DEPARTMENT OF MINES
SOUTH AUSTRALIA

NICKEL EXPLORATION

CLAUDE HILLS EXTENSION

NORTHERN TERRITORY

by

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Rept. Bk. No. 63/119
G.S. No. 3593
D.M. 261/66

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ABSTRACT

Geological mapping and gravity traversing were carried out in the Northern Territory to test possible extensions to the Claude Hills nickeliferous ochre occurrence. Two gravity "lows" were detected, Zone C commencing in South Australia, and Zone D located entirely in the Northern Territory. Two drill holes were put down in each zone. In Zone C, 153 feet of low grade siliceous ochre was encountered near the border, but further east Quaternary sands and gravels were present to a depth of 156 feet. In Zone D no ochre was encountered, the "low" being caused by Quaternary sediments infilling a depression in the basement rocks.

Detailed logs and nickel assays are included.

INTRODUCTION

As a result of a nickel exploration programme carried out in the northwest corner of South Australia by the South Australian Department of Mines during the 1965 field season, additional reserves of nickeliferous ochres were located in a concealed area in the Claude Hills.

Drilling in South Australia had revealed several mineralised intersections, some of economic grade, on a gravity "low", which on the available information appeared to continue across the border into the Northern Territory.

Recommendations were made to extend the exploration programme across the border (Miller 1965), and a formal request

for permission to enter the Northern Territory was made to the Northern Territory Administration. After discussion with Dr. R. Dodson, Senior Resident Geologist, Darwin, and upon a later field visit, an exploration programme involving gravity traversing and test drilling was formulated. Approval for this programme was granted under the following conditions.

Geological, geophysical and associated services were to be performed by the South Australian Department of Mines at no charge to the Northern Territory Administration. Test drilling was to be undertaken by the South Australian Mines Department and recharged to the Northern Territory Administration. A sum of $4,000 was granted for the drilling programme within the Northern Territory.

Field work commenced in May, 1966, and all geophysical and drilling phases were completed by mid-June.

This report covers the work in the Northern Territory and pertinent adjacent areas in South Australia.

LOCATION AND TOPOGRAPHY

The Claude Hills are a range of hills adjacent to the N.T.-S.A. border. The eastern extremity of the range curves to the E.N.E. and extends into the Northern Territory, but the main range is located within South Australia, approximately 12-18 miles N.W. of Mount Davies. (See plan No. S5492).

The S.A.-N.T. border is here unmarked, and although a boundary survey is in progress further east, it will be some time before it is marked in the Claude Hills area. For the purposes of the nickel exploration the boundary has been taken as the edge of the Davies 1-Mile Sheet published (Thomson 1960). This boundary is based on trigonometrical surveys and astronomical observations in the Northern Territory by National Mapping, in Western Australia by the Department of Lands, and in South Australia by the Department of Lands.

The boundary was transferred from the base map for the Davies 1-Mile to enlarged aerial photographs which were used for the geological mapping, gravity traversing, and location of test drill holes. Whilst not exact it is reasonably accurate and is the best that can be established under present conditions, as a steep and variable regional gravity gradient prevents accurate celestial observations in the area.

Agreement on the acceptance of this as a pro-temp boundary for the purposes of the survey was received from the Northern Territory Administration.

Access to the area is by track from the Kulgera-Giles road, the turn-off being approximately four miles north of the Mount Davies airstrip (See plan No. S5492). Water supplies in the area are from a shallow bore near the airstrip, and although water quality is good, (700 p.p.m.) supplies are only of the order of 600 gallons per hour.

Topography is subdued with isolated low relief rock masses arising above an extensive sand dune and sand plain area.

REGIONAL GEOLOGY

The area examined is portion of the Musgrave Block, a large positive area of crystalline Archaean metasediments and basic intrusions, situated in the northwest corner of South Australia and extending into the Northern Territory and Western Australia.

Geological Succession

Archaean

Meta-sediments

These comprise a thick sequence of gneisses and granulites, ranging from acid to basic in composition. The sequence originally comprised medium to coarse-grained clastic sediments

with a high felspar content, and with thin impure dolomite and quartzose members throughout the succession. The rocks, which are remarkably lacking in hydrous minerals have been highly metamorphosed to the granulite metamorphic facies.

Basic Igneous

Giles Complex

These are a series of layered basic and ultra basic intrusives, composed essentially of norites and gabbros, but with substantial bodies of olivine and pyroxene rich varieties. The sequence is complex and although broadly concordant, local discordant bodies and plugs do occur.

The mechanics of the emplacements and the cause of the layering are not fully understood, but it is believed that the intrusion took place at depth, and generally post metamorphism of the sediments. Contacts, where exposed, are relatively sharp, and chilled margin effects are narrow. The layering appears to have been a combination of gravity settling and successive injection.

Serpentinisation of the olivine rich ultra-basic varieties has occurred in some areas presumably at the same time as or soon after the intrusion, and the serpentinites are of genetic significance to the distribution of the nickel minerals within the complex, and to the much younger period of ochre formation.

Dolerite Dykes

A younger series of dykes traverses the whole region of the Musgrave Block, occurring as numerous swarms, generally with a northwesterly trend, although northeasterly and easterly trends do occur. The swarms are remarkably persistent, some extending over a distance of 150 miles.

In composition the dykes approach norite and gabbro with some olivine rich varieties. Although obviously intruding the Giles Complex the dykes could be genetically related.

Tertiary

This era is represented mainly by weathering profiles although some basal gravels and clays infilling the depressions in the Archaean basement may be of Tertiary age.

Laterite residuals and deeply weathered profiles occur throughout the area, and the nickeliferous ochres with associated jasper and magnesite zones are probably of Tertiary age.

Quaternary

A complex series of fluvial outwash and valley floor sediments, lacustrine limestones and aeolian sands, infilling and flanking the Archaean crystalline basement surface, constitute the Quaternary succession. Maximum thickness recorded to date is 150 feet, but deeper sections undoubtedly occur.

Basal sediments are a sequence of gravels and sands grading up to clays, which are in turn overlain by a lacustrine limestone which has been dolomitised and silicified.

Calcrete formation, the resultant of a particular weathering cycle overlies the fluvial sediments.

Aeolian sands as sief dunes and sand sheets are widespread, and represent the youngest significant deposits. Subsequent sedimentation is confined to minor alluvial and low angle outwash material in the vicinity of the elevated basement rocks.

During the Quaternary era the nickeliferous ochre bodies have been modified to their present day configuration, and it is believed that some of the ochre bodies have been removed almost completely by erosion during the era.

Structure

The meta-sediments are extensively folded into a succession of relatively open synclines and anticlines, the axes of which trend to an S shaped pattern under the influence of regional clockwise sheares.

Major sheares are strike slip faults, generally with a W.N.W. strike, with minor faults E to E.N.E. or W.N.W. to N.W.

The Giles Complex has been strongly folded and is generally concordant with the meta-sediments.

DETAILED GEOLOGY AND MINERALISATION CLAUDE HILLS

The Claude Hills consist of a long narrow east-west trending zone of discontinuous ultra-basic outcrops, composed essentially of norite and pyroxenite. In the eastern limits of the occurrence the intrusion swings to the east-northeast and crosses into the Northern Territory, with the development of a second outcropping ultra-basic band to the south of the main one.

Outcrop is poor in the area due to a cover of wind-blow sand but from the gravity work and test drilling it would appear that the intrusion is elongate, bounded to the south by acid gramulites, and presumably so to the north. It appears to be mainly concordant with the trends within the granulite, but with only the one contact exposed in the area, this fact cannot be proved.

The nickeliferous ochres overlie the centre of the intrusion, bounded by norites and pyroxenites. The ochre is intimately associated with jasper and magnesite, and is underlain by serpentinites which appear to have formed the core or cores of the intrusion.

Detailed geology is shown on the attached plan No. 66-835.

