COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

1961/112

HALF-YEARLY REPORT OF PETROGRAPHIC AND MINERAGRAPHIC WORK FOR THE PERIOD JANUARY-JUNE, 1961.

Compiled by

W.M.B. Roberts.

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CONTENTS

INTRODUCTION

This record is composed of minor reports completed by the petrographic and mineragraphic sections of the geological laboratory, Bureau of Mineral Resources during the period January to June, 1961. The reports are in chronological sequence and each report gives its date of completion and the relevant file number above the heading.

The officers responsible for the work in this record are: W.B. Dallwitz (A/Supervising Geologist), W.M.B. Roberts (A/Senior Geologist), R. Bryan (Geologist Grade II), and G.J.G. Greaves (Geologist Grade I).

CONTENTS (Contd.)

REPORT 1. 139G/1
15th February, 1961.

IDENTIFICATION OF AN EFFLORESCENT SUBSTANCE FROM BURRINJUCK DAM.

By W.M.B. Roberts.

Following is a report on a sample from Burrinjuck Dam for Dr. Raggatt.

"A white crystalline material from a bore hole in the inspection gallery in the side walls of Burrinjuck Dam has been identified by X-ray diffraction as CALCITE".

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REPORT 2. 106G/17
16th February, 1961.

EXAMINATION OF FORAMINIFERA FROM DRIBBLING BORE, SANDRINGHAM STATION, Q'LD.

By W.M.B. Roberts.

A quantity of arenaceous foraminifera tests were submitted by Dr. I. Crespin for identification of a black mineral dispersed throughout the quartz grains forming the tests.

Examination of the ground material under the binocular microscope revealed that, in addition to the black mineral in question, there was an appreciable quantity of pyrite and zircon present.

The pyrite had a well developed crystal form, and usually occurred as aggregates of small crystals. Zircon is present, both in well developed crystals, and as well rounded grains. The ones having the crystal faces developed were invariably pale pink; the crystal faces observed were the typical prism and pyramid. The rounded grains were a deep honey colour; no crystalline brown grains or rounded pink zircons were observed. This differential hardness has been observed in beach sand zircons from the east coast of Australia, and follows the same pattern - the brown or honey coloured mineral is always the softer.

The black mineral is present as sub-angular in the well rounded grains; sufficient was separated under the binocular microscope for an X-ray powder photograph to be taken; this, coupled with an X-ray spectrographic analysis of the tests, identified the mineral as ilmenite.

The X-ray spectrogram showed that, in addition to the zirconium, iron, and titanium, of these minerals about 0.5% arsenic is present, as well as traces of manganese, nickel, lead, strontium and rubidium.

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REPORT 3.

106Q/7
16th March, 1961.

EXAMINATION OF MARLSTONE SPECIMENS FROM THE BOULIA AREA, QUEENSLAND.

By W.M.B. Roberts.

Two samples of marlstone, labelled B.557 and B.452 were submitted by G. Brown for identification of the clay minerals. The examination, using the X-ray diffractometer, showed that sample B.557 is composed of about 95% calcite and 5% quartz. No pattern for any clay mineral appeared on the chart for this sample.

Sample B.452 is almost identical with B.557 except that 1% or 2% of dolomite is present.

Some of sample B.452 was dissolved in 1 : 1 HCl, and the residue, about 5% of the total sample, was examined by X-ray diffraction which showed it to be mainly quartz with a few faint lines which could not be identified. The unidentified material could not have been more than 5%-10% of the total residual solids.

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REPORT 4.

106G/13/60
5th April, 1961.

EXAMINATION OF A ROCK SPECIMEN FROM PICKANJINNIE NO.1 WELL. QUEENSLAND.

By W.B. Dallwitz.

Following are some brief notes on part of Core 18 from Pickanjinnie No.1 Well at 4611 ft. previously described as a tuff. The specimen was submitted by D.M. Traves of Associated Australian Oilfields N.L.

Some difficulty was experienced in making a thin section of this rock, due to the fact that it broke up in contact with water. The section was eventually made entirely by dry grinding. The behavior of the rock in water suggests the possibility that it is volcanic, as altered glassy or tuffaceous rocks occasionally behave in this way.

In thin section the rock is found to consist mainly of fine-grained clayey (?montmorillonite) material in the form of wispy flakes. These flakes have a marked parallel arrangement when viewed between crossed polarizers, but there are also quite a few of them which do not conform to this pattern. Embedded in this clayey matrix are clots of dark sideritic material, small clots of calcite, scattered grains of plagioclase (probably andesine), leucoxene and rare zircon; these minerals make up no more than 20 % of the rock.

