DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

Rept.Bk.No. 80/126

# BLACK ROCK PLAINS COPPER DEPOSIT, ML 4324 sec 359 hd. BLACK ROCK PLAINS CO. DALHOUSIE

GEOLOGICAL SURVEY

By

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and

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FIELD ASSISTANT

D.M.E. No. 935/73

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DEPARTMENT OF MINES AND ENERGY
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Rept.Bk.No. 80/126
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# BLACK ROCK PLAINS COPPER DEPOSIT, ML 4324 sec 359 hd. BLACK ROCK PLAINS CO. DALHOUSIE


## ABSTRACT

Since 1972, 13.5 tonnes of copper ore have been handpicked from malachite and azurite mainly on cleavage planes exposed in trenches in Tarcowie Formation siltstone of Marinoan age, 7 km south of Orroroo in the Mid North.


## INTRODUCTION

Mineral Resources Section was first aware of the Black Rock Plains Copper deposit in early 1979 after ML 4324 was renewed. There is no record of the deposit in Departmental publications and it is not marked on ORRORRO 1:250 000 geological map sheet (Binks, 1968) nor on ORRORRO metallic index map sheet - mineral deposits.

The deposit was inspected by J.J. Martins and B.W. Atterton (Field Assistants) in May 1979. The accompanying sketch plan, Figure 2, is based on a tape and compass survey. Nine chip samples were collected and submitted to Australian Mineral Development Laboratories (AMDEL) for chemical analysis.

Subsequent checking of section files revealed that K. Every (then Geologist, Metallics Section) inspected the deposit on 15 November 1973 at the request of the leasholders and collected 5 samples. Results of x-ray diffraction analysis, petrography and chemical analysis of these samples by AMDEL comprise Appendix I.

## LOCATION AND ACCESSS

ML 4324 is on section 359, hundred Black Rock Plains, county Dalhousie, within the District Council of Orrorro part of the Mid North Planning Area, 7 km south of Orrorro township and 5.5 km north east of Pekina (Fig. 1).

Access is southwards from Orrorro along the Pekina road and thence eastwards along a good all-weather farm track to within 400 m of the lease, a total distance of 9 km.

Topography is controlled by a series of narrow northerly trending ridges. ML 4324 is located in undulating terrain cleared of natural vegetation (Plates 1 and 2). A dry stream channel drains westwards through the middle of the lease to Wepowie Creek, about 1 km away.

The land is used for rotational cereal cultivation and livestock grazing.

## MINERAL TENURE

On 14.3.71, Mineral Claims 6944 and 6945 were registered for C.G. Gibb and Mineral Claim 6946 for W.H. Cottrell. The claims were contiguous and each of 16 ha. The land is freehold owned by Cottrell.

MC 6946 lapsed on 16.10.71 and MC 7424 was registered for W.H. Cottrell over the same area on 5.11.71.

MC 6944 and 6945 lapsed on 7.7.73 and MC 7424 on 14.7.73.

MC 304 of 20 ha covering the central portion of the original three claims was registered on 19.9.73 for G.C. Gibb and W.H. Cottrell.

Mineral Lease 4324 was granted over MC 304 for 5 years from 3.12.73, renewed for 2 years and is due to expire on 2.12.80.

## MINING OPERATIONS

The workings are on top of a low hill in the northern part of ML 4324. Prospecting, ripping and bulldozing were reported in 1971 by the operators with hand picking of ore in 1972.

In 1973, K. Every recorded seven trenches and a larger bulldozed scrape at each end of the trenches, all less than one metre deep.

R.E. Mathews (Inspector of Mines) reported further bulldozing in 1975 which deepened some of the earlier trenches. In 1977, the workings were about 17 m wide and extended north-south for 75 m with six trenches 2 m wide and 1 m deep and a larger area at each end bulldozed to a depth of 1-2 m (Fig. 2)

Production in Table 1 is based on returns submitted to the Department.

TABLE 1

Production of Copper Ore

| Year | Tonnes mined | Tonnes stockpiled |
|---|---|---|
| 1972 | 1.5 | 1.5 |
| 1973 | 5 | 6.5 |
| 1974 | 5 | 11.5 |
| 1975 | 2 | 13.5 |

Ore grade of 5.8% Cu is quoted on the production return for December 1979.

