PATHFINDER EXPLORATION PTY LTD
- GEOCHEMISTRY - PETROLOGY - GEOLOGY

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PETROGRAPHIC AND MINERAGRAPHIC DESCRIPTIONS

BRIEF PETROGRAPHIC DESCRIPTIONS

SAMPLE NO: PETRO - 1 **LOCATION:** Mt Hardy, Arunta Complex, NT

SAMPLE TYPE: Core

SECTION TYPE: Thin Section

FIELD IDENTIFICATION: Minor pyrite mineralisation occurring in a deformed quartz vein containing minor biotite.

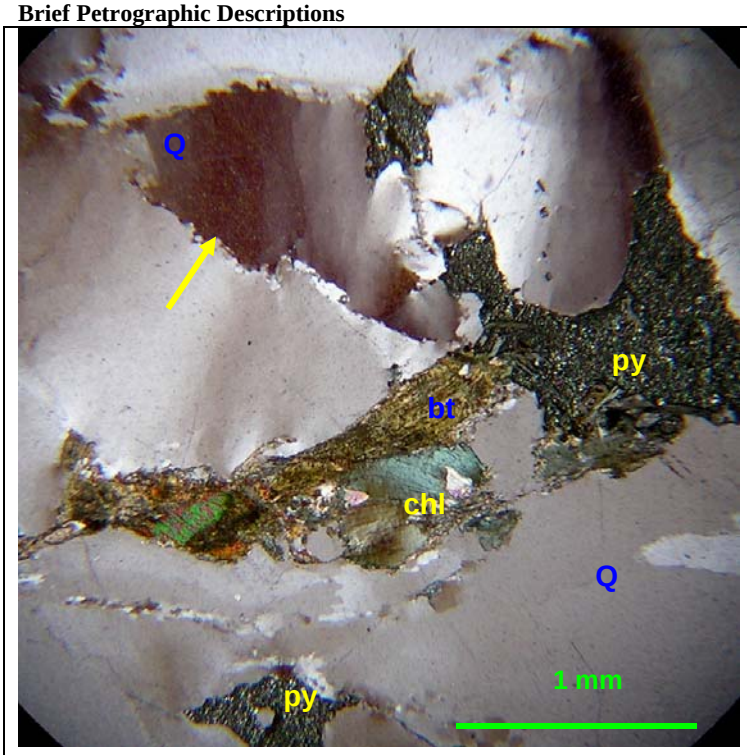
DESCRIPTION:

Quartz (vein)	94%
Biotite	1%
Muscovite	tr
Fe chlorite	2%
Clay	1%
Opaques – pyrite	2%
- chalcopyrite	tr

The quartz vein comprises a medium to coarse grained quartz mosaic associated with minor interstitial platy biotite and minor muscovite. Biotite has been progressively altered to Fe chlorite. Pyrite (opaque) represents a minor interstitial phase in the matrix and is closely associated with biotite that has been pseudomorphed by Fe chlorite and scaly clay.
The quartz vein has been deformed with attenuation of the quartz component that has developed ubiquitous sector or ribbon-like undulose extinction and serrated grain boundaries.
Pyrite in the vein exhibits simple intergrowths with trace chalcopyrite is apparent in reflected light.

Comments: The mineralised quartz vein contains minor pyrite associated with original biotite and probably has a hydrothermal origin. The vein may have a granitic origin. Gold could be expected to occur in the mineralised vein although this was difficult to confirm with a thin rather than polished thin section available.

CLASSIFICATION: *Deformed quartz vein associated with pyrite and minor original biotite. The mineralised vein probably has granitic affinities and may potentially host gold mineralisation.*



Sample Petro - 1

Pyrite (py) occurs interstitially in a quartz (Q) vein host. The quartz vein has been deformed with the development of ubiquitous undulose extinction and serrated grain boundaries (arrowed). Platy biotite (bt) forms part of the vein assemblage and has been locally altered to Fe chlorite (chl). Crossed polars under reflected and transmitted light. Field of view – 3 mm.

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SAMPLE NO: PETRO - 2 **LOCATION:** Mt Hardy, Arunta Complex, NT

SAMPLE TYPE: Core

SECTION TYPE: Thin Section

FIELD IDENTIFICATION: Possible native copper mineralisation occurring in a deformed quartz vein. A portion of the vein reacts strongly with dilute HCl.