There is nothing clearly suggestive of a tuffaceous origin to be gleaned from the microscopic examination. The best pointer to such an origin is to be found in the feldspar grains. Their shapes are either irregular, or tabular, or like those of microlites in basalt or andesite. The irregularly-shaped grains seem to be more in keeping with what might be expected in a tuff, rather than in a normal sedimentary rock or a lava. The grains range in size from about 0.05 mm. to 0.2 mm.

No really conclusive clues as to the nature of this rock can be got from the thin section. However, nothing contrary to the suggested tuffaceous origin was found, and one or two features which might be indicative of such an origin were noted.

It seems, in fact, that the rock may be an altered intermediate ashstone.

REPORT 5.

84G/8
13th April, 1961.

ANALYSES OF RADIOACTIVE SPECIMENS FROM EL SHERANA MINE, NORTHERN TERRITORY.

By W.M.B. Roberts.

Nine radioactive samples were submitted by the Manager, El Sherana mine, for analysis of the radioactive constituents; the following results were obtained :-

175717	$\%U_3O_8$	5.55
17518	"	7.07
17519	"	4.79
17520	"	20.0
17521	"	27.5
16915B	"	0.55
16917	"	0.16
16919	"	0.32
17372	"	0.28

In all except 16917, these results are very much higher than those obtained by radiometric assay and no explanation can be given for this discrepancy; the duplicates done on each sample by X-ray fluorescence showed good agreement.

No significant quantity of thorium is present in any of the samples.

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REPORT 6.

198PNG/1
10th May, 1961.

MINERAGRAPHIC DESCRIPTION OF THREE SPECIMENS OF COPPER ORE FROM BOUGAINVILLE, NEW GUINEA.

By G.J.G. Greaves.

Following are descriptions of three specimens of copper ore from Bougainville submitted by J.E. Thompson of the Bureau of Mineral Resources.

P436 (b) - Pungana Creek near Pamkana lode, headwaters of Vaba Creek, Bougainville.

The hand specimen is a massive, fine-grained, grey rock intersected by a green-stained brecciated quartz vein which in turn encloses a brassy yellow and black sulphide vein about 0.5 cms. wide.

Sulphides form roughly 30% of the specimen: in order of abundance, chalcopyrite 50%, bornite 40%, chalcocite and covellite 10%.

There are inclusions of quartz, hydrous iron oxides and malachite up to 2 mm. long in the sulphide vein. Fracture fillings of these minerals up to 0.2 mm. wide, also cut the vein.

The chalcopyrite has numerous elongate inclusions of bornite up to 6 mm. long; these are generally parallel to the margins of the vein.

Some bornite grains have exsolution lamellae of chalcopyrite in the (111) planes. Peripheral alteration of bornite to covellite has proceeded along two crystallographic directions. Bornite has been altered to chalcocite and covellite to a greater extent than has chalcopyrite.

The green colouration in the quartz vein is due to malachite. Hydrous iron oxides and small amounts of magnetite, chalcopyrite and bornite are also present. The chalcopyrite occurs both as irregular inclusions in magnetite and as separate grains marginally altered to covellite. The bornite is partly altered to chalcocite and subordinate covellite.

P436 (a) - same locality as P436 (b).

The hand specimen is massive and consists of equidimensional grains of black sulphide, quartz, smaller grains of brassy yellow sulphide, and interstitial green oxidation products.

Sulphides form roughly 30% of the specimen. Of these, bornite forms about 65%, chalcopyrite 20%, and chalcocite and minor digenite and covellite 15%. The textures are similar to those of specimen P436 (b).

Irregular grains of chalcopyrite up to 3 mm. long have been altered along grain boundaries and quartz-filled fractures to chalcocite.

Bornite grains up to 7 mm. diameter have been extensively shattered, and subsequently recemented with quartz. Bornite is considerably altered to chalcocite and covellite along these fracture fillings and around the margins; it also contains inclusions of digenite up to 0.05 mm. diameter.

Hydrated iron oxides and malachite have formed around the quartz grains and to a lesser extent the sulphide grains.

P437 - Old Kupei Mine, 10 miles S.W. of Kilta, Bougainville.

The hand specimen consists of irregular grains of black and brassy yellow sulphides in quartz.

The sulphides form roughly 10% of the specimen. Of these, chalcopyrite forms about 45%, bornite 50% and covellite and minor chalcocite 5%.

Grains of chalcopyrite up to 2 mm. in diameter are generally associated with the bornite.