## GEOLOGICAL SETTING

The deposit is located on the eastern limb near the northern closure of the Pekina Syncline as shown on figure 1 which has been modified from ORRORO0 (Binks, 1968). The core of the syncline comprises Tarcowie Formation intertonguing with carbonate rocks of Etina Formation to the north between the deposit and Orroroo township (Binks, 1971). These sediments are units of the Umberatana Group of Marinoan age.

Host rocks to the copper mineralisation are Tarcowie Formation interbedded green-grey siltstone and sandy siltstone with minor limestone beds. In the workings, siltstone is micaceous and poorly bedded with well developed axial plane cleavage. Bedding strikes 182-187° and dip is 40-45° to the west. Wavy or ripple marked bedding is common. Cleavage strikes 184-196° and dips 69-76° to the west.

## COPPER MINERALISATION

In 1973, copper carbonate minerals were exposed in situ at the following sites, mainly on cleavage rather than bedding planes as reported in Appendix I.

(1) Northernmost trench 1 - malachite and azurite in a zone 25 cm wide on cleavage striking 187°.

(2) Trench 4 - malachite zone, 10 cm wide, with yellow green mottramite and jarosite (see P672/73 and P673/73, Appendix I).

(3) Trench 5 - mainly azurite, minor malachite in films along cleavage in zone 15 cm wide (P674/73).

(4) Trench 5 - 4.5 m east of (3) - malachite disseminated in siltstone and as veinlets parallel to cleavage (P675/73).

(5) Southernmost trench 9 - malachite and azurite extend more or less continuously along strike for 15 m. Largest patch is 2 m long and 70 cm wide. A1435/73 was collected from small stockpile nearby.

No copper minerals were found in the creek, 150 m south of the workings where Cottrell first found copper staining.

In 1979, malachite and azurite were exposed in four of the six trenches (see Fig. 2).

Results of chemical analyses are summarised in Table 2 from the appendices.

Samples A2110-2117/79 are composite chip samples along the

trench and A5159/79 is from the mineralised zone (see Fig. 2 for locations).

TABLE 2

Comparison of Chemical Analyses

| Sample | Copper | Lead(ppm) | Zinc(ppm) |
|---|---|---|---|
| A1435/73 | 0.65% | 150 | 30 |
| Average A2110-2117/79 | 148 ppm | 23 | 64 |
| A5159/79 | 4.3% | 45 | 100 |

On the relative abundance of malachite and azurite, Dr. R. Davey in AMDEL Report MP2642/74 commented in 1974 as follows:-

'There is probably little or no relationship between the presence of malachite or azurite and the fundamental mineralogy of specimens P674/73 and P675/73. These sediments were laid down as clastic materials and were compacted by diagenetic recrystallisation of micas/clay and by diagenetic formation of dolomite. There is evidence in P675/73 to suggest that chalcopyrite may have been a primary component of this rock and it follows that deposition (and diagenesis) was likely to have taken place in reducing conditions. Malachite and azurite are both products of oxidation and, as far as the greater proportion of these minerals are concerned, are exotic and supergene in origin, being emplaced in fractures along preform bedding planes at a late stage in the rocks' history.

It seems likely, therefore, that the incidence of azurite as opposed to malachite is independent of the mineralogy of the rock but does depend on the copper available, and the concentration of carbon dioxide, oxygen and water in the supergene system.

Garrels, R.M. and Christ, C.L. (1965, Solutions, Minerals and Equilibria, Harper and Row, New York) discuss the various copper-carbonate-oxide reactions (p.154-157) and show that azurite is only stable when the partial pressure of $CO_2$ exceeds

a value given by log $PCO_2$ = -2.5, where P is expressed in atmospheres, (that is, when there is a very high concentration of carbon dioxide) and both malachite and azurite are stable only when log $PCO_2 \geq -40$. When log $PCO_2$ is less than -3.5 malachite becomes unstable and tenorite is the stable mineral. In more reducing conditions, cuprite forms at the expense of malachite, and at the expense of some azurite, and under very reducing conditions, in the absence of sulphur, native copper is formed.

