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1987/16. Petrography of altered and mineralised Cambrian rocks from beneath Tertiary basalt in the Mount Cattley area.

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Abstract

Cambrian volcanic and sedimentary rocks intersected by holes drilled through Tertiary basalt in the Mount Cattley area contain minor amounts of chalcopyrite, sphalerite, galena and tetrahedrite. These features, together with chlorite-carbonate-sericite alteration of moderate intensity and local fuchsite, and the similarity of the rocks to those of the Hellyer-Mt Charter area, suggest the area might be highly prospective for massive sulphide deposits.

INTRODUCTION

Pancontinental Mining Limited holds Exploration Licence 14/85 in the Mount Cattley area. As part of its exploration program the company drilled three holes through Tertiary basalt into Cambrian basement rocks.

Drill hole MCPD1 was collared at approximately 399 605 mE, 5 405 800 mN AMG and passed into weathered felsic pyroclastic rocks and vesicular extrusive rocks at 87 m. From 129.2 m to the end of the hole at 144.4 m interbedded siltstone and micaceous sublitharenite was present.

Drill hole MCPD2 was collared at approximately 399 900 mE, 5 405 700 mN AMG and intersected fine grained amygdaloidal basalt from 60 m to the end of the hole at 117.5 m.

Drill hole MCPD3 was collared at approximately 400 020 mE, 5 405 010 mN AMG and intersected feldspar-phyric andesite lava and minor tuff from 83 m to 109.4 m, and a similar rock type is present from 125.1 m to the end of the hole at 129.5 m. A feldspar-quartz-chlorite porphyry body is present between 109.4 and 125.1 m.

Samples were collected from the drill cores for isotopic and chemical analyses as part of the Mount Read Volcanic Project. Polished thin sections were prepared from the samples, and at the request of Mr K. Airas of Pancontinental have been described. Particular emphasis has been placed on the alteration and mineralisation present.

RESULTS

The rocks are described on the following sheets.

Mineral abbreviations used are:

py	:	pyrite
sl	:	sphalerite
gn	:	galena
mc	:	marcasite
cp	:	chalcopyrite
thd	:	tetrahedrite
ru	:	rutile

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Mines Dept. No.: **Field No.:** MCPD1 141.37 m **Co. No.:**

Location : Mount Cattley DDH1 at 141.37 m.

Hand Specimen

Primary textures :

Poorly sorted pale grey quartz-rich sandstone

Mineralogy and alteration :

Scattered grains of py, gn, cp and sl discernable in hand lens.

Thin section

Primary textures :

Angular to subrounded grains, poor sorting. Abundant matrix.

Mineralogy (and estimated proportions) : Framework grains: quartz 80%, white mica 10%, minor chlorite, quartz-mica schist, chert, phyllite, altered felsic volcanics, K-feldspar, quartzite, carbonate; matrix is fine grained mica and quartz. Patches of secondary carbonate. Max. size 700 µm.

Mineralisation (relation to cleavage) :

About 0.5% syndiagenetic sulphides: py, sl, cp, gn as grains up to 540 µm replacing and displacing matrix and rarely replacing clasts. Coarsest grain 540 µm honey coloured sl with cp inclusions. Others: 240 µm red sl, 360 µm composite py-sl-gn, 180 µm composite py-cp, colloform py-gn 430 µm, irregular spongey "question mark" shaped py 290µm. Other trains of minute py, sl.

Alteration (inclusions in feldspars, veining etc.):

Although coarser sulphide grains are similar in size to framework grains there is little evidence sulphides are clastic. Colloform pyrites are complete and not broken, pyrite rims and partly replaces one detrital quartz grain. Secondary carbonate present.

CONCLUSION: Sublitharenite, dominantly Pε provenance, moderately mineralised.

$\delta^{13}C$ $\delta^{18}O$ $\delta^{34}S$ **Probe :**

Whole rock analysis

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PETROGRAPHY

Mines Dept. No.: **Field No.:** MCPD2 88.80 m **Co. No.:**

Location : Mount Cattley DDH2 at 88.8 m

Hand Specimen

Primary textures : Grey-green fine grained amygdaloidal basalt with sub equant vescicles to several mm diameter filled with chlorite or carbonate.

