MP 3/572/0

REPORT MP 3634/74

DESCRIPTION OF SULPHIDE-BEARING CARBONATE ROCK

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3 April 1974

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REPORT MP 3634/74

YOUR REFERENCE:	Letter dated 22.3.74
MATERIAL:	Three rock samples
LOCALITY:	Tasmania
IDENTIFICATION:	A 602, 603 and 609.
DATE RECEIVED:	28.3.74
WORK REQUIRED:	Minerographic and petrographic description and analysis for gold.

Investigation and Report by:
Petrography and Mineragraphy: Sylvia Whitehead
Chemical Analysis: M.R. Hanckel

Officer-in-Charge,
Mineralogy/Petrology Section: Dr. K.J. Henley,

K.J. Henley

for F.R. Hartley,
Director

pjm

DESCRIPTION OF SULPHIDE-BEARING CARBONATE ROCK

1. INTRODUCTION

Three small samples of drill-core obtained from a drilling programme at Beaconsfield in Tasmania were submitted by Allstate Explorations N.L. for mineralogical and petrographic analyses with particular emphasis on the form and associations of gold present. The samples (each consisting of two small pieces) were delivered to Amdel on 27 March 1974 by Mr L. Denholm and, following discussion between Mr Denholm and Dr. Henley of Amdel, the following programme of work was agreed.

One piece of each sample would be ground very fine in a Sieb mill and assayed for total and cyanide-soluble gold. The results would be expected to indicate the proportion of free metallic gold of reasonably coarse grain size in the samples. Large discrepancies between the values for total and cyanide-soluble gold would indicate that the gold was present in one or more of the following forms:-

(1) As gold tellurides or other gold minerals insoluble in cyanide solution.

(2) As metallic gold of very fine grain size locked in other minerals and not accessible to cyanide solution.

(3) As gold in solid solution in sulphides or other minerals.

Polished and thin sections of the other piece of each sample would be made and examined in detail to (a) locate any gold minerals present and determine their associations, and (b) assess the likely genesis of the samples.

This programme of work was carried out and the results are given below.

2. CHEMICAL ANALYSES

Assays for total and cyanide-soluble gold on the Sieb-milled samples (particle size approximately -200 mesh B.S.) are as follows:-

Sample	Total Au ppm	Cyanide-soluble Au, ppm	Cyanide-soluble Au as % of total Au
602	41.0	5.5	14
603	24.7	5.7	23
609	23.6	4.6	19

The total Au values for samples 602, 603 and 609 are very high, being equivalent to 26.8, 16.1 and 15.4 dwt/ton respectively. However, cyanide-soluble gold values are much lower and constitute only 14 - 23% of the total Au.

These results suggest that the majority of the gold does not occur as relatively coarse grains of metallic gold but in one or more of the forms listed in the Introduction

3. PETROGRAPHIC AND MINERAGRAPHIC DESCRIPTIONS

Sample A602 TS 32032 PS 21894

Hand Specimen:

A pale grey rock extensively veined and replaced by sulphide.

Thin and polished sections:

A visual estimate of the minerals present is as follows:

	%
quartz	10 - 15
carbonate (ankerite)	50 - 60
pyrite	25 - 30
chalcopyrite	trace
arsenopyrite	trace
sphalerite	minute trace

The host rock or vein material is now composed of recrystallized or secondary quartz of varying grain size up to 0.5 mm intergrown with carbonate up to 1 mm in grain size. There are a few fine grained zones composed mainly of carbonate intergrown with minor quartz which may represent remnants of original rock but elsewhere no relict textures are preserved and much of the carbonate is moderately coarse grained, similar to vein carbonate.

The rock has been extensively fractured, crushed and partly granulated and it has been invaded by pyrite which occurs as a network of veins 0.05 - 0.3 mm thick and as larger interstitial masses up to 1 mm across. Finer grained (5 - 20 microns) pyrite is dispersed through some granulated portions of the breccia. Most of the pyritic masses are slightly porous, finely crystalline and have very irregular boundaries. Some of the larger, coarser grained masses of pyrite show evidence of fracturing and partial granulation similar to that shown by the carbonate and quartz.

Arsenopyrite occurs as small, subhedral to anhedral grains 0.02 - 0.05 mm in size associated with some of the pyrite. A few grains are included within larger pyrite crystals and some arsenopyrite grains have been fractured.

Chalcopyrite occurs as very small grains averaging 0.01 mm in size in a few interstices between fractured fragments of pyrite and some occurs as thin films along fractures in larger pyrite crystals.

Sphalerite was found only in one small area where there are a few grains less than 0.02 mm in size. It is quantitatively insignificant.

No gold was found by visual examination of the section.

The carbonate has a refractive index (ordinary ray) of 1.72 and is very probably ankerite.

Conclusion

Pyrite has invaded and partly replaced a carbonate-quartz breccia and has also been fractured and partly crushed by later movement.

Sample A 603 TS 32033 PS 21895

Hand Specimen:

A yellowish grey to white, carbonate rock or breccia has been invaded and extensively replaced by sulphide minerals.

