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1986/75. The petrology and mineragraphy of some New Henbury samples.

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Abstract

Samples described include panned concentrates, Devonian alkali granites, and Mathinna Beds sandstones. The concentrates contain cassiterite, gold, authigenic pyrite, and metallic lead. The sandstones are feldspathic quartzwackes with minor disseminated base metal sulphide mineralisation, and one is largely altered to epidote and montmorillonite.

INTRODUCTION

The following samples were collected by V. M. Threader at New Henbury, near Avoca, and submitted for petrography and mineragraphy. Sample locations are described by Threader (1987).

Sample No.	*Borehole*	*Depth (m)*	*Description*
C100040	BH2	0-6	1st Riffle
C100041	BH2	0-8	2nd Riffle
C100042	BH2	6-8	1st Riffle
C100043	BH2	0-8	3rd Riffle
C100044	BH1		Pb metal
C100045	BH1		Pan concentrate - Lab No. 85101
C100046	BH1		Pan concentrate - Lab No. 85106
C100047	BH1		Pan concentrate - Lab No. 85111
C100048	BH1		Pan concentrate - Lab No. 85116
C100066	BH1	85	?Mathinna Beds sandstone
C100067	-		Granite -1 (Storys Creek)
C100068	-		Granite -2 (outcrop near New Henbury mine)
C100069	BH4	13.6	Granite/Mathinna Beds contact
C100070	BH4	14.2	Granite
C100071	BH4	15.3	Mathinna Beds
C100072	BH5	4.51	Granite
C101401a	BH1	100	Mathinna Beds sandstone
C101401b	BH1	84	Mathinna Beds sandstone
C101416	BH9		Pyrite

PANNED CONCENTRATES: C100040-48

The mineralogical constitutions are summarised in Table 1, with the exception of C100044 which is described below. Quartz, pyroxene, siderite, pyrite and zircon are the major constituents of all but the latter sample. The first three of these minerals are relatively low in specific gravity and their presence is variable and largely dependent upon sample preparation.

Siderite occurs as small hollow spheres (commonly containing very fine pyrite) or crystalline aggregates and is probably of authigenic origin in

Tertiary sediments. Pyrite and marcasite occur mainly as aggregates (colloform, radiating and framboidal) and euhedral crystals, also indicating an authigenic origin. Some anhedral pyrite may, however, be detrital. Rock fragments and magnetite are commonly pyritised, and marcasite is commonly overgrown or replaced by pyrite.

Sphalerite is subangular to rounded and is presumably detrital, but the arsenopyrite is quite angular and may represent contamination. Cassiterite is relatively coarse and subangular, suggesting a nearby primary source.

Several gold grains were detected, most being in C100041. These are typically quite flaky, 0.1 - 1 mm in size, and some are attached to quartz and limonite. Probe analyses of one grain are listed in Table 2.

Zircon is bimodal (well rounded and euhedral), tourmaline is green, blue and brown, and ilmenite is variably altered to leucoxene and hematite.

Various metals, rust and other probable synthetic phases are very common and often abundant, but were omitted from Table 1.

PYRITE: C101416

This sample consists of quartz sand and colloform aggregates of pyrite. The pyrite exhibits three growth stages: framboids (not in the cores of all aggregates); fine-grained and rapidly tarnishing pyrite; and overgrowths of medium-grained pyrite, some exhibiting cubic morphology. Some are attached to quartz grains, and probably formed authigenically in sandy Tertiary sediments.

LEAD METAL: C100044

Sample C100044 contains lead metal grains, handpicked from the concentrates by L. Rhodes. These grains are up to 1.5 mm in size, and contain inclusions and attachments of quartz, pyrite and several unidentified phases. Some of the quartz and pyrite could conceivably have been 'pressed' into the very soft lead metal, but the unidentified phases require further study to help determine the origin of this material.

GRANITE: C100067-70, C100072

These samples are typical of the alkali granites in the area (McClenaghan and Williams, 1982), and only a summarised description is given below.

