DEPARTMENT OF MINES
SOUTH AUSTRALIA

R|B 64/98

HALCOTRACK, TRACK MOUNTED AIR DRILL

ORIENTATION PROGRAMME

BRUKUNGA

Hd. Kanmantoo

by

M.G. MASON
GEOLOGIST
METALLIC MINERALS SECTION

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Rept. Bk. No. 64/98
G.S. No. 3710
D.M. 305/67

31st May, 1967

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Rept.Bk.No. 64/98
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HALCOTRACK

TRACK MOUNTED AIR DRILL

- ORIENTATION PROGRAMME -

BRUKUNGA

Hd. Kanmantoo

ABSTRACT

Use of the Halcotrack, track mounted air drill is confined to easily accessible, almost flat areas with dry subsurface conditions. Compact, indurated rocks are best drilled. Hole locations must be closely spaced, and holes preferably vertical. This is not a versatile machine and would not suit specifications for a Department of Mines exploration tool where versatility is of primary importance.

INTRODUCTION

Purchase of a Halcotrack, track mounted air drill in 1967 was contemplated and following delivery, at the end of March, for a trial period, a programme of orientation and testing was initialed with Brukunga, the venue of operations.

The project began on Tuesday 14th March and finished on Wednesday 22nd March, 1967. Machine repairs occupied the 16th and 17th. Holes 82A, 49A, 49B and two shallow trial holes were drilled on sections 5278 and 5280, hundred of Kanmantoo. Samples from holes 82A and 49A were compared with core from diamond drill holes 82 and 49. Comparison was confined to assays of equivalent sections, for Fe, S, Cu, Pb, Cn, Zn and V.

Suitability of the Halcotrack for Mines Department work was examined as to:

1. Mobility of the machine to the site and on site

2. Rate of penetration
3. Effect of inclination of holes
4. Effect of water content of formation
5. Deviation of hole with depth
6. Problems of sample collection
7. Geological information obtained
8. Comparison of assays with those of diamond drill holes
9. Average cost per foot of drilling

Finally the type of work the drill is suitable for was determined.

ORIENTATION PROGRAMME AND RESULTS

Mobility of the Halcotrack

The Halcotrack drill and compressor were transferred to Brukunga by an E. & W.S. low loader, while the return trip was accomplished by a five tone truck using a loading ramp. Many sites, especially in hilly areas would be inaccessible to a five ton truck towing a five ton compressor.

On location the drill must tow the compressor to within 50ft. or the length of available air hose, of the drill hole site. Difficulty is experienced in climbing 10^{o} slopes. Therefore, sites on the sides or top of steep hills or surrounded by rough ground, are inaccessible.

The top speed of the machine is $1\frac{3}{4}$ m.p.h. If drill hole sites are even only a few hundred yards apart, shifting time is greatly increased.

Once in position, drilling can commence almost immediately, as setting up time is reduced to , essentially, setting up the sampling equipment.

Rate of Penetration

Rate of penetration during drilling averaged 20 feet per hour. A maximum rate of 30 feet per hour could be expected with proficient drillers under dry subsurface conditions. Slower rates were experienced in softer formations due to cushioning of the hammer blows. Maximum penetration was obtained in moderately indurated unweathered rocks.

It was noticed that the air exit holes on the bottom of the bit were further from the bit face than usual. Coarse cuttings were not immediately lifted, resulting in fine cuttings at the surface and a slower rate of penetration.

Deviation of Hole with depth was not tested since the maximum depth penetrated was 85 feet.

Inclination of Hole

Hole 49A was drilled at an angle of 30° to the horizontal and four feet north ; of DDH 49. The only difficulty encountered was in forming an air tight seal at the collar. (See Plate 3). The high air pressures used by the drill necessitates a strong seal at the collar. Therefore areas with gravel, sand or soft overburdens are difficult to drill due to blow by and associated widening of the hole near the surface.

Holes drilled in rock strata with wide fissures, especially if another hole is nearby, show a lowering of air pressure and loss of cuttings at the surface.

Drilling below the Water Table

Where minor quantities of water were encountered below the water table few cuttings came to the surface. This may be overcome by using water circulation (if possible with this machine), however, washing of soft or brecciated zones then occurs and bad contamination results. Sample procedure has to be altered and is time consuming.

Sample collection

With dry subsurface conditions, coarse fragments are lost at the collar of the hole and fines are blown out of the cyclone. Refinement of equipment may eliminate this.

Under wet subsurface conditions the sample has to;be collected by settling and the dried and split. Quartering may be possible while wet but drying is still time consuming.

Geological Information is confined to colour changes, diagnostic mineral changes, mainly using binocular microscope, and assay changes. Therefore little geological information is obtained compared with diamond drilling cores.

Comparison of assay results with those of diamond drill core

Fig. 3 shows a good comparison of Fe and S assay results from holes 82 and 82A. On the average, at low sulphide contents, diamond drill cores assay higher than the Halcotrack cuttings, which at high sulphide contents, the opposite is true. This is probably due to two factors. At low sulphide concentrations, loss of fines by Halcotrack sampling equipment has little effect but bars of coarse sulphide grains at the collar causes a lower sulphide assay. At high sulphide concentrations the effect of the errors is reversed and higher sulphide assays are obtained. Refinement of equipment assay eliminate this. Therefore, assay results from air drill samples are essentially comparable with diamond drill hole results.

Results for 49 and 49A show a poor comparison. This may be due to irregular dispersion of elements in the oxidized zone, and a cross cutting fault in lower parts of the holes. This also applies to minor element comparisons (Fig. 4). Difficulty was experienced with contamination of samples from upper portions of Hole 49A, especially below water level.

Drilling Costs

The average cost per foot of drilling was approximately

$2.50; assuming a bit life of 300 feet. With more efficient drillers and techniques, a cost of $2.00 is possible. However, i if plant hire is included a figure of $3.00 per foot is about right (assuming plant hire of $100 per day). This compares rather unfavourably with diamond drilling cost of $400 per foot.

