Open File Envelope No. 674

SML 96 AND SML 121

MOUNT GUNSON AND PERNATTY LAGOON

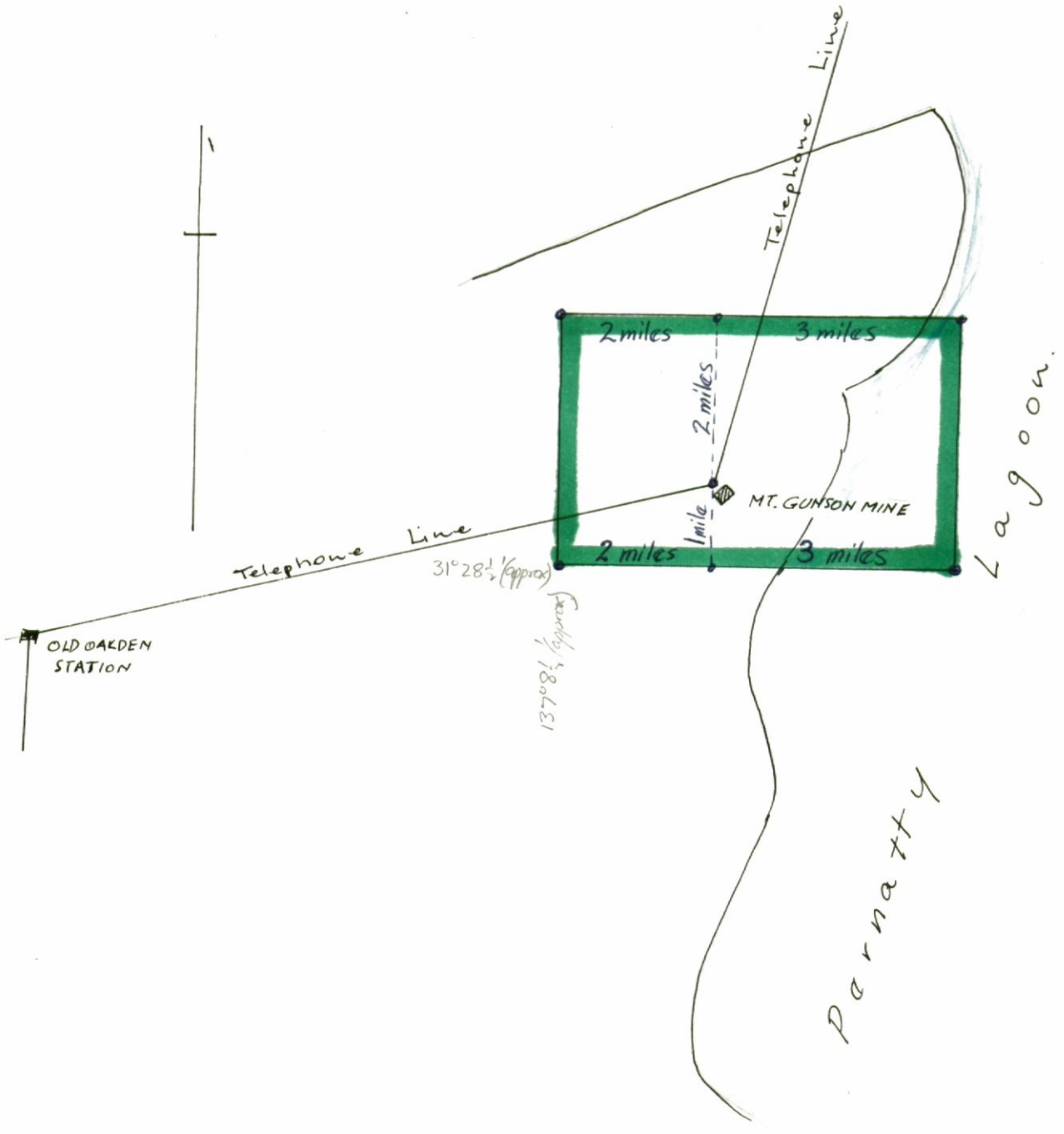
JOINT ANNUAL REPORT TO LICENCES' EXPIRY/RENEWAL, FOR THE PERIOD 1/12/1965 TO 30/11/1966

Submitted by
Austminex Pty Ltd
1966

Enquiries: Customer Services Branch
Minerals and Energy Resources
7th Floor
101 Grenfell Street, Adelaide 5000

Telephone: (08) 8463 3000
Facsimile: (08) 8204 1880

Government of South Australia
Department for Manufacturing, Innovation, Trade, Resources and Energy



AUSTMINEX PTY. LTD.

D.M. 1141/65 S.M.L. 96

D.M.	S.A. DEPT. OF MINES	SCALE
Tcd.		
Ckd.		Date

Please indicate approximate location of bore and return sketch to—DEPARTMENT OF MINES,
169 RUNDLE ST., ADELAIDE

SCALE
1" = 4 miles

N

31°30'

137°

South Point (Trig Station)

S.M.L. 96

137° 09'

8.0 miles

26.0 miles

31° 44'

AUSTMINEX PTY. LTD.

D.M. 1124/66 S.M.L. 121

137° 30'

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TENEMENT: S.M.L. 96 & 121 - Mt. Gunson, Pernatty Lagoon Area.

TENEMENT HOLDER: Austminex Pty. Ltd.

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CSR LIMITED

MT. GUNSON - STUART SHELF TENEMENTS

SML 96 (A)
Env. 625, 674
39 sq. km.
1.12.65 - 30.11.66

SML 121 (A)
Env. 674
508 sq. km.
1.8.66 - 30.11.66

SML 139 (A)
Env. 868, 906
629 sq. km.
1.12.66 - 30.11.68

SML 139 A (A, M, P)
Env. 1101, 1399, 1490
699 sq. km.
1.12.68 - 30.11.70

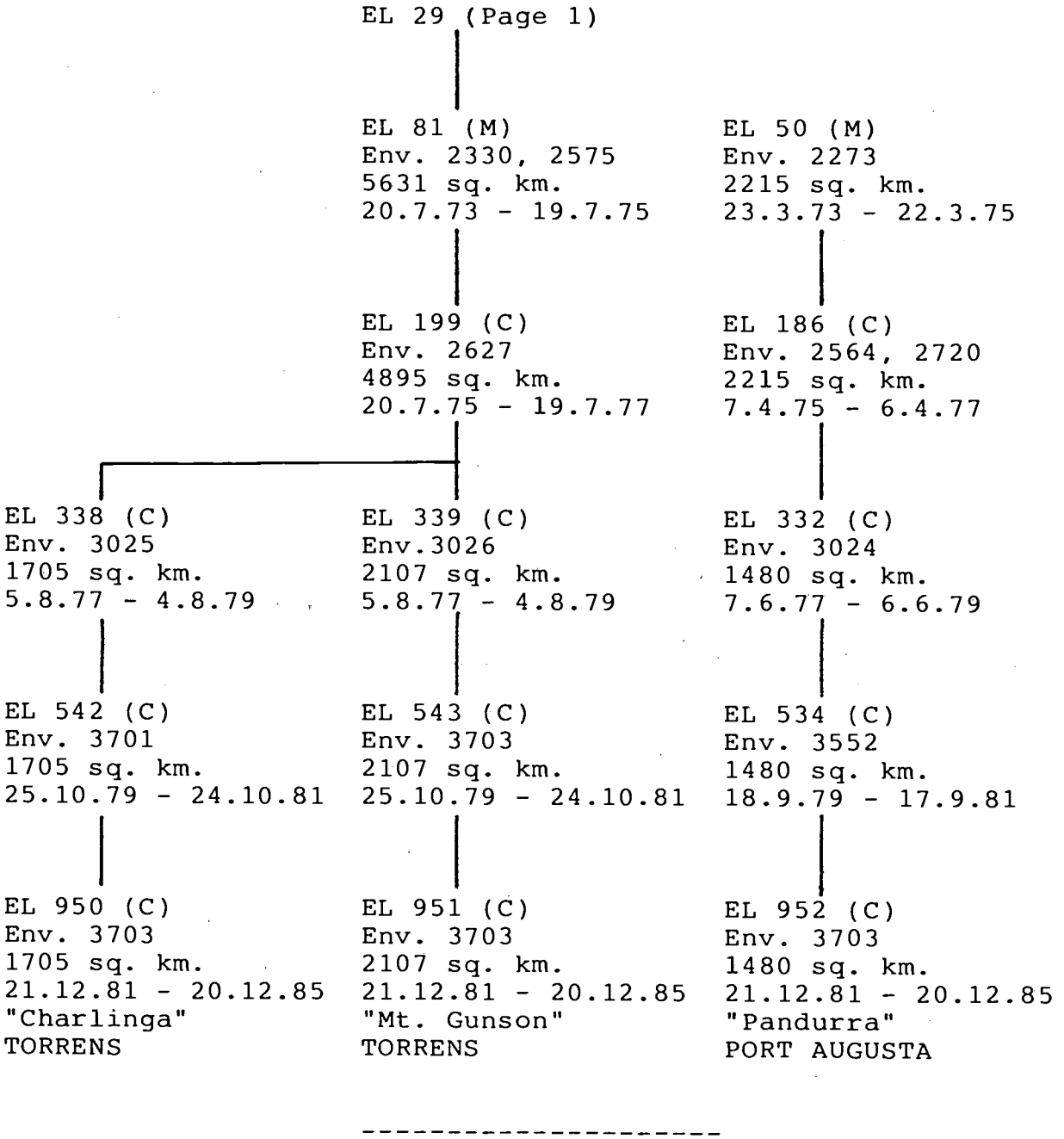
SML 494 (P, U)
Env. 1523
2461 sq. km.
5.11.70 - 4.11.71

SML 527 (P, U)
Env. 1563
699 sq. km.
3.12.70 - 2.12.71

SML 641 (P)
Env. 1855
1067 sq. km.
4.11.71 - 3.11.72

EL 29 (P)
Env. 2187
1067 sq. km.
7.12.72 - 19.7.73

EL 81 (Page 2)



Legend

1. Tenement No. (Company)
2. Env. No.
3. Area of tenement
4. Period of tenure
5. Tenement Name
6. 1:250 000 Sheet

Company abbreviations

A	Austminex Pty. Ltd.
P	Pacminex Pty. Ltd.
M	Mount Gunson Mines Pty. Ltd.
U	United Uranium N.L.
C	CSR Limited

Env. 674
2C

Data relating to exploration described in this Envelope may be included in some of the Envelopes here listed.

DATA AND REPORTS

RECEIVED FROM

CSR LTD., 1986

- 'MT. GUNSON area'

D.J. Flint

ENVELOPE	CLASSIFICATION	CONTENTS
6591	Open	Index (to be prepared)
6593	Open	Cattlegrid: Geology.
6594	"	" Drilling summary data & Drilling logs.
6595	"	" Plans. (Includes flotation tests and concentrate grades)
6596	"	" Mine Period Reports.
6597	"	" Mill " "
6598	"	" Shipping Data.
		Reports.
6604	Open	Lagoon: A) Reserves - East Lagoon & West Lagoon orebodies.
		B) Geophysical Surveys on East Lagoon orebody (Larson, 1970).
		C) Plans (face geology, geology, grade control, mining).
6605	"	MG14 Deposit: Metallurgy
6606	"	Main Open Cut: "
6607	"	Cattlegrid: Metallurgy & Mineragraphy (1973 & 1974 studies).
6608	"	" 1975 Mineragraphy of Mill products & feed.
6609	"	" Flotation testing of diamond drillholes.
6610	"	" Mineragraphy of mill products 1975-1983 by Pontifex & Associates.
6611	"	PETROGRAPHIC STUDIES: Includes Cattlegrid, Main Open Cut, Lagoon Workings, Powerline Embayment, Pandurra Formation, MG14, Gully
6612	"	DRILL LOGS: Main Open Cut Sheet and Main Open Cut deposit A) ABC GRID SERIES B) BGC (Biogeochem) GRID SERIES C) 3-4-XD series (9 holes) 3-13-XP series (Plateau area) MX GRID SERIES

D) Rod E. Jones XXX/XXX SERIES, 1981/1982.
E) 3-4-XP SERIES, 1971/1972 where X=1 to 325.
F) Notes/memos on exploration and drilling at Main Open Cut deposit.

6613 Open

DRILL LOGS:
A) HOUSE SHEET: ABC GRID SERIES
'R' SERIES
MAIN OPEN CUT SHEET:
'N' to 'L' series
(AUSTMINEX, 1966)
B) HOUSE SHEET: 3-3-XP SERIES.
(Mt. Gunson Mines Pty. Ltd., 1971/1972).
C) BGC GRID SERIES for:
HOUSE SHEET, Lines 4S to 30S South of TOWNSHEET.
(Austminex, 1967).
D) HOUSE SHEET - MN GRID
(Austminex, 1967/1968).
E) HOUSE TO MAIN SHEETS, Rod E. Jones XXX/XXX SERIES
of 800-770
to 870-540 (1981/1982).
F) MAIN OPEN CUT TO HOUSE SHEETS.
3-7-XP SERIES
(Mt. Gunson Mines, 1970-1972).
3-7-1P to
3-7-173P.

6614 "

DRILL LOGS - GUNYOT SHEET.
A) 1) Percussion drilling by Austminex, 1966-1967.
Millsite area.
2) ABC Grid (1966).
3) BGC Grid (1967) from lines 94N to 22N.
4) RAMSAY No. 1.
5) WATERHOLE No. 1.
B) Percussion drilling by Mt. Gunson Mines, 1971-72.
3-5-XP series
where X=1 to 32.

6615 "

GUNYAH LAKE SHEET:
Vol. 1) Report: Geochemical Test Survey, Gunyah Lake
(PMR Report 7/73, K.J. Maiden 1973).
Plans : Location of drillholes & I.P.
traverses.
: Location of drillholes - East
Lagoon & eastern area.
: IP surveys: proposed program.
: Bedrock Lithology.

6616 "

GUNYAH LAKE SHEET - DRILL LOGS:
Vol. 1A) MYSTERY AREA (1971).
3-6-XD series where X=1 to 7.
B) GUNYAH LAKE (1971-1972).
3-8-XD series where X=1 to 8.
Vol. 2A) MYSTERY AREA (1970-1972).
3-6-XP series where X-1 to 65.
Note: Both GUNYAH Sheet & HOUSE Sheet.
B) 3-12-XP series, (1971-1972)
where X=1 to 12.
South of HOUSE WORKINGS.