NICKELIFEROUS OCHRES

These are the only occurrences of economic significance in the area. The ochres are of the residual goethite type, formed by the leaching of iron rich ultra-basic rocks, with subsequent enrichment of the primary nickel.

In form the ochre is a yellow-brown cellular hydrated iron oxide (goethite) often with well preserved relict textures after olivine and pyroxene. The nickel content varies from 0.2% to 2.2%, the higher values occurring at the base of the ochre zone.

The mechanics of ochre formation are relatively simple, although the physical chemistry involved is complex and not fully understood. Under conditions of high seasonal rainfall, and probably although not essentially a tropical to sub-tropical climate, silica and magnesium are leached from ultra-basic rocks or their serpentinised equivalents. The iron is left as goethite, and the nickel which in the original rock averages approximately 0.2%, is concentrated several fold, both by residual and supergene enrichment.

In many respects the ochres in South Australia are similar to those of New Caledonia, and Cuba, but there are important differences both morphologically and economically. In the overseas occurrences the silica and magnesium are almost invariably removed from the weathering profile, whereas in the Claude Hills area they often remain at the base of the profile, the silica as jasper, and the magnesium as magnesite. This could be due to restricted groundwater circulation resulting in stagnant waters at the base of the profile from which the silica and magnesium are precipitated, or it could be that the physio-chemical environment is different from that in the overseas occurrences.

Another difference which is important economically is that the nickel silicate garnierite so common in overseas

occurrences, is not generally found at the base of the weathering profile. Consequently the grade of the enriched zone is not as high. Recent work by the Australian Mineral Development Laboratories has revealed that in the Claude Hills area the nickel is intimately associated with cobalt and manganese, probably as an oxide, but not with silica or iron. Garnierite does occur in limited amounts, but always well below the main ochre zone.

The primary source of the nickel is in the olivine of the ultra-basic rocks. Mineral separation studies by the Australian Mineral Development Laboratories show that the olivine contains up to 0.22% nickel, whereas the pyroxenes, both clino and ortho contain negligible amounts. Consequently the nickeliferous ochres have been derived from olivine rich rocks, although ochre can form from low olivine rocks generally with a resultant low nickel content.

Supergene enrichment of the nickel has occurred, and there has obviously been both vertical and horizontal movement, but the extent to which nickel can migrate is not known.

The removal of the silica and magnesium from the ultra-basic rocks during the leaching process, lowers the S.G. from 3.0-3.2 for the ultra-basic rocks down to 1.6-1.7 for the ochre. It is this density contrast which permits the successful application of gravity method in the search for the ochre zones.

EXPLORATION

In the Claude Hills area the outcropping ochre was drilled by Southwestern Mining Ltd. in the period of their investigation of the area from 1955-1958. Six drill holes were constructed.

The area was held under Special Mining Lease by Southwestern Mining Ltd., the lease lapsing in 1961. However, all work in the area subsequent to 1959 has been undertaken by

the South Australian Department of Mines as a normal mineral investigation for the South Australian Government.

In 1960 a gravity survey was made of the outcropping ochre zone, and the suitability of the method to detect the ochre zone demonstrated (Pegum 1960).

In 1965 the original survey by Pegum was extended, and the outlines of the intrusion and its extent in South Australia determined. Test drilling on new low density zones was carried out, and twelve drill holes were constructed.

In the 1966 survey the gravity work was continued across the N.T.-S.A. border, and the eastern and northern limits of the intrusion were determined. Test drilling was carried out on both sides of the border.

Within the Northern Territory approximately 27,000 feet of line traverse was metered in the detailed gravity work, and four drill holes totalling 657ft., were constructed. At the request of the Bureau of Mineral Resources a reconnaissance gravity traverse was extended for approximately four and a half miles into the Northern Territory to check on postulated ultra-basic occurrences, and to assist in the interpretation of regional gradient effects.

Location of all gravity traverses, drill holes and graphic logs are shown on the attached plans Nos. 66-835 and S5492. Gravity profiles are shown on plan No. 66-538.

DRILLING AND SAMPLING TECHNIQUES

Drilling in the area was carried out with a Failing WW1, (a combination rotary/percussion machine.)

Above the water-table air drilling techniques were adopted using Roller bit, Hawthorn Bit, or Chisel Bit, with a Mission B/42 Downhole Hammer, the type of bit depending upon formation conditions. Percussion tube samples were taken at selected intervals if practicable to check on sample return, and for better lithological identification.

Below the water-table percussion tubes were used continuously if conditions permitted.

When drilling with air, samples were collected at 5 foot intervals. The total sample was broken down to approximately 10lb. with a ½" Jones Riffle Splitter, the remainder of the sample being discarded. The 10lb. sample was further broken down to approximately 50 grammes which was placed in manila envelopes and forwarded immediately to Adelaide for assay. The remainder of the 10lb. sample was stored and will be forwarded at the close of the programme when transport arrangements have been finalized.

Tube samples were grooved and samples at 1 foot intervals forwarded for assay. The remainder of the sample was wrapped in polythene tubing and stored.

Detailed bore logs and sample data are appended to the report.

RESULTS

Gravity Methods (By I.S. Rowan)

Two "gravity troughs", interpreted as low density zones were detected, Zone C commencing in South Australia, and Zone D located entirely within the Northern Territory.

The most easterly extension of Zone C was detected on line 15,600'E, and drilling was recommended on lines 12,800'E and 15,600'E.

Zone D, an anomaly similar in shape and magnitude to Zone C was recorded on lines 17,600'E and 19,600'E and drilling was recommended on both lines. Drilling was not recommended on Line 21,600'E, as the steep gravity gradient to the northeast indicated that the ultra-basic rocks dip steeply in this direction. A dip of 45° to 90° is estimated, depending upon the magnitude of the estimated regional gradient which must be removed before calculations can be attempted.

In an attempt to distinguish between gravity "lows" caused by ochre, and those due to alluvium, an Elsec Proton Precession Magnetometer was read across various "lows". The results however were inconclusive, and to date there is no distinguishing criteria between anomalies caused by the two sources.

The results of the reconnaissance gravity line, (see Plan No. S5492), indicate that there is no detectable ultra-basic mass north of the border in this area. Even though the readings were uncontrolled, the high density ultra-basic rocks cause such a large gravitational effect, that it is possible to detect intrusions without applying the usual elevation and latitude corrections.

Drilling

Four drill holes were constucted, two on Zone C, and two on Zone D.

Zone C

Hole No. NC20 on Line 12,800'E, encountered a low grade siliceous ochre profile beneath 40 feet of Quaternary sediments. The hole bottomed in saponitic clays at a depth of 193 feet. Maximum grade of ochre encountered was 0.91% Ni, and average grade of the ochre profile was 0.51% over a depth of 153 feet. Hole No. NC23 on Line 15,600'E, did not encounter any ochre or evidence of deep chemical weathering, the hole bottoming at a depth of 163 feet in Quaternary sediments.

These results indicate that the ochre zone is lensing out or deepening under a cover of Quaternary sediments to the east-northeast.

Zone D

The two drill holes in this Zone did not encounter any ochre or evidence of ochre or deep chemical weathering.

Hole No. NC21 on Line 19,600'E encountered Quaternary sediments to a depth of 155 feet.

Hole No. NC22 on Line 17,600'E encountered Quaternary sediments to a depth of 100 feet, underlain by saponitic clays to a depth of 138 feet.

These results indicate that the anomaly is due to an infilling of or depression in the basement rocks with less dense unconsolidated sediments. The depression may have been caused by the removal of the softer products of chemical weathering, but this is only an assumption and cannot be proved with the available information.

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PGM:SMA
21.11.1966

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APPENDIX

Detailed Logs and Assay Data

Holes Nos. NC20 to 23 (inclusive)

Department of Mines, South Australia

Log of Borehole No. N.C. 20

Project: N.W. Province - Nickel Investigation.

