705001

THE SHELL COMPANY OF AUSTRALIA LIMITED

METALS DIVISION

GEOPHYSICAL RESPONSE OF THE KARA SCHEELITE DEPOSIT

Author: G. OAKES

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02_4816

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705003

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1. INTRODUCTION

Gravity, magnetics and VLF-EM were read along three lines (see figure 14) in the Eastern Ridge Area of the Kara Scheelite Deposit (Tasmania) on 23/9/81, 24/9/81 and 2/10/81. The aim of the survey was to define the response of magnetite - skarn type orebodies and to determine their detectability under a basalt cover up to 60 metres thick and in rugged terrain.

Line one was 340 metres long and subparallel to 6280N of the mine grid. Gravity and VLF were read at a 10m station spacing while magnetics was read at a 5m interval. Two skarn bodies, separated by sandstone, outcrop along this line, as does the granite contact (see fig. 1).

Line two, also 340 metres long, was subparallel to 6500N. The two skarns and the granite in this case are covered by approximately 60 metres of basalt (see fig. 2).

Line three was 380 metres long and subparallel to 6420N. A basalt cover of 30 to 40 metres overlies the skarns in this case (fig. 3).

Corrections to the gravity (bouguer, drift and terrain) have been performed to give an overall accuracy of $\pm$ 0.1 mgal. Stations have been located to within $\pm$ 5 metres horizontally and $\pm$ 0.1 metres vertically. In drawing the profiles in figures 1 to 3, stations have been projected parallel to strike by up to 20 metres. Given the long, linear nature of the ore body, such projection is not expected to significantly affect the accuracy of the results.

2. RESULTS - LINE 6280N

Outcrop

2.1 Gravity

Gravity (terrain corrected assuming a density of 2.5 g/cm^3) for line 6280N is shown in figure 1. Two anomalies are clear on this line - a 0.8 mgal anomaly overlying the upper (thicker) skarn, and a 0.4 mgal anomaly overlying the lower skarn. The form of these anomalies clearly indicates the location, width and westerly dip of the skarns.

Figure 4 shows the results of modelling the geological section given in figure 1. Since the geology is well constrained by outcrop/drillhole information, the only variable is the density contrast. Thus, once a good fit has been obtained between the observed and modelled gravity, we have a reliable estimate of the bulk density of the skarn (probably more reliable than the estimate obtained from measurements on a few core samples, given the small sample obtained from any drillhole, and the sampling bias).

The fit between the gravity profiles in figures 1 and 4 is well within the accuracy of the survey (± 0.1 mgal, ± 5 metres horizontally) and the modelling programs used (± 0.03 mgal), thus a reasonable estimate of the bulk density of the skarn can be made. The density contrast between sandstone and skarn used in modelling ranged from 0.3 to 0.9 g/cm^3, and was generally in the range 0.7 - 0.9 g/cm^3. Given a sandstone density of 2.5 (measured range for the Moina Sandstone is 2.5 to 2.7; mean wet density of sandstone, from Telford, Geldart, Sheriff and Keys (1976), is 2.35), the magnetite skarn at Kara has a density ranging from 3.2 to 3.4 g/cm^3.

2.2 Magnetics

Two very large magnetic anomalies (14000 - 15000 nT) are clear in Fig. 1, correspnonding to the skarns. The width, location and dip of each skarn is apparent from the anomalies. The principal problem to interpretation is the noise in the profiles, caused by near-surface variations and unreliable readings due to large horizontal and vertical gradients.

Skarn susceptibilities of the order of 60,000 x 10^{-6} cgs were measured (range: 18,000 to greater than 100,000 x 10^{-6} cgs). Basalt susceptibilities were generally in the range 200 - 300 x 10^{-6} cgs, while granite susceptibilities were generally less than 100 x 10^{-6} cgs.

Modelling results (in figure 4) give anomalies of the correct amplitude and form for skarn susceptibilities of 40,000 x 10^{-6} cgs, which is within the measured range and hence probably represents a reasonable figure for the bulk susceptibility of magnetite skarns at Kara. As with the gravity, the best fit for the observed magnetics is obtained with a gradational upper contact for the upper skarn, probably representing decreasing magnetite content away from the granite. The form of the magnetic anomalies suggests that there is a significant remanent component.

2.3 VLF-EM

At a frequency of 17.4 KHz (Yosami station, Japan) 2 conductors, corresponding to the 2 skarns, are apparent. The large anomalies indicate that the two skarns are reasonable conductors and are well-coupled to Japan (which is consistent with their northerly strike). The lower skarn appears to be a better conductor than the upper, although interference between the two anomalies makes interpretation difficult.

The higher conductivity of the lower skarn, coupled with its higher modelled density and susceptibility, would be consistent with a greater magnetite content in the lower skarn than the upper skarn. Thus the general pattern appears to be decreasing magnetite content away from the granite.

At 22.3 KHz (North West Cape station) a weaker anomaly overlies the lower skarn but there is no clear response over the upper skarn. This is consistent with the upper skarn being a poorer conductor than the lower, and with both skarns being poorly coupled to North West Cape. A broad anomaly to the west of the line (crossover at 7660E) is probably related to the base of the basalt, possibly with interference from an anomaly due to the upper skarn.

3. RESULTS - 6420N

30 to 40 m of basalt cover

3.1 Gravity

Gravity for line 6420N is shown in figure 3. A broad anomaly of roughly 0.3 mgal overlies the skarns. This anomaly is indistinguishable from the anomaly which could be expected from basalt thickness variations. Thus gravity cannot be said to have unambiguously detected the skarns beneath 30 to 40 metres of basalt.

The modelled gravity (figure 5) gives an anomaly of 0.25 mgal coincident with the observed anomaly. The densities used in modelling for this line, and 6500N, are those obtained from modelling 6280N, where the geological and geophysical control is better. This modelling confirms that the observed anomaly in this case is due to the skarns, and not basalt thickness changes. A 0.25 mgal anomaly cannot be detected with confidence by a survey of $\pm$ 0.1 mgal accuracy. In any event, as noted above, it is impossible for gravity to distinguish between the anomaly due to basalt thickness variations of the order of 20 to 50 metres, and the 0.25 mgal anomaly due to buried skarns.

3.2 Magnetics

A large magnetic anomaly (roughly 4000 nT) directly overlies the skarns in figure 3. This anomaly clearly indicates the location of the skarns, but does not indicate the presence of 2 skarns, rather than one relatively thick body. A westerly dip, or decreasing magnetite content to the west, is suggested by the anomaly.

Figure 5 shows the magnetic model for this line. Considerable difficulty was experienced in fitting the steep gradient to the east of the anomaly. To overcome this, it was necessary to include remanent magnetization in the lower skarn. A remanent magnetization vector plunging 20 degrees to 270^{o} was used, from remanence measurements in the Moina wrigglite. A Konigsberg ratio of 0.75 to 1.0 was used. It did not appear to be necessary to include remanence in the upper skarn in order to fit the western half of the anomaly reasonably well. Reconsidering line 6280N, it seems likely that similar remanent magnetization (probably with a lower Konigsberg ratio) might improve the fit slightly.

Modelled skarn susceptibilities range from $20,000 \times 10^{-6}$ cgs to $80,000 \times 10^{-6}$ cgs, increasing towards the granite.

3.3 VLF-EM

No VLF anomaly was observed at 17.4 KHz or 22.3 KHz. The measured dips were generally quite large (greater than 10^{o}), suggesting that the basalt cover is reasonably conductive, hence giving a phase rotation. This would be consistent with borehole measurements and resistivity soundings elsewhere in Tasmania.

4. RESULTS - LINE 6500N

4.1 Gravity

No gravity anomaly was observed overlying the skarns on line 6500N. If anything, there is a gravity low overlying the skarns, although this probably relates to basalt thickness changes.

The modelled gravity is shown in figure 6. The modelled anomaly is only of the order of 0.2 to 0.3 mgal even without the increasing thicknesses of basalt to east and west. Such an anomaly is not detectable by a survey of $\pm$ 0.1 mgal. The basalt thickness changes completely to destroy any gravity anomaly due to the skarns.

The small 'bumps' on the observed gravity curve clearly must represent reading error, near surface variations and basalt thickness changes. Magnetite skarns of the same size as Kara are virtually undetectable by gravity beneath 60 metres of basalt.

4.2 Magnetics

A 2000 nT anomaly is clear in figure 2. As on line 6420N, this anomaly clearly indicates the location of the skarns (especially the lower skarn). Either westerly dip or decreasing magnetite content towards the west is suggested by the form of the anomaly. It seems likely that significant remanent magnetism is present, especially in the lower skarn.

Figure 6 shows the magnetic model for the line. Considerable remanent magnetism in the lower skarn was required to obtain a reasonable fit. Even so, the fit is not particularly good, suggesting variable near-surface conditions are significant and that the geology is considerably more complex than can be easily modelled. However, the amplitude and location of the anomaly are explained by this model.

Modelled susceptibilities are 30,000 x 10^{-6} to 40,000 x 10^{-6} cgs, with Konigsberg ratios of up to 3.0.

4.3 VLF-EM

No significant VLF anomaly is apparent at either frequency.

5. ADDITIONAL MODELLING

5.1 Spectral Analysis

The results of spectral analysis of the magnetic data from the three lines is given in figures 7,8 and 9. In addition, optimum filters designed from consideration of the power spectra have been applied to the data.

The power spectrum for line 6280N is shown in figure 7. The spectrum is fairly 'rough', reflecting the relatively small number of data points (fewer than seventy), which lessens the effectiveness of the fast fourier transform routines used. There is also probably some aliasing in the spectrum. The spectrum cannot be divided into more than one trend with any confidence, suggesting that the source of the magnetic anomaly is shallow. Two possible trend lines are shown, with slopes of - 2.4 and - 7.1 station spacings per cycle. For a station spacing of 5 metres, these slopes represent depths (= $-\frac{1}{2}$ by slope) of 6 and 18 metres respectively - effectively an outcropping source, as is known from the geology.

Figure 8 shows the power spectrum for line 6420N. Two trends can be seen on this spectrum. The slope of the high frequency trend gives a depth of 5.5 metres and clearly represents the near-surface noise and basalt. The low frequency trend gives a depth of 36 m, which is in excellent agreement with the depth to the top of the skarns as determined by drilling.

Figure 9 shows the power spectrum for line 6500N. Again, two trends can be seen, yielding depths of 8.5 metres and 57 metres. These two magnetic sources are clearly the near-surface basalt and magnetite skarn, and are again in excellent agreement with the drillhole results.

It is interesting to note that as the skarn gets deeper (especially line 6500N), the low frequency trend corresponding to the skarn becomes more pronounced, thus making interpretation of the power spectrum easier and the presence of a deep magnetic source clearer For the three lines here, at least, as the space domain anomaly has decreased, the wavenumber domain anomaly has increased. Thus it might be possible to detect the presence of skarns at depths greater than 60 metres using spectral analysis, when no clear space domain magnetic anomaly is present. For depths up to 60 metres, a clear space domain anomaly exists and spectral analysis is not necessary.

No surprises arose from the optimum filtering, since the anomalies were clear prior to filtering. Optimum filtering would only be particularly useful where a deep source has been interpreted from spectral analysis but no clear anomaly is present. In this case, optimum filtering would be essential to provide drill targets.

5.2 IP Modelling

Figures 10 to 13 show some IP models for Kara. The resistivities and IP properties of the rocks here are not well known and hence only a rough idea of anomaly magnitude and form can be obtained. The main aim is to determine the effect of a relatively conductive basalt overburden on the anomaly.

The VLF results discussed earlier suggest that both the basalt and the skarn are conductive (compared to the sandstone and granite). From this, and bearing in mind the results of drill holes and modelling elsewhere in Tasmania, the following rock properties were used :-

Skarn	-	resistivity = 100 ohm m PFE = 50
Basalt	-	resistivity = 500 ohm m PFE = 20
Sandstone/Granite	-	resistivity = 4000 ohm m PFE = 10

Figures 10, 11 and 12 show the dipole-dipole pseudo-section for 50 metre dipoles over outcropping skarns, 30 metres basalt cover and 75 metres basalt cover respectively. Figure 13 gives the results for 100 metre dipoles over 60 metres of basalt. A clear IP/resistivity anomaly is present in all cases, although IP is unable to distinguish between 2 skarns, even when they outcrop. The anomaly for 6500 N and 50 m dipoles is only 25% above background and would therefore be difficult to detect in a noisy environment.

For 50 metre dipoles, the anomaly amplitude has decreased considerably for 75 metres of cover compared to outcropping skarns and the anomaly peak has shifted from n=1 to n=5. Given the noise levels present in most surveys, it is unlikely that a significant anomaly would arise for skarns greater than 100 metres deep.