6617	Open	EAST LAGOON - DRILL LOGS: MT. GUNSON MINES PTY. LTD., 1970. 3-1-XP series where X=1 to 262.
6618	"	WEST LAGOON - DRILL LOGS: Mt. GUNSON MINES PTY. LTD., 1970-1972. 3-2-XP series where X=1 to 323.
6619	"	LAGOON AREA - DRILL LOGS: AUSTMINEX (1968) Diamond drillholes.
6620	"	LAGOON AREA - DRILL LOGS: AUSTMINEX (1966-1968) Auger drillholes. On grid: 6,520,000 to 6,521,000 mN and 707,000 to 709,000 mE.
6621	"	LAGOON AREA - DRILL LOGS: AUSTMINEX (1968). Vol. 1) Drilled on grid: 6,520,000 to 6,521,000 mN and all eastings up to 707,000 mE. Vol. 2) Drilled on grid: 6,521,000 to 6,522,000 mN and all eastings.
6622	"	LAGOON AREA - DRILL LOGS: AUSTMINEX (1967). Assorted drillholes.
6623	"	MAGAZINE HILL CLAY DEPOSIT: PACMINEX PTY. LTD., 1973-1974.
6624	"	PERNATTY LAGOON - DRILL LOGS: Western edge of Pernatty Lagoon. Regional Scout drilling by Pacminex in 1972, *5XX-XP series where *=F to L 5XX=505 to 520.
6625	"	MANGANESE WORKINGS (PERNATTY LAGOON): A) MT. GUNSON MINES PTY. LTD. memos of 1977. B) PACMINEX (1971-1972) percussion drilling of 3-10-XP series where X=1 to 20.
6626	"	WOOCALLA, IRONSTONE LAGOON, FAIR NELL MINE, SWEET NELL MINE, MONALENA: A) Geological plans and cross-sections. B) Pacminex, 1970. Drill logs - Sweet Nell Mine Fair Nell Mine 3-9-XP series where X=1 to 22. C) Pacminex, 1971. Drill logs - Woocalla area. 3-11-XP series where X=1 to 9. D) Pacminex, 1972. Drill logs - Monalena area (Woocalla). MONA XP series where X=1 to 16.

6627	Open	MG14 DEPOSIT: GEOLOGY AND DRILL LOGS, with plans and cross-sections. A) Pacminex (1973-1977) rotary percussion/hammer drilling of MG 1 to 21 29 to 41 82 to 100 B) Pacminex (1973-1975) rotary & diamond drilling of MG 14D to 93D (not inclusive). C) Pacminex (1983) drilling of MG501 to MG511. D) Relog of Woomera Bore and LY3.
6628	"	GULLY PROSPECT: Drilling and evaluation of copper resource. Drill logs of: GY1 to GY16 (1975) 3-7-127P to 3-7-129P 3-7-160P to 3-7-162P 3-7-165P 3-7-172P 3-7-173P.
6629	"	OAKDEN HILLS AND SELBY DAM: Pacminex (1973-1980). A) Regional rotary percussion, OK X series, i.e. OK1 to OK157. B) Geochemical drilling at: 1) OK3 Grid i.e. OK3-1 to OK3-86. 2) Selby Dam Grid i.e. holes 1 to 114. C) Diamond drilling - OK XD series i.e. OK36D "109-111D "113D "115D "119D.
6630	"	WINNIE PINNIE AREA: EL199 Pacminex (1976-1977). A) Interpretation of Input data. B) 1976 Rotary percussion drilling of 'input' anomalies, WP series, i.e. WP31 to WP88. C) Drill logs WP31 to WP88.
6631	"	LAKE WINDABOUT: EL199 Pacminex (1976). A) Drill testing of input targets in Lake Windabout district.. B) LW Series, Gamma ray logs. " " drillhole " .
6632	"	LAKE WINDABOUT: A) Drill logs - LW series, i.e. LW1 to LW97. B) Detailed diamond drill logs for: LW52,58,60-66 inclusive.
6633	"	LUCAS HILL: (=WEST LAKE WINDABOUT) Geophysical and Geological Logs.

6634	Open	POWERLINE EMBAYMENT: A) 1975 Summary report of exploration. B) 1977 Geophysical logging of PL32.
6635	"	POWERLINE EMBAYMENT: Drill logs, PL SERIES, i.e. PL1 to PL47 inclusive.
6636	"	BOOKALOO-LAKE DUTTON: Geophysical logging of drillholes, LD series BK series.
6637	"	BOOKALOO-LAKE DUTTON-LAKE MACFARLANE: Drill logs: Bookaloo BK1-BK22 Lake Dutton LD8-LD38 Lake MacFarlane MF1-MF13.
6638	"	LY SERIES DRILLING: A) LY2 (Cattlegrid) 1974 Geophysical logs. B) LY4-LY11 and 83/108 (East of Cattlegrid), 1983 Geological logs.
6639	"	BIOGEOCHEMISTRY: A) CATTLEGRID & MG14 AREAS (Pacminex 1978). B) PERNATTY LAGOON (Austminex, 1966).
6640	"	GROUNDWATER GEOCHEMISTRY - Stuart Shelf: Pacminex (1978) - Report PMR90/78.

6663	"	MT. WHYALLA BARITE DEPOSIT: Pacminex (1974) report - PMR 57/74.
6664	"	GEOLOGICAL MAPPING: Report: Elizabeth Creek area (Chisholm, 1974) Plans: Pernatty Lagoon Mt. Gunson Mines area Elizabeth Area Canegrass Dam area Wirrappa area.

6666 Open

DRILL LOGS - ELIZABETH CREEK & CANEGRASS AREAS:
EC23-EC54 (Elizabeth Creek)
TOC1-TOC4
SP1-SP19 (Snakepit)
3-14-19P to 3-14-41P (Canegrass Dam area)
3-14-1P to 3-14-46P (Canegrass field logs).

6667 "

DRILL LOGS-PANDURRA AREA (EL405):
Vol. 1. EX1-EX157
2. EX158-EX163 & YD1-YD15
3. EX164-EX184.
4.

Area	1:100 000	Drillholes
	6332	J12-J24
Roopena	"	P1-P4
"	"	J1-J11
"	"	I1
Cultana	6432	Q1, Q2
Cariewerloo	6333	Y1-Y6
"	"	T1-T5
"	"	X1-X3

6668 "

DRILL LOGS-WATER BORES in the MT. GUNSON area.

6669 "

DRILLING SUMMARIES:
3-1-X to 3-14-X series.

6670 "

DRILL LOGS-LAKE TORRENS AREA:
(see also ENV. 3769)
BDH1-BDH4
SLT101-SLT107
YAD1.

6674 "

ELECTROMAGNETIC SURVEYS:
A) Gunyah Lake, 1971 hand-held survey (1 plan only)
B) Cattlegrid & MG14 areas, airborne EM INPUT Test Survey by Geoterrex, 1973.
C) Winnie Pinnie area & Yudnapinna area, airborne electromagnetic survey, Barringer INPUT system, 1975. Geoterrex report 83-253 PMR Report 144/75.
D) Stuart Shelf (EL186, EL199), airborne EM INPUT survey by Geoterrex, 1975.
E) Mount Gunson Pulse Electromagnetic Test, 1977. (Ground Survey) PMR Report 58/77. Cattlegrid anomaly & Anomaly 'J' (margin of Pernatty Lagoon).
F) Pandurra & Cariewerloo, airborne EM INPUT Survey by Geoterrex, 1977.

6675 "

REFRACTION SURVEYS:
A) Austral Exploration (1967) Refraction Test Survey at Main Open Cut; West Lagoon; East Lagoon.
B) Austral Exploration (1973) Reconnaissance Seismic Refraction Survey - Mt. Gunson area.

6676 Open

GRAVITY SURVEYS:

A) Gravity survey - Pandurra area, EL186. Survey by Solo Geophysics, PMR114/77.

B) Gravity anomaly 'A' - Site for drillhole LH1. Notes (1978).

C) Magnetic & gravity survey with levelling at Illeroo Grid (Pandurra area, EL534. Report by Solo Geophysics (1979), PMR87/79.

D) Gravity Survey with barometric levelling at Yudnapinna Reconnaissance Line, EL534. Report by Solo Geophysics (1979), PMR88/79.

E) Interpretation of Geophysics, Illeroo area, EL534. Report by Langron (1980) PMR10/80.

F) Gravity survey - Pernatty Lagoon area, EL543. Survey by Solo Geophysics (1980).

G) Gravity survey - Mt. Gunson area, 'Blue Mag' anomaly 1981.

6677 "

AEROMAGNETIC SURVEYS:

A) Report on stage 1 on the interpretation of results of airborne magnetometer survey covering SML139, 152.

B) Report on an aeromagnetic interpretation, Torrens map sheet, S.A. PMR80/75.

C) Plan, EL186, April 1977. Magnetic Profiles.

D) Geoex (1978) Survey.
Plans of: Aeromagnetic total intensity
: Profiles.

E) Report on airborne magnetic surveys over an area East of Lake Dutton (Pernatty & Bookaloo 1:63 360 sheets). PMR10/78.

6678 "

RESISTIVITY SURVEYS:

A) Resistivity Survey at Pandurra near Port Augusta for Pacminex Pty. Ltd. EL186. Report No. 265 by Murdoch Geophysics, 1977. PMR60/77.

B) A resistivity survey at Mt. Gunson, S.A. for Pacminex. (Survey in June 1976) EL199. Report No. 266 by Murdoch Geophysics, 1977. PMR142/76.

C) Evaluation of a resistivity survey at Mt. Gunson, June 1976. PMR173/76, EL199.
(Localities: Cattlegrid; Oakden Hills; MG14).

D) Geophysical Survey at Cattlegrid, July 1973. Survey by CGG; PMR report 133/73.

6679 "

MISCELLANEOUS GEOPHYSICAL SURVEYS - MT. GUNSON AREA:

A) Report on a combined Induced Polarisation, Seismic and EM survey in the Mt. Gunson area. MacPhar Geophysics (1973).

B) Gravity and magnetic surveys on the North Pernatty Grid.
Lines 6,530,000N to 6,540,000N.
Solo Geophysics (1981).

C) Magnetic surveys of 'Blind Dyke', 1982-1983. Un-compiled plans and notes. Includes data of Solo Geophysics (1982).

2 K

6680 "

GEOPHYSICAL LOGGING OF DRILLHOLES-STUART SHELF:

A) Geophysical Logging of Drillhole PL32, Gunson area (i.e. Powerline Embayment). PMR138/77.

B) Geophysical logging of drillholes in the Mt. Gunson and Pandurra areas. PMR59/78.
i.e. OK117-OK120
OK128-OK129
WPB2-WPB4
WPB6
WOB10-WOB13
LW34, LW38, LW40
PL34
MG-11-3
PANDURRA AREA:
J12, J15, J16, J20, J21.

C) Geophysical logging of percussion drillholes, June-August 1978. PMR89/78. (EL332,338,339),
i.e. EC5
PL40
LD31
BK10-BK12
EX158-EX163

D) Geophysical logging in the lake Windabout, Powerline and Oakden Hills areas, EL339,
i.e. LW61-LW75
PL42-PL44
OK132-OK135
PMR Report 36/79.

F) Gamma logs - assorted drillholes.

6681 "

INDUCED POLARISATION SURVEYS:

1) IP Survey by Geoscience (1965) for Austminex, SML55.

2) IP and test resistivity survey by MacPhar Geophysics (1967-1968) for Austminex.

3) IP survey by Austral Exploration, 1971-1972, at: Main Open Cut
Gunyah Lake
East Lagoon
West Lagoon
Mystery
Sweet Nell areas.

4) Multi-mode I.P. survey by McPhar Geophysics, 1974 at: - Cattlegrid
- Gunyah Lake
PMR report 75/74.

6682 "

INDUCED POLARISATION SURVEY:
by SOLO GEOPHYSICS, 1983.
CATTLEGRID - MAIN OPEN CUT AREAS,
Includes: 'Haul Road' anomaly
'Dyke" anomaly.

6683	OPEN	'MOUNT GUNSON area' - regional plans and reports. Includes: A) Austminex (1966-1968) reports for SML 96, 121 and 139 - Pernatty Lagoon area. B) SADME articles on Mt. Gunson - extracted from Mining Reviews.
6714	"	MAIN OPEN CUT - plans
6715	"	CATTLEGRID - cross-sections.
6718	OPEN	HOUSE WORKINGS and GUNYOT workings. Plans only - sections, ore reserves, grade control and hole locations. Austminex Pty Ltd and Mount Gunson Mines Pty. Ltd.
6721	OPEN	CATTLEGRID: Surveying and engineering plans, pit development 1974-1986. Includes 1977 aerial survey.
6722	"	TOWN, CARAVAN PARK, SERVICES & TAILINGS DAM - surveying and engineering plans.
6723	"	CATTLEGRID - grade control for areas C2, C3 and Area IV. Predominantly plans - blasthole layout, top-of-ore, grade control plans and cross-sections.
6724	"	EAST LAGOON OREBODY - plans
6725	"	NORANDA AUSTRALIA Ltd (1967). Plans - Main Open Cut, House Workings, West Lagoon, East Lagoon, Mystery.
6726	OEPN	MAIN OPEN CUT - Cross-sections by Austminex Pty Ltd (1967-1968).
6727	"	WEST LAGOON - plans by Mount Gunson Mines and Austminex Pty Ltd. (Grade control, block plans, face geology, drillholes, cross-sections etc.)
6728	"	CATTLEGRID - Grade control plans for areas B2, B3 and B4 (east-northeast Cattlegrid). Plans of bottom-of-ore, top-of-ore, diamond drill-holes, diamond drilling influence areas as well as pit - and grade control - cross-sections.
6729	"	CATTLEGRID - End-of-period Survey Plans (1980-1982).

TOTAL: - 73 open file

Report of Exploration

in

S.M.Ls. Nos. 96 & 121

Period Ending November 30, 1966

AUSTMINEX PTY. LIMITED
INCORPORATED IN THE AUSTRALIAN CAPITAL TERRITORY
SUITE 20, 541 ST. KILDA ROAD,
MELBOURNE, VICTORIA, AUSTRALIA

NERAL EXPLORATION
NE DEVELOPMENT

TELEPHONE: 51-7002
TELEGRAPH: "CHAPWOLD" MELBOURNE

0004

HAR:vc

November 30, 1966

The Director of Mines,
Department of Mines,
169 Rundle Street,
ADELAIDE, S.A.

Dear Sir,

Re: S.M.L. No. 96 and S.M.L. No. 121

In accordance with the regulations governing the granting of Special Mining Leases, Austminex Pty. Limited herewith submits its report covering exploration activity in the Mt. Gunson - Pernatty Lagoon Area, S.A.

This report reviews all progress achieved on S.M.L. No. 96 and S.M.L. No. 121 up until November 30,1966.

Yours faithfully,
for AUSTMINEX PTY.LTD

H. A. Robinson

H. A. ROBINSON

AUSTMINEX PTY. LIMITED

MT. GUNSON - PERNATTY LAGOON AREA, S.A.

REPORT OF EXPLORATION ACTIVITY

in

SPECIAL MINING LEASES NOS. 96 AND 121

for

TWELVE MONTHS ENDING NOVEMBER 30, 1966

Dated in Melbourne
November 30, 1966

Submitted by H.A. Robinson

Chapman Wood Griswold & Evans Pty. Ltd.

MT. GUNSON - PERNATTY LAGOON AREA, S.A.