D.M.: 261/66

Sec. - Hd. - Co. -

Hole Serial No.:

Collar Co-ordinates: 900'S, 12800'E R.L. 458'-0

Grid: Claude Hills Grid 1

Direction: - Angle: Vertical Depth: 193'

Plan Ref.: 66-835

Date Hole Commenced: 1.6.1966 Completed: 4.6.1966

Driller: A. Stummer

Plant: Failing W.W1

Hole logged by: K.R. Warne On: at drill site

Hirer: Northern Territory Administ

Object: To test geophysical gravity "low" anomaly.

Result: Low grade siliceous ochre under 40' of Quaternary sediments, 40'-60' 0.40%Ni 60'-71' 0.81%Ni 71'-97' 0.80%Ni, 97'-117 0.51%Ni, 117'-127' 0.91%Ni, 127-147' 0.39%Ni, 147'-193' 0.28%Ni.

Water was cut at 145. Static Water Level at 136'.

Log comprises: Geological Descriptions Assay Results.

Depth in feet From	To	Geological Description
0'	8'	Coarse loose red-brown sands with interstitial clay and occasional gravels and boulders (angular to subrounded) of granulites. The sands ar rounded to subrounded, composed mostly of stain ed quartz grains, some granulite and black magnetite.
8'	10'	Coarse gravels and boulders, angular to rounded, generally about ¼"-diam., but up to 2"x1"x1", composed of qtz.-feldspar granulite in a loose matrix of red-brown sand.
10'	11'6"	Mostly gravel and boulders of hard kaolinized qtz.-feldspar granulite but with hard dense pink siliceous calcrete.
11'6"	18'	Gravel and boulders of weathered granulite often coated with white powdery calcrete, and altering to kaolinic clays.
		Some boulders of pyroxenite.
18'	20'	Hard pink-white siliceous calcrete with angular to sub-rounded gravels and boulders up to 2"x 1"x1" of weathered granulite altering to kaolinic clay, and coated with white powdery calcrete.

Depth in feet From	To	Geological Description
20'	30'	Mainly coarse gravel and boulders of weathered and altered granulite, and pyroxenite with occasional bands of coarse granulite sand.
30	40	Soft light brown sandy limy clay (80%), with occasional boulders and gravel of kaolinised granulite (20%). Calcrete is scattered throughout the clay as small soft white fragments.
40	60	Hard tough dense light brown jasper with spotted manganese oxide staining. Some white dense chalcedony chippings, (up to 10%). Between 55-60ft. some soft bands of brown ochre.
60	71	Mainly soft moist orange-brown ochre (70%), with dark brown goethite staining, and faint manganese oxide staining. Some thin bands of hard brown jasper with white-grey chalcedony. Pale olive-green saponitic clays appear from 65' comprising about 10-15% of the samples. Some chips of ochre show suggestion of fine banding.
71	76	Mainly brown-green (Khaki) ochre with olive-green saponitic clay (70%). Occasional fragment of weathered pyroxenite, brown jasper, and white-grey chalcedoney - agate.
76	86	Soft serpentinised green pyroxenite, altered to saponitic clay, with bands of hard brown jaspe and white chalcedony. Occasional chipping of fresh pyroxenite with spotted iron oxide stain (after olivine ?).
86	97	Thin alternating bands of hard dense brown jasper with white chalcedony-agate, with soft light brown ochre with green saponitic clays (khaki sludge). Occasional thin band of hard pale green pyroxenite. Tube sample between 96-97ft. - weathered soft moist serpentinised green-brown pyroxenite altering to olive-green saponitic clays. Some fine brown ocherous spots or iron stainings (after olivine ?). Jointing and slickensiding in brown-orange ocherous clay at 70° to drill axis, and coated with apple-green saponitic clay concretions.
97	119	Mainly tough dense brown jasper with white chalcedony. Thin bands of soft moist yellow-brown ochre, and occasional bands of slightly weathered pale-green pyroxenite.
119	127	Soft moist yellow-brown to orange-brown ochre with occasional chips of brown jasper.
127	193	Mainly hard dense brown jasper, (75-80%), with bands of soft yellow-brown to orange-brown ochre mixed with olive-green saponitic clays. Some chips of pyroxenite from 127 to 147ft. Chalcedony is associated with the jasper and occasional chips of chrysoprase between 142-152ft.

End of Hole

Assay Results

Depth From Ft.	Ins.	To Ft.	Ins.	Sample No.	% Ni
40	0	45	0	A255/66	0.27
45	0	50	0	256/66	0.24
50	0	55	0	257/66	0.41
55	0	60	0	258/66	0.66
60	0	65	0	259/66	0.63
65	0	66	0	260/66	0.91
66	0	71	0	261/66	0.97
71	0	76	0	262/66	0.74
76	0	81	0	263/66	0.65
81	0	86	0	264/66	0.70
86	0	91	0	265/66	0.94
91	0	96	0	266/66	0.87
96	0	97	0	267/66	1.33
97	0	102	0	268/66	0.55
102	0	107	0	269/66	0.73
107	0	112	0	270/66	0.27
112	0	117	0	271/66	0.49
117	0	122	0	272/66	0.87
122	0	127	0	273/66	0.94
127	0	132	0	274/66	0.37
132	0	137	0	275/66	0.35
137	0	142	0	276/66	0.49
142	0	147	0	277/66	0.35
147	0	152	0	278/66	0.22
152	0	157	0	279/66	0.20
157	0	162	0	280/66	0.35
162	0	163	0	281/66	0.35
163	0	168	0	282/66	0.32
168	0	173	0	283/66	0.30
173	0	178	0	284/66	0.39
178	0	183	0	285/66	0.32
183	0	188	0	286/66	0.18
188	0	193	0	A287/66	0.25
Averages					
40	0	60	0		0.40
60	0	71	0		0.81
71	0	97	0		0.80
97	0	117	0		0.51
117	0	127	0		0.91
127	0	147	0		0.39
147	0	193	0		0.28
40	0	193	0		0.51

Department of Mines, South Australia

Log of Borehole No. N.C.21

Project: N.W. Province-Nickel Investigations D.M.: 261/66
Sec. - Hd. - Co. - Hole Ser. No.:
Collar Co-ordinates: 2400'S, 19600E R.L.: Grid: Claude Hills Grid I
Direction: - Angle: Vertical Depth: 156' Plan Ref: 66-835
Date Hole Commenced: 6.6.1966 Completed: 8.6.1966 Driller: A. Stummer
Hole Logged by: K.R. Warne Plant: Failing W.W1
On: at drill site Hirer: Northern Territory Adminis

Object: Testing of a gravity low in a concealed area.

Result: Quaternary sediments encountered to a depth of 156ft. Water cut at 136ft. Static Water Level at 134ft.

Log comprises:-

Depth in feet From	To	Log
0	17	Coarse red-brown sand of rounded, white, red, brown quartz grains, and occasional gravel of quartz-feldspar granulite. Magnetite is scattered throughout as fine to coarse black rounded grains (up to 5%). Becoming very claye from 10ft.
17	35	Coarse gravels and boulders of fresh and kaolinised rounded, subrounded to angular quartz-feldspar, quartz-feldspar-pyroxene granulite which vary from less than 1/16" diam. to greater than ½" diam. Also fragments of white calcrete, which often coats the granulite gravels. Fragments of hard pink siliceous calcrete between 20-25ft. The coarse gravels are in a matrix of buff-pink sandy limy clay, (up to 40%). Some gravels of pyroxenite.
35	45	Soft medium to coarse-grained red-brown clayey sand (70%), with angular to rounded gravel of granulite (15%), and larger fragments of red-brown clayey sandy grit carrying faint manganese oxide stainings.
45	138	Soft red-brown sandy limy clay with faint manganese oxide stains - becomes very plastic when we Gravels and boulders of granulite, occasionally pyroxenite, and rarely chalcedony, are scattered through the clay as isolated fragments, (often rounded), or as thin gravel beds.
138	140	Coarse gravel and boulders of rounded to angular fragments of qtz.-feldspar granulite in a matrix of soft sandy limy clay.
140	146	Soft red-brown plastic sandy limy clay with occasional rounded gravels of granulite and some coarse sands.

