** 50 μm  
PTS. RPL. (x200). Pale yellow-white partly porous melnikovite pyrite ex-pyrrhotite, with grey rutile in a carbonate-rich zone.

**KORCH-007, 109m      Chlorite-carbonate-quartz-rutile-pyrrhotite-altered,      probable  
dolerite.**

### **Hand Specimen**

This sample has dark patches in a paler matrix.

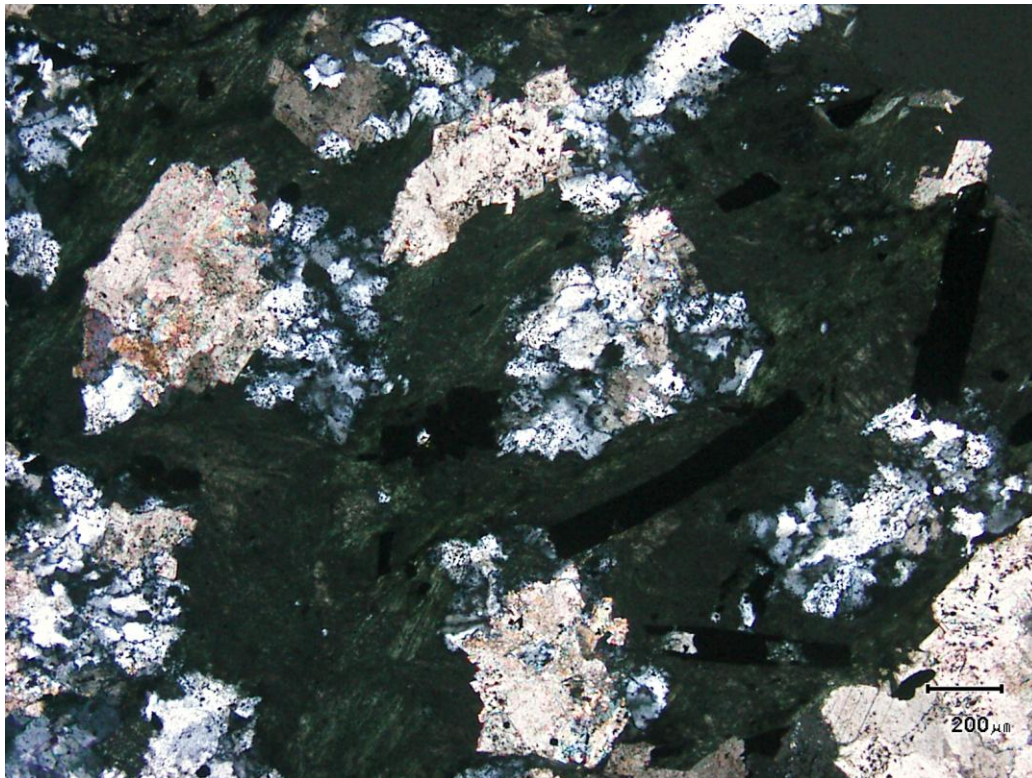
### **Thin Section**

This thin section has about 35% carbonate, mostly in vein-like lenses to 4mm wide but also in granular aggregates to 2mm in diameter. About 10% quartz occurs partly within or adjacent to carbonate-rich lenses and partly as aggregates to 3mm in diameter. Much of the quartz is irregularly clouded by leucoxene, but inclusions of leucoxene-free quartz or carbonate seem to represent euhedral crystals, formerly enclosed in possible pyroxene, probably clinopyroxene, or amphibole.

Much of the rock consists of foliated pale green almost isotropic chlorite with disseminated ilmenite as bladed crystals to 0.5mm long, partly or completely altered to rutile  $\pm$  quartz  $\pm$  pyrrhotite. There is also minor (2-3%) disseminated sulphide, mostly pyrrhotite with sparse chalcopyrite and very minor pentlandite as grains and 'flames' within pyrrhotite.

This sample appears to represent original dolerite, possibly with minor olivine represented by inclusions within leucoxene-clouded quartz. The assay suggests 28% carbonate.



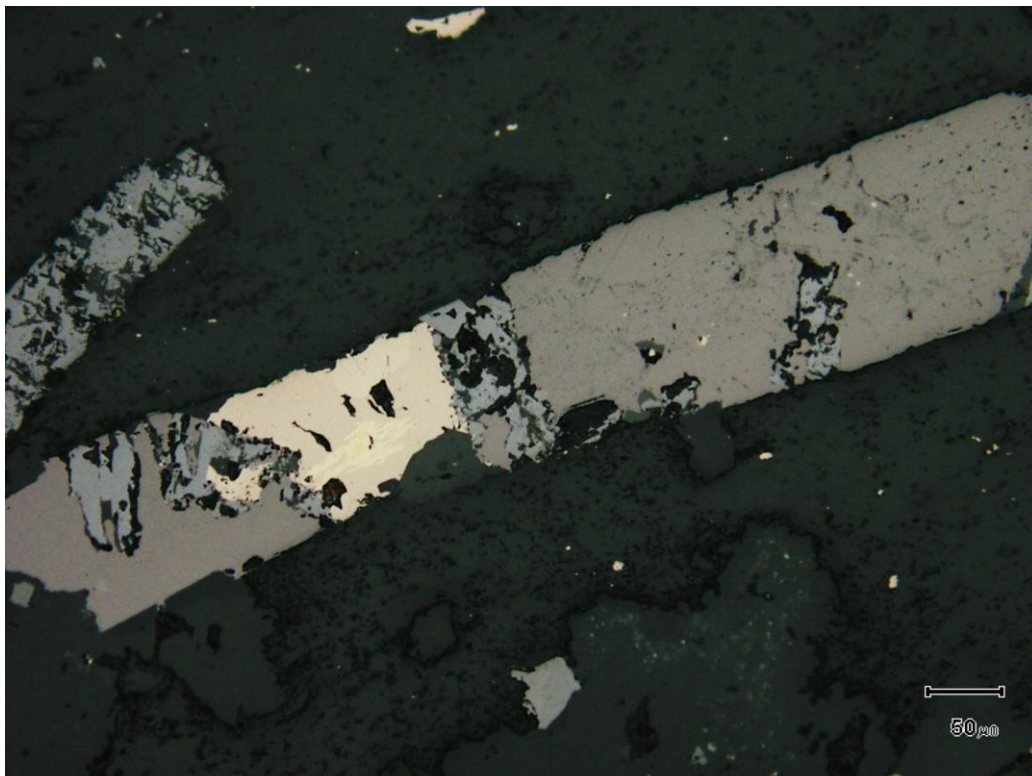


**Fig 3**

**KORC-007, 109m**

200 μm

TS. Xnic. (x50). Scattered pink carbonate and white quartz, clouded with leucoxene, in massive almost isotropic chlorite.

