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SML 420

OLARY AREA

PROGRESS AND FINAL REPORTS TO LICENCE EXPIRY FOR THE PERIOD 21/5/70 TO 20/5/72

Submitted by
Sundowner Minerals NL
1972

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PRIMARY INDUSTRIES AND RESOURCES SA

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SUNDOWNER MINERALS N.L.

THREE MONTHLY REPORT

SPECIAL MINING LEASE 420

SOUTH AUSTRALIA.

INTRODUCTION

S.M.L. 420 covers an area of approximately 300 square miles in the Olary district. The lease forms the eastern half of the old S.M.L. 207 (1968-1969) including mineral claim nos. 6125/8 previously held by Australian Gold & Uranium Pty. Ltd.

Minoil Services Pty. Ltd. has managed the exploration programme for Sundowner Minerals N.L. Exploration geologists were Messrs D. Lopes, B. Rebuli and T. Steel.

Drilling contractors were Northbridge Pty. Ltd. and Department of Mines of S.A. Austral Exploration Services Pty. Ltd. conducted the geophysical exploration.

EXPLORATION - Luxemburg Mine Area

(a) Diamond Drilling

Two diamond drill holes have been completed and three are in progress. Total footage to date 2850 feet (1453 feet within mineral claim Nos 6125/8)

(b) Percussion Drilling

Five exploratory holes and seven pre-collaring holes have been completed. Total footage 2307 feet (780' within mineral claim Nos. 6125/8)

EXPLORATION - Other prospects

(a) Geophysical

Seven I.P. lines have been completed on Wilkins prospect and twelve are underway on Mildaltie, Dalkey and Winklers mine areas.

RESULTS

(a) Drilling

D.D.H.	L6	intersected several zones of mineralization (mainly pyrite) corresponding with the Queen Bee system of reefs. Drilling was discontinued at 1203'10".
D.D.H.	L7	intersected minor amounts of pyrite and magnetite on an I.P. anomaly ¾ mile east of the mine area. Drilling was discontinued at 816'5".
D.D.H.	L12	is in progress at 490'. Narrow zones of copper mineralization have been encountered at 112', 170', 173', 179', 182', 184', 189' and 191'. The? Bismark reef, which was intersected between 361'-366' was found to contain 1.4% copper.
D.D.H.	L14	is in progress at 464' and is expected to intersect the Bismark reef at (approx.) 900' down hole (or 730' vertical)
D.D.H.	L19	is in progress at 622'. Copper mineralization has been noted from 561'4"-571'4" and 602'0"-612'0". Assays are not yet available.

Percussion drilling has mainly been used to collar diamond holes, however, three exploratory holes have also been completed in the above programme. PDH3, PDH4, PDH5 ???

(b) Geophysical

An I.P. investigation of Wilkins prospect has indicated possible extensions of mineralization reported by Australian Gold & Uranium Pty. Ltd. in the 1969-70 annual report.

SUMMARY

Drilling has located several mineralized zones associated with east-west quartz reefs in the granite gneiss immediately east of a large amphibolite body. Complete assay results are not yet available.

It is expected that subsequent drilling will establish the full extent of these zones. Exploration in the ensuing three months will particularly examine the amphibolite/gneiss contact as this area is considered to be the focus of copper mineralization. The quartz reefs occupy tension fractures (probably related to the MacDonald fault) and these appear to have carried the sulphide mineralization.

Adelaide
17/8/70

D. Lopes,
Geologist,
MINOIL SERVICES PTY. LTD.

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SUNDOWNER MINERALS N.L.

Special Mining Lease 420.

Olary District
South Australia.

Three Monthly Report
17/8/70 - 17/11/70

By
D. Lopes.
Minoil Services Pty. Ltd.
ADELAIDE

INTRODUCTION

S.M.L. 420 covers an area of approximately 300 square miles in the Olary district, approximately 270 miles by road NNE from Adelaide. The lease includes mineral claims 6125/8 previously held by Australian Gold and Uranium Pty. Ltd.

Minoil Services Pty. Ltd. has managed the exploration programme for Sundowner Minerals N.L. Exploration geologists were Messrs D. Lopes and B. Rebuli.

Drilling contractors were Northbridge Pty. Ltd. and Department of Mines of S.A. Austral Exploration Services Pty. Ltd. conducted I.P. surveys and Minoil Services staff have undertaken VLF and ground magnetometer surveys.

1 Luxemburg Mine Area

(a) Diamond Drilling

Diamond drill holes L12, L14, and L19 have been completed. Holes L17 and L18 are ~~L18 are~~ in progress. Total footage to date is 10,120'9".

(b) Percussion Drilling

Nine exploratory holes and sixteen pre-collaring holes have been completed. Total footage 4,099 feet.

(c) Exploration

(i) Geological: The Luxemburg Mine are has been mapped at 1" = 50' scale. (Approx. 1 square Mile) Petrological chip samples have been collected in the course of mapping.

(ii) Geophysical: A VLF survey has been conducted over approximately ½ square mile in the mine area. A VLF contour map is being compiled.

II WILKINS PROSPECT

(a) Diamond Drilling

One diamond hole has been completed to a depth of 729' (Total diamond drilling 564')

(b) Percussion Drilling

One pre-collared hole was drilled to 165'

III DALKEY MINES AREA

(a) Exploration

(i) Geological: This are is being geologically mapped in detail.

(ii) Geophysical: A VLF and magnetometer survey is in progress on a 250' grid covering 1¼ square miles.

IV OTHER PROSPECTS

(a) Exploration: Initial chip sampling surveys have been conducted on several areas. The most promising of these are being made ready for detailed geophysical and geological inspection. Namely Lux South, McDonald Hill and Winklers lead.

SUMMARY

Drilling has located several narrow parallel copper mineralized zones in the Luxemburg mine area and at least one broad zone (40') of disseminated copper in the Lux South Area.

Results have indicated a hidden ore body some 70' - 80' south of the Queen Bee workings extending to 1000' (Approx) vertical depth but of limited strike length (400' approx). At least three other mineralized veins exist but these are less than 3' true width and assay 2% or less copper.

Recent geological and geophysical surveys have located three possible areas of economic mineralization: namely Dalkey Mines area, McDonald Hill and Winklers lead.

ADELAIDE
17/1/71

D. Lopes
Geologist
MINOIL SERVICES PTY. LTD.

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SUNDOWNER MINERALS N.L.

Special Mining Lease Number 420

Olary Area

South Australia

Geological Report No. 1

on the

Queen Bee Mine Area

by

W. G. Shackleton, M.Sc.(Sydney).
M.Sc.(London), D.I.C.

of

MINOIL SERVICES PTY. LTD.

February 1971

8-3-71

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PLAN REFERENCE

(in end pocket)

PLAN NO.	TITLE	SCALE
420-28	Luxemburg Mine Area - Geological Plan with Drill Holes	1" = 100'
420-29	Luxemburg Mine Area - Vertical Drill Section DDH - L4	1" = 50'
420-30	Luxemburg Mine Area - Vertical Drill Section DDH - L6	1" = 50'
420-31	Luxemburg Mine Area - Vertical Drill Section DDH - L17	1" = 50'
420-32	Luxemburg Mine Area - Vertical Drill Section DDH - L18	1" = 50'
420-33	Luxemburg Mine Area - Vertical Drill Section DDH - L19	1" = 50'
420-34	Luxemburg Mine Area - Vertical Drill Section DDH - L21	1" = 50'
420-35	Luxemburg Mine Area - Vertical Drill Section DDH - L23	1" = 50'

SUMMARY

Three diamond drill holes in the Queen Bee Mine area intersected economic grades of copper over a mineable width in the New South Queen Bee Reef. Preliminary tonnage/grade calculations suggest that a small scale mining venture may be economically viable. However, at least three additional drill holes are considered essential to confirm the above calculations and a limited drilling programme costing $18,000 is strongly recommended.

1. INTRODUCTION

The Luxemburg-Queen Bee Mining Area lies in Special Mining Lease (S.M.L.) Number 420 held by Sundowner Minerals N.L., and is located approximately six miles south of Cutana railway siding on the Adelaide-Broken Hill railway line in the north-east of South Australia. The Queen Bee Mine worked the auriferous and cupriferous Queen Bee Reef.

This report summarizes the results of geological, geophysical and drilling programmes carried out to assess the economic potential of the area.

2. GEOLOGY

2.1 REGIONAL GEOLOGY

The Queen Bee mining area is in the Olary Province of Campana and King (1958). Mineralization is related to quartz reefs which intruded undifferentiated granites, gneisses, etc.. Campana and King consider that the quartz reefs are of Early Palæozoic age because of their likeness to similarly orientated quartz veins which intersect the Archaean-Proterozoic unconformity in other numerous locations.

2.2 DETAILED GEOLOGY

Plan 420-28 is a detailed geological map of the mine area. The gold and copper mines of the area are located along a system of parallel quartz reefs cutting granites and metamorphosed sediments on the eastern boundary of an extensive amphibolite body. The reefs do not occur in the amphibolite but radiate away from the amphibolite. They pinch and swell, have a sharp, clean contact with the intruded rocks and dip steeply (70°-80°) to the north.

The emplacement of the reefs is structurally controlled, either by axial plane zones in folded granite-metasediments (see gneissosity trends, Plan 420-28) or by shears which have a general radiating nature suggesting a cupola of amphibolite at depth.

Alternatively, some reefs may be tension fractures associated with the MacDonald Shear and Overthrust Zone (Parkin, 1969). In many localities, the quartz reefs have adjacent pegmatites which, however, do not appear to be related to any mineralization.

Discussion of mineralization follows the section on drilling results.

3. GEOPHYSICS

A detailed report on all geophysical exploration carried out in the area has been compiled (Whiteley, 1971) and what follows is a brief summary of the relevant sections of that report.

The results of induced polarization (I.P.) and very low frequency (V.L.F.) electromagnetic surveys define a large anomaly of possible conductors striking east-west associated with the Queen Bee - New South Queen Bee Reefs. A strong anomaly defined by a ground magnetometer survey coincides with this anomaly. The results of the diamond drilling programme support this conclusion. It is significant that although there is no information on the New South Queen Bee Reef above 580 feet the I.P. and V.L.F. surveys indicate that strong conductors exist at relatively shallow depths in this area suggesting that mineralization extends continuously from the surface to the mineralization intersected in drill holes DDH-L4, L19 and L21.

4. DRILLING RESULTS

4.1 INTRODUCTION

Seven holes totalling 9687 feet were drilled in the Queen Bee Mine area to 31.1.71. Pre-collaring by percussion drilling accounted for 980 feet of this total. Diamond drill hole L4 was drilled by the previous lease holders.

4.2 DIAMOND DRILL HOLE - L4 (PLANS 420-28, 29)

Intersected the New South Queen Bee Reef at a vertical depth of 570 feet where it contains 2.6 per cent copper over a true width of 10 ft 8 ins.. The Queen Bee Reef was intersected at a vertical depth of 400 feet but mineralization is restricted to patchy sulphides. A blind, slightly mineralized, quartz reef was intersected at a vertical depth of 500 feet.

4.3 DIAMOND DRILL HOLE - L6 (PLANS 420-28, 30)

Intersected the Queen Bee Reef at a vertical depth of 535 ft where the reef has a true width 7 ft and contains 0.028 per cent copper. The New South Queen Bee Reef was not recognized. However disseminated pyrite and chalcopyrite occur in very thin quartz and granite veins at a vertical depth of between 700 and 760 feet.

4.4 DIAMOND DRILL HOLE - L17 (PLANS 420-28, 31)

Intersected the main Queen Bee Reef at a vertical depth of 1285 feet where it has a true width of 30 feet with irregular mineralization. Best assay is 1.20 per cent copper over a true width of 5 ft 6 ins., at a vertical depth of 1300 feet. Two minor quartz veins were intersected above the main reef.

A thin, very siliceous granite at a vertical depth of 880 feet may represent the New South Queen Bee Reef. However, interpretation of the results of this hole is difficult and it is possible that the main quartz reef may be the New South Queen Bee Reef.

4.5 DIAMOND DRILL HOLE - L18 (PLANS 420-28, 32)

Intersected the New South Queen Bee Reef at a vertical depth of 780 feet. True width 11 feet 2 ins., containing 0.17 per cent copper with a one foot intersection (809'4"-810'4") of 3.0 per cent copper. The ore-body is pyrite rich - i.e. pyrite> chalcopyrite> magnetite. The blind reef was intersected at a vertical depth of 620 feet - true width one foot, less than 0.1 per cent copper.

4.6 DIAMOND DRILL HOLE - L19 (PLANS 420-28, 33)

Intersected the New South Queen Bee Reef at a vertical depth of 630 feet. True width 6 ft., 3.3 per cent copper. The blind mineralized quartz reef located by DDH - L4 was intersected between 561'4" and 571'1" (520 ft. vertical depth). 1.25 per cent copper occurs over a true width of 4 feet.

4.7 DIAMOND DRILL HOLE - L21 (PLANS 420-28, 34)

Intersected the New South Queen Bee Reef (true width 16 feet) at a vertical depth of 900 feet. 2.43 per cent copper over a true width of 3 ft 11 ins., or 1.56 per cent over a true width of 7 ft 11 ins.. The Queen Bee Reef was intersected at a vertical depth of 670 feet. True width one foot with little mineralization.

4.8 DIAMOND DRILL HOLE - L23 (PLANS 420-28, 35)

Intersected faintly mineralized quartz reef at the contact of amphibolite and anatectic granite at a vertical depth of 780 feet. Disseminated sulphides in amphibolite intersected at a vertical depth of 750 ft.. It is not considered that the quartz reef is the New South Queen Bee Reef or, if it is, it is thin and poorly mineralized because of the influence of the amphibolite.

5. DISCUSSION

5.1 GENERAL

Geological investigations of the Queen Bee Mine area and drill hole intersections of the New South Queen Bee Reef allow some conclusions to be reached (which probably applies to the area as a whole) as follows:

(a) The quartz reef has a typical pinch-and swell structure.

(b) Between holes L19 and L18 the copper content of the ore-body decreases by a factor of more than ten.

(c) Mineral zoning occurs, viz. copper-rich near the amphibolite grading to pyrite with increasing distance from contact.

The zoning is important as it suggests that the copper present in the ore-body may have originated

in the amphibolite. An alternative mechanism suggested, is that the copper is genetically related to the original quartz reefs and the introduction of the amphibolite set up a thermal gradient which gave rise to the zoning.

(d) A small oxidized zone occurs in the Queen Bee Reef to 80 feet with a little secondary chalcocite and bornite.

(e) Gold occurs adjacent to the amphibolite and near the surface but no gold values at depth in the Queen Bee Reef.

5.2 ORE RESERVES

Ore reserves have been previously calculated by two independent workers. It must be emphasized that the calculations are based on limited information and that the results only indicate the size and grade of the mineralized zone.

(a) Minoil Services Pty. Ltd.

Assuming an average grade of 2.5 per cent copper over 8 feet from holes L4, L19 and L21.

Strike length: 180 feet

Depth: 600 feet

Tonnage factor: 205 lbs/cu. ft.

$$\frac{180 \times 600 \times 8 \times 205}{2240} \text{ tons}$$

i.e. Inferred reserves: 79,000 tons averaging 2.5 per cent copper to a depth of 600 feet.

(b) W. H. Morton, Consulting Geologist

1. If the orebody is continuous between holes L4, L19, L21 with a true width varying from 5 to 10 feet of average 2.5 per cent copper then known reserves are calculated at 27,000 tons.

2. The orebody is likely to continue upwards to the base of the main shaft. Taking an average width of 5 feet, this would give additional reserves of 13,000 tons, making a total of 40,000 tons of 2.5 per cent copper.

3. If it can be proved that the orebody continues westward to the contact zone then the above figures can be doubled to give total reserves of 80,000 tons.

(c) Present calculations

Assuming that DDH-L23 did not intersect the New South Queen Bee Reef and inferring from holes L4, L19 and L21 that the reef averages 2.5 per cent copper over 8 feet true thickness from the surface to 900 feet depth.

Then strike length = 200 feet

Depth = 900 feet

tonnage factor = 205 lbs/ cu. ft.

$$\text{Inferred reserves} = \frac{200 \times 900 \times 8 \times 205}{2240}$$

= 130,000 tons

It should be noted that:

(i) all calculations depend on additional information which must be obtained by additional drilling, and

(ii) the present fluctuation in the price of copper makes any prediction difficult of what constitutes a profitable grade/tonnage factor.

6. CONCLUSIONS AND RECOMMENDATIONS

Sufficient reserves could possibly be available for a small scale mining operation of the order of 75 tons per day production. Assuming production for 200 days per annum (i.e. 15,000 tons per annum) this will give a mine life of 9 years.

It is estimated that capital expenditure on plant, development work including shaft sinking will be of the order of $250,000 which would be depreciated over 9 years at $28,000 p.a. (i.e. approx. $2/ton ore).

Assuming an average price for copper of $1,000/ton and treatment at $5/ton (including depreciation) then for a break-even operation, mining costs must be $20/ton. It is considered feasible to reduce mining costs to approximately $15/ton, giving a pre-tax profit of $5/ton ore or $75,000 p.a.

Alternatively, a larger plant with a throughput of 200 tons per day could be considered. However, problems of the higher production rate would have to be solved.

The above calculations are based on incomplete information and are to be regarded as an indication only of the size of operation possible. At least three additional drill holes are necessary before a more accurate assessment of the project can be made, preferably by a mining engineer.

The drill holes recommended are detailed below:

Number of Hole:	DDH-L25	
Collar Location:	See Plan 420-28	
Bearing:	330° magnetic	
Angle:	-60°	
Length:	385 feet	
Purpose:	To intersect the New South Queen Bee Reef at a vertical depth of 200 feet.	
Cost:	200 feet percussion drilling @ $2/ft.	= $ 400
	185 feet diamond drilling @ $7/ft.	= $1295
	Total	$1695

Number of Hole:	DDH-L26	
Collar Location:	See Plan 420-28	
Bearing:	330° magnetic	
Angle:	-60°	
Length:	730 feet	
Purpose:	To intersect the New South Queen Bee Reef at a vertical depth of 400 feet.	
Cost:	200 feet percussion drilling @ $2/ft.	= $ 400
	530 feet diamond drilling @ $7/ft.	= $3710
	Total	$4110

Number of Hole:	DDH-L27	
Collar Location:	See Plan 420-28	
Bearing:	150° magnetic	
Angle:	-60°	
Length:	920 feet	
Purpose:	To intersect the New South Queen Bee Reef at a vertical depth of 750 feet.	
Cost:	200 feet percussion drilling @ $2/ft.	= $ 400
	720 feet diamond drilling @ $7/ft.	= $5040
	Total	$5440

Rig Location charges etc.	= $1000
Geologist (20 days @ $70 per day)	= $1400
Total cost of drilling programme including 10 per cent for contingencies	=$13645
say	$14,000
Indirect costs will be	
Analyses of drill samples	$ 1,000
Geological supervision, laboratory investigations and report compilation	$ 3,000
Total	$4,000

Thus the all-inclusive cost of the programme is estimated to be $18,000.

8.3.71

W. G. Shackleton
Senior Geologist
Minoil Services Pty. Ltd.

REFERENCES

CAMPANA, B. and KING, D.	1958	Regional Geology and Mineral Resources of the Olary Province S. Aust. Geol.Surv. Bull. No. 34
PARKIN, L.W.	1969	Handbook of South Australia Geology. S.A. Dept. Mines.
WHITELEY, I.D.	1971	Report on Geophysical Exploration in the Luxemburg Mine Area, Olary District, S.M.L. 420, from 1.7.69 to 28.2.71. Unpub.

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SUNDOWNER MINERALS N.L.

Special Mining Lease Number 420.

Olary Area

South Australia

Summary of Exploration

for the

Period 20.5.70 to 20.2.71

By

W. G. Shackleton M.Sc.(Sydney),
M.Sc.(London), D.I.C.

of

MINOIL SERVICES PTY. LTD.

March, 1971.

CONTENTS

PLAN REFERENCE

(In end pocket)

NUMBER	TITLE	SCALE
420-37	S.M.L. 420 - Olary District. Mineral Occurrences and Chip Sample Results.	1" = 60 chs.
420-28	S.M.L. 420. Luxemburg Mine Area Geological Plan with Drill Holes.	1" = 100'
420-48	S.M.L. 420. Luxemburg Mine Area Vertical Drill Section DDH-L9.	1" = 50'
420-49	S.M.L. 420. Luxemburg Mine Area Vertical Drill Section DDH-L12.	1" = 50'
420-50	S.M.L. 420. Luxemburg Mine Area Vertical Drill Section DDH-L13.	1" = 50'
420-51	S.M.L. 420. Luxemburg Mine Area Vertical Drill Section DDH-L14.	1" = 50'
420-52	S.M.L. 420. Luxemburg Mine Area Vertical Drill Section DDH-L24.	1" = 50'

SUMMARY

Detailed geological, geophysical and drilling investigations have shown that S.M.L. 420 contains several areas of potential economic mineralization.

Drilling of the New South Queen Bee Reef, in particular, suggests that a small scale mining operation may be economically viable. In addition, preliminary investigations of Winkler's Lead Prospect are most encouraging and a limited drilling programme has been recommended to test two significant I.P. anomalies.

Several other prospects are also considered worthy of additional geophysical exploration and/or drilling.

1. INTRODUCTION

Special Mining Lease (S.M.L.) Number 420, held by Sundowner Minerals N.L., covers an area of 319 square miles in the Olary district of South Australia. The S.M.L. forms the eastern half of the old S.M.L. 207 (1968-1969) including mineral claim numbers 6125-8 previously held by Australian Gold and Uranium Pty. Ltd..

This report summarizes the results of exploration to 20/2/71. The more interesting areas of mineralization with summaries of analyses of specimens and samples, are shown on Plan No. 420-37. Appended to this report are geological and geophysical reports which have been prepared for all areas subjected to detailed exploration (with the exception of the Luxemburg Mine Area proper). A brief report on this latter area is included followed by references to each of the other areas in order of their priority for future work.

A separate report containing drill hole locations, logs, sections and assay results has been prepared (Shackleton, 1971(a)).

2. LUXEMBURG MINE AREA

2.1 GENERAL

The geology and mineralization of this area is described in full by Shackleton (1971(b)) and is detailed on Plan No. 420-28. Five drill holes totalling 3978 feet were drilled in the period under review. Pre-collaring by percussion drilling accounted for 786 feet of this total.

2.2 DDH - L9 (Plan Nos. 420-28, 48)

Intersected Bayes Reef at a vertical depth of 465 feet. No significant mineralization was noted.

2.3 DDH - L12 (Plan Nos. 420-28, 49)

Intersected Bayes Reef at a vertical depth of 400 feet. The only mineralization noted was 1 per cent copper between 361' and 366'.

2.4 DDH - L13 (Plan Nos. 420-28, 50)

Intersected John Brown's Reef at a vertical depth of 400 feet. The only mineralization encountered was a pyrite seam.

A quartz reef containing 0.7 per cent copper was intersected between 320'0" and 323'4", and a gneiss containing 0.8 per cent copper was intersected between 391'8" and 395'8". A quartz vein containing 3-5 per cent combined pyrite and chalcopyrite was intersected between 891'6" and 895'6".

2.5 DDH - L14 (Plan Nos. 420-28, 51)

Intersected 7 feet (true width) of 0.29 per cent copper in granite at a vertical depth of 460 feet. Quartz veins were intersected between 372'6" and 382'6" and 820'6" and 825'0" - the latter containing 3-5% pyrite only.

2.6 DDH - L24 (Plan Nos. 420-28, 52)

Intersected several zones of weak mineralization. Best assay was 0.3 per cent copper at 708 feet.

2.7 CONCLUSIONS AND RECOMMENDATIONS

Drilling did not locate any significant mineralization and no further work is recommended at this time.

3. QUEEN BEE MINE AREA

Three diamond drill holes drilled in this area intersected economic grades of copper over a mineable width in the New South Queen Bee Reef. Preliminary tonnage/grade calculations suggest that a small scale mining venture may be economically viable. However, at least three additional drill holes are considered essential to confirm these calculations and a limited drilling programme costing $18,000 is strongly recommended (Shackleton, 1971(b), Appendix I).

4. WINKLER'S LEAD PROSPECT

A zone of lead-silver (with minor molybdenum) mineralization has been traced by geological mapping over a strike length of 900 feet. An induced polarization (I.P.) survey extended the strike length by a further 700 feet and located two areas of probably intense mineralization.

A limited drilling programme consisting of three percussion/diamond drill holes totalling approximately 950 feet at a cost of $10,000 is strongly recommended (Shackleton, 1971(c), Appendix II).

5. LUXEMBURG SOUTH AREA

I.P. surveys have located several significant anomalies in this area. A shallow percussion drilling programme intersected four zones of pyritic tillite, the best of which contains 0.4 per cent copper over 10 feet true width with 0.4 oz. silver/ton over two feet true width.

Primary and secondary drill targets have been chosen for diamond drilling (Lopes, 1971(a), Appendix III).

6. DALKEY - MILDALTIE MINE AREA

Intensive exploration has been carried out in this area and numerous geophysical anomalies have been located. A number of these anomalies are associated with copper-silver mineralization which shows a correlation between the presence of a low-resistivity iron rich bed, fold structures and shear zones. (Moriarty, 1971, Appendix IV).

7. MACDONALD HILL AREA

Detailed geological mapping and sampling has defined at two veins containing up to 4.6 per cent copper, 15 parts per million of silver and 0.1 per cent molybdenum. Ground magnetic and very low frequency (V.L.F.) electromagnetic (E.M.) surveys are recommended to define the extent of the veins (Benbow, 1971(a), Appendix V).

8. LUXEMBURG EAST PROSPECT

An I.P. survey has located a significant anomaly of over 2000 feet in length which coincides with a ground magnetic anomaly. Limited drilling located minor amounts of pyrite and graphite which are considered insufficient to cause the strong I.P. anomaly. A diamond drill hole is recommended to test the I.P. anomaly. (Lopes 1971(b), Appendix VI).

9. CUTANA COPPER MINE

Detailed geological mapping indicates that the mineralization in the mine is only 30 feet long and of limited depth. Ground magnetic and V.L.F. surveys are recommended to locate any possible extensions to the mineralization (Benbow, 1971(b), Appendix VII).

10. LUXEMBURG SOUTH - BILL'S HILL AREA

Detailed geological mapping located several areas of copper mineralization associated with amphibolites or ironstones. Although selected specimens assayed up to 13 per cent copper, mineralization is minor compared to other prospects in the lease and thus this area has a low priority in the exploration programme (Benbow, 1971(c), Appendix VIII).

11. CONCLUSIONS AND RECOMMENDATIONS

Detailed geological, geophysical and drilling investigations have shown that S.M.L. 420 contains several areas of potential economic mineralization. Drilling of the New South Queen Bee Reef, in particular, suggests that a small scale mining operation may be economically viable.

Preliminary investigations of Winkler's Lead Prospect are most encouraging and a limited drilling programme has been recommended to test two significant I.P. anomalies.

Several other prospects are also considered worthy of additional geophysical exploration and/or drilling as detailed in the various reports which are appended.

W Shackleton

15.3.71

W. G. Shackleton,
Senior Geologist,
MINOIL SERVICES PTY. LTD.

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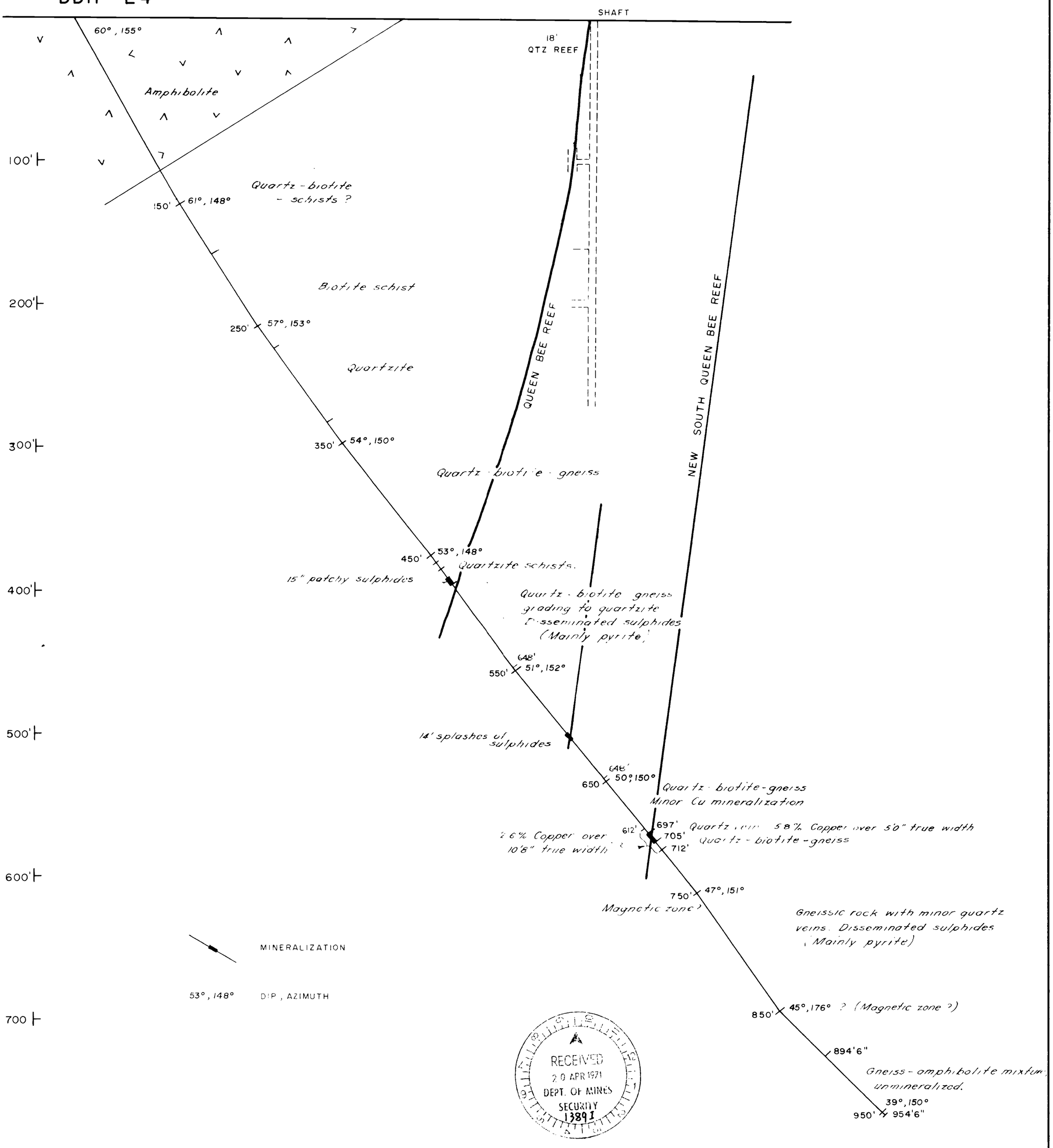
DDH - L4



SCALE

50 0 50 100

FEET

(Drilled by previous lease holders) 1389 1 (2)

SUNDOWNER MINERALS N.L.
S.M.L. 420 LUXEMBURG MINE AREA
VERTICAL DRILL SECTION DDH-L4 LOOKING 223° MN

DATE 15·5·70 REVISED 23·3·70 GEOL D.LOPES, B. FARRELL	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A

N

S

DDH-L23

Amphibolite

70°, 146°

100' ⊢

100' 78°, 150°

200' ⊢

200' 66°, 162°

Amphibolite

300' 66°, 166°

300' ⊢

354'6"

Biotite - Sericite - Schist

400' 397° 3" 71°, 169°

400' ⊢

500' 69°, 170°

Occasional trace of sulphides Cp - Py
Magnetite 10%

500' ⊢

600' 61°, 170°

600' ⊢

Amphibolite

700' 62°, 172°

700 ⊢

800' 62°

810' 1"

Traces of Py-Cp 819'8"

834'

9'7" @ ·09% Cu

837'3"

3'3" @ ·08% Cu

839'10"

843'10" Quartz Reef

857'9" Quartz - Biotite - granite greiss.

800' ⊢

900' Anatectic Granite

948'

798.05

900' ⊢

LEGEND

Py	Pyrite
Cp	Chalcopyrite
Cu	Copper
70°, 146°	Dip, Azimuth

SCALE

50 0 50

FEET

1389 I (2)

SUNDOWNER MINERALS N.L.		
S.M.L 420 LUXEMBURG MINE AREA		
VERTICAL DRILL SECTION DDH-L23 LOOKING 90° MN		
DATE: JAN. 1971	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: B FARRELL		

ENV 1389(I)-2 420-35

N

S

DDH – L13

60°, 180°

Mag 60%

Granite

44'

Quartzite

→ 60% Mag

74'

100'

Anatectic Granite

148'
152'

Quartz - Biotite schist

200'

Anatectic

Granite

300'
303'

Quartz - Biotite Gneiss

320'
323'4"

Minz Cp-Py

Quartz Vein

Granite Gneiss

320'-323'4" @ ·7% Cu

348'

Trace Py-Cp

Anatectic Granite

377'6"
388'

Cp(tr)-Py : 2% →

Gneiss with some granite

391'8"-395'8"
i.e. 4' @ ·8% Cu

400'

?

Py seam

Quartz rich

Anatectic

500'

Granite

600'

624'

Granite

Gneiss

662'

700'

Anatectic

Granite

789'6"
800'
805'

Granite Gneiss

Anatectic

Granite

Trace Py

856'8"

Granite Gneiss

Py - Cp(tr)

871'

Anatectic Granite

889'
891'6"

Granite Gneiss

(3·5%) Sulphides Py - Cp

895'6"
900'

Quartz vein

Granite

Gneiss

304-80

1000'

JOHN BROWNS REEF

?

?

100' 200' 300' 400' 500' 600' 700' 800' 900'

LEGEND

———	Quartz reef
Cp	Chalcopyrite
Py	Pyrite
Mag	Magnetite
Cu	Copper
78°, 153°	Dip, Azimuth
Minz	Mineralization

SCALE

50 0 50 100

FEET

1389 I (1)

SUNDOWNER MINERALS N.L.

S.M.L. 420 LUXEMBURG MINE AREA

VERTICAL DRILL SECTION
DDH-L13 LOOKING 90° MN

DATE: 14 JAN. '71	OLARY AREA	MINOIL SERVICES PTY LTD.
GEOLOGIST B FARRELL	SOUTH AUSTRALIA	ADELAIDE S A

ENV 1389(I)-3

420-50

N

S

DDH - L12

60°, 180°

Granite & Granite Gneiss

BISMARK REEF

BAYES REEF

100'

100' ⊢

Granite Gneiss

Minz 6" Cc
112'-114' = 2' @ .06% Cu

(SHEARED)

Minz Trace amounts
Po - Cp - Cu. Dissem mag.
Copper carbonate
staining on shears.

181'6"
184' Quartzite

200' 58°

Granite Gneiss

200' ⊢

242'
246' Quartzite

Granite Gneiss

296'
298' Quartzite

300' 56°

Granite Gneiss

300' ⊢

353' Biotite Schist
359'6" Quartz Vein
365'9" Granite Gneiss
368'4"
374'6" Quartz Vein

361-366' 1% Cu

Minz Cc - Cp - Py - He

Granite

393'

400' 58°, 173°

Granite Gneiss

Dissem mag

400' ⊢

471'
479' Quartzite

500' '52°, 175 Granite Gneiss

514

Trace Py - Cp

500' ⊢

600' 51°, 175° Granite

600' ⊢

700' 45°, 172°

Quartz

779' Quartz Vein
782'6"
40° Granite
800' 809'10"
818'2" Quartzite

Granite Gneiss
860'5"
41°, 173°

Trace minz - Py

700' ⊢

262.26

LEGEND

———	Quartz reef
Cp	Chalcopyrite
Cc	Chalcocite
Ten	Tenorite
He	Hematite
Cup	Cuprite
Po	Pyrohotite
Py	Pyrite
Cu	Copper
Mag.	Magnetite
60°, 180°	Dip, Azimuth
Minz	Mineralization

SCALE

50 0 50 100

FEET

1389 (I)

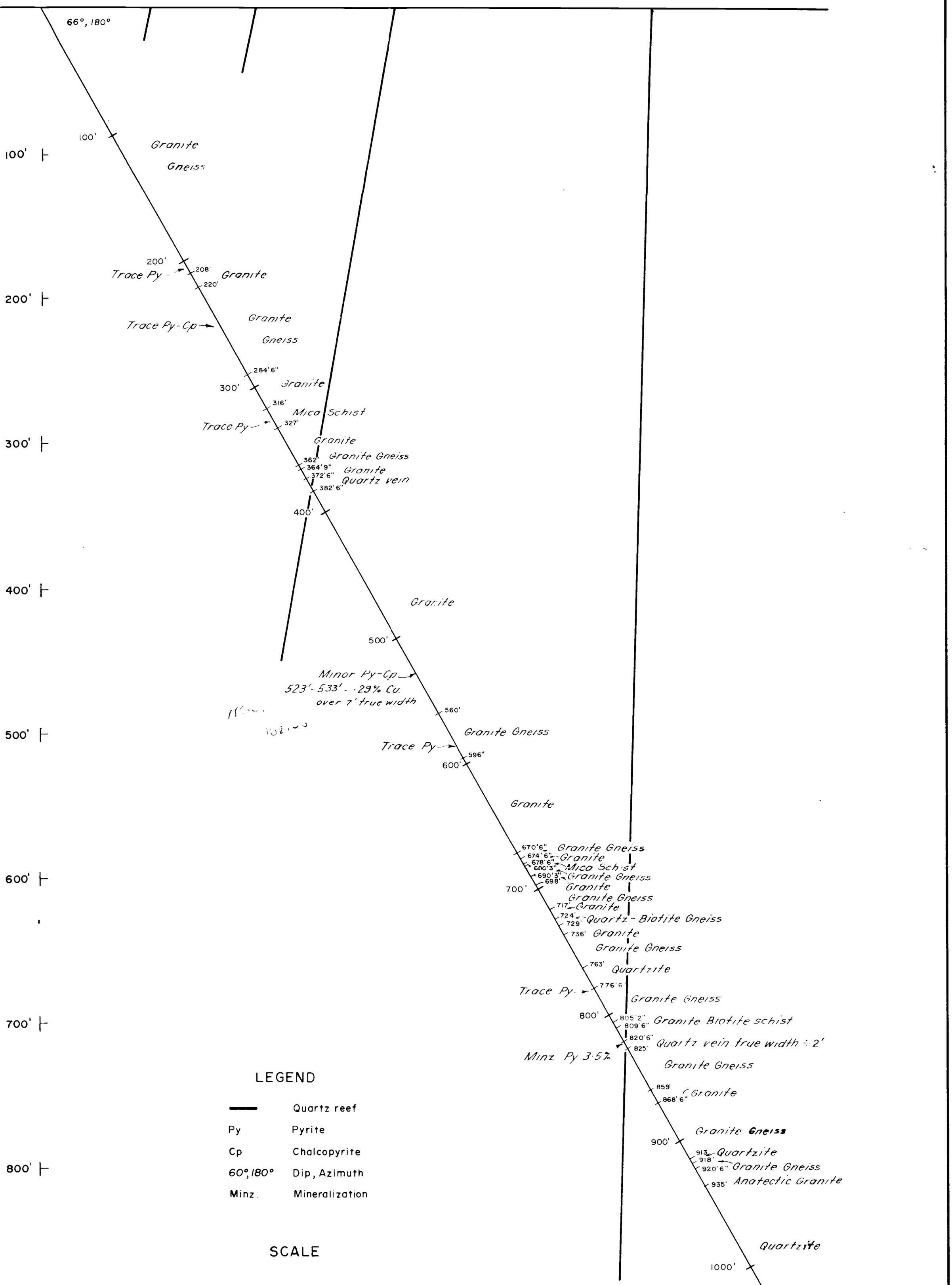
SUNDOWNER MINERALS N.L.		
S.M.L 420 LUXEMBURG MINE AREA		
VERTICAL DRILL SECTION DDH-L12 LOOKING 90° MN		
DATE 14 JAN '71	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A
GEOLOGIST B FARRELL		

ENV 1389(I) - 4.