DESCRIPTION:

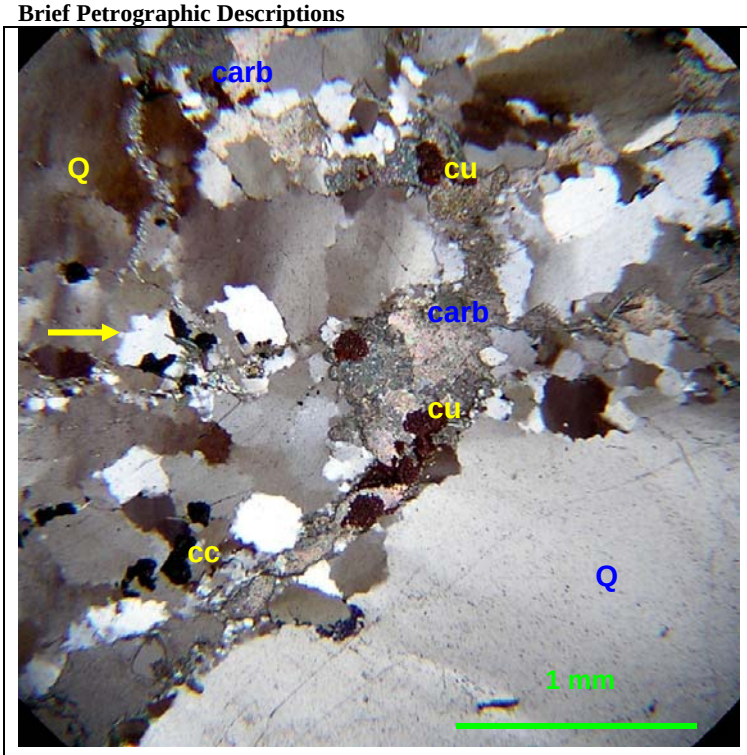
Quartz (vein)	91%
Biotite	tr
Muscovite/sericite	1%
Fe to Fe/Mg chlorite	3%
Carbonate – calcite	2%
Clay	1%
Opaques – chalcocite	1%
- native copper	1%

Like Sample Petro 1, the quartz vein has undergone deformation with the development of attenuated and ribbon-like anhedral quartz that exhibits ubiquitous undulose extinction and serrated grain boundaries. Portions of the vein have been recrystallised to a fine grained anhedral quartz mosaic. The phyllosilicate component in the matrix includes fibrous to platy Fe to Fe/Mg chlorite and platy muscovite that has been oriented parallel to the tectonic trend. Minor biotite has been preserved in the chlorite aggregates.

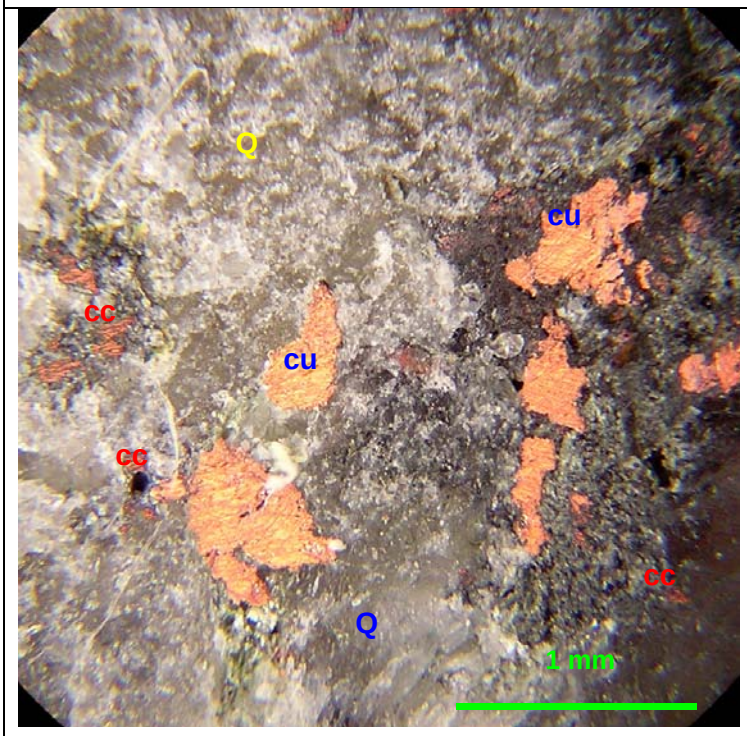
Minor anhedral chalcocite occurs as fine inclusions in the quartz vein and have probably replaced chalcopyrite in the weathering profile. A series of later carbonate veins have penetrated the deformed quartz vein host and can be associated with anhedral native copper blebs.