CONCLUSIONS

The Halcotrack drill is a cheap method ;of putting a hole in the ground, in a short period of time to obtain assay information. It is easy to set up but the low speed of locamotion from one site to another may affect this advantage.

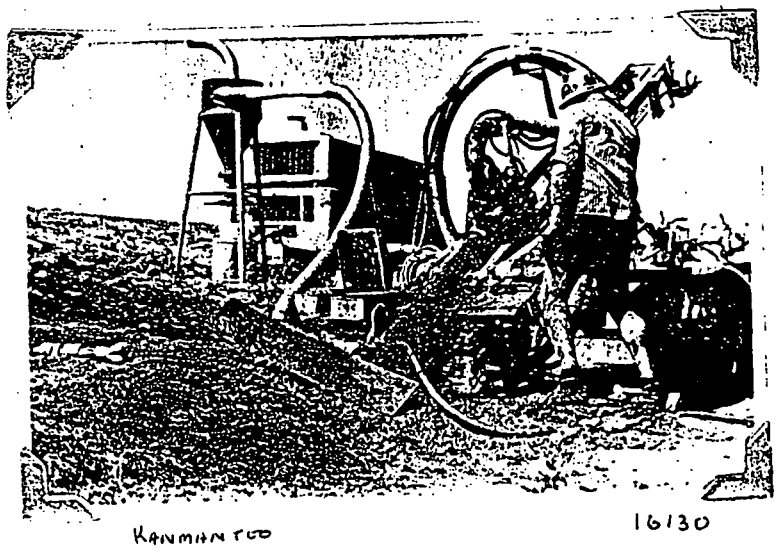
Its use is limited to readily accessible, nearly flat areas where dry subsurface conditions exist. Holes with an inclination of less than 30° to the horizontal cannot be drilled. Collaring of the hole is difficult in porous and on soft surface formations. Sample collection is not perfect and limited essentially to dry subsurface conditions. Sites must be closely spaced to make use ;of small setting up time required.

Assay results are fairly comparable to diamond drill results ($\pm$ 1.0%), for minerals in concentration 5-20% of rock). Geological information is low and holes must be controlled geologically by previous information.

This drill would be geologically economical under only a few specialized projects carried out by the Mines Department.

MGM:CM
31.5.1967

M.G. MASON
GEOLOGIST
NON METALLIC MINERALS SECTION



Halcotrack drill in operation showing layout of equipment. Type ;of bit used shown at left centre. Difficulty being experienced in sealing the collar of the hole (especially when water level cut) due to soft stony soil at surface.

DEPARTMENT OF MINES
SOUTH AUSTRALIA

Average Assay Results of % S and % Fe — Hole No. 49A

Project: Nairne Pyrites Pty. Ltd. — R.L. 1,303ft.

Feature: Timmin's Hill — Sect. 5278 — Hun. Kanmantoo

Location: Brukunga — Co-ordinates: 3884N 1484E

Analysis by: S.A. Alexander - AMDEL — Angle from horizontal: 30°

Ref: AN2496/67 - 11A, pr. 67 — Direction: 305°T

Sample Nos: A1362/67 to A1377/67

Geological Remarks	Depth (feet) From	To	Average Assays % S	% Fe
	5.0	10.0	0.15	3.1
	10.0	15.0	1.14	11.8
	15.0	20.0	3.40	14.9
	20.0	25.0	4.15	12.9
	25.0	30.0	1.23	9.1
	30.0	35.0	0.66	8.15
	35.0	40.0	1.17	6.9
41ft. limit of oxidation	40.0	43.5	3.75	6.45
	43.5	45.0	5.0	6.65
	45.0	50.0	5.3	7.35
	50.0	55.0	3.1	4.8
58ft.	55.0	60.0	2.9	5.4
Fault Zone?				
64ft.	60.0	64.0	1.4	9.9
	65.0	70.0	5.3	6.75
	70.0	75.0	5.5	5.3
78ft. Water Level	75.0	80.0	5.4	5.95

Hole No: 49 — Co-ord. 3880N 1484E — Machine: E1000

Carried out by: James, D.L. — Ref: AN 2640/67

Sample Nos: A1410/67 to A1421/67

Also carried out by Nairne Pyrites Pty. Ltd.

Geological Remarks	Depth (feet) From	To	Average Assays % S	% Fe
	0	5	0.03	4.6
	5	10	0.04	2.4
	10	15	0.09	2.4
	15	20	0.74	10.9
	20	25	0.80	14.9
Oxidized Zone	25	30	2.81	16.1
	30	35	0.65	4.2
	35	40	0.02	1.6
	40	45	0.79	10.2
50ft.	45	50	5.10	17.9
	50	52	13.2	14.4
Waste Zone	52	60	8.0	8.4
	60	65	5.0	5.4
	65	70	2.4	4.7
74ft.	70	74	4.8	5.3
Fault Zone	74	79	1.27	5.4
83ft.	79	83	0.72	13.8

Note: Hole 49A on same strike and elevations but HOLE NO. 49 4ft. Nth. Therefore, footages essentially equivalent.

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Average Assay Results of % S and % Fe

Project: Nairne Pyrites Pty. Ltd. **Sect.** 5280 **Hole No:** 82A

Feature: Timmin's Hill **Hundred:** Kanmantoo **R.L.:** 1.245ft.

Location: Brukunga **Co-ordinates:** 3628N 1230E **Angle from Horizontal:** 90°

Drilling: 15 March 1967.