Mineralogy and alteration :

Irregular carbonate veinlets <1 to 4 mm wide (one per 1 to 2 cm). Some hematite in one veinlet.

Thin section

Primary textures : Relict hyalo-ophitic, amygdaloidal texture. Feldspar laths (av. 0.5 mm), feldspar, stumpy clinopyroxene phenocrysts to 1 mm in groundmass which was originally glass. Amygdules to 3 mm common.

Mineralogy (and estimated proportions) :

Carbonate ∿40%, chlorite ∿25%, white mica 18%, quartz 12%, albite ∿4%, minor opaques, rutile etc.

Mineralisation (relation to cleavage) :

Less than 0.1% sulphides, but a variety of minerals are present. Pyrite occurs as framboidal to subhedral grains 2 to 3 μm in diameter. Traces of chalcopyrite, to 10 μm, hematite laths to 30 μm long and equant magnetite are present. One composite tetrahedrite-galena-chalcopyrite-sphalerite grain 50 μm across occurs in an altered feldspar crystal.

Alteration (inclusions in feldspars, veining etc.):

Feldspar microlites totally sericite + quartz altered. Feldspar phenocrysts strongly altered to sericite + carbonate - minor albite preserved. Clinopyroxene altered to dolerite ± carbonate. Groundmass very fine grained chlorite + quartz + opaques. Irregular carbonate veinlets to 1 mm wide are common. Vescicles filled with chlorite carbonate or quartz.

CONCLUSION: Altered basalt.

$\delta^{13}C$ $\delta^{18}O$ $\delta^{34}S$ **Probe :**

Whole rock analysis

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Mines Dept. No.: **Field No.:** MCPD2 114.95 **Co. No.:**

Location : Mt Cattley DDH2 at 114.95 m

Hand Specimen

Primary textures : Pale grey green amygdaloidal basalt with submillimetre dark green spots (chloritised ferromagnesians). Amygdules are simple ovoids most a few mm, density about 1 per cm^2. One amygdule 2 cm across.

Mineralogy and alteration :
Amygdules filled with carbonate ± quartz. Large one has hematite as well. Reticulating sub-mm carbonate veinlets - usually one or two per cm. A few have grey sulphide-bearing rims or cores.

Thin section

Primary textures : Relict hyalo-ophitic texture - poorly aligned relict feldspar laths averaging 0.5 mm long, relict equant clinopyroxenes to 2 mm and chloritised lath-like ferromagnesian minerals in fine grained groundmass of chlorite and opaques after glass. Amygdules common to 4 mm diameter.

Mineralogy (and estimated proportions) :

Chlorite ∿30%, Carbonate ∿30%, white mica ∿30%, quartz ∿4%, opaques ∿0.5%.

Mineralisation (relation to cleavage) :
About 0.1% total sulphides present. One sphalerite patch is 700 µm across. This is a spongy grain replacing more of the rock groundmass than the surrounding feldspar laths. Scattered equant chalcopyrite to 12 µm occurs in carbonate patches.

Alteration (inclusions in feldspars, veining etc.):

Feldspars totally altered to quartz + white mica; euhedral form preserved. Ferromagnesians altered to chlorite +/- carbonate. Amygdules of carbonate +/- chlorite and rarely quartz. Carbonate veinlets present.

CONCLUSION: Altered basalt.

$\delta^{13}C$ $\delta^{18}O$ $\delta^{34}S$ **Probe :**

Whole rock analysis

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Mines Dept. No.: **Field No.:** MCPD3 105.5 m **Co. No.:**

Location : Mt Cattley DDH 3 at 105.5 m

Hand Specimen

Primary textures :

Dominantly a grey-green homogeneous feldspar-phyric vescicular andesite with scattered angular to subrounded pale and dark green clasts 5 mm to 10 mm in diameter.

Mineralogy and alteration :

Veinlets and patches of quartz to several cm, showing growth banding in places, connected by quartz veins with bleached margins. Some of these bodies are associated with dark grey chalcedonic quartz.