Depth in feet From	To	Log
146	156	Coarse gravels and boulders of granulite, calcrete and pyroxenite set in a matrix of soft red-brown sandy clay. The gravels and boulders are mainly rounded. Those of granulite are of quartz-feldspar compositions and are often weathered and coated with white calcrete.

End of Hole

Department of Mines, South Australia

Log of Borehole No. NC.22

Project: N.W. Province - Nickel Investigation
Sec. - Hd. - Co. -
Collar Co-ords.: 2400'S 17600'E R.L.:
Direction: - Angle: Vertical Depth: 138'
Date Hole Commenced: 9.6.1966 Completed: 11.6.1966
Hole Logged by: K.R. Warne On: at drill site.

D.M.: 261/66
Hole Ser. No.:
Grid: Claude Hills Grid I.
Plan Ref.: 66-835
Driller: A. Stummer
Plant: Failing W.W1
Hirer: Northern Territory Administration.

Object: To test a gravity low.

Result: Quaternary sediments encountered to a depth of 138ft.
Water cut at 134', Static Water Level 133'.

Log comprises: Geological Description, Assay Results.

Depth in feet From	To	Geological Description
0'	5'	Coarse red-brown clayey sand with scattered gravels of granulite. The sand is dominantly of rounded quartz grains, stained red, brown, yellow and pink. Magnetite is scattered throughout as fine to coarse-rounded grains up to 5% of sample.
5	20	Coarse sands and gravels with occasional boulders of weathered kaolinised quartz-feldspar, and quartz-feldspar-pyroxene granulite. Pyroxenite boulders are rare. The gravels and boulders vary from angular to rounded, and occur in a soft loose coarse clayey sand. White calcrete occurs throughout usually coating the granulite gravels.
20	25	Medium to coarse red-brown limy clayey sand (60-70%) with coarse gravels and boulders of weathered granulite coated with calcrete and altering to kaolinic clays. Also some gravels of pyroxenite.
25	35	Hard red-brown-pink dense fine-grained calcrete with pink-brown limy clayey sand.
35	50	Very coarse angular to subrounded gravels and boulders of kaolinised granulite coated with white calcrete, with hard pink siliceous calcrete in a fine to medium grained pink buff clayey sand made up of angular and subrounded grains of granulite, and calcrete.
50	71	Moist red-brown soft sandy limy clay with angular gravels and boulders of granulite. Calcrete is scattered throughout, in the matrix as fine flakes, or coating the kaolinised gravels. The sediments are progressively more limy with depth.

Depth in feet From	To	Geological Description
71	75	Pink-mauve-white mottled limy clay with gravels and boulders of black-green pyroxenite, and traces of ocherous brown clay.
75	95	Mottled pink-mauve-white limy clay with faint manganese oxide stainings throughout. The materia is fairly hard and well compacted.
95	100	Mottled pink-white clays with soft buff pink saponitic clay.
100	138	Soft buff-pink to khaki green saponitic clays. Tube samples show that the material is an extremely weathered coarse-grained pale green pyroxenite altered to mottled green-white saponitic clays. Faint manganese oxide staining throughout. Between 137 and 138ft. the rock is a compact dense pale olive-green pyroxenite, altered to dense brittle serpenitic clay, and showing a coarse-grained relict texture.

Water was cut at 134ft. and stands at 133ft.

End of Hole

NC.22 continued

Assay Results

Depth From Ft.	Ins.	To Ft.	Ins.	Sample No.	% Ni	
60	0	65	0	A288/66	0.05	
65	0	70	0	289/66	0.06	
70	0	75	0	290/66	0.05	
75	0	80	0	291/66	0.02	
80	0	85	0	292/66	0.01	
85	0	90	0	293/66	0.02	
90	0	95	0	294/66	0.01	
95	0	100	0	295/66	0.02	
100	0	105	0	296/66	0.04	
105	0	110	0	297/66	0.03	
110	0	111	0	298/66	0.04*	1ft. sample
111	0	116	0	299/66	0.10	
116	0	121	0	300/66	0.18	
121	0	122	0	301/66	0.38	
122	0	127	0	302/66	0.36	
127	0	132	0	303/66	0.26	
132	0	137	0	304/66	0.25	
137	0	138	0	305/66	0.15	

Department of Mines, South Australia

Log of Borehole No. NC.23

Project: N.W. Province-Nickel Exploration D.M.: 216/66
Sec.: - Hd.: - Co.: - Hole Ser. No.:
Collar Co-ords.: 600'S 15600E R.L.: Grid: Claude Hills Grid I.
Direction: - Angle: Vertical Depth: 163'
Date Hole Plan Ref.: 66-835
Commenced: 13.6.1966 Completed: 14.6.1966 Driller: A. Stummer
Hole Logged by: K.R. Warne On: at drill site. Plant: Failing W.W1
Hirer: Northern Territory Administration

Object: To test a gravity low for possible extensions of nickel mineralisation.

Result: The hole was drilled through Quaternary sands, clays and gravels for its full length. The cause of the gravity anomaly is probably due to deep succession of red-brown limy clays.

Water was cut at 124ft. Static water level at 121ft.

Log Comprises:

Depth in feet From	To	Log
0'	4'	Coarse red-brown loose sand with interstitial clay material, and occasional gravels of weathered angular to subrounded fragments of quartz-feldspar granulite. Magnetite is scattered throughout as rounded fine to coarse grains.
4	35	Coarse gravels and boulders of weathered quartz-feldspar, and quartz-feldspar-pyroxene granulites altering to kaolinitic clays in part, and often coated with white calcrete. The size of the rounded to subrounded and angular fragments vary. Generally about $\frac{1}{4}$" diam., but up to 2"x1"x1". The matrix is a loose sand of quartz and granulite with white flakes and fragments of calcrete scattered throughout.
35	163	Soft loose red-brown sandy limy clay with scattered or occasional angular fragments and gravels of granulites. Gravel-boulder beds between 182-185 ft. and 151-155ft. where the rock is mostly a weathered granulite occurring as rounded and angular fragments up to $1\frac{1}{2}$" x 1" x 1". Some boulders of pyroxenite and rare gravels of angular chips of chalcedony. The clayey matrix is very plastic below water level. Water was cut at 124ft. and stands at 121ft.