For 100 metre dipoles, the anomaly peak is only at n=2 for 60 metres of basalt cover. Thus it seems likely that skarns up to 200 metres deep could be detected using 100 metre dipoles. Larger dipoles might offer even greater depth penetration, but there would be problems defining the exact location of a 50 metre wide skarn using larger dipoles, making interpretation difficult. In any event, a small body such as a skarn will only give a relatively small anomaly for such large dipoles.

6. CONCLUSIONS

6.1 Outcropping Skarns and Magnetite Skarn Properties

Magnetics, gravity and EM all give good responses to outcropping magnetite skarns, and it is certain that IP would give an equally clear anomaly. Magnetics and gravity both are able to give information on the width and dip and are able to discriminate between skarns which are close together. VLF is also able to discriminate between two skarns, but does not give much information on dip (although other EM systems, eg max-min, could well give dip information). IP is unable to distinguish between 2 close-together skarns, but gives a reasonable indication of dip.

Gravity and magnetics are capable of giving more quantitative interpretations than the other methods. In making quantitative interpretations, magnetics is handicapped by the presence of remanent magnetism, which is hard to measure in the field, while density contrasts are generally much less than susceptibility contrasts, thus handicapping gravity.

Since the body geometry at Kara is well constrained by drilling and outcrop, it is possible to obtain reasonable estimates of magnetite skarn densities and susceptibilities from modelling (especially for line 6280N, where the geology is very well constrained). The skarn density is probably in the range 3.2 to 3.4 g/cm^3. The magnetic susceptibility is of the order of $40{,}000 \times 10^{-6}$ cgs. Remanent magnetism can be very significant, and could well be larger than the induced component of the magnetism. The VLF results suggest that the skarn is also reasonably conductive.

6.2 Buried Skarns

For magnetite skarns covered by 30 metres of basalt, magnetics gives a clear, easily interpretted anomaly. Although it is unable to distinguish between the two skarn bodies, it does give a clear indication of the skarn width and dip. Gravity gives a small anomaly, but this anomaly cannot be interpreted quantitatively and would be easily destroyed by basalt thickness variations. VLF gives no anomaly, but it seems probably that EM methods with a local source (eg max-min, SIROTEM) would give an anomaly, since there is certainly a conductivity contrast between skarn and sandstone or granite. Similarly, it is probable that IP would give a clear anomaly.

For skarn buried beneath 60 metres of basalt, there is no gravity or VLF anomaly (or at least none that could be detected within normal survey accuracies). Magnetics gives a clear anomaly. It is probable that Ip would also give a clear anomaly. Whether max-min would give an anomaly is debatable, and this should be tested if possible.

6.3 Depth of Exploration for Magnetite Skarns

Gravity and VLF are unable to detect magnetite skarns buried beneath more than superficial basalt cover, except in very favourable conditions.

A clear magnetic anomaly can be expected for skarns under 60 metres of basalt. Given that the anomaly amplitude decreases from 15000 to 2000 nT for outcropping versus skarns at 60 metres depth, it seems unlikely that a clear anomaly would result from skarns at depths much greater than 100 metres, when basalt noise of at least $\pm$ 200 nT is common.

Spectral analysis of ground magnetics gives a clearer anomaly in the wavenumber domain than the space domain for magnetite skarn beneath 60 metres of basalt. The wavenumber domain anomaly increases with increasing skarn depth (at least for the depths tested here), thus it seems likely that skarns deeper than 100 metres can be detected by spectral anolysis of ground magnetics, with optimum filtering.

It is probable that IP can detect skarns at up to 200 metres depth.

The depth of penetration of max-min and transient EM techniques remains to be tested. I do not think max-min will be able to do better than 100 metres, if that, since magnetite is not as conductive as massive sulphides. SIROTEM may be able to penetrate deeper than 100 metres, but it has many logistic problems in Tasmanian conditions.

6.4 Recommended Exploration Technique

Ground magnetics is cheap, easy, offers quantitative enterpretation and has excellent depth penetration when adequate computing facilities are available. It is the obvious mothod to use for reconnaisance. IP is the best method to use to follow up magnetics. This is necessary to distinguish between deep skarn sources and shallower sources due to large basalt features (basalt hills, valleys etc. can also give large magnetic anomalies when remanence is present, as it is in Tasmania).

EM (max-min) would be cheaper than IP to use for follow-up, but I do not think it would have the same depth penetration. This may not be important in many cases. Sirotem could offer the same depth penetration as IP, but I do not think it would be any cheaper and is probably not as well suited as IP in exploration for magnetite skarns, which may not be particularly conductive.

It should be noted that sulphide skarns are somewhat different to the magnetite skarns discussed here. Magnetics would not be as effective in exploration for sulphides, since pyrrhotite has a much lower susceptibility than magnetite. On the other hand, pyrrhotite is much more conductive and hence EM would be more effective. Massive pyrrhotite has a density of the order of 4.5, and hence may give a larger gravity anomaly than those measured here.

VLF - 22.3 KHz
(North West Cape Station)

LEVEL 125%, 100%, 75%

DIP 20° N, 0, 20° S

VLF - 17.4 KHz
(Yosami Station, Japan)

LEVEL 300%, 200%, 100%

DIP 20° W, 0, 20° E

CONDUCTOR 2

CONDUCTOR 1

TOTAL MAGNETIC FIELD
(nT) ——

MAGNETIC SUSCEPTIBILITY
(10^{-5} S.I.) x———x

72 000 — 70 000 — 65 000 — 60 000 — 57 000

10 000 — 2 500 — 1 600 — 1 000 — 630 — 400 — 250 — 160 — 100 — 63 — 40 — 25 — 16 — 10

62 000 — 36 000 — 18 000

GRAVITY
(m.gals)

(Terrain corrected for density of 2.5 g/cm³)

2.0 — 1.0

inferred regional

ELEVATION
(metres)

510 — 500 — 450

GEOLOGY

Metres
480 — 460 — 440 — 420 — 400

DDH 275 (425) DDH 138 (477) DDH 139 (474)

BASALT

UPPER SKARN

UPPER SANDSTONE

GRANITE

LOWER SKARN

LOWER SANDSTONE

SURVEY CO ORDINATES
MINE CO ORDINATES

00 E — 100 E — 150 E — 200 E — 300 E

7600 E — 7700 E — 7800 E

REDUCE THIS TO THIS

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

0 10 20 30 M

The Shell Company of Australia Limited
METALS DIVISION

M.T. 24
KARA SCHEELITE DEPOSIT
(Eastern Ridge)
LINE 6280 N

Scale 1:500

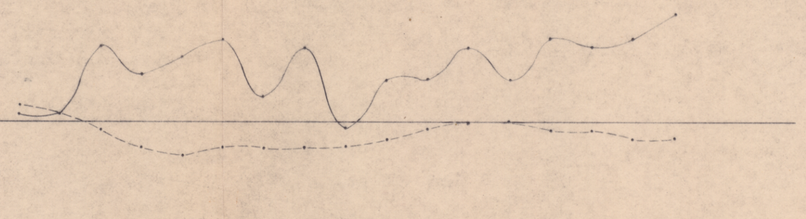
FIG. No. 1.	REPORT No. 08-1060
	DRG. No. MT 24/1022
DATE 28-9-81	AUTHOR G. OAKES.
DRAWN H.L.H.	OFFICE DEVONPORT.

5 cm

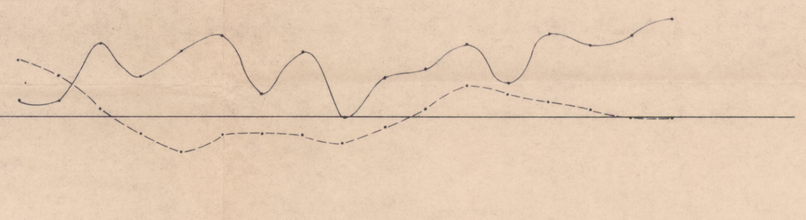
705013

7400E 7500E 7600E 7700E 7800E 7900E 8000E

+10%
222 Hz
0
-10%



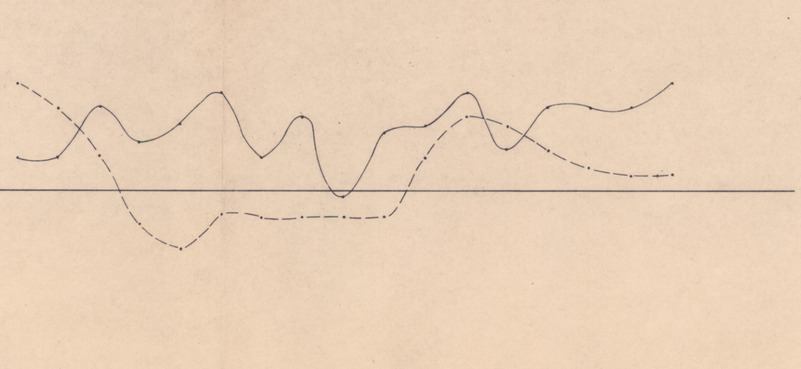
+10%
444 Hz
0
-10%



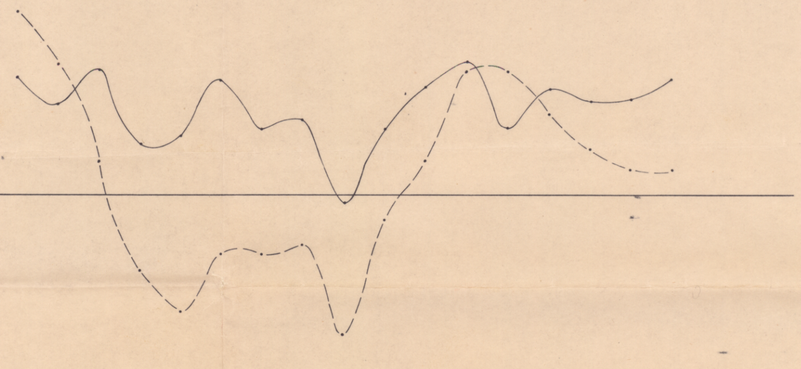
MAX - MIN E.M.

COIL SEPARATION = 100 m
IN PHASE
OUT OF PHASE
100 metres

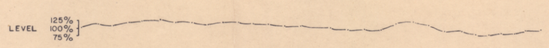
+20%
+10%
888 Hz
0
-10%
-20%



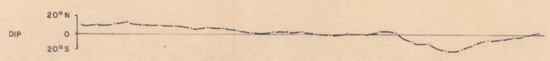
+20%
+10%
1777 Hz
0
-10%
-20%



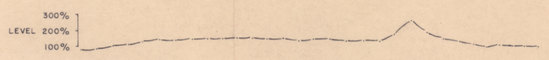
VLF-22.3 KHz
(North West Cape Station)
LEVEL 125% 100% 75%



DIP 20°N 0 20°S



VLF-17.4 KHz
(Yosami Station, Japan)
LEVEL 300% 200% 100%

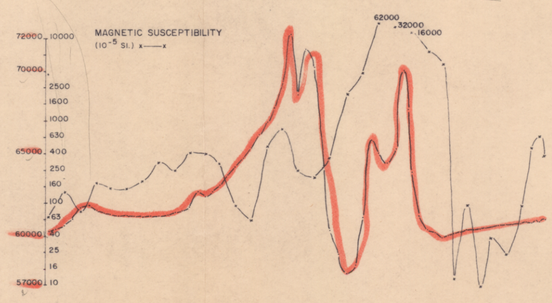


DIP 20°W 0 20°E
CONDUCTOR 2
CONDUCTOR 1

TOTAL MAGNETIC FIELD
(RTP)

MAGNETIC SUSCEPTIBILITY
(10^{-5} SI.) x——x

72000 70000 65000 60000 57000
10000 2500 1600 1000 630 400 250 160 100 63 40 25 16 10
62000 32000 16000

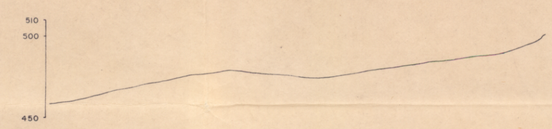


GRAVITY
(m.gals)
(Terrain corrected for density of 2.5 g/cm³)

2.0
1.0
inferred regional

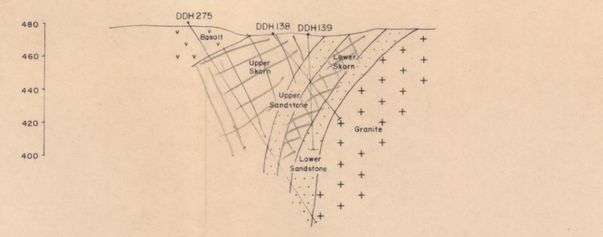
ELEVATION
(metres)

510
500
450



GEOLOGY
(metres)

480 460 440 420 400



7400E 7500E 7600E 7700E 7800E 7900E 8000E

02_4816
Geophysical Response of the Kara Scheelite Deposit
Shell Company of Australia Limited*
Oakes, G.F.
705014

5 cm

The Shell Company of Australia Limited METALS DIVISION	
MT 24 KARA SCHEELITE DEPOSIT (Eastern Ridge) LINE 6280N Scale 1:2500	
FIG. No. 1a	REPORT No.
ENCL. No.	DRG. No. MT24/1026
DATE FEB '82	AUTHOR N. HUNGERFORD
DRAWN VICKI CATON	OFFICE AHO-MELB

TASMANIA

VLF - 17.4 KHz
(Yosami Station, Japan)

LEVEL
200%
20° W 100%
DIP 0
20° E

TOTAL MAGNETIC FIELD
(nT) .——.

