Applied Petrological Services

PETROLOGICAL STUDIES
OF
DIAMOND CORE
FROM
THE SUNLINE PROSPECT

FOR
NEWMONT EXPLORATION PTY LTD

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SUMMARY

1. A gold-arsenic association is evident in early pre peak-metamorphic quartz veining hosted by sheared and deformed mafic volcaniclastic mudstones and silty mudstones and minor basalt intersected in a single diamond drill hole at the Sunline prospect.

2. There is good evidence for mobilisation of copper and arsenic as a result of local metasomatism in relation to peak-metamorphic and tectonic overprinting of the gold-bearing quartz-arsenopyrite veining. This is to suggest that further investigations would also reveal mobilisation of gold in line with other prospects with similar quartz vein and metamorphic overprinting paragenesis in the Tanami region.

3. In the absence of any preserved silicate wallrock replacement assemblages, the distribution of arsenopyrite in the wallrock immediately peripheral to metamorphosed and tectonically overprinted gold bearing quartz + arsenopyrite veins defines alteration halos. The distribution of arsenopyrite in the wallrock provides evidence of protore fluid-wallrock interaction, and a means for mobilisation of iron into the vein forming environment where the presence of locally derived iron and arsenic introduced by hydrothermal fluids facilitated the formation of abundant arsenopyrite. The availability of iron in the mafic metasediments and mobilisation into fracture systems is thought to be the main controlling factor in the formation of arsenopyrite-rich vein/cement assemblages.

4. Peak metamorphic replacement mineralogy in the wallrock host to quartz veining, is masked by extensive retrograde chlorite and illite some of which is apparently genetically related to post peak-metamorphic quartz veining. The pervasive chlorite dominated overprint is in part testament to a preferential focus of ongoing tectonism within the predominant meta-mudstone lithologies.

5. The post peak metamorphic quartz veining may be differentiated from the pre peak metamorphic quartz veining by a predominance of brittle deformation within plastically deformed chlorite-rich metasediments, and a relative absence of arsenopyrite either within or peripheral to quartz veining.

INTRODUCTION

Four samples were collected from the Sunline prospect for petrological studies. The four samples taken from various depths down diamond hole HYD003 were petrographically and mineragraphically analysed as part of a continuing petrological review of the Sunline deposit (26024).

Preliminary petrological studies (26024) found that mainly interbedded mudstones and siltstones host structurally controlled hydrothermal alteration and mineralisation. Minor amounts of feldspathic and quartz sandstone was found amongst the metasediments, with the metasediments overlying or intruded by basalt in the lower part of the diamond core intersection. All hydrothermal alteration and mineralisation resolvable at the scale of investigation, together with unaltered wallrock lithologies were interpreted to be thermally and tectonically overprinted. It was considered that the grade of thermal overprinting might be less than that at Hyperion (and Groundrush), the exact nature of which is not resolvable in hand-specimen. Metamorphic K-feldspar was determined to be present in the sandstone, amphibole in the basaltic rock, and chlorite and possible amphibole and biotite in the mudstones and siltstones. Recrystallised quartz and carbonate were determined to comprise the thermal overprinting of the hydrothermal deposition assemblages. At the scale of investigation, no post peak-thermal hydrothermal alteration and mineralisation were found to be evident, although retrograde chlorite after peak metamorphic biotite was considered to be present.

The preliminary studies included comment that the character of veining and differences in style and geometry in comparison with the Hyperion prospect appear to have been determined by the nature of the host rock. Dilational structures and brecciation at Sunline have occurred preferentially along bedding plane parallel or near parallel shears within (pre-hydrothermal, regional metamorphic) chloritic altered mudstones and siltstones. At Hyperion the nature of fracturing and preparation for hydrothermal fluid flow were influenced by deformation of a sequence of relatively competent and voluminous basalt flows. The presence of both arsenopyrite and chalcopyrite in the thermally overprinted hydrothermal system at Sunline was not considered significant in terms of defining a difference with the Hyperion prospect. What was possibly considered significant, is the local high concentration of arsenopyrite in the Sunline veins, in places comprising much greater than 50% of the vein/cement assemblages (together with quartz and carbonate). The limited amount of sandstone present amongst the sediments at Sunline was suggested to be an equivalent of the more voluminous sandstone present at the Groundrush deposit, complete with abundant secondary (peak metamorphic) alkali feldspar.

The scope of the current study is to investigate in detail aspects of the relationships between hydrothermal alteration and metamorphism, quartz vein paragenesis and gold paragenesis, as well as confirm the presence of a metamorphosed basalt rock type, and possible detrital composition/provenance of the sedimentary rocks.