Report for Twelve Months Ending 30 November, 1966

Special Mining Leases Nos. 96 and 121

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C.W.G & E Drwg No. 18	Pernatty Lagoon Area Biogeochemical Plan - Inset 1
C.W.G & E Drwg No. 19	Pernatty Lagoon Area Biogeochemical Plan "A" - Inset 2
C.W.G & E Drwg No. 22	Pernatty Lagoon Area Induced Polarization Plan
Austminex Pty.Ltd., Drwg No. GP-5	Gunson - Main Open Cut Drill Hole Location & Assay Plan
Austminex Pty.Ltd., Drwg No. GP-6	Gunson - Pernatty Lagoon Area Drill Hole Location Plan
Section "C"	Mt.Gunson, Main Open Cut

ABSTRACT

Exploration activity by Austminex Pty. Limited in Special Mining Lease No. 96 in the Mt. Gunson - Pernatty Lagoon Area, S.A., prior to August 1, 1966, indicated copper mineralization of economic interest.

Following the granting of Special Mining Lease No. 121, a concentrated program involving biogeochemical, geochemical and geological investigation, outlined numerous other areas deserving more detailed examination.

Application has been made for a further Special Mining Lease covering this area. A program of exploration activity has been planned that could lead to the possible exploitation of the deposit.

RECOMMENDATIONS

1. Percussion dri lling should be carried out to further test the known mineralization in the Main Open Cut and Lagoon Workings.

2. Percussion drilling should be used to test anomalous areas outlined by the biogeochemical survey.

3. A bulk sample of the sulphide mineralization below the water table at the Main Open Cut Workings should be obtained.

4. A geochemical survey should be undertaken adjacent to known mineralization in the Lagoon.

5. Biogeochemical sampling should continue over already outlined areas still requiring more definite delineation.

6. Biogeochemical sampling should be used to survey the remaining tree covered portions of the Lease area.

7. The application of Induced Polarization techniques should be reinvestigated in the light of present geological knowledge of the area.

8. Cuttings from previously drilled holes should be re-examined with the aid of a binocular microscope.

9. Metallurgical test work should continue on the existing bulk sample and be undertaken on the new bulk sample.

10. Investigations into possible mining methods should be undertaken.

INTRODUCTION

As a result of a preliminary field examination in the Mt.Gunson-Pernatty Lagoon Area of South Australia, Austminex Pty. Limited applied for and was granted Special Mining Lease No. 96 over 15 square miles surrounding the old Mt.Gunson Main Open Cut Workings.

Initial percussion drilling over portion of the known mineralization gave sufficient encouragement to lead Austminex to exercise an option held over two Mineral Claims in the area and to plan a more extensive exploration program.

Field work involving 10,000 ft. of percussion drilling, with on site assaying of drill hole samples, yielded a Drill Measured and Drill Indicated Reserve Tonnage of economic interest. Geological mapping and geochemical sampling gave additional interesting information of the area. Metallurgical testing and investigations into marketing and facilities gave favourable results.

Austminex then applied for and was granted Special Mining Lease No. 121 comprising approximately 208 square miles enveloping the existing Special Mining Lease No. 96.

A permanent field camp was established on site as a base for the more extensive exploration activity planned.

A bulk sample was obtained from each of three areas of known economic mineralization and is being used for metallurgical testing by both C.S.I.R.O. and AMDEL.

An exploratory geophysical survey was carried out by the S.A. Department of Mines over parts of S.M.L. No. 96 and detailed geological mapping done over S.M.L. Nos. 96 and 121 by Austminex.

A program of biogeochemical sampling was undertaken over amenable tree covered areas of S.M.L. Nos. 96 and 121. This survey in conjunction with the geological mapping has outlined a number of areas in S.M.L. No. 121 warranting further detailed investigation and drilling.

REVIEW OF WORK PRIOR TO AUGUST 1, 1966

In August, 1965, Austminex Pty. Limited optioned two Mineral Claims Nos. 4368 and 4476 covering the Mt.Gunson Main Open Cut Workings in the Mt.Gunson - Pernatty Lagoon Area of South Australia, Area File SH 53.16.

On December 1, 1965, Austminex was granted Special Mining Lease No. 96 covering 15 square miles surrounding the two optioned Mineral Claims.

During January, 1966, a preliminary drilling program was carried out in a portion of the known mineralized zone of the Main Open Cut Workings. This work, involving 1,014 ft. of percussion drilling indicated the presence of ±500,000 tons of better than 1% Cu, amenable to open pit mining methods.

In February, 1966, Austminex exercised its option over the two Mineral Claims.

Geological mapping and geochemical sampling was undertaken within the area covered by S.M.L. No. 96 during March, 1966. The geochemical sampling was not conclusive but did indicate a weak anomaly in the region of the old Gunyot workings.

Composite samples made up from percussion drill hole cuttings were metallurgically tested by the C.S.I.R.O. Ore Dressing Division at the University of Melbourne. This work indicated, for the sample tested, an acid consumption of 2.3 lb. of acid/lb. Cu recovered yielding a 90% recovery of contained Cu.

Preliminary enquiries were initiated into the possibility of obtaining process water and electrical power from facilities feeding the Weapons Research Establishment at Woomera, S.A.

In April, 1966, a second drilling program was commenced. A total of 9,597 ft. of percussion drilling and 300 ft. of auger drilling, accompanied by onsite assaying of the drill hole samples, was carried out over three areas of known Cu mineralization within S.M.L. 96.

This work, completed in June, 1966, yielded a combined Drill Measured and Drill Indicated Reserve of 1.8 million tons of 1.2% Cu. A possible open pit layout was prepared over the mineralization in the vicinity of the Main Open Cut and indicated a stripping ratio of 2:1, waste to ore.

The total expenditure by Austminex on the Mt.Gunson project to this stage was $52,777.

As a result of the encouraging results of the drilling campaign, Austminex applied to the Mines Department for a further Special Mining Lease comprising approximately 208 square miles enveloping the existing S.M.L. No. 96.

A further exploration program involving the mining of a representative bulk sample from three areas of known mineralization within S.M.L. 96 together with the metallurgical testing of these samples, was planned. It was also planned to carry out investigations into the availability of process water in the Lagoon area. A survey involving biogeochemical methods was proposed as a means of exploring the area.

WORK DONE AFTER AUGUST 1, 1966

1. Camp Set-up

During prior exploration campaigns at Mt. Gunson, the field crews were housed in makeshift accommodation, caravans or a vacant out-station dwelling.

Because of the encouraging results obtained from the previous drilling and also because of the extent of the proposed future exploration program, it was decided to establish a permanent camp on the property. It was also considered that such an establishment would be suitable to house personnel during possible pre-production activity.

During August, 1966, a camp with accommodation for sixteen men was established. This set-up consisted of two eight-man bunkhouses, one kitchen diner, one ablution-toilet unit and one laboratory-assay unit. Approximately 4½ miles of pipeline were laid to provide fresh water and a motor generator set was installed to provide the necessary power. An airstrip was constructed on the property and radio communication through the Royal Flying Doctor network was established.

2. Bulk Sample

Metallurgical test work had already been carried out on composite samples made from percussion drill hole cuttings obtained during the initial Gunson drilling. This sample was not representative of the material encountered in the second stage drilling, but did indicate the amenability of the mineralization to sulphuric acid leaching.

For the more detailed investigations now required, a larger sample representative of the mineralization was needed. Initially two areas were selected,

(a) one to the North-West of the Main Open Cut enveloping percussions drill hole 147N-1001E. (Austminex Drg GP-5)

(b) one to the South-West of the Main Open Cut enveloping percussion drill hole 696S-341W. (Austminex Drg GP-5)

in which drilling had indicated a grade similar to that obtained for the Drill Measured Tonnage in the Main Open Cut Workings, i.e. 1.2% Cu.

It was later decided to obtain a further sample from the sulphide mineralization, indicated by the lagoon Drilling and a cut was planned enveloping percussion drill hole C4 (Austminex Drg GP-6)

A contractor equipped with drilling and earth moving equipment was engaged to mine these areas and obtain the required bulk sample.

In each case the over burden was removed by a bulldozer and by blasting where necessary. Then two successive cuts 50 ft. long, 6 ft. wide and 5 ft. deep were made through the indicated ore zone. The material from each of these cuts was then crushed to -1" and a portion of the crushed material split out as a sample, by taking two successive 1/3 splits from the conveyor belt emptying the crushed ore bin of the mobile crusher.

This sample was then further split one for one; one half into drums for transport to the metallurgical laboratory, one half onto a holding dump on the site, for future reference.

Approximately 700 tons of ore grade material were mined, from which approximately 80 tons was extracted as a bulk sample.

3. Geological Mapping and Investigations

The earlier exploration activity in the area had been directed towards indicating reserves sufficient to attract economic exploitation of the mineralization. As the drilling progressed, it became apparent that the deposit was more complex than originally imagined.

In August, 1966, Austminex was granted a Special Mining Lease No. 121 covering 208 square miles, enclosing, on a North-South trend the original S.M.L. No. 96. This larger area had been covered by regional geological mapping but contained little known mineralization from which exploration could expand.

Consequently, a program of detailed geological mapping and interpretation became necessary.

The result of this work is contained in Appendix II to this report.

The copper is now known to be intimately associated with a discontinuous lithic sandstone horizon deposited disconformably on top of an eroded quartzite-dolomite surface.

Further to this, the Mineragraphic Section of the C.S.I.R.O. is conducting an investigation into the mineralogy of the deposit. This work is still in progress and the report on it will be furnished with the subsequent progress report on the area.

As a result of the geological mapping, the mineragraphic work and the mineralization seen in the bulk sample cuts, it was decided to re-examine the drill hole cuttings using a binocular microscope.

Initially, all drill cuttings from one line across the Main Open Cut Workings were examined under the microscope. This work proved the presence of copper sulphide mineralization, in the form of chalcocite, below the water table.

Section 'C', drawn as a result of this work, shows the relationship of the rock types, carbonate and sulphide mineralization and water table as they are now known.

Work is progressing on a program to re-examine all the percussion drill cuttings in this manner.

4. Geophysical Investigations

An experimental geophysical survey was carried out over areas of known mineralization by the S.A. Department of Mines. The result of this work is contained in Report No. RB 63/75, "Exploratory Geophysical Surveys at Mount Gunson - Pernatty Lagoon (S.M.L. 96)" by B.E. Milton, J.J. Hussin and B.J. Taylor.

At the time of this investigation, very little was known concerning the geology of the area and the amount of sulphide mineralization in the Main Open Cut area was considered to be small. Consequently, the I.P. effects reported were considered to be caused by wet clay as recorded on driller's log sheets.

Subsequent geological and mineragraphic work has established the presence of copper sulphide mineralization which corresponds with these anomalies. It would now appear that Induced Polarization is a technique that could be applied to the Mt. Gunson deposits.

The field results obtained by I.P. traverses laid down by Geoscience Inc. over the Mt. Gunson-Pernatty Lagoon Area have been examined and it is considered that they may now indicate possible sulphide mineralization in both S.M.L. No. 96 and S.M.L. No. 121.

None of the other geophysical methods tried, namely Magnetics, Electro-magnetics, Self Potential, Radiometric and Gravity gave responses significant enough to enable their use as exploration tools in the area.

5. Biogeochemical Survey

Because of the apparent inconclusiveness of previously applied exploration tools, it was decided to carry out an exploratory investigation to test the effectiveness of biogeochemical techniques in the Mt. Gunson - Pernatty Lagoon Area.

The orientation program gave sufficiently encouraging results to enable an exploration survey to be undertaken with confidence.

Because of the limited tenure on S.M.L. No. 121 and because of its size, biogeochemical prospecting was selected as the tool most appropriate for this area. To date, surveys have been carried out in two sections of S.M.L. No. 121.

(i) one south of S.M.L. No. 96 - S.M.L. No. 121 boundary

(ii) one at the south end of S.M.L. No. 121

Work is continuing in S.M.L. No. 121 north of S.M.L. No. 96.

A report covering the work already completed is included as Appendix No. 1. This work has indicated the presence of a number of areas warranting more detailed investigation.

6. Lagoon Geochemistry

Preliminary investigations into the applicability of geochemistry as a tool for prospecting in Pernatty Lagoon were carried out during October, 1966.

Samples taken from the "playa", about 6 inches below the surface, over and beyond the mineralization indicated by the percussion drilling in the Lagoon, indicated that anomalous areas may be outlined by this method. It is now thought that the copper near the surface does not migrate over the Lagoon area because of the formation of copper oxychloride in the saline environment.

7. Metallurgical Testing

Portions of the bulk sample have been forwarded to both The Australian Mineral Development Laboratories in Adelaide and to the C.S.I.R.O. Ore Dressing Division in Melbourne.

Both these organisations are carrying out investigations on these samples, into possible treatment methods. These investigations incorporate the following possibilities:-

(i) agitation leaching,

(ii) percolation leaching,

(iii) sulphidization of carbonate ore followed by flotation,

(iv) solvent extraction.

At the conclusion of these experiments, a decision will be made as to the most suitable process and pilot plant testing commenced.

8. General

Further discussions were held with Weapons Research Establishment officials regarding the availability of water and power from the lines supplying Woomera. As a result of these discussions, studies are being undertaken by the engineers of this authority into the feasibility of obtaining water and power for industrial use in the Mt. Gunson area.

A "draw-down" test, designed to investigate the possibility of obtaining saline water from Pernatty Lagoon for metallurgical treatment is scheduled to commence at the end of November, 1966. Heavy rain during September-October, 1966, delayed this project and it was decided to allow the Lagoon to dry out in order to test water availability under the driest possible conditions.

Preliminary studies into possible mining techniques were initiated. A ground seismic survey over the Main Open Cut and Gunyot Workings was carried out to determine the rippability of the rocks in these areas.

Technical consultants in the fields of geophysics, geology, mineragraphy, botany, metallurgy and mining visited the property during the period September-November, 1966, to assist in the exploration and possible exploitation of the property.

EXPENDITURE TO DATE

The following tabulation shows direct expenditure by Austminex Pty.Ltd. up to October 31, 1966, on S.M. L. No. 96 and S.M.L. No. 121. At the time of writing, actual accounts for the month of November are not finalised and consequently cannot be included.

Expenditure on Mt. Gunson-Pernatty Lagoon Exploration to October 31, 1966

	S.M.L.96	S.M.L.121	Total
Salaries	$38,296	6,997	45,293
Travel	5,473	449	5,922
Vehicles	3,938	916	4,854
Office and Communications	463	92	555
Direct Field Expenses	10,381	2,407	12,788
Drilling	9,390	-	9,390
Assaying	1,218	-	1,218
Geochemistry	104	870	974
Field Equipment	2,855	951	3,806
Maps and Photos	114	141	255
Bulk Sample Mining	11,932	-	11,932
Metallurgical Testing	1,000	-	1,000
Legal Fees	187	-	187
Acquisition of S.M.Ls.	53	53	106
Total Expenditure to October 31, 1966	$85,404	$12,876	$98,280

PROPOSED EXPLORATION PROGRAM FOR SIX MONTHS TO JUNE, 1967

1. Drilling

As a result of the geological mapping and of the re-examination of drill hole cuttings, further drilling is required in the Main Open Cut Area to test the continuity of the mineralization to the North and North-West.