Bornite forms rectangular grains up to 4 mm. long and exsolution lamellae of chalcopyrite occur in the (111) planes of bornite. Very fine veins of chalcopyrite in some of the bornite grains are just visible at a magnification 1,050 X. Bornite, more so than chalcopyrite, is altered to covellite and chalcocite around the margins and along fracture fillings of quartz. The exsolution - lamellae of chalcopyrite are unaltered, although the enclosing bornite is partly altered to covellite.

Irregular magnetite grains form less than 0.5% of the specimen and have a maximum diameter of 1.6 mm.

Summary

The sulphides present are bornite, chalcopyrite, chalcocite, covellite and very minor digenite in order of decreasing abundance.

Chalcopyrite and bornite have been fractured and recemented by quartz and supergene alteration to chalcocite and covellite has taken place.

The presence of exsolution lamellae of chalcopyrite in bornite indicates that the temperature of deposition of these two sulphides was greater than 475°C (Schwartz, 1931).*

The complete absence of pyrite and the presence of minor amounts of magnetite is notable.

Surface weathering of the copper minerals has produced malachite and hydrous iron oxides.

"Intergrowths of bornite and chalcopyrite."

* Schwartz, G.M., 1931 - Econ.Geol., 26 186-201.

1980/4
10th May, 1961.

REPORT 7.

MINERAGRAPHIC EXAMINATION OF COPPER ORES FROM THE RUDDYGORE MINE AREA, CHILLAGOE, N. Q'LD.

By G.J.G. Greaves.

Following are descriptions of a specimen of copper ore from the Ruddygore Mine and of core from a diamond drill hole 2,300 feet north-east of the Mine. These were submitted by W.C. White.

No.12 - Enriched copper ore from bottom of open cut, Ruddygore Mine, Chillagoe. (so called black ore).

The hand specimen is massive and consists mainly of brassy yellow and black minerals; green oxidation products form surface coatings, pockets, and crack fillings in the massive ore.

Sulphides make up over 80% of the specimen; the remaining 20% is quartz, hydrous iron oxides and malachite. Of the sulphides, chalcopyrite forms roughly 45%, digenite 40%, covellite 10%, and pyrite 5%. Bornite is a very minor accessory.

The massive chalcopyrite has been strongly fractured, and some of the fractures are filled with quartz, hydrous iron oxides and malachite. Chalcopyrite has been altered along the fractures to form veinlets of digenite and covellite. The largest of these is 0.3 mm. wide; the largest residual grain of chalcopyrite is 0.3 mm. in diameter.

Shattered pyrite grains up to 3 mm. in diameter are altered along the margins and fractures to hydrous iron oxides. Two small elongated pyrite grains, 0.15 mm. long, appear to have been deposited with quartz along fractures in the chalcopyrite subsequent to the alteration of the chalcopyrite.

Very small spindles of bornite, the position of which appears to be crystallographically controlled within the chalcopyrite, indicate exsolution of bornite as a result of rapid cooling. Bornite blebs less than 0.01 mm. in diameter were noted in the digenite.

No.11 - Mt. Isa Mines Ltd. D.D.H. No.8
2,300 feet N.E. of the Ruddygore Mine, Chillagoe.

The hand specimen consists of massive pale brassy yellow sulphide and subordinate quartz.

Pyrite forms over 70% of the specimen; the other sulphides present, pyrrhotite, chalcopyrite, and digenite form less than 1% of the specimen.

In places the pyrite is fractured and the fractures filled with quartz. Quartz also occurs as idiomorphic and irregular inclusions in the pyrite. Other inclusions in the pyrite consist of very minor blebs of pyrrhotite up to 0.3 mm. long and one chalcopyrite grain 0.3 mm. in diameter; this grain is extensively altered along fractures and around the margins to digenite.

106W/5
10th May, 1961

REPORT 8.

EXAMINATION OF OPAQUE MINERALS IN A SPECIMEN FROM MACDONALD, WESTERN AUSTRALIA.

By G.J.G. Greaves.

Following is a description of the opaque minerals in a specimen from Macdonald, Western Australia submitted by A. Wells.

S4C. The hand specimen is schistose and consists of a lenticular mass of fine-grained opaque mineral with a selvedge of sericite-schist containing thin quartz-feldspar veins. The maximum width of the lens is about 1 inch.

The opaque mineral is hematite; it contains bladed inclusions of silicate (possibly mica) parallel to the twin planes of the hematite. The hematite is extensively twinned or else forms a fine mosaic; these features could be expressions of different degrees of shearing and recrystallisation of the hematite after its formation.

