DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

MINERAL RESOURCES DIVISION

RECOVERY OF COPPER
DOME ROCK MINE

(Dome Rock Pty.Ltd.)

CURNAMONA

Kalabity

by

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Metallic Minerals Section

Rept.Bk.No. 72/147

8th August, 1972

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PLANS

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No.72/147
G.S. No. 4913
DM. No. 442/68

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DOME ROCK MINE

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ABSTRACT

In the Dome Rock mine, a number of steeply-dipping lenticular cupriferous orebodies have been emplaced in metasedimentary slates, hornfels, schists and quartzites of the Lower Proterozoic Willyama Complex, near a granite intrusion thought to be Carpentarian in age. The host rocks are mainly obscured by soil and gravels. The most important lode found to date is up to about 6ft. wide and 110ft. long and has been mined in Day shaft to a depth of 220ft. This lode contains both primary and secondary copper sulphides, associated in the upper levels with copper carbonates and oxides; chrysocolla, a little native copper and rare copper arsenates. Scattered shallow trenches and pits on the property have exposed irregular thin veins and partings of chrysocolla with some malachite, locally forming concentrations up to at least 30 ft. wide assaying almost 2% copper.

Difficulties have been encountered during heap-leaching with acid, due partly to the packing down of fine material to form an impermeable bed. Permeability is reduced also by the precipitation of fine gypsum produced by the action of the sulphuric acid on fragments of dolomitic gangue on the heap.

Laboratory tests have been carried out by Amdel on the different types of ore. Flotation tests on mixed carbonates and sulphides were unsatisfactory because of high sliming losses containing a large proportion of the available copper, and recovery was poor in an agitation leach test. Agitation leach tests on four representative samples containing chrysocolla were more encouraging, giving a recovery of between 71% and 85% copper. Reserves of this type of material

available for opencut working are not known but may be considerable, particularly near Meehan shaft.

Further trenching is recommended in order to determine the extent of oxidised ore. Shallow pattern drilling to prove reserves is desirable.

As in other small secondary copper deposits in the State, a cheap and effective method of agitation leaching for the production of cement copper is required.

INTRODUCTION

In response to a request by the leaseholders, the mine was visited on 8th October, 1971 to examine development in Day shaft since the last investigation carried out by the Department of Mines in 1968 (Warne, 1970); and to advise on the different types of cupriferous lode material encountered on the leases.

The operators are attempting to produce cement copper by precipitation with ribbon iron from liquor obtained by heap-leaching mineralised rock obtained from dumps and from the 65ft. level in Day shaft. The material contains oxidised copper minerals as well as secondary copper sulphides, with some dolomitic gangue. It was noted that elsewhere on the leases, the most abundant copper-bearing mineral exposed in a number of shallow excavations appears to be chrysocolla associated with smaller amounts of malachite.

The efficiency of the leaching process being used is uncertain. Samples of lode material containing secondary sulphides were forwarded by J.R. Adam (Mineral Development Engineer) to Amdel for leach tests. The recovery of copper was poor.

In early 1972, the leaseholders requested further advice on problems which had arisen in the leaching process. The mine was visited on 27th March, 1972 with Scientific Officer J. Lackey of Amdel who has been studying various copper leaching methods. A specimen of white precipitate formed on the heap was taken for identification, and four representative samples of chrysocolla-bearing material were collected for agitation leach tests. The results are described in this report and Amdel reports are attached in the Appendices.

LOCATION

The mine is about 40 miles northeast of Olary which is on the main road and railway line to Broken Hill, 250 miles from Adelaide. It is reached by graded roads from Olary via Kalabity homestead; or from Mingary siding (277 miles from Adelaide) via Boolcoomata homestead, a distance of about 26 miles.

TITLE

Dome Rock Pty. Ltd. holds Mineral Leases 3371, 3557, 3558, 3559, 3560, 3561 and 3562, each of 40 acres.

PRODUCTION

Total production up to 1940 was about 126 tons of copper from dressed ore averaging 20% copper. (Dickinson, 1942). An unknown but small tonnage of cement copper has been produced since that time. At one period during 1969, between one and two tons with a grade of about 70% copper was being extracted monthly (Horn and Duncan, 1969).

RECENT DEVELOPMENT AND EXPLORATION

Warne (1970) summarised activities carried out between 1918 and 1968. In 1971, an irregular northern drive about 110ft. long was cut at the 65ft. level in Day shaft, extending from the shaft to a point about 25ft. beyond the intersection with the underlie shaft sunk from the bottom of the opencut (see Plan 72-573). The drive is on the course of an irregular lode formation dipping steeply eastwards, with a maximum width of about 6ft., and thinning at the northern end. The formation contains aggregates and bands of copper carbonates, with kernels of chalcocite in places, within shattered slate or hornfels.

In 1969, Trans Australian Explorations Pty. Ltd. carried out an extensive exploration programme over Special Mining Lease 269 covering an area of 8 square miles round the mine (Horn and Duncan, 1969). The whole of the area was mapped geologically on a scale of 1 in: 400ft. The programme included auger drilling, geochemical soil sampling and channel sampling in trenches, supported by magnetometer and induced polarisation surveys. Scintillometer and electromagnetic surveys were made across the line of workings.