End of Hole

DEPARTMENT OF MINES — SOUTH AUSTRALIA

GRAVITY SURVEYS N.W. PROVINCE
MT. DAVIES REGION
CLAUDE HILLS ZONE
UNCONTROLLED GRAVITY PROFILE

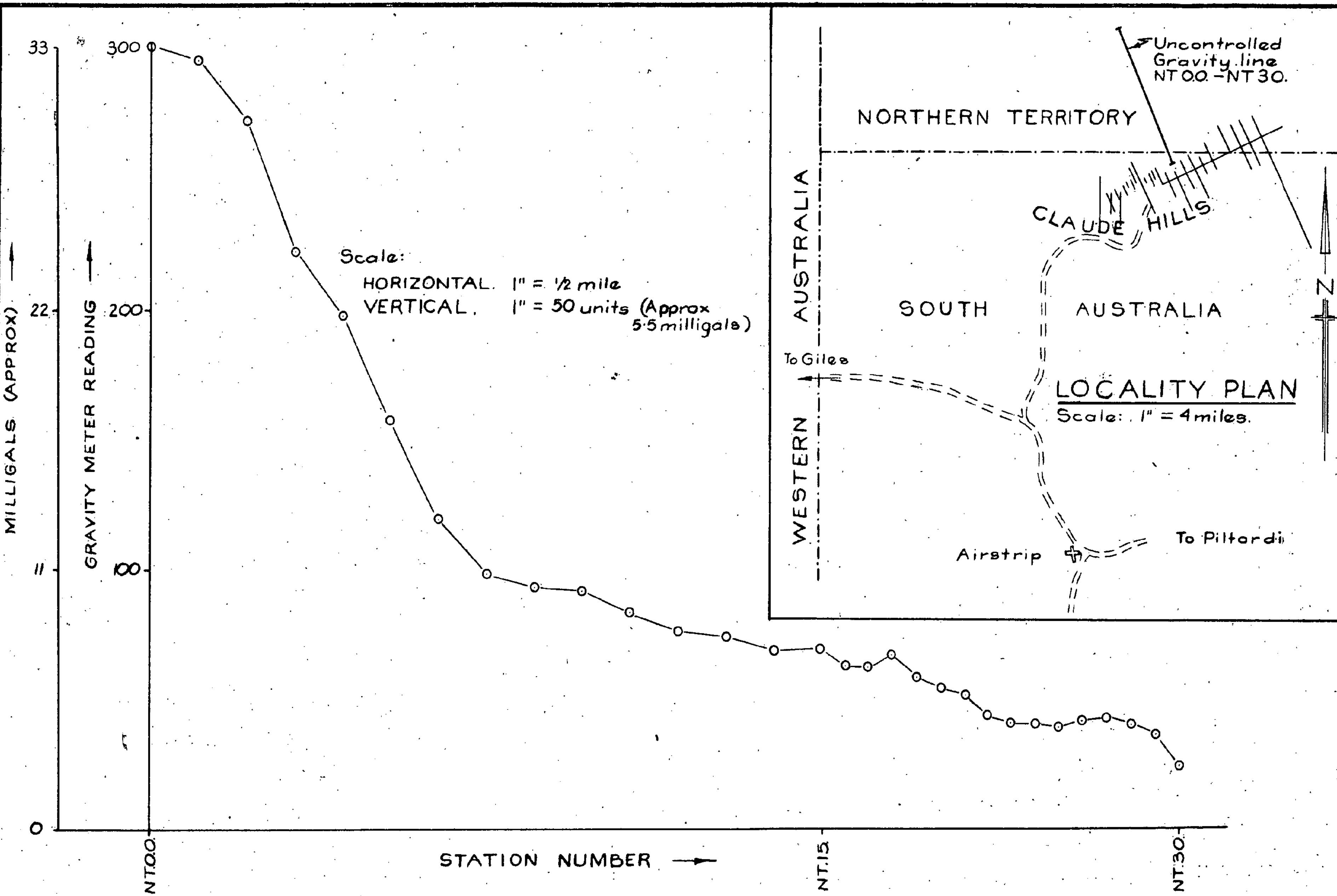
Drn. I.R.
Tcd. NHE
Ckd. LVW
Exd.

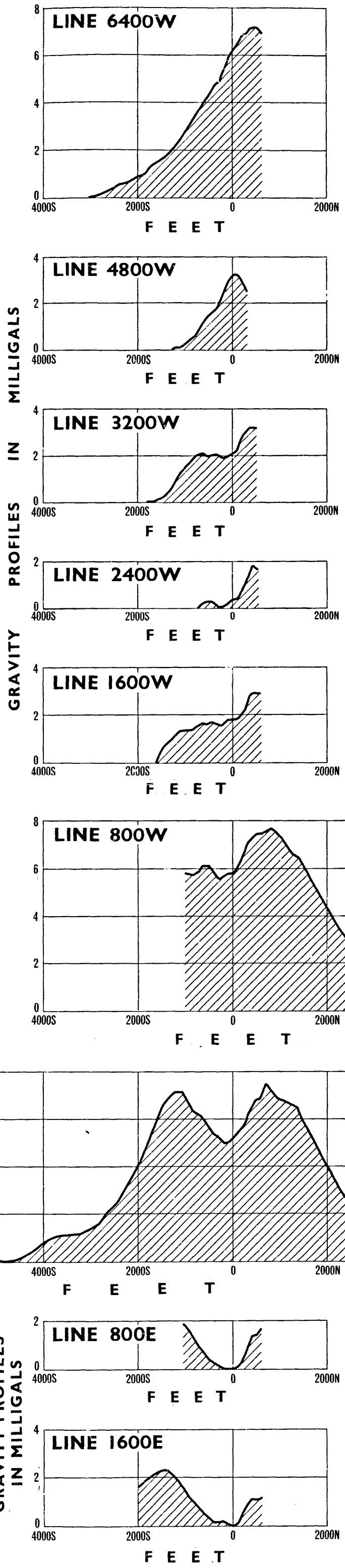
SCALE: As shown.

S5492.

Ad.

DATE: 5 Oct 66.





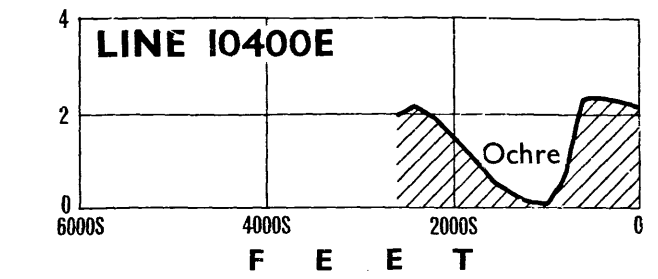
I. S. Rowan Geophysicist P. G. Miller Assistant Senior Geologist S.A. Dept. of Mines

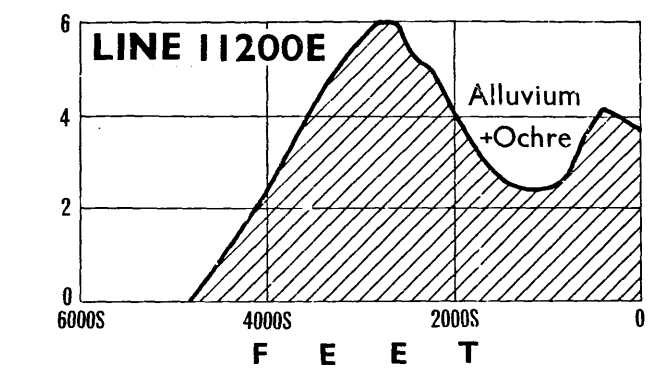
BOUGUER ANOMALY PROFILES
CLAUDE HILLS ZONE - GRID 1
NORTH WEST PROVINCE
MT. DAVIES REGION