MAGNETIC SUSCEPTIBILITY
(10^{-5} S.I.) X----X

64 000
63 000 1000
62 000 500
61 000 0

GRAVITY
(m.gal)

(Terrain corrected for density of 2.5 g/cm³)

1·0
0·5
0·0

ELEVATION
(metres)

550
500
470

GEOLOGY

Metres
500
480
460
440
420
400

DDH 151
DDH 277

BASALT

UPPER SKARN

LOWER SKARN

SAND-STONE

SANDSTONE

GRANITE

SURVEY CO-ORDINATES
MINE CO-ORDINATES

00 E
100 E
200 E
300 E
7 600 E
7 700 E
7 600 E

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

0 10 20 30 M

The Shell Company of Australia Limited
METALS DIVISION

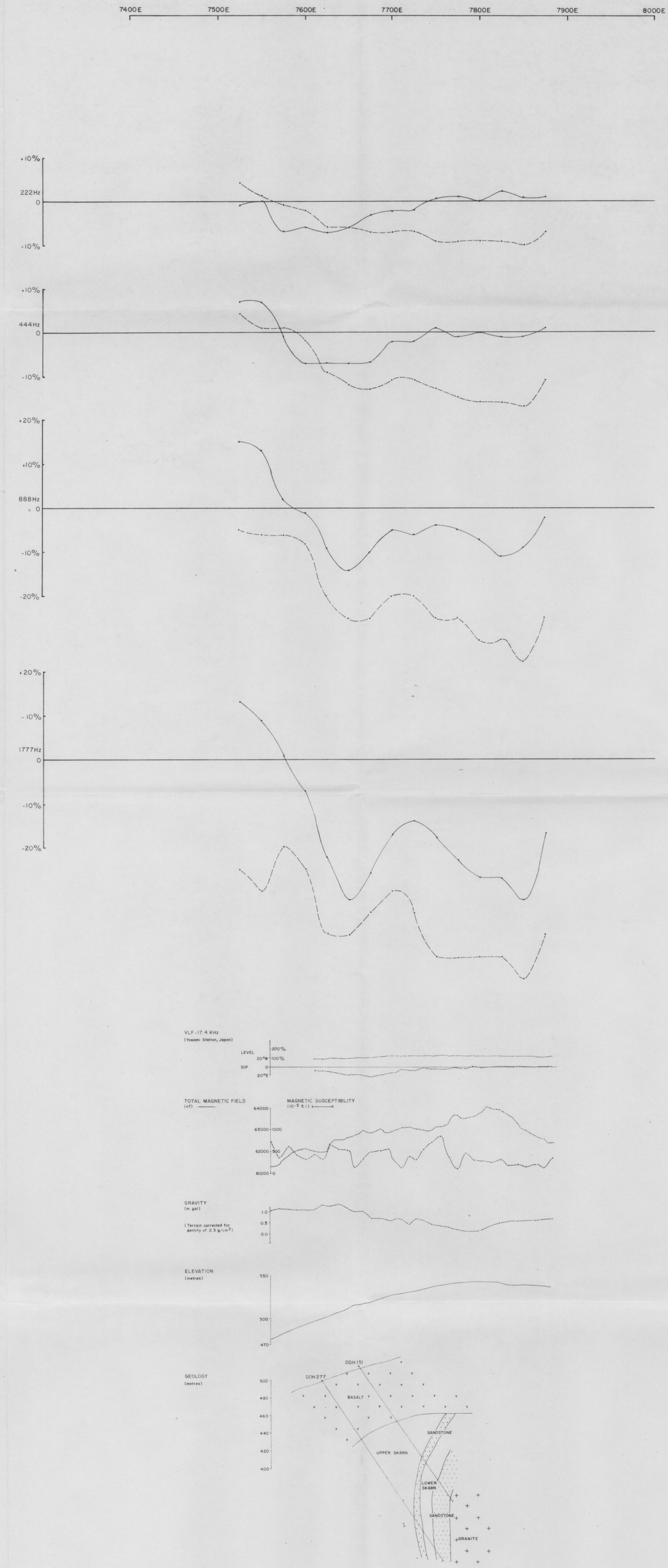
M.T. 24
KARA SCHEELITE DEPOSIT
(Eastern Ridge)
LINE 6500 N

Scale 1 : 500

FIG. No. 2.	REPORT No. 08·1060
	DRG. No. MT 24/1021
DATE 29-9-81	AUTHOR G. OAKES.
DRAWN H. L. H.	OFFICE DEVONPORT.

5 cm

705015



705016

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

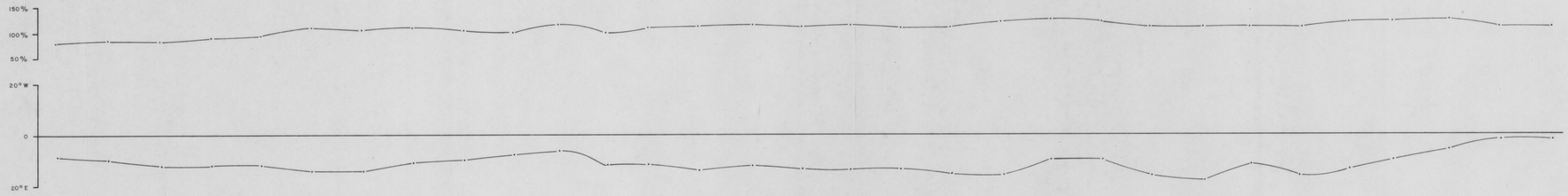
5 cm

The Shell Company of Australia Limited METALS DIVISION	
MT24 KARA SCHEELITE DEPOSIT (Eastern Ridge) LINE 6500N Scale 1:2500	
FIG. No. 2a	REPORT No.
ENCL. No.	DRG. No. MT24/1027
DATE FEB '82	AUTHOR N.HUNGERFORD
DRAWN VICKI CATON	OFFICE AHO - MELB

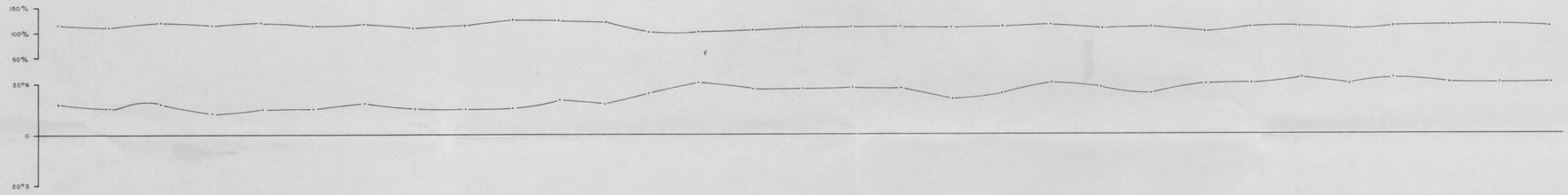
SURVEY COORDINATES: 00E, 100E, 200E, 300E, 380E

MINE COORDINATES: 7600E, 7700E, 7800E, 7900E

VLF - 17.4 KHz
(Yosami Station)

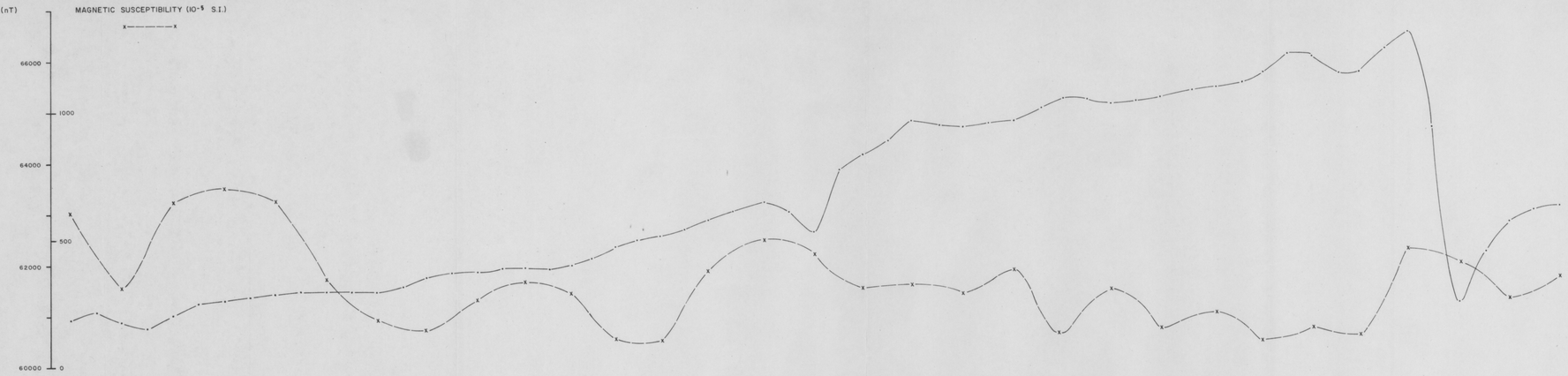


VLF - 22.3 KHz
(North West Cape Station)

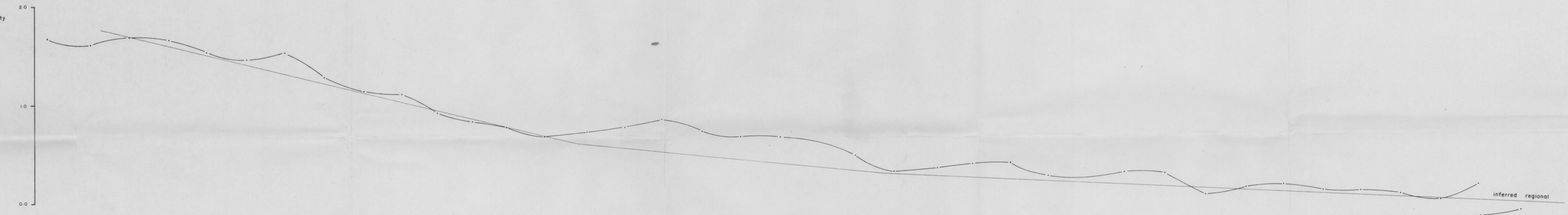


TOTAL MAGNETIC FIELD (nT)

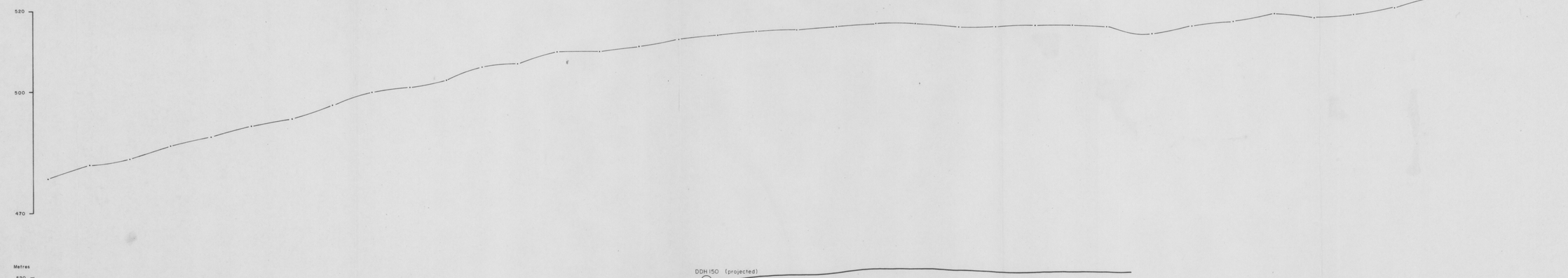
MAGNETIC SUSCEPTIBILITY (10^{-5} S.I.)