RESULTS

TABLE 1. PETROGRAPHIC/MINERAGRAPHIC SUMMARY			
Sample	**Comment**	**Lithology and Replacement**	**Deposition**
26027.01 HYD003/ 205.9 m 06406	The vein has been pulled apart rather than boudinaged as a result of bedding plane parallel shearing in a lower temperature and brittle strain regime. Much of the unresolvable detrital material may be of mafic volcanic provenance. An apparent absence of biotite in the overprint assemblage may be a function of wallrock chemistry.	Volcaniclastic mudstone 1.(met) quartz, alkali feldspar , arsenopyrite 2.chlorite, illite/sericite, pyrite, rutile	1.(veinlet) quartz, arsenopyrite, rutile; chlorite, biotite (→ chlorite, illite, quartz 2.(vein) quartz, pyrite, chalcopyrite; quartz, sericite, chlorite, chalcopyrite
26027.02 HYD003/ 189.2 m 06407	Arsenopyrite records a brittle response to deformation whereas quartz has deformed plastically. Ghosted alkali feldspar and possible cordierite are concentrated at vein-wallrock margins, and in discrete quartz + alkali feldspar + arsenopyrite + chlorite ± biotite veinlets. Some amounts of the chlorite in the wallrock may be after biotite.	Volcaniclastic silty mudstone 1.(met) quartz, ?arsenopyrite 2.chlorite, sericite/illite	1.(vein/cement) quartz, apatite, arsenopyrite, pyrite, alkali feldspar (→sericite), ?cordierite (→ chlorite, sericite), native gold; quartz, chalcopyrite, biotite (→ sericite, chlorite), chlorite, carbonate 2.(veinlet/cement) quartz, alkali feldspar, biotite (→sericite, chlorite), chlorite, arsenopyrite, rutile, apatite
26027.03 HYDD003 / 215.7 m	Early quartz veinlets have been plastically deformed together with metamorphic overprinting of the wallrock. Peak metamorphism is represented by ghosted fibrous amphibole. A chloritic overprint to peak metamorphism is related to late quartz veining and shearing.	Doleritic basalt 1.(met) actinolite/tremolite, quartz, rutile 2.sericite/illite, chlorite, pyrite	1.(veinlet) quartz; chlorite, apatite, rutile 2.(vein/veinlet) quartz, pyrite, chlorite, chalcopyrite, carbonate 3.(shear) chlorite, quartz
26027.04 HYD003/ 189.3 m	Pervasive chlorite and sericite/illite overprint an early wallrock replacement assemblage comprising alkali feldspar. Deformation and thermal overprinting of an early quartz + arsenopyrite vein assemblage is represented by recrystallisation of quartz and fracturing of arsenopyrite. Ghosted alkali feldspar is also part of the recrystallised vein assemblage.	Mafic volcaniclastic rock 1.(met) quartz, alkali feldspar, rutile 2.chlorite, pyrite, rutile	1.(vein/cement) quartz, arsenopyrite, rutile, apatite, alkali feldspar (→ sericite/illite); chlorite, biotite (→ illite, chlorite), chalcopyrite, quartz 2.(veinlet) quartz, alkali feldspar (→ sericite, chlorite) arsenopyrite, apatite; biotite (→ sericite, chlorite), rutile, chalcopyrite

WALLROCK TYPES AND METAMORPHISM

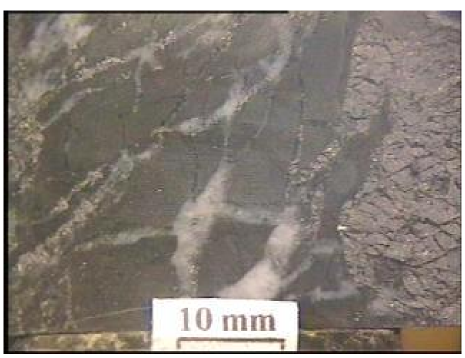
The petrology of sample 26027.03 confirms the presence of a metamorphosed and hydrothermally altered basaltic rock intersected lower within the diamond hole. Peak metamorphic replacement mineralogy dominated by pervasive fibrous amphibole (actinolite/tremolite) formed after pyroxene and interstitial glass is itself completely replaced by pervasive chlorite intergrown with ultra fine-grained quartz. The pervasive chlorite and quartz is locally related to late, post peak metamorphic hydrothermal alteration centred upon late quartz veining, but may be more widely related to retrograde metamorphism that was concurrent with the late hydrothermal alteration.

Left. 26027.01. 1200 µm ppl. Fragmental texture and lamination ghosted secondary feldspar or cordierite crystals.

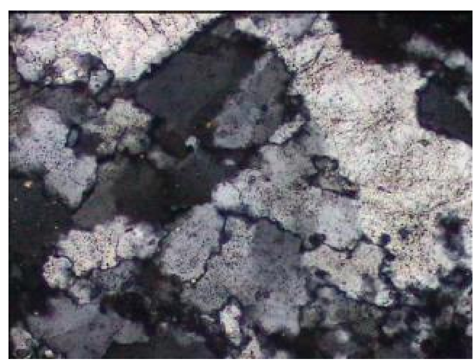
Right. 26027.03. Ghosted feldspar and pyroxene ghosted fibrous actinolite after the latter. 1200 µm. ppl.