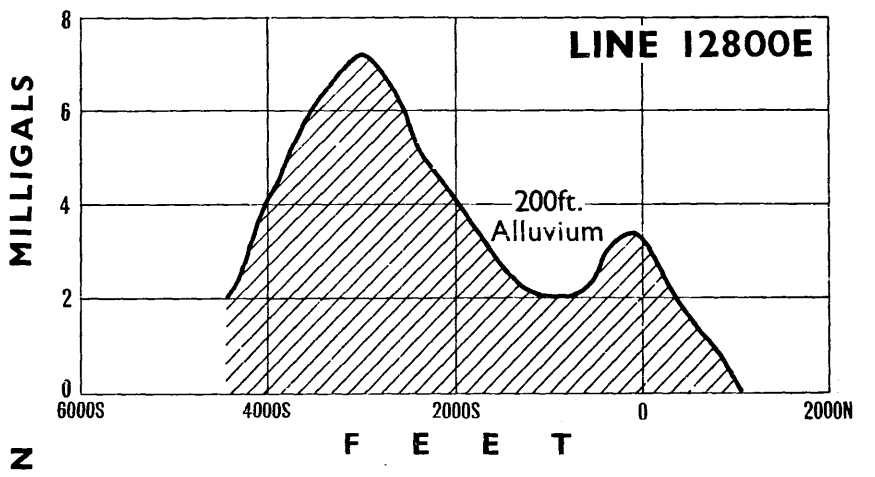
M.L. 66-538A/4 Ad 27-3-66

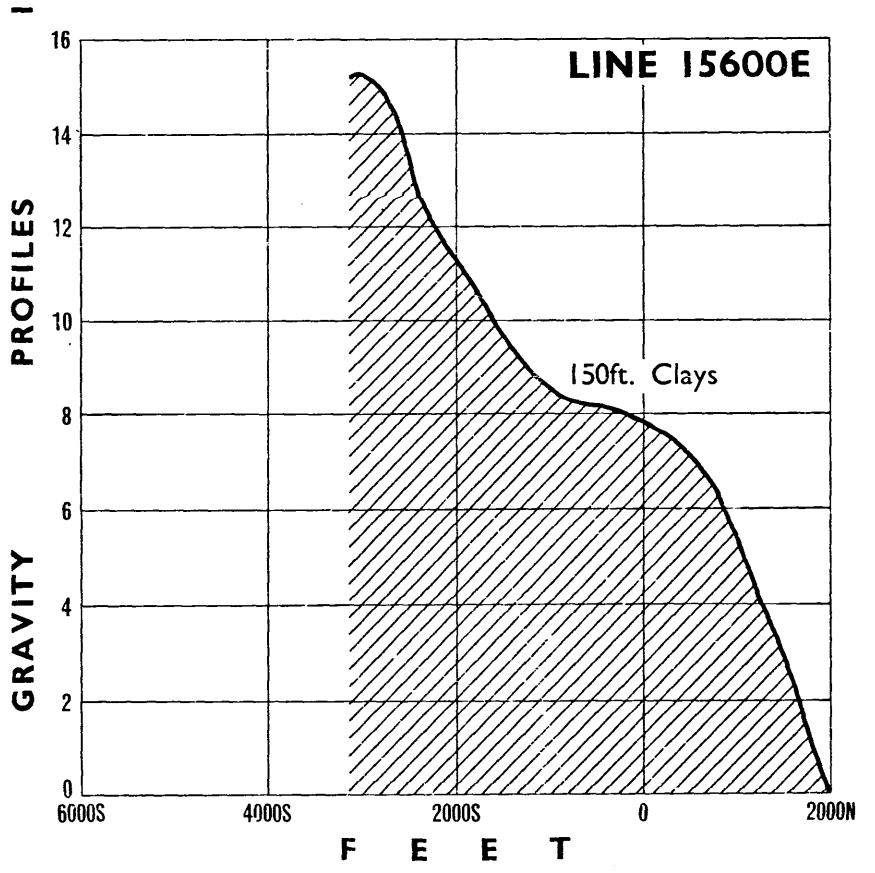
R.125 /

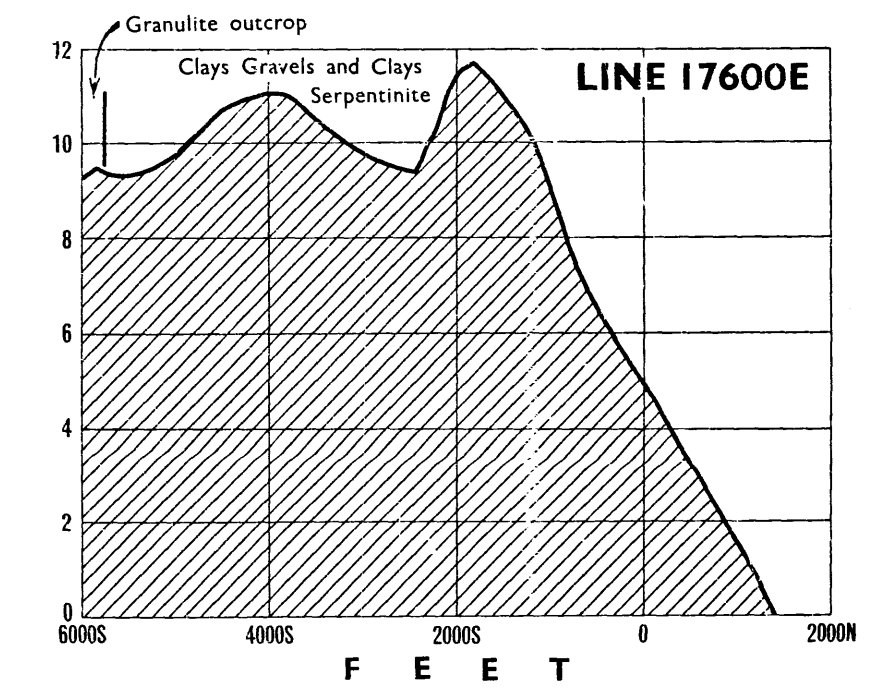
CENTIMETRES
INCHES

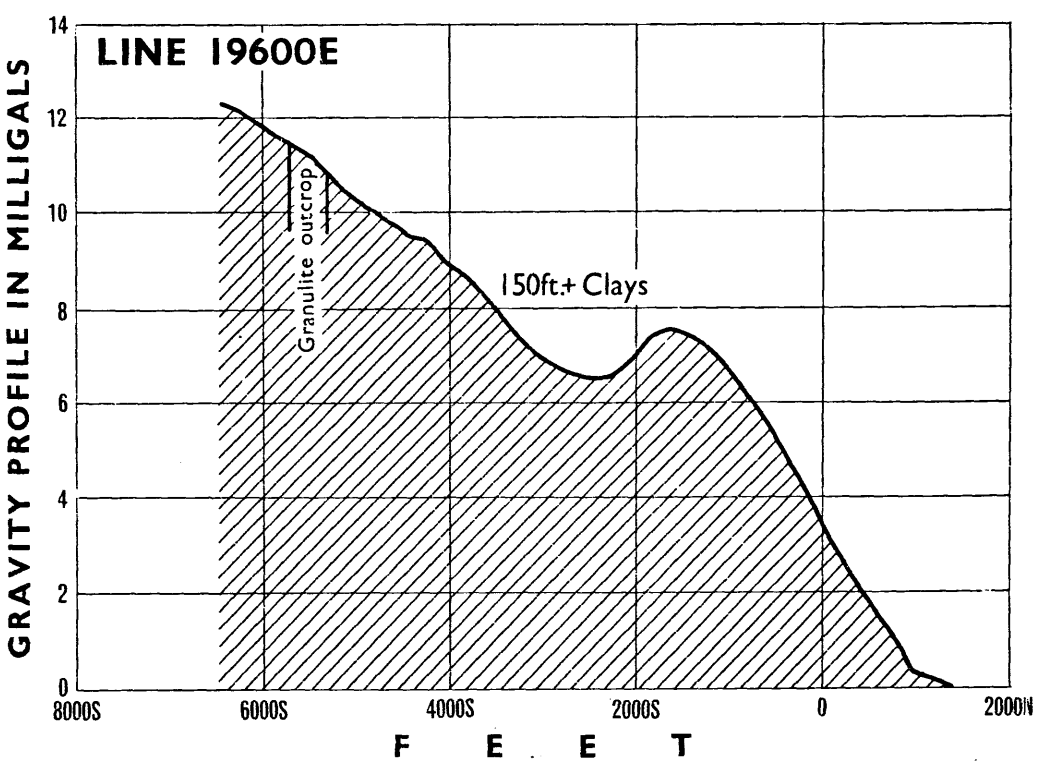






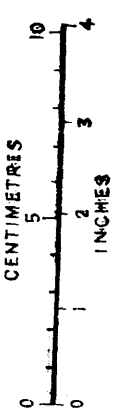






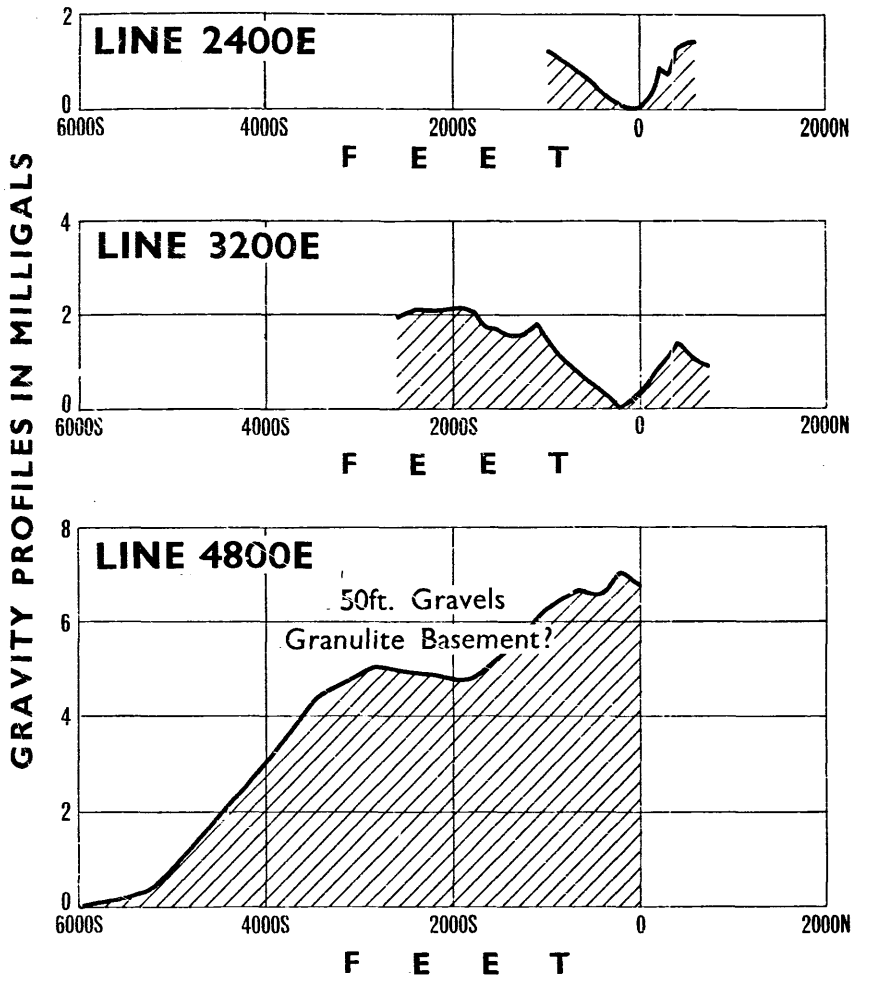
66-538B I. S. Rowan Geophysicist P. G. Miller Assistant Senior Geologist S.A. Dept. of Mines

BOUGUER ANOMALY PROFILES
CLAUDE HILLS ZONE-GRID 1
NORTH WEST PROVINCE