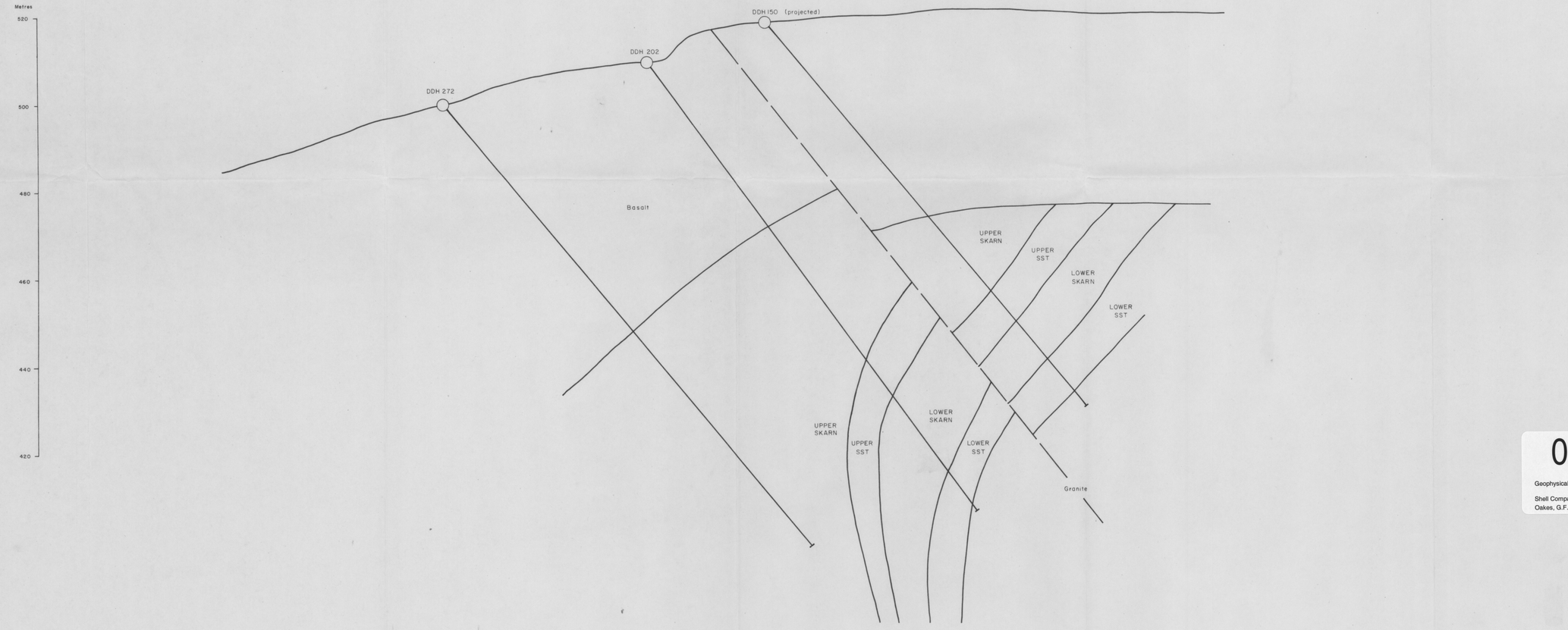


GRAVITY (mgal)
(Terrain corrected for density of 2·5 g/cm)



ELEVATION (metres)





SURVEY COORDINATES: 00E, 100E, 200E, 300E, 350E

MINE COORDINATES: 7600E, 7700E, 7800E

705017

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

5 cm

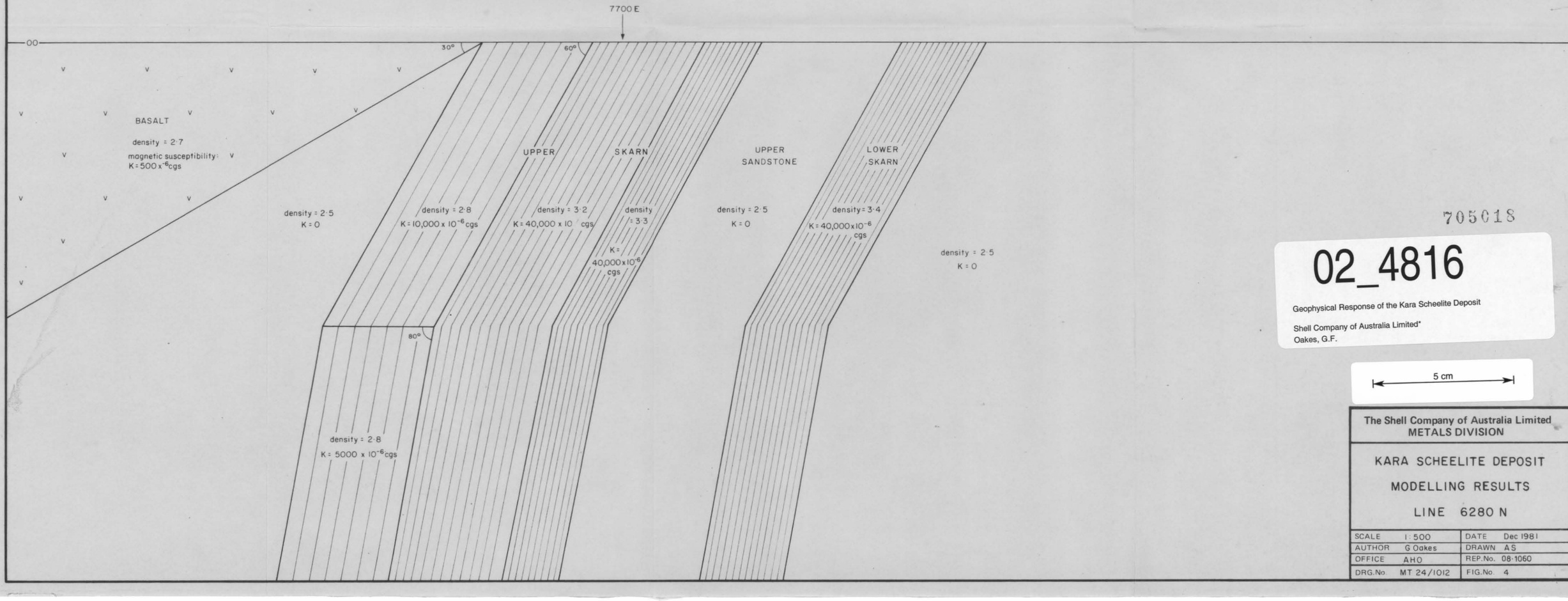
The Shell Company of Australia Limited
METALS DIVISION

KARA SCHEELITE DEPOSITE

(EASTERN RIDGE)

LINE 6420 N

SCALE	DATE DEC '81
AUTHOR G. OAKES	DRAWN V. CATON
OFFICE MELB - AHO	REP.No. 08 1060
DRG.No. MT24/1011	FIG.No. 3



705018

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

5 cm

The Shell Company of Australia Limited
METALS DIVISION

KARA SCHEELITE DEPOSIT

MODELLING RESULTS

LINE 6280 N

SCALE	1:500	DATE	Dec 1981
AUTHOR	G Oakes	DRAWN	AS
OFFICE	AHO	REP.No.	08:1060
DRG.No	MT 24/1012	FIG.No	4

MAGNETICS

nT

4000

3000

2000

1000

0

-1000

GRAVITY

m.gal.

1·0

0·5

Inferred regional

-90 -50 00 50 100 150

00

7700 E

BASALT

density = 2·8

magnetic susceptibility:
K = 500 x 10^{-6}cgs

Königsberg ratio:
Q = 0·0

30° 60°

density = 2·5
K = 0·0
Q = 0·0

density = 3·1
K = 20,000 x 10^{-6}
Q = 0·0

UPPER SKARN
density = 3·1
K = 50,000 x 10^{-6}
Q = 0·0

density = 2·5
K = 0·0
Q = 0·0

LOWER SKARN
density = 3·4
K = 80,000 x 10^{-6}
Q = 1·0

density = 3·4
K = 60,000 x 10^{-6}
Q = 0·75

density = 2·5
K = 0·0
Q = 0·0

NB. Remanent magnetization vector in the Lower Skarn plunges at 20° to 270° magnetic.

5 cm

Horizontal Scale: 1:500
Vertical Scale: 1:1000

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

705019

The Shell Company of Australia Limited
METALS DIVISION

KARA SCHEELITE DEPOSIT

MODELLING RESULTS

LINE 6420 N

SCALE	1:500	DATE	Dec. 1981
AUTHOR	G Oakes	DRAWN	AS
OFFICE	AHO	REP.No.	08·1060
DRG.No.	MT 24/1013	FIG.No.	5

MAGNETICS

nT

2000

1000

0

GRAVITY

m.gal.

1·2

1·0

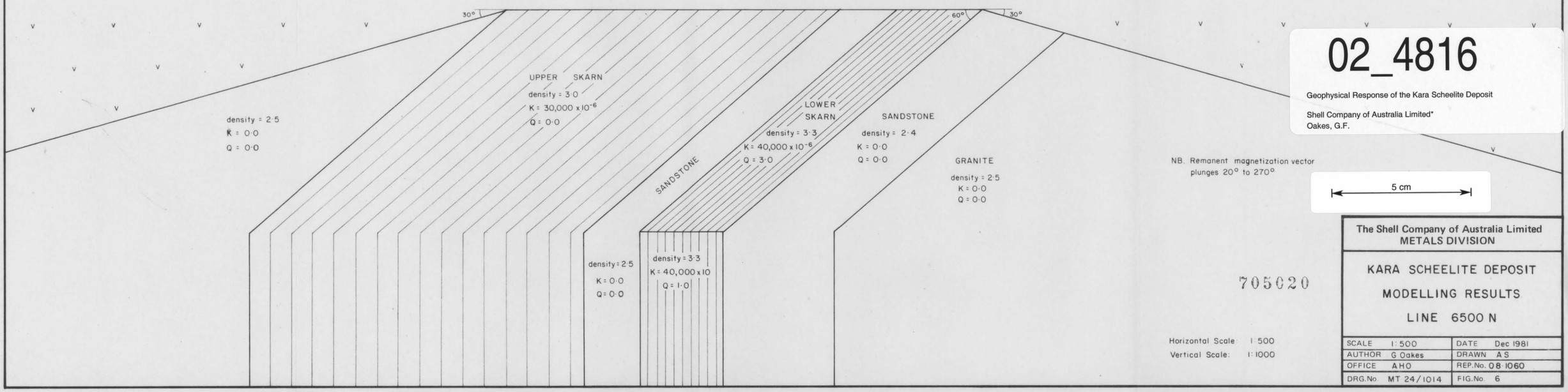
7700 E

BASALT

density = 2·9 - 3·0

magnetic susceptibility
K = 500 x 10^{-6}cgs

Königsberg ratio:
Q = 0·0



NB. Remanent magnetization vector plunges 20° to 270°

5 cm

705020

Horizontal Scale: 1:500
Vertical Scale: 1:1000

02_4816

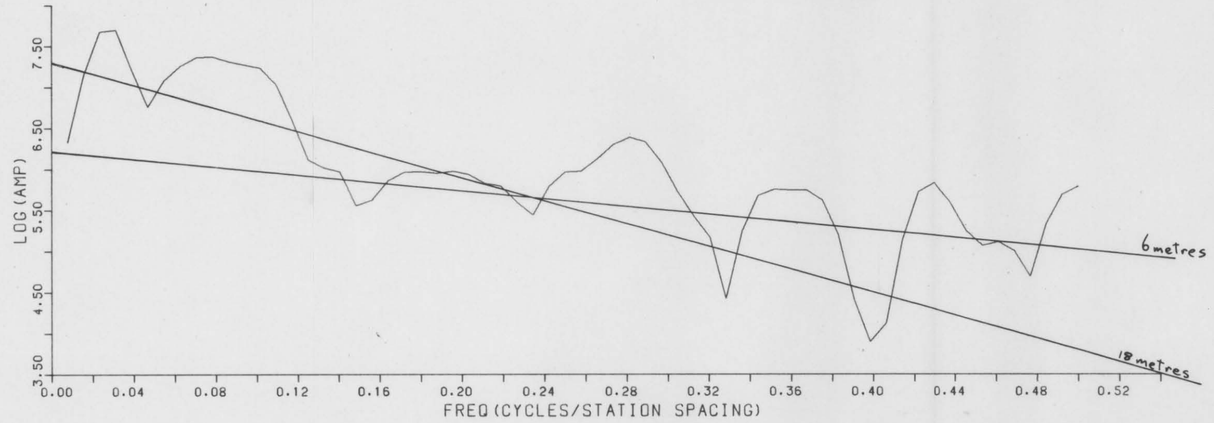
Geophysical Response of the Kara Scheelite Deposit

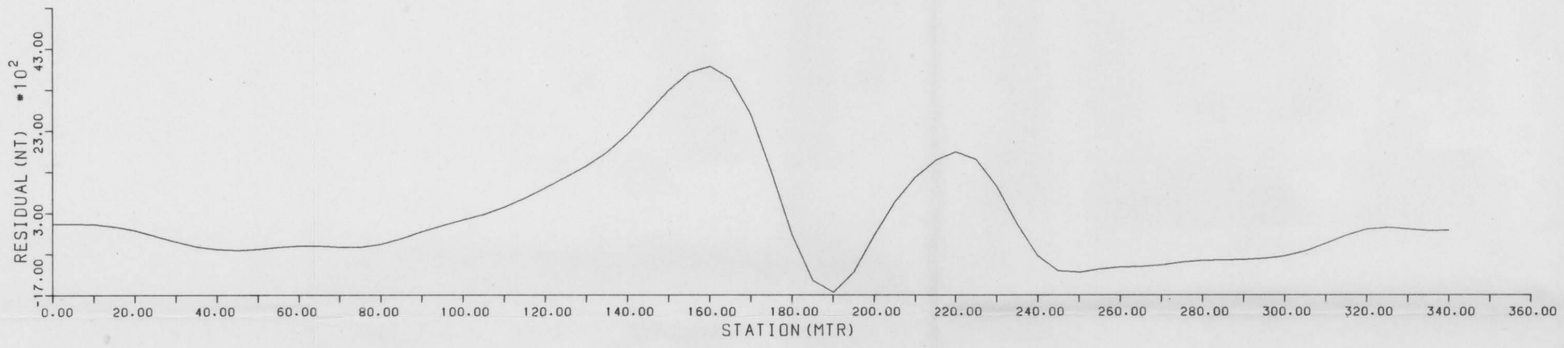
Shell Company of Australia Limited*
Oakes, G.F.