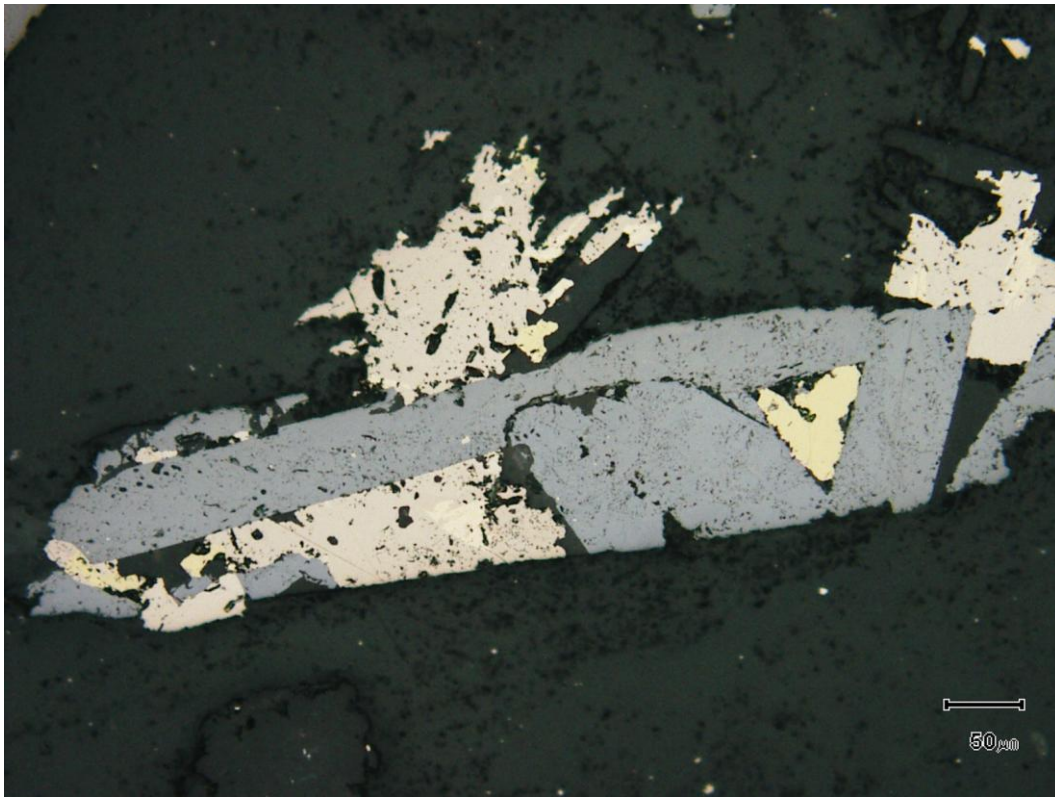


**Fig 4**

**KORC-007, 109m**

50 μm

PTS. RPL. (x200). Brownish grey ilmenite with inclusions of grey rutile, and of pale brown pyrrhotite containing microscopic 'flames' of pentlandite.



**Fig 5** **KORC-007, 109m** 50 µm  
PTS. RPL. (x200). Grey rutile crystals with pyrrhotite, yellow chalcopyrite and sparse cream pentlandite.



**KORC-008, 25m**      **Chlorite-carbonate-goethite-rutile-leucoxene-sulphide-altered, hyaloclastite. Probably mafic with low temperature pyrite and rare chalcopyrite.**

### **Hand Specimen**

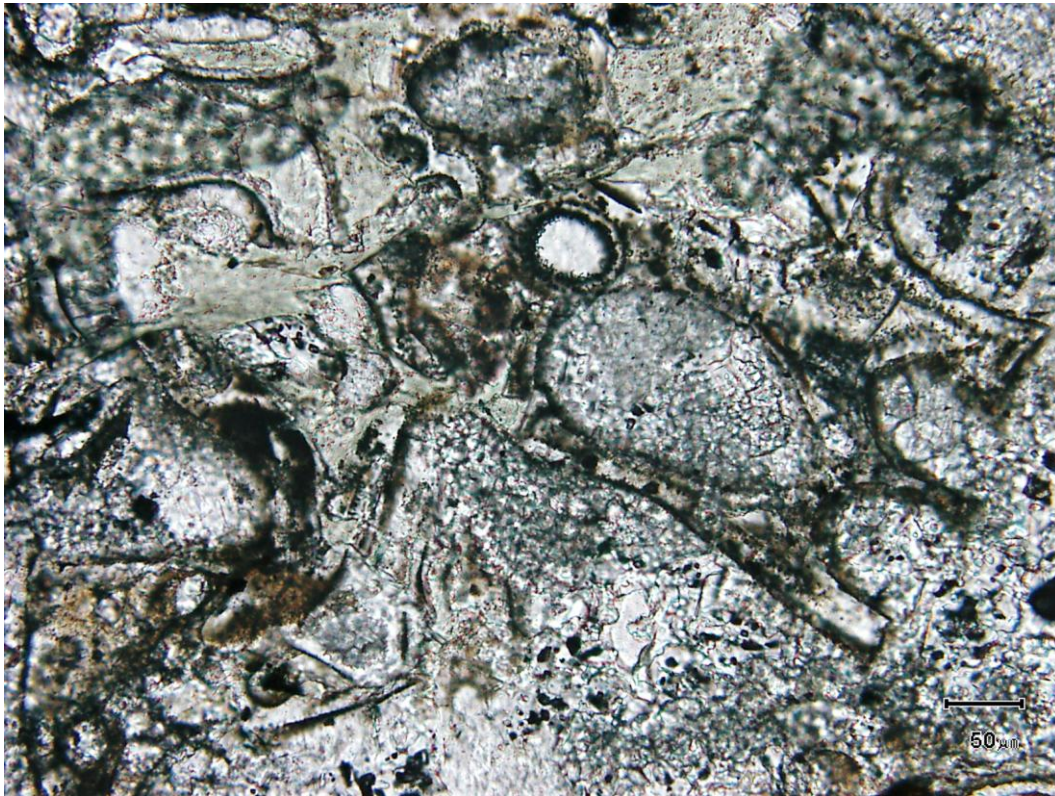
This sample is mottled but mostly grey but seems to be fragmental. It has minor sulphide.