N

S

DDH - L14



328.45'

LEGEND

———	Quartz reef
Py	Pyrite
Cp	Chalcopyrite
60°, 180°	Dip, Azimuth
Minz.	Mineralization

SCALE

50 0 50 100

FEET

1389 I (I)

SUNDOWNER MINERALS N.L.		
S.M.L 420 LUXEMBURG MINE AREA		
VERTICAL DRILL SECTION DDH-L14 LOOKING 90° MN		
DATE 14 JAN. 71 GEOLOGIST: B. FARRELL	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A

ENV 1389 (I) - 5

420 - 51

N

S

DDH-L9

60°, 179°

?

100' ⊢

100' — 65° Granite Gneiss

186'

200' — 66°

200' ⊢

Trace Mag 10% Py-Po.

Anatectic Granite

300' — 64°, 186°

300' ⊢

338'6" Granite Gneiss

368'10" Anatectic Granite

Faulting

389'4" Biotite Schist

394'6"

400 — 62°, 191°

400' ⊢

Anatectic Granite

495'

500' — 62°, 182° Quartzite

511'6" Granite Gneiss

515'

518'6" Quartz Vein

Quartzite

500' ⊢

?

Feldspathic Quartzite

600' — 60°, 184°

Some dissem Py

626' Quartz - Biotite Schist.

657' Granite Gneiss

676' Feldspathic Quartzite

691'6"

700' — 60°, 182° Quartz-Biotite Schist

708'6" Quartzite

716'6" Quartz - Biotite Schist

727'6" Anatectic Granite

735'6" Biotite-Sericite Schist

740'6" Quartzite

748' Biotite - Sericite Schists.

775'6" Anatectic Granite

788'6"

800' — 58°, 178° Quartz - Biotite schists

842' Feldspathic Quartzite

875' Quartz - Biotite - Sericite.

900' — 57°, 172°

917'3"

925' Anatectic Granite.

BISMARK REEF

BAYES REEF

600' ⊢

700' ⊢

800' ⊢

900' ⊢

LEGEND

———	Quartzite
Py	Pyrite
Po	Pyrrhotite
Mag	Magnetite
62°, 159°	Dip, Azimuth

SCALE

50 0 50 100

FEET

281.94

RECEIVED
20 APR 1971
DEPT. OF MINES
SECURITY
1389 I

1389

SUNDOWNER MINERALS N.L.		
S.M.L. 420 LUXEMBURG MINE AREA		
VERTICAL DRILL SECTION DDH-L9 LOOKING 89° MN		
DATE 14 JAN. '71	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY LTD. ADELAIDE S.A
GEOLOGIST B FARRELL		

ENV 1389(I)-6.

TN MN

LF LEF LE LED LD LC

DDH L14

DDH L12

L24

L9

L13

DDH L6

DDH L4

DDH-21

DDH L1

DDH-L27 -60°

DDH L23

DDH L19

DDH L18

DDH L17

DDH-L25 -60°

DDH-L26 -60°

LUXEMBURG MINE

QUEEN BEE MINE

BISMARK REEF

BAYES REEF

JOHN BROWN REEF

QUEEN BEE REEF

NEW SOUTH QUEEN BEE REEF

I.P BASE LINE

950' 945' 940' 955' 960' 965' 970' 980' 990' 995' 985' 975' 930'

LEGEND

V	AMPHIBOLITE	DDH	DIAMOND DRILL HOLE
+	GRANITE	PDH	PERCUSSION DRILL HOLE
	GNEISS		MINERALIZED INTERSECTION
	BIOTITE SCHIST		CONTOUR
	QUARTZITE		SHAFT
	QUARTZ VEIN		TRENCH
	PEGMATITE		WORKINGS
	FAULT	DDH -60°	PROPOSED DIAMOND DRILL HOLE SHOWING INCL NATION
	DIP		

SCALE

100 50 0 100 200 300 400 500

FEET

SUNDOWNER MINERALS N.L.

S.M.L 420 LUXEMBURG MINE AREA

GEOLOGICAL PLAN WITH DRILL HOLES

DATE JANUARY 1971	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A
GEOLOGIST B. FARRELL		

N

S

DDH - L19

70°, 180°

QUEEN BEE REEF

100'

100'

Granite Gneiss

200'

200' 69°, 177°

270' Quartzite
277'
Granite Gneiss
292'
Quartzite
300' 67°, 172°
306' Granite Gneiss
310'6" Quartzite
317'

300'

Tr Py

Granite Gneiss with some Granite

NEW SOUTH QUEEN BEE REEF

Granite

400' 66°, 168°

Minz Py-Cp

423'6" Mica Schists
434'6"

Granite Gneiss

500' 66°, 168°

515'
519'8" Biotite-garnet-quartz schist

Tr Py

Granite Gneiss

556'-570' 6' @ .02% Cu.
562'-570' 8' @ 1.24% Cu Minz Py-Cp-Cc(?)
570'-572 4' @ .01% Cu.

581'4"
571'1" Quartz Vein

Tr-Py-Po-Cp

Granite Gneiss

600' 64°

615'
619'6" Quartzite

Dissem mag tr Py

Granite Gneiss

671'

685'10" Quartzite

QUARTZ VEIN NEW SOUTH QUEEN BEE REEF (True width 7')

685-701' = 2.57% over 8' true width
689-701' = 3.04% over 6' " "
691-699' = 4.3% Cu " 4' " "

Minz Cp-Bn-Py

61°

697' Granite Gneiss
700'
707' Quartz Vein
710'

Cp(tr)-Py

Granite Gneiss

733'

Tr Py

Mica Schist

760'

Granite Gneiss

786'2" Quartz Vein
789'4"

Cp(tr)-Py

Granite

800' 63°, 168°

Quartz biotite schist

Tr Py

807'2"

Granite Gneiss

Tr Py

851'6"

Granite

861'

Granite Gneiss

874' Quartzite
877'

Tr Py

Granite

897'

900' 61°, 170°

Granite

931'

Granite Gneiss

947'5"

Biotite Schist.

963'4"

Granite

1000' 59°, 171°

Gneiss

1027'

Anatectic Granite

1078'11" Quartz Vein
1079'

Tr Py

1100' 56°

Anatectic Granite

SHEARED

1167' Granite Gneiss
1172'6" Micaceous Quartzite
1176'8" Granite Gneiss.
1181'7" Micaceous Quartzite
1184'6"

1200' 54° Granite Gneiss
1207'2" Anatectic Granite with micaceous quartzite.
1217'

Mag 20-75% Py(tr)

Gneiss

1234'

Anatectic Granite

1287'
1293' Biotite-quartz gneiss.
1300' 51°

Anatectic Granite

1358'10"

Granite Gneiss

1391'6"

Anatectic Granite

1400' 47°

1418'4" Biotite-Sericite Schist
1427'6"

Granite Gneiss

1454'6" Pegmatite
1463'6"

Biotite-chlorite-garnet-Schist

1482'6" Quartz-biotite-garnet Gneiss
1486'
1497' Biotite-chlorite schists.

1500'

Granite Gneiss

1549' Granite Pegmatite.
1550'6"

Granite

1600'

1617'

Anatectic Granite

39°

1665'6" Granite Gneiss
1674'
1685' Anatectic Granite

512.59

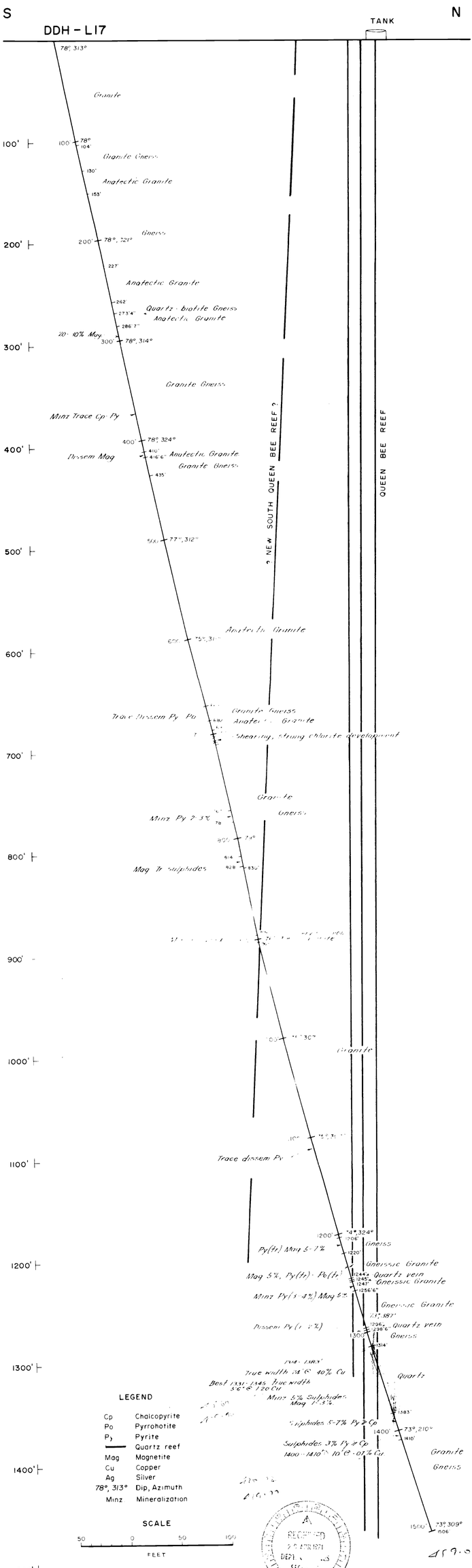
LEGEND

Cc	Chalcocite
Cp	Chalcopyrite
Br	Bornite
Py	Pyrite
Po	Pyrrohotite
Mag	Magnetite
70°, 180°	Dip, Azimuth
——	Quartz Reef
Minz.	Mineralization

SCALE

FEET 50 0 50 100 FEET

SUNDOWNER MINERALS N.L.	
S.M.L 420 LUXEMBURG MINE AREA	
VERTICAL DRILL SECTION DDH-L19 LOOKING 90° MN	
DATE JAN 1971	OLARY AREA SOUTH AUSTRALIA
GEOLOGIST B FARRELL	MINOIL SERVICES PTY. LTD ADELAIDE S.A.



SUNDOWNER MINERALS N.L.

S.M.L. 420 LUXEMBURG MINE AREA

VERTICAL DRILL SECTION

DDH - L17 LOOKING 223° MN

DATE 4 JAN 7	OLARY AREA	MINOIL SERVICES PTY LTD
GEOLOGIST B FARRELL	SOUTH AUSTRALIA	ADELAIDE S A

ENV 1389(I) - 9

420 - 31

S

N

DDH-L18

81°, 317°

Granite Gneiss

NEW SOUTH QUEEN BEE REEF

100'

100' — 79°

120'

200'

200' — 84°, 302°

Anatectic Granite

300'

300' — 82°, 299°

331 4" Biotite Schist
333'6"

Fracturing XXX

400'

400' — 85°, 299°

Anatectic Granite

XXX

472 - 485'4"
Py - magnetic - Cp

500'

500' — 77°, 303°

XXX

576'
579'6" Biotite Schist

Anatectic Granite

594'

600'

600'

Minor Py

611'

Granite Gneiss

620'

Anatectic Granite

627'7"

Granite Gneiss

627'7" - 637'7" Trace Py - Cp -

632'7" Quartz vein

10' @ .08% Cu

665'10" - 677'10" Py - Cp (tr)

12' @ .04% Cu

Granite Gneiss

700'

729

Anatectic Granite

779 4"

11' True width .17% Cu

800'

Quartz Reef (11' true width)

829

Anatectic Granite

850'6"

Granite Gneiss

865'10"

900'

900'

Anatectic Granite

957

967' Schist & Granite Gneiss

Trace Py

Anatectic Granite with some Granite Gneiss

1000' 7"

1000'

304.08

LEGEND

———	Quartz reef
Py	Pyrite
Cp	Chalcopyrite
Mag	Magnetite
Cu	Copper
84°, 302°	Dip, Azimuth
XXX	Fracturing

SCALE

50 0 50 100

FEET

1389 I (2)

SUNDOWNER MINERALS N.L.

S.M.L 420 LUXEMBURG MINE AREA

VERTICAL DRILL SECTION
DDH-L18 LOOKING 90° MN

DATE 14 JAN 1971	OLARY AREA	MINOIL SERVICES PTY LTD
GEOLOGIST B FARRELL	SOUTH AUSTRALIA	ADELAIDE S.A.

N

S

DDH-L21

78°, 153°

18" Quartz Reef

Main ladder shaft 25' East of section

100' level

100'

100' 77° Amphibolite

CONTACT ZONE

192' Granite Gneiss

200' 75°

214' Quartz-Biotite-Schist

218'

227'6" Anotectic Granite

Quartzite

247'

Anotectic Granite

276'

300' 75° Mainly Quartz-biotite Gneiss.

333'1" Quartz Reef

335'8"

345' Micaceous Quartzite.

Anotectic Granite

376'6"

Trace Minz Cp.

400' 74°

Quartz-biotite-gneiss.

500' 63°

508'8"

Anotectic Granite

Trace Minz Cp-py

564'3"

575' Quartz-biotite gneiss.

600' 65°

Anotectic Granite

Minz Py-Cp

641'9"

643'6"

647'6" Gneiss and Quartzite

658'5"

658'7"

660'5" Anotectic

Minz Cp-py-po

678'5" Quartzite

683'6"

700' 65° Quartz-biotite Gneiss

708'3" Quartz vein (true width ~12")

709'10

718'8" Granite Gneiss

Minz Cp-py

Anotectic Granite

714'4" Granite gneiss

Minz dissem Cp-py

750'5"

Anotectic Granite

774'10" Granite Gneiss

788'6"

800' 56°

Anotectic Granite

834'11"

840'10"

Minz 20% mag. Py-Cp ∠·08% Cu

855'8" Granite Gneiss

894'

900' 53°

Anotectic Granite

1000' 49°

1002'6"

1008'6" Quartz Reef

1014'6"

1029'5"

Minz Cp-py 2·43% Cu

True width 3·9' @ 2·43% Cu.

Anotectic Granite

1008'6" - 1014'6" = ·75% Cu.

True width 4' @ ·75% Cu.

ie Combined true width 7'11" @ 1·56% Cu.

1081'11"

1099'6" Granite

1100'

1109' Gneiss

1099'6" - 1109' =

∠·08% Cu

1148' Anotectic Granite

1162'6"

Granite Gneiss

1192'6"

1200' Anotectic Granite approaching Granodiorite

1247'8" Biotite schist

1249'8" Anotectic Granite/Feldspathic Quartzite

1281'6"

Granite Gneiss

1294'

1300' Anotectic Granite

1333' Granite Gneiss

1343'4"

1346' Quartz biotite Gneiss.

Granite Gneiss

1389'

18" Quartz Reef

QUEEN BEE REEF

NEW SOUTH QUEEN BEE REEF

True width 16'

LEGEND

———	Quartz reef
Cp	Chalcopyrite
Py	Pyrite
Magnetite	Magnetite
Cu	Copper
78°, 153°	Dip, Azimuth
Minz.	Mineralization
Po	Pyrrhotite

SCALE

50 0 50 100

FEET

123.37

1389 I (2)

SUNDOWNER MINERALS N.L.		
S.M.L 420 LUXEMBURG MINE AREA		
VERTICAL DRILL SECTION DDH-L21 LOOKING 63° MN		
DATE 14 JAN. 1971	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY LTD. ADELAIDE S.A
GEOLOGIST B. FARRELL		

ENV 1389(I) - 11

N

S

DDH - L24

Mine Dump

Costean

60°, 153°

Granite and Gneisses

Granite

Amphibolite

60'
64'
Biotite schist
Quartz - biotite gneiss

78'

60°
100'

100' ├

Granite

200'
61°
Quartz - biotite - sericite schist
214'
Anatectic Granite

200' ├

238'

Granite Gneiss

282' 3"

57°, 153° 30'
300'
303'
Anatectic Granite

334'
·04% Cu.
345' 9"
Granite Gneiss

300' ├

383'
·08 % Cu.
384'
54°, 153° 30'
400'
403' 2"
Quartzite
413' 6"

Granite Gneiss

441' 10"
453' 6"
Quartzite

400' ├

Granite Gneiss

50°
500'
515'

Anatectic Granite

Trace Minz 0·03% Cu.
Ten - Cp - Cc.
547' 6"
549' 6"
549' 5"
563' 8"
567' 6"
Quartzite
Quartzite - biotite Gneiss

500' ├

49, 164°
600'
614' 10" –
623' 6"
Minz. splashes of Py

Quartzite

600' ├

47°, 158°
700
0·3% Cu.
Minz.
Cp - Py
732' 7"
738' 7"
750'

Anatectic Granite

44°, 158° 30'
800'

700' ├

840'
Granite Gneiss
868'

Minz
mag 2-3%, Py(tr)
44°, 166°
900'
905' 6"
915'
Granite Gneiss
Feldspathic Quartzite

800' ├

946'
Anatectic Granite
962'
Feldspathic Quartzite

42°, 158°
1000'
1002'

305·2

LEGEND

Py	Pyrite
Mag	Magnetite
Cp	Chalcopyrite
Ten	Tenorite
——	Quartz reef
42°, 158°	Dip, Azimuth
Minz.	Mineralization

SCALE

50 0 50 100

FEET

1389 I (2)

SUNDOWNER MINERALS N.L.

S.M.L 420 LUXEMBURG MINE AREA

VERTICAL DRILL SECTION
DDH - L24 LOOKING 63° MN

DATE 14 JAN 1971	OLARY AREA	MINOIL SERVICES PTY LTD
GEOLOGIST: B FARRELL	SOUTH AUSTRALIA	ADELAIDE S.A.

ENV 1389 I - 12

N

S

DDH - L6

SHAFT

SHAFT

63°, 180°

100'

100'

Granite Gneiss

200'

64°, 180°

200'

QUEEN BEE REEF

NEW SOUTH QUEEN BEE REEF ?

300'

62°, 181°

302'

Quartzite

317'

Granite Gneiss

322'6" Quartz vein

Minz Trace Py

324'

Granite Gneiss

Minz fine dissem. Py

356'

Biotite Quartzite

379'

400'

58°

Granite Gneiss

447'6" Quartz vein

449'

400'

Biotite Quartzite

500'

59°

512'

Granite Gneiss

Minz dissem Py

556'

Micaceous Quartzite.

500'

54°, 176°

600'

603'

Quartz vein

614'

Granite

620'8" Quartz vein

625'1"

Quartzite

602'-614' = ·028% Cu Minz 10% Sulphides

true width 7' @ ·028% Cu Py (tr)

Minz Tr Py

653'4" Quartz vein

614'-633' = ·01% Cu

655'6"

Minz Tr Py

Quartzite

683'6"

600'

Granite Gneiss

698'

700'

52°

Granite

Granite Gneiss

50°

800'

804'

Granite

809'

Minz 10% mag. - Py (·01% Cu.)

Granite Gneiss

832'

833'

Quartz vein

Trace Minz Py - Cp (tr)

Granite Gneiss

Minz Trace Py

883'

884'6" Quartz vein

900'

47°, 190°

Minor Minz Py

45°, 182

1000'

Granite Gneiss with some granite

43°, 177°

1100'

40°, 172°

1200'

1203'10"

366.93

LEGEND

——	Quartz reef
Py	Pyrite
Cp	Chalcopyrite
Mag	Magnetite
Cu	Copper
63°, 180°	Dip, Azimuth
Minz.	Mineralization

SCALE

50 0 50 100

FEET

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20 APR 1971
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SECURITY
1389 I

1389 I (2)

SUNDOWNER MINERALS N.L.

S.M.L 420 LUXEMBURG MINE AREA

VERTICAL DRILL SECTION
DDH-L6 LOOKING 86° MN

DATE: 14 JAN '71	OLARY AREA	MINOIL SERVICES PTY. LTD
GEOLOGIST B FARRELL	SOUTH AUSTRALIA	ADELAIDE S.A

ENV 1389(I) - 13

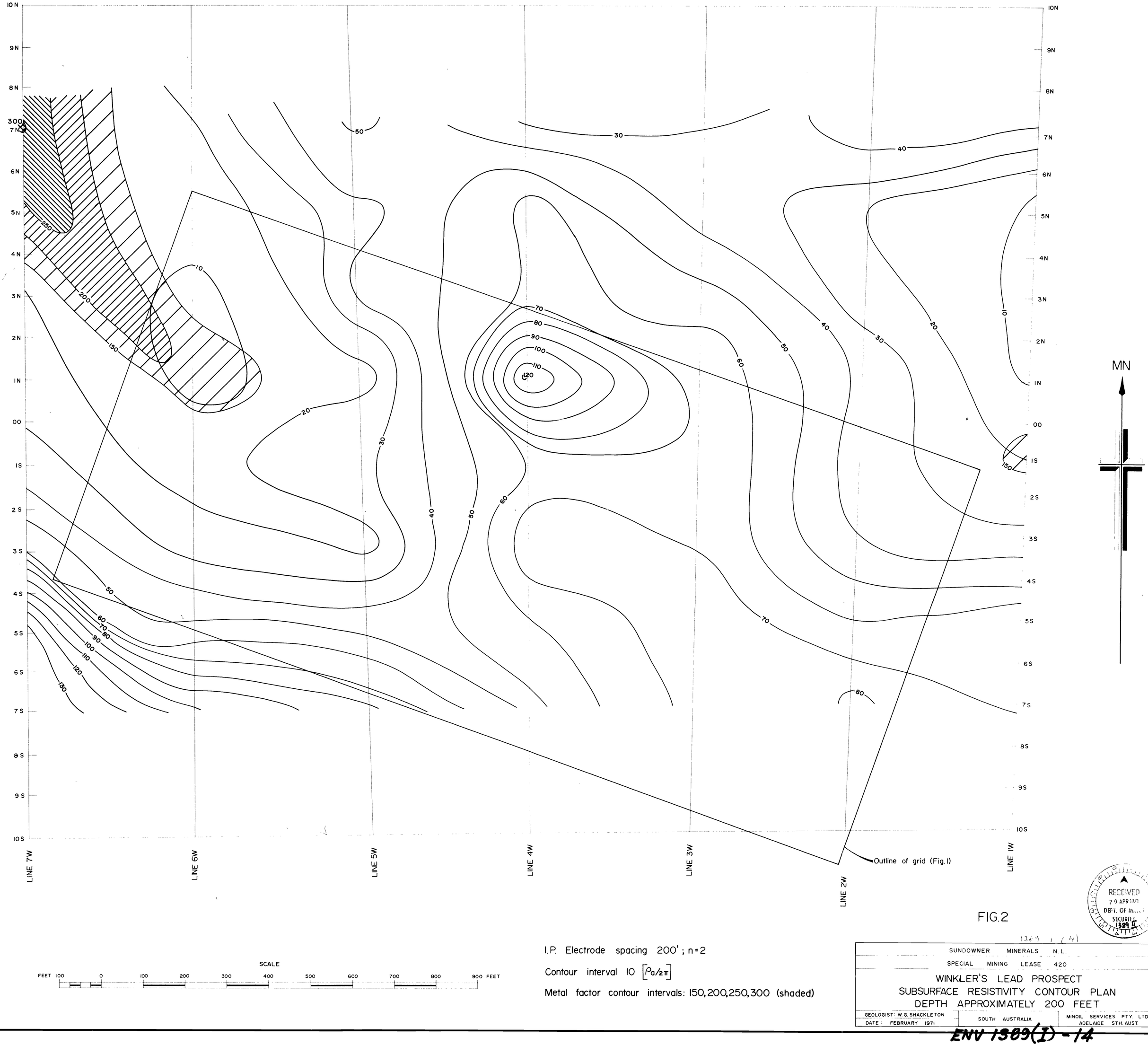

FIG.2

SCALE

FEET 100 0 100 200 300 400 500 600 700 800 900 FEET

I.P. Electrode spacing 200'; n=2

Contour interval 10 $\left[\rho_a/2\pi\right]$

Metal factor contour intervals: 150, 200, 250, 300 (shaded)

(1389) 1 (4)

SUNDOWNER MINERALS N.L.

SPECIAL MINING LEASE 420

WINKLER'S LEAD PROSPECT
SUBSURFACE RESISTIVITY CONTOUR PLAN
DEPTH APPROXIMATELY 200 FEET

GEOLOGIST: W.G. SHACKLETON
DATE: FEBRUARY 1971

SOUTH AUSTRALIA

MINOIL SERVICES PTY. LTD.
ADELAIDE STH. AUST.

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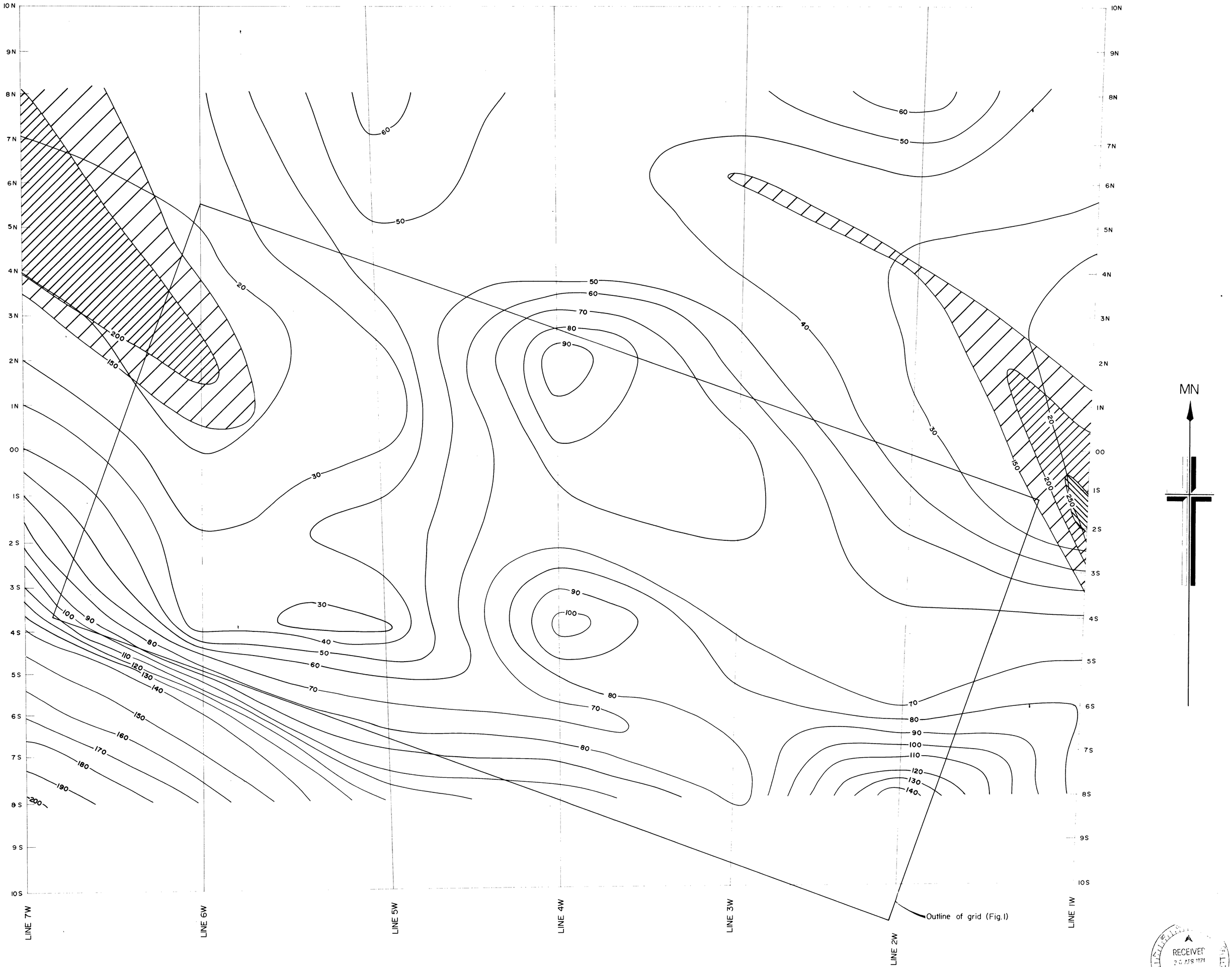

FIG.3

SCALE

FEET 100 0 100 200 300 400 500 600 700 800 900 FEET

I.P. Electrode spacing 200' ; n=3

Contour interval 10 $\left[\rho_a/2\pi\right]$

Metal factor contour intervals: 150, 200, 250 (shaded)

SUNDOWNER MINERALS N.L.

SPECIAL MINING LEASE 420

WINKLER'S LEAD PROSPECT
SUBSURFACE RESISTIVITY CONTOUR PLAN
DEPTH APPROXIMATELY 300 FEET

GEOLOGIST: W.G. SHACKLETON
DATE: FEBRUARY 1971

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MINOIL SERVICES PTY. LTD.
ADELAIDE STH. AUST.

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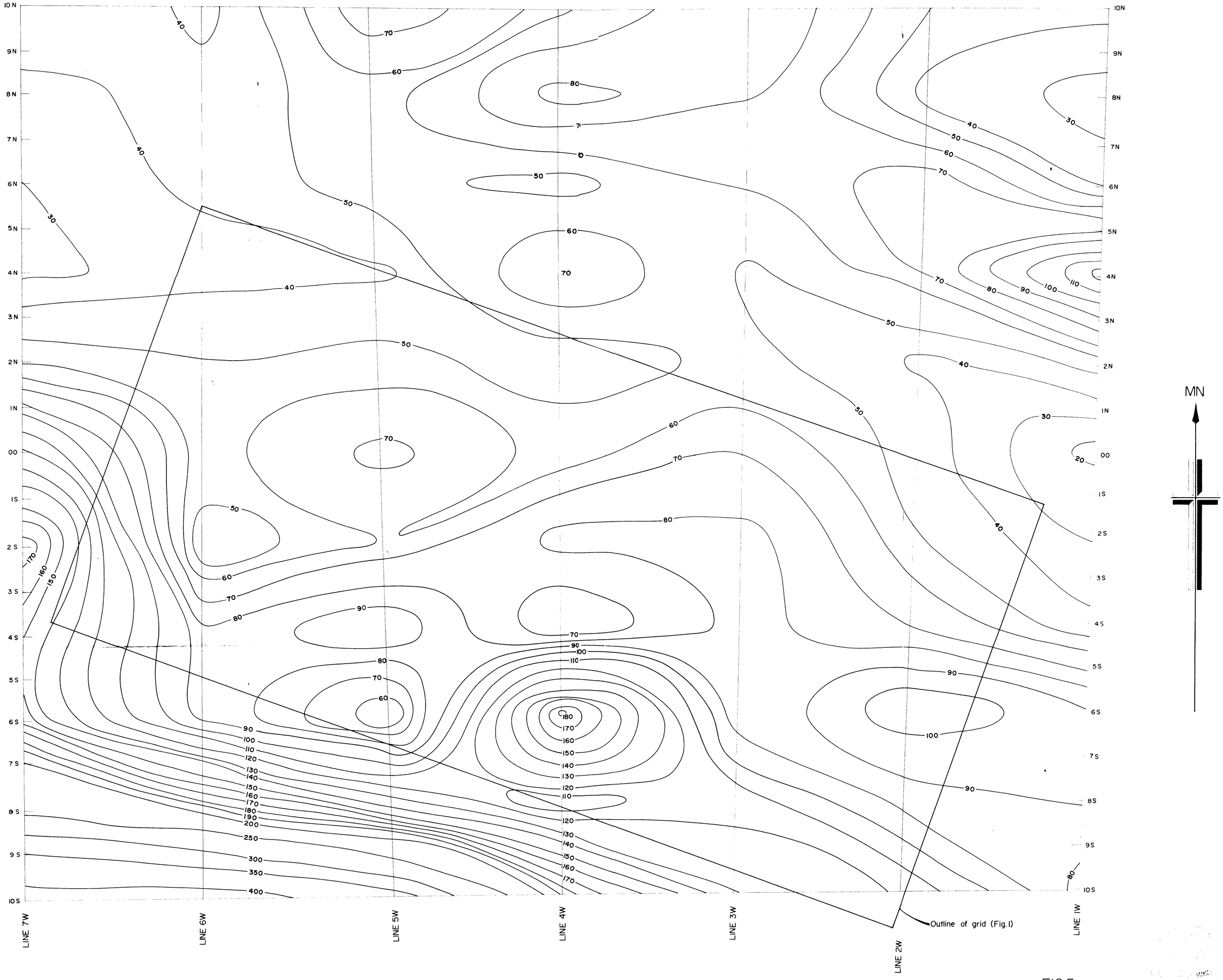

FIG.5

SCALE

FEET 100 0 100 200 300 400 500 600 700 800 900 FEET

I.P. Electrode spacing 200' ; n=5

Contour interval 10 $\left[\rho a/2\pi\right]$

to 200, thence 50

ENV 1389 (I)

16

SUNDOWNER MINERALS N.L.

SPECIAL MINING LEASE 420

WINKLER'S LEAD PROSPECT
SUBSURFACE RESISTIVITY CONTOUR PLAN
DEPTH APPROXIMATELY 500 FEET

GEOLOGIST: W.G. SHACKLETON

DATE : FEBRUARY 1971

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MINOIL SERVICES PTY. LTD.
ADELAIDE STH. AUST.

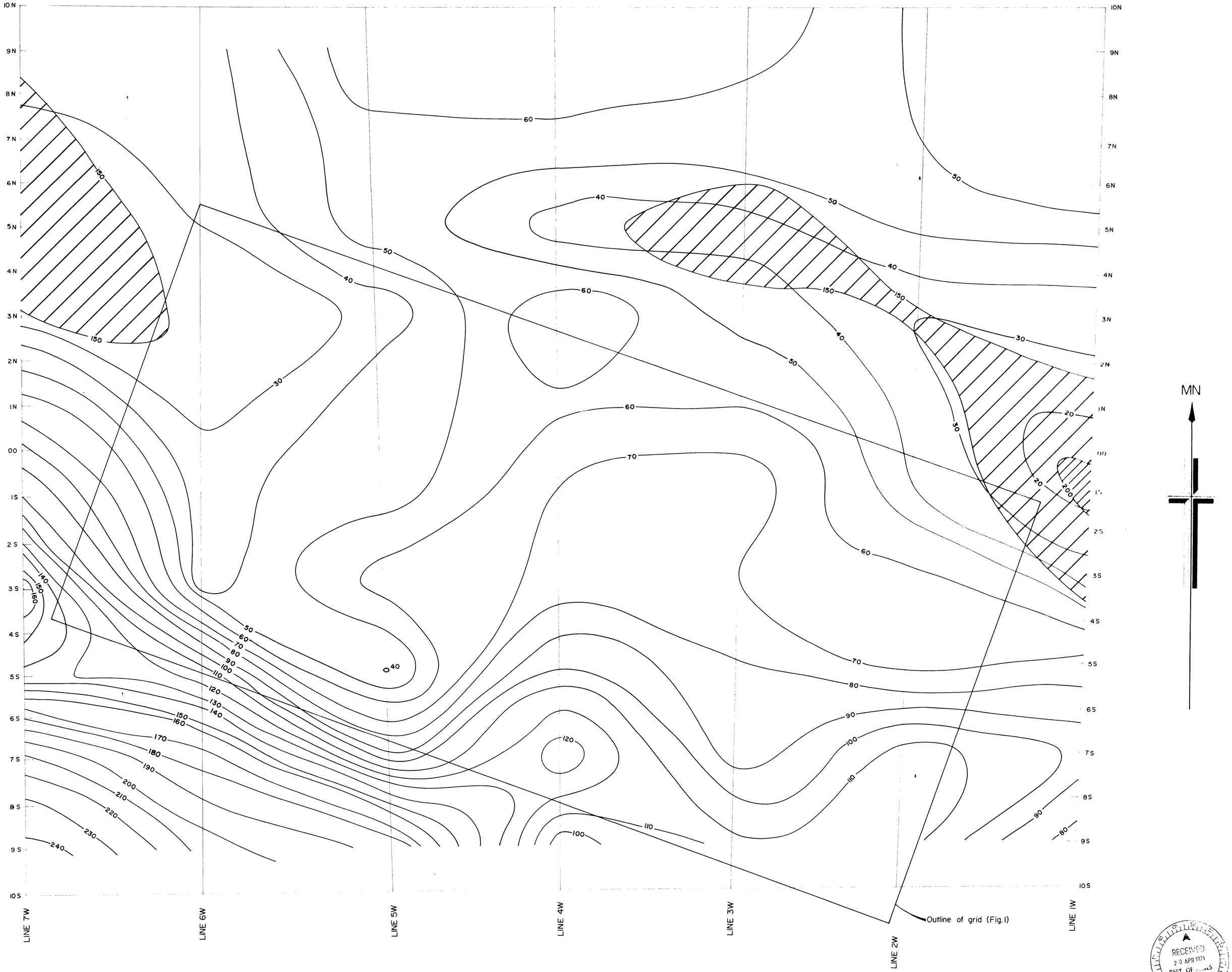

FIG. 4

SCALE

FEET 100 0 100 200 300 400 500 600 700 800 900 FEET

I.P. Electrode spacing 200' ; n=4

Contour interval 10 $\left[\rho a/2\pi\right]$

Metal factor contour intervals: 150, 200, (shaded)

1389 I (47)

SUNDOWNER MINERALS N.L.		
SPECIAL MINING LEASE 420		
WINKLER'S LEAD PROSPECT SUBSURFACE RESISTIVITY CONTOUR PLAN DEPTH APPROXIMATELY 400 FEET		
GEOLOGIST: W.G. SHACKLETON DATE: FEBRUARY 1971	SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST.

ENV 1389(I)-17

SUNDOWNER MINERALS N.L.

SML 420 — OLARY DISTRICT

MINERAL OCCURRENCES AND CHIP SAMPLING RESULTS

GEOLOGIST: D LOPES | SOUTH AUSTRALIA | MINOIL SERVICES PTY. LTD. ADELAIDE S.A.