The provenance of the mudstone to silty mudstone lithologies is not readily resolvable as a result of both metamorphic and hydrothermal overprinting. Some minor amounts of detrital quartz are determined to be present; otherwise the majority of the silt to less-than silt-sized detrital fragments might be interpreted to be mainly of mafic volcanic provenance on account of the predominance of mafic metamorphic and hydrothermal replacement minerals. Present amongst the replacement mineralogy are ghosted alkali feldspar crystals, completely replaced by late sericite/illite that is part of a retrograde metamorphism or more localised hydrothermal overprint. Ghosted plates of biotite, altered to chlorite and sericite/illite are present. As well as pyrite, grains of arsenopyrite are dispersed about the secondary silicate mineralogy, however attributing the arsenopyrite to any particular stage of replacement is difficult. The arsenopyrite appears to predate a late retrograde chlorite + sericite/illite alteration, and probably a peak metamorphic replacement assemblage represented in part by (ghosted) biotite, alkali feldspar and recrystallised detrital quartz. The arsenopyrite in fact has a close spatial association with early quartz + arsenopyrite veining.

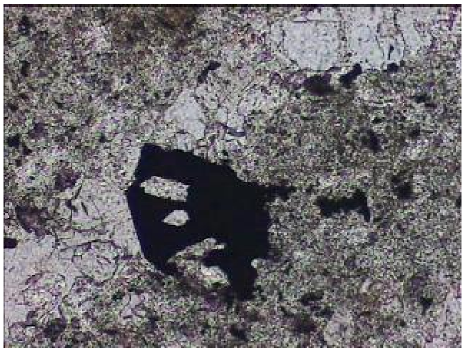
VEIN/CEMENT MINERALOGY AND TEXTURES



Left. 26027.02. Thermally and tectonically overprinted quartz + arsenopyrite cemented breccia in mudstone host. Right. 26027.02. Locally porphyroclastic textured and generally recrystallised early quartz veining of early arsenopyrite association. 600 µm. cpl.

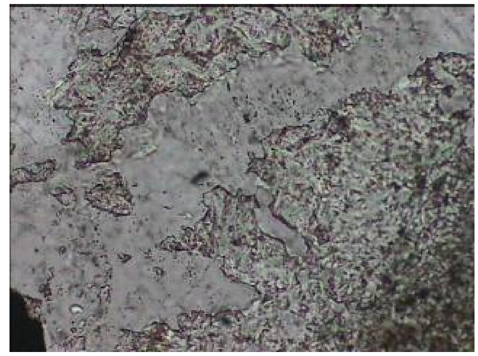


Paragenetically earliest veining and breccia cement comprises variably voluminous quartz and arsenopyrite. Minor associated and preserved vein/cement mineralogy includes rutile and chalcopyrite. Where the quartz has been extensively recrystallised and plastically deformed in conjunction with peak metamorphism of the wallrock, arsenopyrite has been subjected to extensive brittle fracture and brecciation. Any associated hydrothermal wallrock replacement has been overprinted by peak metamorphic mineralogy. In association with recrystallisation, quartz is intergrown with interstitial chlorite, biotite (altered to chlorite and sericite), apatite, carbonate and alkali feldspar, some or all of which may have formed after early mica vein/cement mineralogy. Alkali feldspar, biotite and chlorite are typically concentrated at vein-wallrock margins.

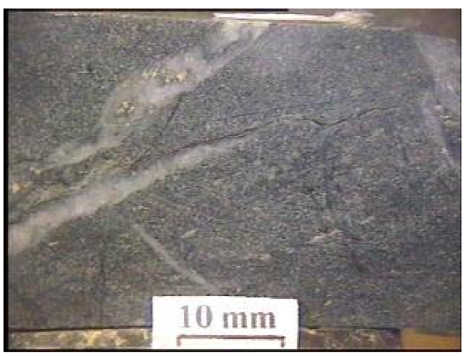


Left. 26027.04. Secondary quartz + alkali feldspar (→ illite) + arsenopyrite + apatite + chlorite + biotite veinlet. 600 μm. ppl

Right. 26027.02. Ghosted alkali feldspar at vein-wallrock margin. 300 μm. ppl.



The alkali feldspar and biotite/chlorite at vein/wallrock margins link with secondary microfractures filled with very fine-grained quartz, arsenopyrite, rutile, alkali feldspar (→ illite), chlorite and biotite (→ chlorite, illite). These veinlets in turn link with fluid inclusion trails in recrystallised quartz and microfractures in "framework" arsenopyrite filled with quartz, biotite (→ chlorite, illite), chlorite, carbonate, apatite and secondary arsenopyrite, pyrite and chalcopyrite. Some of these veinlets in arsenopyrite link with partly annealed microfractures in quartz along which carbonate, biotite/chlorite, rutile and very fine-grained arsenopyrite are concentrated. Secondary fluid inclusions spatially associated with the secondary veining comprise abundant gas-rich/filled CO_2-bearing types co-existing with less abundant aqueous liquid-rich types.



Left. 26027.03. Second stage quartz veining hosted by basalt.

Right. 26027.03. Typically well preserved and relatively unmodified euhedral to subhedral quartz of second-stage, post peak metamorphic veining. 1200 μm. cpl.