### **Thin Section**

This sample has 25-30% inequigranular carbonate set in abundant chlorite. The carbonate is partly fine-grained, about 0.25mm in grain size, but also occurs as larger grains and aggregates to 2.5mm long. Aggregates of rutile and goethite are evident, to 3 or 4mm long, commonly enclosing low temperature pyrite, with sparse separate pyrite grains and rare chalcopyrite, mostly in low temperature pyrite.

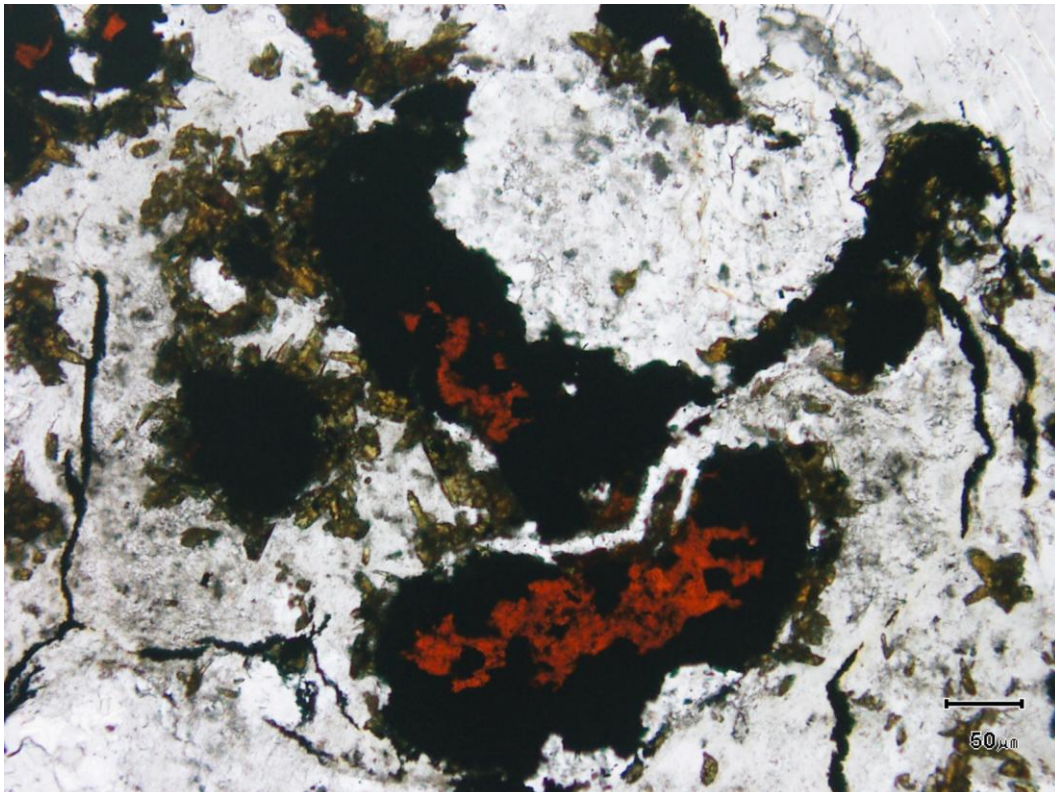
Small aggregates of very fine-grained rutile also occur, but the texture of the protolith, best seen in low-angle incident light, is outlined by leucoxene. This indicates unsorted shards and amygdaloidal or scoriaceous glassy basalt clasts of uncertain maximum size, possibly 2-3mm.

This sample represents altered hyaloclastite of mafic composition. The assay suggests 34% carbonate.



**Fig 6** **KORC-08, 25m**  
TS. PPL. (x200). Vesicular shard textures in carbonate-chlorite-altered hyaloclastite (or vitric tuff).

50 µm



**Fig 7** **KORC-08, 25m**  
TS. PPL. (x200). Orange goethite rimmed by black opaque low temperature pyrite, also small crystals of partly yellow rutile, all within carbonate.

50 µm

**KORCH-008, 42m      Chlorite-carbonate-quartz-leucoxene-rutile-altered    hyaloclastite  
with goethite, low temperature pyrite and rare chalcopyrite.**