DATE: FEBRUARY 1971

ENV 1389(I)-18

420-37

1389 I (1)

MacDonald Reef
4 Samples - Barren
MacDonald-Joan 2 (10 samples)
300 - » 10000 p.p.m. Cu
< 1.0 oz. Ag
MacDonald-Joan 1 (6 Samples)
3000 - > 10000 p.p.m. Cu
< 10000 p.p.m Mo

< 10000 p.p.m Cu
Perc Drill samples
< 3.0% Cu from Chip Samples
Green & Gold Mine Au

Wilkins Prospect
Drill & Chip Samples
< 10000 p.p.m. Cu

Winklers Prospect
Burrow Prospect
Lady Elizabeth
Premier Mine
Uncle Tom
Pb?
» 10000 p.p.m. Cu
Bills Hill
100 - > 10000 p.p.m. Cu
Small Diggings Cu

Dalkey Hill
< 300 p.p.m Pb 3oz Ag
Mildaltie Diggings
< 10% Cu p.p.m
< 8000 p.p.m Zn < 0.5oz Ag
Mildaltie Shoots
(69 Samples)
300 - » 10000 p.p.m Cu
< 10000 p.p.m Bi
< 1.5oz Ag
Dalkey Diggings (10 Random Samples)
2500 - > 10000 p.p.m Cu
< 2oz Ag
Dalkey 1 Cu
20 - > 10000 p.p.m. Cu
< 1oz Ag
Dalkey 2 (Mildaltie 1968)
< 4.3oz Ag
Dalkey 3
> 10000 p.p.m Cu
Dalkey Mine
5000 p.p.m Cu
10000 p.p.m Cu

Mulga Hill

Cemetery Prospect
0.8 - 10.4% Cu

Michelle Hill
(24 Random Samples)
200 - > 10000 p.p.m Cu

Extension Hill
(16 Random Samples)
60 - 10000 p.p.m. Cu
5 - 5000 p.p.m. Co

Bonython Hill (36 Random Samples)
< 3000 p.p.m Cu
Taylors Shaft (2 Samples)
< 100 p.p.m Cu

Dey Hill 2 - 1000 p.p.m Cu
Dey Hill 1 - > 10000 p.p.m. Cu

SCALE

60 CHAINS

LEGEND

- Cu Field test results only
- % Cu A.M.D.E.L. results
- Main road
- Railway
- River or creek
- Track
- Mine
- Homestead

LEGEND

- Alluvium, brown, friable, covered in most places by a thin veneer of small quartz float
- Shale, grey, well weathered.
- Schistose tillite.
- Anatectic granite, outcropping to some degree Light coloured, medium grain size
- Lead lode – accurate, approximate, inferred.
- 30' Accessible shaft. showing present depth.
- 20° Accessible shaft, showing dip of shaft.
- Collapsed shaft.
- Shallow diggings.
- Q Quartz outcrop
- X I.P. survey peg.
- S2 Sample location
- Quartz vein
- 80° Bedding with dip
- 30° Layering with attitude
- Geological boundary, approximate
- O WD1 90°, 350' Proposed drill hole with inclination and depth

WD1 – 90°, 250'

WD2 – 90°, 350'

WD3 – 90°, 350'

Outline of grid

MN

FIG. 1

SCALE

FEET 100 0 100 200 300 400 500 600 700 800 900 FEET

MAPPED BY B.R.CLARKE JAN. 1971

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1389 (4)

SUNDOWNER MINERALS N.L.

SPECIAL MINING LEASE 420

WINKLER'S LEAD PROSPECT

GEOLOGICAL PLAN

GEOLOGIST: W.G. SHACKLETON
DATE: FEBRUARY 1971

SOUTH AUSTRALIA

MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST.

ENV 1389(1) – 20

71-14

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SUNDOWNER MINERALS N.L.
Special Mining Lease Number 420

Olary Area
South Australia

Geological Report No. 2 on Winkler's Lead Prospect

By
W.G. Shackleton, M.Sc. (Sydney), M.Sc. (London), D.I.C.

of
MINOIL SERVICES PTY. LTD.
February 1971

CONTENTS

FIGURE REFERENCE
(in end Pocket)

SUMMARY

A zone of lead-silver (with probably minor tungsten and molybdenum) mineralization has been traced by geological mapping over a strike length of 900 feet. An I.P. survey has extended the strike length by a further 700 feet and located two areas of probably intense mineralization.

A limited drilling programme consisting of three percussion/diamond drill holes totalling approximately 950 feet at a cost of $10,000 is strongly recommended.

1. INTRODUCTION

Winkler's Lead Prospect, or O'Brien's Show, lies in Special Mining Lease (S.M.L.) Number 420 held by Sundowner Minerals N.L. and is located approximately ten miles due south of Cutana Siding on the Adelaide - Broken Hill railway line in the north-east of South Australia.

This report summarizes a comprehensive literature survey of the mine and also geological and geophysical work carried out on behalf of Sundowner Minerals N.L.

2. PREVIOUS INVESTIGATIONS

The mine is mentioned briefly by Brown (1908, p. 194). In 1898, 62½ tons of (probably hand picked) ore gave a return of 35¼ tons of lead (60 per cent) and 689 ozs. of silver (6.5 ozs/ton of ore or 11 ozs/ton of lead). The deepest shaft reported is 80 feet and the mine was worked only intermittently.

Mawson (1907) records the lead tungstate mineral, stolzite, from this mine and notes that lead molybdenate, wulfenite, is also present.

Campana and King (1958) consider that Winkler's Prospect occurs as a narrow and discontinuous seam of galena associated with iron oxides (and gold?) in bedding plane fissures in dolomitic slates, which immediately overlie the (Adelaidian) basal grit formation and thus falls into their classification of post-Proterozoic epithermal veins.

3. REGIONAL GEOLOGY

Winkler's Lead Prospect occurs in Adelaidian Proterozoic rocks of the Olary Province of Campana and King (1958). Although these authors consider that the deposit occurs in dolomitic slates which immediately overlie the basal grit formation, the Olary Province geological map (Campana, 1955) shows the prospect to occur in basal boulder tillite unconformably overlying undifferentiated granitic rocks. This area is within the MacDonald Shear and Overthrust Zone (Parkin, 1969).

4. PRESENT INVESTIGATIONS

4.1. GEOLOGY

An area 2000 by 1000 feet, which included the workings, was gridded at 100 foot intervals in preparation for detailed geophysical surveys and was mapped by Clarke (1971) whose report is presented as Appendix 1 and whose geological plan is included herein as Fig. 1.

The mineralization occurs at the contact of shales and mica schist with granitized tillite. The tillite contains granite boulders but metamorphism generally has been extreme resulting in an anatectic granite. Thus, the attitude of these rocks is difficult to determine, but layering strikes approximately east-west.

The shales also strike east-west but dip approximately 30° to the south. Inspection of the workings indicates that the zone of mineralization has a similar attitude.

The mineralization, where visible, occurs as a thin band approximately three feet thick with galena veins only a few inches thick. Mapping by Clarke (1971) indicated a strike length of mineralization of 650 feet as shown by workings having visible lode or lead bearing minerals on their dumps. Subsequent field investigations extended the strike length to 900 feet (Fig. 1).

4.2. GEOPHYSICS

A detailed induced polarization (I.P.) survey was carried out in August, 1970 (Webb, 1970). Resistivity contour plans were prepared from the information obtained and are included as Figs 2 to 5. Where metal factor values are considered to anomalous these have been superimposed on the resistivity plans.

It is obvious that one low resistivity - high metal factor anomaly occurs on the eastern and one on the western margins of the grid. Neither anomaly has been completely defined by the I.P. survey, but it is obvious that the western anomaly is along the strike of the lead lode, and displaced to the south because of the low angle of dip of the lode.

5. CONCLUSIONS AND RECOMMENDATIONS

Mineralization appears to have occurred by hydrothermal action at the boundary between the shale and anatectic granite-tillite where shearing and brecciation took place. Surface geological mapping indicates a strike of at least 900 feet but the results of the I.P. survey suggests that the mineralization extends for at least a further 700 feet to the north-west and is more intense.

It is considered that the shale/granite contact is a favourable structural feature in which mineralization occurs - in particular in areas of flexure which could produce down-dip plunging ore shoots.

The strong I.P. anomaly on line 7W, fig. 2, which consists of very low resistivity and a high metal factor within a frequency effect high, is at the projected position of the mineralized horizon at that depth and thus constitutes a most favourable drilling target.

A similar I.P. anomaly occurs at the north-east corner of the grid although no geological reason is at present known for its origin.

It is strongly recommended that a series of vertical drill holes test both these anomalies as detailed below. The holes will be pre-collared by percussion drilling to the water table and continued by diamond drilling to the target depth.

Number of Hole	:	WD1
Collar Location	:	I.P. line 7W, 7N.
Angle	:	-90^{o}
Length	:	250 feet.
Purpose	:	To test the coincident resistivity high metal factor I.P. anomaly of Fig. 2 at the projected position of mineralized horizon at a depth of approximately 200 feet.
Cost	:	150 feet Percussion Drilling @ $2/ft. - $300 100 feet diamond drilling @ $7/ft. - $700 Total $1000.

Number of Hole	:	WD2
Collar Location	:	I.P. line 7W, 6N.
Angle	:	-90^{o}
Length	:	350 feet
Purpose	:	To test the coincident low resistivity high metal factor I.P. anomaly of Fig. 3 at the projected position of mineralized horizon at a depth of approximately 300 feet.
Cost	:	150 feet percussion drilling @ $2/ft - $300 200 feet diamond drilling @ $7/ft - $1400 Total $1700

Number of Hole	:	WD3
Collar Location	:	I.P. line 1W, 1S.
Angle	:	-90^{o}
Length	:	350 feet.
Purpose	:	To test the coincident low resistivity high metal factor I.P. anomalies at a depth of approximately 200 to 300 feet.
Cost	:	150 feet percussion drilling @ $2/ft - $300 200 feet diamond drilling @ $7/ft - $1400 Total $1700

Rig location charges etc.	:	$1000
Geologist (10 days at $70 per day)	:	$700

Total cost of drilling programme including 10 per cent for contingencies = $6710 say $7000.

0041

Indirect costs will be:

Analysis of drill samples	$1000
Geological supervision laboratory investigations and report compilation	$2000
TOTAL	$3000

Thus the all-inclusive cost of the programme is estimated to be $10,000.

If the results of the drilling programme are encouraging a further I.P. survey is recommended to fully define both I.P. anomalies and to locate future drilling targets.

17/2/71

W.G. Shackleton.
Senior Geologist.
Minoil Services Pty. Ltd.

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APPENDIX I

SUNDOWNER MINERALS N.L.
Special Mining Lease Number 420
Olary Area
South Australia
Geological Report No. 1

on
Winkler's Lead Prospect

By
B.R. Clarke, B.Sc.
of
MINOIL SERVICES PTY. LTD.
January 1971.

CONTENTS

Figure Reference

Geological Plan (in end pocket)

1. INTRODUCTION

The area mapped lies in S.M.L. 420 held by Sundowner Minerals N.L., and is located approximately ten miles due south from Cutana Siding on the Adelaide - Broken Hill railway line in the north-east of South Australia. It contains a number of diggings dating back to the 1870's known as Winkler's Lead Prospect or O'Briens Show. The mines produced (probably hand-picked) ore which contained approximately 60% lead plus 11 ozs. silver/ton. (Brown 1908)

The country covered by the grid includes a shallow valley to the south-west of two low hills. The valley is severely eroded by a water course flowing towards the south east.

2. GEOLOGY

A geological plan of the prospect is included in this report.

The valley floor consists of brown alluvium through which the underlying rocks are exposed at only a few places in the creek. These rocks consist of grey, well-weathered shales which have a strike of approximately 100° magnetic and dip towards the south at an angle ranging between 85° and 90°. The alluvium is covered in most parts by a thin layer of quartz float.

The hills consist of anatectic granite and quartzite, metamorphic products of the tillite and fluvio-glacial sediments of the Proterozoic Adelaide System. Granite boulders in these sediments are severely fractured. The distribution of the granite outcrops varies greatly. Layering planes were difficult to detect but, where measured, they had a strike of 70° to 90° magnetic.

In addition to the granite and quartzite, a weathered schistose tillite is visible in a few places. Quartz veins up to approximately 50 feet long occur in a direction generally parallel to the layering of the tillitic rocks.

immediately east of the old Plumbago fluorite workings and to the north of the Plumbago - Bimbowrie road. The retrogressed zone is shown on a 1:5,000 scale map of the area (Plan 9). Ground magnetics were surveyed over this area (Plan 10).

A thick section of the Willyama Sedimentary Sequence is exposed. North-northeast strikes and steep to moderate west dips predominate. The sequence (up-dip) was subdivided into three groups:

i. Biotite-quartz-oligoclase micro-gneiss grading upwards to laminated biotite gneiss and quartz-feldspathic gneisses.
ii. Interbedded albite rocks and calc-silicate rocks.
iii. Biotite-feldspar-quartz schists with calc-silicate beds and banded iron formations.

Numerous concordant pegmatites and small leucocratic granitic bodies wereno doubt derived by high grade metamorphism of the metasedimentary sequence. A retrogressed zone, sheared, mylonitized, brecciated and sericitized, also parallels the bedding.

The Willyama Complex is unconformably overlain by the fluvioglacial sediments of the Adelaidean System which have been subjected to low grade metamorphism and open folding. Faulting in a north-westerly direction is associated with dolerite intrusion. Mylonite occurs in some fault zones.

Highly anomalous radon values, up to 14 standard deviations above the mean, and anomalous soil geochemistry (20 ppm over 2.5 ppm) occur in the retrogressed schist. Malachite and fluorite, apparently located in east-southeast shears, occur in close proximity to the schist and assay up to 49 ppm U_3O_8.

2.3.2 Plumbago Airstrip Area

Outcrop consists of a complex of granitoid rocks varying in composition from granite to monzonite with some alaskite, migmatite and biotite gneiss bodies. The alaskite bodies were emplaced conformable with the migmatite banding which is parallel to an east-north-east trending fracture cleavage. Northeast and northwest trending shear cleavages with associated quartz veining and alaskite pegmatite intrusion cut all major lithologies. Minor quartz-magnetite-biotite veining occurs. Mapping at 1:5,000 and ground radiometrics (BGS-ISL) and magnetics (G 816) are complete over an area of 304 ha. (Plans 11, 12, 13: Appendix 5). Anomalous soil radon values from the 1977 reconnaissance work (mean plus 2.5-3.3 standard deviations) were followed up by detailed Track Etch and Alpha Nuclear surveys. These defined areas of anomalous radon (greater than mean plus 3 X standard deviation) as shown in Plan 14. 61 soil geochemistry samples were collected and 17 Alpha Nuclear measurements made southeast of the area.

2.3.3 Ethiudna North Area

The area surrounding Track Etch cup site 46319* was surveyed

(*Footnote: The location of this station is not recorded - PCR 1981)

in detail by Track Etch and Alpha Nuclear methods on a grid with 50m line spacings and 50m to 25m centres. Strongly anomalous radon readings in the order of 20 standard deviations above the mean were detected (Plan 15). The anomaly is spatially related to east-northeast shears. No ground magnetic survey was done in this area. Data from the radiometric surveys are in Appendix 6.

Diopside-actinolite-plagioclase metasediments are intruded by leuco-adamellite gradational to pegmatite. A fracture cleavage trending east-north-east and a later parallel trending shear cleavage are cut by a north-westerly trending shear. The intrusive rocks carry anomalous values of thorium (up to 150 ppm ThO_2) and low uranium values (up to 1.6 ppm U_3O_8).

2.4 DRILLING OF RADON ANOMALIES

Shallow rotary percussion holes were drilled in the final quarter of 1977 to test selected soil radon anomalies in the Ethiudna North, Plumbago Airstrip,and Plumbago Homestead areas (Figure 1). Drilling statistics are summarized in Table 2 and geologic logs are in Appendix 7. All holes were barren except hole PH-1 and PA-4 which gave maximum readings of 425/100 cps and 410/100 cps respectively over distances of less than 1 metre on the Mt. Sopris logs. (These values are not reflected in scintillometer readings of the cuttings shown on the log sheets of Appendix 7).

Area	Local Grid Co-ordinates	Hole No.	Total Depth	Remarks
Ethiudna North	25N: 00	EN 1	50m: Inclined	
	50N: 50E	EN 2	58m: Inclined	
	70N: 30E	EN 3	13m: Inclined	Abandoned
	125N:150E	EN 4	77m: Inclined	
Plumbago Homestead	575N: 90W	PH 1	84m: Inclined	
	580N: 35W	PH 2	75m: Inclined	
Plumbago Airstrip	100N:300E	PA 1	35m: Vertical	
	300N:100E	PA 2	35m: Vertical	
	400N: 00	PA 3	35m: Vertical	
	500N: 00	PA 4	35m: Vertical	

TABLE 2: Radon Anomaly Drill Hole Statistics - 1977

2.5 HELICOPTER-BORNE RADIOMETRIC SURVEYS AND FOLLOW-UP

The first detailed survey was done in December 1977 and January 1978 in the Crockers Well-Ninnerie area (Plans 16 and 17). A total of approximately 870 line kilometers were flown; lines were 125m apart and flown at 50 knots at a height of 50 metres. A Geometrics Exploranium DGRS-1002 spectrometer was used for the survey.

Cont/d.

This same system was used at this time to fly reconnaissance surveys in the Glenorchy area, to the north, over anomalous areas detected by previous programmes. It was apparent that a new grid survey was required in this area and this was flown in June 1978. A total of 605 line kilometers were flown in the Glenorchy region. A Bell 206B Jetranger was used for the survey and instrumentation comprised an Exploranium DGRS-1002 analog differential gamma-ray spectrometer, a 452 cu. in. cylindrical crystal detector and a Mars 6 channel chart recorder. A radar altimeter and tracking camera were also used. The helicopter attempted to maintain a mean terrain clearance of 50m and an average ground speed of 60 knots. Data recovery was performed manually and the flights paths were recovered by plotting on 1:10,000 scale photomosaics. The recovered flight paths and the anomaly locations are shown on Plans 18 and 19.

2.5.1 Crockers Well - Ninnerie Area

Appendix 8 contains a report on the follow-up of 91 anomalies with geological descriptions and assay results of rock chip samples from anomalous areas.

2.5.2 Glenorchy Area

33 anomalies were selected for follow-up in the Glenorchy survey area (Plan 18 and 19). Field check sheets, rock chip assay results and a summary of the anomalies are attached in Appendix 9.

2.6 EVALUATION OF CROCKERS WELL AREA

2.6.1 Introduction

Prospects within and near the Crockers Well area are the Crockers Junction, Original, Central, Main Eastern, Southwestern and Western, Flats, the Camp South prospect and the Blackboy prospect (Plan 20). These are discussed individually below. The correlations of these areas with those of E-Z is illustrated in Plan 21.

By the end of 1976 the Crockers Well area had been mapped at 1:10,000 scale (Plan 22). An orthophotographic survey was flown over a 10 x 8km area , including both the Crockers Well and Ninnerie Dam areas. 1:5,000 scale photographic and topographic sheets were produced (Plans 23-42). Detailed topographic maps at 1:1,000 scale with a contour interval of 1 metre were produced for several of the major prospects (Plans 43-66). All the prospects were thus tied to the Australian Metric Grid co-ordinates.

50m x 25m grids with a permanent star-picket base line based on A.M.G. co-ordinates were surveyed in the Junction, Original, Southwestern and Western and Central-Main Eastern prospect areas.

Cont/d.

An initial percussion and diamond drilling programme (Phase 1) was completed in August to October, 1977. This programme tested areas of uranium mineralization outlined by SADM and EZ-Newmont in previous drilling on the Original, Central, Main Eastern and Southwestern prospect areas. A major percussion drilling programme (Phase 2) started in November 1977 based on the results of Phase 1 drilling and encouraging results from drilling on the Junction prospect. The objective of the drilling was to test the potential of the Crockers prospects for low-grade, large tonnage uranium deposits of the Rossing type. Holes were drilled on a 50m square grid except in the Main Eastern and Central prospects where the pattern was modified because of previous drilling. For hole locations see Plan 67.

Phase 1 drilling was contracted to W.L. Sides and Son, using a Schramm. The 19 percussion holes in this programme are X-1 to X-7, Y-2, and Z-1 to Z-10. Rockdril Contractors did the main programme from November 1977 to March 1978. A Rotamec 1800, Rotamec 1300 and a Gryphon were used. 5¼ inch diameter holes were drilled in both programmes.

Diamond Drilling Pty. Ltd. drilled all 13 diamond drill holes with a Longyear 38 rig. Most core was HQ, the remainder NQ. Total sample recovery from the percussion drilling was sought, but because of drilling and personnel problems, this ideal was at best only partially achieved. In particular, sample recovery from the wet or damp holes was often up to 50% lower than that achieved from dry holes. Some preferential loss of uranium bearing minerals is suspected in the drilling and sampling phases. Samples from radiometrically active zones were split down to 1 to 2 kilogram size and assayed by the XRF technique by Amdel. Duplicate samples from the early stages of the major programme were assayed by A.C.S. Laboratories, mainly as a check of the analytical technique. The duplicate sample assays generally compared reasonably (to within ± 10% of the U_3O_8 value on average).

The initial 5 diamond holes were sawn and sampled by Amdel at 1m intervals throughout, with local 1-2m zones being sampled at 10cm intervals. The remainder of the holes were sawn throughout, but sampled at 2m intervals over radiometrically active zones. All samples were assayed by Amdel using the XRF technique.

Because of the expected difficulty of reliably estimating the average grade of the erratic brannerite mineralization, calculations of equivalent U_3O_8 the ThO_2 grades from down hole radiometric logs were undertaken in addition to the normal sampling. It was expected that the volume of material influencing the radiometric data would be significantly greater than that represented by the percussion sample and the split diamond core.

Cont/d.

With the exception of several holes which caved on the completion of drilling, all holes were radiometrically logged with a Mt. Sopris 2500 total count system. Where possible, all active holes were also logged spectrometrically to enable corrections for the significant and variable thorium content of the mineralization to be made. Initially a Geometrics Disa 400 system was used to collect the spectrometer data, but this was later superseded by a Geometrics GR 410 instrument. Where possible, all the original Disa 400 data has been disregarded in preference for the GR 410 data. All radiometric grades quoted in this report refer to the GR 410 information. A summary of the radiometric grade estimating technique, including Compton Stripping formulae etc. is given in Appendix 10.

Four calibration pits of varying grades were manufactured from material from the Main Eastern underground workings (courtesy of the SADM) and installed approximately 0.5 km west of the Junction prospect. These pits were used to regularly monitor the consistency of the two logging instruments (Appendix 11).

Chemical and radiometric values for drill intercepts are summarized on Plans 68 to 71. Plans 70 and 71 illustrate inferred areas of ore based on chemical and radiometric cut-offs of 5m x 300ppm U_3O_8.

2.6.2 Crockers Flats Area

The Crockers Flats area is that area generally north and northwest of the Crockers Well deposits. In early 1977 a 200m by 50m grid was put over an area of 30 km² (Plan 72). 991 Track Etch cups were placed at 100m intervals along grid lines (Plan 73-74: Data in Appendix 12). Bottom of hole samples were assayed for U_3O_8, ThO_2, Cu, Pb and Zn (Appendix 13).

A series of shallow, vertical percussion holes (E-1 to E-153) were drilled to penetrate the alluvium in the Crockers Flats area. Spacing between holes was closed in over the area of Crockers Junction prospect. Hole locations are shown on Plan 72. The holes were drilled with a TR-4 rig by Boring Enterprises. Hole diameter was 133.4mm.

Each hole was geologically logged and each 1m sample was measured with a BGS-ISL scintillometer (Appendix 14). The holes were later logged with a Mt. Sopris 2500 total count spectrometer and, later, active holes were re-logged with a Geometrics DISA-400 spectrometer (Appendix 14: See also Appendix 10).

Ground magnetics and ground spectrometry on a 200 x 25m grid were surveyed over the Crockers Flats area (Plans 75-79). A Geometrics G 816 magnetometer was used to measure the magnetics.

cont/d.

II

71-20 (S) 0050

SUNDOWNER MINERALS N.L.

S.M.L. 420

Olary District
South Australia

Geological Report No. 1

On

MACDONALD HILL AREA

By

M. C. BENBOW
Of
MINOIL SERVICES PTY. LTD.

CONTENTS

PLAN REFERENCE

(In end pocket)

SUNDOWNER PLAN NO.	TITLE
18	MacDONALD HILL GEOLOGICAL PLAN.

1. INTRODUCTION

Special Mining Lease (S.M.L.) 420 held by Sundowner Minerals N.L., is located 250 miles north-east of Adelaide and 60 miles south-west of Broken Hill.

The MacDonald Hill prospect is located some 8 miles east-north-east of Olary, and 2 miles to the north of the Barrier Highway.

Two shafts exist, sunk to a depth of 35' and 45' (Plan No. 18) and both lie in hilly terrain, covered with sparse salt bush, blue bush and sheoak trees.

2. PREVIOUS INVESTIGATIONS

In 1889 the inspector of Mines reported that "Very little work had been done, the deepest pit being 20'. In the first pit there was visible a branch of fair grade carbonate and oxides of copper well worth sinking on; apparently a true lode, gradually increasing in size as depth is attained, with east and west bearing and south under-lie. Like most of the copper ores in the north-east a small quantity of gold is present, but not sufficient to pay for the cost of extraction. The other costeanings on the ground show that considerable extent of it is copper bearing, and the claims are only 2 miles from a railway. There is sufficient inducement for further prospecting" (Brown, 1908).

Subsequent to the above report, the two shafts mentioned have been sunk.

3. GEOLOGY

3.1 GENERAL GEOLOGY

The area under discussion lies in Carpentarian granitic rocks, namely granite gneisses, pegmatites and migmatites. Again, as at the Cutana and Luxemburg

mines, this unit shows a metasedimentary nature in part.

During an early Palaeozoic orogeny extensive shearing occurred; a major zone being the north-west south-east MacDonald Shear and Overthrust Zone (Parkin, 1969), approximately one mile west of MacDonald Hill. Related to this are secondary(?) shears, often filled by quartz with which copper, silver and gold mineralization is sometimes associated. Such is the case at the Queen Bee, Luxemburg, (Campana and King, 1958) and Cutana mines.

3.2 DETAILED GEOLOGY

The predominant metamorphic rocks are granite gneisses, aplitic in part, and pegmatites with some light coloured schists, often with porphyroblasts of quartz and feldspar. It is apparent that the area has undergone a high grade of metamorphism resulting in numerous pods and stringers of probably metasomatic pegmatite, which cut across the schistosity at a slight angle. The high grade of metamorphism has also given rise to the well developed foliation of the area, and some garnet-diopside mineral assemblages.

3.3 MINERALIZATION

Near the Shaft I, a distinct outcrop of limonitic shale, striking about 70°, can be traced for a length of 400' in the area mapped, and for a further 300' outside to the south-west. Its maximum width is 75'.

At the shaft, the granite gneiss dips 58° south. A 1'6" thick quartz-ironstone reef dipping 50° south has cut across the gneissosity only to cut out completely some 10' down. Malachite and haematite occur in this reef. Specimen M2 was taken from the reef and contained 1 per cent copper and 3.0 parts per million silver (Appendix 1). A little copper carbonate is found at the granite gneiss, quartz ironstone contact, but none was observed within the

gneiss. Sample M1 came from the granite gneiss near its contact with the reef but contained only minor amounts of copper and silver. Sample M3 (from the ore dump) contained 2.7 per cent copper and 15 parts per million of silver.

Much hornblende is also found with the reef. In places a migmatite has been developed at the quartz reef - gneiss contact.

At Shaft II, an ironstone with a little quartz has filled one of the secondary shears, which developed in incompetent shale. At the top of the shaft, the ironstone, which appears to be a gossan, is only 3" thick, but near the 25' level it thickens to 3' and contains visible traces of malachite. From this point to the base of the shaft (35' deep) malachite and pyrite are visible within the walls. A small drive has followed the base of the gossan.

Specimen M5 and sample M6 taken from the ore dump contained notable amounts of copper and silver - viz. 4.6 per cent copper and 0.3 parts per million silver; and 3.3 per cent copper and 10.0 parts per million silver, respectively.

Sample M8 came from the base of the shaft and contained 0.8 per cent copper and 10.0 parts per million of silver.

On the surface, traces of ferruginous shale, (gossanous in part) can be traced as very small outcrops in schists. Some quartz is sometimes associated, but no continuous quartz or gossan outcrop exists.

4. GEOCHEMISTRY

Samples have been taken from both shafts (Appendix 1) and a geochemical soil sampling programme over a 1,700 x 500 foot grid has been completed (assay results awaited).

5. CONCLUSIONS AND RECOMMENDATIONS

Copper mineralization of this area appears to fall into the category of Post - Proterozoic vein deposits of the crystalline basement as discussed by Campana and King (1958).

Assay results indicate that encouraging grades of copper and silver are present at both Shafts I and II. A sample taken previously from Shaft II contained 0.1 per cent molybdenum.

In view of the results from the initial sampling, ground magnetic and V.L.F. electromagnetic surveys are recommended to define the mineralized zones.

11/2/71

M. C. Benbow.
Junior Geologist.
MINOIL SERVICES PTY. LTD.

REFERENCES

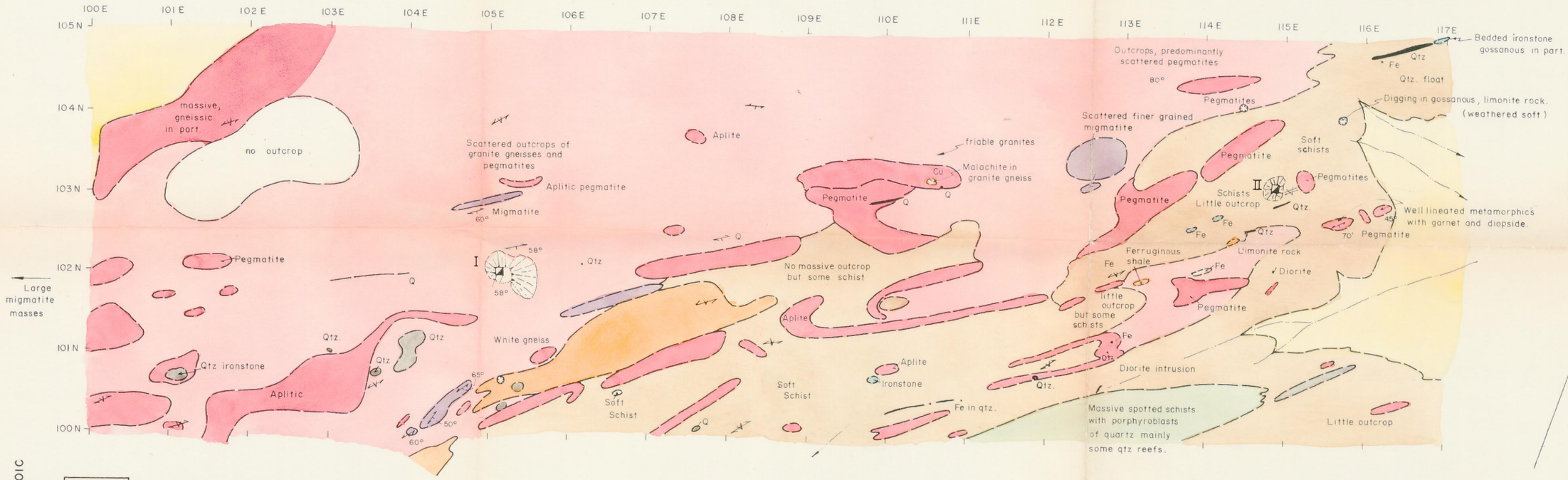
BROWN, H.Y.L.	1908	Record of the Mines of South Australia 4th Edition
PARKIN, L.W.	1969	Handbook of South Australian Geology S.A. Dept. of Mines
CAMPANA, B. and KING, D.	1958	Regional Geology and Mineral Resources of Olary Province. Geol. Survey S. Aust. Bull. No. 34

APPENDIX 1.

Assay results of samples taken at MacDonald Hill.

Detection limits in brackets.

Sample No.	Description	Cu per cent	Ag (0.1) parts per million	Au (3) parts per million
M1	Grab sample from Shaft I	0.03	0.1	X
M2	Specimen from Shaft I	1.00	3.0	X
M3	Grab sample from ore dump at Shaft I	2.7	15.00	X
M5	Ore specimen from ore dump at Shaft II	4.6	0.3	X
M6	Grab sample from ore dump at Shaft II	3.3	10.0	X
M8	Chip sample within ore but parallel to strike, Shaft II	0.8	10.0	X



CRYSTALLINE BASEMENT — CAINOZOIC

PROTEROZOIC - ARCHAEAN (UNDIFFERENTIATED)

GRANITIC ROCKS

LEGEND

Recent creek alluvium sandy, red, with little clay.

Dominant, distinct outcrops of granite gneisses, granites, pegmatites and aplites. which grade to scattered outcrops, with gradual transition.

Massive spotted schists with quartz phorphyry blast.

Predominant little or no outcrop with outcrop usually being soft schists, in addition some float.

Dark, migmatites.

Shale, ferruginous, sometimes gossanous

Q, Qtz — *Quartz reefs*

Fe — *Iron mineralization*

Cu — *Copper mineralization, limonitic in part.*

Essentially outcrop boundary often makes a gradual transition to just scattered outcrops of the same

LEGEND

Vertical bedding

Strike and dip of schistosity and gneissosity.

Dip of schistosity and gneissosity, vertical.

Shaft with depth indicated.

Shaft inclined to horizontal at 58°

Mullock heap surrounding shaft.

Diggings usually 1' deep.

Creek

SCALE

100 0 100 200 300

FEET

1389 I (5)

SUNDOWNER MINERALS N.L

S.M.L. 420 MACDONALD HILL AREA

GEOLOGICAL PLAN

DATE: FEBRUARY 71'	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: M.C. BENBOW		

ENV 1389 (II) 5

II

(3)

71-19

0058

SUNDOWNER MINERALS N.L.

S.M.L. 420

OLARY DISTRICT

SOUTH AUSTRALIA

Geological Report No. 1

On

Luxemburg South - Bill's Hill Area

by

M. C. Benbow

of

MINOIL SERVICES PTY. LTD.

Mar. 71

CONTENTS

1. INTRODUCTION

Special Mining Lease (S.M.L.) 420 held by Sundowner Minerals N.L., is located in the Olary Province, some 250 miles north-east of Adelaide, and 60 miles south-west of Broken Hill. The Luxemburg South - Bill's Hill Area is located in the S.M.L. 8 miles south of Cutana Railway Siding, and 1½ miles south of the Queen Bee, Luxemburg Mine Area. The area lies on dry,low lying, undulating hill and plain topography, with salt bush, blue bush and mulga tree cover.

This report discusses detailed geological mapping, at 500 feet to the inch from Bill's Hill, Luxemburg South or Premier Mine to grid reference 5 north (plan No. 13).

2. PREVIOUS INVESTIGATIONS

Brown, Record of Mines 1908, states the following: "The Luxemburg South or Premier Copper Mine is situated 1½ miles from the New Luxemburg and from the Mingary and Queen Bee gold mines. A vertical shaft has been put down, and (says the Inspector of Mines) at about 11 fathoms it reached a very heavily mineralized country, with thin veins of sulphides interlacing in all directions.

" The indications are very favourable, and it is considered an excellent prospect.

" The lode sunk upon is said to carry silver in small quantities" (1889).

3. GEOLOGY

3.1 CARPENTERIAN

The Carpentarian System (Willyama Complex) forms part of the crystalline basement of South Australia. Although the rocks of this unit are granitic in nature, they show a definite sedimentary origin, as does this same unit in other parts of the Olary Province (e.g. Cutana and MacDonald Hill). Massive pegmatite development,

and a granitization and feldspathization (Campana and King, 1958) has altered the original sedimentary rocks masking in part their original nature. Two sub-units of the Carpentarian are represented here; one predominantly quartzites and schists, and the other granites, gneisses and quartzites.

3.2 ADELAIDEAN

3.2.1. Yudnamutana Sub-Group

The glacial sequence attains a thickness of 3,000 feet in the Olary Province and lies unconformably on the crystalline basement. The basement here is represented by massive, green, amphibolitized dolomite. " The intimate association and the gradation of these beds to boulder tillites suggests that they have been precipitated as a result of the lowering of the water temperature due to invasions of floating ice " (Campana and King, 1958). This dolomite is found only near 0°E, 10S, where it grades to a coarse, basal tillite. Both units have been amphibolitized to varying degrees.

Elsewhere the base is represented by the boulder tillite, which marks an unconformity with the crystalline basement.

Within the sequence and associated with the boulder tillite is a thinly bedded and discontinuous fluvioglacial quartzite.

The tillite contains the glacial detritus of granites, gneisses, and quartzites, derived from the basement. Often there is so much of this material that it gives the impression of being part of the basement.

3.3 INTRUSIVE ROCKS

3.3.1. Amphibolite

There are three lines of evidence suggesting that the amphibolite body in the area is intrusive.

(1) Petrological work has indicated that no relict sedimentary features exist, and the texture indicates that the amphibolite was derived from a basic (gabbro in part) intrusive.

(2) The contact of the body with the crystalline basement is brecciated.

(3) The outcrop pattern as mapped.

The basic intrusive was metamorphosed to an amphibolite during a period of regional metamorphism.

3.3.2. Minor Intrusive Rocks

Minor intrusive rocks of the area are quartz reefs and pegmatites. Both types cut across the country rock in a predominantly east-west to north-east, south-west direction. Both were probably derived from the granitic crystalline basement.

It is probable that several periods of quartz reef emplacement occurred. Most reefs do not cut across the amphibolite/granite gneiss contact; but those that do are massive, unsheared and often have some associated copper mineralization.

Some of those reefs that do not cut across the contact, such as the Queen Bee, have some mineralization associated with them, but this mineralization may have taken place after their emplacement.

3.4 STRUCTURE

The tillite outcrop pattern suggests that the area once formed a local embayment onto the crystalline basement. However, as the area has suffered several deformations it is possible that the bulge in the unconformity is due to such deformation. Mapping of the structure of the area was difficult because of the complex tectonic history, very poorly bedded tillite, and foliation obscuring the bedding.

4. MINERALIZATION

Detailed mapping has shown that copper, silver, gold and iron mineralization is usually near or at the amphibolite body. It is possible that the amphibolitization of the country rock, especially at the amphibolite contact made conditions favourable for later mineralization. Alternatively, it is possible that mineralization took place with the amphibolitization.

At Bill's Hill (55S, 40E) several ironstone bodies occur within the dark siltstone of the glacial sequence. (Plan No. 13). Some amphibole porphyroblasts are developed in the tillite near these bodies. A small amphibolite body crops out nearby suggesting that these ironstone bodies are amphibolitized tillite beds. No significant mineralization was located in the ironstone bodies (Appendix 1, Samples B4-B22). No quartz intrusions are associated with these bodies. Development of schists and phyllites indicate some shearing with which the mineralization may be associated.

At the Yankee Shaft, from which copper was won, the surrounding massive, basal, boulder tillite has undergone a certain degree of amphibolitization. Shearing has taken place and it is possible that mineralization may be related to the shearing in the amphibolitized zones.

Two other small diggings in the Bill's Hill area contained visible malachite (Samples B25, B26, Appendix 1). These workings are in schistose material, again indicating a relationship between mineralization and shearing.

At Luxemburg South amphibolitization of the tillite and some shearing has taken place. Quartz reefs with associated copper, silver, and iron mineralization intruded the tillite.

5. CONCLUSIONS AND RECOMMENDATIONS

The detailed geological mapping in the Luxemburg South - Bill's Hill area has elucidated mineralization controls. Namely:-

(i) that mineralization is associated with amphibolitized zones and is often found at or near the amphibolite body, and

(ii) shearing and quartz intrusions are often associated with the mineralization.

In a report on specific exploration of the Luxemburg South or Premier Mine, Lopes (1971) recommends further work.

Apart from the Luxemburg South Mine area, mineralization in the area mapped (in particular, Bill's Hill) is minor compared to the other prospects in the lease and no further work is recommended at this time.

W Shackleton
for

March, 1971.