The mineralization in the Lagoon has only been indicated by the previous drilling. Before this mineralization can be placed in a Drill Measured category, extra holes must be drilled to reduce the present wide hole spacing.

It is estimated that approximately 10,000 ft. of percussion drill hole would be required to test for extensions of known mineralization and to fill-in the previous scout drilling on the Lagoon.

The anomalous areas outlined by biogeochemical methods must be tested by percussion drilling. Already many of these anomalies are sufficiently well defined to enable a drill program to be planned. Others will require further sampling before drilling can be considered. A further 10,000 ft. of percussion drill hole is estimated to be necessary to test these anomalies and to indicate the presence or absence of economic mineralization.

2. Bulk Sampling

The bulk sample already mined was obtained from predominantly carbonate mineralization. Geological work since has proven the presence of sulphide mineralization below the water table in the Main Open Cut Area. Metallurgical testing must be made on this material.

It is proposed to sink a small shaft to the North of the Main Open Cut to below the water table. From this shaft it is further proposed to cut a series of drifts to examine the mineralization and obtain a bulk sample.

3. Lagoon Geochemistry

Copper mineralization has already been indicated by percussion drilling in the embayment on the North-West side of Pernatty Lagoon. Orientation work in a portion of this area, has indicated that geochemical techniques may prove successful.

It is proposed to take mud samples, on an initial 200 ft. x 400 ft. grid, over this area and over an area in the lagoon, East and North of the Lagoon Dolomite Workings.

These areas represent approximately 10 square miles of the Lagoon surface and because of the presence of known mineralization are considered the most suitable for initial investigation.

Should the results of this work prove encouraging, further geochemical testing of the Lagoon surface would be carried out.

4. Biogeochemical Survey

This work has indicated numerous anomalous and possibly anomalous areas. Many of these require more detailed sampling to delineate possible drill targets.

Approximately half of the tree covered area of S.M.L. No. 121 has already been explored with this method. Further sampling is required in the remainder of this Licence Area and in S.M.L. No. 96.

5. Induced Polarization Survey

Because the presence of sulphide mineralization below the water table has now been established, it appears likely that the Induced Polarization method may be useful at Mt. Gunson.

It is intended to take I.P. measurements using various electrode intervals and frequencies over the known mineralization on the shore and at the edge of the lagoon. These measurements would be extended on long lines in both areas to determine the background values to be expected.

The result of this work would determine the future use of this method at Mt. Gunson.

6. Drill Hole Logging

The re-examination of drill hole cuttings using the binocular microscope has been very interesting. This work is continuing at present and will continue until all the previously drilled holes have been re-logged.

7. Metallurgical Test Work

Tests on the bulk sample supplied to both C.S.I.R.O. and AMDEL have not yet been completed.

Results of this work will be assessed after the reports are submitted and a decision will then be made regarding the method to be finally adopted. Pilot plant tests on the bulk sample material will be carried out.

8. Mining Investigations

Further studies into the possibility of mining the material using a Caterpillar D9 tractor equipped with hydraulic rippers are planned. It is proposed to hire such a maching to test its applicability to this deposit.

COST ESTIMATE OF PROPOSED EXPLORATION

1.	Drilling			
	20,000 ft. of percussion drill hole @ $1.25/ft. including drilling, sampling and assaying			$25,000
2.	Bulk Sample			
	50 ft. of shaft @ $50.00/ft.	2,500		
	160ft. of drift @ $40.00/ft.	6,400		
			say	10,000
3.	Geochemistry			
	3,000 samples @ $1.50/sample including sample collection, surveying and assaying			4,500
4.	Biogeochemistry			
	2,500 samples @ $2.00/sample including sample collection, surveying and assaying			5,000
5.	Re-examination of Drill Cuttings			
	One (1) C.W.G & E Geologist for 1 month			1,000
6.	Induced Polarization survey			
	McPhar Geophysics quotation			6,000
7.	Metallurgical Test Work			
	AMDEL Quotation Initial Program	6,000		
	Pilot Plant Test Work	say 10,000		
	Transportation of Sample	say 1,000		
				17,000
8.	Mining Investigations			
	Hire of Caterpillar D9 Tractor 10 days @ $200.00/day	2,000		
	Transport of Tractor	750		
	Miscellaneous	250		
				3,000

9.	On-site Supervision and Data Assessment		
	2 C.W.G & E staff for 6 months		$9,000
10.	Vehicles		
	3 units @ $250.00/month for 6 months		4,500
11.	Camp Labour		
	1 Cook @ $400.00/month for 6 months	2,400	
	1 helper @ $250.00/month for 6 months	1,500	
			3,900
12.	Camp Supplies		
	3,000 man days @ $3.00/man day		9,000
13.	Camp Charge		
	$2,000/month for 6 months		12,000
14.	Crew Travel		
	10 men @ $250.00		2,500
15.	C.W.G & E Head Office Direction		
	Communications etc. 6 months @ $1,000.00/month		6,000
	TOTAL		$118,400

SUMMARY OF PROPOSED EXPENDITURE

	$ Au.
Drilling	25,000
Bulk Sample	10,000
Geochemistry, Biogeochemistry and Geology	10,500
Geophysics	6,000
Metallurgical Testing	17,000
Mining Investigations	3,000
On Site Supervision and Data Assessment	9,000
Vehicles	4,500
Camp Labour	3,900
Camp Supplies	9,000
Camp Charge	12,000
Travel	2,500
C.W.G. &. E Head Office Direction	6,000
Total Estimated Proposed Exploration Cost	$118,400
Say	$120,000

Attachments to Accompany
Report of Exploration
in
S.M.Ls. Nos. 96 & 121
Period Ending November 30, 1966

Attachments

C.W.G & E Drwg No. 20	Pernatty Lagoon Area Geological Map
C.W.G & E Drwg No. 21	Pernatty Lagoon Area Biogeochemical Location Plan
C.W.G & E Drwg No. 18	Pernatty Lagoon Area Biogeochemical Plan - Inset 1
C.W.G & E Drwg No. 19	Pernatty Lagoon Area Biogeochemical Plan "A" - Inset 2
C.W.G & E Drwg No. 22	Pernatty Lagoon Area Induced Polarization Plan
Austminex Pty.Ltd., Drwg No. GP-5	Gunson - Main Open Cut Drill Hole Location & Assay Plan
Austminex Pty.Ltd., Drwg No. GP-6	Gunson - Pernatty Lagoon Area Drill Hole Location Plan
Section "C"	Mt.Gunson, Main Open Cut

APPENDIX NO. 1

BIOGEOCHEMICAL SURVEY

PERNATTY LAGOON, S.A.

AUSTMINEX PTY.LIMITED

MT. GUNSON - PERNATTY LAGOON AREA

Progress Report

for

Period Ending 30 November, 1966

Appendix No. 1

BIOGEOCHEMICAL SURVEY

PERNATTY LAGOON, S.A.

Dated in Melbourne
30 November, 1966

Submitted by

Geyra Lovinn

Chapman Wood Griswold & Evans Pty.Ltd.

BIOGEOCHEMICAL SURVEY

PERNATTY LAGOON, S.A.

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Recommendations	2
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Environment	4
Sampling Method	5
Analytical Technique	7
Orientation	8
Discussion	14

ATTACHMENTS

Biogeochemical Location Plan	C.W.G & E Drwg. No. 21
Biogeochemical Plans - Inset 1	C.W.G & E Drwg. No. 18
Biogeochemical Plan 'A' - Inset 2	C.W.G & E Drwg. No. 19

ABSTRACT

In an attempt to find a suitable exploration tool for the Pernatty Lagoon Area of South Australia, where due to the type of mineralization and absence of soil, conventional methods have been inconclusive to date, biogeochemical investigations over and near the oxidized orebody were carried out. As a result of an extensive orientation survey it has been established that the copper content in the branch twigs of Acacia aneura and Acacia linophylla is an indicator of near-surface copper mineralization. These two closely related species, although erratically distributed, are sufficiently abundant in the Special Mining Lease 121 area to be utilized in prospecting.

A biogeochemical survey conducted over this lease resulted in a number of anomalies warranting further investigation.

RECOMMENDATIONS

Following a large-scale biogeochemical sampling program in S.M.L. 121 it is recommended that -

a. anomalies outlined by the survey be tested by drilling, in the following order of importance:-

   (i) those of west of Gunyot; C.W.G & E Drwg No. 21

   (ii) those in Inset 1, C.W.G & E Drwg No. 21

   (iii) those in Inset 2, C.W.G & E Drwg No. 21

b. exploratory percussion drill holes be a minimum of 70 ft. deep,

c. drill cuttings be logged on-site with the aid of a binocular microscope,

d. the biogeochemical survey be continued in S.M.L. 121 and S.M.L. 96,

e. further work be done in search for copper accumulator and indicator plants.

INTRODUCTION

Special Mining Lease 121 covers 208 square miles in the Pernatty Lagoon Area of South Australia(Drwg No. 21).

Exploration methods previously applied over and near the Mt.Gunson copper deposits, including geochemical sampling, induced polarization, resistivity gravity, magnetic, electro-magnetic, self potential and radioactive techniques, yielded inconclusive results. Therefore, the probability of successful application of biogeochemical methods in the partly sand covered lease area was investigated.

Research of the available literature indicated that biogeochemistry has been effectively applied under similar climatic conditions, but different ecological conditions in Zambia, Arizona, New Mexico and Queensland. Consequently, a program of orientation was planned to test the response of vegetation to copper mineralization in the Pernatty Lagoon area. As a result of this orientation a large scale biogeochemical survey was carried out.

Austminex Pty. Limited is indebted to Dr. Hj.Eichler, The Director of the State Herbarium of South Australia, for generously giving his time for field conference and for identifying plant specimens.

ENVIRONMENT

The rocks of the area are composed mainly of sandstones, quartzites and some dolomites. Because of the silicious nature of the parent material and the inadequacy of chemical weathering soil development is very poor.

The area consists of isolated tablelands surrounded by sand dunes. Of the 208 square miles which comprise S.M.L. 121 approximately 15% is tree covered. Trees and large shrubs preferentially occur in the sand dunes and drainage depressions. Acacias are the most common tree type occurring but their distribution is sporadic. The shrub coverage of the area is well developed.

Distinct vegetation associations with definite lithological units were observed but this selectivity has not as yet been studied from a geobotanical point of view.

The climate is arid with a rainfall of 6 to 8 inches annually.

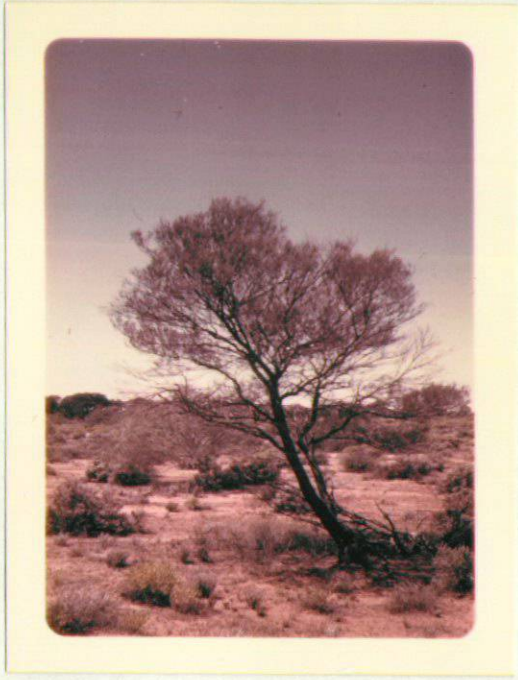
SAMPLING METHOD

In order to establish proper control of sample density in heavily tree-populated areas selected for sampling, a physical grid control system was laid out. Compass and chain controlled arbitrary baselines with pegs at 200 ft. intervals were constructed. From these baselines, at 400 ft. spacing in the northern area (Drwg No. 18) and at 800 ft. spacing in the southern area (Drwg No. 19) of S.M.L. 121, striplines were surveyed in.

The closest Acacia aneura or Acacia linophylla to the station was marked with colored flagging. Branch twigs, the organ selected to be used in the survey, were collected from two diametrically opposite sides of the tree, because the branches of a given side of a tree are connected most directly with roots on the same side. Larger trees were selected in preference to small ones because it is thought that there is a relationship between tree size and root penetration. Dry and/or parasite-bearing trees were not sampled.

Approximately 30 grams of branch twig was taken, cut up into 1 inch lengths and placed in a polyethylene bag. The bag was marked with the co-ordinates of the nearest station and the letter 'C' or 'F' designating Acacia linophylla or Acacia aneura, respectively.

A number of trees re-sampled by two different field crews yielded identical analytical results. Thus, it was concluded that the sampling technique was well standardized.



Acacia aneura

Branch twig of Acacia aneura

ANALYTICAL TECHNIQUE

The analytical work was performed in routine fashion in a well equipped, 10 ft. x 20 ft. mobile field laboratory,

The sample was rinsed with de-mineralized water, dried and ashed to constant weight in a nickel crucible. A 0.2 gram ash sample was slowly digested with 2 ml 9N nitric acid and the near dry residue was diluted to 10 ml with de-mineralized water. An aliquot, depending on copper concentration in sample, was colorimetrically analyzed for copper with 2'2 - biquinoline.

The sensitivity of the technique applied was 10 parts per million. It is reasonable to assume that hot nitric acid extracts more than 85% of the total copper from the ash.

Atomic absorption spectrophotometric analysis (25% hot nitric acid leach), of randomly chosen samples, carried out by McPhar Geochemical Laboratory, Adelaide, S.A., showed very satisfactory correlation with the Austminex results.

ORIENTATION

Orientation work is an essential and somewhat tedious part of all biogeochemical investigations. Orientation serves two main purposes. Firstly, it establishes which, if any, of the plant species, common in the region, carries abnormally large amounts of a trace element over mineralization. Secondly, it helps to determine the correct choice of sampling medium.

Plants growing over and around the Main Open Cut and Gunyo workings (Dwg No. 21) have been studied both as accumulators and indicators of copper. These areas were chosen because drilled sections of known grade, thickness and depth of copper mineralization were available. Fourteen types of Pernatty Lagoon flora, varying from three to forty feet in size, were studied in these areas. The result of this orientation work is presented in Table 1.

The data presented indicates that a number of the plants tested, respond positively to near-surface copper mineralization; and that different plant species accumulate copper in different amounts. The five types that appear to be good indicators are Acacia aneura, Acacia linophylla, Callitris columellaris, Eremophila glabra and Eremophila oppositifolia. Unfortunately, however it is only the two acacias that are sufficiently abundant to be useful in prospecting.

In order to select the most suitable sampling medium, four different organs of Acacia aneura were studied. Phyllode and twig samples analyzed showed mineralization the most positively. It is however suspected that these parts are more sensitive to seasonal variations in availability of copper than other less actively growing plant organs.