The higher I.P. readings coincided fairly well with the geochemical anomalies. The main anomaly (500 p.p.m. to 8 500 p.p.m. copper) is centred along the northeasterly-trending line of old shafts and excavations, with a separate area about half a mile south of Day shaft. Less well-marked anomalous zones west of Meehan and Crawford shafts trend northwesterly.

Three inclined diamond drill holes were put down into the sulphide zone from the east. (See Plan 72-573). Hole No. DRM1 was sunk to 648ft. at an angle of 55° westwards below Meehan shaft. The highest assay obtained was 0.44% copper over a length of 29ft. 5 ins. from 300ft. (i.e. at a vertical depth below surface of about 250ft.). A 3ft. 0 ins. band containing 0.6% cobalt was recorded.

DDH No. DRM2 was drilled towards Day shaft at 60° to 766ft. The most important intersections were 0.24% copper over 24ft. 9 in. from 382ft. (vertical depth 330ft.); and 0.31% cobalt over 31ft. 9in. from 416ft. (vertical depth 370ft.).

Hole DDH No. DRM3 sited northeast of Crawford shaft was drilled at 50° to 647ft. The best intersection was 0.43% copper over 25ft. from 294ft. (vertical depth 225ft.).

Mineralised horizons in the boreholes consisted of sulphides. Pyrite and arsenopyrite with traces of chalcopyrite occur as stringers, blebs and disseminations, mainly in bands of hornfels. Some pyrrhotite was noted in borehole DRM2. (Horn, 1969).

Assays of channel samples from trenches cut at intervals along the line of workings indicated a number of mineralised concentrations, the most important of which are shown on Plan 72-573.

GEOLOGY

The host rocks belong to the Willyama Complex of Lower Proterozoic age, lying on the western limb of a syncline trending north-northeasterly, intruded by Carpentarian granite and aplite. They consist of a sequence of sandstones, siltstones and shales converted by regional and thermal metamorphism into micaceous quartzites, cleaved blue grey slates, siliceous hornfels and mica schists. Scattered fragments of large chiastolite crystals derived from chiastolite-schist can be seen on the ground northwest of Meehan shaft.

Dragfolding in the slates and hornfels may have been a major control in the localisation of the orebodies (Dickinson, 1942). Mineralisation was probably related to the intrusive granite, the fluids being channeled along fault and fracture planes.

MINERALISATION

Evidence from surface excavations and from the underground workings indicates that the copper occurs in steeply dipping elongated lenses and in localised patches. The most important body discovered to date is that worked in Day shaft, which is about 110ft. long, having a maximum width of about 6ft. and apparently becoming thinner laterally and in depth. It dips at about 70° to the southeast and pitches southwards at 80°. (Warne, 1970).

Primary sulphide minerals present in the lower workings are mainly pyrite with some chalcopyrite. Arsenopyrite also was observed by Trans Australian Explorations Pty. Ltd. in the diamond drillholes. Cobalt recorded in assays is probably contained in cobaltiferous pyrite or cobaltite.

Secondary minerals, in the oxidised zone extending downwards to between the 130ft. and 220ft. levels in the Day workings, include malachite and azurite, copper oxides, native copper, and chrysocolla. Several varieties of copper arsenate, including olivenite, have been noted (Bayliss, et al., 1966). There are traces of erythrite (hydrated cobalt arsenate).

Irregular bands, patches and aggregates of the secondary copper sulphides chalcocite, covellite and bornite occur on the 65ft. level and below. In the lower levels, there are coatings and partings of atacamite (copper chloride) and chalcanthite (copper sulphate). The chalcanthite has probably been formed by oxidation since mining began, and also by the precipitation process carried out in 1968 (see below).

Thin veins and partings of chrysocolla are abundant locally in surface excavations, particularly near Meehan and Crawford shafts.

BENEFICATION AND TESTING

Tests by Weir (1958) on partly oxidised ore containing pyrite and copper sulphides showed that recovery of the copper minerals by tabling and flotation was poor because of the complex nature of the ore and also because of excessive sliming. (The slimes contained over 23% of the total copper). Weir concluded that leaching is the only feasible method for economic treatment of this type of ore.

Warne (1970) noted that in 1968, cement copper assaying between 66% and 67% copper was being produced by pumping cupriferous water from Day shaft, precipitating copper with scrap iron, and returning the water down the shaft.

The present leaseholders are using the heap-leaching method. Several hundred tons of material from old dumps, and some ore containing sulphides as well as oxidised minerals from the new 65ft. level, has bee placed on a large heavy plastic sheet, raised into a gutter round the lower edge, from whence a plastic-lined channel leads into a liquor pit. Dilute acid is pumped on to the heap; the liquor runs into the pit and i then pumped up to a row of round concrete vats connected by short overflow pipes, each filled with ribbon iron, in which the cement copper is produced.

The main problem is that the copper-bearing rock is not screened and the proportion of fines is high. The material on the heap packs down into an almost impermeable mass, and there is a tendency for insoluble slime to be carried in suspension into the liquor pit. As the fine fraction probably contains a high proportion of the copper available for leaching, some type of agitation during leaching is essential, followed by settlement of the insoluble fraction before it reaches the precipitation vats.