As the normal atmospheric concentrations of $CO_2$ and $O_2$ are (logs) -3 and -0.7 respectively it is clear that malachite is normally the stable mineral and that azurite can only exist under ambient conditions in a metastable state. The presence of enough moisture to fulfil conditions for forming either malachite or azurite is assumed, and, apart from the more arid regions, applies in practice. The partial pressure of $CO_2$ is the major control, determining whether malachite or azurite is deposited. Increased $CO_2$ (above atmospheric levels) is most likely to be found where acid solutions (from the oxidation of sulphides) react with carbonate rocks. In these conditions, azurite is the more stable mineral.

Thus it may be confidently said that for P674-675/73 the partial pressure of carbon dioxide in P674/73 was higher at the time of formation of the secondary copper minerals than it was in P675/73.'

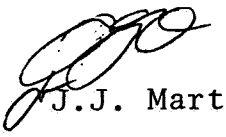
## CONCLUSIONS

Secondary copper mineralisation as malachite and azurite has been emplaced mainly along cleavage planes in Tarcowie Formation siltstone, a unit in the Umbertana Group sediments of Marinoan age.

Since 1972, 13.5 tonnes of ore with a reputed grade of 5.8% Cu have been mined but not sold.

The deposit is not economic and no further investigation is warranted.

J.G. Olliver



J.J. Martins

## REFERENCES

Binks, P.J., 1968. ORROROO map sheet, Geological Atlas of South Australia 1:250 000 series. Geol. Surv. S. Aust.

_____, 1971. The geology of the ORROROO 1:250 000 map area. Rep. Invest., geol. Surv. S. Aust., 36: 114 pp.

Plate 1: Black Rock Plains Copper Deposit, May 1979. View to southwest. Trenches in foreground with Mr. Cottrell's homestead in background.

Plate 2: Black Rock Plains Copper Deposit, May 1979. View to west along trench, showing several generations of trenching. Pekina Hill range in background.

# APPENDIX I

X-RAY DIFFRACTION ANALYSIS, PETROGRAPHY AND CHEMICAL ANALYSIS EXTRACTED FROM AMDEL REPORT MP2642/74 BY DR. R. DAVY.

## X-RAY DIFFRACTION ANALYSIS

(a) P672/73 (T4A), Black Rock Plain:

(i) Yellow green mineral:

This sparsely distributed mineral is a member of the descloizite group of vanadates and probably corresponds to mottramite (the Cu Pb member of the group - Pb Zn OH $VO_4$), though, because of inadequate X-ray diffraction reference data, other members of the series, namely calciovolborthite, Cu Ca OH $VO_4$, or turanite, $Cu_2$ OH $VO_4$, are possible.

(ii) Black-brown thin coating:

The only mineral detected was muscovite in spite of the considerable trouble to collect material free of the underlying schist. It appears that the brownish staining material has penetrated the muscovite of the schist somewhat. No information was forthcoming about the brown material itself.

Sample: T4B, P673/73: TS 31633

Location: Black Rock Plain, MC 304

Rock Name: Dolomitic Siltstone

Hand Specimen: A well banded grey-green sedimentary rock displaying on its broken bedding surface both azurite and malachite. The rock displays micro current bedding.

Thin Section:

An optical estimate of the constituents gives the following:

| | % |
|---|---|
| Quartz | 40-50 |
| Chlorite | 5-10 |
| Carbonate | 23-35 |
| Feldspar | 2-3 |
| Mica | 10-25 |
| Tourmaline | trace-1 |
| Opaques | trace |
| Goethite | trace |

The rock has quite a variable composition in the different layers of the rock. It contains irregular subsequent grains of quartz, 0.05-0.15 mm in diameter, cemented variably by dolomite and/or mica and chlorite. Small amount of plagioclase are present. "Veins" of malachite, mica and azurite penetrate the rock along the bedding, particularly where there is a concentration of mica.

Quartz and plagioclase retain their fundamentally detrital appearance but interpenetrate when in contact and are slightly corroded by the groundmass mica and calcite. Where grains are elongate they tend to be parallel to the bedding.

Phyllosilicates have an overall pale green colour. Most appear to be muscovite but there is a significant proportion of genuine chlorite. Some larger grains of both minerals appear to be wholly detrital. Their maximum size is 0.1 mm. The mica tends to be parallel to the bedding whereas some chlorite is randomly orientated.