Due to the insignificant seasonal variations in desert climate, it is assumed that the copper content of acacia branches does not vary significantly throughout the year and therefore survey results can be correlated all year around. According to a series of tests carried out on ten branch samples, the inner marrow part of the organ accumulates copper preferentially to the outer young layers. As to the depth of root penetration, there is no information available, although it is thought that in dry climates they would go deep attempting to reach the water table. Mineralization occurring at a depth of 45 ft. has been detected by Acacia linophylla in the Main Open Cut area.

The branch twig copper content of Acacia aneura and Acacia linophylla over mineralized ground displayed a sharp enough contrast from the background and its sampling was proved to be reliable, Therefore this organ was selected to be sampled in the regional survey. Because the two species responded to copper mineralization in a similar manner, they were sampled impartially. The background and threshold values were arrived at using both empirical and statistical methods. The threshold value was determined to be 80 ppm. Anomalous values were divided into two groups, possibly anomalous (80-90ppm) and anomalous (90 ppm and above). The correlation between the statistical (Figure 1) and the empirical (Table 1 and Figure 2) background and threshold values established is remarkable.

Orientation work has shown that all superjacent biogeochemical anomalies are associated with known copper mineralization.

TABLE 1

DISTRIBUTION OF COPPER (in ppm) IN PLANT ASH

Plant	Organ	Over known mineralization			Over barren ground		
		No. of samples	Range	Mean	No. of samples	Range	Mean
Acacia aneura	Branch stem	42	70 - 140	86	50	10 - 80	42
	Branch twig	42	70 - 180	96	50	10 - 80	44
	Twig & phyllodes	26	80 - 260	105	10	20 - 90	47
	Phyllodes	23	80 - 200	125	18	20 - 100	66
Acacia ligulata	Branch twig	6	30 - 60	47	3	30 - 40	33
	Branch stem	6	20 - 60	48	---	---	---
Acacia linophylla	Branch twig	11	70 - 130	93	21	20 - 80	39
	Branch stem	11	70 - 120	89	21	20 - 80	39
Acacia nemophila	Branch twig	1	120	120	---	---	---
	Branch stem	1	90	90	---	---	---
Acacia sowdenii	Branch twig	2	90 - 100	95	---	---	---
	Branch stem	2	30	30	---	---	---
Callitris columellaris	Branch twig	4	140 - 330	220	3	50 - 120	80
	Branch stem	4	120 - 230	155	2	80 - 100	90
Casuarina cristata	Branch twig	1	100	100	1	40	40
	Branch stem	1	80	80	---	---	---
Crotalaria dissitiflora	Branch twig	1	50	50	---	---	---
Eremophila glabra	Branch twig	3	80 - 200	130	4	80 - 100	85
	Branch stem	3	80 - 100	87	4	50 - 90	62
Eremophila oppositifolia	Branch twig	3	220 - 480	340	3	90 - 240	163
	Branch stem	3	120 - 220	187	3	80 - 90	83

DISTRIBUTION OF COPPER (in ppm) IN PLANT ASH - Cont.

Plant	Organ	Over known mineralization			Over barren ground		
		No. of samples	Range	Mean	No. of samples	Range	Mean
Heterodendrum oleaefolium	Branch twig Branch stem	4 4	50 - 140 30 - 140	92 70	3 3	60 - 80 40 - 50	73 45
Lysiana exocarpi	Branch twig	1	15	15	---	---	---
Pittosporum phylliraeoides	Branch twig Branch stem	1 1	40 40	40 40	--- ---	--- ---	--- ---
Santalum spicatum	Branch twig Branch stem	2 2	220 - 240 70 - 120	230 95	--- ---	--- ---	--- ---

Frequency distribution of copper in 810 ash samples of Acacia aneura and Acacia linophylla in background area

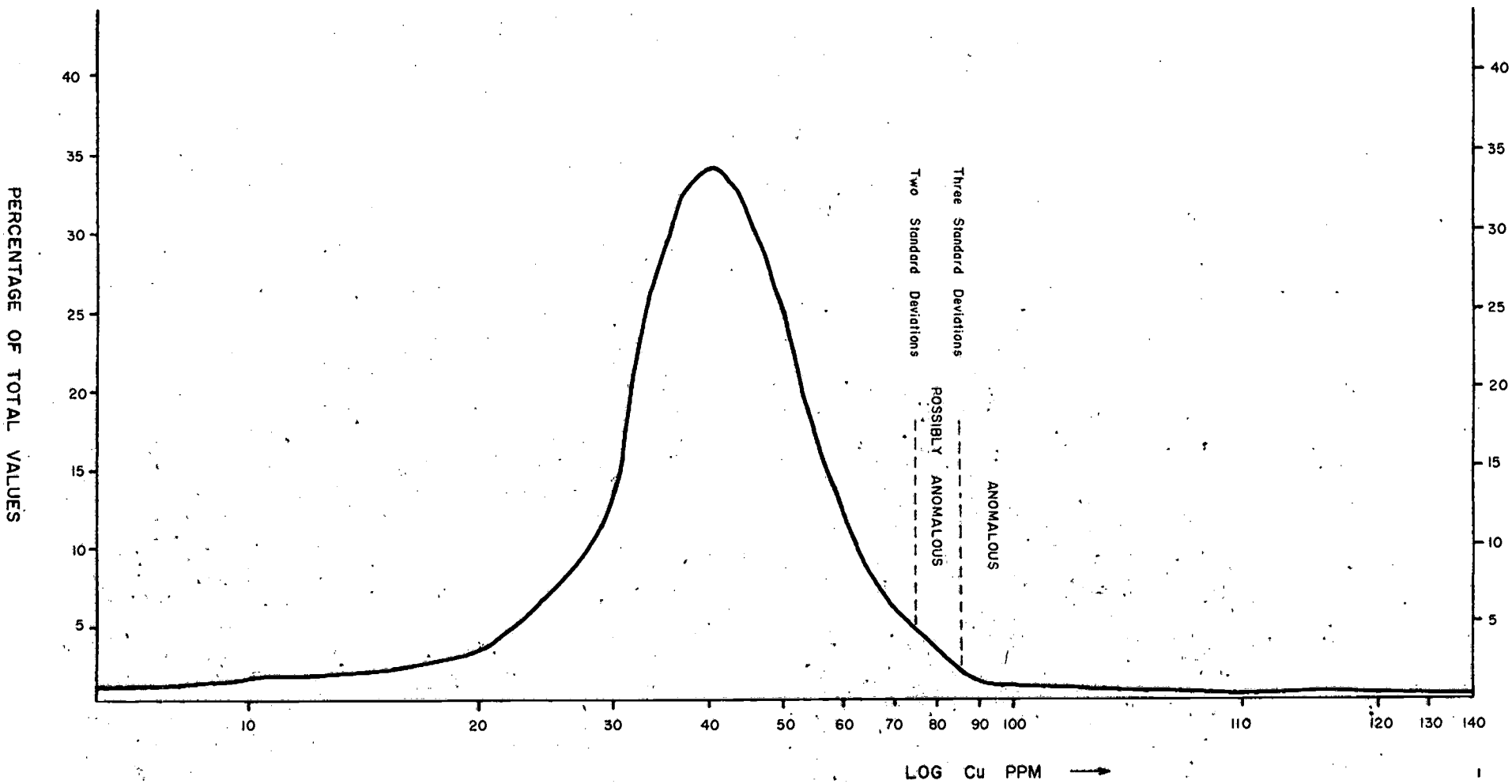


FIGURE 1.

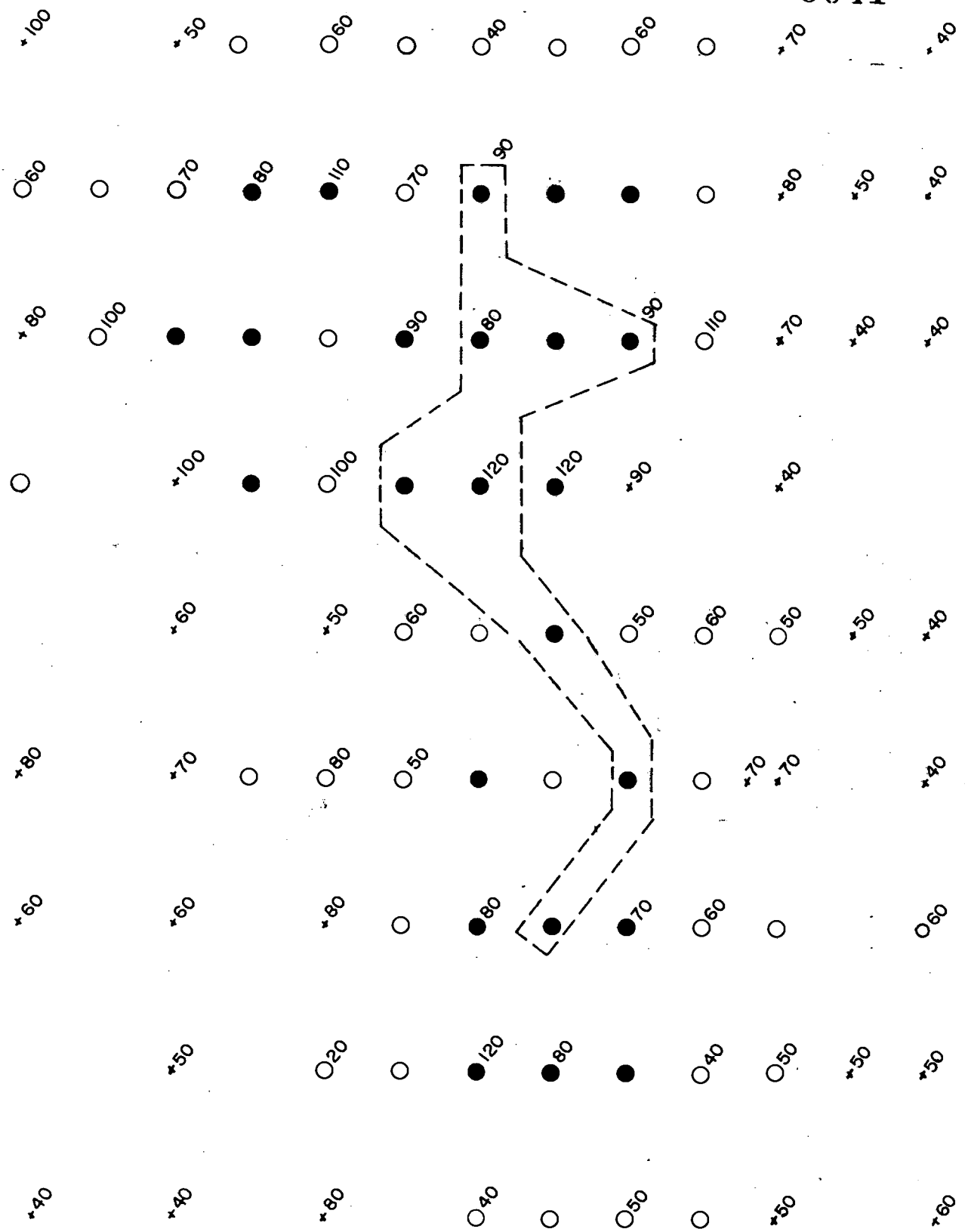

Assumed limit of economic mineralization
Mineralized drillhole
Unmineralized drillhole < 0.1%
Cu (ppm) in ash
THRESHOLD VALUE – 80 ppm

FIGURE 2

DISCUSSION

As a result of reconnaissance field examinations, two favorable areas for Acacia aneura and Acacia linophylla branch twig sampling were selected. During the course of the survey a total of 2,200 samples was collected along 112 miles of pegged lines. The data of the biogeochemical survey were used to construct two maps (Drwg Nos. 18 and 19) showing the concentration of copper in the ash of the organ sampled. Numerous super-threshold values were obtained in both areas. Anomalous and possibly anomalous areas were arbitrarily delineated only to indicate localities that merit further attention.

Inset 1 - Drwg No. 18

The area, located just south of S.M.L. 96 and adjacent to the western boundary of S.M.L. 121, is densely populated with acacias. There is no known copper occurence in this area. 1.5×10^6 square feet of anomalous area were outlined. Three of the large anomalies lie along the same regional disconformity as the Main Open Cut and Gunyot deposits. In order to be able to determine the actual extent of these anomalies, further detailed sampling work must be performed in this area.

Inset 2 - Drwg No. 19

The ground sampled is located in the south-east corner of the lease. In this inset, co-ordinates are prefixed by the letter 'A' (i.e. A - 100N - 70E). The distribution of Acacia aneura is erratic; Acacia linophylla is almost entirely absent in this area. Acacia sowdenii is abundant, but because it is not found over known mineralization, no orientation work has been done on this species.

It is not known what the underlying rocks are east and south-east of the Ironstone Lagoon. Consequently, the 2.5×10^6 square feet of anomaly obtained are, at the present, of secondary interest to that of Inset 1.

During the course of the preliminary orientation survey, several anomalies were outlined west of the Gunyot workings. Since these anomalies are near known economic mineralization they are of great interest from an exploration point of view. The area adjacent to the Gunyot workings, where there are no outcrops observed and the sand cover is known to be approximately 20 ft. deep, is considered to be ideal for further biogeochemical investigations.

The anticipated minimum footage to prove or disprove the anomalies delineated to date is 10,000 feet.

It must be emphasized that there is no direct correlation between the amount of copper accumulated in vegetation and the concentration of copper in the underlying rocks. The biogeochemical anomalies merely reflect abnormal trace element content in a given rock type, they do not necessarily indicate presence of ore.

APPENDIX NO. II

GEOLOGY OF THE

PERNATTY LAGOON AREA, S.A.

AUSTMINEX PTY.LIMITED

MT. GUNSON - PERNATTY LAGOON AREA

Progress Report

for

Period Ending 30 November, 1966

Appendix No. II

GEOLOGY OF THE PERNATTY LAGOON AREA, S.A.

Dated in Melbourne
30 November, 1966

Submitted by D. G. Forbes

Chapman Wood Griswold & Evans Pty.Ltd.

GEOLOGY OF THE PERNATTY LAGOON AREA, S.A.

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SUMMARY AND CONCLUSION

A geological investigation of a 208 square mile area in the Mt. Gunson - Pernatty Lagoon district of South Australia was undertaken by Austminex Pty. Limited during October and November, 1966. This area, designated as Special Mining Leases 96 and 121, contains a number of old, well known copper occurrences.

The Pernatty Grit Formation in the Pernatty Lagoon Area is host to all the known copper deposits and has been subdivided into five distinct lithological units. These are:

1. A white porous sandstone, uppermost in the sequence.
2. A disconformable lithic sandstone and siliceous sandstone unit.
3. A disconformable lenticular dolomite.
4. A red quartzite, sandstone and grit unit.
5. A basal unit containing buff coloured quartzites, pebbly quartzite and conglomerate.

All known copper occurrences in the area are located immediately above and below the disconformity in units 2, 3 and 4. Copper has been found principally as malachite above the water table and chalcocite below. Other minor forms observed include atacamite, chrysocolla, cuprite, azurite, covellite, bornite, chalcopyrite and digenite, a non-stoichiometric form of chalcocite. Mineralization occurs both as interstitial and fracture fillings.