The operators reported the formation of a white precipitate round pools of liquor lying on the heap. Analysis of a specimen showe that it is mainly magnesium sulphate ("Epsom salts"), with smaller amounts of calcium, iron and copper sulphates (See Appendix II). The magnesium and calcium sulphates are formed by the action of the dilute sulphuric acid used in the leaching process upon fragments of dolomiti gangue on the heap. As the calcium sulphate is relatively insoluble, most of it is precipitated on the heap as gypsum, thus further reducin the permeability of the bed. The magnesium sulphate becomes more concentrated as leaching and evaporation continue until the solution becomes saturated and eventually it also is precipitated. This phenomenon is therefore a direct result of the poor circulation of the acid.

Specimens of this type of material containing secondary copp sulphides collected from Day Shaft were sent by J.R. Adam (Mineral Development Engineer) to Amdel for agitation leaching tests. The recovery of copper from ore containing 4.7% copper was only 40% after 8 hours leaching. This figure was improved to 60% extraction after 8 hours by adding an oxidising agent. In a percolation leach test, only 8.5% of the available copper was recovered after 48 hours.

Four representative samples of mineralised rock containing chrysocolla with grades ranging from 1.60% to 3.15% copper were collected from trenches. A typical specimen is described in Appendix III. Agitation leach tests showed that copper is extractable from the chrysocolla by this method, though the process is slower than for copper carbonates. Recovery over 6 hours ranged from 71.2% to 85.1% of the total copper. The analyst commented that recovery might be improved b by fine grinding and by using higher concentrations of acid. It was noted that acid consumption was high for sample DR4 which probably contains dolomite gangue.

CONCLUSIONS AND RECOMMENDATIONS

1. It is doubtful whether the primary or secondary copper sulphides could be extracted economically at the Dome Rock Mine because of the difficulty of separating the small tonnage available from copper carbonates and other secondary minerals.
2. Laboratory tests have shown that the recovery of copper by flotation or leaching of the mixed carbonate/sulphide ore is poor. In practice, heap leaching has been unsatisfactory due to the high proportion of fine material which packs down into an impermeable barrier. Dolomite in the gangue, though not abundant, has two deleterious effects; it increases the consumption of acid, and gypsum precipitated by this reaction further decreased the permeability of the dump material.
3. In tests, a high proportion of available copper was extracted from chrysocolla by agitation acid leach. There is an unknown but possibly considerable tonnage of this type of material which could be won from opencuts, particularly near Crawford and Meehan shafts, and which may be more amenable to treatment than the mixed ore. Assays obtained by Trans Australian Explorations Pty. Ltd. from channel samples in trenches show that oxidised copper deposits of significant grade (over 1% copper) are not necessarily continuous; they may represent localised lenses along the strike of the host rocks, or concentrations near cross-cutting fault or shear zones.

Further trenching and sampling west-east across the trend of the beds is proposed, at 50ft. intervals from a point 200ft. south of Crawford shaft southwards for a total of about 800ft. to a point 200ft. south of Meehan shaft. The results obtained would help determine whether shallow pattern drilling is warranted to indicate reserves available for extraction by opencuts.

The following conclusions on treatment of the ore are drawn:

1. Dolomitic gangue should be discarded where practicable to avoid excessive acid consumption.
2. Some means of agitation of the feed during leaching is essential to obtain a satisfactory extraction of copper.
3. Settling pits are necessary to filter off fine suspensions of insoluble material to prevent circulation to the precipitation vats and consequent contamination of the cement copper.

A.H. BLISSETT
ASSISTANT SENIOR GEOLOGIST
METALLIC MINERALS SECTION

AHB:FdeA
8.8.72

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__________, and Duncan, N., 1969. Report on Dome Rock Copper Prospect, South Australia. Summary stages I, II and III Results. Rept. to Trans Australian Explorations Pty.Ltd. (Unpub.) DRM2. (Env. 1 085).

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APPENDIX I

BATCH LEACHING TESTS

<u>Amdel Report CM.1/31/0-3902/72, 5th May, 1972</u>

1. INTRODUCTION

On 27th March, Mr. H. Blissett, Mines Department, Officers of Dome Rock Pty. Limited and Mr. J. Lackey of Amdel, visited the Dome Rock area. Samples were taken from areas where testing had indicated copper concentrations greater than 1%. Approximate locations of these four (4) samples are:-

DR 1	Open Cut N-W of Mechan's shaft
DR 2	Trenches around the open cut
DR 3	Trench further north of the open cut
DR 4	Trench south of Day's shaft

2. PROCEDURE

These samples were tested for their suitability to sulphuric acid leaching. A 500 g sample of ore, ground to minus 10 mesh BSS, with an equal weight of water was leached with sulphuric acid in a 1.5 litre beaker. The slurry was agitated with a stainless steel impeller which was rotated fast enough to keep all the solids suspended. The pH of the solution was controlled at 1 by adding concentrated sulphuric acid from a burette. Residue samples were taken at 1, 2, 4 and 6 hours after the commencement of the leach. The residue samples and a head sample were analysed for % Cu.