Thin section

Primary textures : About 1/3 of slide is chalcedonic quartz vein. Most of remainder of section consists of feldspar-phyric andesite, but subtle and sharp changes in groundmass texture define margins between andesite fragments. Felsic dacite fragments to 8 mm diameter are also present, these are feldspar-phyric. Some have a granular groundmass, the largest has snowflake texture and perlitic cracks.

Mineralogy (and estimated proportions) :

Nature of rock prevents accurate estimation of mineral proportions. Major chlorite, quartz, albite, carbonate, minor sericite, leucoxene and rutile. Trace sulphides.

Mineralisation (relation to cleavage) :

Rock contains about 0.2% py euhredra from submicron size to about 170 µm. Small minority of py grains have fine cp inclusions - up to 50% of the py may be replaced by cp exceptionally. Some py fractured with white mica beards suggesting mineralisation predates the very weak cleavage. Some py grains rimmed by cp and very rarely sl. Chalcedonic quartz area generally barren - a few small grains of cp up to 30 µm are present. Large leucoxene + rutile altered ferromagnesian minerals to 0.5 mm other fine grained leucoxene is present.

Alteration (inclusions in feldspars, veining etc.):

Feldspars moderately to strongly sericitised, almost completely so in felsic fragments. Matrix very fine grained quartz and chlorite vescicles filled with quartz ± green chlorite (length slow; blue-green anisotropism) ± carbonate. Chalcedony veinlet consists of spherulitic, length fast fibres. Carbonate patches common in surrounding rock. Abundant deformed carbonate, chlorite and quartz veinlets.

CONCLUSION:

Matrix free, polymict lapilli tuff.

$\delta^{13}C$ $\delta^{18}O$ $\delta^{34}S$ **Probe :**

Whole rock analysis

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PETROGRAPHY

Mines Dept. No.: **Field No.:** MCPD3 111.50m **Co. No.:**

Location : Mt Cattley DDH3 at 111.50 m

Hand Specimen

Primary textures :

Pale cream groundmass with ∿1 mm quartz phenocrysts, pink or pale green feldspars to a few mm and tabular chlorite + leucoxene altered ferromagnesians (after hornblende?). Few elongate amygdules.

Mineralogy and alteration :

Amygdules filled with grey chalcedonic quartz or pale cream carbonate. Minor irregular veins of quartz.

Thin section

Primary textures :

Quartz-feldspar (plagioclase) - clinopyroxene? - hornblende? porphyry with snowflake-texture groundmass and vugs. Feldspar glomerocrysts reach 2 mm across, individual phenocrysts normally are about 0.8 mm. Quartz normally about 0.5 mm across, as are relict clinopyroxenes. Relict fuchsite-chlorite-carbonate altered hornblende is 3 mm long.

Mineralogy (and estimated proportions) :

Quartz 60%, sericite 75%, carbonate 10%, albite 10%, chlorite 4%, rutile, leucoxene 4%, traces of pyrite, fuchsite and apatite.

Mineralisation (relation to cleavage) :

Traces of euhedral py generally 2 to 40 μm, with two grains 240 μm across. Pyrite lacks inclusions of other sulphides. Leucoxene and rutile are two of the alteration products of ferromagnesian minerals and occur in patches to 250 μm.

Alteration (inclusions in feldspars, veining etc.):

One tabular ferromagnesian grain altered to fuchsite + chlorite + carbonate. Other squat ferromagnesian phenocrysts altered to chlorite +/- fuchsite. Carbonate patches and quartz/carbonate or quartz-sericite filled vugs common. One vug filled with chalcedonic quartz similar to MPD3 105.5 m. Feldspar phenocrysts 20 to 40% sericitised, exceptionally to 100%. Chlorite is green, pleochroic, length slow blue-green anisotropism. Groundmass weakly sericitised. A number of sericite-filled microfractures, quartz microveinlets present.

CONCLUSION: Dacite shallow intrusive or lava; fuchsite alteration suggests proximal mineralisation.

$\delta^{13}C$ $\delta^{18}O$ $\delta^{34}S$ **Probe :**

Whole rock analysis

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Mines Dept. No.: **Field No.:** MCPD3 128.55 m **Co. No.:**

Location : Mt Cattley DDH3 at 128.55 m

Hand Specimen

Primary textures :

Blotchy grey/cream/green feldspar-phyric vescicular lava; vescicles ovoid, show preferred orientation.