### **Hand Specimen**

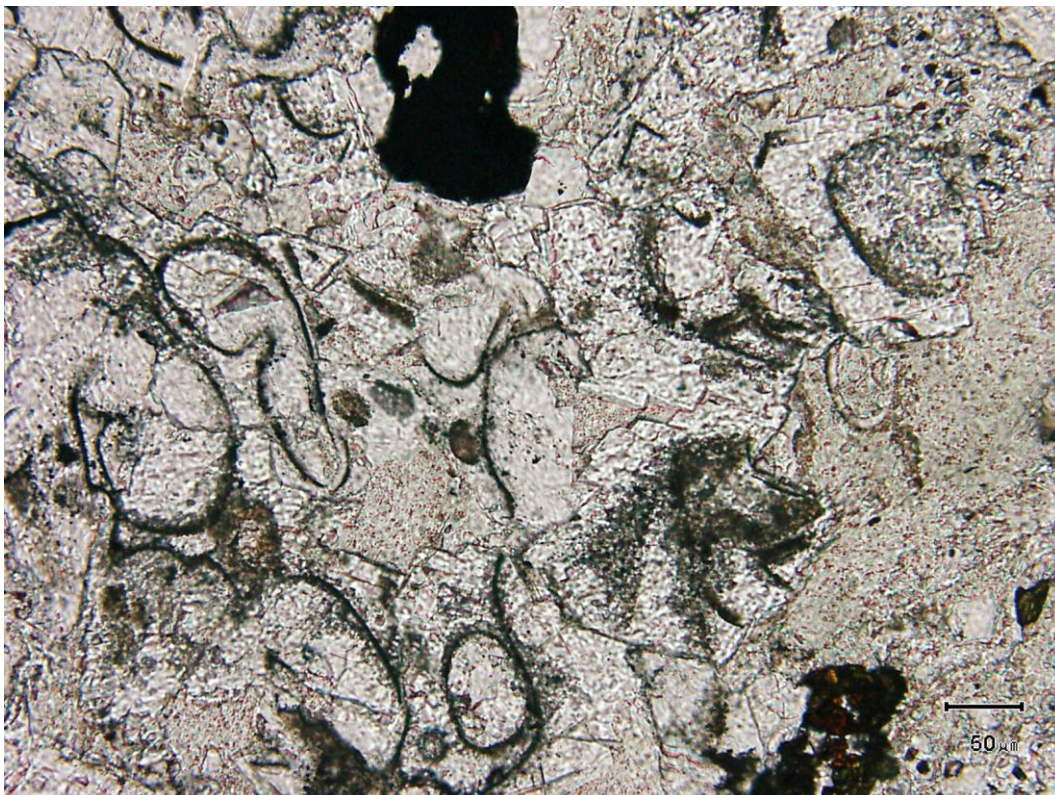
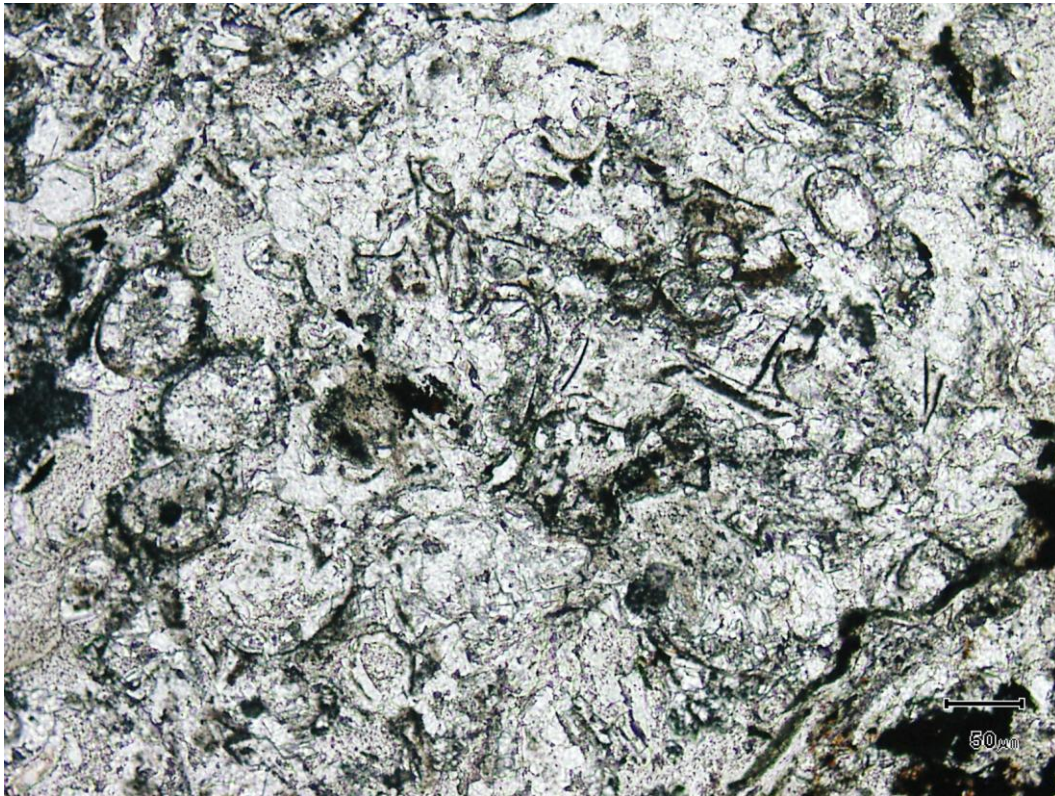
This sample is similar to that described above.

### **Thin Section**

There is mostly fine-grained carbonate in this thin section (40%) compared to the previous sample, in a matrix largely composed of chlorite (50-55%) plus 7-10% microcrystalline quartz in small lenses. Limonite occurs together with low temperature pyrite  $\pm$  chalcopyrite and rutile, with some pyrite also in filaments. Leucoxene defines small shards and amygdaloidal clasts to 2mm in diameter.

The overall composition is mafic. The assay suggests 33% carbonate.