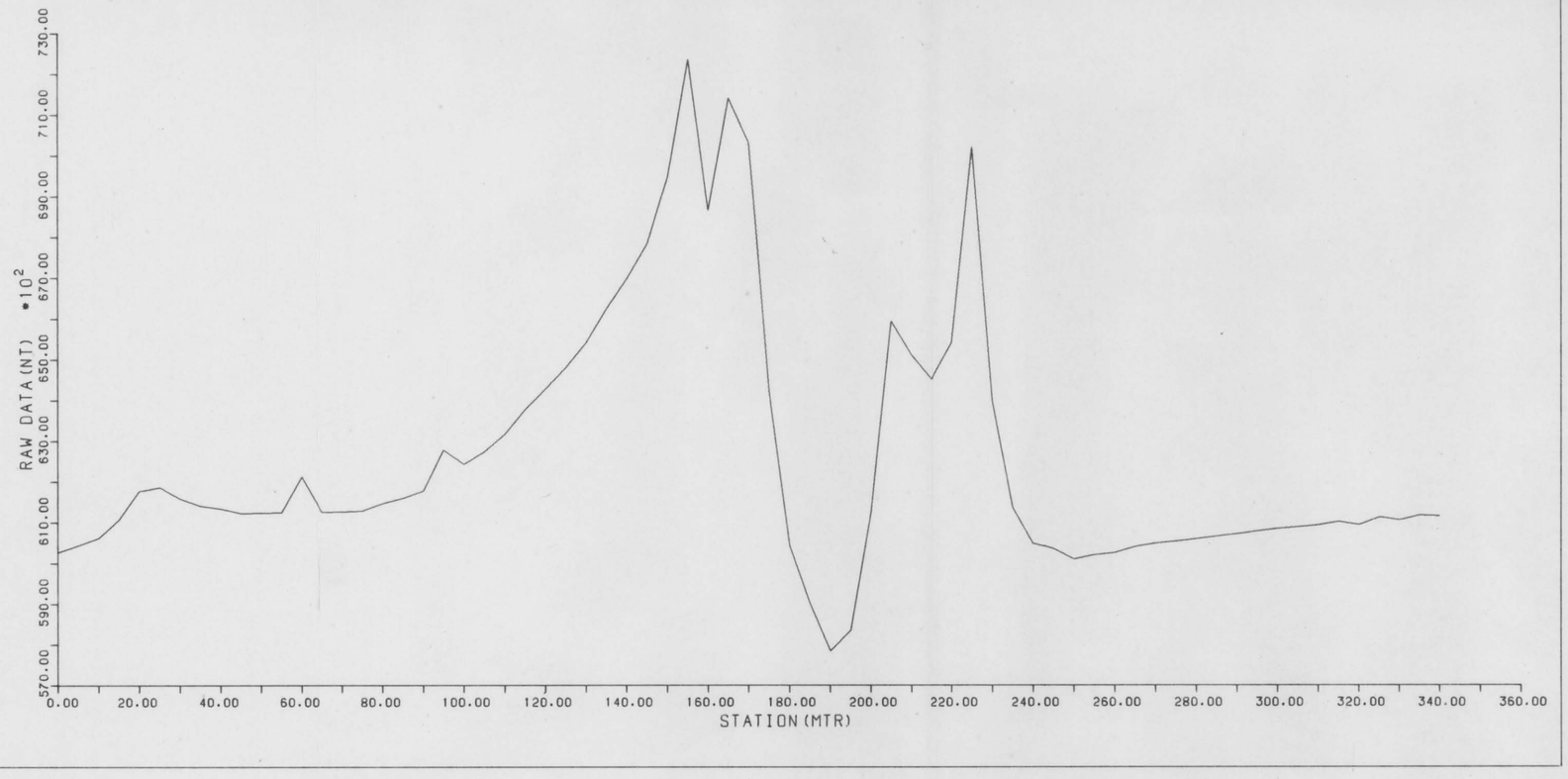
The Shell Company of Australia Limited
METALS DIVISION

KARA SCHEELITE DEPOSIT
MODELLING RESULTS
LINE 6500 N

SCALE 1:500	DATE Dec 1981
AUTHOR G Oakes	DRAWN A S
OFFICE AHO	REP.No. 08·1060
DRG.No. MT 24/1014	FIG.No. 6







PROGRAM MAGFIL

FILTER TYPE 7

(POWER SPECTRUM IS OF UNFILTERED DATA)

FILTER CHARACTERISTICS

FREQUENCY	FILTER COEFFICIENT
0.020	1.000
0.040	0.940
0.060	0.800
0.080	0.840
0.100	0.770
0.120	0.710
0.140	0.610
0.160	0.520
0.180	0.410
0.200	0.290
0.220	0.160
0.240	0.000
0.260	0.000

KEY TO FILTER TYPES

0= NO FILTERING
1= MOVING AVERAGE(3)
2= MOVING AVERAGE(5)
3= SHEPHERD FILTER(5)
4= HANNING FILTER(3)
3= WAVELENGTH CONVOLUTION OPERATOR(15)
6= FREQUENCY CUTOFF
7= GENERAL FREQUENCY FILTER

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

5 cm

SHELL COMPANY OF AUSTRALIA
METALS DIVISION

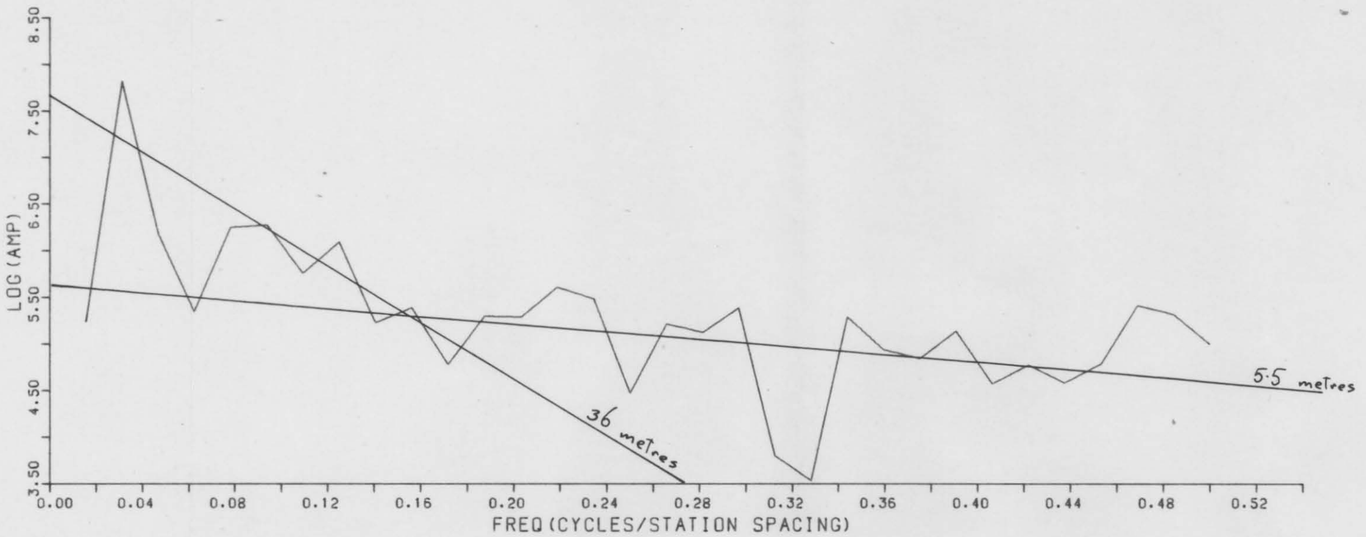
KARA SCHEELITE BODY
6280N

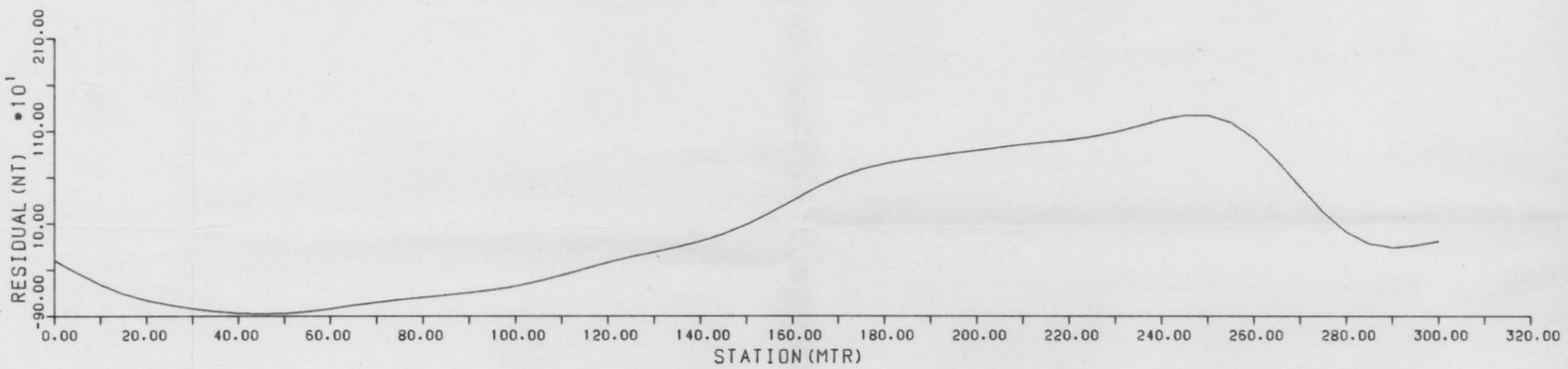
SPECTRAL ANALYSIS
& OPTIMUM FILTERING

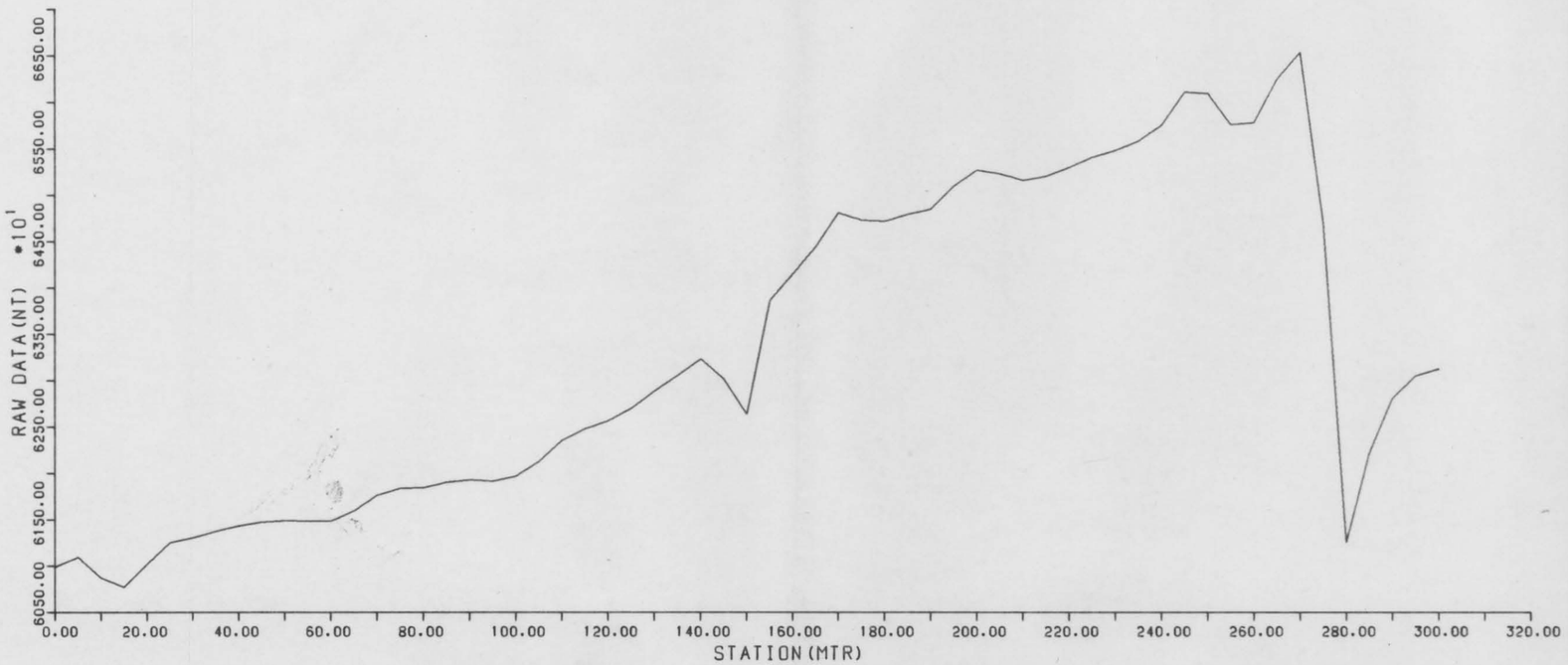
SCALE: 1: 1000.