M. C. Benbow,
Junior Geologist,
Minoil Services Pty. Ltd.

6. REFERENCES

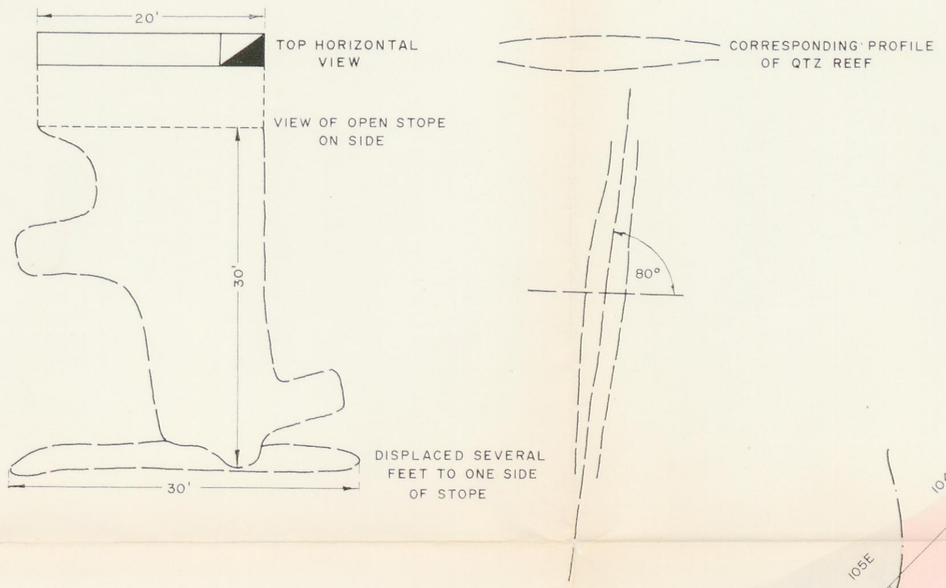
Brown, H.Y.L.,	1908	Record of the Mines of South Australia 4th Edition.
Campana, B., and King D.,	1958	Regional Geology and Mineral Resources of Olary Province. Geol. Survey S. Aust. Bull. No. 34.
Lopes, D.,	1971	Special Mining Lease Number 420, Olary Area, South Australia. Geological Report on the Luxemburg South Prospect. Unpub.
Parkin, L.W.,	1969	Handbook of South Australian S.A. Dept. of Mines.

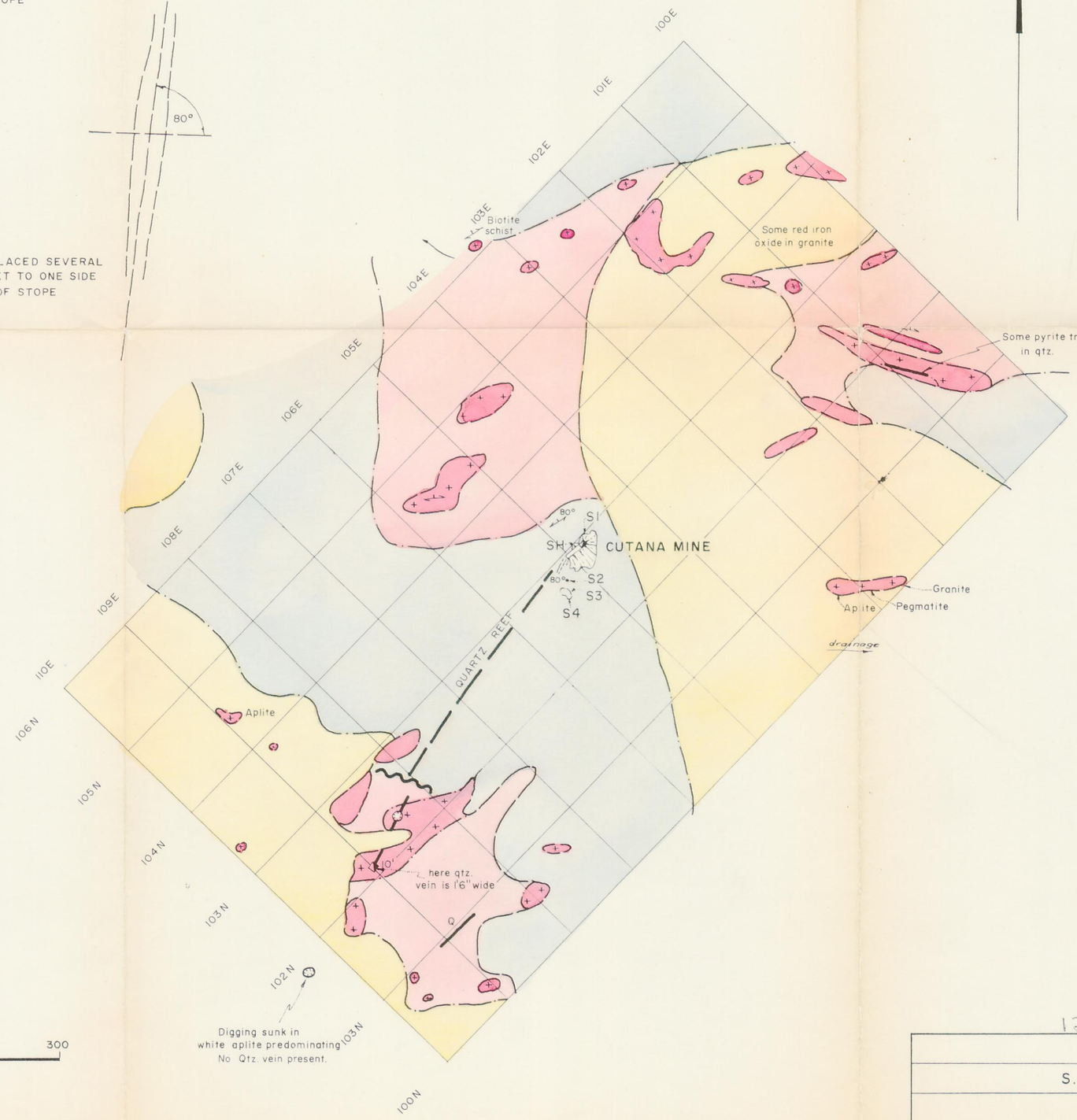
7. APPENDIX 1

Assay results of samples taken at Bill's Hill. For locations, see Plan No. 13. Detection limits in brackets.

Sample No.	Cu	Ag (0.1)	Au (3)
	per cent	parts per million	parts per million
B1	13.0	3	X
B2	0.4	3	X
B3	2.6	5	X
B4	0.1	0.1	X
B5	3.9	3	X
B6	< 0.1	0.1	X
B7	< 0.1	X	X
B8	< 0.1	0.3	X
B9	< 0.1	X	X
B16	< 0.1	0.1	X
B17	< 0.1	0.1	X
B18	< 0.1	0.1	X
B19	< 0.1	X	X
B20	< 0.1	X	X
B21	< 0.1	X	X
B22	< 0.1	0.1	X
B25	1.0	5	X
B26	13.0	10	X

SKETCH PLAN OF CUTANA MINE





LEGEND

CRYSTALLINE BASEMENT
PROTEROZOIC-ARCHAEAN CAINOZOIC
(UNDIFFERENTIATED) QUATERNARY
GRANITIC ROCKS RECENT

- Zones of no outcrop or float. A sandy loam, with nodules of calcretes.
- Predominantly float with visible outcrop of predominantly pink granite with variations, to a gneissic, schistose or pegmatitic or aplitic nature.
- Zones of quartz float, with very little outcrop, being almost indistinguishable from float material.
- Quartz reef
- Quartz reef inferred
- Fault observed
- 80° Direction and dip of gneissosity and schistosity
- Outcrop bounaaries
- Outcrop boundary of quartz.
- Open stope, inclined with shaft.
- Small diggings.
- Mullock
- S1, SH Sample locations.

SCALE

100 0 100 200 300

FEET

1389 II (3)

SUNDOWNER MINERALS N.L.		
S.M.L. 420 CUTANA COPPER MINE		
GEOLOGICAL PLAN		
DATE: FEBRUARY 71'	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: M.C. BENBOW		

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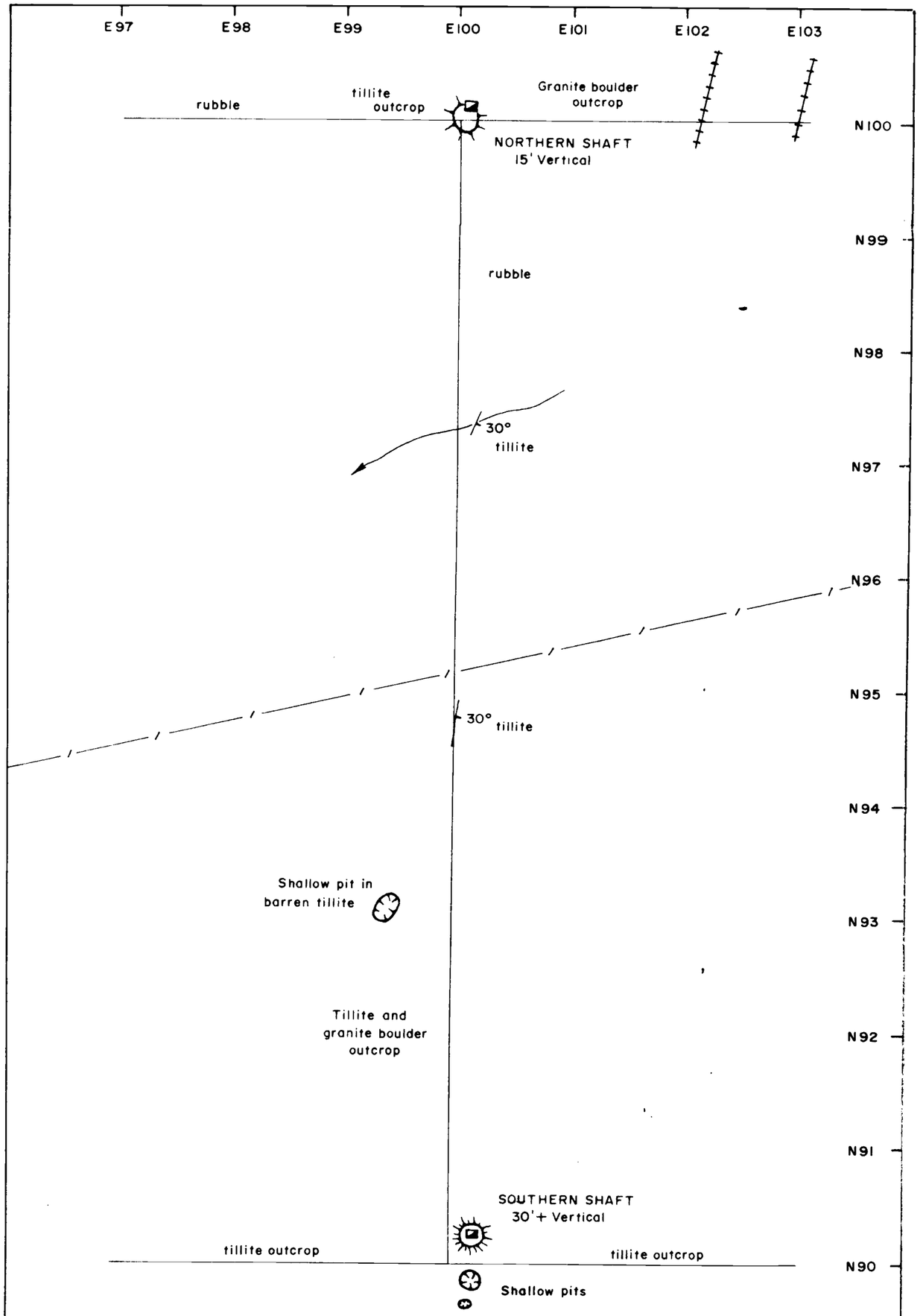

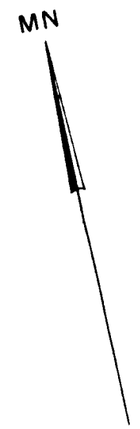

SHAFT

PIT

30° STRIKE AND DIP

QUARTZ REEF

CREEK

FENCE

SCALE

100 0 100 200

FEET

1389 III

SUNDOWNER MINERALS N.L.

S.M.L. 420 OLARY DISTRICT

GALL WELL EAST COPPER PROSPECT

GEOLOGICAL SKETCH MAP AND GRID LAYOUT

DATE MAY 1971	SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: T.J. KENNEDY		

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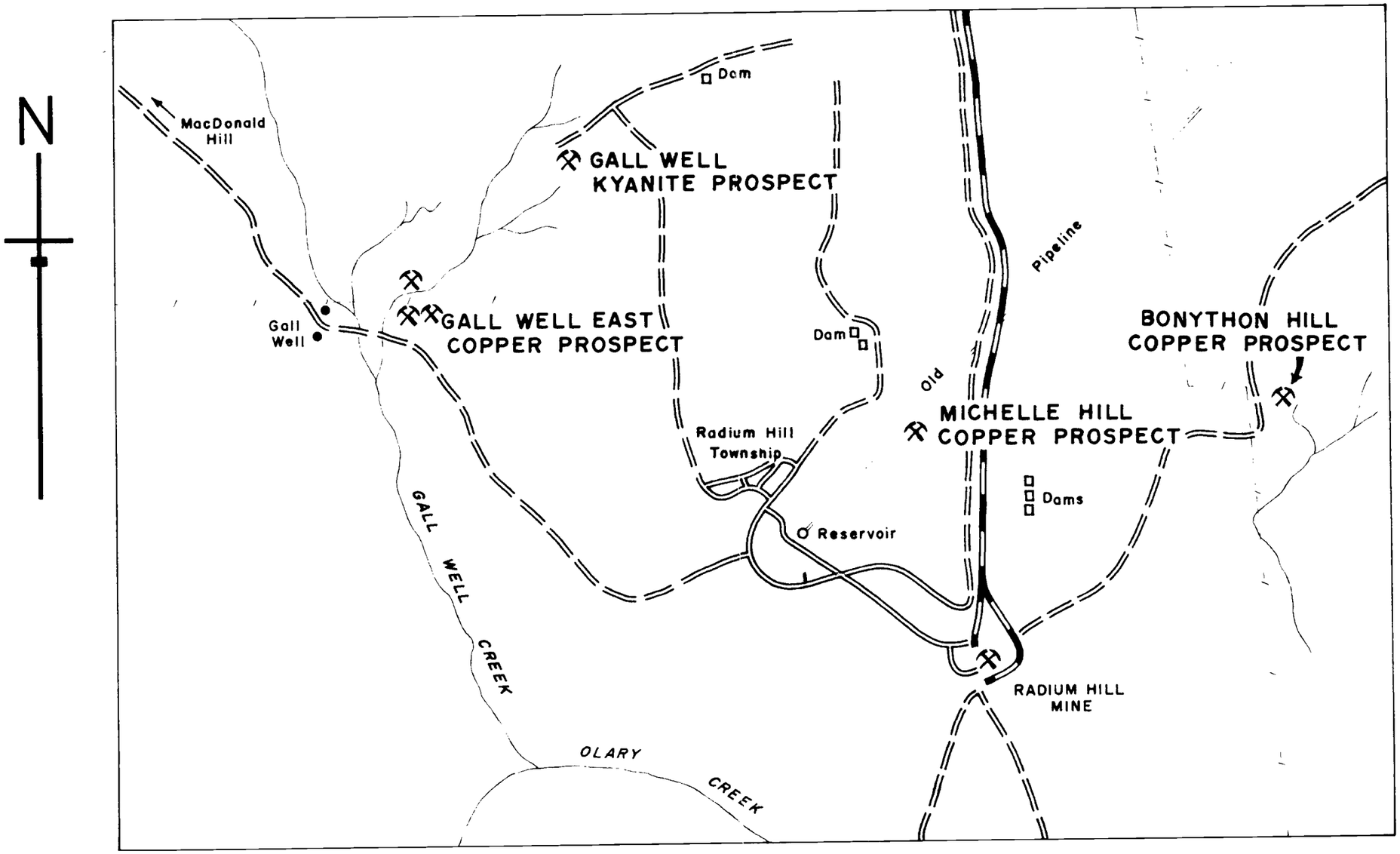
420-68



LEGEND

- Main Road
- Track
- Railway
- Mine
- Creek
- Fence

SCALE

0 0·5 1 2 3

MILES

1389 III

SUNDOWNER MINERALS N.L.		
SML 420 — OLARY DISTRICT		
PROSPECT LOCATIONS		
GEOLOGIST: T.J. KENNEDY DATE APRIL 1971	SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.

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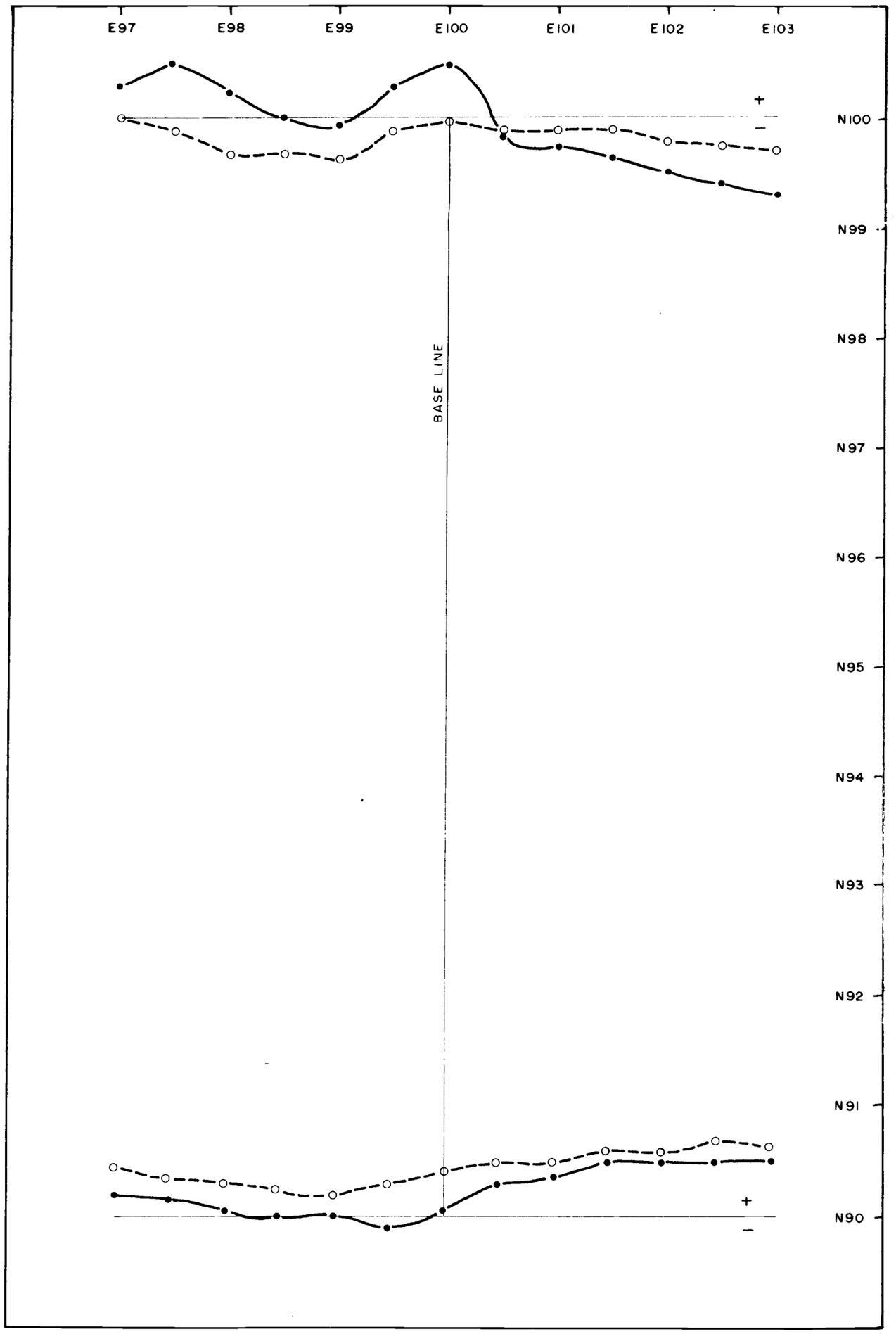
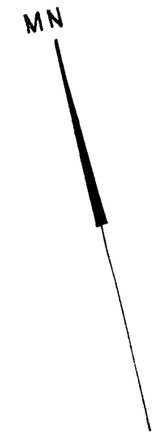
420-64





READINGS TAKEN FACING SOUTH-WEST

DIRECTION OF TRAVERSE ⟶

IN PHASE PLOT

OUT OF PHASE PLOT

SCALE

100 0 100 200

FEET

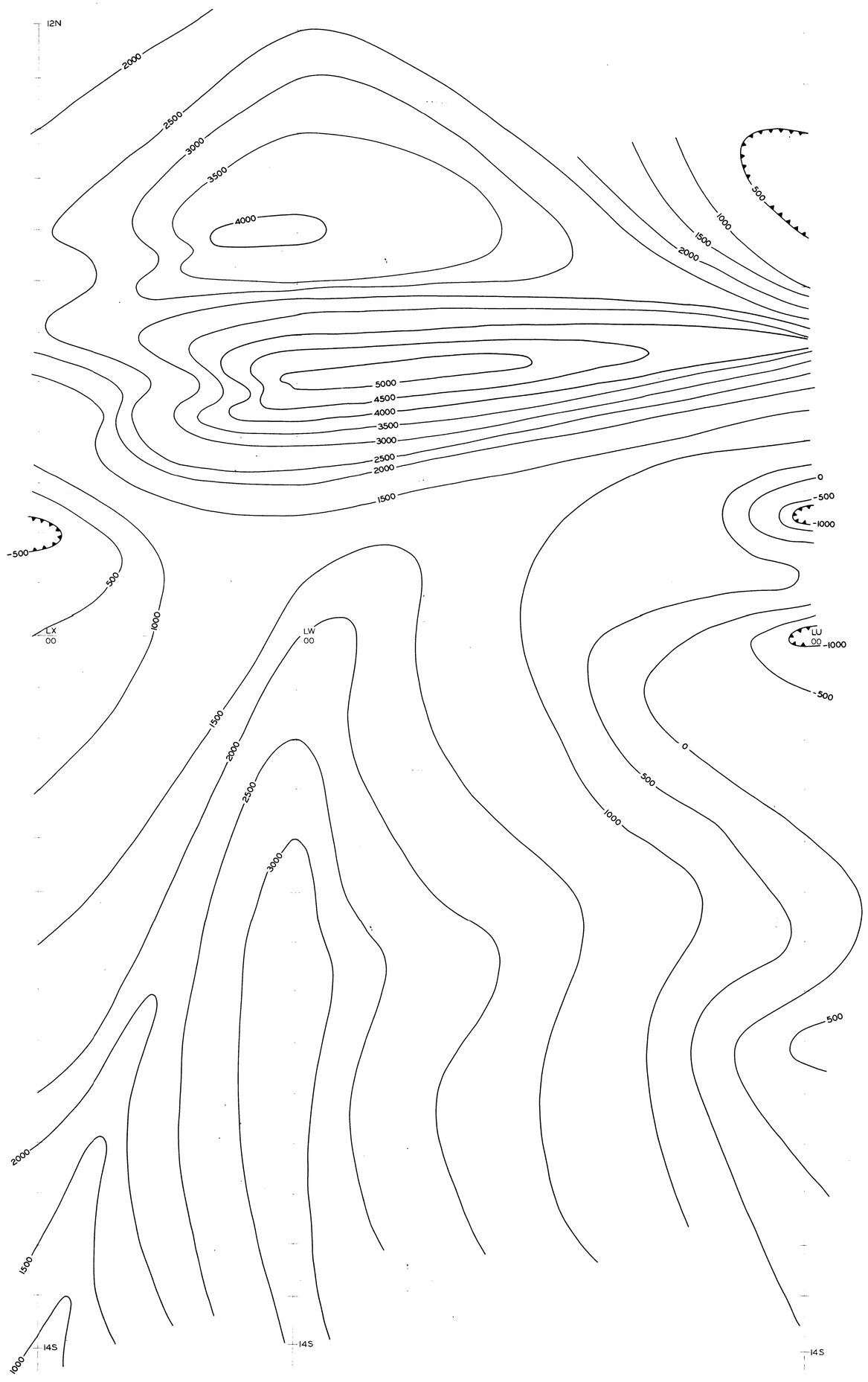
VERTICAL SCALE 1" = 10%

1389 II

SUNDOWNER MINERALS N.L.		
S.M.L. 420 OLARY DISTRICT		
GALL WELL EAST COPPER PROSPECT		
V.L.F. PLOT		
DATE: MAY 1971	SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD.
GEOLOGIST T.J. KENNEDY		ADELAIDE S.A.

ENV 1389 (II) - 4

420-69



14N

LEGEND

1500 / 2000 — MAGNETIC CONTOURS

-500 — MAGNETIC LOW

LS 00 — LU 00 — I.P. LINES

6S

SCALE

100 0 100 200 300 400 500 600 700 800 900 1000

FEET

1389 II (2)

SUNDOWNER MINERALS N.L.		
S.M.L. 420 LUXEMBURG EAST PROSPECT		
MAGNETIC CONTOUR PLAN		
DATE: FEB. 1971 GEOLOGIST: D. LOPES	OLARY DISTRICT SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.

ENV 1389 II - 6

SUNDOWNER PLAN 420-12

K (I.P. LINE)
L (I.P. LINE)
M (I.P. LINE)
N (I.P. LINE)

LEGEND

M.F. 50 – 100

M.F. 100 – 150

M.F. > 150

60 Resistivity contours ($\rho a/2\pi$)

MN

SCALE

100 0 100 200 300 400 500 600 700 800 900

RECEIVED
20 APR 1971
DEPT. OF MINES
SECTION
1389 II

1389 II (1)

SUNDOWNER MINERALS N.L.

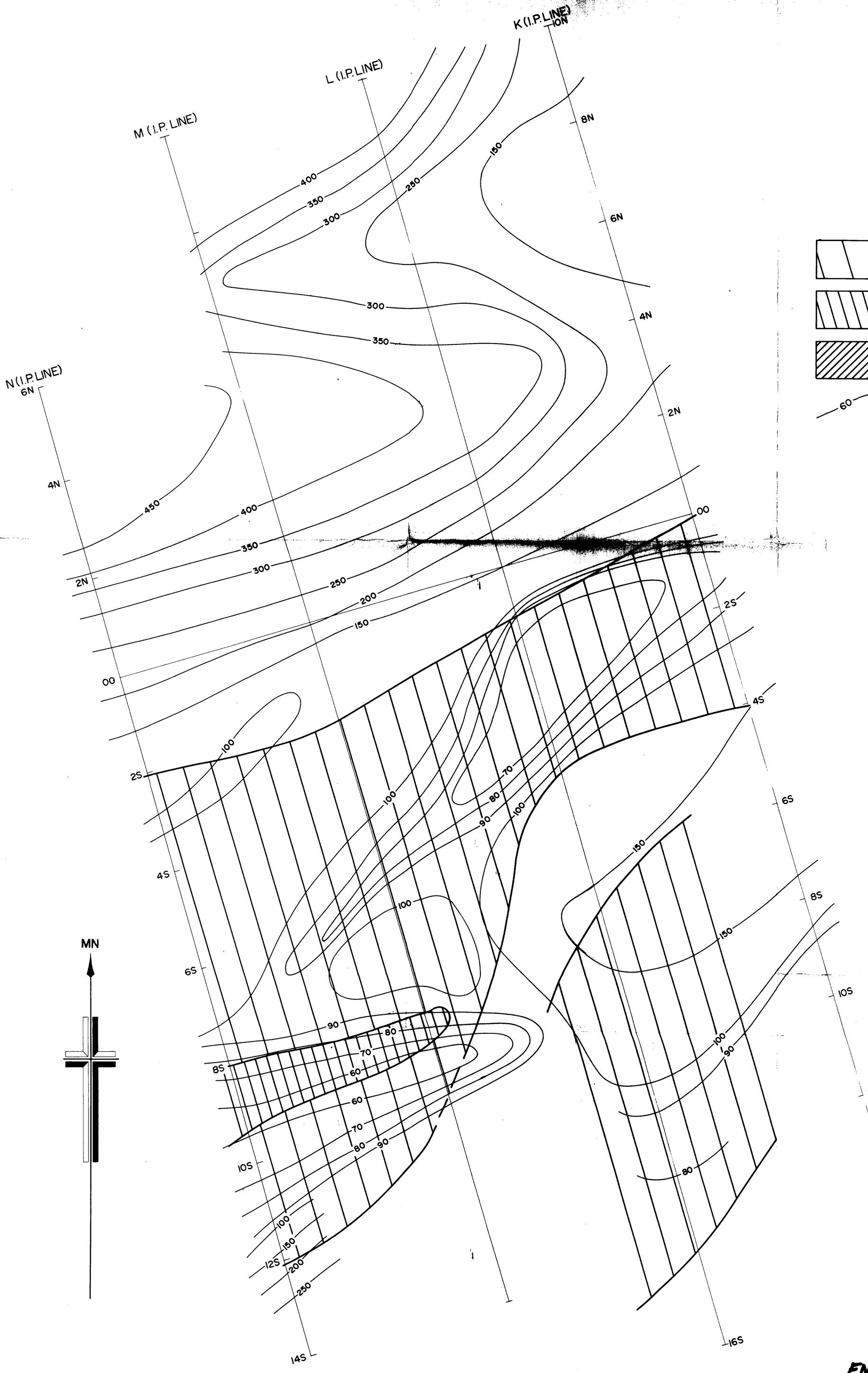
S.M.L. 420 SOUTH LUXEMBURG ENVIRONS

PLAN SHOWING RESISTIVITY AND METAL FACTOR ANOMALIES VERTICAL DEPTH 500 FT.

DATE: FEBRUARY 1971	O'LARY AREA	MINOIL SERVICES PTY. LTD.
GEOLOGIST: D. LOPES	SOUTH AUSTRALIA	ADELAIDE STH. AUST.

ENV 1389 II-7

420-27



LEGEND

M.F. 50 – 100

M.F. 100 – 150

M.F. > 150

60 Resistivity contours ($\rho a/2\pi$)

SCALE

100 0 100 200 300 400 500 600 700 800 900

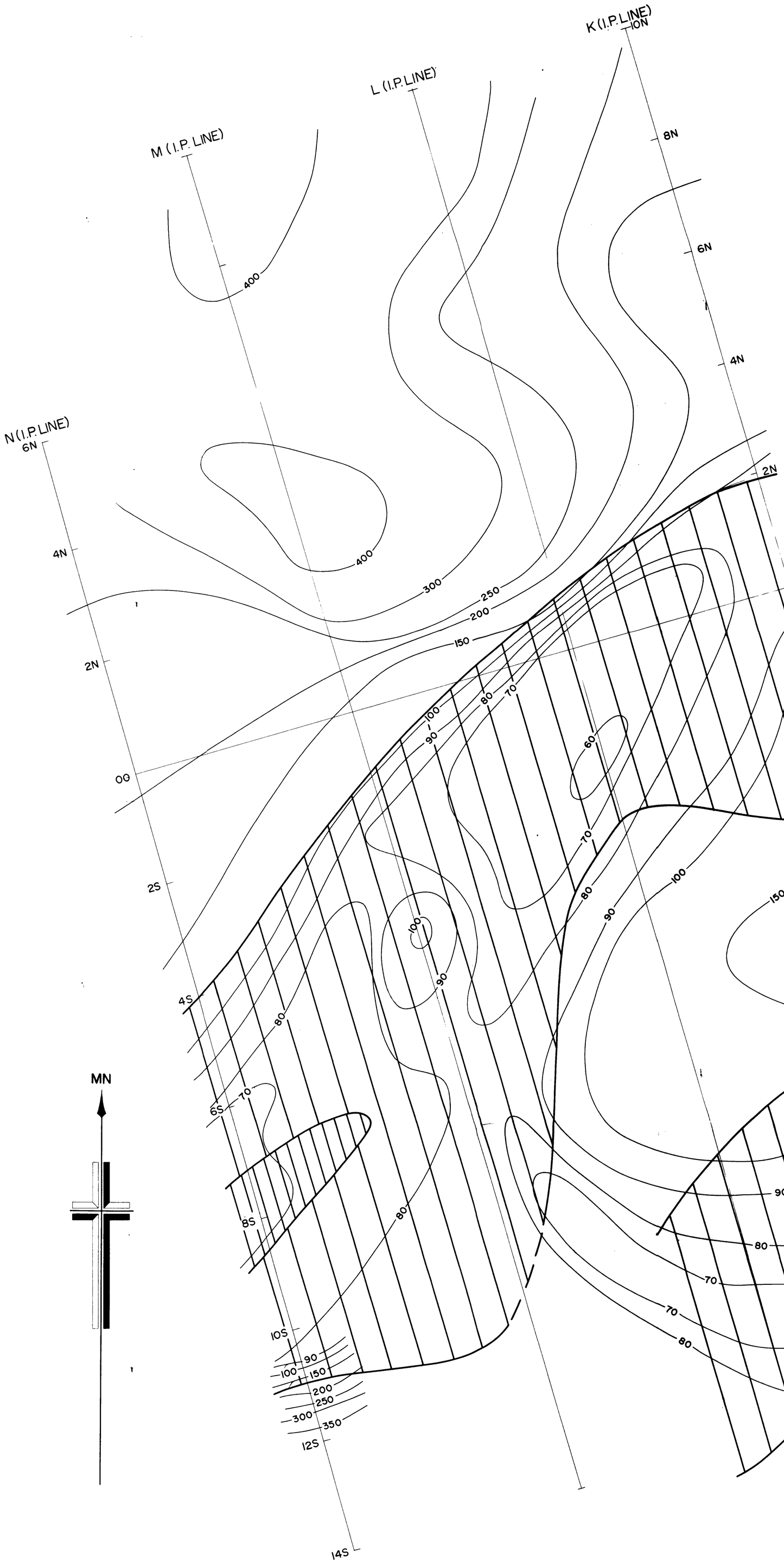
ENV 1389 II-8

SUNDOWNER MINERALS N.L.

S.M.L. 420 SOUTH LUXEMBURG ENVIRONS

PLAN SHOWING RESISTIVITY AND METAL FACTOR ANOMALIES VERTICAL DEPTH 400 FT.

DATE: FEBRUARY 1971	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST.
GEOLOGIST: D. LOPES		



LEGEND

- M.F. 50 – 100
- M.F. 100 – 150
- M.F. > 150
- 60 — Resistivity contours ($\rho a/2\pi$)

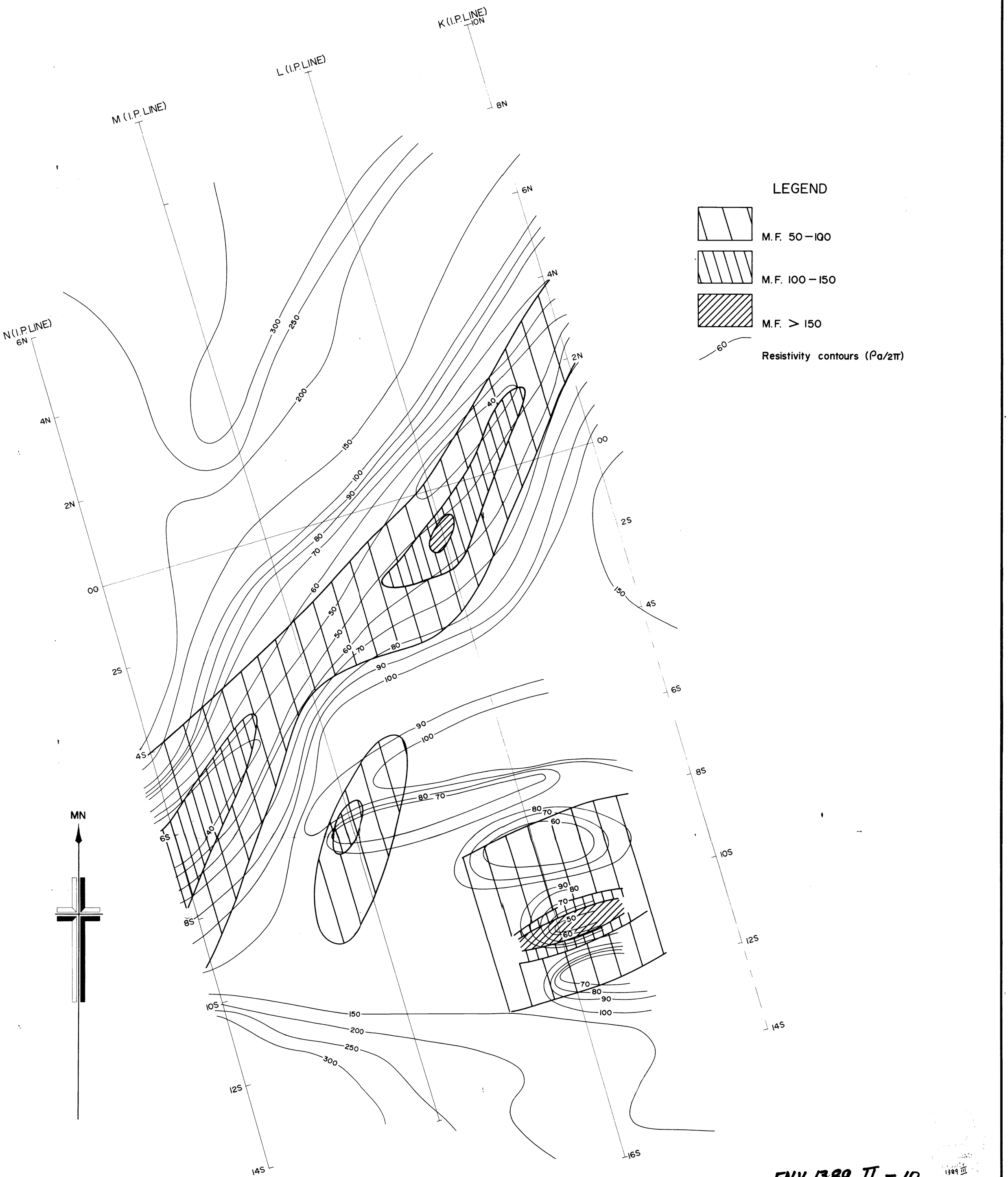
MN

SCALE

100 0 100 200 300 400 500 600 700 800 900

ENV 1389 II-9

SUNDOWNER MINERALS N.L.	
S.M.L. 420 SOUTH LUXEMBURG ENVIRONS	
PLAN SHOWING RESISTIVITY AND METAL FACTOR ANOMALIES VERTICAL DEPTH 300 FT.	
DATE : FEBRUARY 1971	OLARY AREA SOUTH AUSTRALIA
GEOLOGIST : D. LOPES	MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST.