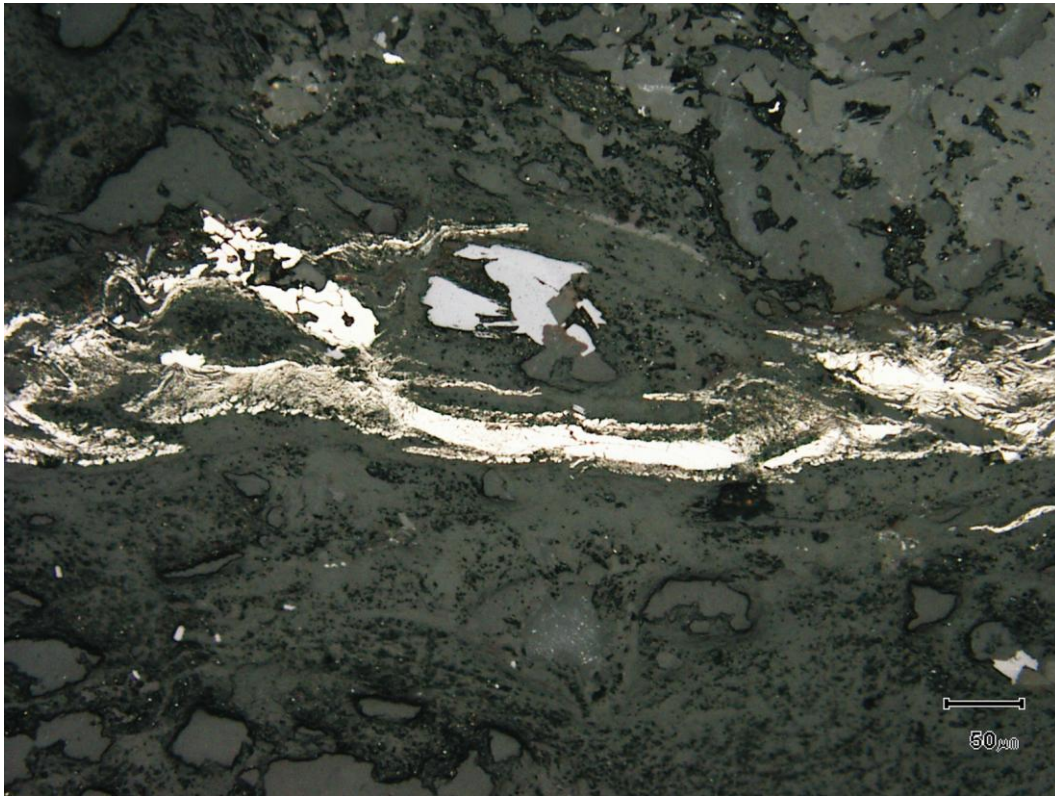
**Figs 8 & 9**

**KORCH-008, 42m**

TS. PPL. (x200). Amygdroidal and fragmental textures in carbonate-chlorite altered hyaloclastite or vitric tuff.

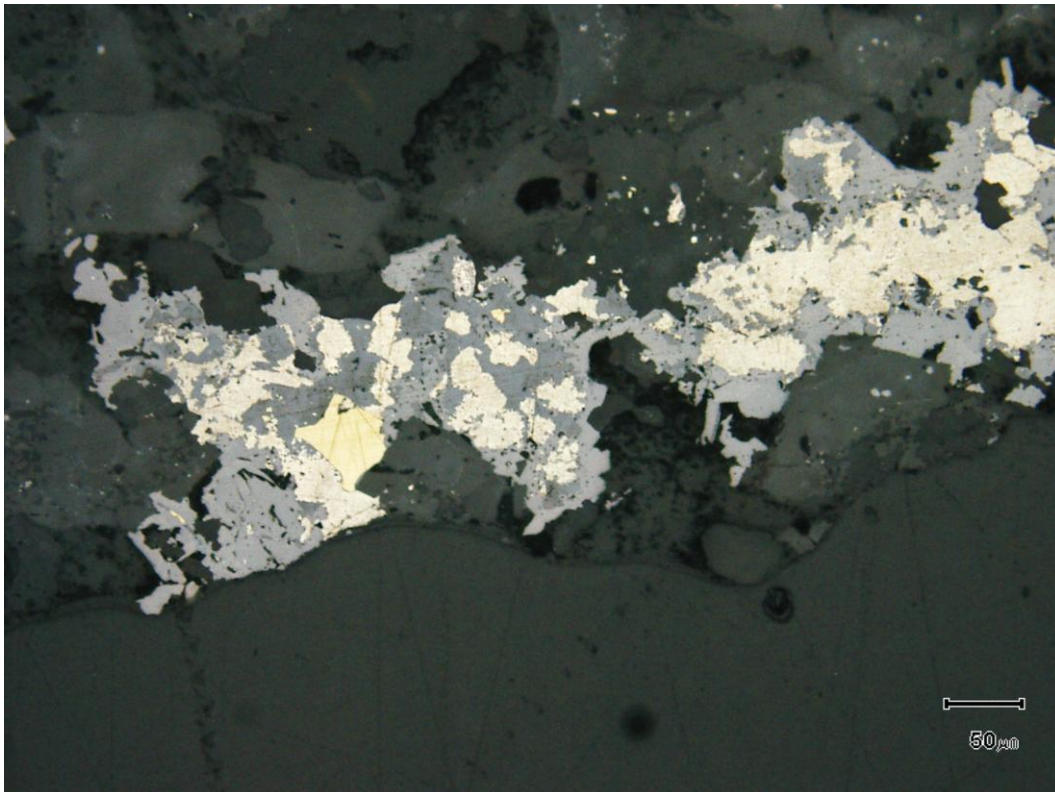
50 µm





**Fig 10** **KORCH-008, 42m**  
PTS. RPL. (x200). Fractures filled with low temperature pyrite: minor small grey crystals of rutile.

50 µm



**Fig 11** **KORCH-008, 42m**  
PTS. RPL. (x200). Composite of cream low temperature pyrite with yellow chalcopyrite, pale grey rutile and darker goethite, all in carbonate on the edge of the drill chip.

50 µm

**KORCH-008, 59m**      **Chlorite-carbonate-quartz-leucoxene-altered, hyaloclastite, with low temperature pyrite in patches with goethite, rutile and rare chalcopyrite and in fractures. Also rare chalcocite, covellite and bornite.**