3. RESULTS

Table 1 reports the results of the leaching tests and Plan S9912 shows the extraction with time.

These results are fairly encouraging and show that the main copper mineral in the ore - chrysocolla - will extract in sulphuric acid leaching. The liberation is probably slower than in ores where the main Cu mineral is malachite but is not excessively slow. Acid consumption for DR1, DR2, and DR3 are quite acceptable but for DR4 is probably excessive. (Effervescence was observed in the initial part of the leaching of DR4 indicating the presence of some carbonates in the ore).

4. CONCLUSIONS

The extraction of copper is lower than might be hoped (71.2 - 85.1%) and it is recommended that further work be done to increase the final extraction and speed up the reaction rate. This would be done by considering:-

a. Finer grinds - e.g. minus 14 or 22 mesh BSS

b. Higher sulphuric acid concentrations.

Investigation and report by: J.A. Lackey

Officer in Charge

Chemical Metallurgy Section: J.E.A. Gooden

TABLE I: AGITATION LEACHING TESTS

Sample	Head Analysis % Cu	Acid Consumption		Acid Consumption	Extraction with Time % Cu Residue (% Extraction)			
		lb H_2SO_4 per ton ore	kg H_2SO_4 per tonne ore	Theoretical %	1 hr	2 hr	4 hr	6 hr
DR 1	3.15	172.0	76.7	185	1.80 (42.9)	0.97 (69.3)	0.77 (75.6)	0.47 (85.1)
DR 2	1.85	91.0	40.6	193	1.10 (40.6)	0.68 (63.3)	0.54 (70.0)	0.49 (72.8)
DR 3	2.25	107.0	47.8	193	1.75 (22.3)	1.25 (54.5)	0.89 (60.5)	0.65 (71.2)
DR 4	1.60	140.6	62.7	336	0.73 (54.4)	0.42 (73.8)	0.40 (75.0)	0.39 (75.7)

APPENDIX II

ANALYSES OF WHITE PRECIPITATE

Amdel Report CM.1/31/0-3902/72, 19th April, 1972

Visit to Dome Rock on 27 March 1972

During the visit, a sample was taken of a white deposit which had formed around the edges of the liquor in the dump leach.

The sample was analysed and major elements were found to be:-

Mg	7.7%
Ca	1.4%
Fe	0.9%
Cu	1.9%
SO_4	34.0%

From these data, the following compositions were deduced:-

$MgSO_4.7H_2O$	78.9%
$CaSO_4.2H_2O$	6.0%
$FeSO_4.7H_2O$	4.4%
$CuSO_4.5H_2O$	7.4%
	96.7%

Approximately 5% of the sample was not digested in the 10% hydrochloric acid used to solubilise the sample. The insoluble fraction was considered to be mainly ore.

A sample of the dump feed ore was taken by Mr. J.R. Adam (A53 - see Progress Report No. 1CM 1/1/138) and this was mineralogically examined and found to contain approximately 10-15% dolomite ($CaCO_3.MgCO_3$).

When dolomite is contacted with sulphuric acid, it dissolves to form calcium sulphate and magnesium sulphate. However, the calcium sulphate is only slightly soluble (approx. 2 g/1) and most of it would immediately precipitate while the magnesium sulphate stays in solution. The precipitate of calcium sulphate (as gypsum $CaSO_4.5H_2O$), would form in the bed tending to block it, thus reducing liquor circulation. (This is a problem that has been experienced in the dump).

The magnesium sulphate gradually builds up in concentration by successive leachings and evaporation until the solution becomes saturated. Where the liquor forms a pool and further evaporation takes place, then the magnesium sulphate will precipitate as a white deposit.

Other compounds would also precipitate as their solubility is exceeded, (e.g. gypsum $CaSO_4.2H_2O$, iron sulphates $FeSO_4.7H_2O$, $Fe(SO_4)_3.9H_2O$ and $CuSO_4.5H_2O$) but these occur at much lower concentrations.

This basically explains the chemical precipitation actions taking place. The absence of gypsum in larger concentration in the white deposit is a bad omen and indicates precipitation in the bed.

W.M. Walker
for F.R. Hartley
Director

APPENDIX III

Amdel Report CM 1/31/0-3902/72 5th May, 1972

QUALITATIVE MINERALOGICAL EXAMINATION OF A SAMPLE FROM DOME ROCK COPPER MINE, OLARY PROVINCE

1. INTRODUCTION

A chrysocolla-rich hand specimen was received for qualitative mineralogical examination. Information was required of the constituent minerals and how the sample compared with others previously examined in connection with this project.

2. PROCEDURE

A thin section, TS 28826, and a polished section, PS 18603, were prepared from the hand specimen and these were examined optically.

A bulk diffraction trace was run on the sample. X-ray diffraction photographs were taken of a green mineral which occurred in vugs and as spherules in chrysocolla, and of a black mineral which occurred as a coating typically lining the margins of chrysocolla veins.