K-feldspar (perthite): (dominant)

Phenocrysts 4-12 mm (up to 25 mm in hand specimen), subhedral to anhedral, with abundant fine inclusions (including sericite and hematite). Some exhibit microcline twinning but most have only simple twins. Zones and patches of graphic quartz are common. Some grains appear to contain more plagioclase than orthoclase, probably due to late stage albitisation.

Quartz: (subdominant)

Bimodal in size (0.5-7 mm), some forming graphic intergrowths or euhedral inclusions in perthite. Patches of fine quartz near the contact (C100069) appear to derive from Mathinna Beds sediments. Coarser quartz is usually anhedral, with undulose extinction, and often occurs as rounded aggregates.

Plagioclase: (subdominant)

Albite (Ab_{0-8}) is euhedral, bimodal (0.2-5 mm, rarely as phenocrysts up to 12 mm in C100170), with cores especially rich in inclusions (principally sericite). The finer albite and inclusion-free zones probably relate to late stage albitisation.

Biotite: (accessory)

Anhedral to euhedral, 0.5-3 mm, variably altered to fine-grained hematite and/or chlorite and/or muscovite or tourmaline. Zircon, opaques, epidote, fluorite, anatase and unidentified fine inclusions giving pleochroic haloes, are usually associated, especially in C100068. Red-brown to green-brown, probably annite.

Tourmaline: (absent to accessory)

This is present in C100069 and 70 as anhedral grains, 0.1-1 mm, typically replacing biotite and interstitial to feldspar and quartz. It is mostly brown but varies from red-brown to blue-green. Some skeletal crystals appear to replace feldspar.

Muscovite: (trace)

This is present in most samples as sporadic coarse flakes (up to 1.5 mm) as well as the fine sericite in feldspar. Most coarse muscovite replaces biotite or, rarely, feldspar (C100072).

MATHINNA BEDS

C100069

This sample contains hornfelsed Mathinna Beds sediment in contact with granite. Quartz (up to 1 mm) and K-feldspar (up to 0.2 mm) are codominant, with subdominant biotite (to 0.1 mm) and plagioclase (to 0.2 mm), and trace muscovite, opaque minerals and zircon. Most muscovite is intergrown with feldspar and biotite, and may indicate both primary and retrograde formation.

C100071

This is a hornfels similar in composition to the above but shows sedimentary layering, represented by layers rich and poor in biotite, and coarser quartz in some layers. Quartz veins contain only trace feldspar and biotite, and are bordered by feldspar-rich zones.

C101401a (BH1, 100 m)

This is a moderately-sorted quartzwacke or feldspathic wacke consisting dominantly of stretched quartz grains about 0.2-0.5 mm in size. Plagioclase (albite), K-feldspar (orthoclase?), lithics and detrital muscovite are minor constituents. The matrix consists of granular quartz with variable amounts of white mica and chlorite. The texture is almost quartzitic, with sutured grain boundaries, and some sedimentary layering is evidenced by variations in quartz grain size and proportions of matrix phyllosilicates. Sulphides are widely dispersed in trace amounts, up to 150 µm in size. Pyrrhotite is the most abundant (0.5-1%), as aggregates and flakes, rarely with fine pyrite inclusions. Traces of chalcopyrite and sphalerite are also present. Other trace constituents include zircon, carbonaceous material, rutile, tourmaline (subrounded to euhedral) and a carbonate (as veinlets and blebs).

C101401b (BH1, 84 m)

This is a somewhat similar wacke to the above, but is less well sorted, with quartz up to 1 mm in grain size, and carbonates are absent. Feldspars are still about 0.2-0.6 mm in size. Some altered biotite is present, and ilmenite is rarely present in rutile aggregates. Ilmenite shows late overgrowths. Sulphides (<1%) are relatively inhomogenously distributed as fine grains and aggregates to 0.25 mm, some forming apophyses into quartz. Pyrite is the most abundant and includes late stage veinlets, while galena, sphalerite, chalcopyrite and arsenopyrite are all present. Some chlorite veins occur, with minor epidote, pyrite and chalcopyrite. Quartz veins are minor and relatively barren. Apatite is widespread as a well-rounded trace constituent to about 0.1 mm.