Machine: Halcotrack Air Drill

Carried out by S.A. Alexander AMDEL Ref. AN.2389/67 Date:4 Apr.67

Sample Nos. A.1341/67 to A.1352/67

Geological Remarks	Depth (feet) From	To	Average Assays % S	% Fe
	5.0	7.5	0.25	6.0
	7.5	10.0	1.63	4.7
Oxidized Zone	10.0	12.5	2.42	5.7
	12.5	15.0	3.85	6.3
	15.0	17.5	3.80	6.8
17ft.				
	17.5	20.0	4.75	6.6
Waste Zone	20.0	25.0	4.35	7.0
	25.0	30.0	5.85	8.3
30ft.				
	30.0	35.0	12.2	13.6
No. 1 Ore Zone	35.0	40.0	16.0	16.6
	40.0	45.0	15.4	17.2
	45.0	50.0	14.2	15.8
:				

Co-ordinates: 3620N 1230E **R.L.** 1245 feet **Hole No.** 82

Start: 26 Jan. 67. **Finish:** 27 Jan. 67 **Angle from Horizontal:** 90°

Assays carried out by: Nairne Pyrites Pty. Ltd. **Machine:** Diamond Drill E1000

Geological Remarks:	Depth (feet) From	To	Average Assays % S	% Fe
	3.0	5.5	0.72	3.1
Oxidized Zone	5.5	8.0	0.14	6.8
	8.0	10.5	2.5	4.6
12ft.	10.5	13.0	2.8	5.4
	13.0	15.5	3.9	4.7
	15.5	18.0	5.3	6.2
Waste Zone	18.0	23.0	4.4	5.4
	23.0	28.0	5.25	7.1
30.5ft.	28.0	30.5	3.92	6.29
No. 1 Ore Zone	30.5	35.0	10.8	12.9
	35.0	38.0	14.7	15.7
	38.0	45.0	14.9	16.3
	45.0	49.5	12.5	14.2

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APPENDIX 3

SEMI QUANTITATIVE SPECTROGRAPHIC ANALYSIS

Project: Nairne Pyrites Pty. Ltd. Sect.: 5278 Hole No.: 49A

Feature: Timmin's Hill Hd.: Kanmantoo R.L. 1303

Location: Brukunga Co-ordinates: 3884N 1484E

Angle from Horizontal: 30°

Direction: 305°T

Carried out by N.V. Johnston AMDEL Ref.: AN.2496/67 date: 4 Apr. 67.

Samples: A.1362/67 to A.1377/67

Depth (feet)		Results in p.p.m.				
FROM	TO	Cu	Pb	Zn	Cn	V
5.0	10.0	50	50	25	100	25
10.0	15.0	150	250	25	100	40
15.0	20.0	60	200	20	30	20
20.0	25.0	50	200	20	30	40
25.0	30.0	80	400	30	30	40
30.0	35.0	80	300	20	50	150
35.0	40.0	80	120	30	50	50
40.0	43.5	100	150	50	30	400
43.5	45.0	60	100	100	30	60
45.0	50.0	100	200	200	100	120
50.0	55.0	80	150	150	50	80
55.0	60.0	120	150	120	50	200
60.0	65.0	80	120	60	20	20
65.0	70.0	150	500	300	100	400
70.0	75.0	150	500	300	200	400
75.0	80.0	120	250	200	150	250

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APPENDIX 3

SEMI QUANTITATIVE SPECTROSCOPIC ANALYSIS

Project: Nairne Pyrites Pty. Ltd. Sect.: 5278 Hole No.: 49

Feature: Timmin's Hill Hd.: Kanmantoo R.L.: 1303ft.

Location: Brukunga Co-ordinates: 3880N 1484E

Angle from Horizontal: 30°

Direction: 305°T

Carried out by: N.V. Johnson AMDEL Ref.: AN.2388/67, AN.2390/67.

Sample Nos.: A.1331/67 to A.1340/67, A.1315/67 to A.1330/67

Date: 4th Apr. 1967.

Depth (feet)		Results in p.p.m.				
FROM	TO	Cu	Pb	Zu	Cn	V
0	5.0	40	70	20	50	100
5.0	10.0	40	60	20	60	50
10.0	15.0	30	80	20	60	40
15.0	20.0	100	120	40	40	40
20.0	25.0	120	200	60	20	40
25.0	30.0	50	250	25	20	40
30.0	35.0	40	200	25	50	25
35.0	40.0	6	40	20	120	40
40.0	45.0	100	40	70	30	40
45.0	50.0	40	100	150	15	15
50.0	52.0	100	250	70	30	150
52.0	60.0	120	400	50	30	30
60.0	65.0	120	300	500	50	150
65.0	70.0	80	200	30	50	120
70.0	74.0	150	250	20	150	400
74.0	79.0	100	150	30	40	100
79.0	83.0	80	70	80	12	40

DEPARTMENT OF MINES — SOUTH AUSTRALIA

LOG OF DIAMOND DRILL HOLE

HOLE NO.	82
SHEET	1 OF 1

SERIAL No. 710/12

PROJECT NAIRNE PYRITES PTY LTD — SECTION ~~3578~~ 5280 — R.L. 1245 FEET

FEATURE TIMMINS HILL — HUNDRED KANMANTOO — ANGLE FROM HORIZONTAL 90°

LOCATION BRUKUNGA — CO-ORDINATES 3620N . 1230E — DIRECTION —

Column headings: ROCK TYPE / DEGREE OF WEATHERING SHOWN IN CORE | DESCRIPTION OF CORE | LIFT CORE LOSS % 20 60 | CORE SIZE R.L. DEPTH FT. | LOG | FRACTURE LOG 1 4 16 64 | STRUCTURES JOINTS VEINS SEAMS SHEARED, CRUSHED ZONES | WATER LEVEL | CASING | DRILL WATER LOSS 50 25 75 | WATER PRESSURE TESTS PERMEABILITY IN LUGEON UNITS 10 20 30 / 40 120

Rock type: CAMBRIAN - KANMANTOO GROUP, NAIRNE PYRITE FORMATION; No1 ORE ZONE

Core size: CORING BIT; NMG

Depth markers: 10, 20, 30, 40

Description of core

NO CORE

GRANOFELS - CALCSILICATE
Grey - fine to medium grained. 15% brown phlogopite. 50% feldspar. 30% actinolite, little quartz - tremolite ?

NO CORE

NO CORE

GRANOFELS - CALCSILICATE
Light grey - medium grained less 2% Fine Fe sulphide 70% plagioclase, 20% actinolite, tremolite - little quartz.

GNEISS - METASILT — Pale grey Medium grained - 10% Fe sulphides mainly pyrite - 15% fine grained pale phlogopite. 50% quartz Rest Feldspar.