Thin and Polished Sections

A visual estimate of the minerals is as follows:-

	%
carbonate	40 - 50
quartz	2 - 3
arsenopyrite	20 - 25
pyrite	20 - 25
chalcopyrite	3 - 5
sphalerite	1 - 2
galena	2 - 3

The host rock is similar to that in sample A602 in that it is predominantly moderately coarse grained, recrystallized or secondary carbonate with minor recrystallized or secondary quartz. Most of the crystals of carbonate show strain between crossed nicols and there are numerous fractures and some granulated zones. The sulphide occurs as a dense network of veins and as irregular aggregates.

Pyrite and arsenopyrite are the dominant sulphide minerals and these are unevenly distributed.

Some areas up to 2 mm across contain slightly porous masses of arsenopyrite crystals which vary in size from 0.01 to 0.05 mm. A little chalcopyrite occurs in interstices between some arsenopyrite crystals and varies in grain size from 0.01 to 0.05 mm. Minute grains of sphalerite accompany some of the chalcopyrite.

Other areas contain coarse grained (up to 0.4 mm) pyrite. This has been fractured and some of it is cut by elongate and irregular vein-like zones containing fine grained arsenopyrite with interstitial chalcopyrite. The general appearance and textural relationship of these minerals strongly suggests that the rock contained masses of moderately coarse grained pyrite which were extensively fractured and partly granulated by crushing. Arsenopyrite then replaced much of the pyrite in the crushed and granulated zones and also penetrated along some of the smaller fractures.

Chalcopyrite, sphalerite and galena have all migrated and crystallized in this rock after crystallization of the arsenopyrite and pyrite. They fill a few interstices between these earlier sulphides occurring as irregular grains a few microns in size and locally up to 0.1 mm in size. Some films of galena and chalocpyrite fill small fractures in pyrite grains.

Some chalcopyrite and sphalerite occur as separate small veins 0.05 - 0.1 mm thick, cutting all other sulphides.

No gold was found by visual examination.

Conclusion

A rock or vein material composed of ankerite, pyrite and minor quartz was extensively fractured and crushed. Activity by migratory solutions resulted in the replacement of much of the finely crushed and granulated pyrite by arsenopyrite. Relatively minor amounts of chalcopyrite, sphalerite and galena were then deposited in interstices between the earlier sulphide mineral grains and in a few fractures in the pyrite. Veins containing sphalerite and chalcopyrite were formed late in the history of this rock.

Sample A 609 TS 32034 PS 21896

Hand Specimen:

A pale grey, carbonate breccia similar to other samples has been extensively veined and replaced by sulphide.

Thin and polished sections:

A visual estimate of the minerals present is as follows:

	%
carbonate (ankerite)	60 - 70
quartz	5 - 10
pyrite	5 - 10
chalcopyrite	5 - 10
galena	trace
sphalerite	trace
arsenopyrite	2 - 3

Moderately coarse grained ankerite is intergrown with, or contains a few irregular and elongate patches of fine to medium grained quartz. This host rock has been extensively fractured and has been partly replaced by sulphide which occurs along numerous fractures and veins and also in interstices between some of the carbonate grains. The sulphide is cut by later fractures and zones of granulation which have produced some very fine intergrowths of sulphide and carbonate.

Pyrite crystals 0.05 - 0.3 mm in size are scattered throughout the rock mainly in interstices between carbonate grains. Some are surrounded by chalcopyrite which forms irregular, interstitial patches up to 0.4 mm across. Some chalcopyrite contains very numerous small (0.1 - 0.2 mm) inclusions of arsenopyrite and its occurence indicates that it has filled interstices in granulated zones which contained fine grained arsenopyrite and remnants of granulated pyrite. Some chalcopyrite occurs as films in fractures in pyrite grains.

Where chalcopyrite forms larger grains 0.1 - 0.2 and rarely to 0.8 mm in size some of it encloses rhomb-shaped crystals of carbonate and in one area some finely porous zones within the chalcopyrite show that at least part of it has replaced a pre-existing mineral. However relict textures are not clearly preserved.

Sphalerite occurs discontinuously as finely porous aggregates along a vein 0.1 - 0.2 mm thick. A little fills a few interstices between arsenopyrite grains.

Two grains of metallic gold were detected in the polished section. Both occurred as inclusions within pyrite, one grain measuring approximately 12 x 5 μm and the other approximately 5 x 3 μm. The metallic gold is a pale yellow colour and probably contains some silver.

Conclusion

This rock has had a similar history to that of sample A 603 but it contains less arsenopyrite and more abundant chalcopyrite.

4. DISCUSSION

The three samples appear to represent a brecciated carbonate-quartz vein which has been invaded first by pyrite and subsequently by arsenopyrite, chalcopyrite, galena and sphalerite. Some brecciation post-dates the introduction of pyrite.

Gold, as evidenced by the analytical data, does not occur largely as relatively coarse grains of metallic gold. The data suggest that it is present as very fine grains of metallic gold locked within other minerals, in solid solution in other minerals and/or as gold tellurides or other cyanide-insoluble gold minerals. The microscopic evidence indicates that at least some of the gold occurs as discrete metallic gold grains of very small size (<3 - 12μm) locked in pyrite but whether such occurences account

for the bulk of the gold would require more detailed investigation. However, it is possible to state with reasonable certainty that, if these samples are typical of the deposit, direct cyanidation is unlikely to recover a high proportion of the gold and some form of pre-treatment (e.g. sulphide flotation and/or roasting) will be necessary.