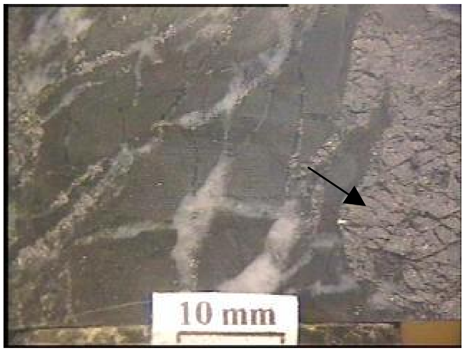
Present in two samples (26027.01 and 26027.03) of the current petrology suite is quartz veining which post-dates peak metamorphism. The quartz in this stage of veining has well preserved euhedral to subhedral quartz morphologies, and deformation is confined to shears and relatively restricted domains of recrystallisation represented by very fine to ultra fine grained quartz. Chlorite is interstitial to the quartz together with sericite/illite. Aqueous liquid-rich types dominate secondary fluid inclusions contained along annealed microfractures. This style of veining is spatially associated with the pervasive chlorite and sericite/illite overprint to peak metamorphic replacement mineralogy within the wallrock.

Left. 26027.03. Folding of early vein cross-cut by later quartz vein style. 1200 μm. ppl.

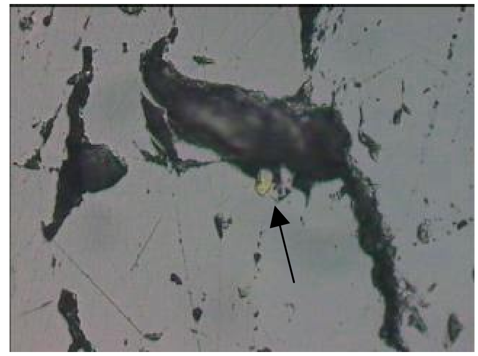
Right. 26027.01. Brittle fracturing of second-stage vein in association with plastic deformation of chlorite-rich mudstone.

Deformation of the post peak-metamorphic quartz veining is in contrast to the pre peak-metamorphic quartz veining. Whereas the early quartz veining had undergone mainly ductile deformation during conditions of peak metamorphism, deformation of the later, post peak-metamorphic quartz veining is more brittle in style. Deformation of the late quartz veining is more brittle in style, even if the enclosing mica altered mudstones have deformed plastically.

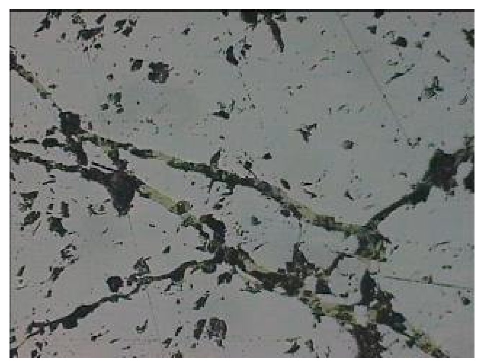
MINERALISATION



Left. 26027.02. Thermally and tectonically overprinted quartz + arsenopyrite cemented breccia in mudstone. Arsenopyrite is host to a gold inclusion.
Right. 26027.02. Native gold inclusion within arsenopyrite. 120 μm. rl/ppl.



Native gold is identified as a single inclusion within early relatively coarse-grained, fractured and cemented arsenopyrite in earliest vein/cement in sample 26027.02. Gold was not identified as inclusions in arsenopyrite anywhere else, nor in any other association: i.e. as grains in assemblages cemented fractured arsenopyrite or associated "secondary" veinlets extending into the wallrock.



Above. 26027.04. Chalcopyrite + quartz veinlets in arsenopyrite. 300 μm.
Left. Chalcopyrite + quartz stringers or veinlets extending from domain of massive arsenopyrite + quartz cement with fractures in arsenopyrite filled with quartz and arsenopyrite.

Chalcopyrite primarily occurs interstitial to and as intergrowths with recrystallised quartz intergrown with fractured and cemented arsenopyrite. Chalcopyrite apparently occurs more widely as grains intergrown with quartz filling/cementing fractured arsenopyrite and filling secondary microfractures/fractures extending from early, plastically deformed quartz + arsenopyrite vein/cement into host wallrock. Grains of biotite (→ sericite/illite, chlorite), alkali feldspar (→ sericite/illite) and secondary arsenopyrite are associated with the chalcopyrite. Some microfracturing within "framework" arsenopyrite is filled almost exclusively with chalcopyrite.

COMMENT AND INTERPRETATIONS

1. Petrographic studies confirm the presence of a doleritic textured basalt towards the base diamond hole HYD003, and that peak metamorphism of this rock represented mainly by pervasive fibrous amphibole (actinolite/tremolite) has been overprinted by retrograde chlorite and sericite/illite. Late, pervasive chlorite and sericite/illite alteration is more effective in obscuring the nature of peak metamorphism and provenance of mudstones and silty-mudstones which dominate the wallrock types intersected within the HYD003 intersection. Together with chlorite, alkali feldspar and biotite were probably present in the peak metamorphic replacement assemblages, and the provenance was probably predominantly mafic volcaniclastic rock.