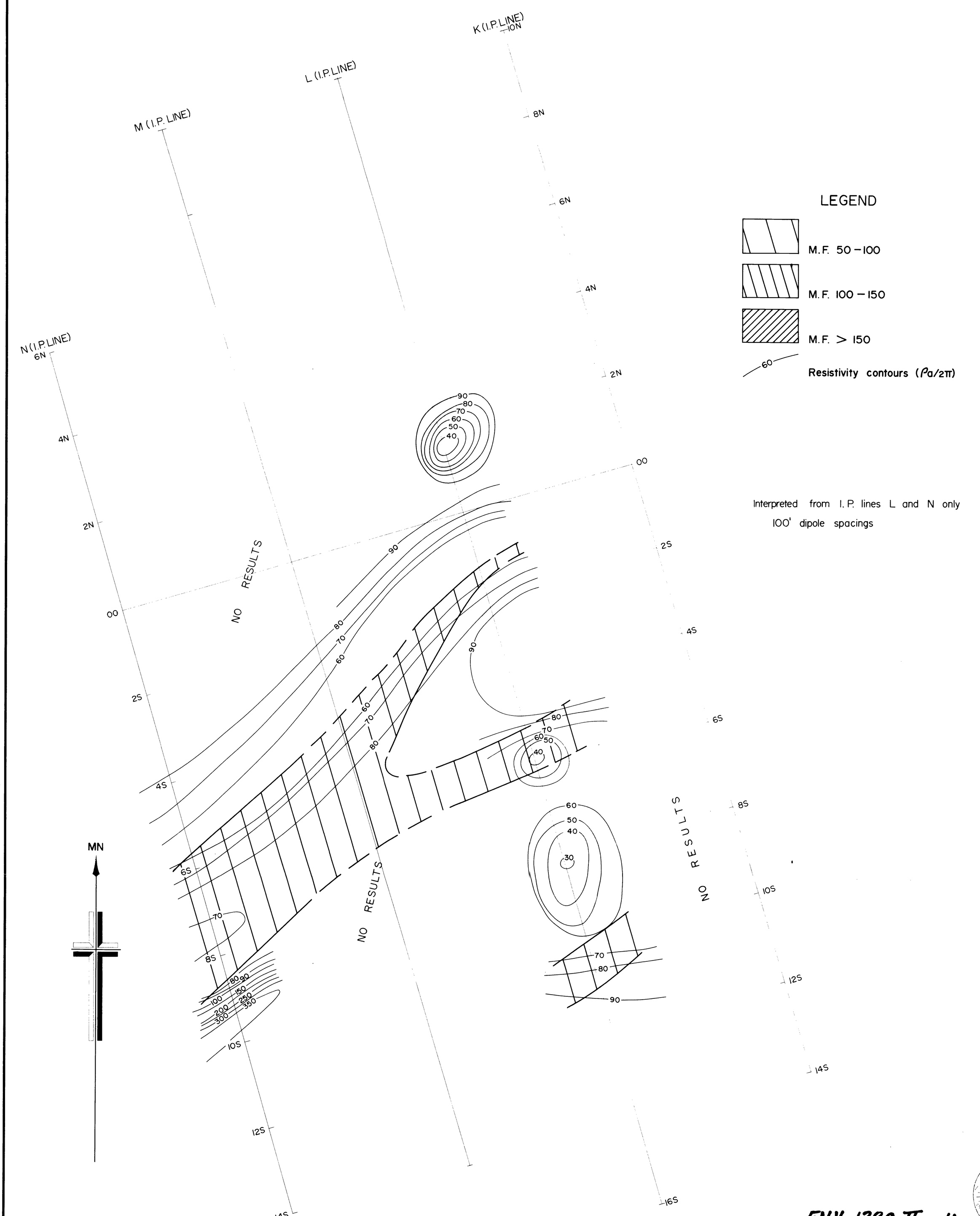


ENV 1389 II – 10

1389 III

SUNDOWNER MINERALS N.L.		
S.M.L. 420 SOUTH LUXEMBURG ENVIRONS		
PLAN SHOWING RESISTIVITY AND METAL FACTOR ANOMALIES VERTICAL DEPTH 200 FT.		
DATE: FEBRUARY 1971 GEOLOGIST: D. LOPES	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST.

420-24



ENV 1389 II – 11

SUNDOWNER MINERALS N.L.		
S.M.L. 420 SOUTH LUXEMBURG ENVIRONS		
PLAN SHOWING RESISTIVITY AND METAL FACTOR ANOMALIES VERTICAL DEPTH 100 FT.		
DATE: FEBRUARY 1971	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST.
GEOLOGIST: D. LOPES		

K (I.P. LINE)
10N
L (I.P. LINE)
M (I.P. LINE)
N (I.P. LINE)
6N
8N
6N
4N
2N
00
2N
4S
6S
8S
10S
12S
14S
2S
4S
2S
00
4N
Qa
Qt
Pc
Ps
Quartz float
Quartz
Schist
Schist
In schists, tillite anatectic granite
In metamorphosed tillite
In metamorphosed tillite
In schistose fluvioglacials
In metamorphosed tillite
PDH 9
PDH 8
PDH 7
PDH 11
PDH 10
10'
45'
35'
62°
60°
75°
63°
40°
65°
MN

LEGEND

LOWER PROTEROZOIC — CARPENTARIAN — WILLYAMA COMPLEX
- Pc — Quartzite and granites with schists and iron
- Pc — cutting pegmatites.

UPPER PROTEROZOIC — ADELAIDEAN — STURTIAN
- Ps — Dark, pred fine grained siltstone usually well foliated. Contains small angular fragments of quartz.
- Basal boulder tillite.
- Fluvioglacial quartzite beds.

CAINOZOIC — QUATERNARY
- Qa — River, and plain alluvium, sands clayey in part Can contain calcareous nodules.
- Qt — Areas of talus with very little outcrop.

- Amphibolite
- Quartz intrusions.
- Approx. boundary of grand unconformity
- Outcrop boundaries
- Mine shaft inclined
- Digging
- Strike and dip of beds
- Strike (dip unknown)
- Strike and dip of foliation (gneissosity , schistosity)
- Creek

SCALE

100 0 100 200 300 400 500 600 700 800 900

ENV 1389-II-12

SUNDOWNER MINERALS N.L.

S.M.L. 420 SOUTH LUXEMBURG ENVIRONS

GEOLOGICAL PLAN WITH DRILL HOLES AND I.P. LINES

DATE: FEBRUARY 1971	OLARY AREA	MINOIL SERVICES PTY. LTD.
GEOLOGIST: M C BENBOW	SOUTH AUSTRALIA	ADELAIDE STH. AUST.

15N

15N

14N

150

140

130

120

110

100

60

70

80

90

90

80

70

60

50

40

30

LU
00

LW
00

LS
00

14S

14S

6S

LEGEND

LU
00 — I.P. LINES

50
40 — RESISTIVITY CONTOURS

M.F. ANOMALY 100 - 200

SCALE

100 0 100 200 300 400 500 600 700 800 900 1000

FEET

ENV 1389 II-13

1389 II (2)

SUNDOWNER MINERALS N.L.

S.M.L. 420 LUXEMBURG EAST PROSPECT

RESISTIVITY AND METAL FACTOR CONTOUR PLAN
VERTICAL DEPTH 500 FT.

DATE: FEB. 1971	OLARY DISTRICT SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: D. LOPES		

SUNDOWNER PLAN 420-10

15N

15N

14N

100
90
80
70
60
50
110
120
130
70
60
50
40
30
40
50
60
70
80
90
100
110
120
LW
00
LU
00
LS
00
90
80
70
80
50
40
40
30
30
6S
14S
14S

LEGEND

LU
00
I.P. LINES

50
40
RESISTIVITY CONTOURS

M.F. ANOMALY 100 – 200

SCALE

100 0 100 200 300 400 500 600 700 800 900 1000

FEET

ENV 1389 II – 14

1389 II (S)

SUNDOWNER MINERALS N.L.		
S.M.L. 420 LUXEMBURG EAST PROSPECT		
RESISTIVITY AND METAL FACTOR CONTOUR PLAN VERTICAL DEPTH 400 FT.		
DATE : FEB. 1971 GEOLOGIST : D. LOPES	OLARY DISTRICT SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.

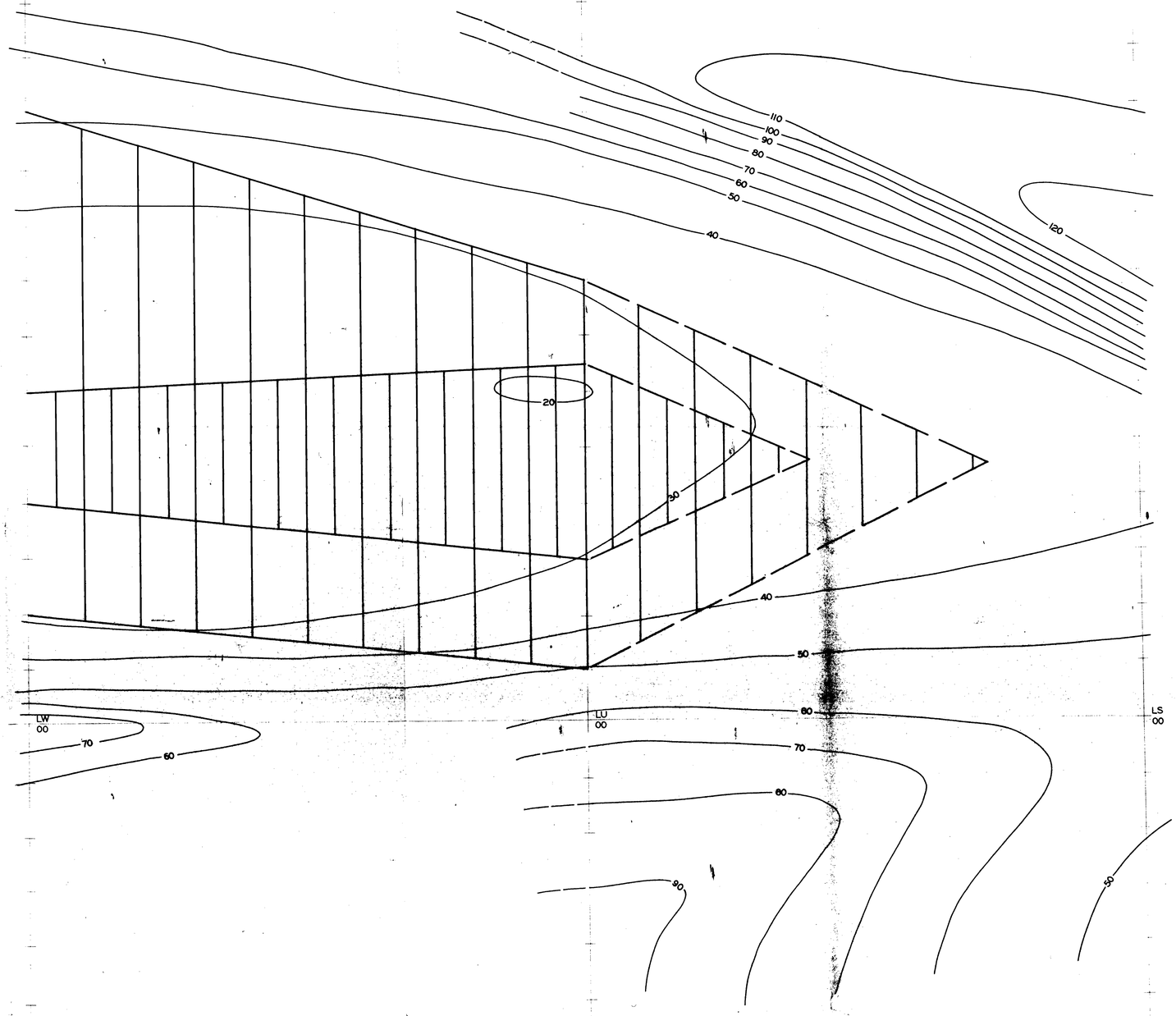
SUNDOWNER PLAN 420-9

15N

15N

14N

12N



LX 00

LW 00

LU 00

LS 00

14S

14S

14S

6S

LEGEND

LU 00 — I.P. LINES

50 40 — RESISTIVITY CONTOURS

M.F. ANOMALY 100–200

M.F. ANOMALY 200–400

SCALE

100 0 100 200 300 400 500 600 700 800 900 1000

FEET

SUNDOWNER MINERALS N.L.

S.M.L. 420 LUXEMBURG EAST PROSPECT

RESISTIVITY AND METAL FACTOR CONTOUR PLAN
VERTICAL DEPTH 300 FT.

DATE: FEB. 1971	OLARY DISTRICT SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: D. LOPES		

SUNDOWNER PLAN 420-8

15N

15N

14N

70

60

50

40

30

20

15

90

80

15

20

30

40

LW
00

LU
00

LS
00

100

90

80

70

60

30

40

50

6S

14S

14S

LEGEND

LU
00 — I.P. LINES

50
40 — RESISTIVITY CONTOURS

M.F. ANOMALY 100 – 200

M.F. ANOMALY 200–400

M.F. ANOMALY 400–800

SCALE

100 0 100 200 300 400 500 600 700 800 900 1000

FEET

ENV 1389 II-16

1389 II (2)

SUNDOWNER MINERALS N.L.

S.M.L. 420 LUXEMBURG EAST PROSPECT

RESISTIVITY AND METAL FACTOR CONTOUR PLAN
VERTICAL, DEPTH 200FT.

DATE: FEB. 1971	OLARY DISTRICT SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST: D. LOPES		

SUNDOWNER PLAN 420-7

III

(3)

71-15

0067

SUNDOWNER MINERALS N.L.

Special Mining Lease Number 420.

Olary Area
South Australia

Geological Report No. 1

on
Cutana Copper Mine

By
M.C. Benbow
of
MINOIL SERVICES PTY. LTD.

11-2-71

CONTENTS

FIGURE REFERENCE

1. INTRODUCTION

Special Mining Lease (S.M.L.) 420 held by Sundowner Minerals N.L., is located in the Olary Province, some 250 miles north-east of Adelaide, and 60 miles south-west of Broken Hill. The Cutana Mine is located on the S.M.L. 5 miles south of Cutana railway siding and 2 miles north of the Luxemburg Mine. The mine itself lies on a flat pedimentary surface, with little outcrop, and sparse salt bush - blue bush vegetation.

2. HISTORY

A limited amount of copper ore was obtained from a well defined quartz-ironstone reef 3' wide trending in a north-east south-west direction for a length of over 60'. Malachite and chalcocite, carrying up to 4 ozs. of silver to the ton and some gold, were mined from small but rich shoots. (Campana and King, 1958)

3. GEOLOGY

The dominant rock type of the area is a coarse grained granite, containing both white and pink feldspar, grading to an adamellite. It is friable in part, due to weathering, and shows exfoliation in some places. This rock unit is part of that described by Campana and King as being anatectic granite, belonging to undifferentiated Proterozoic-Archaean. It shows characteristics of being a metasediment in part, namely with some beds of metaquartzite. Similar characteristics of a metasedimentary nature can be found in the same unit north of the Luxemburg South Mine.

During the Lower Palaeozoic, earth movements in north-east south-west directions, gave rise to the north-east south-west MacDonald Shear Zone (Parkin, 1969). An open stope has been sunk along a secondary north-east south-west shear over a surface length of 20 feet, and to a depth of 30 feet. (see Inset, Fig. 1).

4. MINERALIZATION

The shear has been filled in part by a quartz-ironstone reef very probably carried in by hydrothermal solutions. Also carried in by these solutions, were smaller amounts of copper, silver and gold. It is to be noted that mineralization at the Luxemburg and Queen Bee mines is in a similar environment. At these two mines, the mineralization of copper, silver and gold was probably derived from the amphibolite body. It is possible, that as Cutana is only 2 miles north of the Luxemburg Mine, the mineralization associated with the quartz reef had the same source.

Outside the open stope, the width of the vein appears to be 1'6" for a length of near 500'. At the stope it has widened to a maximum width of 3'. The only mineralization visible in the reef appears to be at the stope. Also, it is only at the stope, that the reef is a quartz-ironstone. Several diggings were sunk along the reef.

Malachite, azurite and chalcocite are visible in the reef, and a little malachite in the granite gneiss walls, but only at the reef contact. Some pyrite and limonite are also present.

The only mineralization noted outside the workings is pyrite and iron oxides as marked on Fig. 1.

Five samples were collected and an assay report is soon expected.

5. CONCLUSIONS AND RECOMMENDATIONS

It appears that the mineralization is limited to a length of approximately 30 feet at the surface. At the base of the stope the quartz-ironstone reef narrows to 1'6". However, because of the pinch and swell nature of the mineralization in the area, it is possible that at depth a widening and lengthening of the mineralization may take place. It is recommended that a limited magnetometer and V.L.F. survey be carried out to determine whether the copper mineralization extends along strike or with depth.

W Shackleton
for

M. C. Benbow.
Junior Geologist.
MINOIL SERVICES PTY. LTD.

11/2/71

REFERENCES

Campana, B., and King, D. 1958 — Regional Geology and Mineral Resources of the Olary Province. Geol. Surv. S. Aust. Bull. No. 34.

Parkin, L.W. 1969 — Handbook of South Australian Geology. S.A. Dept Mines.

71-22 (1)

0073

SUNDOWNER MINERALS N.L.
Special Mining Lease 420

Olary District
South Australia

Geological Report No. 1

on
Exploration of the
Luxemburg South Prospect

by
D. Lopes
of
MINOIL SERVICES PTY. LTD.
March 1971.

10-3-71

III

0074

CONTENTS

PLAN REFERENCE

Number	Title	Scale
6	Luxemburg South Geological Plan with Drill Holes and I.P. lines.	1" = 100'
420-23	Luxemburg South Resistivity, Metal Factor Anomalies, Vertical Depth 100 feet.	1" = 100'
420-24	Luxemburg South Resistivity, Metal Factor Anomalies, Vertical Depth 200 feet.	1" = 100'
420-25	Luxemburg South Resistivity, Metal Factor Anomalies, Vertical Depth 300 feet.	1" = 100'
420-26	Luxemburg South Resistivity, Metal Factor Anomalies, Vertical Depth 400 feet.	1" = 100'
420-27	Luxemburg South Resistivity, Metal Factor Anomalies, Vertical Depth 500 feet.	1" = 100'
420-45	Luxemburg South. Vertical Drill Section PDH 7	1" = 50'
420-46	Luxemburg South. Vertical Drill Section PDH 8	1" = 50'
420-47	Luxemburg South. Vertical Drill Section PDH 9.	1" = 50'

1. SUMMARY

Induced Polarization (I.P.) surveys have located several significant anomalies in the Luxemburg South Area.

A shallow percussion drilling programme intersected four zones of pyritic tillite containing:

10' T.W* of 0.4% Copper (Including 2' T.W. 0.4 oz silver/ton)
18' T.W. of 0.3% Copper (Including 2' T.W. 0.5 oz silver/ton)
14' T.W. of 0.4% Copper (Including 4' T.W. 0.5 oz silver/ton)
6' T.W. of 0.3% Copper (Including 2' T.W. 1.0 oz silver/ton)

However, because of a shallow water table none of the I.P. anomalies was reached.

Recent geological inspections have indicated several areas of mineralization between Winkler's Lead Prospect and Luxemburg South which may be related to local amphibolite bodies.

The author believes that this area provides good prospects for economic mineralization. Primary and secondary drill targets have been chosen for diamond drilling.

* T.W. = True Width.

2. INTRODUCTION

The Luxemburg South Prospect (also referred to as Premier) is an area south of the Luxemburg Mine on Special Mining Lease (S.M.L.) 420 held by Sundowner Minerals N.L. in the Olary district of South Australia.

This report summarizes the exploration work undertaken by Australian Gold and Uranium Pty. Ltd. (1969-70) and Sundowner Minerals N.L. (1970-71) (Lopes, 1969; 1970).

A geological plan has been compiled (Plan No. 6).

A study of I.P. results is made in this report and wherever possible related to known geological features (Plans 420-23, 24, 25, 26, 27).

3. PREVIOUS INVESTIGATIONS

In early 1969 Australian Gold and Uranium conducted a random chip sampling survey in conjunction with the Luxemburg Mine area programme.

During the latter half of 1969, I.P. and magnetometer surveys were conducted over the tillite to the east of Luxemburg South again as part of the Luxemburg programme. (Lopes, 1969; 1970).

In December 1969, three diamond drill holes and one percussion hole tested I.P. anomalies approximately ½-¾ miles east of Luxemburg South. Several mineralized intersections were encountered which contained up to 20% pyrite but generally less than 0.3% copper.

4. GEOLOGY

4.1. WILLYAMA COMPLEX

The Willyama Complex is an ancient (Carpentarian) igneous-metamorphic rock suite which extends several hundred square miles generally east of the MacDonald Fault.

In the Luxemburg South area the Complex is exposed to the north and north-west as granite gneisses, quartzites, anatectic granites and schists which are unconformably (Grand Unconformity) overlain by the Sturtian Series.

4.2. STURTIAN SERIES

4.2.1. Boulder Tillites

The Sturtian Yudnamutana Sub-Group is represented in this area by boulder tillite, dolomites and slates. The tillite is well exposed in the central Luxemburg South area. This rock is commonly structureless and unstratified. It contains unsorted boulders of all sizes and rock types, e.g. granites, quartzites, slates, spotted slates, phyllites, mica schists and occasionally quartz fragments.

The matrix is fine grained, and is often amphibole rich. The slatey fragments are elongated while the quartz and granitic fragments are rounded to sub-rounded.

Campana (Campana and King, 1958) suggests that near the Old Boolcoomata Homestead the tillite rests directly on the crystalline basement which formed the old glacial floor. Glaciers scooped part of the basement forming a depression. The retreat of the glaciers filled these depressions with granitic boulders dumped from the melting ice.

The boulder tillite forming a low east-west hill in the Luxemburg South area has been mapped previously as Willyama Complex. A similar origin as that suggested by Campana seems probable except that in this case slates and quartzites as well as granites have been gouged out by glaciers.

4.2.2. Dolomites

Dolomites of the Lower Glacial Sturtian are exposed to the north of the Luxemburg South area. They appear to be conformable with the tillites and may be the re-worked product of the Torrensian dolomite beds. In places this same material also forms the ground mass of the tillites.

Mineralization may be associated with tillites having only a dolomitic groundmass.

4.2.3. Slates

Glacio-lacustrine slates also outcrop a short distance north-east of the Premier shafts. They are well laminated and grade into siltstones, and have been intruded by quartz veins forming a boudinage structure.

4.3. AMPHIBOLITES

There are numerous outcrops of this rock-type in the Luxemburg South area. Previously the amphibolites were included with the Willyama Complex. However, in this area dyke-like amphib-olite bodies intrude the Lower Sturtian tillites.

Microscopic studies suggest an igneous origin, possibly a gabbro or dolerite (Appendix 1).

It has been noted elsewhere on S.M.L. 420 (e.g. at the Luxemburg Mine and Radium Hill Mine) that mineralization is generally associated with amphibolite bodies. The exact part played by the amphibolites in the mineralizing process is not yet understood.

4.4. QUARTZ VEINS

There appears to be at least two series of quartz veins in the Luxemburg South area. The first stage intruded the crystalline basement and tillites prior to the metamorphism of the tillite. The second stage may have been associated with the dolerite or gabbro intrusions.

Pegmatite dyke swarms that are so common in the Willyama Complex are probably contemporaneous with the first stage quartz veining. These are often faulted.

The second series of quartz veins may have been the last stage differentiate of the dolerite gabbro intrusions.

Both types are mineralized.

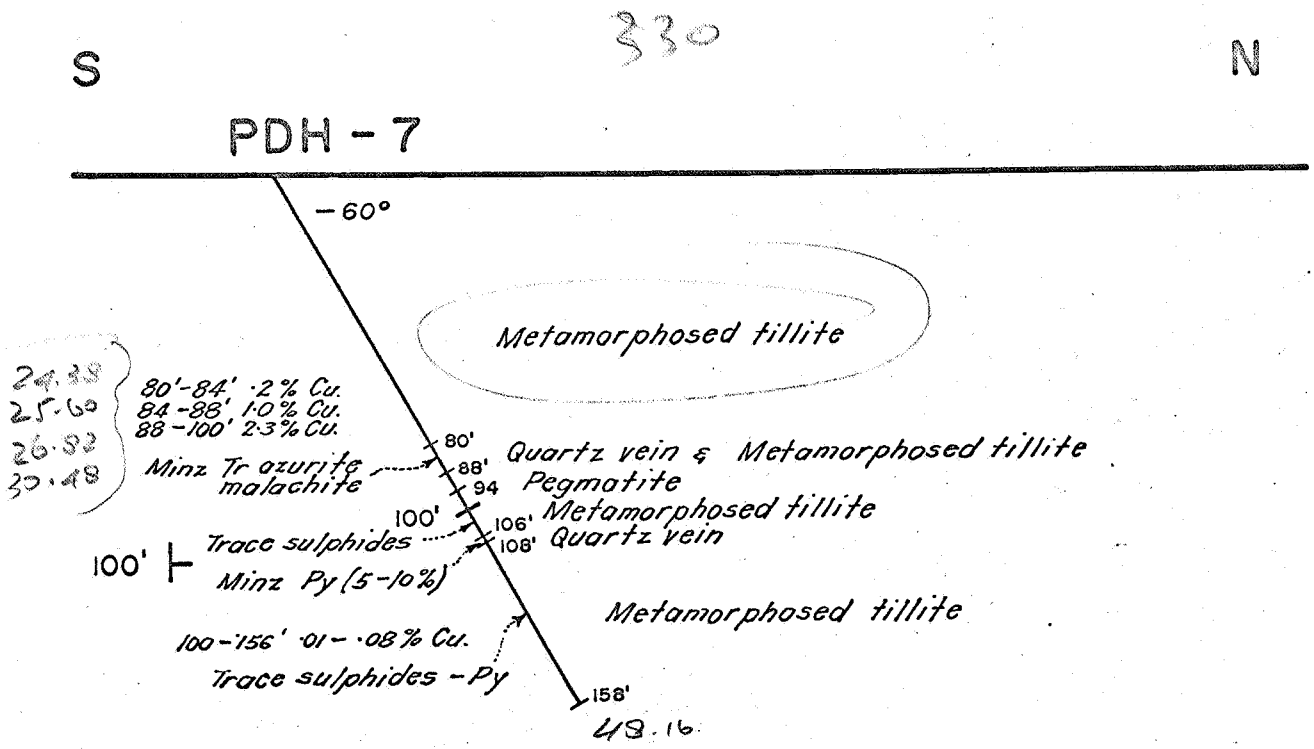
5. MINERALIZATION

To date, four parallel zones of disseminated mineralization have been intersected in the tillite by shallow percussion drill holes PDH 7, 8 and 9 in the Luxemburg South area. (Plan Nos. 420-45, 46, 47).

The mineralized zones contain up to 25% pyrite and 0.3% - 0.4% copper as chalcopyrite, malachite and azurite.

The origin of the mineralizing solutions is not clear. However, it is probable that they were either re-mobilized from basement rocks or introduced during the dolerite-gabbro intrusions.

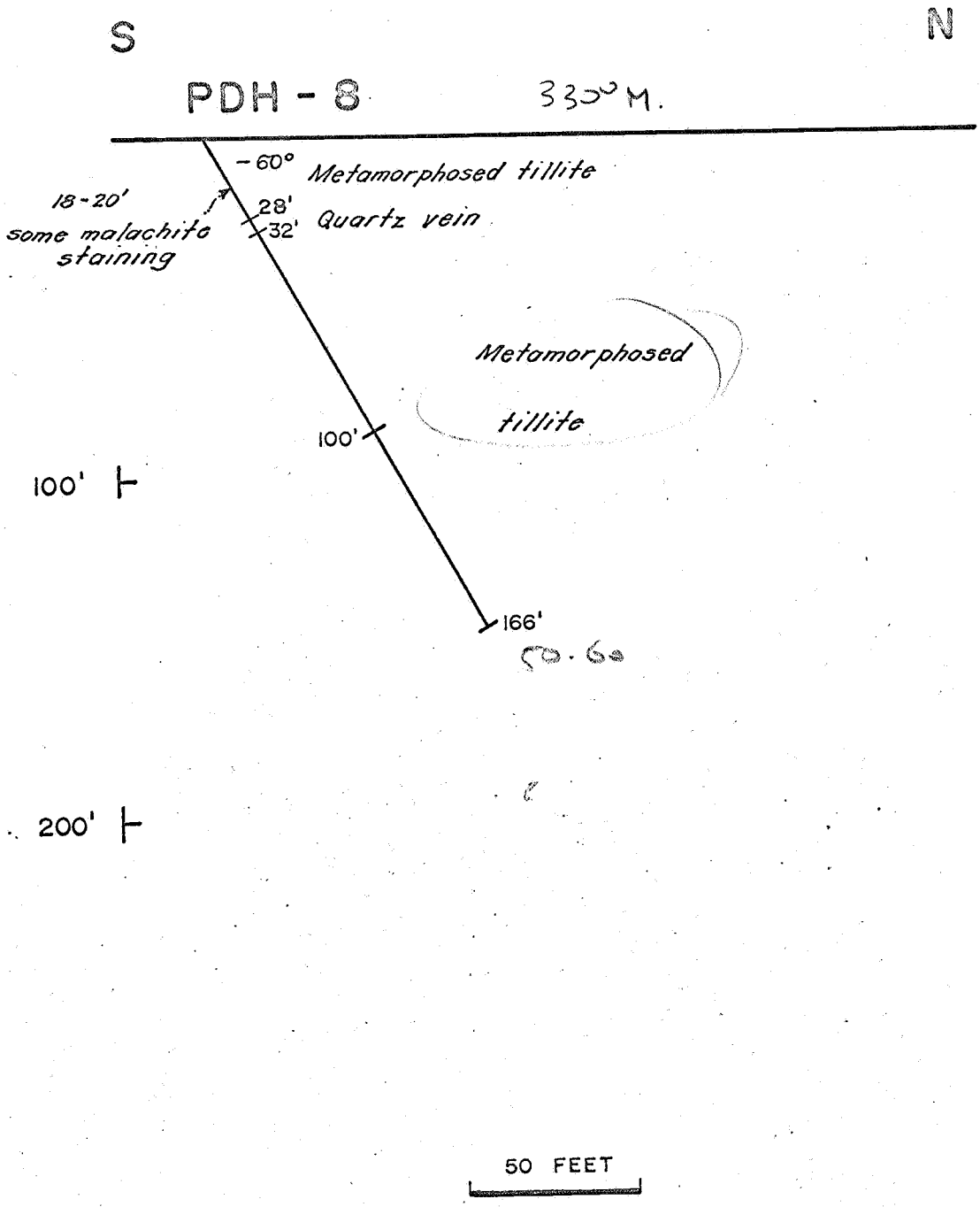
To the east of Luxemburg South, three diamond



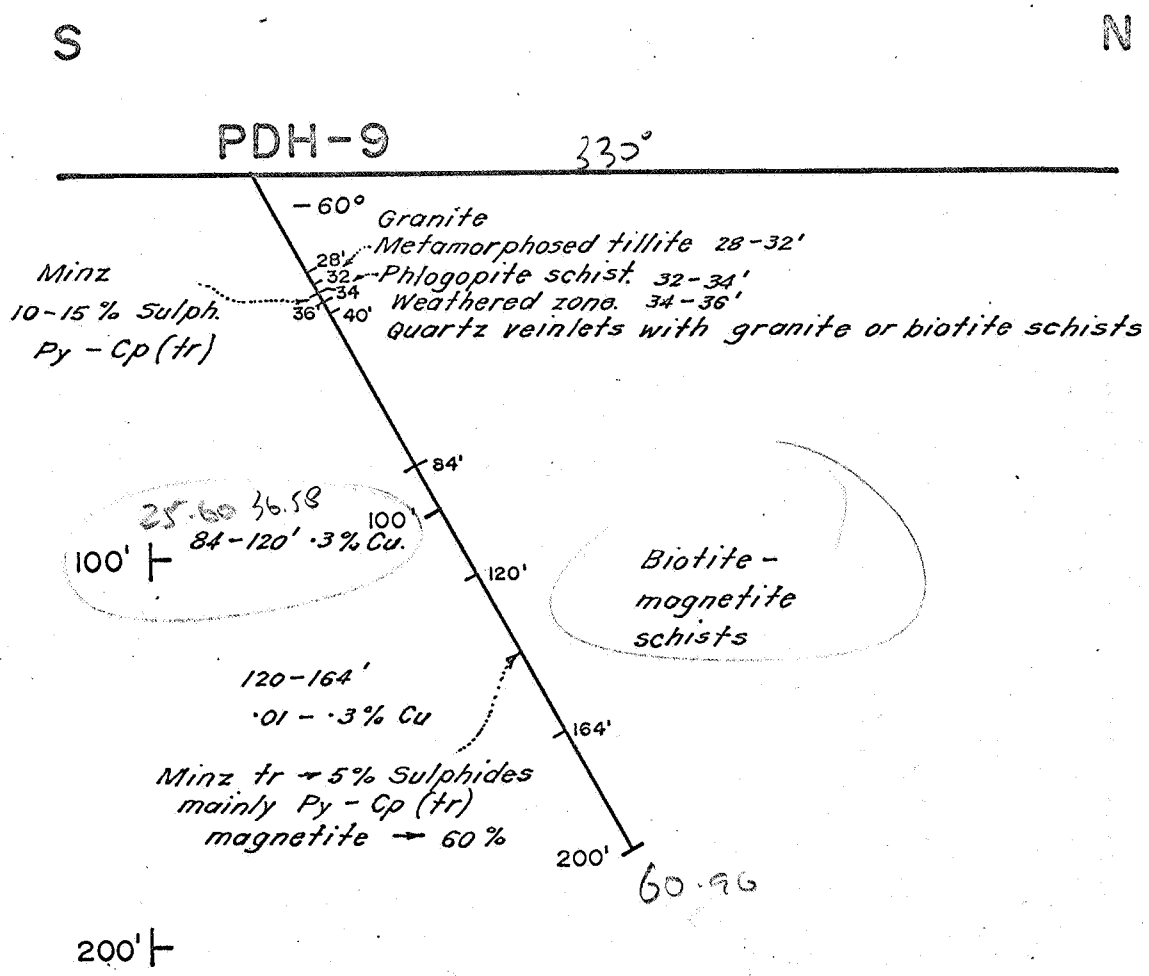
Py	Pyrite
Cu	Copper
60°	Dip

50 FEET

SUNDOWNER MINERALS N.L.		
S.M.L. 420 LUXEMBURG SOUTH AREA		
VERTICAL DRILL SECTION PDH-7 LOOKING 60° MN		
DATE 20 · 1 · 71	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST B.FARRELL		



SUNDOWNER MINERALS N.L.		
S.M.L. 420 LUXEMBURG SOUTH AREA		
VERTICAL DRILL SECTION PDH-8 LOOKING 60° MN		
DATE 20 · 1 · 71	OLARY AREA SOUTH AUSTRALIA	MINOIL SERVICES PTY. LTD. ADELAIDE S.A.
GEOLOGIST B. FARRELL		



Py	Pyrite
Cp	Chalcopyrite
Cu	Copper
60°	Dip

50 FEET

SUNDOWNER MINERALS N.L.

S.M.L. 420 LUXEMBURG SOUTH AREA

VERTICAL DRILL SECTION

PDH-9 LOOKING 60° MN

DATE 20 · 1 · 71	OLARY AREA	MINOIL SERVICES PTY. LTD.
GEOLOGIST B. FARRELL	SOUTH AUSTRALIA	ADELAIDE S.A.

holes DDH2, 2a, and 3 were drilled in 1969-70 by Australian Gold and Uranium Pty. Ltd. in the tillite. It was noted that mineralization was present only in the matrix and especially wherever amphibolitized.

6. GEOPHYSICS

During August 1970 Austral Exploration Services Pty. Ltd. conducted an I.P. survey on behalf of Sundowner Minerals N.L.

The survey consisted of four I.P. lines at 400' interval and 200' dipole-dipole spacing. Two of these lines (L and N) were also surveyed with 100' dipole-dipole spacings. (Webb, 1970).

Several anomalies were located, five of which were drilled by percussion holes PDH 7 - 11.

Resistivity and metal factor values have been contoured at depths of approximately 100', 200', 300', 400', and 500' (Plans 420-23, 24, 25, 26, 27.)

An excellent correlation between resistivity and lithology is evident. Below 100 feet the low resistivity zone is broader and is open at each end of the surveyed area. The strike length of this anomalous zone is at least 1200' and coincides with the major east-north-east shear trends in the tillite.

The metal factor values are highest at 150' - 200' in a zone beneath the Premier mine shafts and approximately 1000' south. At the 500' level another metal factor anomaly appears at the south-east end of line N.

It is considered that there are two primary and four secondary diamond drilling targets as follows:

Target (a)	Line L,	00	at	500' depth	(Primary)
Target (b)	Line L,	1.5	at	200' depth	(Primary)
Target (c)	Line L,	9.0	at	250' depth	(Secondary)
Target (d)	Line L,	10.5	at	150' depth	(Secondary)
Target (e)	Line N,	7.0	at	200' depth	(Secondary)
Target (f)	Line N,	12.0	at	500' depth	(Secondary)

7. DRILLING

Four percussion holes were drilled in October 1970 by Northbridge Pty. Ltd. Because of a shallow water table none of the holes was able to reach target depth. However, in PDH 7, 8, and 9 four zones (6', 10', 14', 18') with up to 25% pyrite and 0.3% - 0.4% copper were intersected. These zones are regarded as being the top of a deeper I.P. anomaly beneath the Premier Shaft.

The vertical depth of these intersections is less than 100' where metal factor values are approximately 60-70. The highest metal factor values, however, occur from 200'-250' (approximately 90-160).

8. CONCLUSIONS AND RECOMMENDATIONS

Mineralization in the Luxemburg South area consists of several parallel zones each 10-20' in width. Resistivity results indicate a mineralized area greater than 1000' in length.

It is considered that all the I.P. anomalies could be tested with three diamond drill holes.

Initially one 400' diamond hole is recommended from 3SE to intersect anomaly (a) at 200' vertical depth and anomaly (b) at 320' vertical depth.

Depending on results two further diamond holes could be drilled to test anomalies (c) and (d) and also (e) and (f) in that order of preference.

Previous drilling did not reach the I.P. targets, and the possibility of having intersected a pyritic halo overlying a richer copper ore-body cannot be discounted.

There is also great scope for further exploration in the amphibolite/tillite contacts that recently have been found through geological mapping and correlations with magnetic profiles.

W. Shackleton
for

10/3/71

D. Lopes
Geologist.
Minoil Services Pty. Ltd.

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Lopes, D., 1969	Report on Exploration S.M.L. 207 Olary District S.A. 1968-69, Unpub.
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Webb, J.E., 1970	Interim Report on I.P. survey at Luxemburg Mine and Luxemburg South area. November 1970. Unpub.

APPENDIX 1

C.M.S. Petrological Report

192 MAGILL ROAD, NORWOOD
SOUTH AUSTRALIA 5067

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0088

CENTRAL MINERALOGICAL SERVICES

10th December, 1970.

SUNDOWNER MINERALS N.L. S.M.L. 420

The Chief Geologist,
Minoil Services P/L,
105 Gouger Street,
ADELAIDE. S.A. 5000.

REPORT CMS 70/11/46.

YOUR REFERENCE: Order No. 749 dated 24/11/70

DATE RECEIVED: 25/11/70

SAMPLE NOS: S1 to S8

SUBMITTED BY: The Chief Geologist

WORK REQUESTED: Petrography.

H.W. Fander.

H.W. Fander, M.Sc.

cd.

CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S1 0089
Orthoamphibolite.

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S1

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4062

a. Hand Specimen:

Dark-green, crumpled ?amphibolite.

b. Microscopic:

This is a coarsely-crystalline amphibolite. It consists predominantly of green hornblende, as quite large poikiloblastic crystals, with interstitial areas and inclusions of quartz and untwinned plagioclase. Occasional oxide opaques occur. Sphene is present.

The hornblende crystals have random to subparallel orientation. There is a total absence of any relict primary features, but it is thought that the rock is of igneous rather than sedimentary origin.

It is thus an amphibolite-facies rock, a regionally metamorphosed basic rock, perhaps a dolerite.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W.Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S2
0090
"Granite"

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S2

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4063

a. Hand Specimen:

Quartzose and hornblendic rock.

b. Microscopic:

This is a stressed, brecciated granitoid rock.
It is composed of quite large anhedral patches of microcline, stressed quartz, and myrmekitic intergrowths of quartz and feldspar. There are random fractures, generally containing mosaic quartz, biotite and acicular actinolitic amphibole, together with small euhedral opaques (?goethite pseudomorphs after sulphide perhaps).
The brecciation of this rock has disrupted its original fabric. Hence there is doubt as to an igneous origin. The rock could be sheared pegmatitic vein material, not necessarily formed by igneous means. The biotite and actinolite are of hydrothermal origin.