FIG.NO: 7	REPT.NO: 08-1060
ENCL.NO:	DRG.NO: MT 24/1025
DATE:	AUTHOR:
DRAWN:	OFFICE:

705021







PROGRAM MAGFIL

FILTER TYPE 7

(POWER SPECTRUM IS OF UNFILTERED DATA)

FILTER CHARACTERISTICS

FREQUENCY	FILTER COEFFICIENT
0.020	1.000
0.040	0.930
0.060	0.840
0.080	0.730
0.100	0.600
0.120	0.400
0.140	0.220
0.160	0.000

KEY TO FILTER TYPES

0= NO FILTERING
1= MOVING AVERAGE(3)
2= MOVING AVERAGE(5)
3= SHEPHERD FILTER(5)
4= HANNING FILTER(3)
5= WAVELENGTH CONVOLUTION OPERATOR(L5)
6= FREQUENCY CUTOFF
7= GENERAL FREQUENCY FILTER

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

5 cm

SHELL COMPANY OF AUSTRALIA
METALS DIVISION

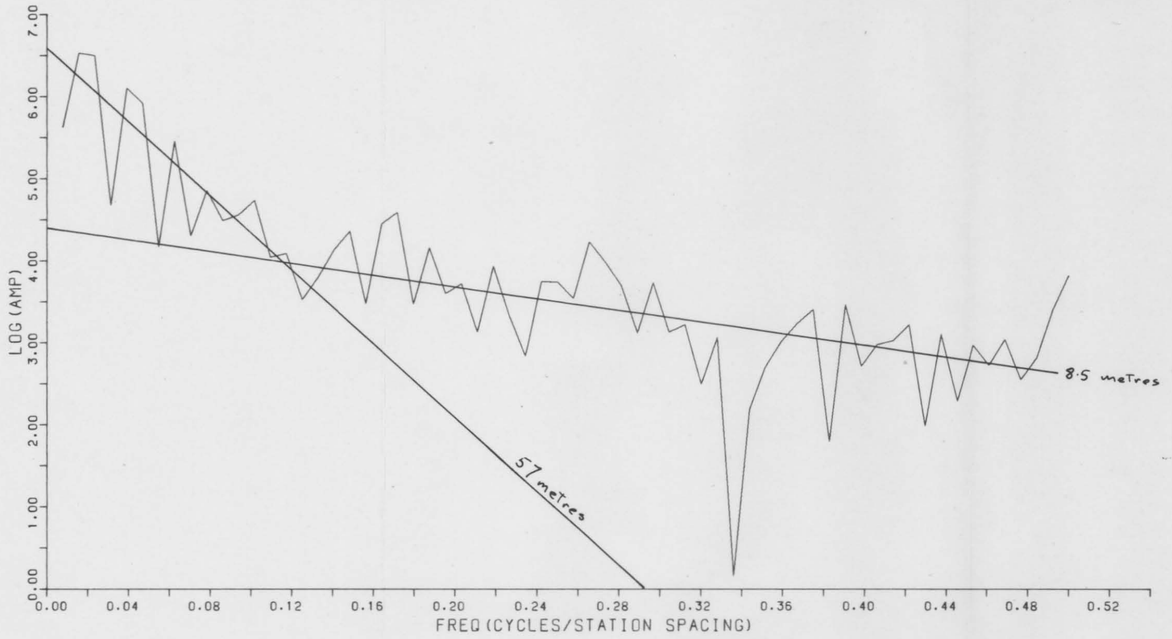
KARA SCHEELITE BODY
6420N

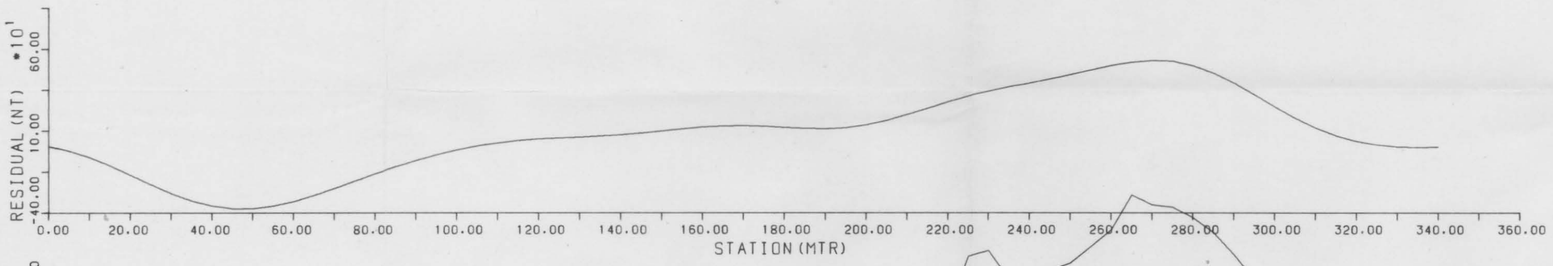
SPECTRAL ANALYSIS
& OPTIMUM FILTERING

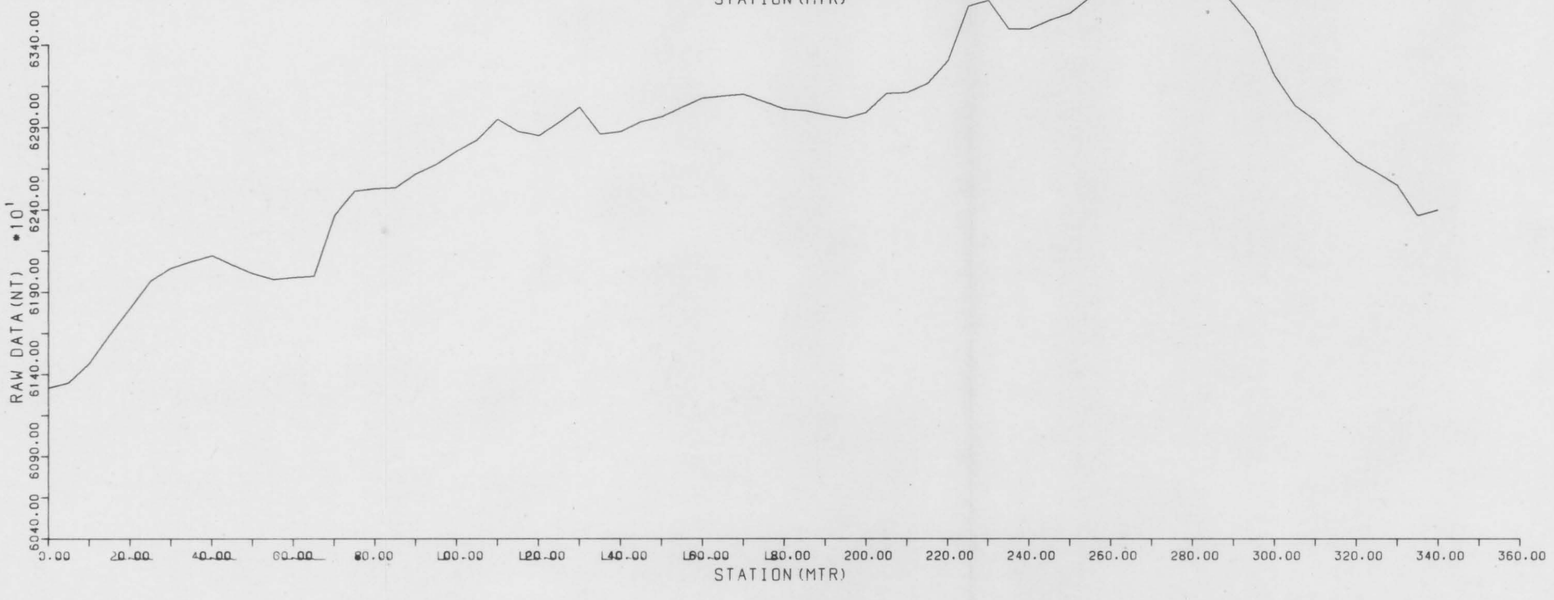
SCALE: 1: 1000.

FIG.NO: 8	REPT.NO: 08-1060
ENCL.NO:	DRG.NO: MT 24/1023
DATE:	AUTHOR:
DRAWN:	OFFICE:

705022







PROGRAM MAGFIL

FILTER TYPE 7

(POWER SPECTRUM IS OF UNFILTERED DATA)

FILTER CHARACTERISTICS

FREQUENCY	FILTER COEFFICIENT
0.020	1.000
0.040	0.910
0.060	0.790
0.080	0.620
0.100	0.390
0.120	0.060
0.140	0.000

KEY TO FILTER TYPES

0= NO FILTERING
1= MOVING AVERAGE (3)
2= MOVING AVERAGE (5)
3= SHEPHERD FILTER (5)
4= HANNING FILTER (3)
5= WAVELENGTH CONVOLUTION OPERATOR (15)
6= FREQUENCY CUTOFF
7= GENERAL FREQUENCY FILTER

02_4816

Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.