2. While not readily resolvable in hand-specimen, optical microscopy has determined the presence of post peak-metamorphic quartz veining, and that this stage of veining is temporally and spatially related to retrograde chlorite and sericite/illite which obscures the nature of peak metamorphic replacement assemblages. While chalcopyrite is associated with this stage of veining, it would appear that arsenopyrite is not abundantly or widely associated with this stage of veining. The lack of or absence of arsenopyrite associated with this stage of veining and lack of evidence of any ductile deformation may provide a means of discriminating this stage of veining from early veining in hand-specimen.

3. Microscopic textures reveal that while there has been some localised hydrothermal remobilisation of arsenic (together with copper and probably gold) into secondary microfractures, arsenopyrite (together with rutile) was part of and in places more than a significant part of the plastically deformed and thermally overprinted quartz vein assemblage. This confirms arsenic as part of the pre-metamorphic overprint or protore chemistry/mineralisation. The distribution of arsenopyrite in adjacent wallrock confirms the extent or protore fluid-wallrock interaction in the absence of preserved silicate hydrothermal replacement mineralogy masked by peak metamorphism, and ultimately retrograde metamorphism and low temperature hydrothermal overprinting. In the absence of any other resolvable mineralogy, the distribution of arsenopyrite within the wallrock defines the protore hydrothermal alteration halo.

4. As previously suggested (26024), the precipitation of abundant arsenopyrite in the wallrock can be readily explained by transport of arsenic in the hydrothermal fluid phase and an availability of iron in the wallrock (i.e. regional metamorphic chlorite, after relatively Fe-rich sediments). Arsenic will mostly likely have been transported into the system and wallrock by hydrothermal fluids as H_3AsO_3. A relative concentration of arsenopyrite in the vein/cement assemblages assumes an availability of iron as well as arsenic in the hydrothermal fluid. The localisation of relatively abundant arsenopyrite in the vein/cement assemblages is most likely to have been determined by the availability of iron in the vein environment rather than arsenic which has been introduced to the system. The local concentration of arsenopyrite in the deposition assemblages will therefore have required a local availability and efficient mechanism of transporting iron from the wallrock into the vein/cement-forming environment. Iron is more generally transported as a chloride complex, however the salinity of the protore fluid is not likely to have varied that much from one part of the system to another. It is therefore likely that it was the availability and form of iron in the wallrock that dictated just where high concentrations of arsenopyrite will have formed in the early vein/cement assemblages.

5. Iron may also be transported as a bicarbonate complex, and alternatively it could then have been the local availability of bicarbonate ions that determined the location of mobilisation of iron from the wallrock and formation of massive arsenopyrite in vein/cement assemblages.

6. The presence of native gold as inclusions in early arsenopyrite confirms a protore gold-arsenic association, an association from which locally generated metasomatic overprinting fluids may have remobilised the gold. While there is evidence for local remobilisation of copper and arsenic into secondary structures in association with metasomatism temporally related to tectonic and metamorphic overprinting there is no evidence for remobilisation of gold, at least in the petrology samples of this study. Chalcopyrite and arsenopyrite are present in secondary microstructures associated with metamorphic and tectonic overprinting, whereas in the samples of this study, gold is not.

APPENDIX ONE:

PETROGRAPHIC/MINERAGRAPHIC DESCRIPTIONS

SAMPLE NUMBER: 26027.01
LOCATION: Sunline prospect. HYD003/205.9-206.0
7836000N, 613000E
ROCK NAME: Tectonically deformed, quartz veined volcaniclastic mudstone.
FIELD DESCRIPTION: Deformed, quartz veined mafic volcaniclastic rock.

OFFCUT DESCRIPTION:

The sample is of mostly dark grey-green, unweathered and unoxidised, Fe-sulphide bearing, quartz veined, chloritic altered fine grained sedimentary rock. Dislocation of quartz vein as a result of bedding plane shear within mudstone wallrock and attenuation of the vein.

THIN SECTION DESCRIPTION

LITHOLOGY: PRIMARY MINERALOGY, TEXTURES

The wallrock has a poorly preserved primary fragmental texture. Sparse to moderate amounts of ghosted, angular, silt-sized fragments contained within a secondary mica assemblage define a primary fragmental texture. Resolvable quartz or recrystallised quartz fragments are present within the framework clast assemblage. Other framework clasts (crystals and rock fragments?) are unresolvable. The distribution of resolvable quartz and concentration of resolvable, ghosted silt-sized clasts defines primary lamination.

A shear fabric penetrative within the rock is parallel to sub-parallel to lamination. There are some stylolitic structures at high angles to the shear/strain fabric.