Remarks/Special Features

N.B.: Typewritten report will follow.

GILLINGHAM

H.W. Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S3
0091
Hornblendite.

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S3

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4064

a. Hand Specimen:

Coarsely-crystalline hornblende-rich dark green rock.

b. Microscopic:

Over 90% of this rock is coarsely-crystalline hornblende, often intergrown, with optically-continuous patches of one crystal enclosed in another. There are a few interstitial patches of poorly-twinned plagioclase, and large areas of oxide opaques partly altered to sphene. Genetically this rock is a problem, but it is thought to be a hornblende-rich diorite bordering on hornblendite (not to be confused with amphibolite). It is probably partly recrystallized, but still substantially igneous in texture and origin. It could be termed a meladiorite, but hornblendite is preferred in view of the low plagioclase content.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W. Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S4
0092 Chlorite Schist.

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S4

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4065

a. Hand Specimen:

Coarsely-crystalline green, chloritic schist.

b. Microscopic:

This is a chlorite-schist which has been subjected to metasomatism, i.e. replacement.

It consists of very finely foliated minute flakes of green, almost isotropic chlorite (probably penninite), in which large, randomly-orientated flakes of another chlorite (amesite or chloritoid) have grown, and occasional, random, acicular crystals of anthophyllite. Pleochroic haloes are very conspicuous in the chlorite, and surround fragments and small zoned crystals of metamict zircon. Euhedral opaques, probably magnetite, are abundant.

Remarks/Special Features

N.B.: Typewritten report will follow.

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H.W.Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S5
Chlorite-Vesuvianite Rock. 0093

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S5

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4066

a. Hand Specimen:

Dark, coarsely flaky chloritic schist.

b. Microscopic:

This rock is best termed a chlorite-vesuvianite rock.
The dominant mineral is a very distinctive chlorite, whose optical properties in some respects resemble those of biotite. It occurs as very large, randomly orientated plates or flakes, with decussate texture, cutting across lines of opaques. The vesuvianite occurs as rather granular patches in the chlorite.
It would appear that the original rock was a chloritic schist, which has been completely recrystallized and metasomatised. It resembles S4 but has been much more thoroughly altered.
The chlorite is the same species as in S4. It's exact identity can only be established by X-Ray diffration.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W.Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S6
"Orthoamphibolite"- Tremolitised Peridotite. 0094

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S6

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4067

a. Hand Specimen:

Dark-green, coarsely-crystalline amphibolic rock.

b. Microscopic:

This may be termed an orthoamphibolite, since it is of igneous origin and contains mainly amphibole.

The fabric of the original rock is well preserved, and there are small patches of relict clinopyroxene. The rock consists of large, euhedral pseudomorphs of tremolite needles after ?olivine, with interstitial patches of cloudy material full of minute oxide opaques (thought to be another pyroxene).

Both primary and secondary opaques are common. Patches of chlorite occur. The relict textures and present mineralogy suggest that the original rock was a peridotite, which has been altered in an unusual way; usually these rocks become serpentinised.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W. Fander, M.Sc.

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CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S7
Actinolite Rock.
0095

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S7

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4068

a. Hand Specimen:

Dark-green, amphibolic rock.

b. Microscopic:

This is an actinolite-rock. It is composed almost entirely of randomly-orientated, large acicular crystals of actinolite.
Small amounts of other minerals occur. Interstitial small patches of untwinned plagioclase, traces of apatite, and aggregates of granular sphene are present. Certain residual patches in the actinolite crystals suggest the former presence of pyroxene.
It is believed that this rock was originally a meladagabbro, i.e. a gabbro rich in mafic minerals (pyroxene in this case) which has been recrystallized to its present form. There are no relict textures.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W.Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

Date: 10th December, 1970.

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

IDENTIFICATION
S8
0096
Actinolite Rock.

Job No. CMS 70/11/46 Date Received: 25/11/70

Reference Order No. 749

Sample No. S8

Nature of Sample: Hand-specimen

DESCRIPTION **SECTION No.** 4069

a. Hand Specimen:

Dark-green amphibolic rock.

b. Microscopic:

This actinolite-rock is very similar to S7, except that there is no plagioclase.

The matted actinolite needles and larger crystals often contain relict textures derived from pyroxene, and sphene aggregates have formed from opaques.

This rock appears to be a recrystallized melagabbro, grading into pyroxenite.

Remarks/Special Features

N.B.: Typewritten report will follow.

H.W.Fander, M.Sc.

GILLINGHAM

III

71-51
0097

SUNDOWNER MINERALS N.L.
Special Mining Lease Number 420.

Olary Area
South Australia

Geological Report No. 1
on
DALKEY-MILDALTIE MINE AREA

by
K.C. Moriarty, B.Sc. (Hons)
of
MINOIL SERVICES PTY. LTD.
March, 1971.

CONTENTS

PLAN REFERENCE

Plan No.	Title	Scale
420-38	Detailed Geological Map Dalkey Mine/Dalkey South Area.	1" = 200'
420-40	Subsurface Resistivity Contour Map from I.P. surveys March - August 1966 (n-1).	1" = 200'
420-41	Subsurface Resistivity Contour Map from I.P. surveys March-August 1966. (n-2).	1" = 200'
420-42	Subsurface Resistivity Contour Map from I.P. surveys March-August, 1966 (n-4)	1" = 200'

1. INTRODUCTION

The Dalkey and Mildaltie mines are in the south-east corner of Special Mining Lease (S.M.L.) 420, and three miles west of the abandoned Radium Hill Township in the north-east of South Australia. The mines and numerous prospect pits are sited in shear zones cutting the Proterozoic Adelaide System tillites and shales with mainly copper and silver mineralization.

The topography of the area consists of steep, rocky hills in the north and south; gently sloping alluvial fans in the east; and low rises in the centre and west. The low rises are linear with outcrop on the top. The alluvial fans thicken toward the Olary Creek in the east.

Vegetation is sparse and consists of grass and saltbush on the lower areas, with trees and shrubs restricted to the water courses and hills. Rainfall is low, and runs off the bare slopes easily. Top soil is thin and easily eroded with extensive caliche content over the slates.

Access roads are those made by the miners, and some parts have been eroded away. However, the tracks are suitable for four wheel drive vehicles.

2. HISTORY AND PREVIOUS INVESTIGATIONS

The mines were opened in the 1890's but operations ceased soon after the shafts were sunk. Only a few wagon loads of ore were removed. Brief accounts appear in Department of Mines reports beginning with Brown (1908).

In 1966 both Austminex Pty. Ltd. and Electrowinning Pty. Ltd. commissioned induced polarization (I.P.) surveys and drilled six locations around the Dalkey 1 and 2 mines.

Australian Gold and Uranium Pty. Ltd. which held the areas as part of S.M.L. 207 from 1/7/68 carried out chip sampling and drilled two holes off the grid area (Lopes, 1969).

The area passed to Sundowner Minerals N.L. in 1970 and is now part of S.M.L. 420. Lopes (1970) recommended that detailed geological mapping be conducted over the Dalkey-Mildaltie mine areas. Four I.P. lines were surveyed in the southern part of the area in September, 1970.

3. GEOLOGY

3.1. REGIONAL GEOLOGY

The generalized geology of the Olary area is summarized in the reports by Lopes (1969 and 1970). Attention was drawn to the importance of major faults in controlling mineralization localities such as the Dalkey-Mildaltie area where the MacDonald and Outalpa shear zones bracket the copper occurrences.

The rocks are Sturtian Series slates and tillites of the Adelaide System which lie unconformably on the Carpentarian Willyama Complex rocks about two miles to the north-east of the mines. The banded tillites consist of boulder erratics in a fine grained matrix with facies changes vertically and laterally to pebbly schists and slates. These are folded against the lower Proterozoic rocks and are commonly faulted at the contact.

The lower Proterozoic rocks north and east of the area of interest contain numerous copper and gold showings in quartz veins and are attributed by King (1958) to mineralizing activity in the early Palaeozoic. These veins occur in Proterozoic rocks and cut the unconformity in places.

3.2. DETAILED GEOLOGY

3.2.1. General

The area of interest is 11,000 ft. x 5000 ft. approximately centred on the Dalkey mines (plan 420-38). It contains four separate mines and numerous prospect pits with major mineral occurrences in the northern half. A grid over the area was mapped in detail in December 1970. A section 3000' x 11,000' of this grid was surveyed by the V.L.F. method with 50' station intervals along east-west lines 250' apart. Much of the area had been covered by previous I.P. surveys, but these used different grid orientations. 45 rock chips were analysed, (Appendix).

3.2.2. Lithology

3.2.2.1. Sediments

The stratigraphy is obscured by the presence of many drag folds and the monotonous similarity of slate and siltstone beds.

In the southern portion, bands of massive grey siltstone alternate with schists and slates. These units dip steeply to the north. The siltstones weather to a red colour, show slump structures and an odd drop boulder indicating some tillitic influence. They are locally discontinuous, probably due to facies changes, but in some cases the sharp contact with slaty siltstone along strike shows that the beds are faulted. These faults strike 025°. Occasionally a quartz siderite cemented breccia, more resistant than the rock it cuts, follows the line of these faults.

These lithologies become less massive higher in the sequence, passing into grey slates and schists with well developed slaty cleavage. The lithologies are similar on the northern side of the Outalpa shear zone, but the slates are folded and weather to a grey colour. There are a few massive bands up to two feet wide of mainly calcareous schistose siltstone and

quartzites which show intensive folding at intervals along strike. There is little folding south of the shear. The slates are fine grained, grey-green to bluish in colour, with a well developed schistosity. Over much of the area they are finely laminated (1-5 mm) with alternating dark and light coloured bands but this is a deformation effect, probably causing a chemical differentiation. The siltstones are dark grey where fresh, and dark brown on weathered surfaces. Slump structures are visible in the more massive units.

The northern section shows a marked change from the generally featureless fine grained rocks to massive boulder tillite of the Sturtian Series. This dips to the south showing that a major synclinal axis runs through the central part of the area. The sequence from oldest to youngest is massive boulder tillite passing to pebbly schists with iron rich and quartzite bands, then into the previously described slates. The boulder tillite weathers to a reddish-brown colour, but is grey on fresh surfaces. It contains erratics of all sizes mainly of granitic rocks, but some sandstones show cross bedding. The contact between it and the finer grained units is not usually marked, indicating facies changes. Several hundred feet up the sequence from the boulder tillite bands is a ferruginous schist of indeterminate width. This is a very incompetent friable rock in outcrop, and in places is a puffy, powdery schist which may be due to intensive leaching, in the weathering zone. The latter areas commonly exhibit much shearing and the rock within the shear zone is more resistant and dense. This indicates that the powdery appearance is due to processes acting after shearing.

Above this unit are interbedded slates and more competent quartzite units, some of which show pyrite pseudomorphs in outcrop. Chlorite development occurs where the beds are folded intensively.

3.2.2.2. Basic Dykes

In the north-west a set of basic dykes intrude along the shears. The dykes often occur in two parts with a shear breccia in between. These shear-dyke zones vary from four to twenty feet in width. The dyke-rock is ultramafic and varies in composition along strike and is discontinuous in outcrop. It is highly weathered and altered in places, while fresh and massive in others. The shear breccias do not show any sign of mineralization. This was confirmed with assays.

3.2.2.3. Quartz Veins

Quartz veins and stringers are abundant throughout the region, and the pattern and density of occurrence is not related to the localization of mineralization. All the veins trend with steep dip toward 112°, and appear to be related to the slaty cleavage, which is distorted around the veins. The schists and slates are chloritized at the contact with quartz veins, and stringers of quartz penetrate into fractures forming knots within the schists. Exotic mineral types often occur at the contact.

The veins are barren except in zones of shearing where copper staining occurs if the shear in mineralized. The shearing has distorted and fractured the veins, showing that they preceded the shears and hence that the mineralization of the shears is not related to the formation of the quartz veins. In some shears the breccia has been cemented by quartz, but this is generally impure, with many cavities unlike the massive quartz of the veins.

3.2.3. Structure

3.2.3.1. Introduction

While the geological mapping was in progress data were collected for a detailed structural analysis of the Dalkey-Mildaltie area. This was necessary to give a

clear picture of the region in three dimensions, and to sort out the apparently complex structure. Basic mapping has shown that the monotonous similarity of rock types in the central regions prevented a clear definition of the structure and it was hoped that the time sequence and inter-relationship of each structural feature could be worked out.

The parameters measured are listed below:

1) Bedding.
2) Slaty cleavage.
3) Schistosity.
4) Lamination L1, 1-5 mm wide with alternating grey and buff layers.
5) Layering L2, Indistinct, and shows up as rippling effect on laminations 4).
6) Plunges of fold axes; including drag folds and crenulations.
7) Joints; up to nine different joints systems.
8) Lineations - included in fold axis data.

3.2.3.2. Results of Structural Analysis

1) Bedding. Folded about horizontal axis, striking 110°.
2) Slaty Cleavage. Vertical - strike 110°.
3) Schistosity. Small scale folds in surface dipping at 20° towards 143°.
4) Lamination L1. Dips 90° towards 220° - folded in places.
5) Layering L2. Dips 70° towards 053°.
6) Plunge of axis. 15° towards 110°.
7) Joints. Main system vertical - strike 025° other directions 005°, 020°, 071° some horizontal.

3.2.3.3. Folding

The general structural trend does not vary greatly since the folds occur in complementary isoclinal sets. In the central parts the trend is variable with much folding of relatively flat beds. The major feature is a syncline plunging 0° - 10° towards 110° with the hinge passing through the area about 45N. The exact position of the hinge is obscured by the lack of outcrop, the many drag folds and the wide keel or hinge where beds are flat lying. The Dalkey 2 mines fall in this region.

The southern limb of this fold is truncated by the Outalpa Shear zone, but the amount of movement is not known.

Associated with this fold are parasitic folds with axes parallel to the main axis, and dimensions of the order of tens to hundreds of feet between the complementary anticlines and synclines. The drag folds are very obvious where a massive siltstone or calc-schist band within slates is folded.

Other younger sets of folds, not immediately obvious on the surface, are shown by crenulations and a poorly developed axial plane cleavage which dips at 70^{o} towards 053^{o} (L2). This results in a structurally complicated outcrop pattern in areas of dip reversals along hinge lines, and the Dalkey mine area shows this.

Since hinge areas of folding are favourable loci for mineralization, due to the tensional nature of the deformations, an attempt was made to correlate the mine areas with fold hinges, but the poor outcrop prevented this, except near Dalkey 2.

3.2.3.4. Faulting.

The Dalkey-Mildaltie area is bounded on the south and north-east by two major sub-parallel fault zones of regional significance - Outalpa and MacDonald faults respectively. The MacDonald fault shows definite major movement, while the Outalpa is more aptly termed a shear zone. The prominent slaty cleavage, which causes much of the geological sequence to be called slates is sub-parallel to the fault planes, and also to the axial plane of the major folds, suggesting that the genesis of both structural features is linked. These major faults in the region very probably continue into the basement opening up channel ways for mineralizing solutions.

Several minor, sub-parallel faults are inferred from photo interpretation and some field evidence in the area. Their effect on the structure is not obvious.

3.2.3.5. Shearing

Outcrop patterns are controlled by the occurrence of zones of shearing striking 025° and the whole region is affected by these. The lithological strike of the beds is obscured partly by this.

The individual shears within a zone vary in width from a few inches to twenty feet, and often contain brecciated rock at intervals along strike and are commonly recemented with siderite and sometimes by quartz. In plan a shear is locally discontinuous and may curve along strike varying from 000° to 030°. These zones, containing many shears, are continuous through the whole area, and the width is difficult to define but is of the order of a hundred feet. They have a constant strike of 025°. The rock within the zones is harder and more resistant to erosion than the unsheared rock, even when not brecciated and recemented. This causes the sheared rock to form the backbone of the low central hills, and enables small shears to be traced across areas of low outcrop profile.

The density of shearing increases to the north and is most intense in the boulder tillite outcrop in the north - this may be due to the excellent exposure and not the intensity of deformation.

The shears are genetically related to a well developed joint system throughout the area, and are actually joints on which movement has occurred. The dominant joint orientation is vertical with strike of 025°. However, less prominent, but important joints control the variation of shear directions within a shear zone.

The shears are normal to the general strike of the country rock, are not affected by the major faulting, and were the latest important deformational event in the region.

4. GEOPHYSICS

4.1. INTRODUCTION

Extensive I.P. and V.L.F. surveys have been carried out in the Dalkey-Mildaltie grid area. All the I.P. work was done for previous lease holders, except for four lines in the southern part.

The V.L.F. survey was conducted for Sundowner Minerals N.L. and covered that part of the grid between 1500E and 1500W from 0N to 11,00N.

4.2. INDUCED POLARIZATION

The I.P. results from the Electrowinning and Austminex surveys were used to produce contoured resistivity (p/2II) plans for three levels (300', 450' and 750') below ground surface (Plan Nos. 420 - 40, 41, 42). The purpose of this was to trace a bed of low resistivity to depth and to correlate the stratigraphy and structure with the metal factor anomalies so as to define possible locations of copper mineralization.

It should be emphasised that the resistivity map is not one of the distribution of actual strata. It is only an indicator of the presence of rock of varying resistivity about the depth given. The penetration of the measured current varies according to the resistance of the rock it passes through, and a highly conductive bed with low dip will allow relatively little penetration for the increased electrode spacing. Alternatively, if it is steeply dipping the penetration will be good but in the vicinity of the bed the picture will be distorted.

Hence the picture obtained from the resistivity maps should be adjusted for the presence of the steeply dipping conductive band in that area. At greater depths, the distortions and averaging effect of the method of measurement will allow only broad features to be significant.

4.3. V.L.F.

By using the profiles obtained from computer simulation together with the analysis of Paterson, it was found that the relation between inflection points and the relative magnitude of the quadrature components was extended. It was found that, points of cross-over on the in-phase and out-of-phase field profiles were frequently associated with zones of shearing, and in some cases, faulting (Whiteley, 1971).

5. MINERALIZATION

5.1. OCCURRENCE

Visible mineralization in the Dalkey-Mildaltie area is confined to specific localities along narrow shear zones. Of these localities two have been mined to some extent - Dalkey 1 and 2 - while several shafts have been sunk on others. The mineralization is copper and silver with the exception of the shafts at 90N, 25E which have high lead and zinc content tailings.

The deepest shaft in the area is believed to be 140 feet deep at Dalkey 1. Hence the mines are in general above the water table and only the surface mineralization was tested. This was rich, but representative assays are not available. Numerous prospect pits and trenches have been dug on small gossans and copper showings throughout the area, and in some places shafts up to 40 feet deep are sited on shears with some mineralization. The Mildaltie shafts are an example of this but little or no ore was removed.

All major diggings are on the main visible shear zones which run from the south-west to the north-east of the grid area. This is covered by alluvium in places, but where exposed in creeks and washaways shows evidence of mineralization only in the central and north parts, and this mineralization is intermittent. There is a local control on the occurrence of copper and silver in a shear which is discussed in Section 5.2.

The mineralization observed is:

(1) confined to shear zones.
(2) discontinuous along the strike of the shears.
(3) mainly in the central, north central and south-east corner of the grid.
(4) copper and silver, except for the Mildaltie diggings which contain lead and zinc.

5.2. MINERALIZATION CONTROLS

In evaluating the causes of the localization of mineralization all the observed relationships between the geological parameters at the locality were considered. If one particular set of relationships can be observed at most of the localities, then this can be used as a guide to finding other occurrences.

The outcrop in the Dalkey-Mildaltie area is not good and the complications which result from the deformations of the strata and the similarity of much of the rock section make it difficult to determine the precise geological setting of each copper showing. The geophysical surveys however, provide much information when combined with the observed surface geology. The data from Austminex Pty. Ltd. (1966) cover the whole north central area. It has been noted (3.2.2.1.) that a ferruginous band outcrops just south of the boulder tillite in the north of the grid area. This could be expected to contain iron sulphide at depth, and the Austminex drill holes apparently intersected this to the east of Dalkey 1 (Section 6). The geological map shows that the region is drag-folded with amplitudes of tens to hundreds of feet, hence this bed would be folded at depth. It was expected that the resistivity maps would show a relatively good contrast between this highly mineralized bed and the very poorly mineralized fluvioglacials and tillites. An inspection of the resistivity maps shows that an irregular band of low resistivity rock passes through the area south of the the boulder tillite. Following this to depth, it can

be seen that in general it dips steeply to the south. The area correlates with the surface occurrences of the iron rich schists and it is reasonable to assume that the resistivity maps give an indication of its occurrence at depth. In support of this, the strike of zones of equal resistivity follow that of the strata, and the apparent folds in the zones of equal resistivity have axes which plunge with low dips (15^{o}) towards 110^{o}, the same as the observed drag folds. In addition the amplitude is similar to that observed on the surface and the folds in the resistivity values keel out at depth, as beds in the limbs approach the hinge line. So it may be assumed that the resistivity maps give a three dimensional picture of the geological structure beneath the Dalkey-Mildaltie area.

Some feature to be noted from the resistivity maps are:

1. The mines - Dalkey 1 and 2 are both in shears which intersect a lower resistivity bed at 300'. At greater depths the intersection is improved for Dalkey 1 and disappears for Dalkey 2.

2. The folds keel out over a few hundred feet vertically due to their shallow plunges.

3. The beds above and below the iron rich band are highly resistive and possibly several other low resistivity bands occur in these. This is shown by the Dalkey 2 mine which lies in a bed of lower resistivity in the hinge area of a fold. However, the interpretation of that area is in doubt since the survey does not cover any depths shallower than 300'.

4. The folding intensity improves the width of the bed at various levels, making it difficult to determine the actual thickness of the conductive unit - it would not be less than several tens of feet and may vary greatly.

5. In the south a band of low resistivity is present at depth and dips in under the high resistivity bands of the central area. This is believed to be the same band as that outcropping north of Dalkey 1, but even if it is not, it is probably mineralized as indicated by the metal factor anomalies over it.

6. The major fold axis referred to in the section on structure passes through the area between 45N and 50N, i.e. approximately at the location of the Dalkey 2 mine. There is a major, but smaller scale, complex structure around the Dalkey 1 mine, where cross folding has occurred and several axes pass through the immediate vicinity.

6. DRILLING RESULTS

Drill holes by Austminex Pty. Ltd. tested anomalies in the Dalkey 1 area and these holes are plotted on the geological map (Plan No. 420-38). Unfortunately, the drilling was parallel to the shear systems and most likely missed the cause of the anomalies by a few feet. It is difficult to evaluate the results because it is uncertain how much the nearby shearing has affected the rocks drilled, however, it was shown that a zone of country rock, rich in iron sulphide (mainly pyrrhotite) dips under the surface strata to the east of Dalkey 1. Some chalcopyrite was found in a small shear with pyrite and pyrrhotite. It should also be noted that many of the beds contain limonite bands at depth.

7. CONCLUSIONS

The copper-silver mineralization observed in the area shows a correlation between the presence of a low resistivity iron-rich bed, fold structures and shear zones. Since this relationship is favourable for the deposition of copper in shears the other localitites with such conditions should be tested for probable copper mineralization.

One other possible control on the mineralization is the effect of lime bands which have been noted in the mine areas. These can provide favourable environments for the deposition of metals from solutions but this does not appear to have been the only control on deposition in the Dalkey-Mildaltie region since most shears are recemented with calcite and siderite and do not show mineralization at the surface. In addition the shear zones are crossed in many places by such bands but do not show mineralization.

8. RECOMMENDATIONS

1. The intersection of the iron rich schists with the Dalkey 1 shear zone should be tested with a diamond drill hole at 70N, 10E at an angle of 60° toward the west. This hole should have priority.

2. The wide intersections of the iron rich schists with shear zones to the east of Dalkey 1 should be tested with a drill hole at 73N, 19E at an angle of 60° toward the east.

3. A similar but less important iron rich schist/shear zone intersection should be tested by a diamond drill hole at 71.5N, 8W at an angle of 60° toward the east.

4. The V.L.F. survey should be extended to 25E and 25W from 65N to 80N. This will enable shears to be detected before drilling this promising area.

All of the diamond drill holes should be at least 800' long., to test as many intersections as possible.

16/4/71

K.C. Moriarty.
Geologist.
Minoil Services Pty. Ltd.

APPENDIX

CONYNGHAM ST. FREWVILLE SOUTH AUSTRALIA 5063 TELEPHONE 79 1662 TELEGRAMS 'TELEX' AA82520

THE AUSTRALIAN MINERAL DEVELOPMENT LABORATORIES

0115

PLEASE ADDRESS ALL CORRESPONDENCE TO THE DIRECTOR.

OUR REFERENCE: AN3/320/0 3057/71
YOUR REFERENCE:

20 January 1971

The Geologist in Charge
Sundowner Minerals NL
C/- Minoil Services Pty Limited
105 Gouger Street
ADELAIDE SA 5000

REPORT AN3057/71

YOUR REFERENCE:	Order No. 861
MATERIAL:	Rock chip
IDENTIFICATION:	As listed (prefix K)
DATE RECEIVED:	13/1/71

Enquiries quoting AN3057/71 to Officer in Charge please.

Spectrographic analysis by: R.R. Robinson

Officer in Charge, Analytical Section: A.B. Timms

for F.R. Hartley
Director

pkm

JOB 2257/71

AMDEL ANALYTICAL SERVICE

Semi-Quantitative Spectrographic Analysis Scheme A2

BATCH 0116

Form 23 Results in ppm unless otherwise stated. Detection limits in brackets.

	Sample No.	Cu (0.5)	Pb (1)	Zn (20)	Sn (1)	Cd (3)	Bi (1)	Ag (0.1)	Au (3)	Ga (1)	Ge (1)	As (50)	Sb (30)
1	D 1	3,000	3	30			x	0.5	x			x	
2	K 3	10	15	120			x	0.1	x			x	
3	4	250	1	20			x	1	x			x	
4	6	20	10	80			1	0.1	x			x	
5	7	>10,000	5	90			3	10	x			300	
6	8	200	10	40			x	3	x			x	
7	9	20	8	20			x	0.1	x			x	
8	10	1,000	8	30			x	0.5	x			x	
9	12	10	3	20			x	0.1	x			x	
10	13A	15	3	20			1	0.1	x			x	
11	13B	20	10	30			3	0.1	x			x	
12	14	15	1	20			x	0.1	x			x	
13	15	100	3	30			x	0.1	x			x	
14	16	10	8	30			3	0.1	x			x	
15	17	20	3	30			x	0.1	x			x	
16	18	30	25	20			5	0.1	x			900	
17	19	10	200	100			x	0.1	x			x	
18	20	30	3	20			x	0.1	x			x	
19	21	120	50	20			30	10	x			2,000	
20	22	>10,000	40	40			10	80	x			200	

Results are semi-quantitative. Elements apparently present in concentrations of economic interest should be redetermined by an appropriate accurate analytical technique. X = Not detected at limit quoted.

Geo A2 45 x 7 = 315

AMDEL ANALYTICAL SERVICE

JOB 3057/71 — Semi-Quantitative Spectrographic Analysis Scheme A2 — BATCH 0117

Form 23 — Results in ppm unless otherwise stated. Detection limits in brackets.

	Sample No.	Cu (0.5)	Pb (1)	Zn (20)	Sn (1)	Cd (3)	Bi (1)	Ag (0.1)	Au (3)	Ga (1)	Ge (1)	As (50)	Sb (30)
1	K 23	>10,000	50	60			20	5	x			200	
2	24	>10,000	25	250			1	30	x			200	
3	25	80	10	100			x	0·1	x			x	
4	26	>10,000	1	100			x	8	x			x	
5	27	30	40	60			x	0·1	x			x	
6	28	30	30	50			x	0·1	x			x	
7	29	20	20	100			x	0·1	x			x	
8	30	20	100	200			x	0·1	x			x	
9	33A	500	200	30			100	20	x			800	
10	K 33C	30	3	20			x	0·1	x			x	
11	34	60	30	80			x	0·1	x			x	
12	35	20	25	20			x	0·1	x			x	
13	37	20	3	20			x	0·1	x			x	
14	38	80	5	30			x	0·1	x			x	
15	40	100	3	20			x	0·1	x			x	
16	41	100	3	20			x	0·5	x			x	
17	42	80	1	20			x	0·1	x			x	
18	43	30	5	70			1	0·1	x			x	
19	44	30	5	80			2	0·3	x			x	
20	45	300	10	30			1	0·3	x			x	

Results are semi-quantitative. Elements apparently present in concentrations of economic interest should be redetermined by an appropriate accurate analytical technique. X = Not detected at limit quoted.

JOB 1057/71

AMDEL ANALYTICAL SERVICE

Semi-Quantitative Spectrographic Analysis Scheme A2

BATCH 0118

Form 23

Results in ppm unless otherwise stated. Detection limits in brackets.

	Sample No.	Cu (0.5)	Pb (1)	Zn (20)	Sn (1)	Cd (3)	Bi (1)	Ag (0.1)	Au (3)	Ga (1)	Ge (1)	As (50)	Sb (30)
1	K46	40	15	100			x	0.1	x			x	
2	47	50	15	100			x	0.3	x			x	
3	48	80	10	100			x	0.1	x			x	
4	50	100	10,000	8,000			3	15	x			800	
5	52	60	4,000	6,000			1	10	x			200	
6													
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15													
16													
17													
18													
19													
20													

Results are semi-quantitative. Elements apparently present in concentrations of economic interest should be redetermined by an appropriate accurate analytical technique. X = Not detected at limit quoted

71-43

III

0119

SUNDOWNER MINERALS N.L.
Special Mining Lease 420.

Olary District
South Australia

Report on
Four Prospects

By
T.J. Kennedy, B.Sc.

of
MINOIL SERVICES PTY. LTD.
May, 1971

CONTENTS

SUMMARY

During the course of a brief regional investigation of areas in S.M.L. 420 within a radius of 5 miles of Radium Hill mine, four old prospects were found and examined.

Interesting copper, silver and gold values have been obtained from specimens taken from the Gall Well East Copper Prospect. Follow up work on this prospect in the form of gridding, geological mapping and V.L.F. survey has been carried out but results are not promising.

The other three prospects, comprising two copper prospects and a kyanite prospect are not as interesting and no further work is recommended.

1. INTRODUCTION

The four prospects examined, comprising three copper prospects and a kyanite prospect lie in Special Mining Lease (S.M.L.) Number 420, held by Sundowner Minerals N.L.

S.M.L. 420 covers an area of 319 square miles in the Olary district of north-east South Australia.

Two copper prospects lie north and north-east of Radium Hill Mine respectively while the kyanite prospect and the third copper prospect occur north-west of Radium Hill. (Plan 420-64)

2. PREVIOUS INVESTIGATIONS

The two copper prospects north and east respectively of Radium Hill, namely Michelle Hill and Bonython Hill have been previously chip sampled by Minoil Services Pty. Ltd. prospector W. van Commence.

Twenty four random samples taken from Michelle Hill contained 200 to 10,000 parts per million (p.p.m.) copper.

Thirty six random samples taken from Bonython Hill contained up to 3000 p.p.m. copper (Shackleton, 1971, Plan 420-37).

3. REGIONAL GEOLOGY

The regional geology of the Olary Province has been previously described by Campana and King (B. Campana and D. King 1958).

This has since been revised by the S.A. Mines Department in 1969. (Olary Sheet 154-2)

Two of the copper prospects occur in Proterozoic Adelaidean rocks whereas the third copper prospect and the kyanite prospect occur in Carpentarian Rocks.

4. PRESENT INVESTIGATIONS

4.1. MICHELLE HILL COPPER PROSPECT

Michelle Hill is approximately one mile north of the Radium Hill Mine. The Radium Hill crusher bears 162° magnetic and the Radium Hill reservoir bears 231° magnetic.

A shallow pit about 3 feet wide has been excavated and a dark medium grained dyke rock containing malachite is exposed. This dyke rock is vertical and strikes south-east. The wall rock consists of Carpentarian granite striking 75°, dipping 70°S. No mineralization is evident in the granite.

Another shallow pit has been excavated just south of the main pit but no mineralization is evident.

4.2. BONYTHON HILL COPPER PROSPECT

This copper prospect occurs approximately 1000 feet west of the Bonython Hill summit and is about 2¼ miles north-east of the Radium Hill Mine.

A shaft has been excavated on an ironstone reef and malachite stained material is to be found in the dump beside the shaft. An original depth of about 20 feet is indicated by the size of the dump.

Adjacent to the shaft the ironstone reef strikes at 120° but the direction and angle of dip are not clear. The texture of the ironstone suggests an amphibolite origin.

Adelaidean quartzites south-east of the ironstone reef strike north-east in a basin formation centred close to the reef.

Carpentarian migmatites, schists and gneisses outcrop north-west of the Adelaidean rocks.

4.3. GALL WELL EAST COPPER PROSPECT

This prospect occurs about one mile due east of Gall Well and diggings are present either side of the fence line running east from Gall Well.

Three shafts and two major trenches together with some minor pits have been excavated on this prospect.

Gridding: A base line between the two main shafts and two cross lines gridded at 100 foot spacing have been laid out. The total line surveyed was 2,200 feet (Plan 420-68).

Geology: The copper occurs as malachite in narrow zones confined to the strike and dip of Adelaidean tillites and ironstones. In the two main shafts, formations are dipping vertical or near vertical and strike approximately north-south. Ironstone reefs with malachite in the tillite show a pinch and swell characteristic. Near the southern shaft small pits in barren tillite suggest the copper mineralization is not continuous along strike.

Tillite outcrop between the two main shafts strikes north-east and dips south-east at approximately 30^{o}. Granite outcrop on the surface probably represents exposed boulders embedded in concealed tillite.

Quartz reefs east of the northern shaft do not appear to be connected with copper mineralization. (Plan 420-68)

Geophysics: A total of 1200 line feet of very low frequency (V.L.F.) electromagnetic survey was conducted on the two cross lines adjacent to the two main shafts. Results are not encouraging as no significant conductors are evident in interpretation of values obtained. (Plan 420-69)

4.4.GALL WELL KYANITE PROSPECT

This prospect is about 1½ miles north-east of Gall Well.

The main prospect is a trench 20 feet long, 4 feet wide and 10 feet deep. This contains a narrow kyanite vein cutting through Carpentarian schists.

This vein is 4 to 6 inches wide and is vertical with a varying strike but trending 315°. It is dislocated in parts and consists of 90% - 100% kyanite. The schist host rock strikes 230° and dips 70° south-east.

There are other smaller trenches in barren schist north and east of the main trench. About 2 tons of kyanite ore are in the dump adjacent to the main trench.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. MICHELLE HILL COPPER PROSPECT

Copper mineralization is very weak and is not continuous along strike.

This prospect compares unfavourably with other prospects in the S.M.L. and hence no further work is recommended.

5.2. BONYTHON HILL COPPER PROSPECT

Specimens taken contained low copper, gold and silver values. No further work is recommended.

5.3. GALL WELL EAST COPPER PROSPECT

No major conductors were located in the V.L.F. survey and hence no further work is recommended.

5.4. GALL WELL KYANITE PROSPECT

The narrow width of the kyanite vein and the lack of kyanite in other shallow trenches do not indicate an economic deposit. No follow up work is recommended.

May 1971

T.J. Kennedy
Geologist.
MINOIL SERVICES PTY. LTD.

REFERENCES

CAMPANA, B. and KING, D.	1958	"Regional Geology and Mineral Resources of the Olary Province" Bulletin No. 34 Dept. of Mines Geol. Survey of S.A.
DEPT. of MINES of S.A.	1969	Olary Sheet 154-2 4 miles = 1" Preliminary Edition.
SHACKLETON, W.G.	1971	Special Mining Lease No. 420, Olary Area, South Australia. Summary of Exploration for the period 20.5.70 to 20.2.71 - Plan No. 420-37.

APPENDIX

Specimen	Location	Description	Copper %	Gold oz/ long ton	Silver oz/long ton
15	Bonython Hill Copper Prospect	Malachite stained sample from dump	0.60	<0.01	<0.04
16	" "	Ironstone	<0.01	<0.01	<0.04
17	" "	Dolomite ?	0.03	<0.01	<0.04
18	Michelle Hill	Copper bearing dyke rock.	3.2	0.01	<0.04
19	Gall Well East Copper prospect	Copper rich tillite.	9.5	0.02	1.27
20	" "	Ironstone from dump.	2.9	0.38	0.22
27	" "	Ironstone from shaft.	1.5	0.43	0.36
28	" " " "	Tillite wall rock from shaft	0.06	<0.01	<0.04

III

0129

GEOCHEMICAL SURVEY AROUND LUXEMBURG MINE AREAS, OLARAY DISTRICT, SOUTH AUSTRALIA.

SUNDOWNER MINERAL N.L.

Dated 21st September, 1971

GEOCHEMISTRY

INTRODUCTION

A geochemical survey was carried out on a reconnaissance scale over the Luxemburg mine area. This study was designed to determine whether metal concentrations could be related to the known mineralised zone and the previous geological and induced polarisation survey. Such an attempt had not previously been undertaken in this area. However, a grid was laid down in the area with a base line trending in NW-SE direction. Eight lines were erected vertical to the base line at 500 feet intervals and pegged at 200 feet intervals on either side of the base line for geochemical sampling; the individual vertical lines extended 2400 feet in each case.

MINERALISATION

Although many indications of mineralisation have been found around the area and the metal mining industry was well developed there, little work is carried on there at the present time. The Radium Hill area is on the south-west sideeof the Luxemburg mine and is not included in

the lease area. The mining industry in this area worked in a polymetallic mineralised zone and produced gold, copper, silver and lead.

METHODS USED

Samples were collected from each point over the whole grid area. These samples consist of both rock-chip samples and soil samples from a depth varying between 15 to 18 inches. The -80 mesh fractions of these samples were analysed for copper, cobalt and gold by the atomic absorption method. Since the intention of the survey was to discover and correlate areas of anomalous mineralisation, extreme exactitude of analysis was not sought, and reproducible results being preferred.

RESULTS

A total of 104 samples were analysed for gold, copper and cobalt. The minimum and maximum contents of the above elements are given below.

Element	Range of Variations
copper	5 ppm to 578 ppm.
cobalt	0.5 ppm to 217 ppm.
gold (in troy oz/long ton)	0.009 to 0.205

A statistical examination of the chemical data permitted the assignation of appropriate mineral values to specific areas in the anomalous zone in the area under investigation. These results provide a method of evaluating the relative economic probability of the deposit. The results of the statistical analysis are tabulated below.

Nos. of sample	Element	Mean	Standard Deviation	2 times Standard Deviation + Mean
104	copper	52	193	438 ppm
	cobalt	32	33	98 ppm

The samples which were found to be anomalous, from the computed values are mentioned here. Samples 2000N/200E and 2500N/200E, of values 578 ppm and 515 ppm are regarded as probable anomalous samples for copper. Cobalt also shows an anomalous result in the samples 3000N/800E and 3000N/600E, producing values of 212 ppm and 217 ppm respectively.

Gold has the highest value of 0.205 troy oz/long ton, in sample 3500N/800W.

Contour diagrams were prepared for the copper and cobalt, using the above analysis results to test for their further significance with reference to economic concentration (Fig. 1 & 2). Finally, a combined contour map was plotted for copper and cobalt on a separate sheet to determine the relationships of these elements (Fig. 3).