Mineragraphic studies indicate that primary chalcocite has been incompletely altered and partially redeposited as secondary sulphides, carbonate and oxides.

Available evidence suggests that the copper mineralization was deposited syngenetically with the lithic sandstone. Alteration, secondary enrichment and redeposition account for the present mode of occurrence.

The known association of copper mineralization with the rocks occurring at the disconformity provides a clue to the possible location of other copper deposits in the Pernatty Lagoon area. The strikingly rounded grains of the lithic sandstone unit permits detection of this favourable rock beneath sand covered plains.

INTRODUCTION

A geological investigation of the Mt.Gunson-Pernatty Lagoon Area was undertaken by Austminex Pty. Limited during October and November, 1966, as an integral part of an exploration program involving geochemical, biogeochemical and geophysical surveys. The program was confined to a search for further copper deposits within the boundaries of South Australian Special Mining Leases 96 and 121 covering an area of 208 square miles.

Geological mapping was controlled by 1:59,000 scale (1 in. ≅5,000 ft.) aerial photography and final plotting was on a ¾ mile to the inch plan (C.W.G & E Drwg No. 20). Detailed geological studies were made in the vicinity of the known copper deposits near the Mt.Gunson Homestead.

Structural interpretation of the geology is hindered by the paucity of rock outcrop. However, the rocky nature of approximately 25% of the area adequately identifies the individual rock units. The other 75% is covered by a playa lake deposit and both residual and dune sand.

The mineralogy of the Mt.Gunson copper deposits has been studied in detail by Dr. J. McAndrew of the C.S.I.R.O. Mineragraphic Division. A report is forthcoming. Contributions to the geological interpretation were presented by Dr. O.P. Singleton of the University of Melbourne Geology School. General data was obtained from reports by R.K. Johns of the South Australian Department of Mines.

REGIONAL GEOLOGY

A. GENERAL GEOLOGY

The area lies within a sedimentary rock sequence which has been named, by Johns(1964), the Pernatty Grit and assigned to the Sturtian Series of the Upper Proterozoic Adelaide System. The beds are described as "a torrent bedded sequence of fluvioglacial grits, arkosic sandstones, pebbly quartzites and minor tillites which exceed 1,200 ft. in thickness", (Johns, 1965).

Within the Pernatty Grit there is a lenticular dolomite formation which, it has been suggested, represents a Stromatolite reef, both because of its form and the presence in it of Collenia. The dolomite is valuable as a reasonably persistent marker horizon.

Immediately overlying the Pernatty Grit are purple siltstones and shales of the Marinoan Series. These outcrop on Bonney Bluff within the Austminex Exploration Licence area (S.M.L.121) and on Mount Gunson to the west. In both localities these residual hills are capped by Arcoona Quartzite, the Pound Quartzite equivalent.

The youngest rocks preserved in the area are remnants of Tertiary stream and lake deposits. These are represented by boulder beds, found mostly near the western margin of Pernatty Lagoon, and by gravels.

B. STRUCTURAL GEOLOGY

Tectonically, the near horizontal strata appear to have remained relatively undisturbed. Gentle warping is evident in the area between Gunyah Lake and the northern tip of the Lagoon. It is apparent elsewhere that the beds are not perfectly horizontal, nor do they have a consistent regional trend.

No persuasive evidence of faulting has been seen. However, in the main open cut area, the brittle red quartzite is quite well fractured near the surface.

C. PERNATTY GRIT FORMATION

Detailed geological mapping has shown that in the Pernatty Lagoon area the Pernatty Grit can be subdivided into five recognizable units. The highest and lowest units of the sequence, which are remote from known mineralization, were studied only in hand specimen. The middle units have been investigated in thin and polished section.

1. White Porous Sandstone

The topmost unit is a white, porous sandstone which outcrops on the hilltops south-west of the Austminex airstrip along the boundary of S.M.L. 121. Iron staining gives the rock a variety of colourations and markings.

2. Lithic Sandstone and Siliceous Sandstone

Beneath the porous sandstone is a disconformable sandstone unit, of variable thickness, whose members grade up from a friable lithic sandstone to a well-sorted, siliceous sandstone. This unit and the disconformity are pertinent to the copper mineralization and will be described more fully in the next section.

3. Dolomite

The disconformity unit just described overlies red quartzite, but also lying disconformably on that unit is a lenticular dolomite, which contains angular fragments of red quartzite near its contact with that unit. Dolomite outcrops are discontinuous and whether the separate exposures are strictly equivalent in age is questionable.

The dolomite is generally manganiferous, especially on the north-eastern shore of Gunyah Lake and north-east and east of Woocalla. At the latter localities residual concentrations of manganese have been commercially exploited.

Many features of shallow-water deposition are exhibited by the dolomite and its nature varies at different localities. Near the Gun workings it is oolitic and also displays possible current-bedding. Throughout the manganese workings to the south it is stromatolitic and at the Sweet Nell mine it is a banded, blue-grey variety. At its margins, the dolomite becomes sandy and grades into quartzose sediments.

4. Red Quartzite, Sandstone and Grit

The top of the red quartzite and sandstone unit is a disconformity, on which lie the previous two units. The unit is chiefly recognisable by its persistent deep red colour, the nature of the rocks being otherwise variable.

Thin and polished sections from the area of the main open cut were studied and here the rock is a banded red quartzite. The bands are uniform and regular and are caused by the presence or absence of a hematite coating around the quartz grains. They may coincide with bedding or cross-bedding, but more frequently are independent of sedimentary structures. It is thought that they have been formed by fluctuations in an ancient water-table.

The grains of this rock are almost exclusively quartz, some of which are clear, others cloudy. Rounding of grains is sometimes good; they tend to be equidimentional but not well rounded. The rock has suffered some compaction, the grains being pushed together, but not interlocking. The matrix does not form a high percentage of the rock and consists of silica in optically continuous overgrowths or, in some bands, a white clayey material. Grainsize varies from fine to very coarse, but within bands the sorting is good.

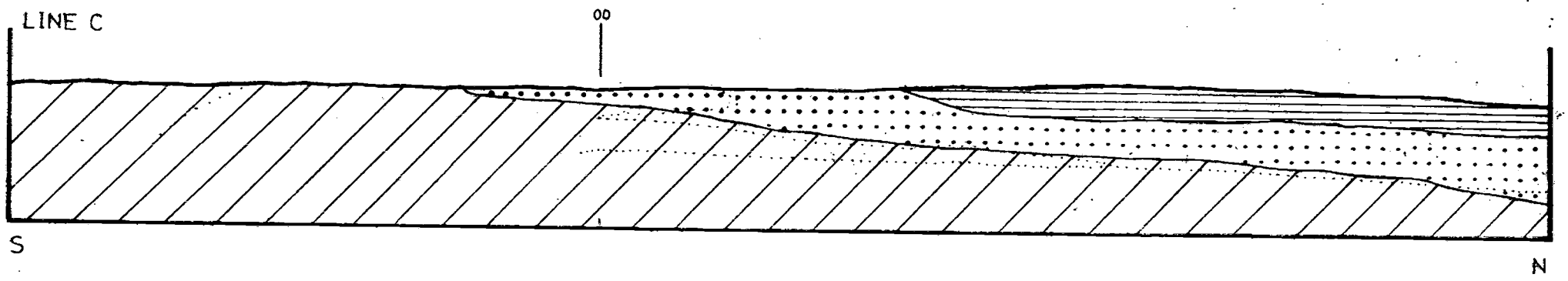
This red quartzite although maintaining its red character, contains a greater degree of silicification in the area of the present copper workings than in the area to the south. Narrow bands of uncoloured quartzite, of lighter conglomeratic rock and a red gritty quartzite occur within the red quartzite unit.

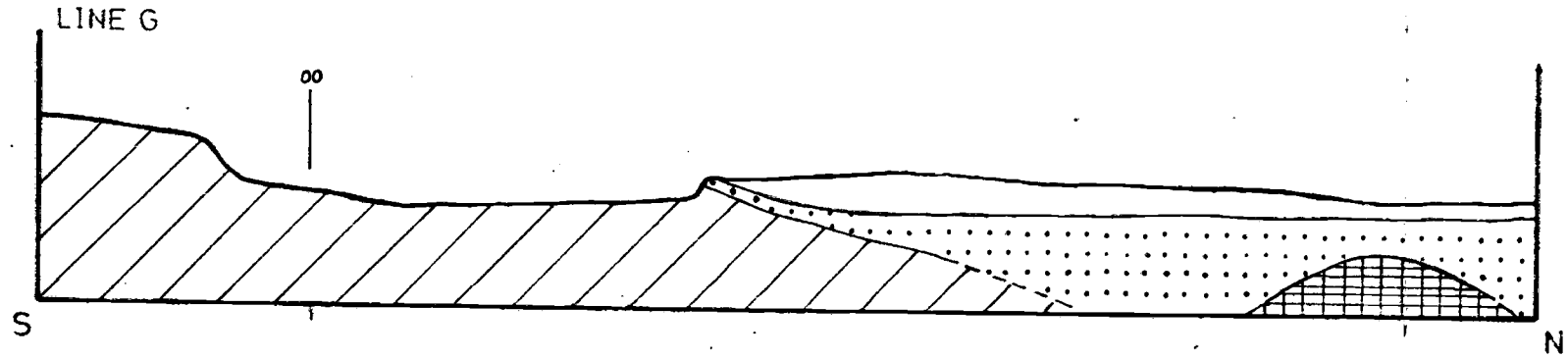
5. Buff Coloured Quartzites, Pebbly Quartzites and Conglomerates

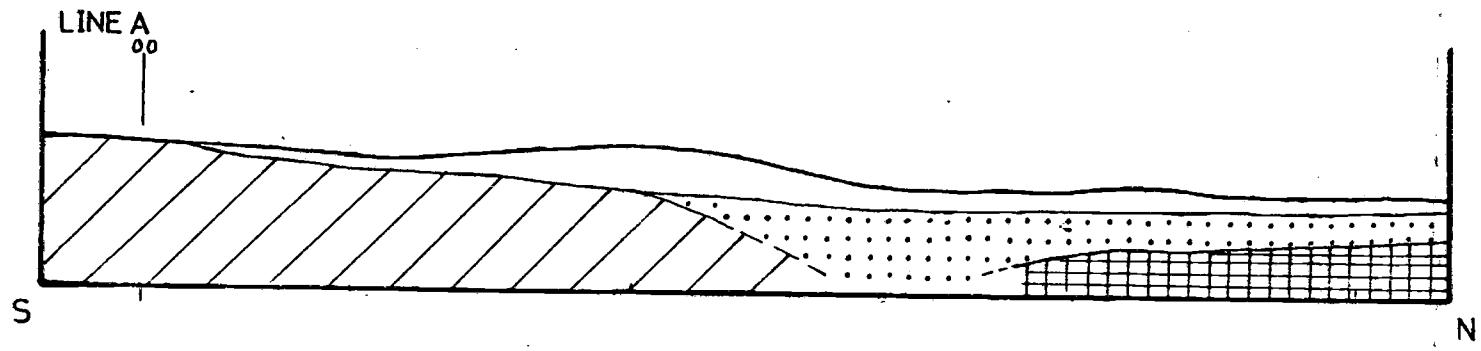
The lowest unit exposed is distinguished principally by a colour change. At the top of the unit is a brown conglomerate containing well-rounded pebbles of milky quartz, chert and jasper set in a limonitic matrix. Beneath this are buff-coloured quartzites or sandstones, fairly coarse-grained, which frequently contain rounded pebbles, mostly of sedimentary origin, up to two inches in diameter.

These rocks are exposed as cliffs along the far north-western edge of Pernatty Lagoon, where they form massive outcrops beneath a scree of angular red quartzite. The topmost conglomerate may be the one exposed along the creek between the southern end of Pernatty Lagoon and Ironstone Lagoon.

GEOLOGICAL SECTIONS - MAIN OPEN-CUT





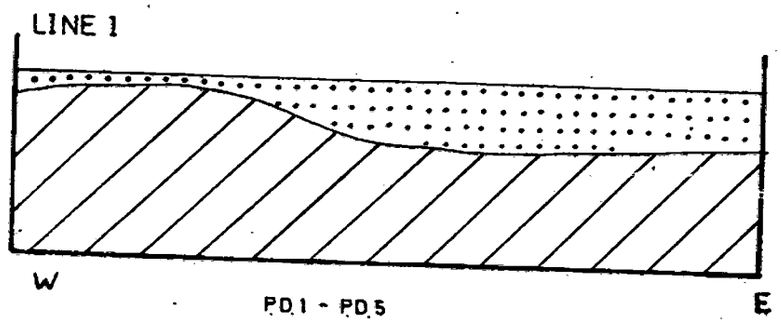


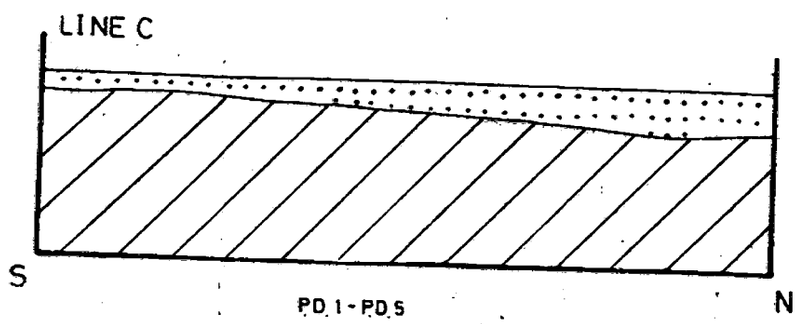
LEGEND

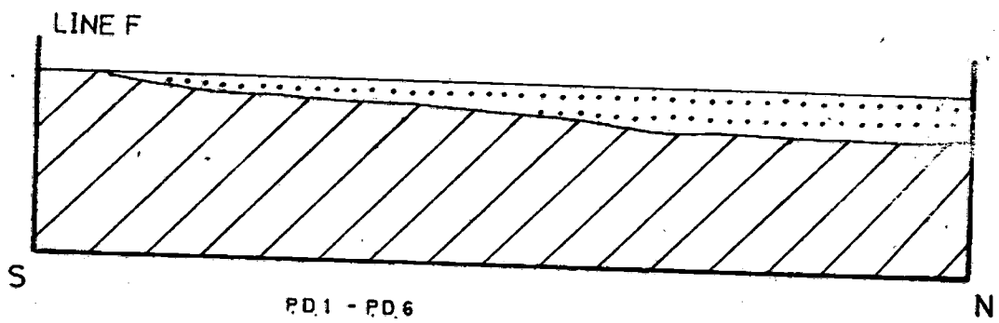
- SAND.
- SILICEOUS SANDSTONE.
- LITHIC SANDSTONE.
- DOLOMITE.
- RED QUARTZITE.