Comments: The mineralised quartz vein contains minor chalcocite, after original chalcopyrite and has undergone a strong tectonism, probably within a shear zone. Original biotite within the vein has been replaced by Fe to Fe/Mg chlorite. Carbonate veins have probably penetrated the vein in the supergene zone and are associated with native copper.

CLASSIFICATION: *Deformed quartz vein associated with chalcocite, after original chalcopyrite plus late carbonate veins containing native copper.*



Sample Petro - 2
The quartz (Q) vein has been locally recrystallised during deformation evidenced by the development of ubiquitous undulose extinction and serrated grain boundaries (arrowed). Minor chalcocite (cc) occurs within the vein that has been penetrated by carbonate – calcite (carb) associated with blebby native copper (cc). Crossed polars under reflected and transmitted light. Field of view – 3 mm.



Sample Petro - 2
Anhedral native copper (cu) and chalcocite (cc) occurring in the quartz (Q) vein host. The blebby native copper occurs in a later carbonate vein. Plane polarised reflected light. Field of view – 3 mm.

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SAMPLE NO: PETRO - 3 **LOCATION:** Mt Hardy, Arunta Complex, NT

SAMPLE TYPE: Core

SECTION TYPE: Thin Section

FIELD IDENTIFICATION: Mineralised (pyrite, chalcopyrite) quartz vein occurring in a meta-psammite host.

DESCRIPTION:

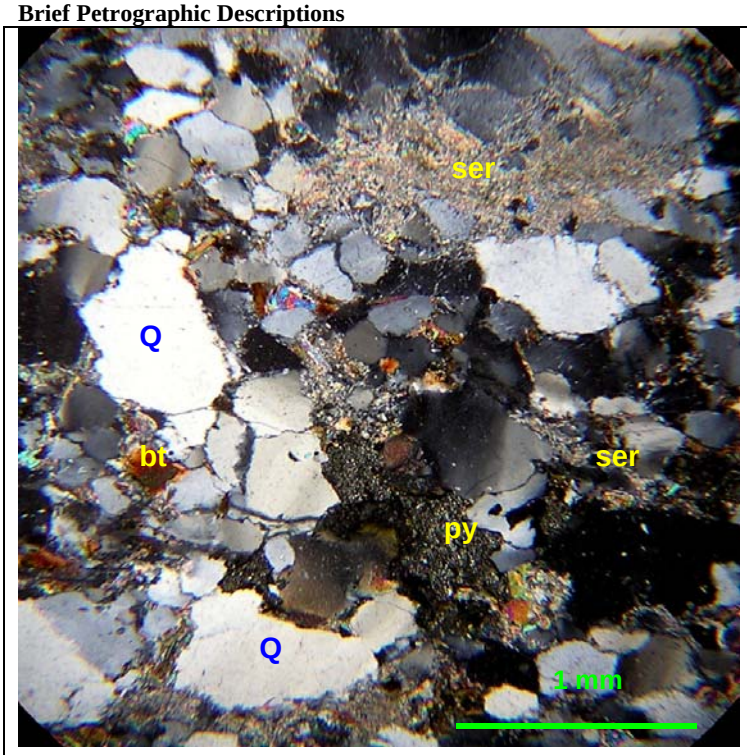
Quartz (vein)	15%
(matrix)	60%
Biotite	4%
Muscovite/sericite	13%
Fe chlorite	tr
Opaques – pyrite	1%
- chalcopyrite	7%

The mineralised quartz vein contains anhedral chalcopyrite (opaque) closely associated with a medium to coarse grained anhedral quartz mosaic that exhibits ubiquitous undulose extinction and the local development of serrated grain boundaries. The sulphides occur interstitially and can be associated with platy biotite that has been progressively replaced by scaly sericite and minor chlorite.
Relict, fine to medium grained (up to 1 mm) quartz grains have been stretched and attenuated in the meta-psammitic host. Platy biotite occurs interstitially and parallels a weak schistosity. Minor interstitial blebby sulphides include pyrite associated with chalcopyrite. Scaly sericite aggregates occur interstitially in the matrix and have clearly replaced biotite as a retrograde phase. Minor rounded xenotime grains are apparent and represent a relict detrital phase.