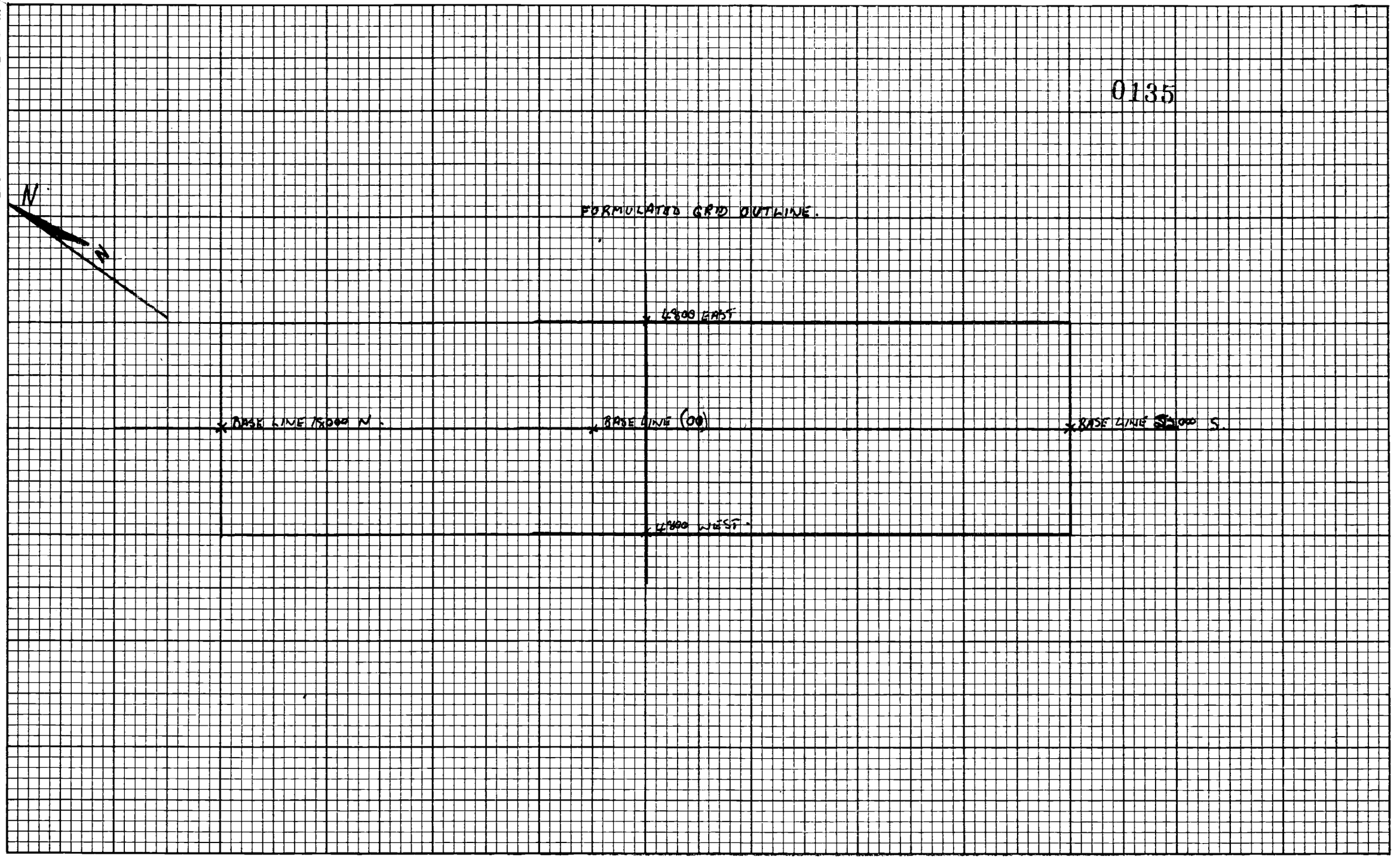
CONCLUSION

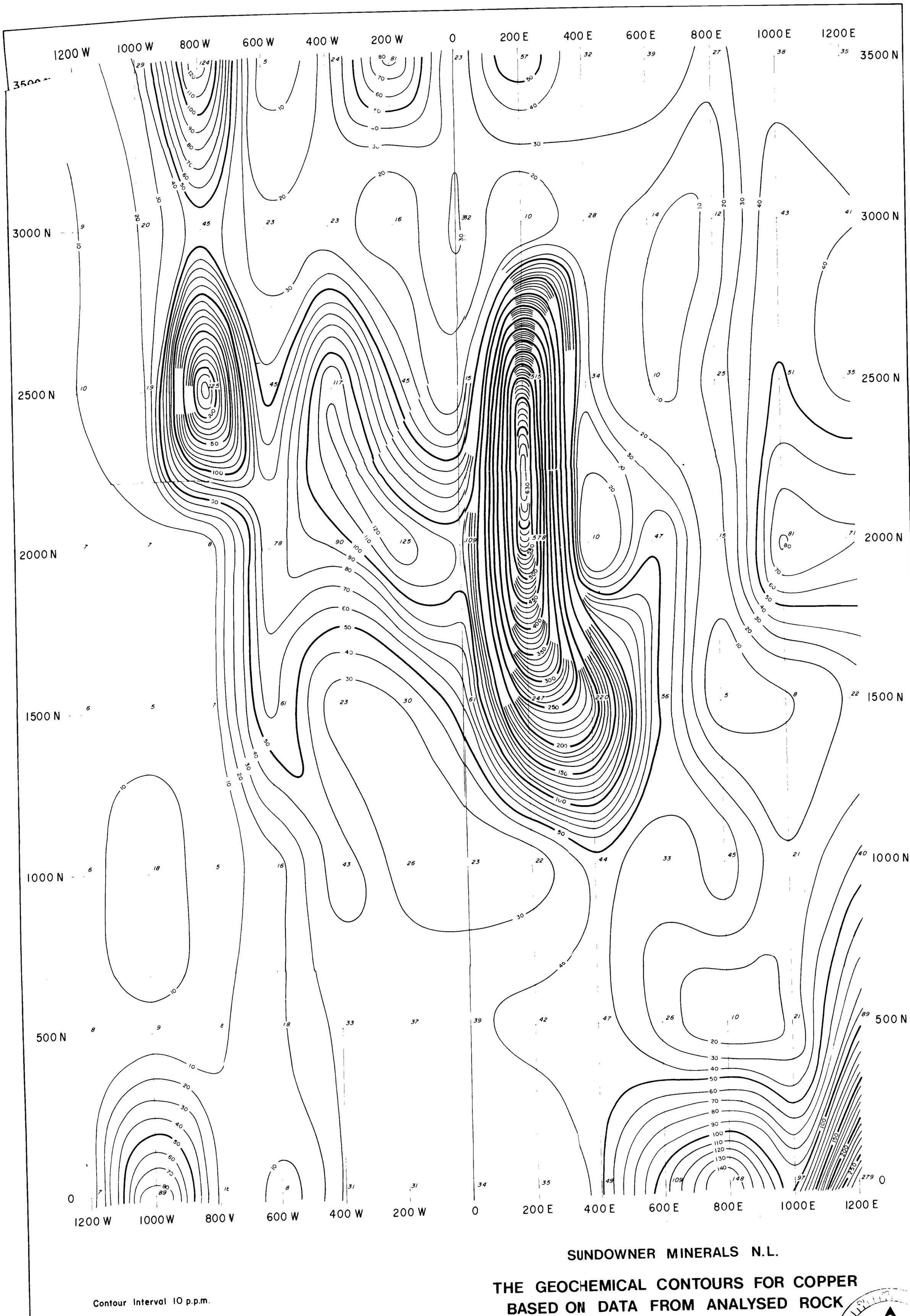
The interpretation of the results indicates that the mineralisation is largely controlled by the structural disposition of the area, and the low relief has greatly influenced the secondary dispersion pattern of mineralisation. Geochemical anomalies are located on the north east and south east of Queen Bee mine and this result coincides with the surface expression during geological study.

The present study reveals that a further detailed geochemical survey should be undertaken on the east side of the Queen Bee mine area.

Dr. P. K. Purkait
Chief Geologist

0135





SUNDOWNER MINERALS N.L.

THE GEOCHEMICAL CONTOURS FOR COPPER BASED ON DATA FROM ANALYSED ROCK AND SOIL SAMPLES BY A.A.S.

Contour Interval 10 p.p.m.

N

FIG. 1.

1200 W 1000 W 800 W 600 W 400 W 200 W 0 200 E 400 E 600 E 800 E 1000 E 1200 E

3500 N
3000 N
2500 N
2000 N
1500 N
1000 N
500 N
0

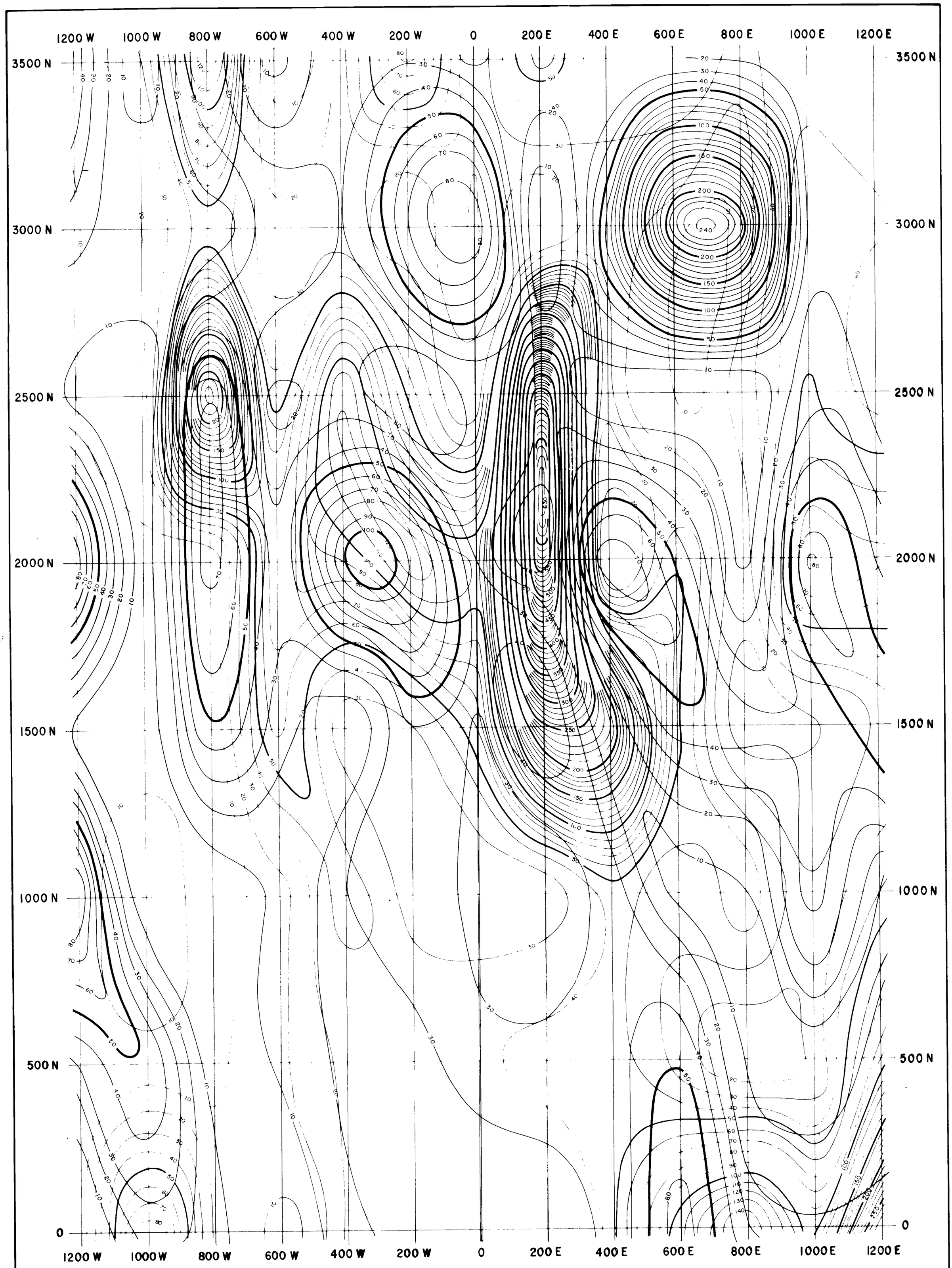
SUNDOWNER MINERALS N.L.

THE GEOCHEMICAL CONTOURS FOR COBALT BASED ON DATA FROM ANALYSED ROCK AND SOIL SAMPLES BY A.A.S.

Contour Interval 10 p.p.m.

N

FIG.2.



LEGEND

COPPER

COBALT

N

SUNDOWNER MINERALS N.L.

THE GEOCHEMICAL CONTOURS FOR COPPER AND COBALT

FIG. 3.

1387 III

ENV 1389(III)-3

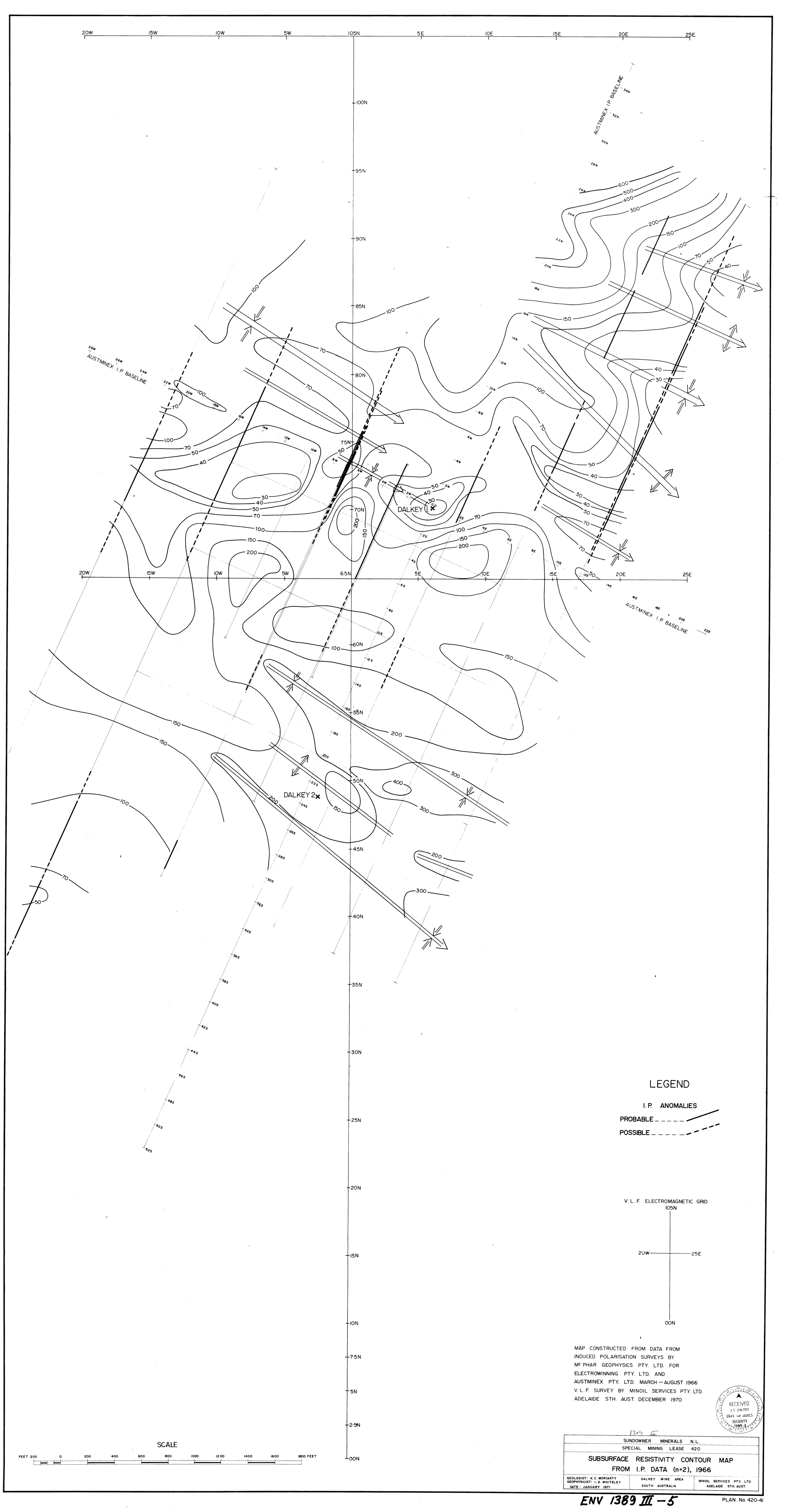
MAP CONSTRUCTED FROM DATA FROM INDUCED POLARISATION SURVEYS BY Mc PHAR GEOPHYSICS PTY. LTD. FOR ELECTROWINNING PTY. LTD. AND AUSTMINEX PTY. LTD. MARCH — AUGUST 1966.
V. L. F. SURVEY BY MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST. DECEMBER 1970

1389 I-4

SUNDOWNER MINERALS N.L.	
SPECIAL MINING LEASE 420	
SUBSURFACE RESISTIVITY CONTOUR MAP FROM I.P. DATA (n=4), 1966	
GEOLOGIST: K.C. MORIARTY GEOPHYSICIST: I.D. WHITELEY DATE: JANUARY 1971	DALKEY MINE AREA SOUTH AUSTRALIA
	MINOIL SERVICES PTY. LTD. ADELAIDE STH AUST

ENV 1389 III – 4

PLAN No. 420-42


20W
15W
10W
5W
105N
5E
10E
15E
20E
25E
100N
95N
90N
85N
80N
75N
70N
65N
60N
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50N
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25N
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15N
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7·5N
5N
2·5N
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AUSTMINEX I.P. BASELINE
DALKEY 1
DALKEY 2
600
500
400
300
200
150
100
70
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40
30
LEGEND
I. P. ANOMALIES
PROBABLE
POSSIBLE
V. L. F. ELECTROMAGNETIC GRID
105N
20W
25E
00N
SCALE
FEET 200 0 200 400 600 800 1000 1200 1400 1600 1800 FEET
MAP CONSTRUCTED FROM DATA FROM INDUCED POLARISATION SURVEYS BY Mc PHAR GEOPHYSICS PTY. LTD. FOR ELECTROWINNING PTY. LTD. AND AUSTMINEX PTY. LTD. MARCH — AUGUST 1966
V. L. F. SURVEY BY MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST. DECEMBER 1970
RECEIVED
SUNDOWNER MINERALS N.L.
SPECIAL MINING LEASE 420
SUBSURFACE RESISTIVITY CONTOUR MAP
FROM I.P. DATA (n=2), 1966
GEOLOGIST: K.C. MORIARTY
GEOPHYSICIST: I.D. WHITELEY
DATE: JANUARY 1971
DALKEY MINE AREA
SOUTH AUSTRALIA
MINOIL SERVICES PTY. LTD.
ADELAIDE STH. AUST.
ENV 1389 III – 5
PLAN No. 420-41

BALLARA

GEOLOGICAL SURVEY OF SOUTH AUSTRALIA
DEPARTMENT OF MINES ADELAIDE

FIRST EDITION 1952

1 MILE GEOLOGICAL SERIES

APPROXIMATE GRID PATTERN.

REFERENCE

CAINOZOIC ERA — QUATERNARY

- Qrt — Talus and thin deposits of pediments.
- Qra — Alluvium.

PROTEROZOIC ERA — TORRENS SYSTEM — STUARTIAN SERIES

- Ps — Slates and laminated slates with numerous interbedded thin quartzites
- Ps — Tillite and glacio-fluvials including thin slates and quartzites
- Ps — Quartzite and sandstone
- Ps — Dolomites and limestones
- Ps Fe — Iron formation (Fe)

ARCHAEOZOIC ERA — WILLYAMA COMPLEX

- A — Schists and gneisses, including garnet, sillimanite, staurolite and kyanite varieties. Gramitizational complexes including augen gneisses and migmatites.

IGNEOUS AND RELATED ROCKS

- Qtz — Quartz reef
- Porphyry dykes. (1) Diorite porphyry. (2) Microgranodiorite
- Pegmatite dyke
- Granodiorite—Aplite and Leucogranodiorite
- Greisen Dyke (Bristowe Hill)
- Amphibolitized gabbros, hornblendites, tonalite, and dolerites (dykes and plugs)
- Pegmatitic granite
- Biotite muscovite granite
- Cu — Ore Deposits

GEOLOGICAL BOUNDARIES
- OBSERVED
- APPROXIMATE
- INFERRED

FAULTS
- OBSERVED
- APPROXIMATE
- INFERRED OR CONCEALED

BEDDING
- STRIKE AND DIP
- VERTICAL
- HORIZONTAL
- STRUCTURE FORM LINES

CLEAVAGE
GNEISSOSITY, SCHISTOSITY

MAIN ROAD
SECONDARY ROAD
TRACK
RAILWAY
TRIG STATION
MINE
QUARRY
RIVER OR CREEK
WELL OR BORE — Well

GOLD — Au
COPPER — Cu
URANIUM — U
LEAD — Pb
IRON — Fe

Geology by R. C. SPRIGG, M.Sc., Senior Geologist.
R. C. Sprigg, M.Sc., Geologist in charge of regional map preparation.

Base map and cartography by Geological Drafting Section Dept. Mines, S.A.

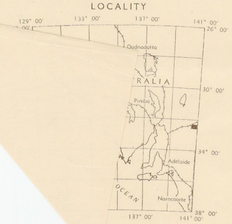
Compiled under the direction of S. B. Dickinson, M.Sc., Government Geologist.

Issued under the Authority of the Honourable A. Lyell McEwin, M.L.C., Minister of Mines.

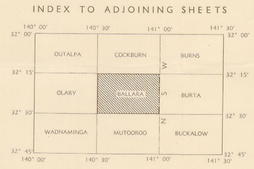
Published 1952.

Photo. Litho. S. R. Delmont Ltd.
Printed by M. E. Sherrah, Government Photolithographer, Adelaide.

LOCALITY



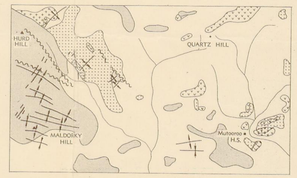
INDEX TO ADJOINING SHEETS



SCALE 1/63,360 OR 1 INCH TO 1 MILE

Chains 80 60 40 20 0 1 2 3 4 5 6 7 8 9 Miles

TECTONIC SKETCH



Faults — Adelaide System
Syncline — Willyama Complex
Anticline
Granitic Rocks
Amphibolites
Porphyry dykes

ENV 1389 III - 6

LEGEND

I.P. ANOMALIES

PROBABLE _____

POSSIBLE - - - - -

V.L.F. ELECTROMAGNETIC GRID

105N

20W — 25E

00N

MAP CONSTRUCTED FROM DATA FROM INDUCED POLARISATION SURVEYS BY Mc PHAR GEOPHYSICS PTY. LTD. FOR ELECTROWINNING PTY. LTD. AND AUSTMINEX PTY. LTD. MARCH — AUGUST 1966
V.L.F. SURVEY BY MINOIL SERVICES PTY. LTD. ADELAIDE STH. AUST. DECEMBER 1970

SCALE

FEET 200 0 200 400 600 800 1000 1200 1400 1600 1800 FEET

13x9 III

SUNDOWNER MINERALS N.L.
SPECIAL MINING LEASE 420

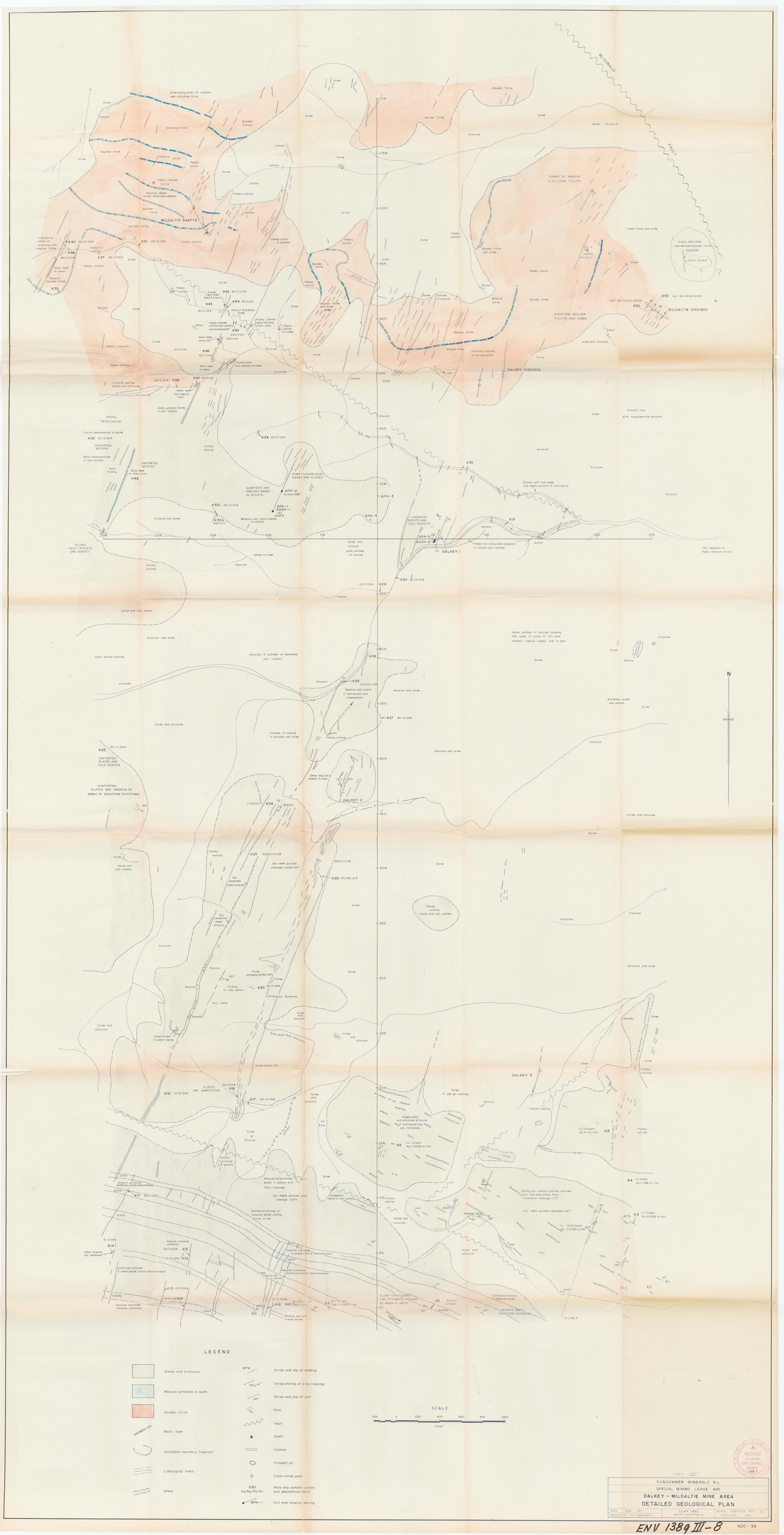
SUBSURFACE RESISTIVITY CONTOUR MAP FROM I.P. DATA (n=1), 1966.

GEOLOGIST: K.C. MORIARTY
GEOPHYSICIST: I.D. WHITELEY
DATE: JANUARY 1971

DALKEY MINE AREA
SOUTH AUSTRALIA

MINOIL SERVICES PTY. LTD.
ADELAIDE STH. AUST.

PLAN No. 420-40



SUNDOWNER MINERALS N.L.
SPECIAL MINING LEASE 420
DALKEY – MILDALTIE MINE AREA
DETAILED GEOLOGICAL PLAN

DATE FEB 1977	DIARY AREA	MINDEL SERVICES PTY LTD
GEOLOGIST R.C. MCKINLAY	SOUTH AUSTRALIA	ADELAIDE S.A.

RECEIVED 13 JAN 1977 DEPT. OF MINES SOUTH AUSTRALIA

ENV 1389 III – B

420 – 38

IV

1389/III

71-29 (2)

0136

SUNDOWNER MINERALS N.L.
Special Mining Lease Number 420

Olary Area
South Australia

GEOLOGICAL REPORT No. 1
on
LUXEMBURG EAST PROSPECT

by
D. Lopes

of
Minoil Services Pty. Ltd.
March, 1971

10-3-71

CONTENTS

PLAN REFERENCE

(In end pocket)

Number	Title	Scale
420-7	Luxemburg East Prospect. Resistivity and Metal Factor Contour Plan. Vertical Depth. 200'.	1" = 100'
420-8	Luxemburg East Prospect. Resistivity and Metal Factor Contour Plan. Vertical Depth 300'.	1" = 100'
420-9	Luxemburg East Prospect. Resistivity and Metal Factor Contour Plan. Vertical Depth 400'.	1" = 100'
420-10	Luxemburg East Prospect. Resistivity and Metal Factor Contour Plan. Vertical Depth 500'.	1" = 100'
420-12	Luxemburg East Prospect Magnetic Contour Plan.	1" = 100'

SUMMARY

The Luxemburg East prospect was discovered as a result of I.P. and magnetometer surveys in August 1969. Between July and November 1970 one diamond and two percussion holes were drilled to intersect I.P. targets. DDH-L7 was discontinued at 816'5" without intersecting any significant mineralization; percussion drill holes DDH L8 (pre-collared) and PDH 6 failed to reach target depth.

Outcrop is poor but drilling located alternating thin amphibolites and schists. Magnetometer results suggest the existence on an amphibolite body while I.P. results indicate the presence of conductors at depth.

One 500' diamond drill hole is recommended to test the area.

1. INTRODUCTION

The Luxemburg East prospect is an area approximately one mile east of the Queen Bee mine in the central portion of Special Mining Lease (S.M.L.) 420, held by Sundowner Minerals N.L., Olary district, South Australia.

Previous exploration has been reported as part of the Luxemburg mine area (Lopes, 1970).

The following is an assessment of exploration to 22/2/71.

2. GEOLOGY

Poor outcrop conditions and alluvial cover allowed geological mapping on a broad scale only. Geology has been inferred largely from magnetic surveys and drilling results.

Recent studies in the Queen Bee and Luxemburg South areas have shown that most magnetic anomalies in this general area are caused by amphibolite bodies. Elsewhere it has been noted that amphibolite areas have become depressions and contain little or no vegetation. This is also the case between I.P. lines LX and LV where the magnetic and I.P. anomalies are present.

The nearest outcrop is a low hill of anatectic granites and granite gneisses near induced polarization (I.P.)line LS.

3. EXPLORATION

3.1. GEOPHYSICAL

Induced polarization surveys have been conducted in conjunction with the Luxemburg - Queen Bee programme. Dipole - dipole spacings of 400', 200' and 100' have been used. Metal factor anomalies of over 400 were located (background 20). The anomalous area is greater than 2000' in length and is best expressed on lines LW and LU. The conductive body appears to be vertical or near vertical with an east-west strike.

The magnetic anomaly is greater than 2500' in length and correlates almost perfectly with the I.P. anomaly.

The accompanying I.P. and magnetic contour plans (Plan Nos. 7-10, 12) show this correlation very clearly. The highest metal factor readings are between 200' and 300' depth at 5N on both LW and LU. However, a deeper anomaly is present at LU,00 which is broadening beyond 300' depth.

3.2. DRILLING

One diamond hole and two percussion holes have been drilled on lines LW and LU.

DDH-L7, intersected biotite schists and amphibolites between 62' and 172'. At a depth, only minor amounts of pyrite and graphite were intersected which are considered insufficient to cause a strong I.P. anomaly.

PDH 6 was drilled to 128' but failed to reach target depth (300') because of water. DDH-L8 was percussion drilled to 158'.

4. CONCLUSIONS AND RECOMMENDATIONS

Previous I.P. work located a significant anomaly which subsequent drilling did not adequately test. Therefore, a 500' diamond drill hole from LU, 2N, depressed at 50° and bearing 180° (mag) is recommended.

W. Kuckieten
for

10/3/71

D. Lopes
Geologist.
MINOIL SERVICES PTY. LTD.

REFERENCES

Lopes, D., 1970 — Report on Exploration during period 1/7/69 to 30/3/70. S.M.L. 207, Olary District. Unpub.

IV

0143

QUARTERLY REPORT

FOR

SUNDOWNER MINERALS N.L.

S.M.L. 420

FOR THE PERIOD ENDED 23RD FEBRUARY, 1972

OLARY DISTRICT

SOUTH AUSTRALIA

DR. P.K. PURKAIT
CHIEF GEOLOGIST

March 17. 1972.

QUARTERLY REPORT FOR THE S.M.L. 420 HELD BY SUNDOWNER MINERALS N.L.

INTRODUCTION

S.M.L. 420, covers an area of approximately 300 sq. miles, and is situated 70 miles south of Broken Hill. The exploration work has continued very pleasingly, since Sundowner Minerals N.L. took possession from Australian Gold & Uranium Pty. Limited. From previous investigations, it was found that the interesting portions around the Luxemburg Mine area, which were drilled, resulted in finds of copper, averaging 2.5%. The reserve as estimated to date has not been sufficient to warrant a large scale operation; so in order to discover further deposits of the copper mineralisation, work is continuing at this site. In general, geochemical work had been very much neglected in this area, so a major programme, with a geochemical bias, was undertaken and as a result, an area of 16 sq. miles grid was formulated at intervals of 400 feet/ 400 feet. This geochemical grid covers

I Luxemburg South

II Luxemburg East

III Luxemburg West

IV Luxemburg North

V Winkler's Lead Mine

VI Mulga Hill Mine

Such an attempt was made to define multi-element geochemical patterns in relation to geology and to find out the dispersion characteristics of different elements in the area. It has been decided to analyse the collected rock and soil samples for the elements Uranium, Thorium, Potassium, Lead, Zinc and Copper. A total of approximately 2600 samples will be analysed in the course of the recently undertaken programme. The work, which was carried out by two geologists and two field assistants, was started at the end of November 1971, and finished by the first week in March 1972.

To this report, the result of the previously analysed rock and soils near the Luxemburg Mine area are attached. Interpretation of the results of previously reported anomalies on the north east and south east of Queen Bee Mine have greatly encouraged the present geochemical study.

This report also gives an indication of possible future development of the Winkler's Lead prospect.

GEOLOGY

A synopsis of the general geology is given below. The rocks covered by the survey are believed to be of Pre-Cambrian age and the oldest rocks are principally highly deformed gneisses, schists and pegmatites of Willyama Complex. The Willyama Complex is unconformably overlaid by younger

Adelaide System which consists of tillite, conglomerates, phyllites and minor dolomites and in some areas is intruded by pegmatite dykes. The regional strike is E-W, but marked divergencies of the strike occur NW-SE direction and as a result of shearing, the rocks are highly shattered. This shear appears to be continuous from south of Radium Hill to north of Green & Gold Mine, passing through the intervening Luxemburg Mine. It is interesting to note that the mineralised zones reported in the area, occur along the NW-SE trending shear zone and consequently most work has been concentrated on the north east portion of the shear plane. The south west portion of the shear plane is still to be investigated.

During present work, it was noted that uraniferous lodes occur as shear replacements and infillings in the fractures or along the foliation planes of the gneissic granite. The structures in the area are extremely complicated by shearing, faulting and folding and though previous workers advanced the work considerably, still more investigation has to be done to understand the structural formations of the area. In view of the above structural complications and considering the nature of uranium mineralisation, the best possible way to understand the uranium mineralising character is to undertake a geochemical study. Thus, it has been decided to analyse the presently collected samples over the 16 sq. mile grid for the elements uranium, thorium, and potassium, to determine their ratios in the different kinds of rocks (particularly in

gneissic granite) and with the help of these determinations, the locations of anomalous zones of uranium mineralisation will be possible in the near future.

Winkler's Lead prospect:-

This prospect has been subject to very detailed investigation and a more precise statement concerning its future development follows.

In 1898, this mine, which lies in the McDonald shear plane, produced 35¼ tons of lead (60% lead) and 689 ozs. of silver (11 ozs./ton). Brown (1908) states that one shaft was sunk in 1898 to a depth of 80 feet, but the deepest existing shaft is only 36 feet, whilst others have collapsed completely. However, this prospect was examined by geological and by induced polarisation surveys by consultant firm and the interpretation of the results of this survey has located anomalies on the eastern and western portion of the grid. This survey suggests that the mineralisation indicates a strike of at least 900 feet.

In view of the above results,and considering a precise geochemical study had been neglected, the present programme was initiated to locate exact drilling targets for future developments. It was decided to undertake a drilling programme of three holes (total 1500 feet), as soon as the geochemical results have been analysed.

CONCLUSION

During the present programme, the grid outline work and the collection of geochemical rock and soil samples have been completed. The analysis of these samples is still unfinished, but when completed, a compilation and correlation study will be undertaken, on the basis of which, a final report will be drafted immediately.

Very serious consideration is being given to the undertaking of a percussion drilling programme at the Winkler's Lead prospect in the near future. However, this will depend on the geochemical result of the present investigations. Expenditure during the quarter to 23rd February 1972 was $7478.00.

Future programme following this Quarter:-

I In the following quarter, major expenditure will be incurred to the analysis of soil and rock samples for the elements thorium, uranium, potassium, lead, zinc and copper.

II A closely spaced scintillometer survey over the 16 sq. miles grid will be undertaken.

III Correlation of all data to establish anomalous zones for

(i) Radioactive minerals

(ii) Lead, zinc and copper

P.K. PURKAIT

Dr. P.K. Purkait

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GSC LABORATORIES PTY. LTD.

A SUBSIDIARY OF GENERAL SUPERINTENDENCE COMPANY (AUSTRALIA) PTY. LTD.

REPORT No.: La/141

LABORATORY RESULTS

TO: Attention Dr. Purkait,
297 Elizabeth Street,
Sydney, N.S.W. 2,000.

QUANTITY: 115 Samples

VESSEL:

COMMODITY: Rocks

MARKS:

ANALYSIS PERFORMED ON SAMPLES SUPPLIED

Sample Number	Cu	Co	Au
00/1200E	279	25	0.003
00/1000E	97	21	0.004
00/800E	148	31	0.005
00/600E	109	62	0.004
00/400E	49	33	0.003
00/200E	35	27	0.007
BLOON	34	25	0.003
00/200W	31	23	0.002
00.400W	31	18	0.003
00/600W	8	3	0.003
00/800W	16	18	0.003
00/1000W	89	24	0.002
00/1200W	7	0.5	0.004
500N/1200E	89	11	0.001
500N/1000E	21	5	0.007
500N/800E	10	8	0.003
500N/600E	26	48	0.004
500N/400E	47	37	0.003
500N/200E	42	33	0.003

DATE:

GSC Laboratories Pty. Ltd.