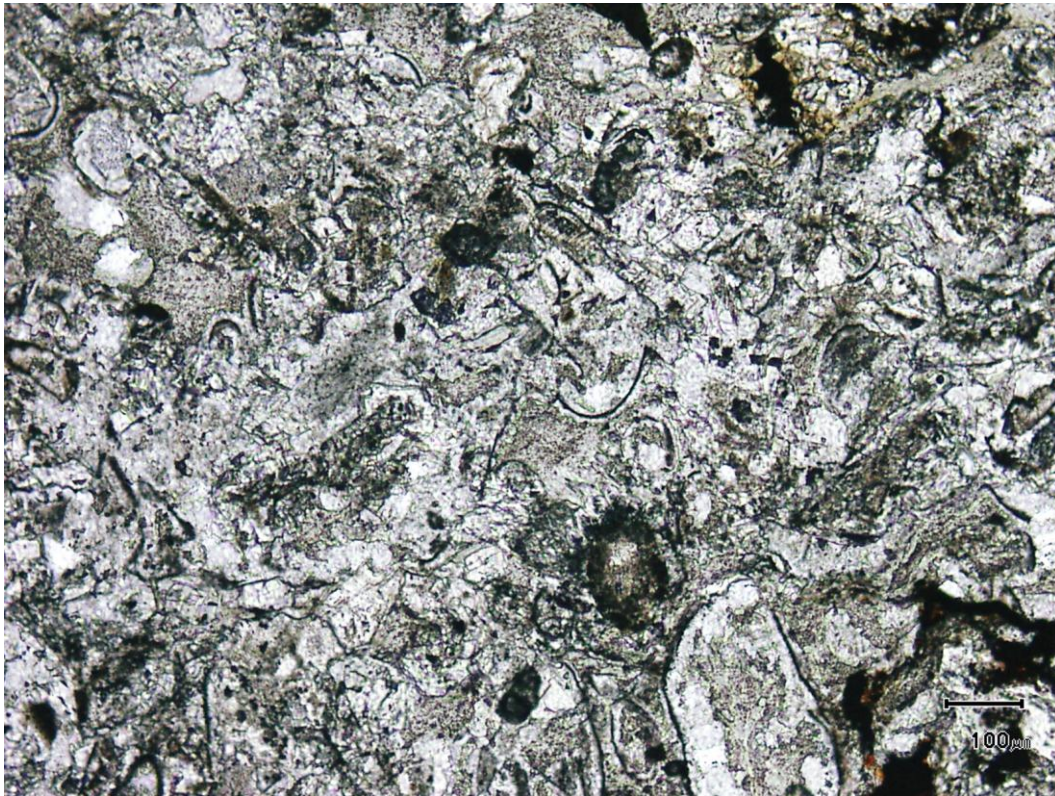
### **Hand Specimen**

This is again grey and mottled.

### **Thin Section**

This thin section has 35-40% carbonate, partly fine-grained but partly as much as 1mm in grainsize. There is also abundant (45%) chlorite and 15-20% irregularly disseminated quartz to 0.1mm in grainsize. The texture is again outlined by leucoxene with shards and amygdaloidal or scoriaceous clasts possibly as much as 6mm long (small lapilli). Scattered aggregates contain low temperature pyrite, rutile and goethite in various combinations. Limonite also accompanied rare microcrystalline aggregate of chalcocite, covellite and possible bornite, but chalcopyrite is rare. The assay suggests 40% carbonate.



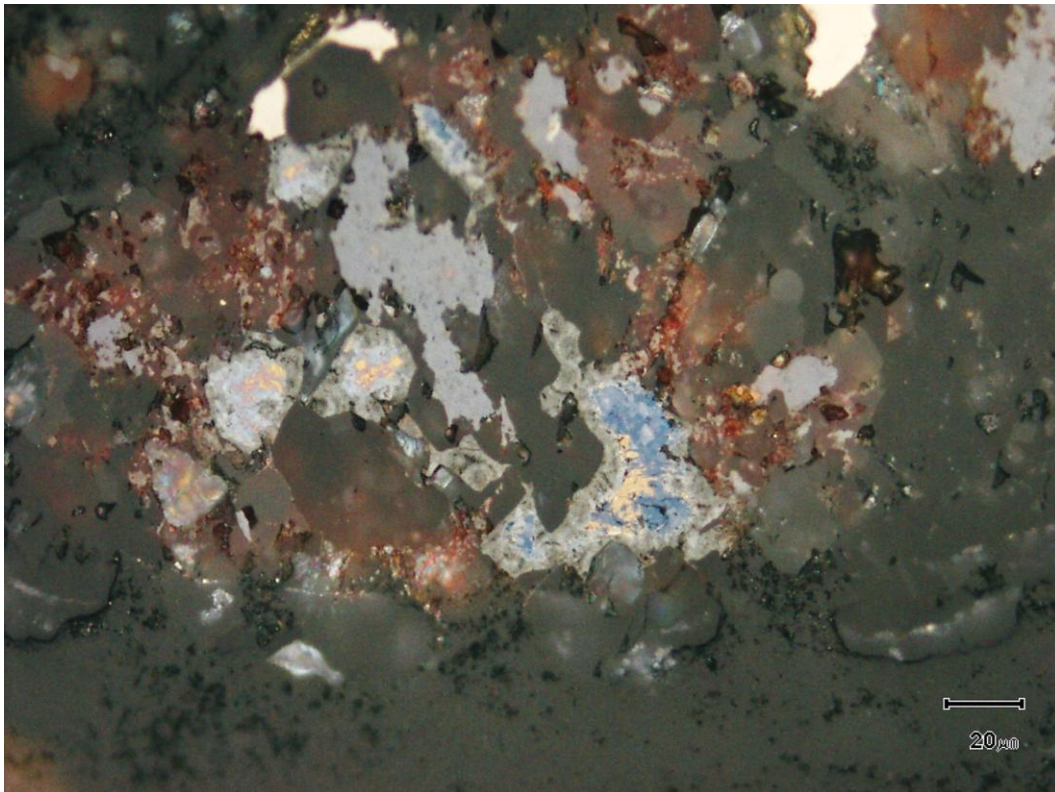


**Fig 12**

**KORCH-008, 59m**

100 µm

TS. PPL. (x100). Amygdaloidal and fragmental textures in altered hyaloclastite or vitric tuff.



**Fig 13**

**KORCH-008, 59m**

20 µm

PTS. RPL. (x500). Microcrystalline composite of copper sulphides: blue covellite, pale blue chalcocite, yellow chalcopyrite and brown bornite, with grey limonite/goethite in a carbonate-chlorite matrix.

**KORC-008, 105m      Carbonate-quartz-chlorite-rutile-pyrrhotite-pyrite-altered,  
poorly preserved lithology with minor leucoxene.**

### **Hand Specimen**

This sample is mottled and may have carbonate  $\pm$  quartz and/or chlorite.

### **Thin Section**

This sample has about 60% mostly granular carbonate to 1mm in grainsize with clouded rhombohedral carbonate rimming lenses with microcrystalline to very fine-grained quartz (20%) to 4mm long, possibly sediment-filled amygdales or rounded clasts of sediment. There are also lenses of isotropic chlorite to 5mm long (15%), and a patch of coarser quartz at least 5mm long.