3. RESULTS

A visual estimate of the minerals present gave the following:

	%
Albite (sodic feldspar)	60-70
Mica	2-4
Quartz	5-15
Kaolin	2-4
Chrysocolla	5-15
Opal	2-4
?Manganese mineral	Trace -2
?Malachite	Trace -2
Iron-oxides	3-6

The rock has a clastic texture and a grain size between 0.05 and 0.5 mm. It consists, according to the X-ray diffractometer trace, of dominant sodic feldspar (albite), with accessory amounts of quartz, kaolin and muscovite.

Cutting across the rock at a large angle to the apparent bedding direction are veins filled with chrysocolla, opal and a green-coloured mineral, ?malachite. Also present in the rock are patches of iron-oxides and patches of an opaque ?manganese mineral.

The largest chrysocolla vein is several millimetres wide. The chrysocolla occurs in layers in the veins or as spherical or botryoidal masses. The opal in the hand specimen can be seen to be present mainly as botryoidal masses infilling vugs in the chrysocolla veins but in the thin section it can, in places, be seen to be closely intergrown with the chrysocolla. The ?malachite occurs as fibrous acicular crystals, either individually or in aggregates up to 0.2 mm across.

The presence of a manganese mineral as well as iron-oxides was confirmed with an X-ray diffraction photograph, but the exact nature of the manganese mineral is not known.

Bulletin 20, of the S.A. Department of Mines, contains a description of the Dome Rock Mine, from which this sample was obtained. The writer of the article notes that the Dome Rock Mine is located in a sequence of metamorphosed sedimentary rocks; sandstones and slates which outcrop adjacent to a granitic intrusion. Copper minerals that have been identified at the Dome Rock Mine include chalcocite, tenorite, cuprite, copper, chlorite (?atacamite), malachite, azurite, copper arsenate (olivenite) and chrysocolla.

From the knowledge of the mineralogy of the hand specimen together with information on the mineralisation at Dome Rock, the ore would appear to be similar to some of the samples previously examined, in particular A56 and A57.