C100066 (BH1, 85 m) - HAND SPECIMEN

This is a well indurated rock with blebs of pyrite (up to 5 mm) and finer sphalerite (up to 1 mm). A weak foliation is defined by elongation of sand-sized quartz grains, supported in a matrix of epidote/clinozoisite and montmorillonite (XRD identifications). Scattered cavities indicate leaching of clay and/or other minerals.

C100066 (BH1, 85 m) - POLISHED THIN SECTION

Non-sulphides

Quartz comprises about 50-60% of the sample, as slightly elongate grains 0.02-1 mm in size with undulose extinction and inclusion trails, or rarely polycrystalline and sutured. Inclusions of sulphides are uncommon (some are apophyses) and both quartz overgrowths and partial replacement by epidote/clinozoisite are common.

Epidote/clinozoisite comprises most of the matrix to the quartz grains, about 30-40% of the sample. It varies from about 10 to 250 μm in size, is commonly poikiloblastic with quartz, sphalerite and chalcopyrite inclusions, partly replaces quartz, and is variably replaced by montmorillonite. It is very pale green and most is optically negative and epidote (with about 10% Fe_2O_3), but some is optically positive and this is clinozoisite.

Montmorillonite (or another mineral of the smectite group) constitutes about 10% of the sample, generally with a grain size of a few micrometres but up to about 50 μm. It largely appears to be replacing epidote/clinozoisite but poorly preserved (plucked) aggregates up to 2.5 mm in size, enclosing some quartz inclusions, probably represent replacement of an earlier phase. It is pale brown in colour.

Other constituents include an unidentified carbonate which occurs in a few patches intergrown with epidote/clinozoisite and/or sphalerite. Sphene is a trace constituent, is poorly crystalline with fine rutile inclusions, and probably represents alteration or original detrital ilmenite or rutile. Carbon occurs in rare patches of very fine-grained aggregates of (?)protographite (weakly bireflectant). Zircon is a subangular to subrounded trace constituent, probably an original detrital phase.

Sulphides

Sphalerite is the most abundant sulphide, approaching 1% in abundance and and up to one millimetre in size. It is widely dispersed throughout the rock, typically intergrown with epidote and montmorillonite (frequently as inclusions). In places it appears to bisect epidote grains, while epidote commonly bisects sphalerite, and they were undoubtedly re-crystallised together. It rarely occurs as inclusions in quartz, up to about 60 µm in size. Chalcopyrite is common as inclusions, usually very fine, while pyrrhotite is rare, pyrite uncommon, and epidote common as inclusions. It is red-brown in transmitted light and probably relatively iron-rich (supported by the pyrrhotite inclusions).

Pyrite occurs in larger aggregates than sphalerite (up to 5 mm in size), with crystals up to one millimetre, and constitutes nearly 1% of the rock. The aggregates often form a network of veins and crystals surrounding and including quartz grains, and many of these appear to have been partly replaced. Some fine crystals are included in epidote, but the relations are not quite clear (cogenetic?).

Chalcopyrite occurs in trace amounts as fine inclusions in sphalerite (up to 30 µm), quartz (up to 120 µm) and epidote (up to 30µm). Rare aggregates up to 0.3 mm occur interstitial to quartz and epidote, often intergrown with pyrite and/or sphalerite. Sphalerite may occur as inclusions.

Pyrrhotite is very rare and only found as inclusions in sphalerite.

Galena is noticeable by its absence.