ALTERATION

REPLACEMENT

Replacement of the sedimentary rock is complete. Pervasive chlorite and ultra fine grained quartz dominate the replacement assemblage. Minor amounts of illitic/sericitic clay are intergrown with chlorite and quartz. Grains of pyrite, rutile and arsenopyrite are dispersed about the replacement assemblage. Chlorite, quartz and illitic clay have been recrystallised with the strain overprint. Pyrite and arsenopyrite are fractured/fragmented and microfractures filled with sericite and chlorite. Ghosted early secondary subhedral to euhedral feldspar grains (→ sericite/illite) are dispersed about the wallrock.

DEPOSITION

Early microfracturing is filled with very fine grained anhedral, tabular quartz complete with sub-grain boundaries and crenulate grain boundaries. Grains of arsenopyrite and less abundant rutile are interlocking with the quartz. Grains of biotite (→ chlorite and sericite) and chlorite are interstitial to the quartz. Fibrous quartz, biotite (→ chlorite, sericite) and chlorite are present in strain-shadows formed about fragmented arsenopyrite.

Voluminous fractures are filled with fine to medium grained, anhedral to euhedral quartz. Faceted quartz crystal faces are relatively well preserved, however there is widespread undulatory extinction and crenulation of grain boundaries. Grains of subhedral to euhedral pyrite and chalcopyrite are intergrown with the quartz. Chalcopyrite is more anhedral and interstitial to quartz relatively to pyrite. The distribution of pyrite defines banding within the more voluminous vein assemblages. Brittle fracturing/microfracturing of pyrite (in association with weak plastic deformation of quartz) is filled with very fine to ultra fine grained quartz, sericite and platy chlorite. Tension fractures/microfractures in pyrite/arsenopyrite are filled with very fine grained quartz, sericite/illite and chlorite. Very fine to ultra fine grained chalcopyrite fills secondary microfractures in some places.

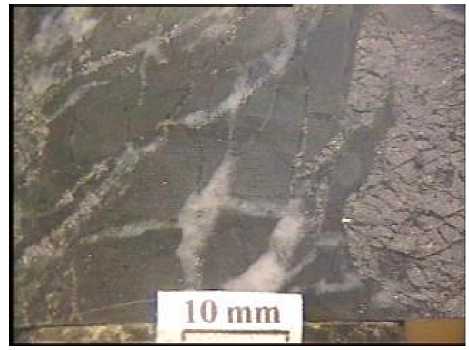
Quartz is host to abundant secondary fluid inclusions concentrated along networks of annealed microshears and fractures. The annealed shears define the strain fabric within the vein assemblage together with tension fractures. Aqueous liquid-rich inclusions dominate the secondary fluid inclusions.

COMMENTS

The vein has been pulled apart rather than boudinaged as a result of bedding plane parallel shearing in a lower temperature and brittle strain regime. Recrystallisation of chlorite and illite/sericite and some recrystallisation of late quartz represent a thermal overprint coincident with a strain overprint. Much of the unresolvable detrital material may be of mafic volcanic provenance. An apparent absence of biotite in the overprint assemblage may be a function of wallrock chemistry.

Right. Fragmental texture and primary lamination superimposed with bedding plane parallel strain fabric.

SAMPLE NUMBER: 26027.02
LOCATION: Sunline prospect. HYD003/189.2-189.5
7836000N, 613000E
ROCK NAME: Sericite/chlorite altered, quartz cemented, thermally overprinted quartz + arsenopyrite cemented fragmented meta sediment.
FIELD DESCRIPTION: Arsenopyrite-rich, quartz vein breccia



OFFCUT DESCRIPTION:

The sample is of medium to dark grey-green and brown-grey, unweathered and unoxidised, quartz and Fe-sulphide cemented, fine grained metasedimentary rock. Arsenopyrite is intensely fragmented and cemented with very fine grained quartz.

THIN SECTION DESCRIPTION

LITHOLOGY: PRIMARY MINERALOGY, TEXTURES

The wallrock has a poorly preserved primary fragmental texture. Sparse, silt-sized, ghosted detrital framework clasts contained within a voluminous secondary mica assemblage define the fragmental textures. The sparse silt-sized detrital fragments are resolvable as recrystallised quartz.

ALTERATION

REPLACEMENT

Replacement is complete. Pervasive very fine to ultra fine grained chlorite dominates the replacement assemblage. Detrital quartz is recrystallised. Grains of rutile, pyrite and arsenopyrite are dispersed about the secondary wallrock assemblage.

DEPOSITION

Angular fragments of wallrock are cemented mainly with quartz and Fe-sulphide, the sulphides massive in texture in places. Quartz is anhedral to subhedral, tabular in texture, and granoblastic to porphyroclastic in textures in some places. Quartz has sub-grain boundaries, undulatory extinction and crenulate grain boundaries. The quartz is interlocking with subhedral to euhedral pyrite and arsenopyrite, and anhedral to subhedral chalcopyrite. Grains of apatite are present. Abundant, ghosted alkali feldspar is interlocking with quartz marginal to wallrock. The alkali feldspar is altered to sericite/illite. Plates of biotite and chlorite are interstitial to the quartz. The biotite is altered to sericite and chlorite. Native gold occurs as inclusions within arsenopyrite. Sparse grains of apatite are present as inclusion in quartz. Tension fractures within arsenopyrite are filled with very fine grained quartz, chlorite, biotite (→ chlorite/sericite) and Fe-sulphides. Secondary quartz is fibrous in texture in some places. Anhedral carbonate is interstitial to quartz in some places, intergrown with biotite (→ chlorite) and chlorite, and linking with fluid inclusion trails. Some ghosted cordierite (→ chlorite and sericite) appears to be present at vein-wallrock margins also. A network of microfractures is filled with very fine grained quartz and alkali feldspar (→ sericite). Some late brecciation of arsenopyrite is cemented with subhedral to euhedral quartz intergrown with sericite/illite and chlorite.