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106W/5
10th May, 1961

REPORT 9.

MINERAGRAPHIC EXAMINATION OF THE HEAVY MINERALS IN FOUR SEDIMENTS FROM MACDONALD, WESTERN AUSTRALIA.

By G.J.G. Greaves.

Following are descriptions of the heavy minerals in four specimens from Macdonald, Western Australia submitted by A. Wells.

The field numbers of the specimens are M80, M81, R113 and R119.

All specimens consist of alternating hematite-rich bands from 0.5 to 5 mm. wide, and non-opaque bands up to 2 mm. wide. Iron oxides form 50% or more of the specimens. Of this, hematite forms roughly 70% and hydrous iron oxides the remainder. Although magnetite was not conclusively identified, several grains from crushed specimens were highly magnetitic.

The shapes of the hematite grains show all gradations from angular to well rounded, and the maximum grainsize is 0.3 mm.; grains from R119 and R113 are more angular and irregular than from M80, M81.

Much of the hematite is twinned and in places the nature of the lamellae indicates that some of the hematite is derived from complete alteration of magnetite.

Some grains of hematite have been extensively fractured and the hematite is altered to hydrous iron oxides along grain boundaries, cleavages, and fractures.

Zircon was the only non-opaque heavy mineral identified from heavy liquid separation of the crushed specimens.

1980/2
1st. June, 1961.

REPORT 10.

IDENTIFICATION OF A SECONDARY ZINC MINERAL FROM McARTHUR RIVER, NORTHERN TERRITORY

By W.M.B. Roberts.

The mineral, submitted by R. Cotton, Carpentaria Exploration Ltd., is a colourless, botryoidal encrustation, in which it was specifically required to know the quantity of zinc present, if any.

The mineral has been identified by X-ray diffraction as the zinc carbonate, smithsonite, which should theoretically contain about 65% ZnO. The only other important metallic element in the mineral is a strong trace of cadmium, in the region of 0.2 - 0.5% CdO.

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REPORT 11.

12ONT/3
1st June, 1961.

IDENTIFICATION OF A CUBIC MINERAL FROM MOUNT YOUNG, NORTHERN TERRITORY.

By W.M.B. Roberts.

The specimens were submitted by H.G. Roberts of the Bureau of Mineral Resources for identification of the pseudomorph and, if possible, the original mineral.

The cubes of brownish-red mineral in the rock from Mount Young, run 9, photo 67, point 2, have been identified by X-ray diffraction as geothite; the mineral is obviously a pseudomorph after pyrite.

Both specimens were examined - the mineral in the piece of silicified rock, and the cubes which had been separated out - they were both the same mineral, except that the separate cubes were slightly more perfectly crystalline.

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REPORT 12.

198NT/1
13th June, 1961.

IDENTIFICATION OF MINERALS FOR THE RESIDENT GEOLOGIST, DARWIN, NORTHERN TERRITORY.

By W.M.B. Roberts.

Two mineral specimens, both from undisclosed localities, were submitted by P.G. Dunn, of the Darwin office. The identities of the minerals were required :

Mineral No.1, a green mineral in quartz associated with pyrite, arsenopyrite and cassiterite - this has been identified by X-ray diffraction as the ferric arsenate, scorodite, which has the formula $(Fe,Al)\ AsO_4.2H_2O$.

Mineral No.2, suspected tantalite. The X-ray powder diagram which cannot distinguish between tantalite and columbite, or mixtures of these two elements, identified the mineral as belonging to the columbite-tantalite series. X-ray spectrochemical analysis identified the elemental composition as a mixture of columbium and tantalum roughly in the ratio Cb/Ta 2:1. The mineral would therefore be correctly called Columbite-tantalite.

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REPORT 13.

84NT/4/A
27th June, 1961

NOTES ON THE "AMPHIBOLITE" FROM D.D.H. NO. 4, WATERHOUSE NO.2 PROSPECT, RUM JUNGLE AREA, N.T.

By Robert Bryan.

There can be little doubt that the core logged by Ruxton (1961, Bur.Min.Resour.Aust.Rec. (in preparation)) as amphibolite is of igneous origin, but the bulk of it falls short of being true amphibolite.