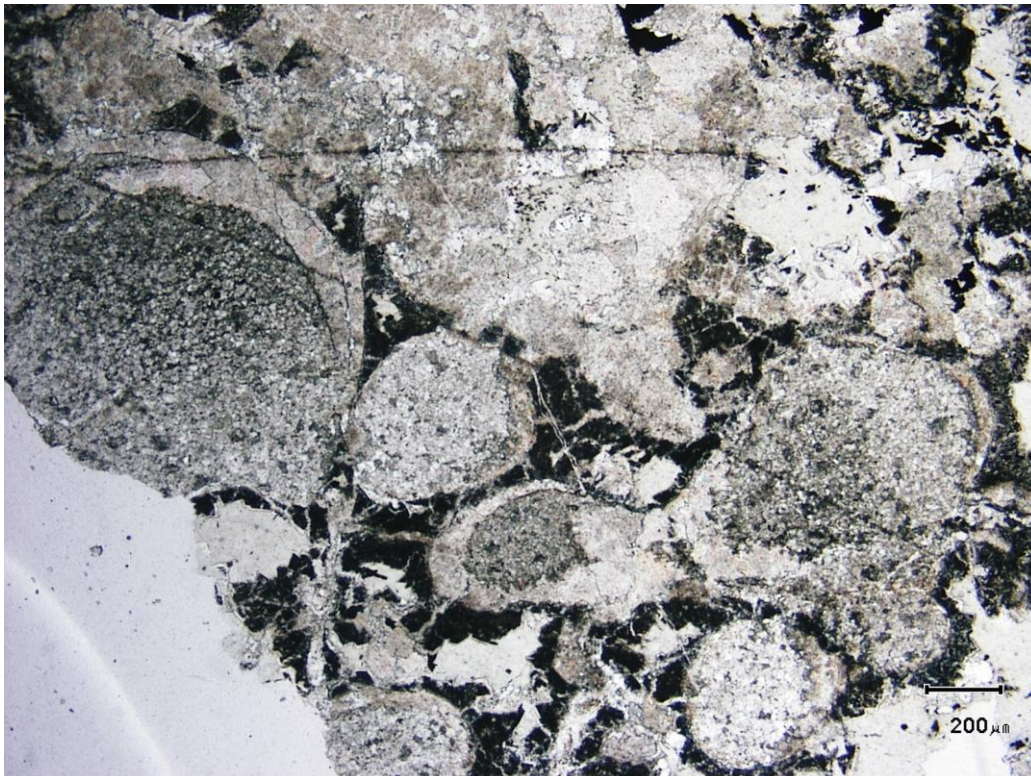
Some carbonate patches have poorly preserved textures outlined by leucoxene, but their origin is unclear. Minor components include rutile and sulphide. The sulphide is mostly pyrrhotite with minor pyrite but chalcopyrite was not seen.

The assay suggests 24% carbonate, if this is ferroan dolomite, but there may be Mg-Fe carbonate.





**Fig 14** **KORC-008, 105m** 200 μm  
TS. PPL. (x50). A dark, oxide-clouded volcanic clast with pale relict phenocrysts, all within carbonate in altered possible lithic-vitric tuff.



**Fig 25** **KORC-008, 105m** 200 μm  
TS. PPL. (x50). Clear and clouded carbonate with elliptical quartz-rich 'silty' aggregates, apparently filling amygdalae.





**Fig 16** **KORC-008, 105m**  
PTS. RPL. (x200). Pale brown pyrrhotite and white pyrite accompanied by grey rutile.

50 µm

**KORCH-008, 115m**      **Chlorite and quartz-rich areas with minor pyrrhotite, rutile and carbonate, partly derived from hyaloclastite. Possibly in contact with siltstone into which amygdaloidal clasts have been dumped. There is rare pentlandite and chalcopyrite.**

### **Hand Specimen**

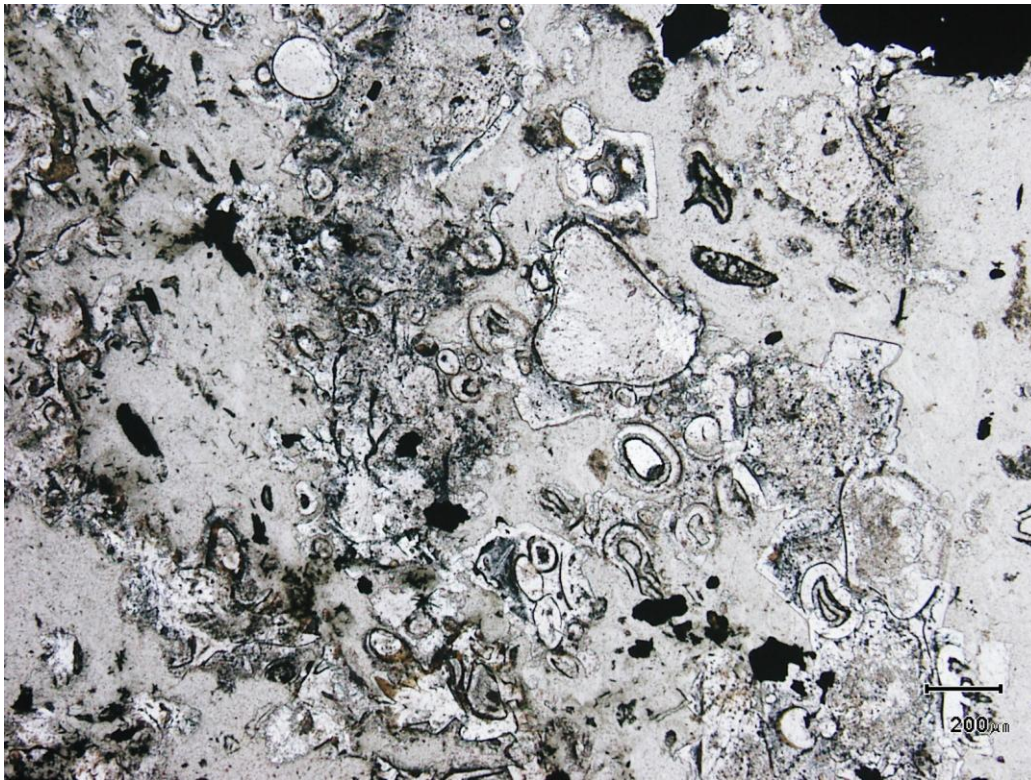
This sample has disseminated pyrite in a dark matrix