Carbonate (calcite) occurs in irregular stringers with mica but, in addition, rhombs of dolomite up to 0.1 m diameter are present in most layers.

Tourmaline (brown and blue) is a minor accessory mineral.

Opaques are rare: many of those present are red-brown and limonitic. Jarosite is indicated in one area suggesting the former presence of a little pyrite. Malachite occurs in "veins" 0.6 mm wide parallel to the bedding. It commonly has brown to almost opaque margins. The malachite is green and turbid with little sign of crystals. Very rarely stringers of malachite penetrate the enclosing mica, drying out as very thin remnants.

This is a typical shallow water sediment of essentially low energy. Cementation has been effected by diagenetic crystallisation of carbonate and/or mica. Copper mineralisation is wholly secondary with the malachite and azurite postdating all other minerals. There is, however, some evidence indicating the former presence of a little sulphide probably pyrite.

Sample: T5A, P674/73: TS 31634:

Location: Black Rock Plain MC 304

Rock Name: Mineralised Siltstone

Hand Specimen: A well foliated grey green sedimentary rock containing abundant filamentous sheets of azurite on some bedding planes.

Thin Section:

An optical estimate of the constituents gives the following:

| | % |
|---|---|
| Quartz | 10-15 |
| Sericite/clay | 75-80 |
| Dolomite | 2-5 |
| Azurite | 2-5 |
| Chlorite | 1-3 |
| Tourmaline | trace |
| Feldspar | trace |
| Biotite | trace-1 |
| Opaques/limonite | trace-2 |

This is a well bedded sediment composed largely of sericite with detrital quartz and feldspar. Isolated, irregular grains of dolomite are scattered through the rock. Azurite has penetrated the rock along fine veinlets parallel to the bedding, in a number of places.

Sericite is the dominant mineral. It appears to be largely recrystallised from clay. Rare grains reach 0.02 mm; most are below 0.005 mm.

The foliation is defined by the mica and by quartz whose irregular elongate grains are elongate parallel to the bedding. The maximum length of quartz grains is about 0.15 mm but most are less than 0.1 mm. The quartz grains show signs of pitting by the mica. There are rare small compound grains of quartz up to 0.2 mm. Chlorite occurs in pale green pods with green interference colours. Much of this appears to be detrital in origin.

Small patches of limonite and trails of leucoxene occur through the rock.

Azurite occurs in stringers parallel to the bedding. Azurite crystals, 0.015 mm wide, occur in one stringer, otherwise the azurite is very fine grained, appearing turbid. The azurite occurs in multiple bands with the stringers bifurcating and then rejoining - giving up to 10 strands of azurite at any one time in a zone 0.15 mm thick. Both sericite and quartz are enclosed in the azurite.

This is a fine grained sediment laid down in essentially low energy conditions, in which the clay/sericite has been transformed by diagenetic recrystallisation. Azurite is a secondary, supergene mineral which has penetrated along bedding planes. It is noticeable that there is relatively little carbonate in this rock.

Sample: T5B, P675.73: TS 31635

Location: Black Rock Plain MC 304

Rock Name: Dolomitic Mineralised Siltstone

Hand Specimen: A well banded grey green sedimentary rock with malachite on the exposed broken surface.

Thin Section:

An optical estimate of the constituents gives the following:

| | % |
|---|---|
| Quartz | 20 |
| Sericite/muscovite | 55 |
| Chlorite | 10 |
| Calcite/dolomite | 15 |
| Malachite | 2-3 |
| Leucoxene | trace-1 |
| Tourmaline | trace |
| Zircon | trace |

In comparison with P674/73 this rock contains rather more quartz and considerably more carbonate. There is proportionally less sericite/muscovite. Much of the malachite is disseminated.

Muscovite grains reach 0.05 mm (rarely 0.1 mm) but most grains are quite small. The larger grains parallel the bedding.

Quartz is irregular with corroded margins, the more elongate grains parallel the bedding. Grains are normally less than 0.08 mm long.

Chlorite forms pleochroic green lenses up to 0.6 mm long. Interference colours are brownish green. Other chlorite grains have about the same size as the quartz, having irregular margins.