Sulphide content increases to 12-15% mainly pyrite. Higher grade due to coarse grained bands 2-5mm thick 10-100mm apart

Structures

- Possible Fault Zone.
- Possible Fault Zone
- Zone breccia coarse primary secondary mineralization. Anastomising vein system. Possible Fault Zone

No Gneissosity — Joints spaced 0.1 to 0.5 ft apart, mainly parallel to layering; open, iron oxide coated, 1-5mm thick.

Joints spaced, 1-2mm thick, Layering moist, planar, 40° at 190 to 60° to axis of core at 30 ft. Layers 1-3mm apart.

Good Gneissosity — Joints { spaced 0.5 to 2.0 ft apart, mainly parallel to layering, open Vermiculite coated.

Layering distinct near planar, foliated. Av 35° to axis of core. Layers 1-5mm apart.

END OF HOLE 49.5 FT

Water pressure tests: NOT TESTED.

Legend

FRACTURE LOG
1 4 16 64 · · · · Breaks in core per foot or 1 / Diameter of fragments in feet
12 3 3/4 3/16 · · Inches Equivalent Diameter

7 May 65 — CASING; WATER LEVEL, DATE

WEATHERING
FR — Fresh
SW — Slightly weathered
MW — Moderately weathered
HW — Highly weathered
CW — Completely weathered

× Gneiss
~ Schist
Calcsilicate
Metasilt
Layering Trend
Breccia Zone
Major Joint
Altered zone

ENGINEERING GEOLOGY SECTION	
DRILL No.	LOGGED MGM
TYPE E1000	DATE 1 Feb '67
DRILLER JARVIS	DRAWN MGM
START 26 JAN '67	TRACED AMcD.
FINISH 27 JAN '67	CHECKED L.V.W.
DRG. No. 55705 HbG.	

DEPARTMENT OF MINES — SOUTH AUSTRALIA

HOLE NO. 49

SHEET 1 OF 5

SERIAL No. . . . . .

LOG OF DIAMOND DRILL HOLE

PROJECT NAIRNE PYRITES PTY. LTD. SECTION 5278 . . . . . R.L. 1302.8. . . FEET

FEATURE TIMMINS HILL. . . . . HUNDRED KANMANTOO . . . . . ANGLE FROM HORIZONTAL 30°.

LOCATION BRUKUNGA. . . . . CO-ORDINATES 3880N. 1484E. . . . . DIRECTION 305° T.

ROCK TYPE / DESCRIPTION OF CORE / DEGREE OF WEATHERING / STRUCTURE OF CORE	LIFT CORE LOSS % 20 60	CORE SIZE DEPTH R.L. FT.	LOG	FRACTURE LOG 1 4 16 64	STRUCTURES JOINTS VEINS SEAMS SHEARED, CRUSHED ZONES	WATER LEVEL CASING DRILL WATER LOSS	WATER PRESSURE TESTS PERMEABILITY IN LUGEON UNITS 10 20 30 50 80 120
GRAVEL - Hematite nodules			No core		70% gravel rest sand Poorly graded GP		
GNEISS - METASILT. - 10% med. grained quartz. 15% hematite particles weathered from amphibole. Rest weathered feldspar. Little phlogopite mica.				Mod Applicable	Layering irregular average 45° to axis of core Planar joints, 45° to axis of core spaced 0.3 ft apart, open clay filled hematite coated		
CLAY - 35% hematite soft nodules 10% sand. Moderate plasticity, green grey.					No structure CH-L Possible Fault zone?		
GRANOFELS - CALCSILICATE - 40% phlogopite, 10% amphibole weathering to hematite, 10% quartz. Rest weathered feldspar. Brown white.		10	NX		Joints, Planar mainly at 40° to axis of core. Few vertical open limonite coated clay filled 1-3mm thick Spaced 0.25 M apart		
SCHIST - 30% phlogopite 15% Hematite nodules 1-2mm diameter weathered from Fe sulphides. Rest weathered feldspar yellow-brown.					Layering wavy inclined 60° to axis of core Joints irregular mainly parallel to layering spaced 0.18 M apart. Open limonite and clay filled.		
CALCSILICATE as above					As above.		
SCHIST - 30% phlogopite 10% hematite 1-2mm nodules weathered from Fe sulphides, 5% quartz, medium grained. Rest weathered feldspar yellow to med. brown, in phlogopite, feldspar and hematite rich layers.		20			Layering 40° to axis of core wavy. Joints mainly parallel to layering. Formed by weathering of sulphide bands. Open 1-3mm thick clay filled or limonite coated.		
GRANOFELS - CALCSILICATE 10% medium grained amphibole 30% quartz, 40% feldspar white tremolite, P Grey - white.					Indistinct layering 30° to axis of core. Joints near planar open limonite coated 1-3mm thick. Few near vertical spaced 0.1 to 0.3 M apart.		
SCHIST - 25% phlogopite 15% Fe sulphide. in 2-5mm bands, 15% medium grained black amphibole. Rest feldspar medium grained - Pale grey.		30			Layering wavy spaced 0.5 to 3mm apart. Averaging 60° to axis of core. Joints mainly due to weathering along sulphide rich layers. Open, near planar 2-5mm thick. Few near vertical Limonite hematite coated Spaced 0.1 M apart		
GNEISS - METASILT. 50% medium grained black amphibole 3mall % phlogopite. Rest fine grained quartz and feldspar - Dark grey 3-6% Fe sulphides, fine grained. Thin veins pyrite averaging 2mm thick, planar 40° to axis of core, coarse grained from 0.2 to 6.0 inches apart. Few thin light grey calcsilicate bands.		40			Layering indistinct 60-65° to axis of core. Joints planar open limonite coated. At angle to layering usually 45-50° to axis of core Spaced 0.1 to 0.4 feet apart.		
		50					
		60	BX				
		70			— Probable Fault.		
GRANOFELS - CALCSILICATE - light grey 1% medium cavities originally occupied by Fe sulphides. Mainly Felspar 60% 3% phlogopite rest amphibole In fault zone highly weathered breccia and shearing.		80	CORE		Layering 80° to axis of core - Fault zone, fault layering 45° to axis of core - Veins up to 10 mm of hematite after pyrite. High angle joints parallel to fault.	22 Mar 67	
GNEISS - METASILT - Dark grey 20% black medium grained amphibole. 2% fine grained Fe sulphide Rest fine grained feldspar quartz.					Layering horizontal indistinct planar joints 45° to axis of hole open 0.3 ft apart Probable fault. Limonite coated some cubic pyrite.		
GNEISS - METASILT. 15-20% med. grained Fe sulphides, mainly in 5mm thick layers associated with dark grey amphibole 30% white bands 3mm thick of medium grained feldspar and quartz. 5mm thick cross cutting vein coarse sulphide (pyrite at 40° to axis of core 45° deslination of strike to layering. Averaging 0.3 ft apart.		90			Layering wavy 90° to 70° to axis of core spaced 2 to 5 mm apart. Joints open planar splits parallel to pyrite wavy but joints limonite filled 2-4 mm. thick at angle to veins and layering 60 to 80 to axis of core. Spaced 2.0 to 3.0 M apart.		
		100					