705023

5 cm

SHELL COMPANY OF AUSTRALIA
METALS DIVISION

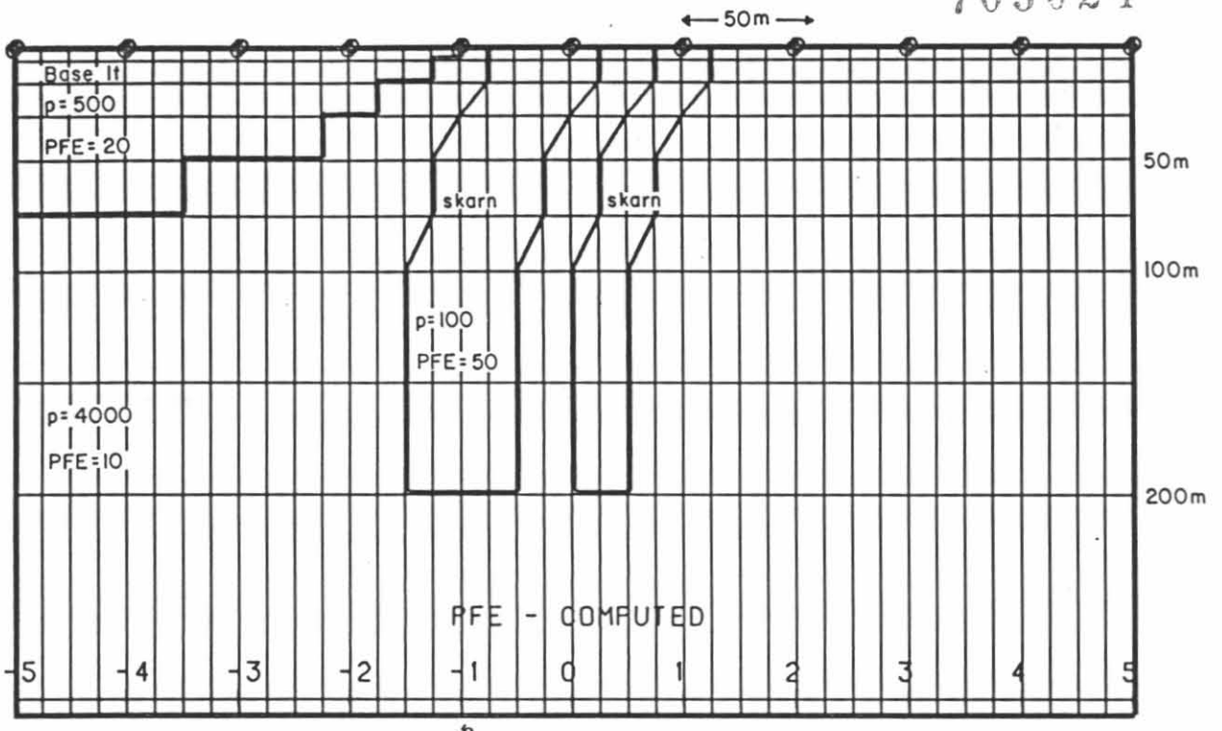
KARA SCHEELITE BODY
6500N

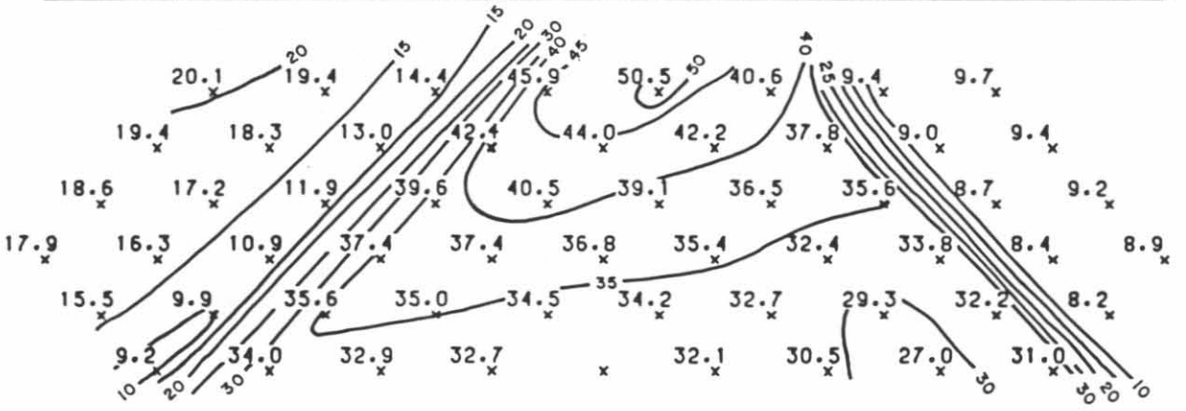
SPECTRAL ANALYSIS
& OPTIMUM FILTERING

SCALE: 1: 1000.

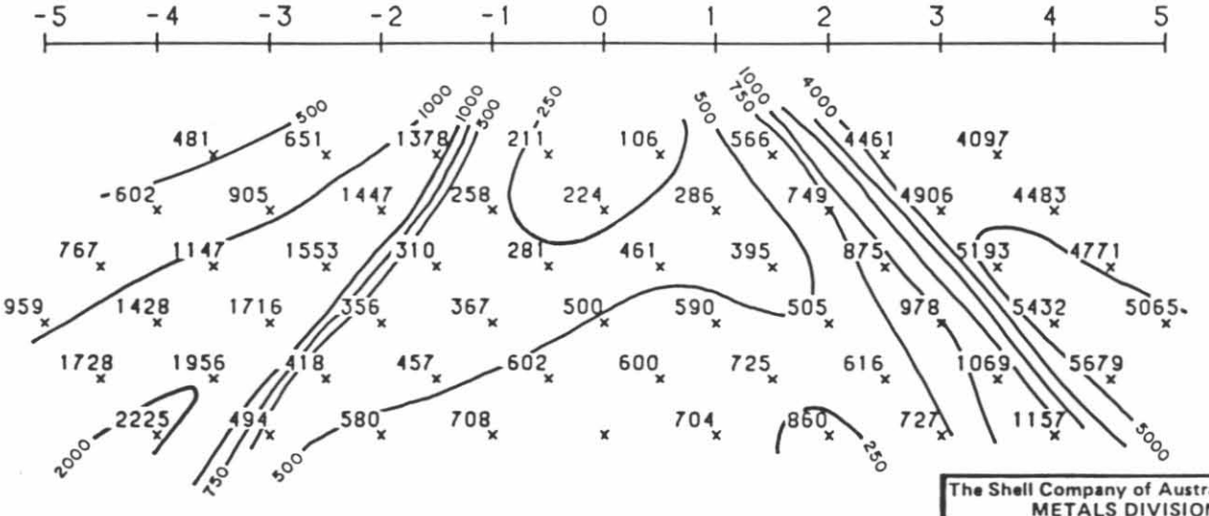
FIG.NO: 9	REPT.NO: 08-1060
ENCL.NO:	DRG.NO: MT 24/1024
DATE:	AUTHOR:
DRAWN:	OFFICE:

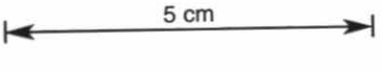
705024





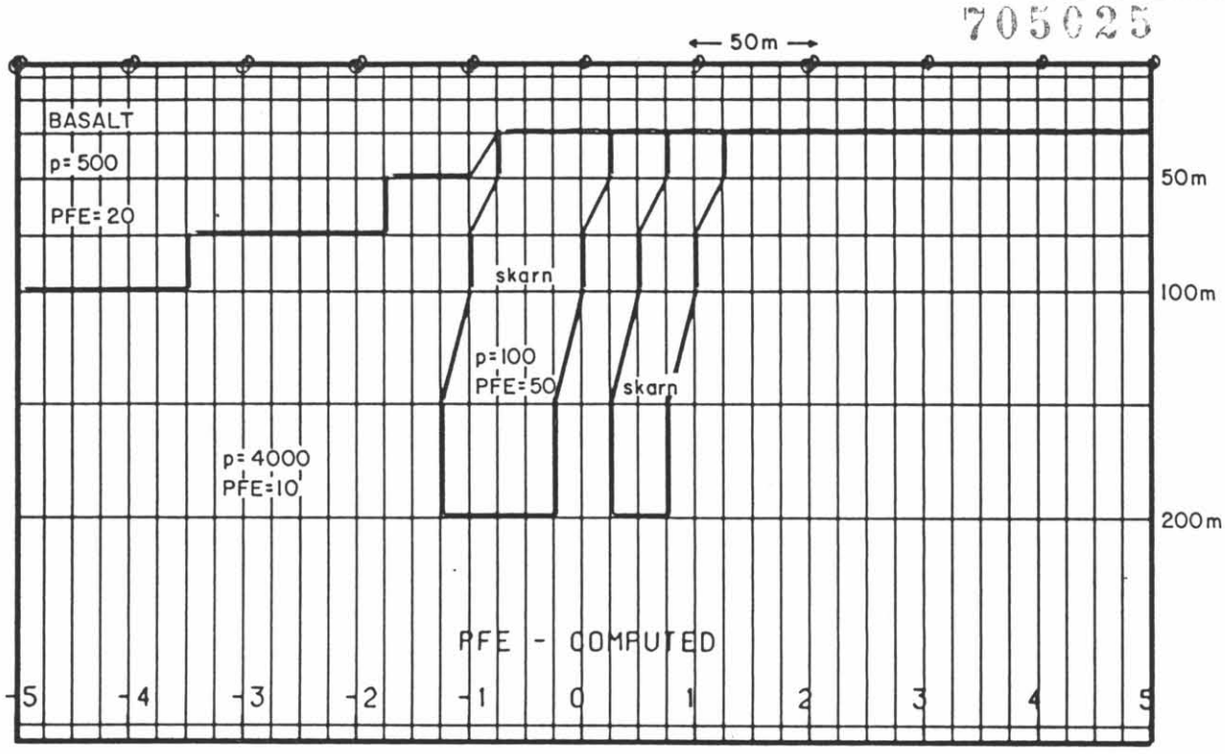
APPARENT RESISTIVITY - COMPUTED

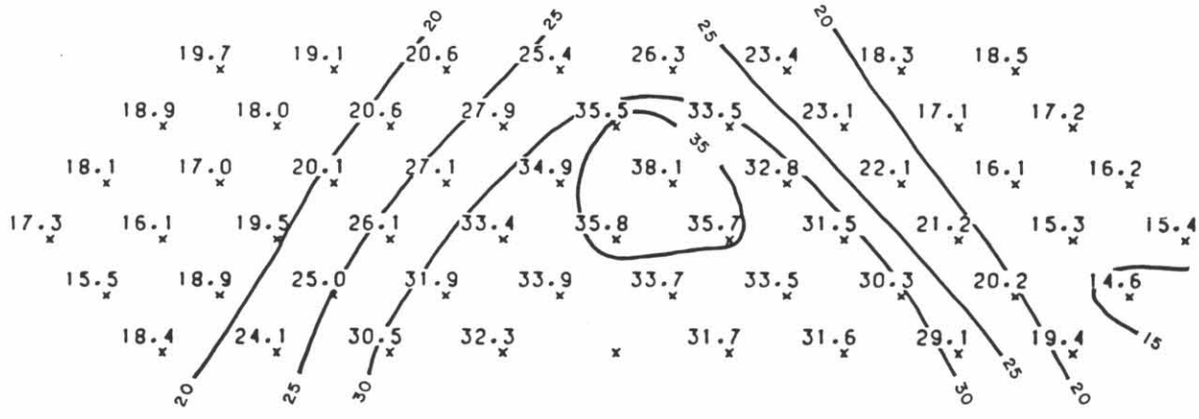




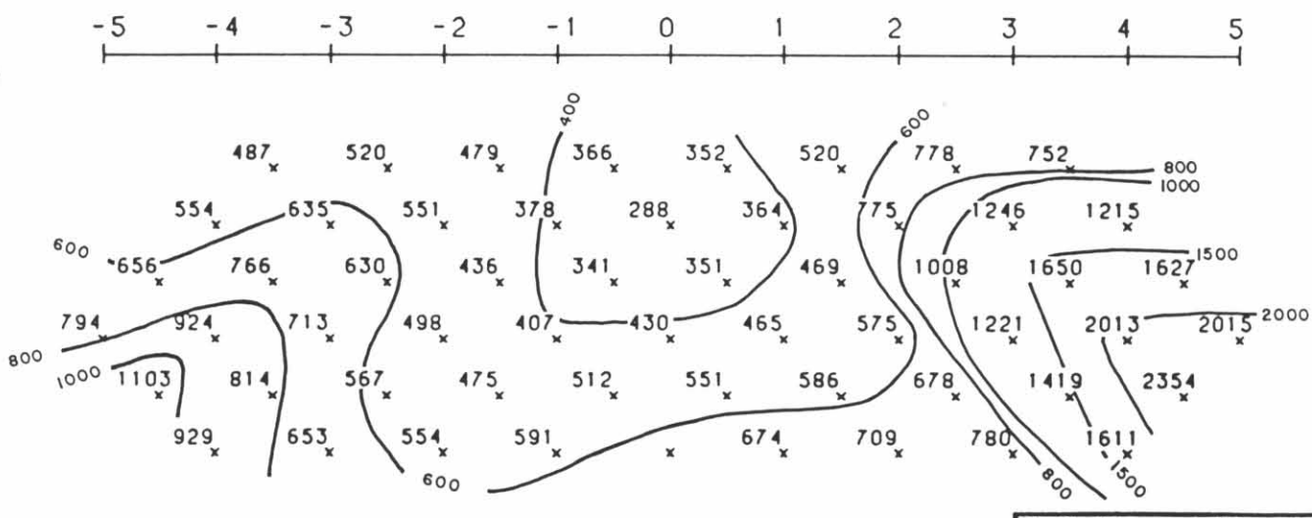
The Shell Company of Australia Limited METALS DIVISION	
KARA SCHEELITE DEPOSIT LINE 6280N IP MODEL 50m dipole	
SCALE	DATE DEC '81
AUTHORG.OAKES	DRAWN V.CATON
OFFICEAHO-MELB	REP.No 08-1060
DRG.No.MT24/1015	FIG.No. 10