C100066 - TEXTURES

The rock has a metasomatic texture, with original detrital quartz in a matrix of epidote, montmorillonite and sulphides. Sphalerite occurs as disseminated grains and less commonly as vague stringers parallel to the foliation (?bedded sphalerite). Most pyrite occurs as larger crystals, aggregates and fine anastomising veinlets (flattened parallel to the foliation), and could be diagenetic and slightly remobilised during metasomatism. Some epidote veinlets, approximately perpendicular to the foliation, occur and contain traces of fine sphalerite and chalcopyrite. They may, however, cut sphalerite stringers and grains and thus post-date most mineralisation. The cavities are probably due to disintegration of the montmorillonite aggregates. The bedding and tectonic foliations are suggested to be approximately parallel, but both are poorly defined.

CONCLUSIONS

The concentrates indicate minor mineralisation in the Cainozoic sediments. The iron sulphides and siderite are predominantly authigenic, while the cassiterite and wolframite are detrital, probably deposited close to their source. The sphalerite is rounded and may be detrital, but the arsenopyrite is angular and of unknown origin. The origin of the lead metal is very conjectural at present, and the possibility of contamination cannot be ruled out, although an authigenic origin in organic-rich sediments should be considered.

The granitic rocks are fairly similar to the alkali granites described by McClenaghan and Williams (1982), although the biotites are more chloritised.

The Mathinna Beds rocks appear to have all originated as quartzwackes with a small content of iron and base metal sulphides. Pyrrhotite seems to replace pyrite with depth in bore hole BH1, perhaps because of desulphurisation driven by contact metamorphism with a conjectural underlying igneous intrusion. The carbonate, chlorite and edidote veining and metasomatism may also be related to this, but the base metal sulphides do not appear to be significantly remobilised. The Scamander-type mineralisation appears unrelated but, while no gold was detected in these rocks, it is interesting to note that Reid (1926) considered much of the gold in the Lisle-Golconda area to derive from Mathinna Beds sandstones rather than veins.

The epidote-rich rock (C100066) could have derived from metamorphism of a marly sandstone, but such rocks are unknown from the Mathinna Beds. Turbiditic quartzwackes are common in the Mathinna Beds and include samples C101401a and b; these were probably epidotised and later partly replaced by montmorillonite. The chlorite-epidote veins in C101401b are possibly related. The metasomatism was basically a replacement of alkalis by calcium, but some silica was probably lost, and alumina added to the rock. Quartz-feldspar-biotite hornfels are produced by contact metamorphism adjacent to the contact with granites in boreholes BH4 and BH5.

REFERENCES

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Table 1. MINERALOGY OF PANNED CONCENTRATES

	Quartz	Lithics	Pyroxene	Siderite	Zircon	Ilmenite	Magnetite	Cassiterite	Rutile	Pyrite	Marcasite	Tourmaline	Sphalerite	Others
C100040	D	A	SD	A	A	A	TR	A	TR	A	ND	TR	ND	Garnet, gold
C100041	D	A	A	A	A	A	A	TR	TR	A	TR	ND	ND	Gold, leucoxene
C100042	D	A	A	SD	A	A	TR	A	TR	A	TR	TR	TR	
C100043	SD	A	A	A	D	A	A	TR	TR	TR	TR	TR	ND	Leucoxene
C100045	SD	A	A	D	A	TR	TR	TR	TR	A	TR	TR	ND	Garnet, leucoxene
C100046	TR	TR	ND	D	A	A	TR	TR	TR	A	A	TR	TR	Wolframite
C100047	A	TR	TR	A	A	A	A	TR	A	D	TR	TR	TR	Leucoxene
C100048	A	TR	TR	D	TR	TR	TR	TR	TR	SD	TR	TR	TR	Arsenopyrite

D: Dominant; CD: Co-dominant; SD: Subdominant (>20%);
A: Accessory (5-20%); TR: Trace (<5%); MD: Not detected.

Table 2. ELECTRON MICROPROBE ANALYSES OF NEW HENBURY GOLD

Analysis	*Au*	*Ag*	*Total (wt %)*
1	100.26	BLD	100.26
2	99.33	1.09	100.42
3	99.11	1.49	100.6
4	98.68	1.23	99.91
5	99.09	1.37	100.46
Average	99.294	1.036	100.33

BLD = Below limit of detection