CAMBRIAN - KANMANTOO GROUP — NAIRNE PYRITE FORMATION — No 1 ORE ZONE

NOT TESTED

FRACTURE LOG: 1 4 16 64 . . . . Breaks in core per foot or . . . . 1 / Diameter of fragments in feet

12 3 3/4 3/16 . . . . Inches Equivalent Diameter

CASING — 7 May 65

WATER LEVEL DATE →

WEATHERING

FR — Fresh

SW — Slightly weathered

MW — Moderately "

HW Highly "

CW Completely "

Gneiss

Schist

Calcsilicate

Metasilt

Layering Trend

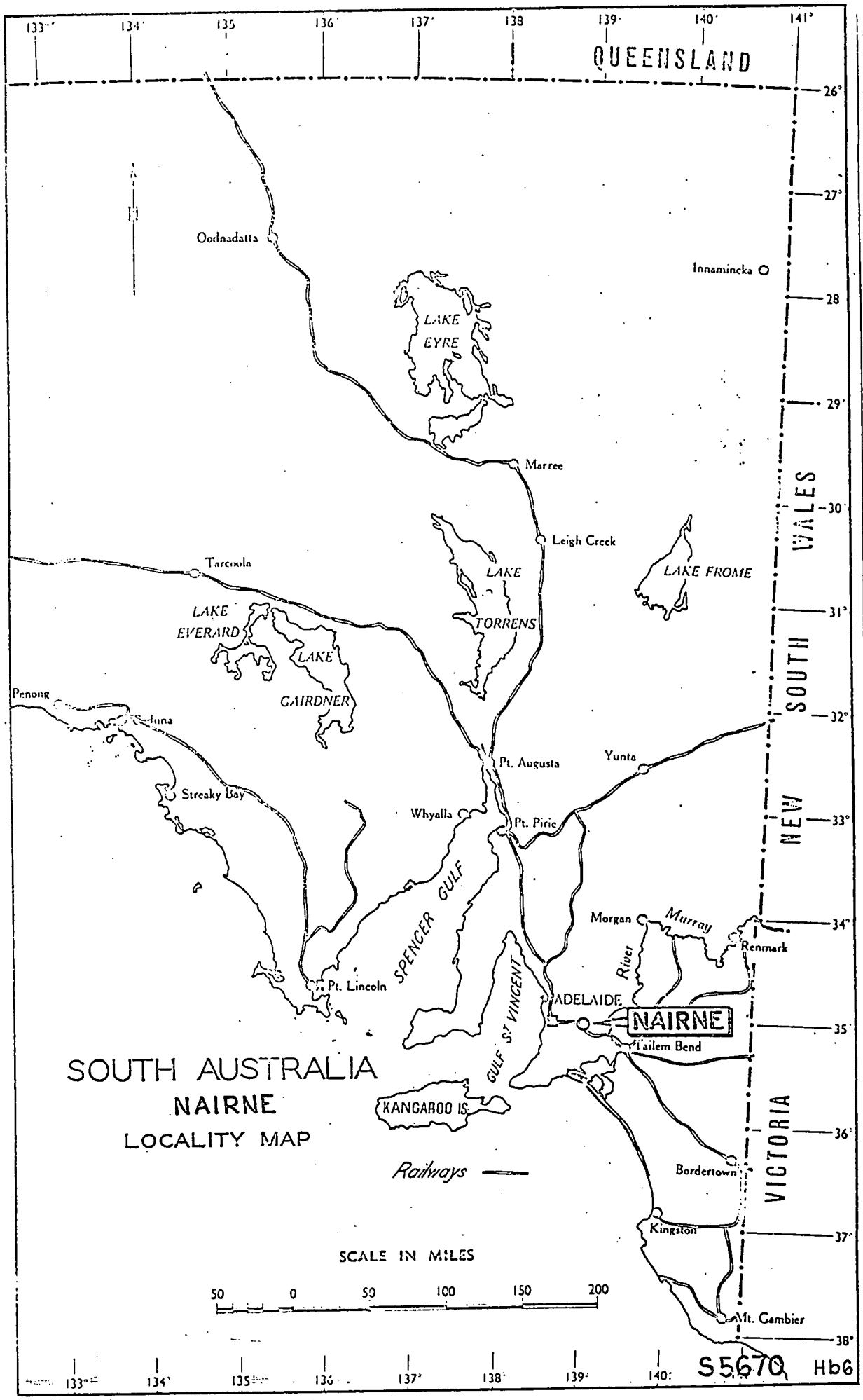
Breccia zone

Major joint

Altered zone

ENGINEERING GEOLOGY SECTION

DRILL No. 15	LOGGED M.G.M.
TYPE E.1000	DATE 10 Dec '66
DRILLER Jarvis	DRAWN M.G.M.
START 28 Nov '66	TRACED A.M.D.
FINISH 20 Jan '67	CHECKED L.V.W.
DRG. No.	55691 H06