Senior Chemist

Sample Number	Cu	Co	Au
500N/BL	39	34	0.003
500N/200W	37	27	0.004
500N/400W	33	24	0.001
500N/600W	18	11	0.003
500N/800W	8	7	BLD
500N/1000W	9	47	0.004
500N/1200W	8	31	0.003
1000N/1200E	40	9	0.004
1000N/1000E	21	42	0.002
1000N/800E	45	10	0.004
1000N/600E	33	7	0.004
1000N/400E	44	33	0.003
1000N/200E	22	22	0.004
1000N/BL	23	24	0.002
1000N/200W	26	39	0.002
1000N/400W	43	30	0.005
1000N/600W	16	13	0.004
1000N/800W	5	5	0.002
1000N/1000W	18	6	0.005
1000N/1200W	6	87	BLD
1500N/1200E	22	58	0.003
1500N/1000E	8	40	0.002
1500N/800E	5	43	0.001
1500N/600E	56	45	0.005
1500N/400E	220	10	0.001
1500N/200E	247	48	0.003

Sample Number	Cu	Co	Au
1500N/BL	61	28	0.001
1500N/200W	30	39	0.002
1500N/400W	23	15	0.007
1500N/600W	61	24	0.002
1500N/800W	7	48	0.003
1500N/1000W	5	5	0.002
1500N/1200W	6	7	0.003
2000N/1200E	71	38	0.005
2000N/1000E	81	64	0.011
2000N/800E	15	6	0.004
2000N/600E	47	49	0.007
2000N/400E	10	74	0.003
2000N/200E	578	6	0.007
2000N/BL	109	30	0.004
2000N/200W	125	89	0.002
2000N/400W	90	98	0.001
2000N/600W	78	35	0.002
2000N/800W	8	73	0.004
2000N/1000W	7	6	0.001
2000N/1200W	7	85	0.001
2500N/1200E	35	17	0.002
2500N/1000E	51	25	0.003
2500N/800E	25	1	0.004
2500N/600E	10	1	0.030
2500N/400E	34	BLD	0.017
2500N/200E	515	19	0.033
2500N/BL	15	22	0.006
2500N/200W	45	10	0.005
2500N/400W	117	26	0.004

Sample Number	Cu	Co	Au
2500N/600W	45	18	0.004
2500N/800W	225	69	0.002
2500N/1000W	19	2	0.002
2500N/1200W	10	8	0.003
3000N/1200E	41	18	0.004
3000N/1000E	43	20	0.004
3000N/800E	12	212	0.004
3000N/600E	14	217	0.002
3000N/400E	28	61	0.003
3000N/200E	10	BLD	0.002
3000N/BL	32	85	0.007
3000N/200W	16	70	0.004
3000N/400W	23	30	0.002
3000N/600W	23	39	0.007
3000N/800W	45	14	0.013
3000N/1000W	20	15	0.005
3000N/1200W	9	23	0.009
3500N/1200E	35	17	0.002
3500N/1000E	38	15	0.003
3500N/800E	27	19	0.001
3500N/600E	39	21	0.003
3500N/400E	32	22	0.001
3500N/200E	57	31	0.003
3500N/BL	23	19	0.004
3500N/200W	81	27	0.002
3500N/400W	24	28	0.003
3500N/600W	5	8	0.005
3500N/800W	124	38	0.205
3500N/1000W	29	7	0.005
3500N/1200W	12	49	0.002

Sample Number	Ag	Pb	Zn	U(ppm)
500N/600W	0.061	13	89	BLD
500N/1200W	BLD	13	39	210
500N/400E	0.037	12	72	BLD
00/1200W	BLD	12	31	BLD
90/600W	BLD	5	36	BLD
2500N/800E	0.042	1	21	120
2500N/1000W	0.023	1	27	360
3500N/800W	0.009	12	53	330
2500N/600E	0.028	6	20	150
00/1000E	0.037	21	75	170

Ag - results in ozs (troy) per long ton.

Pb, Zn - results in ppm.

IV

0154

FINAL REPORT

ON

EXPLORATION OF SPECIAL MINING LEASE NUMBER 420 OLARY AREA, SOUTH AUSTRALIA

By

P.K. Purkait, B. Sc. (Hons),
M. Sc. (Applied), Ph. D.,
A.M. Aust. I.M.M.

Of

Sundowner Minerals N.L.

5th April, 1972.

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ILLUSTRATIONS

ABSTRACT

The field component of this exploration project of S.M.L. 420 was carried out by visiting areas considered to be of economic potential in the environs of the past producing mines. The general aim in each instance was to gain an appreciation of the geological environment and the nature of mineralisation and to sample the ores and host rocks for various supplementary studies and purposes of comparison. The initial programme was therefore, geologically oriented and geochemical techniques were employed pursuant to the investigation of geophysical anomalies. Drilling has been recommended where warranted in certain areas. Southern portions of the area have been discarded.

INTRODUCTION

The Special Mining Lease No. 420, which Sundowner Minerals now holds, covers an area of approximately 285 sq. miles surrounding the uranium deposit of Radium Hill (Fig. 1). Radium Hill itself, though situated inside the present lease area, is classified as Crown Reserve Land and excluded from the Sundowner Lease. This excluded area covers approximately 3 sq. miles. The total area which Sundowner Minerals N.L. wishes to keep at present is shown in Fig. 2.

Since Sundowner Minerals N.L. took possession of the eastern portion of S.M.L. 207 2 years ago, work has been continued there and the exploration stage has advanced very pleasingly. Some of the interesting portions of the prospect were drilled, resulting in finds of copper. The reserve, as estimated to date has not been sufficient to warrant a large scale mining operation, so in order to discover further reserves of the copper mineralisation, work is continuing at this site.

The previous exploration work for S.M.L. 420 was centred on a regional basis, except in few localised interesting portions, for example the Luxemburg Mine areas, Winkler's lead prospect and Green & Gold prospect. Prior to the initiation of a drilling programme, work was also biased towards a

geophysical interpretation and information about the detailed geological settings and the general tectonic framework is still relatively limited. Systematic geochemical techniques had been grossly neglected in the previous exploration programme and in view of the shortcomings in these earlier studies, it is now proposed to undertake a systematic exploration programme in this area to determine the economic potential of the mineralisation. It is important to note that the vastness of the S.M.L. 420 area necessitates the spending of a substantial amount of time for the thorough exploration of the prospect.

From previous work it was concluded that the area tested, under S.M.L. 420, was of economic importance with respect to copper, lead and zinc mineralisation. However, the present programme will include a search for other minerals - eg. uranium, gold, cobalt, cadmium, silver, - whilst the possibility of discovering other minerals which are to be found elsewhere in the Olary district, will not be discounted.

To facilitate such an examination the potentially viable areas in the environs of past producing mines, have been selected and shown in order of preference in Fig. 3. These areas will be the prime targets of exploration, although exploration will continue beyond the known areas of mineralisation. An exploration programme was designed for this project and is

detailed below.

A discussion of the interesting areas is also included to explain the importance of the present exploration programme.

PREVIOUS INVESTIGATIONS:-

Exploration work has been in progress since the early part of the century and several companies have investigated the area in search of different economic minerals. The South Australian Department of Mines was mainly concerned with the search for uranium deposits, following the discovery of the Radium Hill uranium mine. Thus, a radiometric aerial survey was carried out over an area of 2000 sq. miles in the Olary Province and a radioactive deposit was discovered near Crockers Well in 1951.

The Bureau of Mineral Resources subsequently carried out both aeromagnetic and radiometric aerial surveys. The radiometric survey located several minor radioactive anomalies and it was found that aeromagnetic anomalies were related to the banded iron formation in the area. Intermittent work was continued until March 1966, when Electrowining Pty. Ltd. started exploration work around the Dalkey group of mines. In these prospects, the aforesaid company employed Mephar Geophysics Ltd. to carry out I.P. and magnetometer surveys.

On the results of the above survey, a drilling programme totalling 2162 feet in depth (both percussion - 1173 feet and diamond drilling - 989 feet) was undertaken, but no significant mineralisation was discovered.

Following the above programme, Austminex Pty. Ltd. began work in August 1966 around Mulga Hill, Cemetry prospect, Winkler's Lead and Luxemburg Mines. However, in their estimation, these prospects were considered to have no economic potential.

In 1968, Australian Gold and Uranium Ltd. hired Austral Exploration Services Pty. Ltd. to carry out a helicopter scintillometer survey over 130 sq. miles around Radium Hill. This survey located 15 anomalies, of which four were drilled, but without success. Before surrendering the lease to Sundowner Minerals N.L., in June 1969, Australian Gold and Uranium Pty. Ltd. carried out both an induced polarisation survey and a magnetometer survey with a 400 feet dipole spacing around the Luxemburg Mines and Winkler's Lead prospect. The results were encouraging and several anomalies were discovered in the Luxemburg Mine areas.

GENERAL PROBLEMS OF THE PREVIOUS INVESTIGATIONS AND THE SCOPE OF THE PRESENT WORK:-

In recent years, research on different techniques of exploration have been carried out in manifold directions and there has been a marked inprovement in these techniques throughout the world. Ore deposits such as uranium, copper, lead and zinc have attracted the attention and interest of geologists, geochemists, geophysicists and tectonists, and in a broader spectrum of ore geologists in general, and consequently a vast amount of investigation has been concentrated on different facets of exploration.

Workers with a tectonic bias have tried to arrive at a generalised theory of the tectonic structure of uranium, lead, zinc and copper ore metallogeny, but in fact, there is still no unequivocally established criterion by which one can assess whether or not the ore deposits may be considered to have had a structural control of mineralisation. Although affirmative evidence is often put forward and there is reason to believe that the deposition of these ores is structurally controlled, yet it is also true that structure is not the only factor to have controlled the deposition. Whilst previous workers in the Olary area advanced work in this aspect considerably, still more investigation has to be done to understand the structure of the area.

Previous airborne spectrometer surveys over S.M.L. 420 were undertaken with the standard low sensitivity scintillation instruments, but with improved techniques an 800 cubic inch system or a combination of systems (325 & 800 cubic inch volume) can now provide up to 1125 cubic inches of crystal volume gamma-ray spectrometer surveying. The undertaking of such an airborne gamma-ray spectrometer survey over the whole area is under serious consideration and will depend on the present geochemical results.

Results of the chemical analysis data for uranium, thorium and potassium from the granite rocks in the present area, are not yet available. The delineation of a geochemical province indicated by a characteristic enrichment/impoverishment of certain elements in rocks of widespread distribution within a well defined area, has been found to be a useful guide in exploration - areas characterised by the low Th/U and high U/K ratios should still be investigated for evidences of uranium mineralisation. It is anticipated that this technique will be extensively employed in this area.

This study, however, cannot be satisfied by investigation of one isolated facet alone, and a comprehensive knowledge of the different lithic units, representing various phases of geological history, is required. Consequently, whilst the secondary task of the present study will be to determine the

geological history and processes that controlled the deposition and later modification of ore deposits, the emphasis is decidedly on the search for economic minerals in the area.

MINING HISTORY

The area under consideration has a long mining history, although mining work has ceased for the interim in the area. Most of the mining work here was accomplished during the latter part of the last century or early part of this century, except for the Radium Hill mine which was worked for uranium intermittently until 1961. However, the latter will be excluded from the area under consideration as it is Crown Reserve property.

In the present area, as many as 29 mines have been recorded and these mines were worked for copper, gold, silver, lead, zinc, kyanite, uranium and iron ore; of these, uranium, copper and lead were the most important discoveries in the area. The aforesaid mines were located at the central, south central, eastern and north western part of the area (Fig. 3). The central mines formed the Luxemburg group, which included Luxemburg South, Queen Bee Mine, Luxemburg east, Luxemburg West, Bill's Hill Mine, New Luxemburg and Winkler's Lead prospect. The south central mines comprised the Dalkey group and were as follows: Dalkey Mine, Dalkey-I, Dalkey 2, Dalkey 3, Dalkey Hill Mine, Mildaltie and

Gall Well prospect. The most notable eastern mine was Radium Hill; others were Cemetry prospect, Mulga Hill Mine, Michelle Hill Mine, Extension Hill Mine, Bonython Hill Mine, Taylor's Shaft, Dey Hill 1 and Dey Hill 2. Macdonald Joan 1, Macdonald Joan 2, Macdonald Reef, Green & Gold Mines are situated in the extreme north west corner of the area. Cutana Mine is on the northern boundaries of the district.

Thus, it is evident that the area was widely mineralised, although in general it was found that none of these mines had a long production record or was situated on extensive deposits. Of all the mines mentioned above, some of the production figures and the extent of the mining activities are given below to provide an indication of earlier yields. In this way, indications may be gained of possible untested large stretches of mineralisation at depth.

From the record of mines, in 1908, it is found that H.Y.L. Brown stated that a vertical shaft of about 70 feet was sunk through heavily mineralised zones of sulphides interlacing in all directions, at the Luxemburg South or Premier Copper Mine. Silver was also present in this lode.

In 1898, Winkler's Lead mine, which lies in the Macdonald shear plane, produced 62½ tons of ore, comprising 35¼ tons lead (i.e. 60% lead) and 689 ozs. of silver. In 1908, H.Y.L. Brown also states that at this same mine, one shaft

was sunk in 1898 to a depth of 80 feet, but the deepest existing shaft is only 36 feet, This mine was worked intermittently until early in this century.

In the Macdonald Hill group of mines, little work was done and two shafts were sunk to a depth of 35 feet and 45 feet in this area.

Cutana mine produced a limited amount of copper over a distance of more than 60 feet and some silver (about 4 ozs/ton) with small quantities of gold also mined from rich shoots in the area. This was reported by Campana and King in 1958.

In the other aforesaid mines, very limited work was done and it is very difficlut to determine their production quantities. It seems safe to assume the workings were small in each instance.

GEOLOGY, STRUCTURE & STRATIGRAPHY

The first tentative study of Olary geology dates back to the early part of this century, but it was necessary to wait until 1958 for the first comprehensive work (Geol. Survey, South Australia, Bull. No. 34), carried out by Campana & King. This was followed by a number of publications by Thomas (1961), Thomson et al (1964, 1966), Dunn et al (1966), Compston et al (1966), Brown Cambell & Crook (1966) and

Perkin (1969). From a critical analysis of the work already done on this region, it appears that investigations of the Olary district and surrounding regions provide an excellent general background for further intensive work on individual sectors and aspects of the whole prospect. The Precambrian geology of Olary, in general, and of its north eastern part, in particular, has been the subject of some sporadic controversy.

In the field, it is clear that the Willyama Complex forms the oldest rock unit in this area and this Willyama Complex is unconformably overlain by Adelaidean System. The Willyama Complex is represented by high grade metamorphic rocks amongst which pelitic schists, amphibolites, granite gneisses, adamellite and pegmatite are prominent.

The Adelaidean System comprises tillite, conglomerates, phyllites, quartzites and minor dolomites. The composition of the yasement of the Adelaidean System and the top of the Willyama Complex is not yet firmly established and more work is needed to resolve this question. However, the basement of Adelaidean System is represented by the Willourian Series and its type area was described by Thomson (1966) as being the base of the Callanna beds near Wooltana. The Willourian Series comprises siltstone, slate, dolomite and sandstone. This series is secceded by Torrensian Series of the Adelaidean System, which, in turn has been overlain by the Sturtian

Series, which is well developed in the prospect of the Olary district. Thus the general stratigraphic succession of the area, based on regional studies, is as follows:-

PRECAMBRIAN SYSTEM	ADELAIDEAN SYSTEM		STURTIAN SERIES	TILLITES, BRAEMAR IRON FORMATIONS
	- - - - - UNCONFORMITY - - - - -			
	CARPENTARIAN	WILLYAMA COMPLEX		Anatectic granites Adamellite Granite gneiss Foliated Schists Amphibolites Dolerites Iron formations

The north and north eastern portion of the area is largely covered by the rocks of the Willyama Complex, whilst the south and south western part comprise Adelaidean rocks. The Macdonald shear zone cuts across these two rock units, trending in a NW - SE direction through the mid-portion of the prospect.

The regional structural arrangement of the rocks of this area has been investigated and discussed at some length by a number of workers including Campana & King (1958), Thomas (1961), Thomson (1966) and Perkin (1969), but the structures in the area have been extremely complicated by shearing, folding and faulting. Thus, though previous investigations advanced the work considerably, still more research has to be done to understand the structural formations of the area.

Some of the results of the present study are listed below.

(1) The rocks in the area, on either side of the major Macdonald shear zone show a uniform structural plan characterised by a cross-folded pattern to a greater or lesser degree, shearing being a late superimposition on this structural pattern.

(2) There is a progressive rise in metamorphic grade southwards from the granite border, ranging from chlorite to kyanite - sillimanite grade across the shear zone.

(3) The shear zone cuts across stratigraphic and metamorphic boundaries in the south west portion of the area.

(4) It appears that there have been large scale movements along the Macdonald shear zones. The geometry of the major

and minor structures within the shear zone and its environs indicate major movements along a series of sub-parallel shear planes. The shear zone represents a line of overthrust in the area.

(5) The arcuate nature of the shear zone and its convexity northwards, indicate that the shear zone rocks were compressed against a northern landmass which was probably the southern part of the Willyama granite body.

Detailed field work to substantiate these structural observations should serve to elucidate the geological and lithic disposition of the Olary area. Such studies are in progress and when the above substantiated observations are integrated with previous data, a co-ordinated account of the Olary geology in all its facets will result.

SPECIFIC AREAS IN THE PROSPECT:-

It has been noted that there is history of wide mineralisation within the prospect. Within the broader zone of interest shown on Fig. 3, special attention has been directed at specific areas which are commented in detail below.

Work, so far carried out over the previous known areas of mineralisation, does not show any attempt to determine

inter-relations of mineralisation in different parts of the prospect. An attempt has now been made to integrate the relationships of the various mineralisations at closely spaced mining centres. For this reason, the relevant areas are divided into four groups in the following manner.

Group I Luxemburg group of Mines:- includes Lux east, Lux west, Lux south, Bill's Hill, Queen BeeMine, Winkler's Lead, Cemetry prospect and Mulga Hill mine.

Group II Macdonald group of Mines:- includes Macdonald Joan 1, Macdonald Joan 2, Macdonald reef, and Green and Gold Mine.

Group III Dalkey group of Mines:- includes Dalkey 1, Dalkey 2, Dalkey Mine, Dalkey Hill Mine, Mildaltie Shoots Mine, and Gall Well prospect.

Group IV Dey Hill group of Mines:- includes Dey Hill 1, Dey Hill 2, Taylor's Shaft, Bonython Hill Mine, and Extension Hill Mine.

The above mentioned areas are the primary targets of exploration, but work has continued beyond these zones of

mineralisation. In particular, exploration extended between Radium Hill and Luxemburg Mines, and between the Macdonald Hill Mine and Green & Gold Mine.

Group I : Luxemburg Group of Mines:-

A detailed programme over 16 sq. miles was undertaken here to determine geochemical patterns in relation to the geology and structure (Fig. 3). As geochemical work had been grossly neglected here, a major programme with geochemical bias was necessitated. As stated in a previous report on the area dated 17th March 1972, the formulation of a geochemical grid and collection of all the rock and soil samples have been completed. These samples will be analysed for copper, lead, zinc, uranium, thorium and potassium. The interpretation of all the results is as yet incomplete. This project will also include a closely spaced scintillometer survey over the formulated grid pattern and such an integrated study will produce a comprehensive picture of the whole area when completed. The programme for this area is given on page 25 below.

Within this group of mines, the Winkler's Lead prospect has been subject to intensive investigation and it was decided to undertake a drilling programme of four holes (1600 feet) to substantiate the I.P. anomalies in this area.

The location of the drill holes are detailed in Fig. 4 where the relevant geological data are also represented.

Amongst the other mines in this group are Lux South, Queen Bee and Lux East, which are considered to have economic potential, and investigations are continuing at these sites to discover further deposits of copper mineralisation. These mines have been examined in detail, and at present serious consideration is being given to the undertaking of a systematic drilling programme as previous drilling projects failed to reach optimum depth indicated by the I.P. survey. However, the implementation of this new drilling programme will largely depend on the results of the present study.

Group II : Macdonald Group of Mines:-

The results of previously undertaken work warrant further detailed exploration of this area. Previous investigations suggest that further intensive geological and geochemical work is of utmost importance and this recommendation was seconded following the author's critical visit in the area, when it was decided to undertake an extensive geological and geochemical programme which will include all the Macdonald Hill mines and also the Green and Gold mine. Such a study will facilitate the determination of the relationship between the mineralisation and geological

components of the whole area. Although work on the Green & Gold has now reached an advanced stage, it is nevertheless felt that the above study will be of great assistance in finding new locales of mineralisation. An earlier magnetic survey located anomalous zones on the south east portion of the old workings and it has been suggested that an I.P. survey be conducted to determine the correlation between the indicated conductive bodies and the magnetic results. The present exploration programme for this group of mines is given below.

Three of the four located anomalies at the Green & Gold mine have been tested by shallow drilling. Field tests show that there is a concentration of copper mineralisation and the percentage of copper present varies from 1 to 2% approximately. The mineralisation was found mainly in iron stone and the deepest hole was sunk to 60 feet. Granite gneiss, iron stone, porphyry and mica schist rock types were encountered during this work.

Group III : Dalkey Group of Mines:-

Work previously undertaken was either sketchy in nature of limited in extent to isolated patches surrounding each of the separate mines of this group. On the basis of previous results, it was decided to give work in this area

a geochemical bias and it was interesting to note that the mineralisation in this group of mines occurs mainly in association with shales and tillites. This suggests that mineralisation belongs to the Adelaidean System, though the Carpentarian complexes are also in close proximity. The shear zone dominates this area, which warrants further detailed investigations.

Group IV : Dey Hill Group of Mines:-

Renewed attention has been paid to these areas, in particular with respect to radioactive minerals. At Radium Hill, the lodes of uraniferous mineralisation occur mainly in a NE - SW direction and these lodes are controlled by fold axes and overthrusting tendencies. The trend of the lode shears deviates from that of the principal fold axis on Radium Hill, where cross-warpings may be explained by the possible effect of igneous intrusive upwellings and regional faulting influences. Thus, it is evident that the Radium Hill area is structurally very complicated and as an extension of this area, the Dey Hill group of mines requires an exploration programme with a distinct structural bias. In addition, geochemical data will also be needed for the elements uranium, thorium and potassium to locate possible hidden uraniferous lodes in this locality. Weaker development of uranium mineralisation in this area was reported during

the previous investigations. Due to proximity of the area to known uranium mineralisation and bearing in mind its structural and stratigraphical complexities, it is considered necessary to re-investigate these areas using the above mentioned techniques.

DISCUSSIONS

From mining history and the results of the previous investigations the following observations are advanced to summarize the present state of knowledge and suggest further developments.

No mining work was commenced after the early part of the century in these well mineralised areas. Productions from different mines were very limited with the exception of the aforementioned lead yield from Winkler's lead mine (page 9).

After mining work had ceased, the only significant discovery was of copper mineralisation around Lux group of mines, yet this field was not, in itself, economically viable. Recently, Sundowner Minerals N.L. sank 6 drill holes totalling 9117 feet around Queen Bee mine shaft, of which 980 feet was drilled by pre-collaring percussion drilling. These drill holes were nos. L_6, L_{17}, L_{18}, L_{19}, L_{21}, and L_{27}. Drill hole L_4 on the same area was drilled previously by

Australian Gold & Uranium Pty. Ltd. to a depth of 570 feet, where it intersected mineralisation containing 2.6% of copper, over a true width of 10 feet, 8 inches. Amongst the other intersections, drill holes L_{19} and L_{21} are important. Hole no. L_{19} intersected copper of 3.3% over a true width of 6 feet at a vertical depth of 630 feet. In the case of drill hole L_{21}, mineralisation was intersected at a vertical depth of 900 feet with a copper content of 2.43%, over a true width of 3 feet, 11 inches.

From its old record, it was observed that the Queen Bee mine was worked to an approximate depth of 250 feet and that four sub-parallel drives were constructed trending mostly in a NE - SW direction, except in the case of the southernmost drive which trended in an E - W direction. The biggest drive was approximately 800 feet to the NE of the main Queen Bee mine shaft. However, the present drilling programme intersected an ore-body at greater depth around the old mine shaft, and it is noteworthy that no mining work or drilling has been undertaken on the west or south west portion of the shaft, yet I.P. results indicated large conductors striking E - W around this mine. In view of the shortcomings of former investigations, a systematic drilling programme will be undertaken as soon as the present study has been analysed thoroughly.

Around Lux East, hole nos. L_8 and L_6 have failed to reach the drilling target of 300 feet because of water seepage. Here again, I.P. results indicate the presence of a conductive body at depth. The above holes were sunk to a depth of 128 feet.

In the case of Lux South, the I.P. result indicates a mineralised area greater than 1000 feet in length. Two drill holes sunk in the anomalous zone, failed to reach the I.P. anomaly target again due to water seepage. In previous old workings here, the drive went only 250 feet in an E - W direction and the depth of workings was limited to only 70 feet in depth. Thus, there are indications in this area also of a mineralised zone beyond the old workings and consequently a drilling programme will be continued in this locality.

Except in the cases of abovementioned group of mines, no extensive mining work or drilling programme has yet been undertaken. However, the other groups of mines (II, III & IV) will be investigated in order of priority.

CONCLUSION

The main control of mineralisation in the area is structural. Broadly, lodes are emplaced along the surfaces of major tectonic disjunction. These surfaces are parallel to the mineral foliation at upper horizons. It appears that the concentration of mineralisation has taken place usually along the down-dip synforms on the surfaces of pronounced dislocation, giving rise to well defined ore shoots. These synforms are parallel to the down dip lineations such as striae on the slicken sides, grooving and mineral orientation etc. The possibility of other processes of control of mineralisation have not, however, been eliminated. Stratigraphic control of mineralisation is not completely absent, and lithologic control (in the chemical sense of the term) may possibly have occured in this area, although evidence of the above mentioned processes is not yet conclusive.

Dr. P.K. Purkait

Chief Geologist

EXPLORATION PROGRAMME

In view of the shortcomings inherent in the previous studies, it is proposed to undertake a systematic exploration programme in this area to investigate the complex geological history and determine in this way the further economic potential of mineralisation.

The projected exploration studies will be as follows for the Macdonald group of mines (Group II), Dalkey Group of Mines (Group III), and Dey Hill Group of Mines (Group IV), except the Luxemburg Group of mines. Separate programmes have been designed for the Luxemburg group of mines (Group I) and these have now advanced to the drilling stage.

A. Programme for Group II, Group III and Group IV Mine areas:-

(i) Detailed geological grid mapping is necessary for these areas to obtain precise information for the extension of the mineralisation and to determine the structural relationships amongst the rock units.

(ii) Systematic geochemical sampling should be undertaken simultaneously in all areas and the samples will be analysed primarily for copper, lead and zinc. In some cases the samples may also be analysed for uranium, thorium and

potassium depending on surface scintillometer surveys.

(iii) Geophysical - including magnetometer induced polarisation and self potential surveys, will be undertaken with a view to finding new locales of mineralisation. These surveys will be conducted selectively;wherever some processes have already been applied, they will not be duplicated.

(iv) Radiometric surveys will also be conducted in the same geochemical grid for testing for the presence of radioactive minerals.

(v) Finally, the economic concentration of the minerals will be determined by a drilling programme in the recommended sites, on the basis of the above investigations.

B. The programme for the Group I Mine Areas:-

(i) Compilation of all the drilling results to obtain a comprehensive picture of the whole area drilled and to assist in the planning of further drilling programmes in the area.

(ii) An attempt will be made to clarify the complicated structural disposition of the area.

(iii) Four drill holes will be undertaken at Winkler's Lead prospect to test the I.P. anomalies.

(iv) A closely spaced scintillometer survey will also be conducted over the present formulated grid.

(v) Correlation of all the geological, geophysical and geochemical data will be done to assist further drilling programmes around the Luxemburg East and Luxemburg South Mine areas.

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1200 W 1000 W 800 W 600 W 400 W 200 W 0 200 E 400 E 600 E 800 E 1000 E 1200 E

3500 N

3000 N

2500 N

2000 N

1500 N

1000 N

500 N

0

N

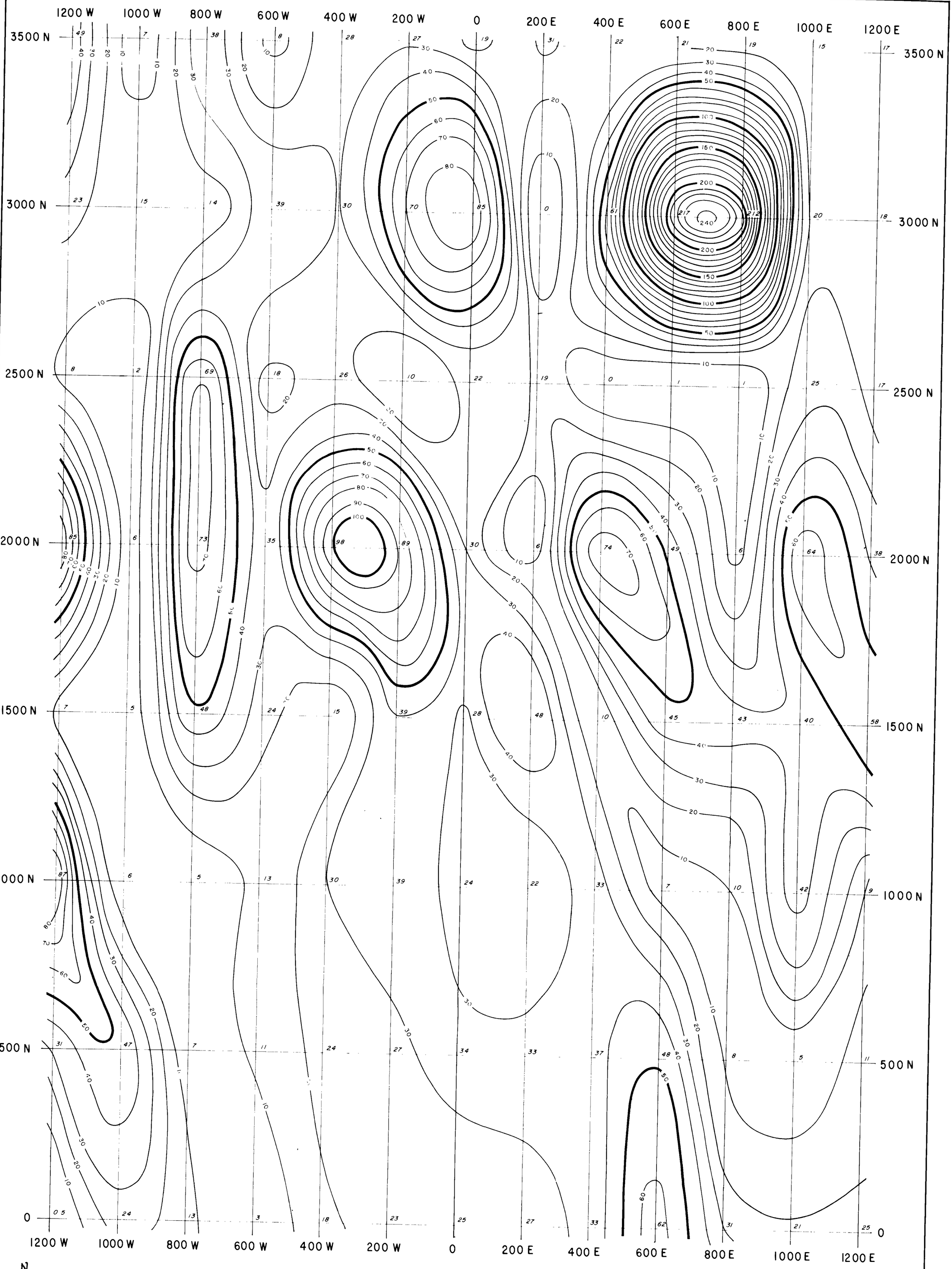
Contour Interval 10 p.p.m.

SUNDOWNER MINERALS N.L.

THE GEOCHEMICAL CONTOURS FOR COPPER BASED ON DATA FROM ANALYSED ROCK AND SOIL SAMPLES BY A.A.S.

FIG.1.

ENV 1389(IV)-1



Contour Interval 10 p.p.m.

SUNDOWNER MINERALS N.L.

THE GEOCHEMICAL CONTOURS FOR COBALT BASED ON DATA FROM ANALYSED ROCK AND SOIL SAMPLES BY A.A.S.

FIG.2.

ENV 1389 (IV)-2

1200 W 1000 W 800 W 600 W 400 W 200 W 0 200 E 400 E 600 E 800 E 1000 E 1200 E

3500 N
3000 N
2500 N
2000 N
1500 N
1000 N
500 N
0

N

LEGEND

COPPER

COBALT

SUNDOWNER MINERALS N.L.

THE GEOCHEMICAL CONTOURS FOR
COPPER AND COBALT

FIG.3.

ENV 1389(IV)-3

140° 23' 140° 25' 140° 30' 140° 32' 140° 35' 140° 38' 140° 41' 140° 44'

32° 08' 32° 10' 32° 11' 32° 12' 32° 13' 32° 14' 32° 21' 32° 23' 32° 24' 32° 25'

Duffer Dam
Bulloo Creek
Station Dam
Bore
"Bulloo Creek"
Tank
Tank
Lucky Bore
Cornish Well Creek
ALDOORRA HILL
Cutana Creek
Mac Donald Reef
Mac Donald Joon 2
Mac Donald Joon
Green & Gold Mine
BARRIER HIGHWAY
Sand Quarry
Wilkins Prospect
MAC DONALDS HILL
Mac Donald Hill
Yard
Sand Quarry
Mac Donald Hill Well & Dam
Cutana Creek
White Dam
Station Dam
"Cutana"
Wattys Dam
Yards
Dams
Cutana Quarries
Old Dam
Dam
Yard
Windmill Dam
Dam
Grant Quarry
Luxemburg Well
New Luxemburg Res.
Lux West
Luxemburg Mine
Queen Bee Mine
Winklers Prospect
Icle Top Mine
Premier Mine
Bills Hill Mine
Small Diggings Mine
HURD HILL
Dam
Woolshed & Yard
"Wiawera"
Wiawera Creek
Yard
Mulga Hill Mine
Eyging Dam
Extension Hill Mine
Birdcage Dam
Golls Well
Golls Bore
Cemetery Prospect
Nilpena Well
Mildattie Shoots Mine
Dalkey Hill Mine
Michelle Hill Mine
Bonython Hill Mine
Taylors Shaft
RADIUM HILL
Peters Dam
Dalkey Diggings
Dalkey-1
Dey Hill-2
Dey Hill-1
Dey Hill Dam
Dalkey 2
Dalkey-3
Dalkey Mine
BRISTOWE HILL
Hut
Maldigo Bore
Maldigo Dam
Olary Creek
Nilpena Well
SOUTH HILL
Dam
DEY HILL
Rockhole Dam
Landing Ground
Maldigo Well
NILPENA HILL
Nilpena Dam
Course Dam
Yards

60 0 60 120 180 240
SCALE IN CHAINS

DATE: 5th APRIL 1972

Main Road
Railway
River or Creek
Track
Mine
Homestead

GEOCHEMICAL EXPLORATION FINISHED
PROPOSED GEOCHEMICAL EXPLORATION
PROPOSED DRILLING

RECEIVED
17 APR 1972
DEPT. OF MINES
SECURITY
1389-4

FIGURE 3

SUNDOWNER MINERALS N.L.

SML.420
PLAN SHOWING PROPOSED EXPLORATION
OLARY DISTRICT
SOUTH AUSTRALIA

ENV 1389 IV - 4

LEGEND

- Alluvium brown, friable, covered in most places by a thin veneer of small quartz float
- Shale, grey, well weathered.
- Schistose tillite
- Anatectic granite, outcropping to some degree Light coloured, medium grain size
- Lead lode — accurate, approximate, inferred
- 30' Accessible shaft showing present depth
- 20° Accessible shaft, showing dip of shaft.
- Collapsed shaft
- Shallow diggings
- Q Quartz outcrop
- S2 Sample location
- Quartz vein
- Bedding with dip
- 80° Layering with attitude
- 30° Geological boundary, approximate
- WP1 Proposed drill hole site

WP1 WP2 WP3 WP4

S1 S2 S3

LINE 7W LINE 6W LINE 5W LINE 4W LINE 3W LINE 2W

Outline of grid

100 0 100 200 300 400 500 FEET
SCALE

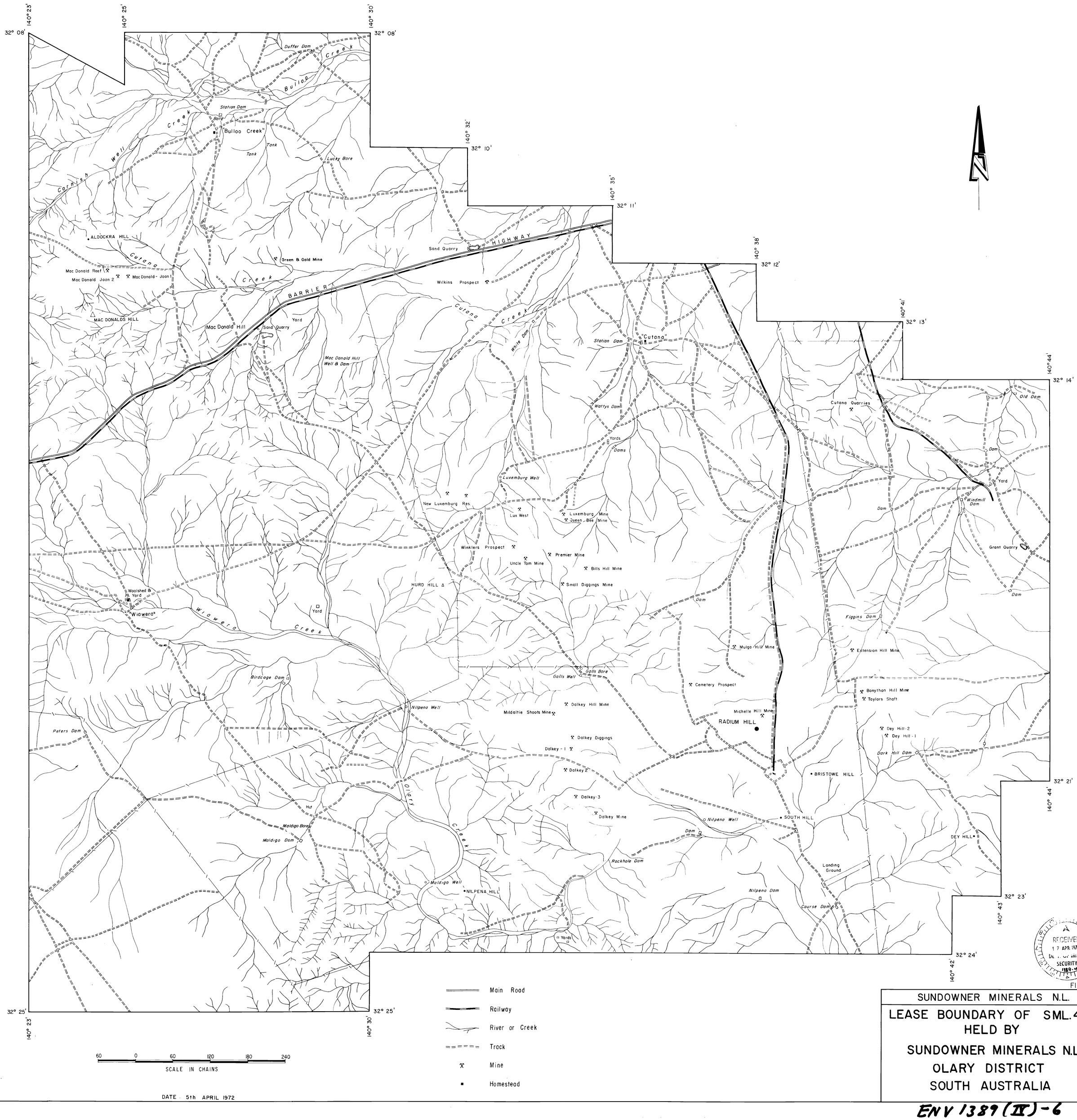
DATE 5th APRIL 1972

FIGURE 4

SUNDOWNER MINERALS N.L.

SML 420
GEOLOGICAL MAP OF WINKLER'S LEAD PROSPECT SHOWING LOCATION OF PROPOSED DRILL HOLES — OLARY DISTRICT SOUTH AUSTRALIA

ENV 1389(IV)-5



DATE 5th APRIL 1972

FIGURE 1

SUNDOWNER MINERALS N.L.

LEASE BOUNDARY OF SML.420 HELD BY SUNDOWNER MINERALS N.L. OLARY DISTRICT SOUTH AUSTRALIA

ENV 1389 (II) - 6