Carbonate, mainly dolomite, is present in various amounts in different layers. In places it occurs as irregular granular grains, elsewhere equant rhombs (of dolomite) are prominent. Locally carbonate concentrations reach 30%. Most grains are about 0.05 mm in diameter.

Malachite occurs in two forms, (a) as granules within the body of the rock and (b) in veinlets which penetrate parallel to the bedding. The granules are commonly between 0.04 and 0.1 mm in diameter. Many of the green grains are tinged with brown suggesting the presence of some iron. The veinlets are very thin (0.02 mm) and irregular. The malachite in these veins is evidently exotic (supergene) and that in the disseminated grains has replaced an unidentified mineral or has filled small leached cavities.

## ASSAY DATA

Copper was determined on A1435/73 (T9) by atomic absorption analysis. The remaining elements were determined spectrographically.

Results in ppm are as follows:-

| | |
|---|---|
| Cu | 6 500 |
| V | 50 |
| Mo | 20 |
| Mn | 150 |
| Pb | 150 |
| Zn | 30 |
| Bi | 1 |
| Ag | 3 |

Tungsten, arsenic and antimony were not detected at their limits of 50, 50 and 30 ppm respectively.

# APPENDIX II

## CHEMICAL ANALYSIS
## AMDEL REPORTS AC4738/79, AC144/80 and AC210/80

The Australian
neral Development
Laboratories

ıgton Street, Frewville,
South Australia 5063
ıone Adelaide 79 1662
. Telex AA 82520

Please address all
correspondence to
O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

# NATA CERTIFICATE

1/15/0
AC12/05/0465-4738/79

The Director General,
Department of Mines & Energy,
PO Box 151,
EASTWOOD, SA · 5063

Attention: J. Martins

REPORT AC 4738/79

| | |
|---|---|
| YOUR REFERENCE: | Application dated 25 May 1979 |
| IDENTIFICATION: | A2110/79 - A2117/79 |
| LOCATION: | Black Rock, Orroroo |
| DATE RECEIVED: | 25 May 1979 |

Enquiries quoting AC 4738/79 to the Manager please

D.K. Rowley
Manager
Analytical Chemistry Division

for Norton Jackson
Managing Director

mhb

t Plant: Osman Place
Thebarton S.A.
Telephone 43 8053
ıch Laboratory: Perth

FORM DP 29

# DATA LAYOUT FOR METALSCAN

AMDEL PROJECT NO . . . . . SADM PROJECT NO . . . . . SHEET . . . . OF . . . . .

AMDEL REPORT NO 4738/79 . . . . SADM PROJECT NAME . . . . . DATE . . . . . .

| Detection Limit | 200 | 5 | 20 | 10 | 3 | 5 | 10 | 50 | 100 | 10 | 0.1 | 50 | 1 | 1 | 1 | 30 | 1 | 20 | 3 | 100 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A-G NUMBER | Ba | Co | Cr | Mn | Mo | Ni | V | W | La | Y | Ag | As | Bi | Cu | Pb | Sb | Sn | Zn | Au | P | | |
| A2110/79 | 700 | 40 | 150 | 600 | X | 50 | 150 | X | X | 50 | 0.3 | X | X | 30 | 40 | X | 3 | 100 | X | 700 | | |
| A2111/79 | 400 | 30 | 100 | 400 | X | 40 | 100 | X | X | 30 | 0.2 | X | X | 30 | 40 | X | 3 | 100 | X | 400 | | |
| A2112/79 | 500 | 50 | 150 | 400 | X | 50 | 100 | X | X | 40 | 0.2 | X | X | 60 | 30 | X | 3 | 150 | X | 600 | | |
| A2113/79 | 400 | 30 | 80 | 400 | X | 40 | 100 | X | X | 30 | X | X | X | 70 | 100 | X | 2 | 100 | X | 800 | | |
| A2114/79 | 800 | 50 | 150 | 300 | X | 50 | 200 | X | X | 50 | X | X | X | 600 | 100 | X | 1 | 70 | X | 500 | | |
| A2115/79 | 300 | 40 | 100 | 500 | X | 70 | 150 | X | X | 40 | X | X | X | 30 | 50 | X | 1 | 100 | X | 500 | | |
| A2116/79 | 800 | 30 | 100 | 400 | X | 40 | 150 | X | X | 50 | 0.1 | X | X | 20 | 40 | X | 1 | 70 | X | 200 | | |
| A2117/79 | 400 | 40 | 100 | 600 | X | 40 | 200 | X | X | 40 | 0.1 | X | X | 20 | 30 | X | 1 | 50 | X | 500 | | |