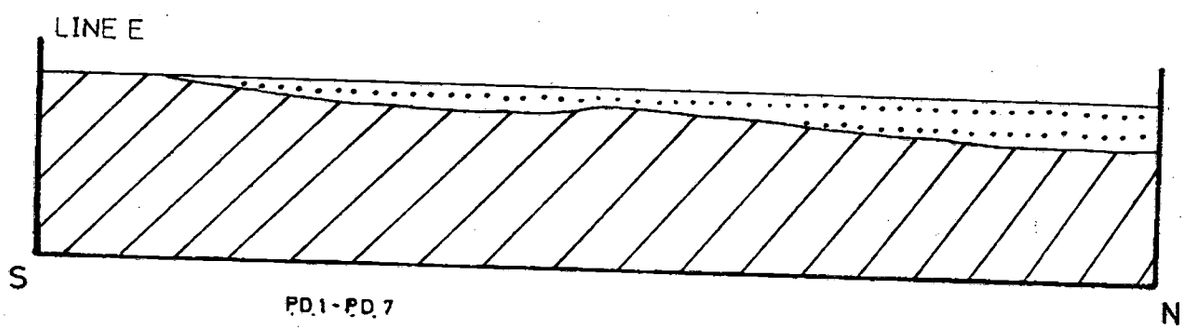
SCALE 1 Inch = 100 Feet.

GEOLOGICAL SECTIONS- LAGOON DRILLING









LEGEND

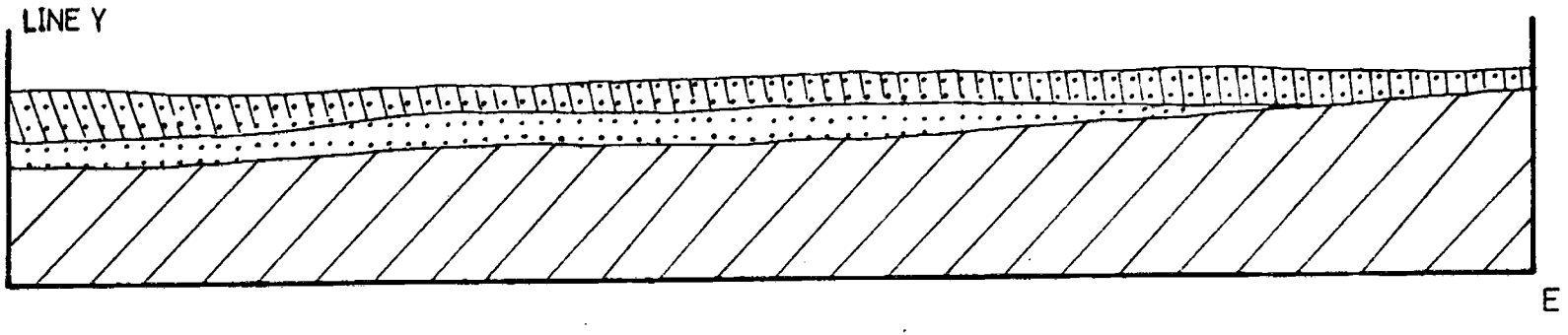
LITHIC SANDSTONE.

RED QUARTZITE.

SCALE 1 inch=100 Feet.

P.D. : PERCUSSION DRILL HOLE

GEOLOGICAL SECTION- GUNYOT DRILLING



LEGEND

WEATHERED, CLAYEY LITHIC SANDSTONE.

LITHIC SANDSTONE.

RED QUARTZITE.

SCALE 1 Inch = 100 Feet.

GEOLOGY OF THE MT. GUNSON AREA

A. THE DISCONFORMITY SANDSTONES

The sandstones above the disconformity are of particular interest because they are intimately associated with and are part of the copper-bearing horizon. They overlie red quartzite or, where it occurs, dolomite. The lowest member of the unit contains angular fragments of the rock it rests upon. Thickness and completeness of this unit varies, being dependent upon the configuration of the eroded surface on which it was deposited. It is best expressed in the mineralized area of the main copper workings, which includes the main open cut area, the Gunyot and the Lagoon (Gunyah Lake) workings.

1. Lithic Sandstone

The lowest member of the unit is a lithic sandstone and can be observed in the "D.J." shaft, in a gully north of this shaft, on the north wall of the main open cut, in the pit beside Brennan's shaft, in the Gunyot open cut, north-west of Ramsey's workings and on the floor of the Lagoon in Gunyah Lake and at the Lagoon Dolomite workings, (Mystery Site). This lithic sandstone can also be recognised in drill hole cuttings from the Austminex percussion drilling program. Cross-sections drawn up after logging of the drill cuttings show the uneven contact between it and the underlying sediments (see geological sections). In all areas of known mineralization the lithic sandstone is either visible or inferred.

The lithic sandstone is made up of two sizes of fragments. The larger grains are one to two m.m. in diameter and are largely quartz with significant chert, clay pellets, other lithics and feldspar. These larger grains are markedly spherical and beautifully rounded. This is the distinctive feature of the rock. Between the larger grains is an abundant matrix of fine (0.1 m.m.), angular quartz and clay.

2. Siliceous sandstone

Above the lithic sandstone is a siliceous sandstone which differs in hand speciment by being somewhat flaggy, quite brittle and finer grained than the friable lower member. Under the microscope the differences are less apparent. The rock is well-sorted and of uniform grainsize, the grains being well rounded quartz with a low proportion of chert grains. Some quartz grains have a coating of hematite adhering to their surface. There is a significant amount of matrix, although not as much as in the lithic sandstone, and this consists mainly of an overgrowth of silica on the grains.

3. Porcellainous Sandstone

There is one other member in the disconformity sandstones, but its exact position is hard to place. The rock, under the binocular microscope, appears, except for matrix, identical in composition and texture with the lithic sandstone. The matrix is a hard, white, porcellainous material. Definite outcrops of this rock are rare and where they do occur the relationship with other members of the sequence is obscure. In the vicinity of the airstrip this porcellainous lithic sandstone occurs as smooth cobbles or concentrations of rounded boulders, apparently on top of the siliceous sandstone member. However this porcellainous sandstone, like the lower lithic sandstone, often contains angular chips of red quartzite, which the siliceous sandstone does not appear to have. On a residual hill at the tip of the promontory between Gunyah Lake and the northern extension of Pernatty Lagoon, porcellainous lithic sandstone directly overlies buff quartzites and pebbly quartzites. It is apparent, along this shoreline, that the red quartzite unit thins out rapidly, this presumably being due to erosion on the disconformity. The porcellainous sandstone here contains abundant large fragments of red quartzite.

B. COPPER BEARING HORIZON

The copper mineralization is located immediately above and below the major disconfirmity which occurs between the lithic sandstone and its underlying beds.

In the lithic sandstone copper occurs as sulphide or oxide copper replacing or representing the matrix of the rock and sometimes penetrating the larger grains. In the red quartzite copper occurs as fracture-filling veins of sulphide and/or oxide copper or as an oxidised mineral replacing the matrix of the rock. Within the dolomite copper sulphides and oxides are found as fracture-filling veins.

C. THE COPPER DEPOSITS

1. Lagoon (Gunyah Lake) Area

Percussion drilling in the lagoon outlined a sulphide zone lying mainly in lithic sandstone but extending into the underlying red quartzite. The sandstone-quartzite contact here dips north into the lagoon and appears to indicate a trough or basin occupied by lithic sandstone (see Geological Sections). A trench approximately 20 ft. deep was cut over percussion drill hole C4. The sulphide found is located mainly in the deeper and less consolidated material ('leaching sand'), where it occurs as a cement between the grains. At the lowest level large (up to one foot) fragments of red quartzite lie within the lithic sandstone and these have veins of copper sulphide along fractures.

2. The Gunyot Area

In the Gunyot open cut, lithic sandstone outcrops bearing green oxide copper minerals and containing angular fragments of red quartzite appear. Percussion drilling revealed a geological environment identical to the lagoon (see Geological Sections). The copper occurs in an oxidised form, mainly in lithic sandstone, but penetrating the red quartzite. The upper part of the lithic sandstone is very clayey. A digging 400 yards west of the Gunyot revealed this same clayey lithic sandstone, whilst a well near the fence west of the Gunyot intersected lithic sandstone. It seems likely that the sand plain of this area covers what was a shallow lake.

3. The Main Open Cut Area

In this area most of the copper mineralization occurs as fracture-fillings or replacement of the red quartzite, with some copper in the overlying lithic sandstone. Mineralized red quartzite is exposed in the Main Open Cut, Youngs Open Cut and in Austminex bulk-sample trenches cut on percussion drill holes B4 (147N/1001E) and H 11 (696S/341W) Drwg No. GP-5. At the level of these exposures the copper is mostly in an oxidised form, although there are remnants of sulphide in larger veins in B4 trench. Examination of drill hole cuttings has shown that below a certain level, presumably corresponding to the water table, all copper occurs as sulphide.

Percussion drilling in this area intersected two members of the disconformable sandstone unit and was responsible for emphasizing the significance of the lithic sandstone. Small exposures of this rock are seen in the "D.J." shaft and on the northern edge of the Main Open Cut, but its relationship to the underlying red quartzite and the siliceous sandstone capping is not apparent from a surface examination. The basin or channel in which the lithic sandstone lies, slopes toward the north and is possibly an extension of the Gunyot structure. Oxidised copper replaced the matrix of this rock in the "D.J." shaft and in this exposure angular red quartzite inclusions are prominent.

4. Ramsey's Workings

This small deposit, lying north of the Gunyot, is similar in its character to the oxidised mineralization of the Main Open Cut. There is no lithic sandstone now overlying the red quartzite in which it occurs, but a remnant of the former rock does outcrop a short distance to the north-west. There was possibly a connecting channel, between the Gunyot lithic sandstone basin and the lagoon lithic sandstone basin, which ran through this area.

5. Dolomite Workings

These include Brennans shaft, the Gun deposit, in which copper and manganese are associated, and numerous small shafts in the dolomite east of the homestead. Copper occurs as fracture-filling. In the lagoon, below the water table it is sulphide, but otherwise the copper minerals are green oxidised forms.

Percussion drilling between the Main Open Cut and Brennan's Shaft (Geological sections, Line G and Line A) intersected dolomite overlain by lithic sandstone. A pit, sunk on the lagoon Dolomite (Mystery Site) workings, located on the eastern side of the dolomite, revealed a steeply-dipping disconformable contact between dolomite and lithic sandstone. Thus lithic sandstone has been deposited in channels cut into the dolomite disconformity surface and as a bed over part or all of the dolomite in this locality.

6. The Sweet Nell Mine Area

At this group of workings, situated two and a half miles east of Woocalla on the edge of Ironstone Lagoon, copper lies in a shale bed beneath a 10 feet thick capping of dolomite. Beneath the copper-bearing shale is red quartzite. The copper occurs as stringers and veins of green oxidised ore.

No lithic sandstone has been found in the Sweet Nell area. However the steepness of the banks of this small lagoon suggest that softer material has been preferentially eroded, andany evidence that this copper deposit lies close to the disconformity could have been removed in this way. The dolomite outcrops here are small and cling to the edge of the lagoon, which probably contained a single larger occurrence of dolomite and/or lithic sandstone.

D. MINERALOGY

Sulphide minerals include chalcocite and digenite, covellite, pyrite and minor chalcopyrite and bornite. Chalcocite is the most abundant copper sulphide. It occurs in the lithic sandstone of the lagoon where it replaces or almost completely comprises the matrix of the rock. Chalcocite fills fractures in this rock and in the included blocks of red quartzite and in the underlying red quartzite. Digenite, chalcopyrite and bornite are found disseminated in the lithic sandstone with the chalcocite. Disseminated pyrite occurs in lithic sandstone, especially at the higher level of the lagoon C4 trench.

Chalcocite is also the copper mineral in the Main Open Cut area, below the water table. None of this material has been exposed. Remnants of chalcocite can be seen in the larger veins of material from the B4 trench. Here the chalcocite is being altered to malachite, and although fine specks of sulphide give the veins a black appearance to the eye, they are predominately composed of carbonate.

In dolomite, chalcocite occurs as veins. It is found in this way below the water table in the pit sunk on the "Mystery Site".

The copper minerals of the oxidised zone include malachite, azurite, cuprite, atacamite and chrysocolla. Green copper minerals are found in the matrix of lithic sandstone at the Gunyot and in the "D.J." shaft. Green copper also replaces the matrix of red quartzite, to a limited extent, in the Main Open Cut and adjacent Young's Open Cut.

In red quartzite and in dolomite, veins of oxidised copper are predominant. Fracture-filling veins are seen in the Main Open Cut, Young's Open Cut, in the B4 and H 11 trenches and in Ramsey's working. All these occurrences lie in red quartzite. Malachite is the most abundant of these minerals. Atacamite has been found, associated with it, in the Main Open Cut, azurite in the H 11 trench and cuprite and chrysocolla in Young's Open Cut.

The dolomites, in the oxidised zone, contain vein-filled fractures of malachite and atacamite. Both minerals occur at Sweet Nell, but at the Gun and Dolomite workings, there is probably only malachite, with accessory calcite.

E. PARAGENESIS OF ORE MINERALS

Preliminary detailed studies of the copper ore, by Dr. John McAndrew of the C.S.I.R.O. Mineragraphic Division, suggest that chalcocite is the primary copper mineral, and that it has been altered and redeposited in part as secondary sulphides, carbonates, oxides and oxy-chlorides. Sulphur is available, in the lagoon, in the form of pyrite and gypsum and has been responsible for the formation of secondary chalcopyrite and bornite. In the incompletely oxidised zone of the (Main Open Cut) B4 trench, chalcocite has been the original vein mineral and is now mostly altered to malachite. This alteration would involve an increase in volume, per unit of copper, of 2:1. It is suggested by Dr. McAndrew that such an increase in volume of copper mineral has been responsible for the permeation of malachite into the matrix of the red quartzite.

F. GENESIS OF COPPER MINERALIZATION

1. Features of the lithic sandstone indicate that it was deposited in shallow basins on an eroded red quartzite-dolomite surface. In the Main Open Cut workings the red quartzite can be seen to be densely fractured. The dolomite usually has a regular joint pattern.

2. Introduction of Copper

The available evidence strongly suggests that the lithic sandstone was intimately involved in the introduction and initial deposition of copper. Since initial deposition, the copper has probably been relocated and concentrated within the lithic sandstone and in fractures in the underlying red quartzite and dolomite.

Copper was probably precipitated as chalcocite. Suitable reducing conditions could have existed in the shallow-water environment envisaged for the deposition of the lithic sandstone, which suggests that copper was deposited simultaneously with that rock. For the copper to have been introduced to the lithic sandstone after deposition of the rock, a suitable channelway for conduction of mineralising solutions would be required. So far, no such structure has been indicated. Deposition of copper in the strata below the disconformity could be effected by descending meteoric water.

3. Ultimate Source of the Copper

Three possible origins for the copper of these deposits are suggested and were discussed by Dickinson (1942). The first suggestion is that the mineral is of sedimentary origin and is syngenetic with the enclosing rock. Dickinson's objection that the ore is not confined to a single rock type can be answered by the indication that copper was originally deposited in the lithic sandstone, and has since been relocated in part.