Mineralogy and alteration :

Vescicles filled with chlorite and/or carbonate. Sparse sub-mm carbonate veining.

Thin section

Primary textures :

~20% plagioclase phenocrysts and glomerocrysts and scarce poikiloblastic ferromagnesians replaced by chlorite (after hornblende?) in an amygdaloidal groundmass with relict perlitic texture. Glomerocrysts to 3.5 mm, phenocrysts average about 1 mm.

Mineralogy (and estimated proportions) :

~39% chlorite, ~37% quartz (including possibly some very fine grained alkali feldspar), 15% albite, 5% white mica, 5% carbonate (probably calcite), minor opaques (mostly rutile, leucoxene), trace apatite.

Mineralisation (relation to cleavage) :

Rock contains <0.1% pyrite. One 100 μm pyrite grain, one of a number of euhedra rimming a sericite-rimmed, chlorite-filled vescicle contains minute inclusions of galena. This grain is intergrown with marcasite. Rutile, leucoxene and sphene to 0.5 mm partly replace chloritized ferromagnesians. Other disseminated e.g. leucoxene.

Alteration (inclusions in feldspars, veining etc.):

Albite phenocrysts 20 to 50% altered to fine white mica. Vescicles show inward zonation: quartz - white mica - chlorite - carbonate, although majority have white mica rim and chlorite core. Irregular microveinlets 0.05 to 0.1 mm wide of quartz ± carbonate. Chlorite in amygdules is pale green, pleochroic, length slow, bluish green anisotropism. Groundmass chlorite is very fine grained, almost isotropic, length fast.

CONCLUSION: Altered andesite.

$\delta^{13}C$ $\delta^{18}O$ $\delta^{34}S$ **Probe :**

Whole rock analysis

DISCUSSION

The feldspar-phyric andesites intersected in drill hole MCPD 3 are very similar to footwall sequences in the Hellyer area; although the polymict nature of the tuff at 105.5 m may be more typical of units in the general host-rock mixed sequence mapped by Komyshan (1986*a*). Caution should be exercised in the correlation of units beyond Hellyer, as Komyshan (1986*b*) has shown that there are rapid facies changes in the volcanic sequence and andesite occurs in the hangingwall position at Mt Charter. Perhaps more suggestive is the presence of minor fuchsite alteration of ferromagnesian phenocrysts in the quartz-feldspar porphyry body in the hole. McArthur (1986, fig. 2) suggests that fuchsite is restricted to the hangingwall at Hellyer. This alteration appears to be controlled by the Jack Fault but is more persistent laterally near contacts of basalt near other units. The felsic porphyry may have produced a similar effect in the Mount Cattley area.

The amygdaloidal basalts in drill hole MCPD 2 are also moderately altered. A major difference in this hole is the higher abundance and diversity of sulphides other than pyrite, and the total alteration of the groundmass feldspar laths. These features might suggest a closer proximity to major mineralisation than for drill hole MCPD 3, but the unknown stratigraphy of the Mount Cattley area makes this suggestion very speculative.

The interesting mineralisation in the sublitharenite is clearly, on textural grounds, syndiagenetic and does not represent clastically redeposited sulphides. Again, lack of appreciation of the stratigraphic setting makes it very difficult to evaluate the importance of this occurrence, as similar rocks occur both above and below the mafic-intermediate volcanic succession in the Hellyer-Mt Charter area.

The minor mineralisation intersected in the drill holes, the degree of alteration in the rocks, especially the occurrence of fuchsite and the similarity of the rocks to those of the Que River-Mount Charter area, are all very encouraging factors for the future exploration of the area.

Further work on the isotope and mineral geochemistry should provide more quantitative information on the extent, and possibly of temperatures, of alteration, but further interpretation is clearly hampered by the lack of knowledge of the stratigraphy of the area. A more detailed assessment of prospectivity could be obtained by deepening one or more of the drill holes; based on the mineralisation encountered, MCPD 1 or MCPD 2 might be favoured.

REFERENCES

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