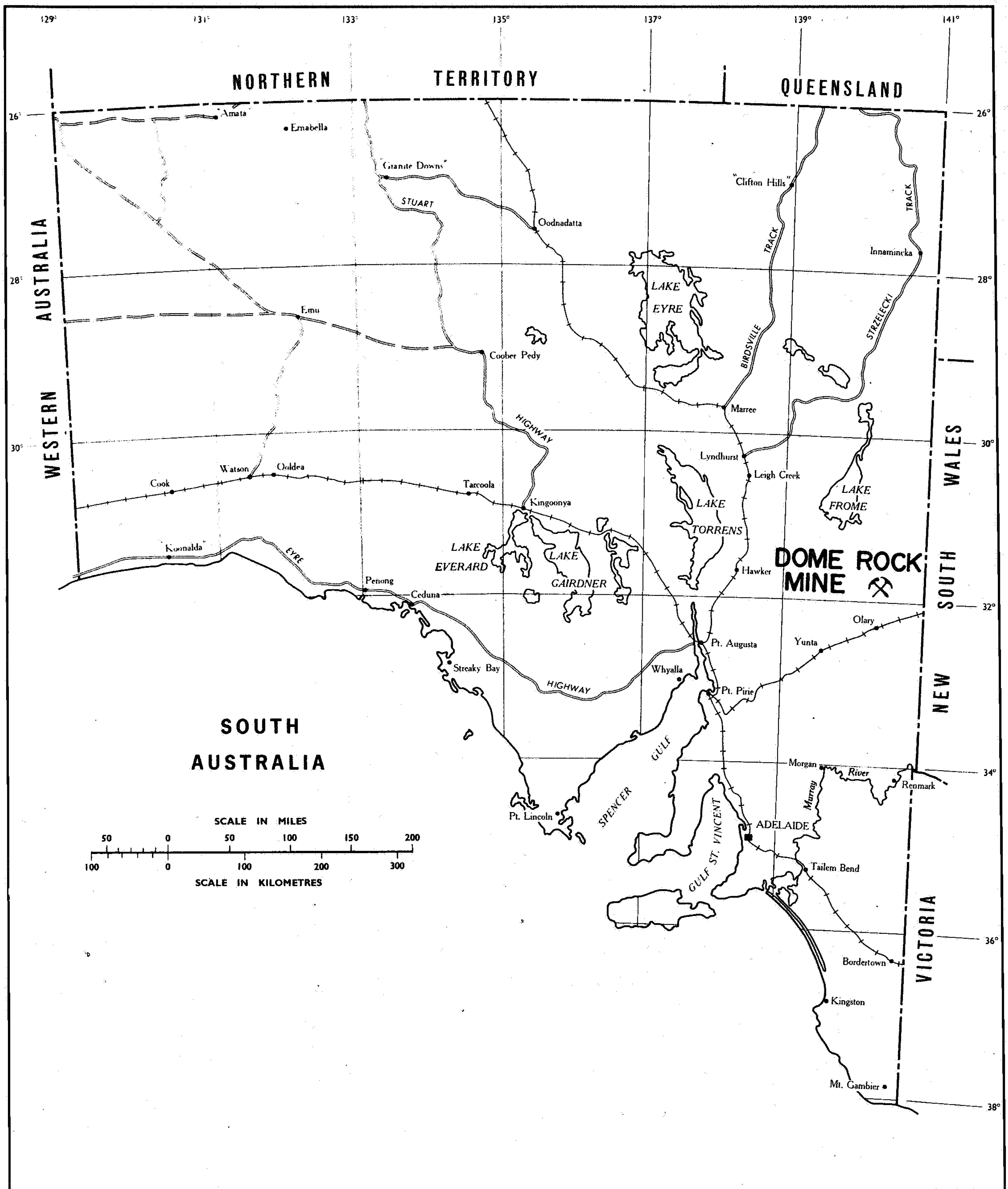
4. REFERENCE

Dickinson, S.B., 1942. The Structural Control of Ore Deposition in some South Australian Copper Fields. No. 1 Part B. The Dome Rock Copper Mine. Bulletin 20, S.A. Dept. of Mines, pp.40-49.

Investigation and report by: R.S. Cooper

X-ray diffraction and interpretation by: Dr. R.N. Brown

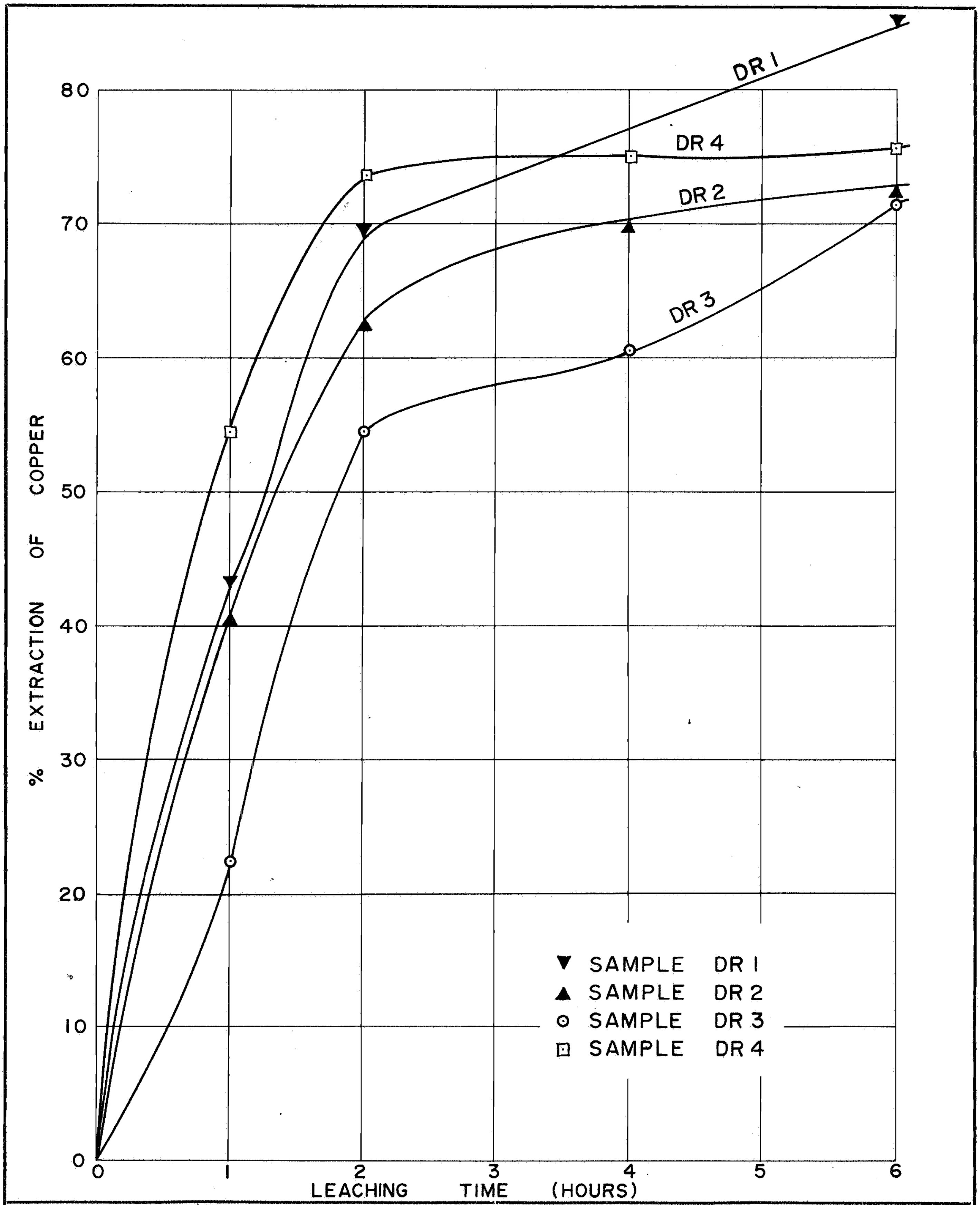
Officer in Charge,
Mineralogy/Petrology Section: Dr. K.J. Henley