MT. DAVIES REGION



BOUGUER ANOMALY PROFILES
CLAUDE HILLS ZONE-GRID 1
NORTH WEST PROVINCE
MT. DAVIES REGION

GRAVITY PROFILES IN MILLIGALS

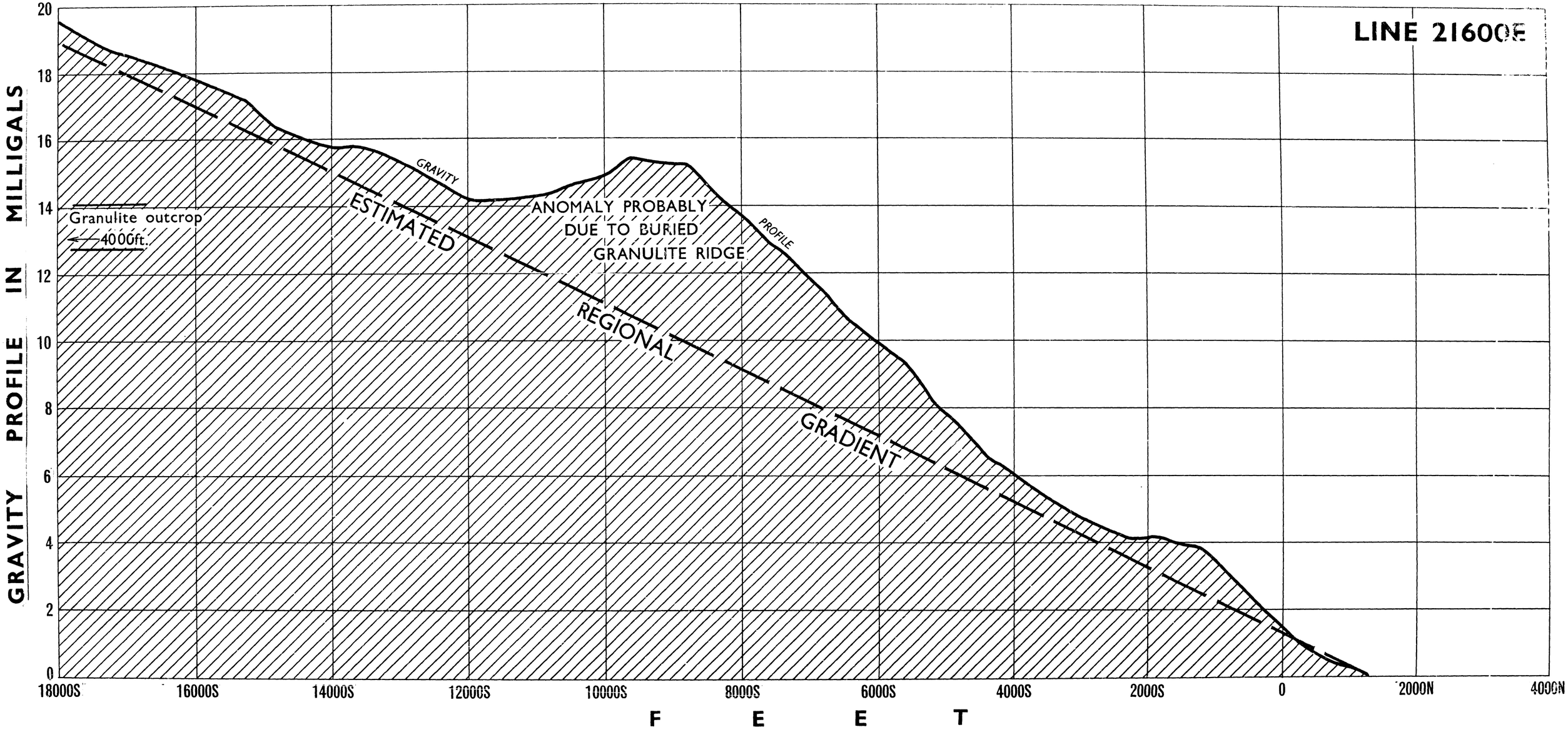


66-538C I. S. Rowan Geophysicist – P. G. Miller Assistant Senior Geologist S.A. Dept. of Mines

Reduce to 2¾ inches

(1)

CENTIMETRES 0 5 10
INCHES 0 1 2 3 4



66-538D

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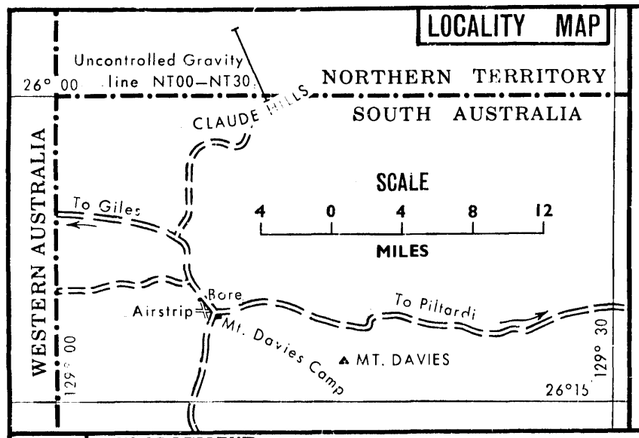
S.A. Dept. of Mines