Two quite distinct textural types were recognized, and will be described separately :

112'8" to 117' *

In the hand specimen the rock is dark grey, consisting of euhedral crystals of hornblende set in a pale white or grey material. In thin section, the hornblende crystals are found to measure an average 0.5 mm. across and 1.0 mm. in length; pleochroism is strong, from deep blue green to pale green to pale brown, and the extinction angle is 24°. This hornblende is probably alumina-poor, and could be either igneous or metamorphic in origin. Albite makes up about 60% of the rock and occupies most of the space between the hornblende crystals. It occurs as even-grained anhedra averaging 0.02 mm. across. Very little twinning is present. Apatite is a common accessory mineral forming slender prisms up to 0.5 mm. long. Opaque minerals are scarce; iron oxide occurs with an equal amount of pyrite and pyrrhotite. In one slide, actinolite has formed instead of hornblende, but the form of the crystals is similar.

The texture of the rock is quite anomalous, it is not typical of either a calc-silicate rock or an altered igneous rock. However, the presence of long apatite crystals would suggest an igneous origin - expecially as similar crystals occur in the underlying igneous amphibolite.

124' - 250'

In appearance, this rock is quite different from that described above. In hand specimen it is light grey and very even-grained, and shows no conspicuous large crystals. Seen in thin section, it consists of fine- to medium-grained fibrous aggregates of actinolite together with subordinate brown hornblende, carbonate, feldspar, iron oxide, and iron sulphides. The actinolite shows varying degrees of pleochroism; some is strongly pleochroic from blue green to olive green to pale brown, but in the bulk of the sections the change is from pale brown to a very pale green. The hornblende is strongly pleochroic from reddish brown to pale buff to pale tan, and shows outlines strongly suggestive of an original poikilitic texture, that could be directly comparable to ophitic texture of pyroxene in some basic igneous rocks. Carbonate is very common as scattered grains and patches, and would appear to be original rather than introduced. Pyrrhotite and some pyrite are present - both in much greater amounts than in the overlying "amphibolite."

* All the limits are conservative, as they had to be based on samples of core sent to me, and not on the complete log.

Albite is not very common, accounting for only 15% of the rock in the ten thin sections examined. Apatite once again forms elongate crystals, similar in every way to those in the overlying "amphibolite".

The texture of the rock is very similar to that of many dolerites of the Katherine-Darwin area, that have been deuterically altered, and regionally metamorphosed to some extent. There is a mineralogical similarity also, except that, in the Waterhouse rocks, sodic plagioclase is very scarce and some residual hornblende occurs.

Conclusion

In the main zone of "amphibolite", from 124' to 250', the presence of relict hornblende showing poikilitic texture, the presence of elongate apatite crystals, and the overall texture of the rock leaves no doubt of its igneous origin. The rock probably formed part of a concordant basic intrusive, notably low in plagioclase - either a hornblende dolerite or gabbro, low in plagioclase. I would favour a doleritic origin, but only because dolerites are the predominant basic rocks of the Katherine-Darwin area. The rock in its present state, falls within the "albite-epidote amphibolite facies" (Williams, Turner and Gilbert, 1954, "Petrography", Freeman.), and was formed from a basic igneous rock by deuteric alteration or low grade regional metamorphism, or both. It has reached a stage of alteration roughly equivalent to that found in "amphibolite" at Mt. Burton, Rum Jungle Creek South, and Brocks Creek.

The material from 112'8" to 117' is problematical. The presence of elongate apatite similar to that in the main mass below, strongly suggests an igneous origin. The main difficulties to explain are the much higher proportion of sodic plagioclase when compared with the lower "amphibolite", and the presence of large, well-formed hornblende crystals which contrast sharply with the fibrous and irregular amphibole of the lower "amphibolite".

There are three possible explanations :-

(1) The rock was plagioclase-rich, contained well-formed primary hornblende, and was a later differentiate of the magma that gave rise to the underlying "amphibolite". The difference in colour of the hornblende in the two masses can be explained by the crystallization of the green hornblende of the differentiate at a lower temperature than that at which the brown hornblende of the main mass crystallized.

(2) The upper mass was originally more sodic than the lower mass, but the hornblende crystals of the upper mass are really porphyroblasts of metamorphic origin. This would involve the recrystallization of the amphibole to a euhedral form, but there is no reason for, or evidence of, this having taken place.

(3) The upper material could be a calc-silicate rock, of sedimentary origin. The presence of elongate apatite crystals, and comparison of the metamorphic grade of the rock with that of the overlying sediments, rules out this possibility.

In my opinion, the first of these explanations seems the simplest and the most likely.

Thin Sections used :- Upper problematical material, 6869-6871
Main mass of altered igneous rocks, 6872-6881, 6912
Adjacent sediments, 6864-6868