DEPARTMENT OF MINES —— SOUTH AUSTRALIA

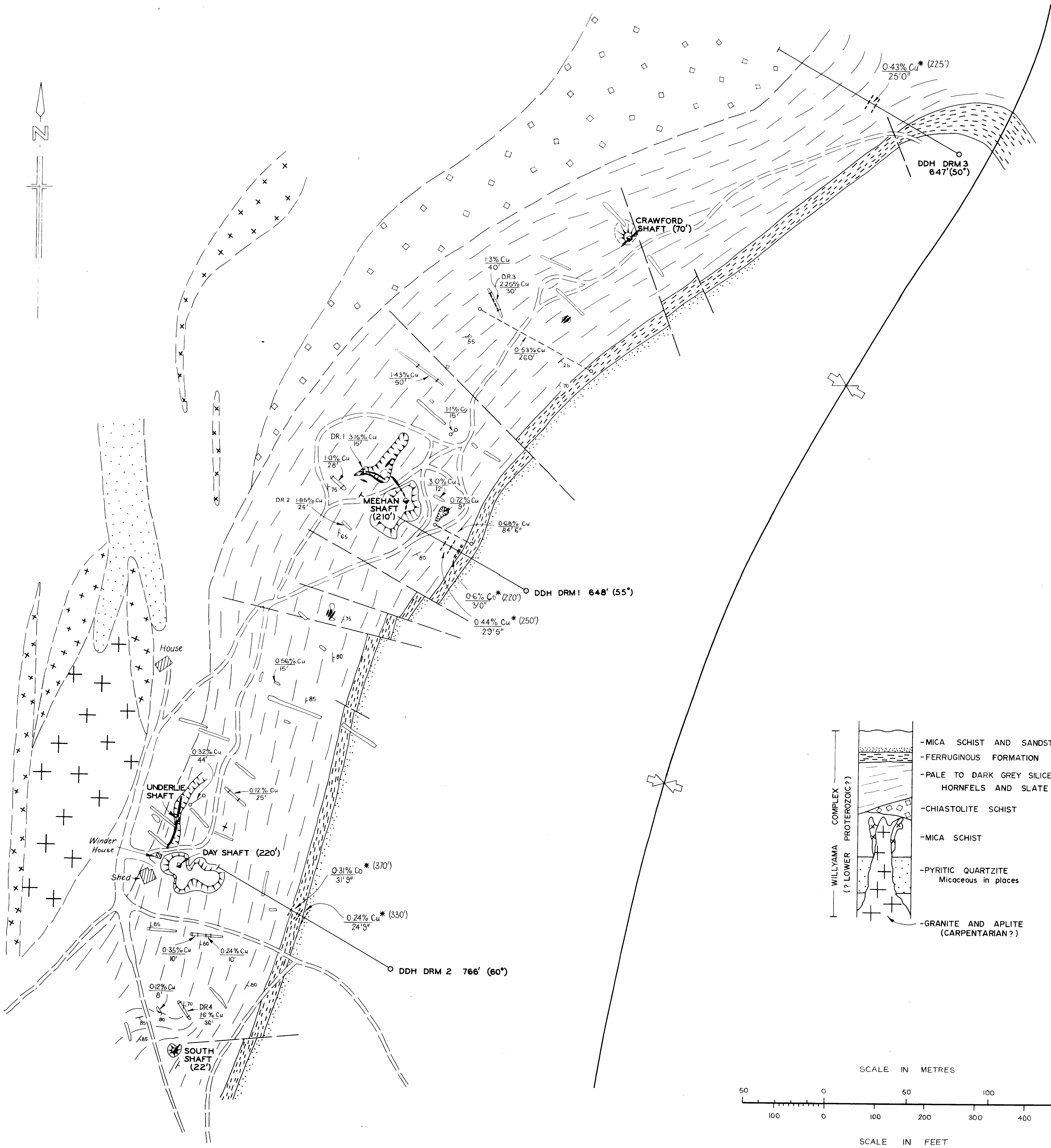
Compiled. *A. H. Blissett*	DOME ROCK COPPER MINE	Date: *17-7-72*
Drn. *D.J.M.* Ckd. A.F.	LOCALITY PLAN	Drg. No. *S9911* *F1*