QUEENSLAND
NEW SOUTH WALES
VICTORIA
133°
134°
135°
136°
137°
138°
139°
140°
141°
26°
27°
28°
29°
30°
31°
32°
33°
34°
35°
36°
37°
38°
Oodnadatta
Innamincka
LAKE EYRE
Marree
Leigh Creek
LAKE TORRENS
LAKE FROME
Tarcoola
LAKE EVERARD
LAKE GAIRDNER
Penong
Streaky Bay
Pt. Augusta
Yunta
Whyalla
Pt. Piric
SPENCER GULF
Morgan
Murray River
Renmark
Pt. Lincoln
ADELAIDE
NAIRNE
Hailem Bend
GULF ST VINCENT
KANGAROO IS
SOUTH AUSTRALIA
NAIRNE
LOCALITY MAP
Railways
Bordertown
Kingston
Mt. Gambier
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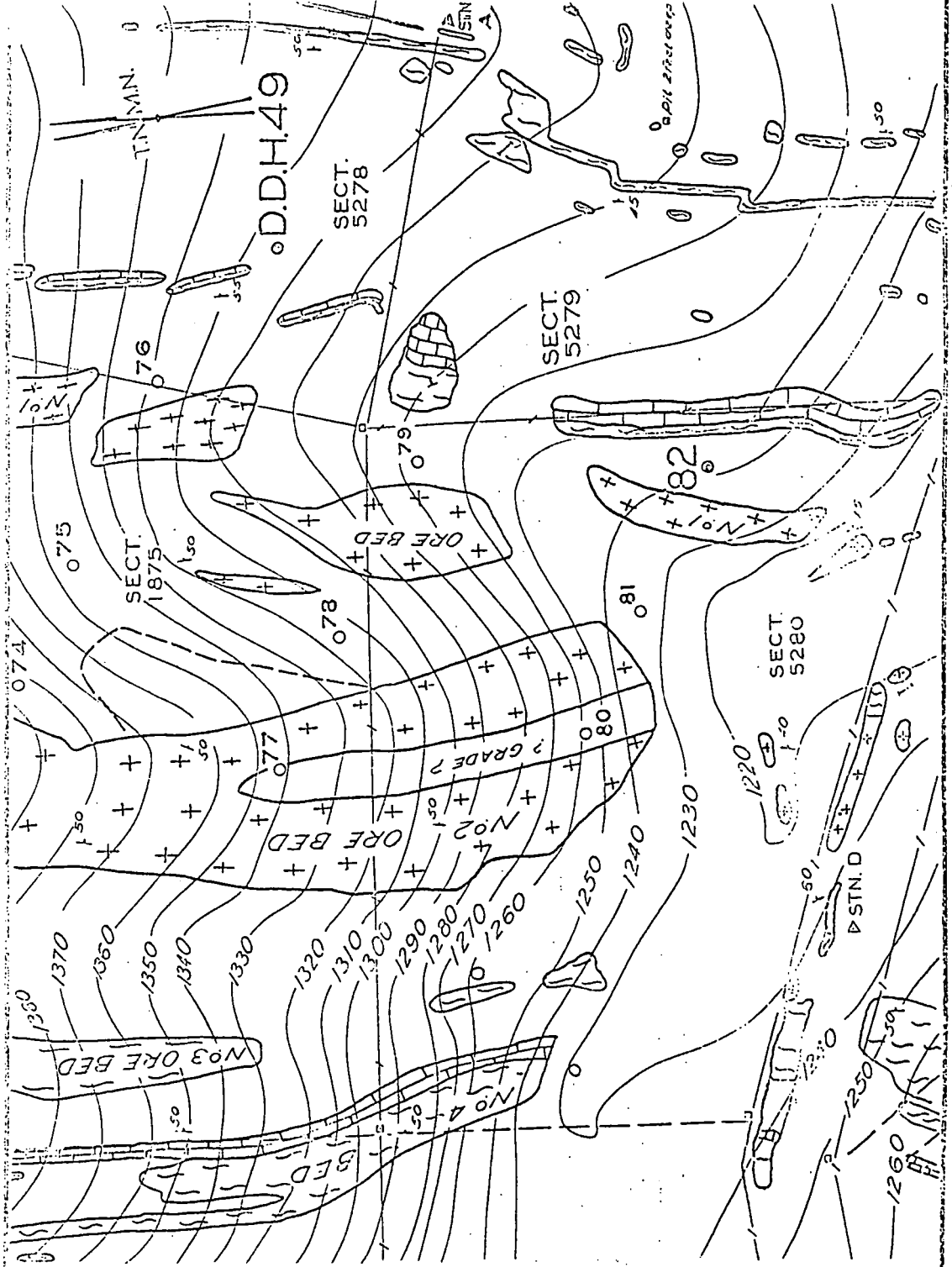

FIG.2

DEPARTMENT OF MINES — SOUTH AUSTRALIA

	Drn. M.G.H.	GEOLOGICAL PLAN	SCALE: 100 feet to 1 inch
	Tcd. G.M.	SHOWING DRILL HOLE LOCATIONS	S5797
	Ch. J.L.W.	SECTS 5278, 5280, 1875 HUNDRED KANMANTOO (TIMMINS HILL)	H.b 6
	Encl.	NAIRNE PYRITES PTY. LTD.	DATE: 18-4-67