NOTE: 9997 : 10000 ppm 9998 : > 10000 ppm 9999 : >> 10000 ppm

The Australian
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gton Street, Frewville,
South Australia 5063
one Adelaide 79 1662
Telex AA 82520

Please address all
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O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

# NATA CERTIFICATE

AC 1/15/0 - 144/80

16 July 1979,

The Director General,
Dept of Mines & Energy,
P.O. Box 151,
EASTWOOD S.A. 5063

REPORT. AC 144/80

| | |
|---|---|
| YOUR REFERENCE: | 12.05.0465. Application dated 9 July 1979. |
| IDENTIFICATION: | Sample No A2110/79 - A2117/79. |
| DATE RECEIVED: | 9 July 1979. |

Enquiries quoting AC 144/80 to the Manager please

D. K. Rowley
Manager
Analytical Chemistry Division

for Norton Jackson
Managing Director

dg

t Plant: Osman Place
Thebarton S.A.
Telephone 43 8053
nch Laboratory: Perth

AMDEL ANALYTICAL SERVICE

FORM 6 JOB 144/80. *Results in ppm unless otherwise stated* BATCH NO. 1

| TT | Sample No. | | Cu | Pb | Zn | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A.2110/79 | | 15 | 10 | 65 | | | | |
| 2 | 11 x | | 10 | 10 | 65 | | | | |
| 3 | 12 | | 520 | 75 | 95 | | | | |
| 4 | 13 | | 60 | 30 | 60 | | | | |
| 5 | 14 | | 550 | 25 | 55 | | | | |
| 6 | 15 | | 10 | 10 | 65 | | | | |
| 7 | 16 | | 12 | 10 | 50 | | | | |
| 8 | A 2117/79 | | 8 | 10 | 55 | | | | |
| 9 | STD | | | | | | | | |
| 10 | 11 x | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | CODE | | C1 | C1 | C1. | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

The Australian
ineral Development
Laboratories

ngton Street, Frewville,
South Australia 5063
hone Adelaide 79 1662
Telex AA 82520

Please address all
correspondence to
.O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

# NATA CERTIFICATE

AC 1/15/0 - 210/80

24 July 1979,

The Director General,
Dept. of Mines & Energy S.A.,
P.O. Box 151,
EASTWOOD S.A. 5063

REPORT AC 210/80

| | |
|---|---|
| YOUR REFERENCE: | 12.05.0465. Application dated 11 July 1979. |
| IDENTIFICATION: | Sample No A2159/79. |
| DATE RECEIVED: | 12 July 1979. |