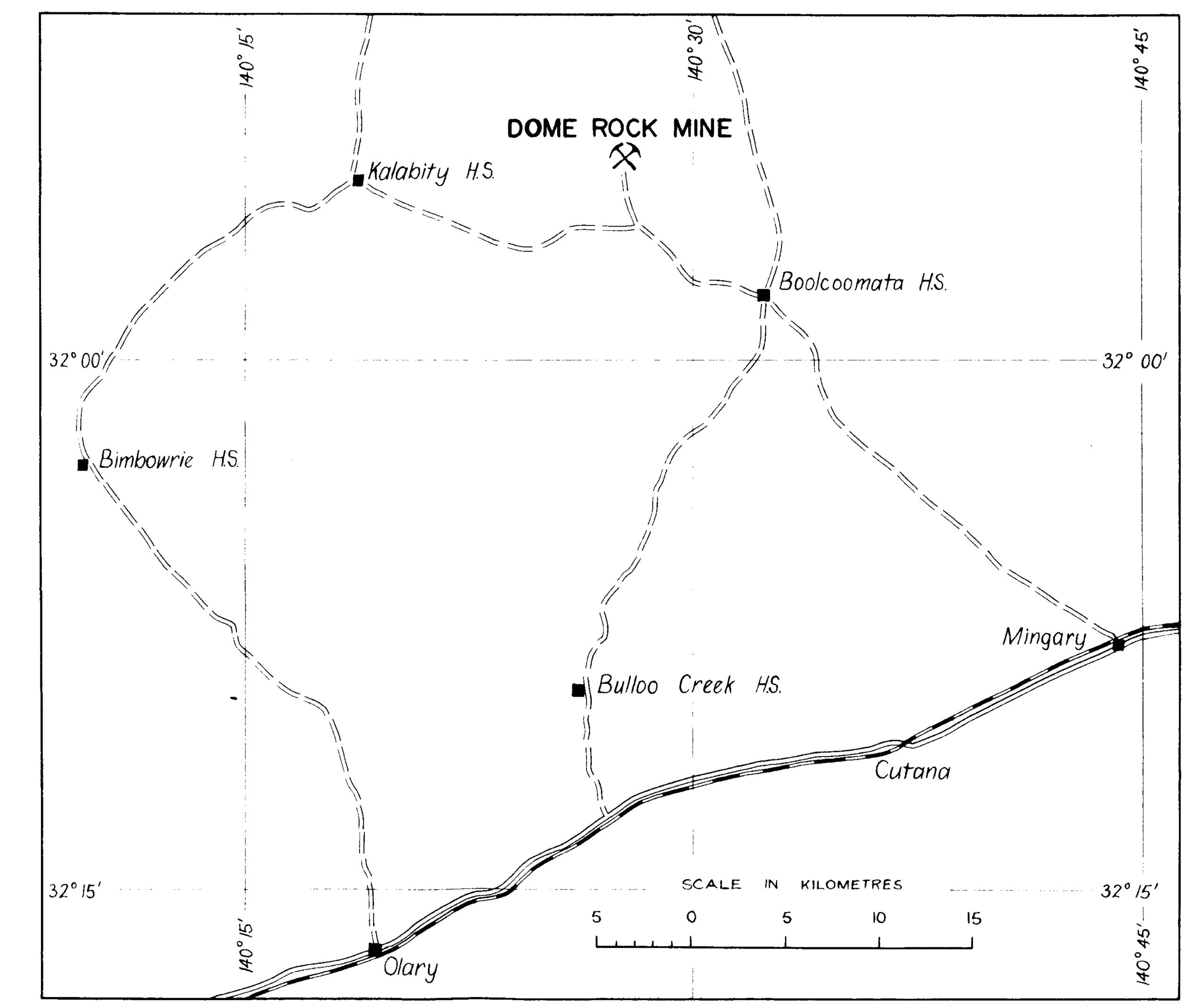
P.F. No. 55850 994.2



	DEPARTMENT OF MINES – SOUTH AUSTRALIA	Scale: *graphical*
Compiled: *J. Lackey*	**DOME ROCK COPPER MINE**	Date: *17-7-72*
Drn. *D.J.M.* Ckd. A.F.	GRAPH OF EXTRACTION EFFICIENCY – LEACHING TIME RELATIONSHIP	Drg. No. *S9912* *Fl*

1M–2.70 A1810





LOCALITY PLAN

LEGEND

WILLYAMA COMPLEX
(? LOWER PROTEROZOIC?)

- MICA SCHIST AND SANDSTONE
- FERRUGINOUS FORMATION
- PALE TO DARK GREY SILICEOUS HORNFELS AND SLATE
- CHIASTOLITE SCHIST
- MICA SCHIST
- PYRITIC QUARTZITE Micaceous in places
- GRANITE AND APLITE (CARPENTARIAN ?)

0.6% Co* (220') — *Vertical depth below surface*
3'0"
DDH DRM 1 648' (55°) *Diamond drill hole (Trans Australian Exploration Pty Ltd) showing projected positions of main intersections, drill footage and inclination of hole*

Shaft and dump

Opencut working

Trench

Pit

Copper-bearing lode exposed at surface

1.3% Cu / 40' — *Copper content and length sampled*

0.31% Co / 31'5" — *Cobalt content and length sampled* } *(Trans Australian Explorations Pty. Ltd.)*

DR 1-4 — *Department of Mines sample*

Approximate position of new trench sample

Geological boundary

Inferred geological boundary

Fault

Approximate axis of syncline

Track

Strike and dip of bedding

Vertical bedding

SCALE IN METRES

50 0 50 100 150

100 0 100 200 300 400 500 600

SCALE IN FEET

After Warne (1970) and R.W. Fidler (1969: Trans Australian Explorations Pty. Ltd.)

DEPARTMENT OF MINES — SOUTH AUSTRALIA

DOME ROCK COPPER MINE
GEOLOGICAL AND LOCALITY PLANS
SHOWING COPPER VALUES IN SAMPLES

METALLIC MINERALS SECTION	GEOLOGIST	Drn. A.H.B.	SCALE: 1 INCH : 100 FEET
		Tcd. D.J.M.	72-573 F6
		Ckd. A.F.	
Director of Mines	SUP. GEOLOGIST	Exd.	DATE: 28th June 1972