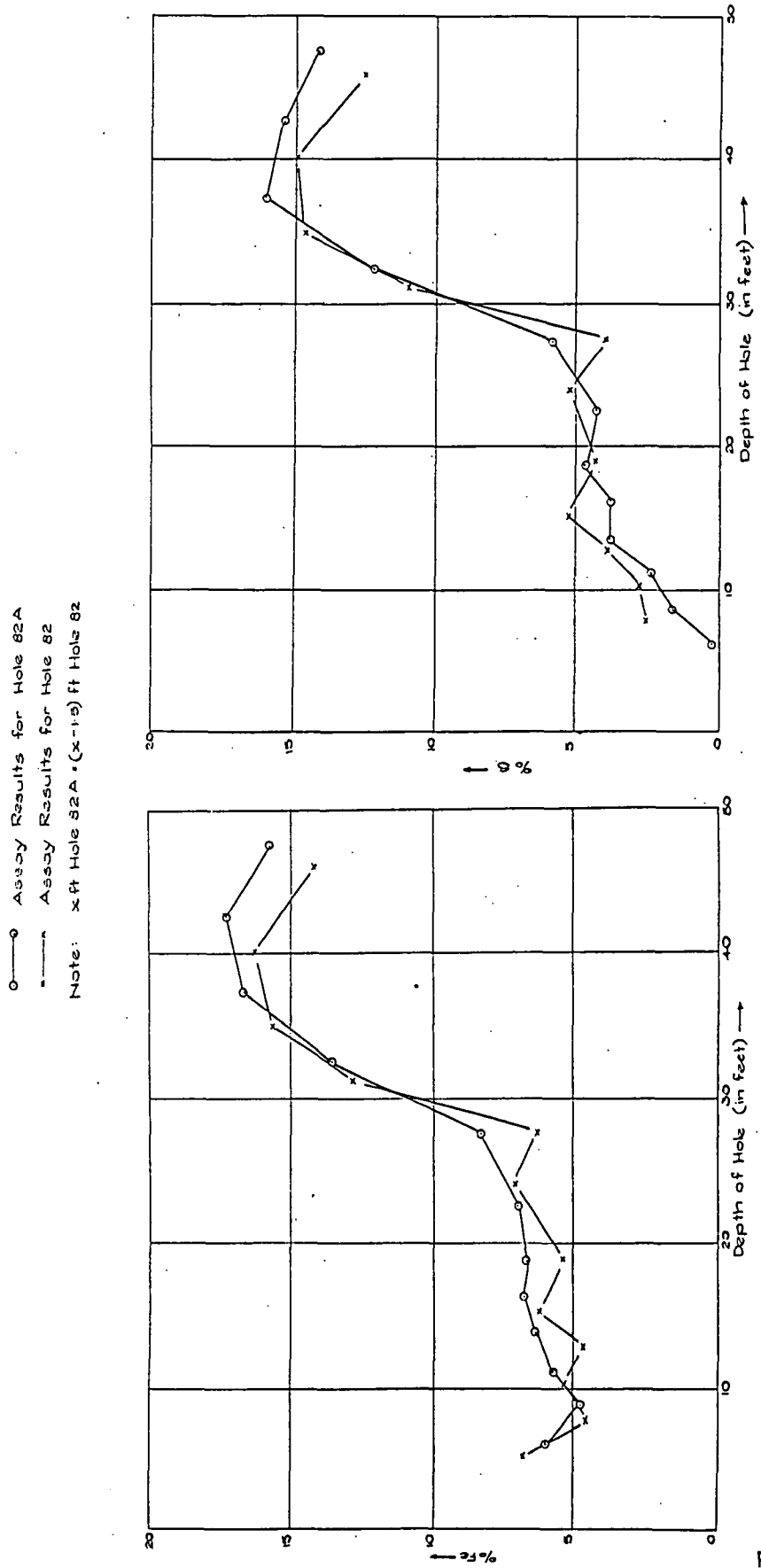

FIG:3a

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
	Drn. M.M.	HALCOTRACK DRILL HOLES 82 AND 82A. SEC. 5260 HD. KANMANTOO - TIMMINS HILL COMPARISON %S AND %Fe WITH DEPTH	SCALE: As shown
	Tcd. AMFO		S5887 H68
	Ctd. LWW		
	Exd.		DATE: 2-6-67