Abundant secondary and pseudosecondary fluid inclusions, contained along annealed microshears/fractures, comprise co-existing gas-rich/filled and aqueous liquid-rich type. CO2 is present in the gas-rich/filled types.

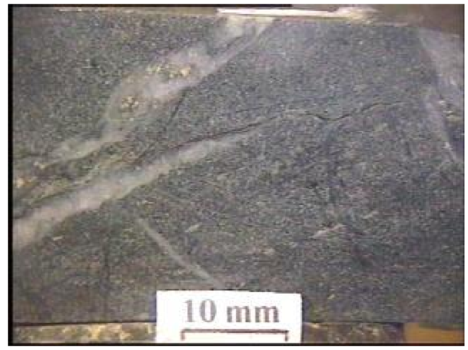
Late microfractures are filled with sericite and very fine grained quartz.

Late sericite + chlorite + quartz veinlets link with late fluid inclusion trails dominated by aqueous liquid-rich inclusions.

COMMENTS

Sericite has formed after alkali feldspar, and sericite and chlorite have formed after biotite within the recrystallised vein assemblage. Some amounts of the chlorite in the wallrock may be after biotite. The Late sericite and chlorite overprint appears to be related to late sericite, chlorite and quartz veining. Arsenopyrite records a brittle response to deformation whereas quartz has deformed plastically. Ghosted alkali feldspar and possible cordierite are concentrated at vein-wallrock margins, and in discrete quartz + alkali feldspar veinlets.

Right. Native gold present as inclusion within arsenopyrite.



SAMPLE NUMBER: 26027.03
LOCATION: Sunline prospect. HYD003/215.7-215.8
7836000N, 613000E
ROCK NAME: Chloritic altered and quartz veined, metamorphosed quartz veined basalt
FIELD DESCRIPTION: Quartz veined basaltic rock.
OFFCUT DESCRIPTION:

The sample is of dark green-grey to green, unweathered and unoxidised, quartz-veined, chloritic altered, fine grained, mafic igneous rock. Later quartz veins with irregular boundaries truncate Early quartz veinlets.

THIN SECTION DESCRIPTION

LITHOLOGY: PRIMARY MINERALOGY, TEXTURES

The wallrock lithology has a moderately well preserved primary doleritic texture. Ghosted, tabular to prismatic feldspar (plagioclase) crystals are interlocking with tabular, subhedral to anhedral, ghosted plagioclase crystals. Ghosted, tabular, anhedral Fe/Ti-oxides are interstitial to and interlocking with the silicate framework minerals. Some amounts of devitrified glass may be interstitial to the ghosted framework silicate minerals.

ALTERATION

REPLACEMENT

Replacement is complete. Pyroxene and any interstitial glass are replaced by early fibrous amphibole (actinolite). The amphibole is in turn replaced by pervasive chlorite intergrown with minor amounts of quartz. Plagioclase is altered to sericite/illite intergrown with chlorite. Grains and aggregates of very fine grained pyrite, intergrown with chlorite, have formed after former Fe/Ti-oxides. Grains of very fine to ultra fine grained Ti-oxides are dispersed about the secondary silicate assemblage.

DEPOSITION

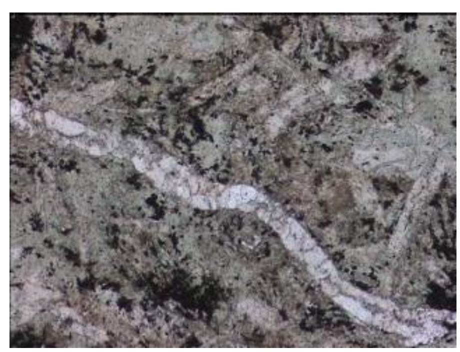
Early fracturing and microfracturing are filled with very fine grained, anhedral, tabular quartz. The quartz is locally granoblastic to porphyroclastic in texture. The quartz has undulatory extinction and subgrain boundaries. Plates of chlorite are interstitial to the quartz. Former banding is defined by concentrations of interstitial chlorite. The early veining is monoclinally folded and generally plastically deformed consistent with the anhedral and locally granoblastic nature of the quartz.