### **Thin Section**

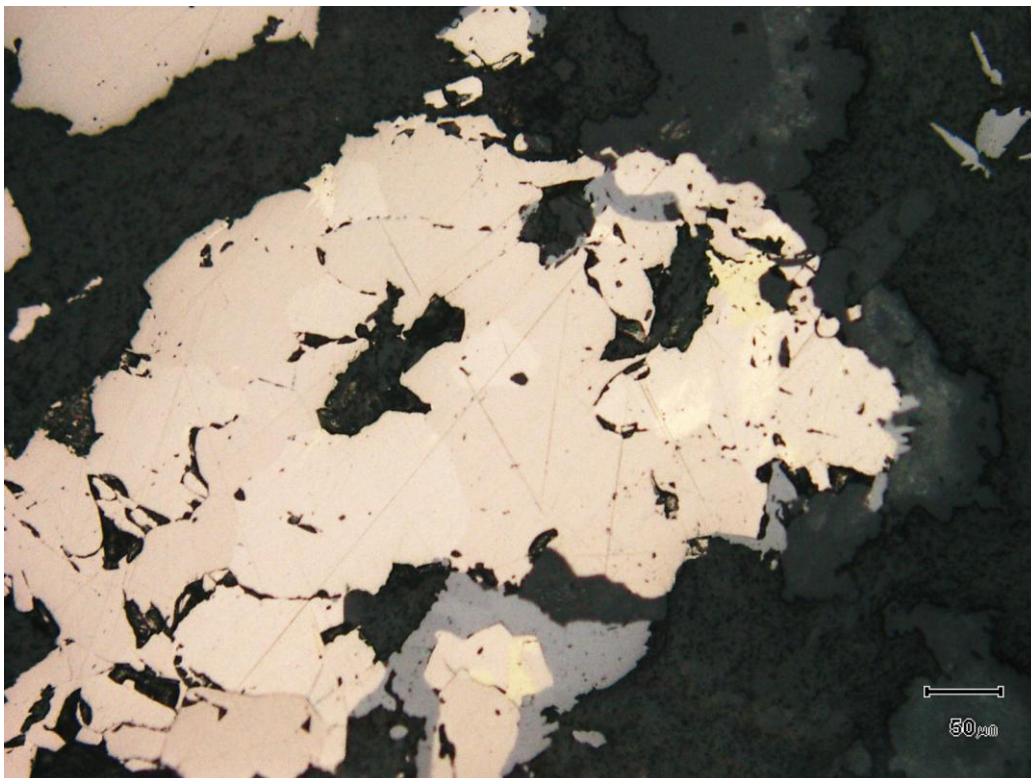
Most of this thin section is occupied by isotropic chlorite with disseminated carbonate, quartz and pyrite. One side of the chip is largely microcrystalline quartz. Parts of the quartz-rich zone and adjacent chlorite-rich areas contain leucoxene-rimmed former amygdaloidal shards, but these textures are largely lacking. The quartz-rich zone could represent altered siltstone with disseminated microcrystalline pyrrhotite and elliptical amygdaloidal volcanic clasts to 3mm long.

The main sulphide (4-5%) is pyrrhotite, commonly enclosing sparse chalcopyrite and/or sparse pentlandite and locally composite with rutile. Rutile has also replaced sparse ilmenite to 0.3mm long and is disseminated as small equant or elongate grains.

The assay results for this sample suggest much more carbonate (41%) than is represented in thin section.

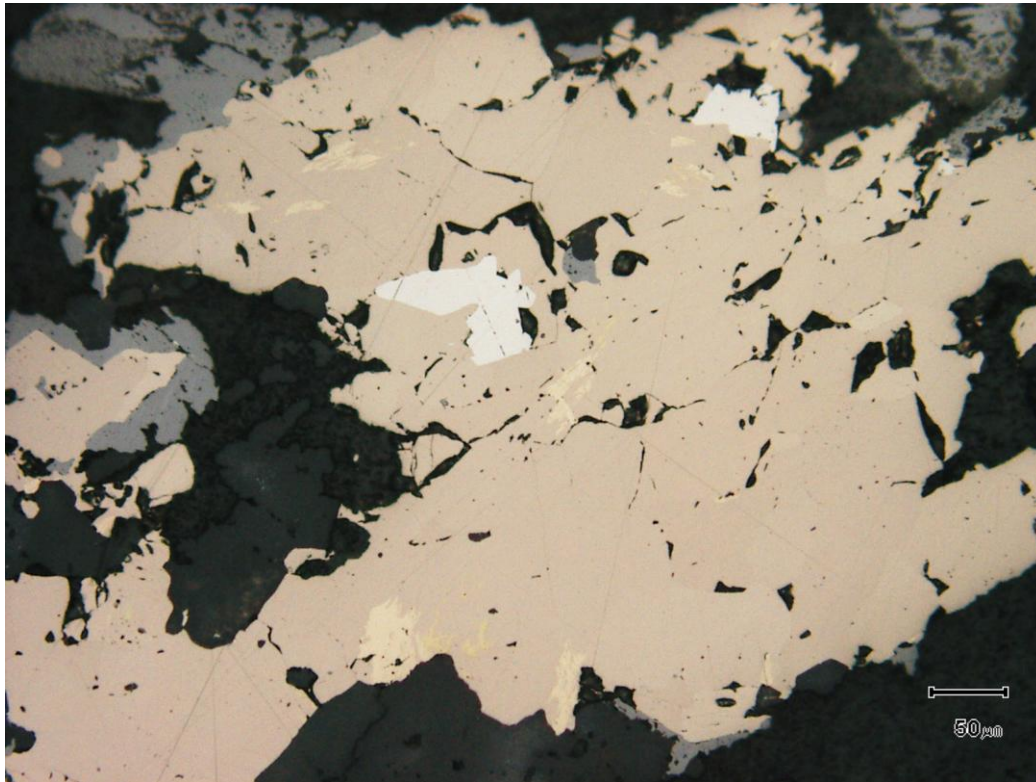


**Fig 17** **KORCH-008, 115m** 200 μm  
TS. PPL. (x50). Amygdaloidal and fragmental textures in chlorite-flooded hyaloclastite or vitric tuff with sparse carbonate.



**Fig 18** **KORCH-008, 115m** 50 μm  
PTS. RPL. (x200). Composite of pale brown pyrrhotite with grey rutile, pale yellow chalcopryite and cream sparse grains of pentlandite.





**Fig 19** **KORCH-008, 115m** 50 µm  
PTS. RPL. (x200). “Coarse” pyrrhotite with grey rutile and white pyrite (or arsenopyrite) and cream pentlandite as very small ‘flames’.



**Fig 20** **KORCH-008, 115m** 50 µm  
PTS. RPL. (x200). Composite of pyrrhotite, rutile, chalcopyrite, pyrite and sparse finer pentlandite.