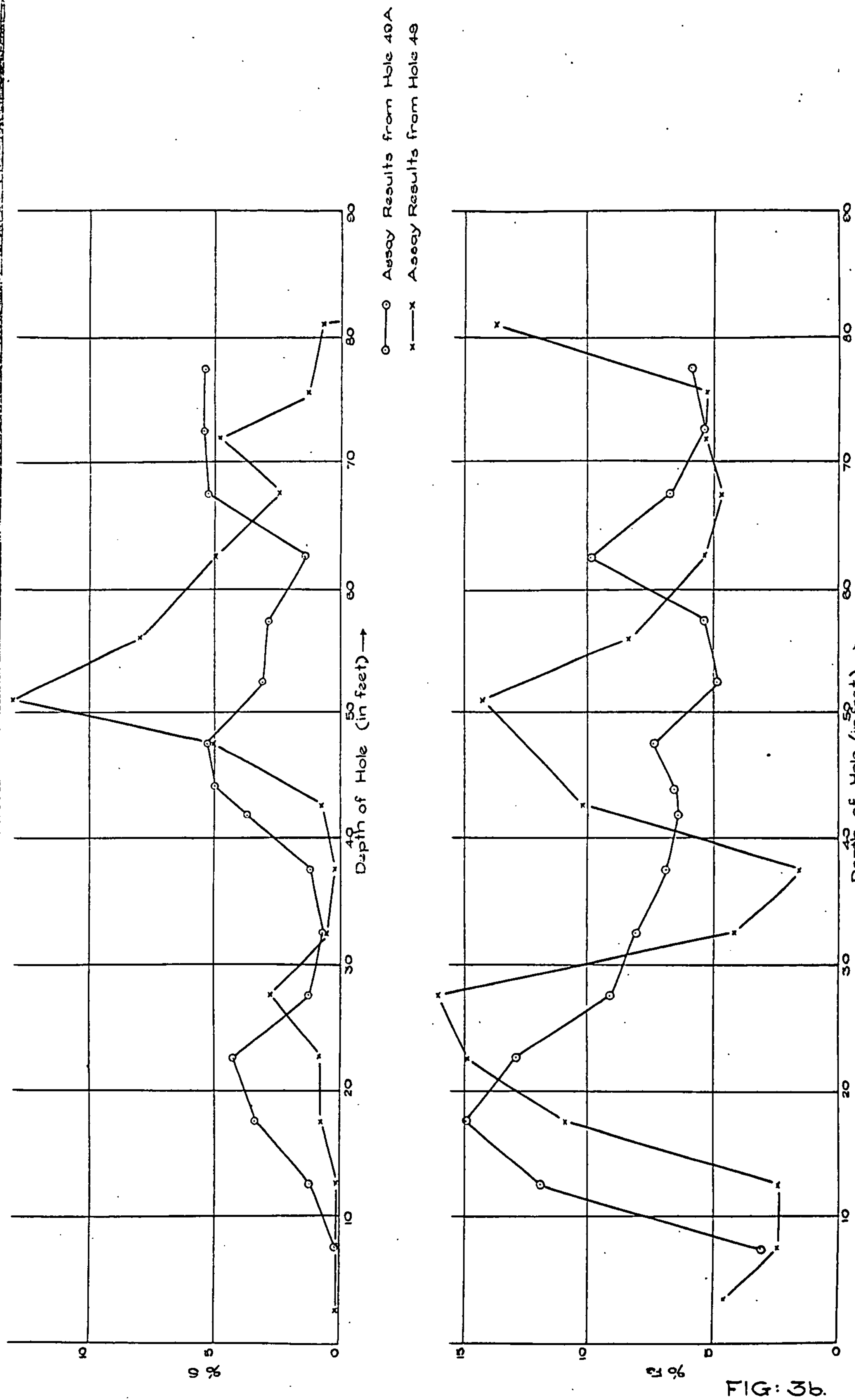

FIG: 3b.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

	Drn. MM	HALCOTRACK DRILL HOLES 49 AND 49A. SEC. 5278 HD. KANMANTOO - TIMMINS HILL COMPARISON %S AND % Fe WITH DEPTH	SCALE: As shown
	Tcd. AMD		S5888 Hb6
	Ckd. LYW		
	Exd.		DATE: 2-6-67

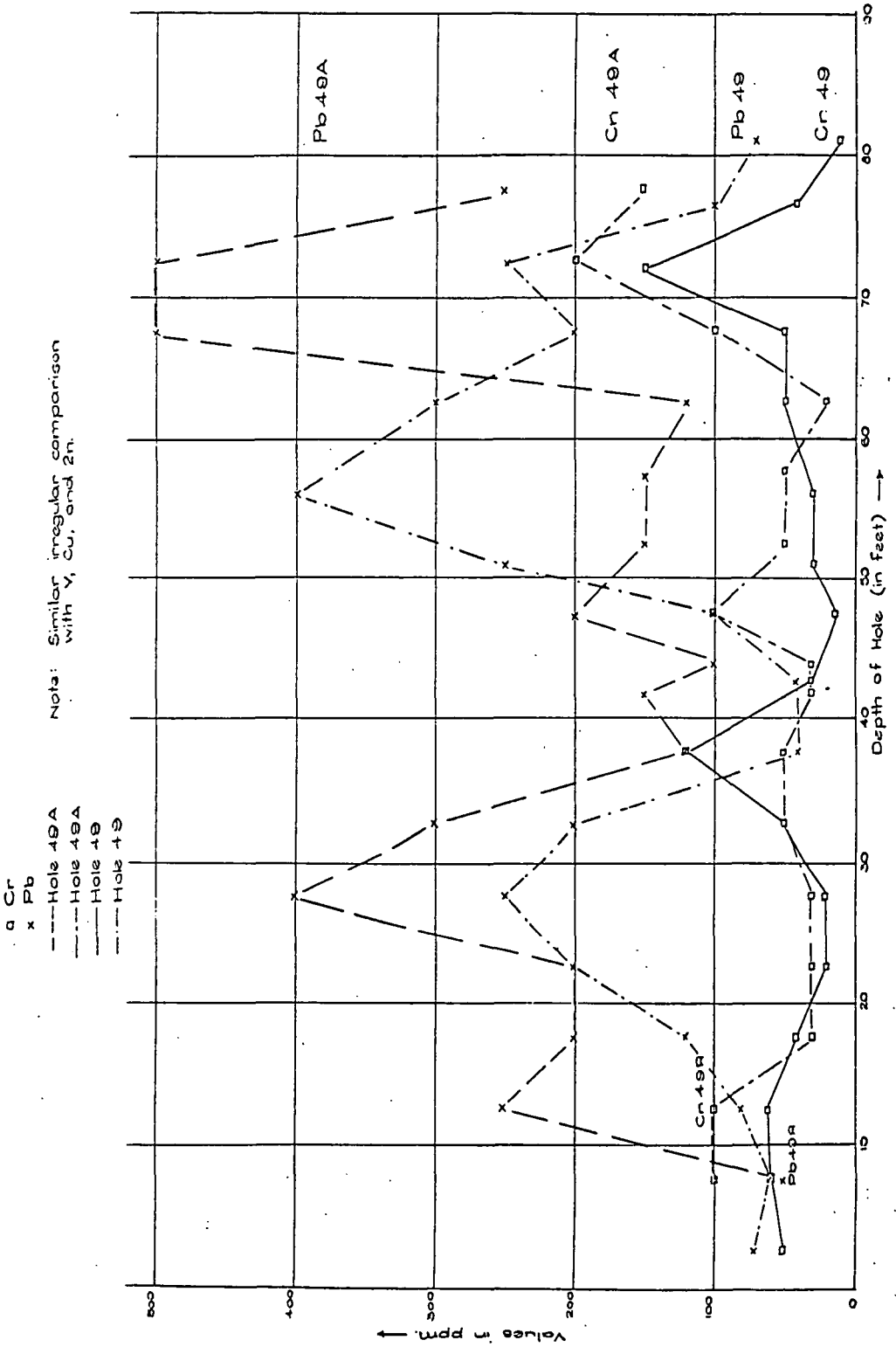

FIG: 4.

DEPARTMENT OF MINES — SOUTH AUSTRALIA			
	Drn. MM	HALCOTRACK DRILL HOLES 49 AND 49A. SEC. 5278 HD. KANMANTOO - TIMMINS HILL COMPARISON Cr AND Pb (ppm) WITH DEPTH	SCALE: As shown
	Tcd. AMFC		S 5889 Hb6
	Chd. I.V.W.		
	Exd.		DATE: 2-6-67