Enquiries quoting AC 210/80 to the Manager please

D. K. Rowley
Manager
Analytical Chemistry Division

for Norton Jackson
Managing Director

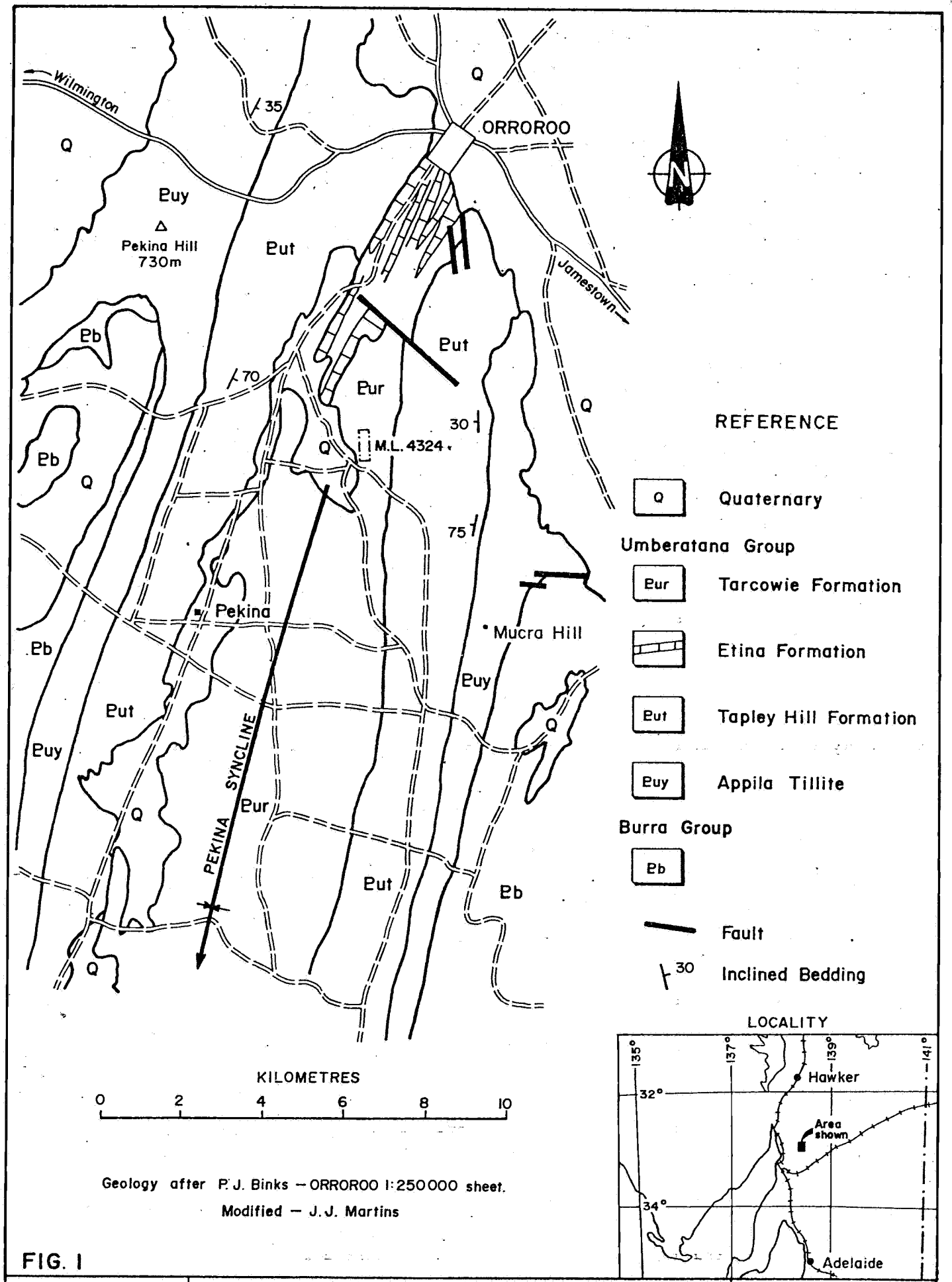
dg

ot Plant: Osman Place
Thebarton S.A.
Telephone 43 8053
nch Laboratory: Perth

AMDEL ANALYTICAL SERVICE

FORM 6 JOB 210/80 *Results in ppm unless otherwise stated* BATCH NO. 1

| TT | Sample No. | | Cu | Pb | Zn | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A5159/79 x | | 4.3% | 45 | 100 | | | | |
| 2 | STD. | | | | | | | | |
| 3 | A5159/79 x | | | | | | | | |
| 4 | BLK. | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | CODE | | C1 | C1 | C1 | | | | |
| 7 | | | % Cu | CODE | F1 | | | | |
| 8 | | | | | | | | | |
| 9 | | | | | | | | | |
| 10 | | | | | | | | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |




Geology after P.J. Binks — ORRORO0 1:250000 sheet.
Modified — J.J. Martins

FIG. 1

| | | |
|---|---|---|
| | DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | SCALE 1:125000 |
| COMPILED J.J. Martins | BLACK ROCK PLAINS | DATE 6·7·79 |
| DRN K.W. CKD | COPPER DEPOSIT | PLAN NUMBER |
| | LOCALITY AND REGIONAL GEOLOGY PLAN | S 14145 |