The ultimate source from which the copper could have been transported remains obscure. Traces of associated metals may possibly suggest an answer. Dickinson and Sprigg (1953) report vanadium with copper at Pernatty Lagoon. Other S.A. vanadium occurrences are near Burra and in the Flinders Ranges. Assays of silver and gold are also recorded from the Pernatty deposits.

The second suggested hypothesis was called, by Dickinson, a hypogenetic origin and involves deposition from ascending hydrothermal solutions. Hydrothermal implies hot, aqueous solution, the source of which must lie unseen and unknown at depth. In addition there is no evidence of structural dislocation or any other structural feature to provide a channelway for such solutions, nor are the red quartzites especially pervious. Finally, there is an absence of introduced gangue and host rock alteration associated with the copper deposits.

The third possible origin was called, by Dickinson, epigenetic and envisages deposition by a process of lateral secretion, concentrating copper from small amounts of metal disseminated in the strata or from copper lodes at depth. Heated saline waters are pictured as leaching copper from deposits at depth, transporting it in solution and depositing it in certain loci in overlying porous sandstones. For such a process to have operated, the solutions, in the absence of structural channelways, would have to have permeated the red quartzite horizon. Where red quartzite is not overlain by a basin of lithic sandstone and is capped directly by siliceous sandstone, there is no trace of copper mineralization, even a few hundred feet from known mineralization. It is difficult to explain how copper-bearing solutions could seek out and travel exclusively towards the favourable porous sandstone. However, if the porous (lithic) horizon was intersected by a zone of dislocation which could provide a channelway for metalliferous solutions, then copper could have been introduced to that horizon from depth, either at the time of deposition of the rock, or at a later period.

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Dickinson, S.B., 1942. The Mt.Gunson - Pernatty Lagoon district, Geol. Surv. S. Aust., Bull.20, pp.50-65

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LAKE WINDABOUT

PERNATTY LAGOON

PERNATTY

GUNYAH LAKE

Ramsey's

1st Lagoon Workings

Gunyot

Lagoon Dolomite

Dolomite Workings

MT. GUNSON HS

Main open cut

Gun workings (Mn Cu)

D.J. Shaft

S.M.L. 96.

MT. GUNSON 850' ▲

△ BONNEY BLUFF 868'

YELTACOWIE H.S.

CREEK

WOOMERA

POWER LINE

WATER PIPE LINE

ROAD

RAIL ROAD

BIRTHDAY RS.

PERNATTY RIDGE

S.M.L. 121.

BLACK OAK CREEK

WOOCALLA RS

SMELTING MINES (Fe Cu)

IRONSTONE LAGOON

MONALENA HS.

SOUTH POINT 469'

LAKE DUTTON

31°30'

30°30'

31°45'

137°15'

LEGEND.

CAINOZOIC

QUATERNARY

- Alluvium, gravels and silts.
- Sand plains, sand dunes with claypans.

TERTIARY

- Boulder beds, ferruginous, grits and sand.

PROTEROZOIC

MARINOAN

- Purple siltstones and shales.

STURTIAN

- White, porous sandstone.
- Lithic sandstone and siliceous sandstone.
- Dolomite.
- Red quartzite, sandstone and grit.
- Buff-coloured quartzites, pebbly quartzites and conglomerate.

GEOLOGICAL BOUNDARIES

~ Observed. ····· Inferred.

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PERNATTY LAGOON AREA, S.A.

GEOLOGICAL MAP

SCALE.

0 1Mile. 2 3

Date: 18th Nov., 1966 Drawn by: D. G. T. Approved by: G.L.

C.W.G.&E. Drwg. No. 20

JE

674-1

LAKE WINDABOUT

MT. GUNSON 850'

YELTACOWIE H.S.

BONNEY BLUFF 868

LAGOON WORKINGS

GUNYOT WORKINGS

MT. GUNSON HS.

MAIN OPENCUT

S.M.L. 96.

100 S

220 S

40 E

Inset No. 1 — Drwg. 18.

137° 15'

WOOMERA

31° 30'

POWER LINE

WATER PIPE LINE

RAIL ROAD

BIRTHDAY RS.

PERNATTY LAGOON

PERNATTY RIDGE

S.M.L. 121.

C.R.

PERNATTY

30° 30'

BLACK OAK CREEK

WOOCALLA RS.

SWEET MOO MINES

IRONSTONE LAGOON.

MONALENA HS.

150 N

60 S

A-100E

A-180E

Inset No. 2 Drwg. 19

SOUTH POINT 469'

LAKE DUTTON

PORT AUGUSTA

137° 45'

31° 45'

LEGEND.

— APPROXIMATE LOCATION OF LARGER BIOGEOCHEMICAL ANOMALIES.

AUSTMINEX PTY. LTD.

PERNATTY LAGOON AREA, S.A.

BIOGEOCHEMICAL LOCATION PLAN

SCALE.

0 1 Mile. 2 3

Date: 21st NOV., 1966. Drawn by: D.J.C. Approved by: G.L.

C.W.G.&E. Drwg. No. 21.

J.E.

674-2

S.M.L. 96.

Pernatty Lagoon

S.M.L. 121.

Base Line

INSET No. 1 Drwg. No. 21

LEGEND

Copper content (in p.p.m) of branch twig ash of Acacia aneura or Acacia linophylla.

Possibly anomalous.

Anomalous.

Road, tracks.+

S.M.L. boundary.

+ Plotted in part from S.A. Dept. Mines Map OL 63-92.

AUSTMINEX PTY. LTD.

PERNATTY LAGOON AREA, S.A.

BIOGEOCHEMICAL PLAN

Scale

Date: 17th Nov. 1966 Drawn by: M.D.B. Approved by: G.L.

C.W.G. & E. Drwg. No. 18

674-3

Sweet Well Mines

Ironstone Lagoon

Railway Track

Power Line

Base Line

S.M.L. 121

INSET No. 2 Drwg No. 21

LEGEND

x10 . Copper content (in p.p.m) of branch twig ash of Acacia aneura or Acacia linophylla

Possibly anomalous

Anomalous

Road, tracks +*

Railway track *

S.M.L. boundary

Power line *

* Plotted from S.A. photo 8972

+ Plotted in part from S.A. Dept. Mines Map 01.63-15

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PERNATTY LAGOON AREA S.A.

BIOGEOCHEMICAL PLAN 'A'

Scale

Date: 22nd Nov. 1966 Drawn by: M.D.B. Approved by: G.L.

C.W.G.&E. Drwg. No. 19

674-4

LAKE WINDABOUT

137° 15'

YELTACOWIE H.S.

△ BONNEY BLUFF 868'

MT GUNSON 850' ▲

33N
21N
9N
3S
15S
30S
60S

S.M.L. 96.

90S
120S
156S
219S
279S
339S
399S
459S
519S
579S

PERNATTY LAGOON

PERNATTY CREEK

WOOMERA

31° 30'

30° 30'

POWER LINE

WATER PIPE LINE

ROAD

RAIL ROAD

BASE LINE — OAKDEN HILLS - PERNATTY FENCE

BIRTHDAY RS.

△ PERNATTY RIDGE

S.M.L. 121.

30N

0

BLACK OAK CREEK

WOOCALLA 85

SWEET MOO MINES 62

IRONSTONE LAGOON

■ MONALENA H.S.

SOUTH POINT 469' △

LAKE DUTTON

PORT AUGUSTA

31° 45'

LEGEND.

— — I.P. TRAVERSE

— — — I.P ANOMALOUS ZONE (PREDOMINANTLY 1ST. DIPOLE SEPARATION - N.1.)

— — — I.P. ANOMALOUS ZONE (PREDOMINANTLY 2ND. DIPOLE SEPARATION - N.2.)

AUSTMINEX PTY. LTD.

PERNATTY LAGOON AREA, S.A.

INDUCED POLARIZATION SURVEY

(Undertaken by Geoscience Incorporated, 1964-65.)

SCALE.

0 1 Mile. 2 3

Date: 18th Nov. 1966 Drawn by: D.J.C. Approved by: G.L.

C.W.G.&E. Drwg. No. 22

J.E.

674-5

AUSTMINEX PTY. LTD.

— GUNSON —

MAIN OPEN CUT

DRILL HOLE LOCATION AND ASSAY PLAN

LEGEND

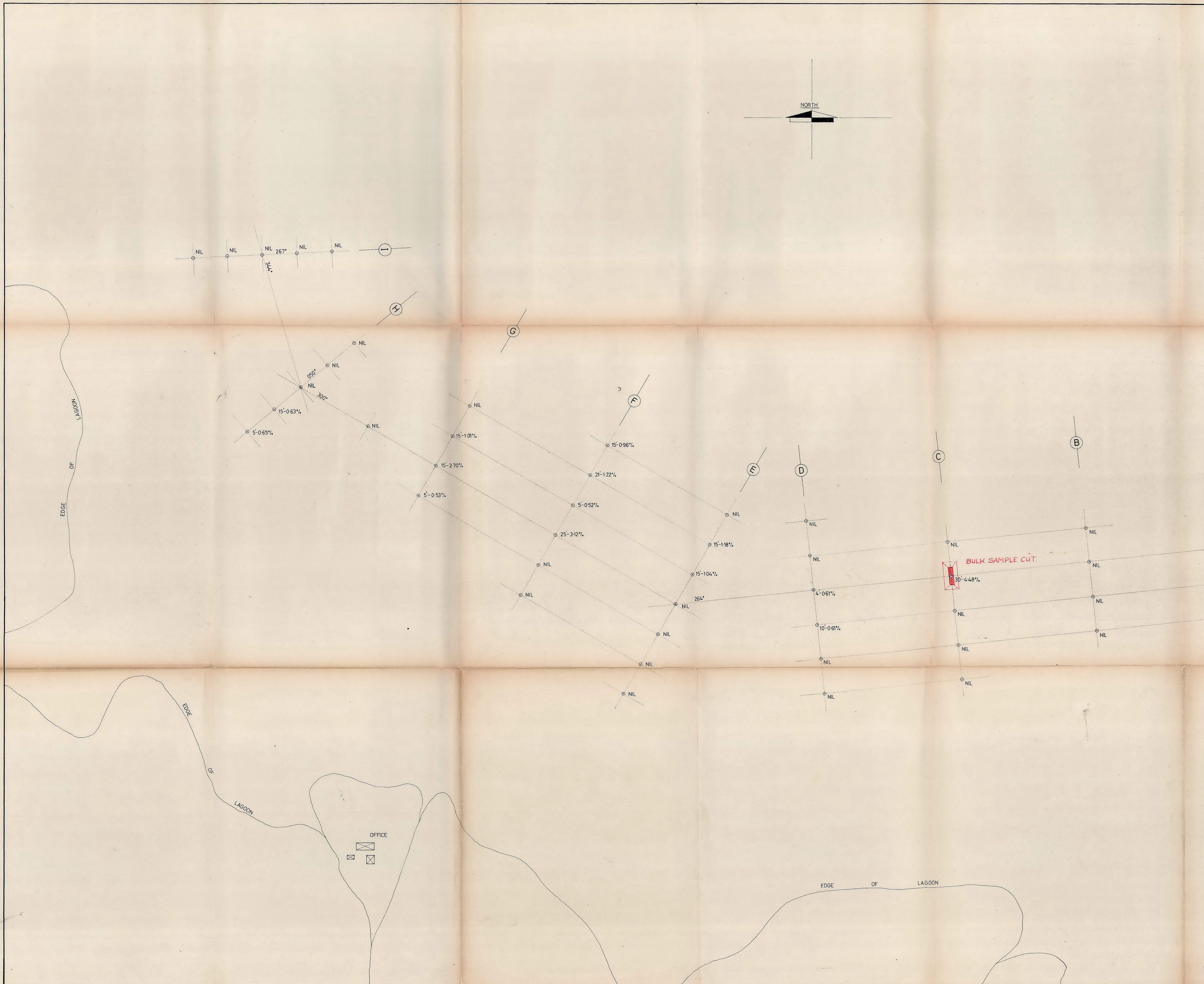
⊙	Percussion Drill Hole Location
⊡	Lease Peg Location
△	Survey Bench Mark
◪	Shaft
15'@ 1·22	Width of intercept in feet and % Copper

SCALE

0 100 200 300 Feet

Drawn by: E. Holt	Date: June 30, 1966	GP5
Approved by:		

674-6



AUSTMINEX PTY. LTD.

— VENTURE No.1 — GUNSON —

PERNATTY LAGOON AREA

DRILL HOLE LOCATION AND ASSAY PLAN

LEGEND

⊙ — Percussion Drill Hole Location

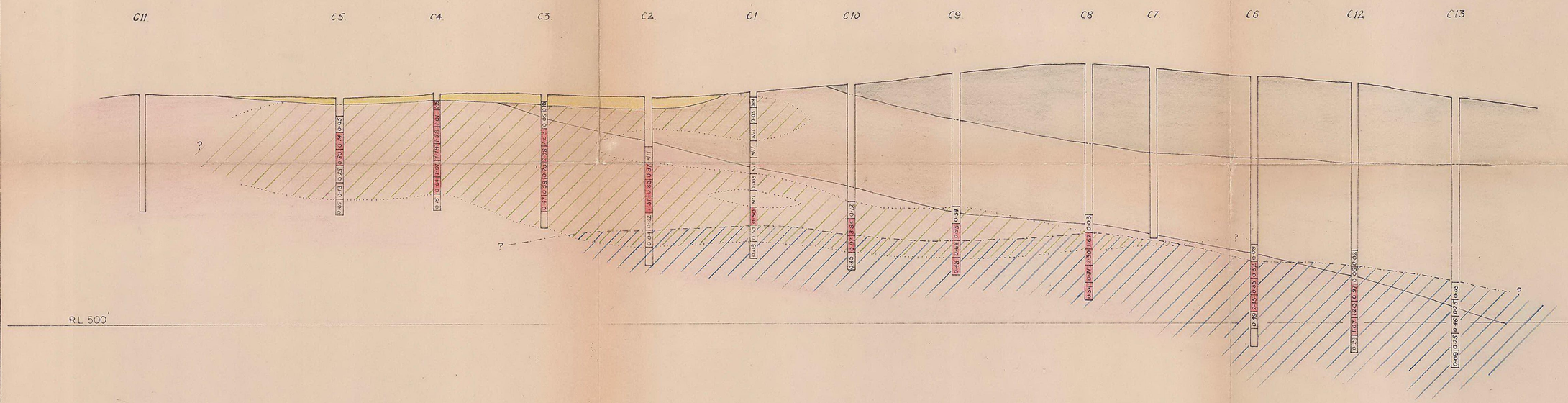
5'-0.52% — Width of Intercept in feet & % Copper

SCALE

0 100 200 300 Feet

Drawn by : G.B.&A	Date : July 4 — 1966	GP6
Approved by:		

674-7



SAND
WHITE SANDSTONE
LITHIC SANDSTONE
RED QUARTZITE

COPPER CARBONATES
COPPER SULPHIDES
ASSAY Cu%

MT. GUNSON.

MAIN OPEN CUT

SECTION C (Looking West)

SCALE.
HORIZONTAL 1"—50'.
VERTICAL -1"—20'.
NOV. 1966

674-8