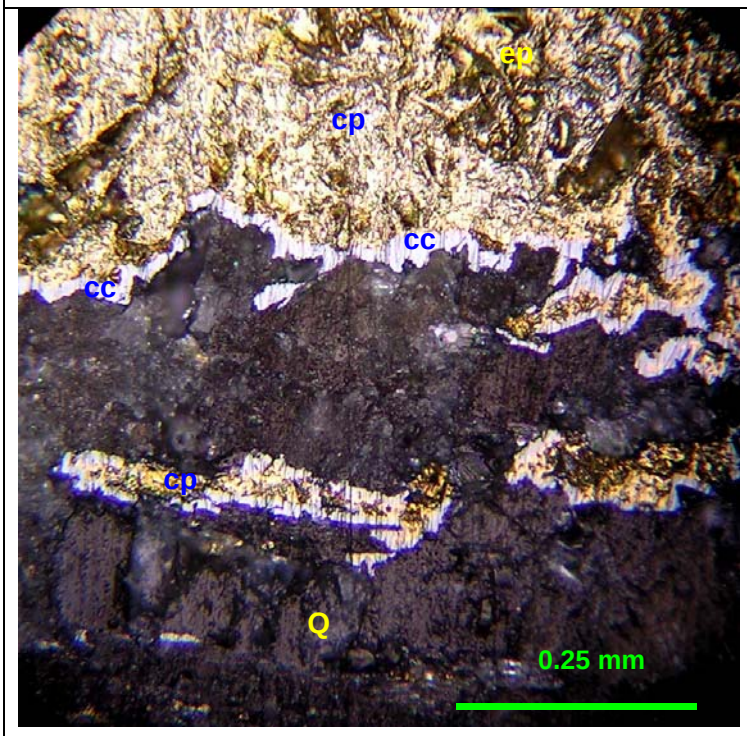
In reflected light, the quartz vein contains chalcopyrite associated with minor pyrite. Chalcopyrite has been rimmed by chalcocite as a supergene phase.

Comments: The quartz – rich psammitic host is stable under upper greenschist to lower amphibolite facies and has been subject to retrograde alteration with the replacement of biotite by sericite. The mineralised (chalcopyrite, pyrite) quartz veins would appear to have accompanied prograde metamorphism and have been clearly affected by the same retrograde alteration event.

CLASSIFICATION: *The metamorphosed psammitic host, stable under upper greenschist to lower amphibolite facies, has been penetrated by a mineralised (chalcopyrite, pyrite) quartz vein and subject to retrograde alteration (sericite).*



Sample Petro - 3
The psammitic host contains attenuated quartz (Q) grains exhibiting undulose extinction and associated with interstitial biotite (bt) that has been sericitised (ser) as a retrograde phase. Minor sulphides – pyrite (py) occur interstitally. Crossed polars under reflected and transmitted light. Field of view – 3 mm.



Sample Petro - 3
A detailed view under reflected light showing chalcopyrite (cp) rimmed by chalcocite (cc) in the quartz vein host. Plane polarised reflected light. Field of view – 0.75 mm.

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SAMPLE NO: PETRO - 4 **LOCATION:** Mt Hardy, Arunta Complex, NT

SAMPLE TYPE: Core

SECTION TYPE: Thin Section

FIELD IDENTIFICATION: Malachite has penetrated fractures in a deformed and mineralised quartz vein.

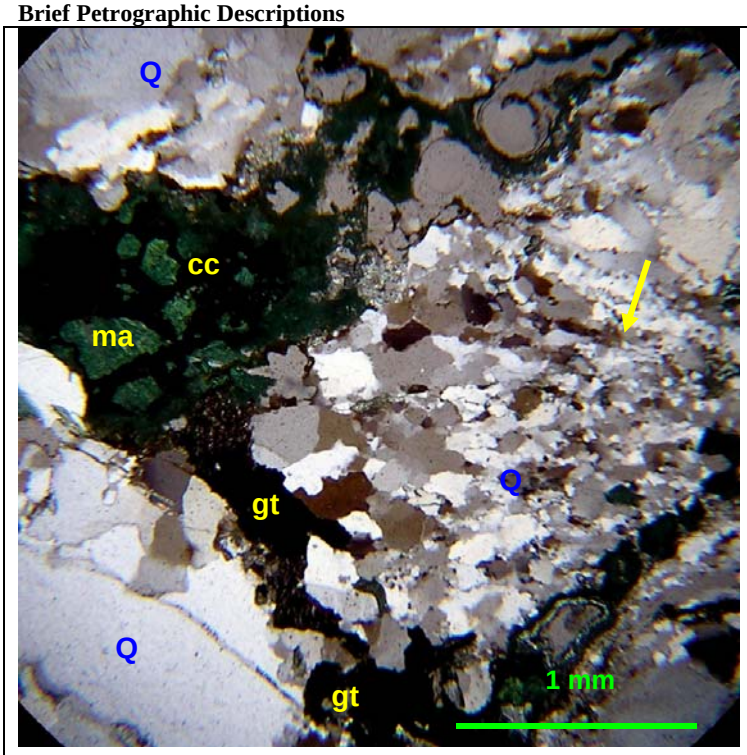
DESCRIPTION:

Quartz (vein)	91%
Biotite	tr
Muscovite/sericite	1%
Fe to Fe/Mg chlorite	3%
Carbonate – calcite	2%
Clay	1%
Opaques – chalcocite	1%
- native copper	1%

Anistropic deformation is apparent in the quartz vein host that comprises evidence of blebby sulphides that have been progressively oxidised to chalcocite and malachite in the weathering profile. The quartz vein comprises a medium to coarse anhedral quartz mosaic that exhibits ubiquitous undulose extinction, localised recrystallisation, serrated grain boundaries and the development of flaser-like textures of annealed – microcrystalline quartz aggregates paralleling the deformation trend. Recrystallisation of the quartz matrix and the development of annealed microcrystalline quartz aggregates typically border the relict sulphides in the matrix.

Comments: The mineralised quartz vein contained blebby sulphides – probably chalcopyrite that formed the focus for later deformation probably within a shear zone. The blebby sulphides have been oxidised to chalcocite, malachite and goethite in the weathering profile, with malachite penetrating along fractures in the host.

CLASSIFICATION: *Deformed quartz vein, originally containing blebby sulphides (chalcopyrite), that has undergone further deformation probably within a shear zone. The blebby sulphides have been oxidised to chalcocite, malachite and goethite in the weathering profile.*



Sample Petro - 4
Original blebby sulphides occur in a quartz (Q) vein host that has been locally recrystallised and annealed (arrowed) during deformation. The blebby sulphides have been oxidised to chalcocite (cc), malachite (ma) and goethite (gt) in the weathering profile. Crossed polars under reflected and transmitted light. Field of view – 3 mm.

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SAMPLE NO: PETRO - 5 **LOCATION:** Mt Hardy, Arunta Complex, NT

SAMPLE TYPE: Core

SECTION TYPE: Thin Section

FIELD IDENTIFICATION: Native copper mineralisation is associated with carbonate in meta-psammitic host. The samples reacts moderately to strongly with dilute HCl.

DESCRIPTION:

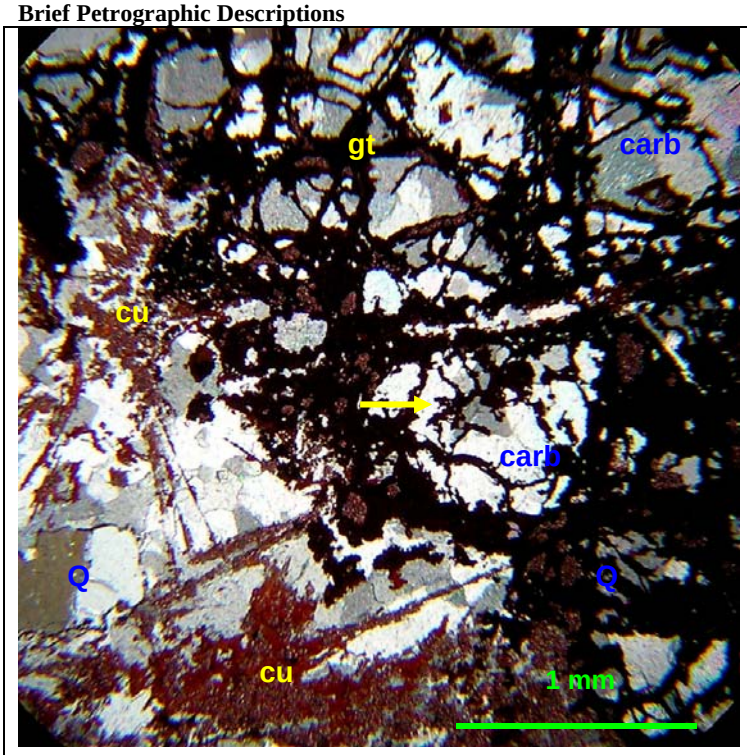
Quartz (vein)	11%
(matrix)	40%
Biotite	tr
Muscovite/sericite	28%
Carbonate – calcite	8%
Opaques – limonite/goethite	8%
- native copper	5%