1467

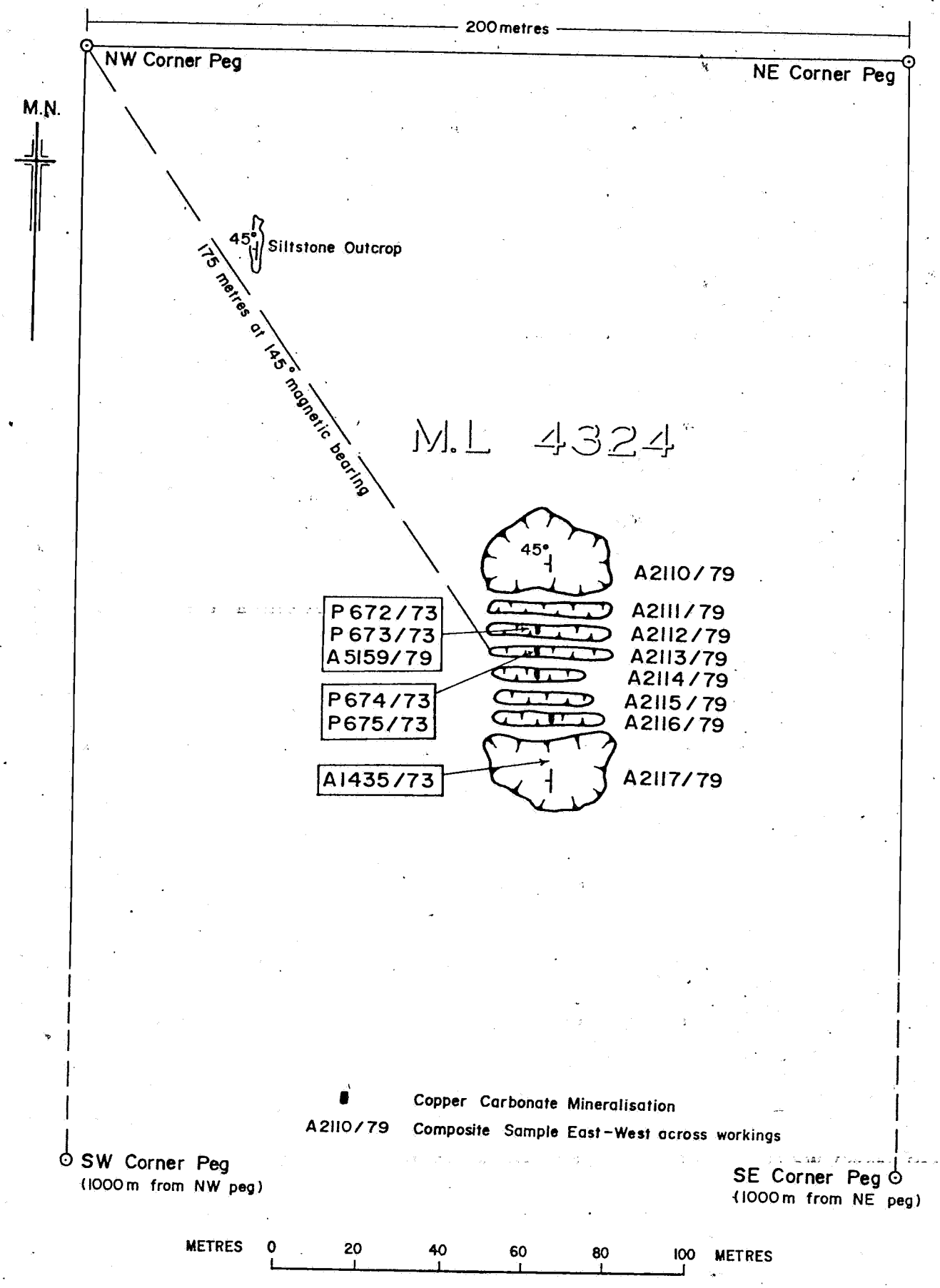



FIG. 2

| | | |
|---|---|---|
| | DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA | SCALE 1:1300 approx. |
| COMPILED J.J. Martins | BLACK ROCK PLAINS | DATE 6·7·79 |
| DRN K.W. CKD | COPPER DEPOSIT | PLAN NUMBER |
| | PLAN OF WORKINGS AND LOCATION OF SAMPLES | S14146 |

1467