The early veining is truncated and cross-cut by late more voluminous fracturing filled with fine to very fine grained quartz. The quartz is tabular to prismatic and anhedral to euhedral in form. Faceted quartz crystal faces are widely preserved. Grains and aggregates of pyrite are interlocking with and interstitial to the quartz. Selvages of chlorite are interstitial to the quartz. Grains of chalcopyrite are interstitial to and intergrown with chlorite and quartz. Mainly aqueous liquid-rich inclusions are present within the quartz. Carbonate inclusions are also present in the quartz.

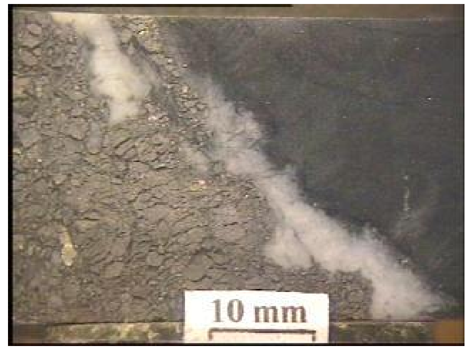
All stages of quartz veining are dislocated along penetrative shears along which platy chlorite and anhedral to subhedral quartz have formed.

COMMENTS

Early quartz veinlets have been plastically deformed together with metamorphic overprinting of the wallrock. Peak metamorphism is represented by ghosted fibrous amphibole. A chloritic overprint to peak metamorphism is related to late quartz veining and shearing.



Right. Early, monoclinally folded, recrystallised quartz vein hosted by chlorite overprinted actinolite altered pyroxene-rich basaltic rock. 1200 µm. ppl.



SAMPLE NUMBER: 26027.04
LOCATION: Sunline prospect. HYD003/189.3-189.4
7836000N, 613000E
ROCK NAME: Tectonically and thermally overprinted quartz + arsenopyrite vein assemblage.
FIELD DESCRIPTION: Massive arsenopyrite + quartz vein in metasedimentary rock.

OFFCUT DESCRIPTION:

The sample is of medium to dark grey-green and brown-grey, unweathered and unoxidised, quartz and arsenopyrite veined metasedimentary rock. Massive textured arsenopyrite has been fractured and cemented with secondary quartz.

THIN SECTION DESCRIPTION

LITHOLOGY: PRIMARY MINERALOGY, TEXTURES

The wallrock has a very poorly preserved primary fragmental texture. Ghosted, angular to subangular, silt to less-than silt-sized detrital fragments partly define the primary fragmental textured. The distribution of ghosted tabular secondary minerals partly defines a primary fragmental texture also. The nature of the primary framework clast assemblage is not resolvable. Relict or recrystallised detrital quartz or rock fragments comprising quartz are present.

ALTERATION

REPLACEMENT

Replacement of the wallrock is complete. Pervasive platy to poorly formed chlorite dominated replacement. Detrital quartz is recrystallised, the secondary quartz comprising granoblastic very fine to ultra fine grained quartz. Sericite/illite has formed after early tabular to prismatic secondary minerals (alkali feldspar?). Sparse grains of pyrite and more abundant rutile are dispersed about the secondary silicate assemblage.

DEPOSITION

Microfractures are filled with very fine grained anhedral quartz, complete with triple-point grain boundaries and sub-grain boundaries. The quartz is granoblastic in places and interlocking with ghosted euhedral alkali feldspar (→ sericite/illite). Grains of arsenopyrite are also present, partly intergrown with both vein and wallrock replacement assemblages. Ghosted alkali feldspar occurs as inclusions within arsenopyrite. Grains of euhedral apatite are present. Grains of biotite (→ chlorite and sericite) are interstitial to the quartz.

More voluminous fracturing is filled with fine to medium grained quartz and arsenopyrite, with arsenopyrite occupying central parts of the vein/cement assemblage. The quartz is anhedral in formed and with triple-point grain boundaries, undulatory extinction, sub-grain boundaries and crenulate grain boundaries. Porphyroclastic textures are present in places. Where there has been plastic deformation of quartz, arsenopyrite has been fragmented and fractured. Fractures and cavities in arsenopyrite are filled with very fine grained quartz much of it fibrous in form. Plates of chlorite and biotite (→ sericite and chlorite) are interstitial to the anhedral quartz. Grains of ghosted alkali feldspar (→ sericite and chlorite) are interlocking with granoblastic quartz and plates of chlorite and biotite and acicular rutile at vein-wallrock margins. Grains of anhedral chalcopyrite are intergrown with secondary quartz formed along microfractures and fractures in arsenopyrite. Quartz is host to mainly gas-filled/rich inclusions co-existing with minor amounts of aqueous liquid-rich inclusions.

Domains of platy chlorite and less abundant very fine grained tabular to prismatic quartz are present along wallrock-vein interfaces in some places.

COMMENTS

Pervasive chlorite and sericite/illite overprint an early wallrock replacement assemblage comprising alkali feldspar. Deformation and thermal overprinting of an early quartz + arsenopyrite vein assemblage is represented by recrystallisation of quartz and fracturing of arsenopyrite. Ghosted alkali feldspar is also part of the recrystallised vein assemblage.

Right. Recrystallised quartz, complete with crenulate and triple-point grain boundaries. 1200 μm. ppl.