LOCALITY MAP



SCALE

FEET 1000 0 1000 2000 3000 4000 5000 6000 FEET

UNCONTROLLED GRAVITY LINE
4½ Miles in length
NT00—NT30

ENLARGEMENT See Fig. 2

SOUTH AUSTRALIA

NORTHERN TERRITORY

00(GRID 2)

00(GRID 1)

2400W 1600W 800W 600E 1600E 2200E 2400E 4800E 6400E 8000E 9600E 10400E 11200E 12800E 15600E 17600E 19600E 21600E 2600S 4800N 3200N 1600N 6400N 8800E

NC 2 NC 3 NC 4 NC 5 NC 6 NC 7 NC 8 NC 16 NC 17 NC 18 NC 19 NC 20 NC 21 NC 22 NC 23

ZONE C ZONE D

N

LEGEND

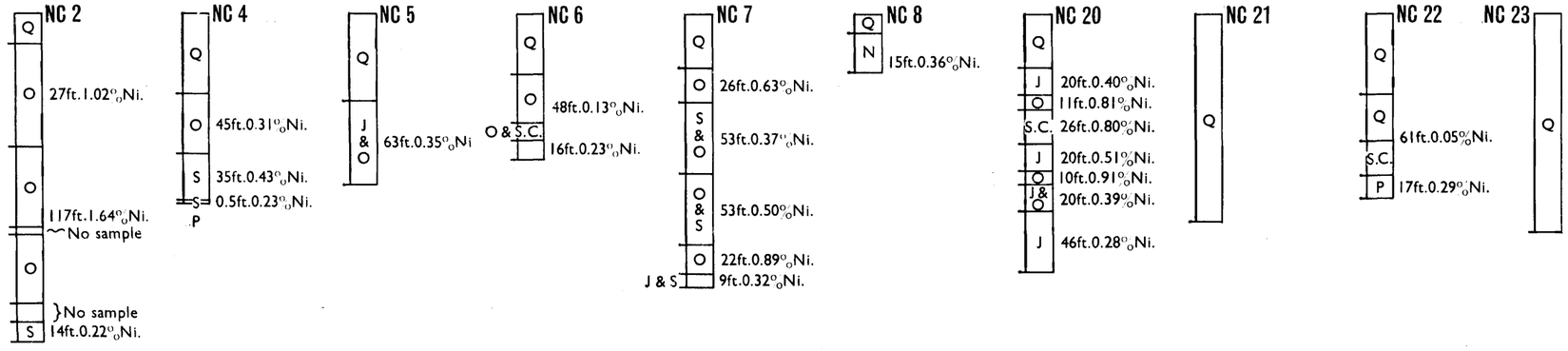
ARCHAEAN

- Metasediments: Quartz, Felspar Gneisses
- Pyroxenite
- Norite
- D Dolerite
- NC 19 Drill Hole
- Gravity station

TERTIARY

- Nickeliferous Ochre
- Jasper
- -27 / -28 Bouguer value gravity contours Interval 1.0 milligals
- Gravity Ridge
- Gravity Trough

GRAPHIC BORE LOGS AND NICKEL ASSAYS



REFERENCE

Q. Quaternary sands, clays and gravels

O. Ochre

J. Jasper

S. Serpentinite

S.C. Saponitic Clay

P. Pyroxenite

N. Norite

66-835

P. G. Miller Assistant Senior Geologist I. S. Rowan Geophysicist

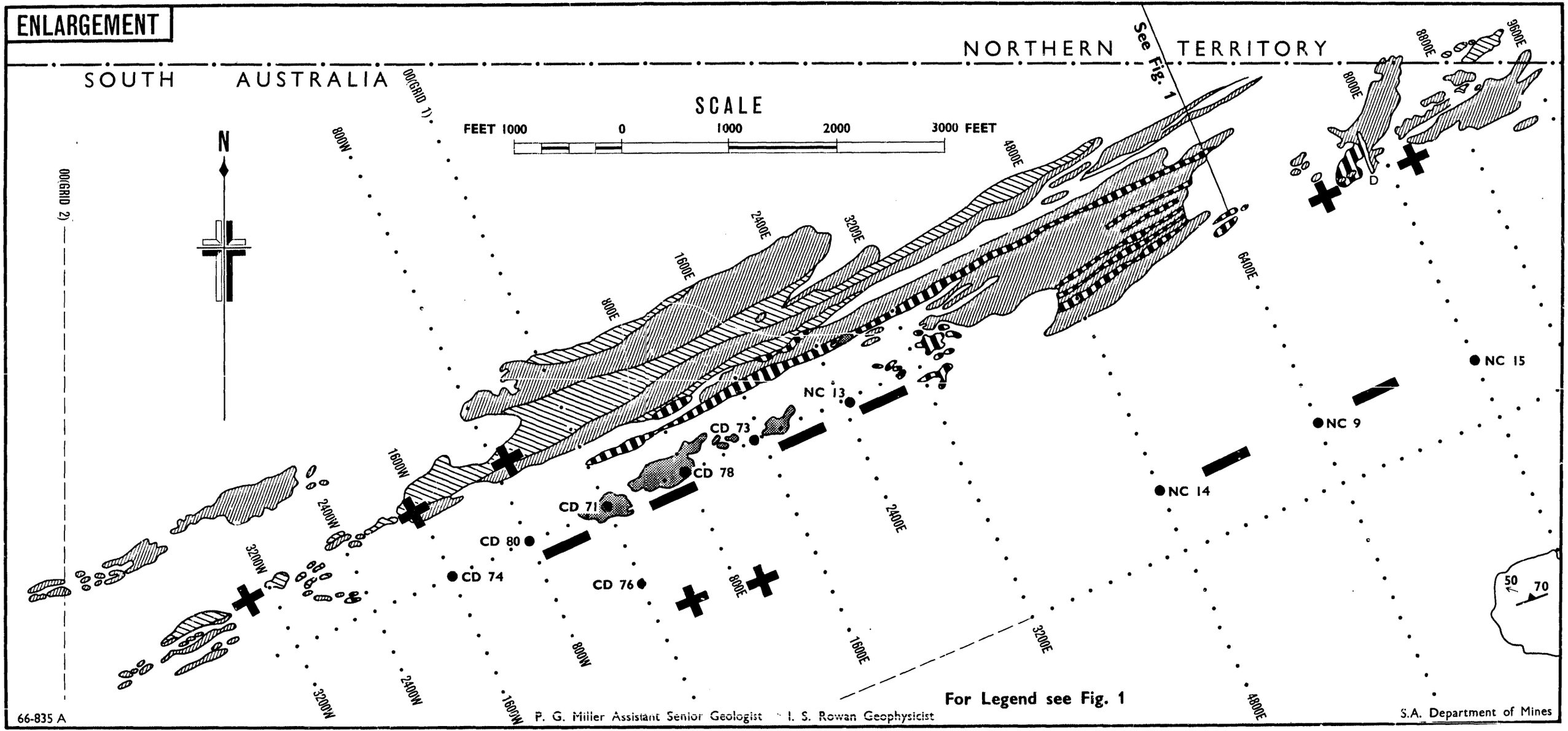
S.A. Department of Mines

SCALE IN FEET
1000 0 1000 2000 3000 4000 5000
500 0 500 1000 1500
SCALE IN METRES

112

C.R.S. 66-835/4
1/4 Ad.
10-11-67

R125


ENLARGEMENT
NORTHERN TERRITORY
SOUTH AUSTRALIA
See Fig. 1
SCALE
FEET 1000 0 1000 2000 3000 FEET
N
00(GRID 1)
00(GRID 2)
800W
1600W
2400W
3200W
800E
1600E
2400E
3200E
4800E
6400E
8000E
8800E
9600E
CD 71
CD 73
CD 74
CD 76
CD 78
CD 80
NC 9
NC 13
NC 14
NC 15
D
50
70
For Legend see Fig. 1
66-835 A
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