Like Sample Petro 3, the mineralised vein occurs in a meta-psammitic host containing fine to medium grained (up to 0.5 mm) quartz that exhibits ubiquitous undulose extinction and occurs in a fibrous sericitic matrix. Fibrous sericite has replaced the original phyllosilicate component – probably biotite, as a retrograde alteration phase. Patchy carbonate has penetrated the matrix as part of the alteration overprint.

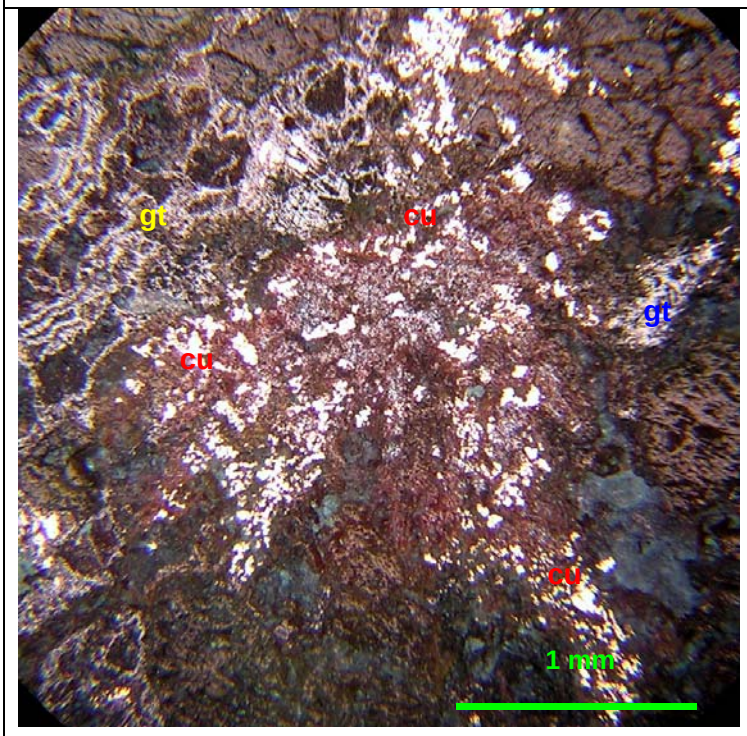
The mineralised vein comprises a medium to coarse grained anhedral quartz mosaic intimately associated with original sulphides that have been replaced limonite/goethite exhibiting boxwork textures. Carbonate has penetrated the mineralised vein and infills the boxwork textures. Native copper occurs as a residual phase and is typically hosted by limonite/goethite. Relict sulphides were not observed although the quadrilateral boxwork textures include fine network-like septa typical of chalcocite.

Comments: The mineralised quartz vein occurs in a meta-psammite host that was probably stable under upper greenschist to lower amphibolite facies but has been subject to a retrograde alteration overprint that includes sericite and carbonate. A mineralised quartz vein probably contained Cu – sulphides – chalcopyrite that has been progressively oxidised to chalcocite and native copper in the supergene zone. The introduction of carbonate, as part of the retrograde overprint, has probably initiated the deposition of native copper after original Cu sulphides.

CLASSIFICATION: *A mineralised (chalcopyrite?) quartz vein occurs in a meta-psammite host, initially stable under upper greenschist to lower amphibolite facies and overprinted by a retrograde alteration phase (sericite, carbonate). Retrograde alteration and oxidation within the supergene zone has produced native copper after the original sulphides.*



Sample Petro - 5
Carbonate (carb) has penetrated the limonite/goethite (gt) boxwork textures after original sulphides. The presence of fine network – like septa (arrowed) favour a chalcocite origin. Native copper (cu) occurs as a residual phase. Crossed polars under reflected and transmitted light. Field of view – 3 mm.



Sample Petro - 5
Another view under plane polarised reflected light showing residual native copper (cu) rimmed by cellular limonite/goethite (gt) boxworks. Field of view – 3 mm.

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