705025





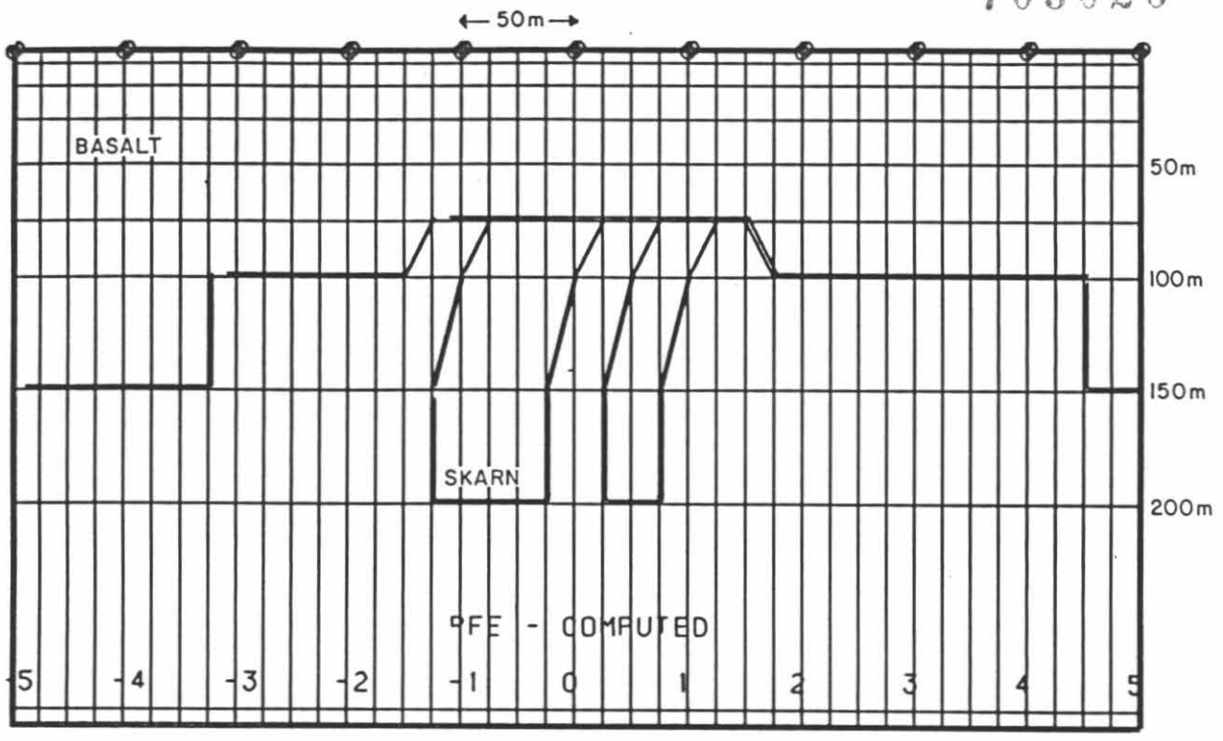
APPARENT RESISTIVITY - COMPUTED

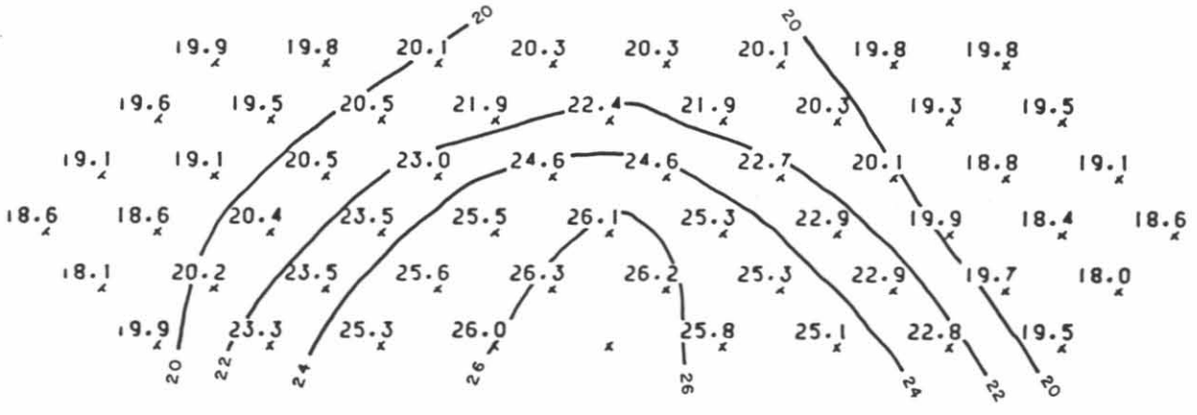


5 cm

The Shell Company of Australia Limited METALS DIVISION	
KARA SCHEELITE DEPOSIT LINE 6420N IP MODEL 50m dipole	
SCALE	DATE DEC '81
AUTHORG.OAKES	DRAWNV.CATON
OFFICE AHO-MELB	REP.No. 08-1060
DRG.No.MT24/1016	FIG.No. 11

705026

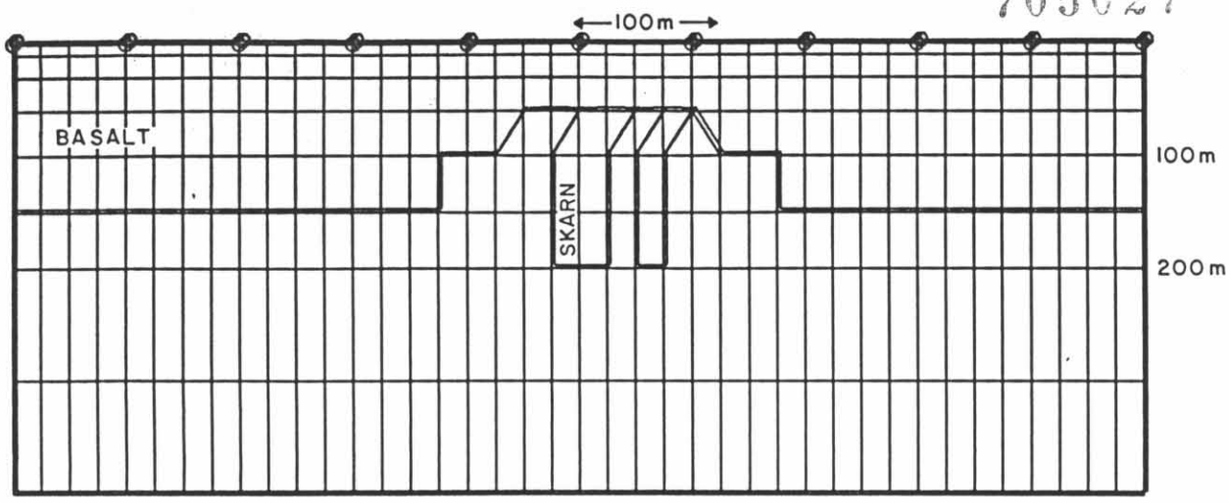




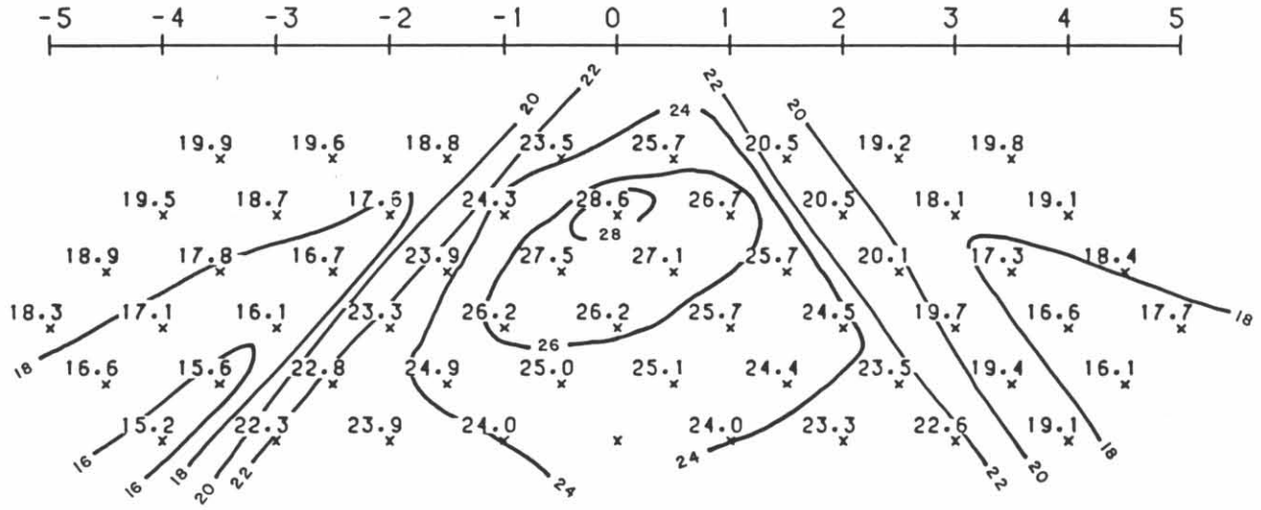
The Shell Company of Australia Limited METALS DIVISION	
KARA SCHEELITE DEPOSIT LINE 6500N IP MODEL 50m dipole	
SCALE	DATE DEC '81
AUTHORG.OAKES	DRAWNV.CATON
OFFICEAHO-MELB	REP.No.08-1060
DRG.No.MT24/1018	FIG.No. 12

5 cm

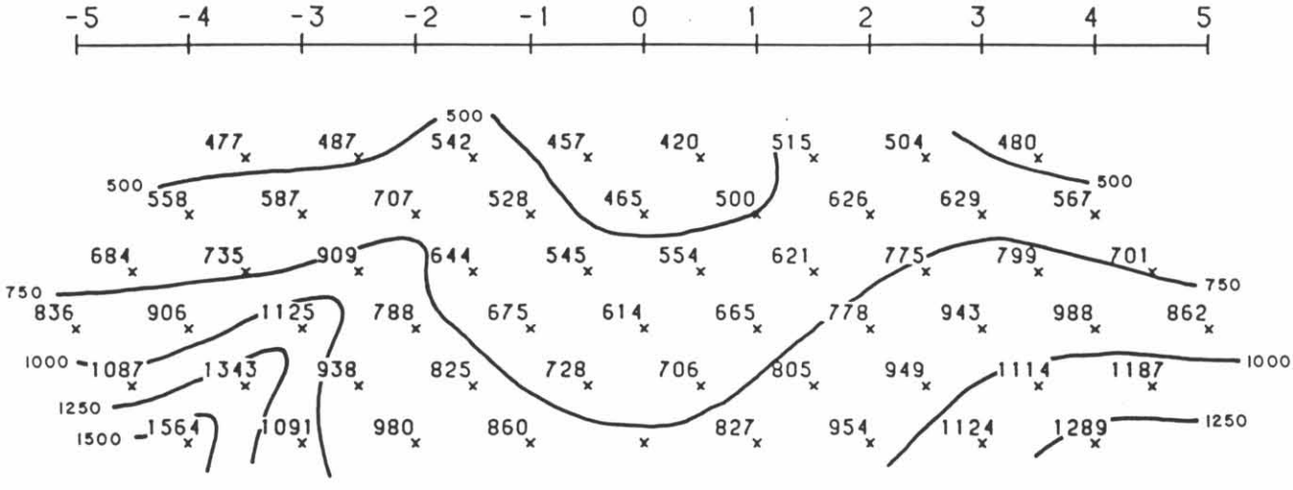
705027



PFE - COMPUTED



APPARENT RESISTIVITY - COMPUTED



The Shell Company of Australia Limited METALS DIVISION	
KARA SCHEELITE DEPOSIT LINE 6500N IP MODEL 100m dipole	
SCALE	DATE DEC '81
AUTHOR G. OAKES	DRAWN V. CATON
OFFICE AHO-MELB	REP. No. 08·1060
DRG. No. MT24/1017	FIG. No. 13

5 cm

GEOLOGICAL LEGEND

F — Overburden (bulldozed rubble)

VOLCANIC SEQUENCE

V — B - Basalt, Bd - Subbasalt

SEDIMENTARY ROCKS

N - Siltstone
C - Conglomerate
S - Sandstone
L - Limestone
T - Skarn
Q - Quartzose rock

IGNEOUS ROCKS

Gr — Granite
Qz — Quartz epidote facies

KARA SEQUENCE

- Limestone unit Thin bedded
- Thin bedded sequence siltstone, sandstone, local conglomerate
- Conglomerate unit Massive

EASTERN RIDGE SEQUENCE

- Upper skarn unit
- Upper sandstone unit
- Lower skarn unit
- Lower sandstone unit
- Sandstone - undifferentiated

Outcrop Float

Geological boundaries — definite; inferred; concealed

Bedding (strike and dip) — normal; overturned

Fault — approximate; inferred

Axis of magnetic anomaly

Weathering characteristics of skarn
X - unaltered
Y - partially weathered
Z - clayey
Scm - visible scheelite

GENERAL LEGEND

Drainage
Surveyed track
Unsurveyed track
Trench No, ppm or % WO3
Survey station
Surveyed spot height
DDH 206 -50° 402m — Diamond drill hole number inclination and depth drilled
Contours (metres indicated)
8242N —— 8242N Drill line section

7600 E. 7700 E. 7800 E.

6600 N. 6600 N.

6500 N. 6500 N. 6500 N.

6460 N. 6460 N.

6420 N. 6420 N.

6400 N. 6400 N.

6376 N. 6376 N.

6363 N. 6363 N.

6328 N. 6328 N.

6300 N. 6300 N.

6280 N. 6280 N.

6242 N. 6242 N.

6200 N. 6200 N.

DDH 2-3 DDH 201 DDH 144 DDH 27 DDH 139 DDH 138 DDH 275 DDH 276 DDH 143 DDH 151 DDH 274 DDH 203 DDH 150 DDH 212 DDH 145

LINE 2 LINE 3 Line 1

EASTERN RIDGE "WINDOW"

UPPER SKARN LOWER SKARN UPPER SANDSTONE LOWER SANDSTONE GRANITE

KARA CREEK EAST KARA CREEK GULLY BULLDOZED

7700E

KEY

MAGNETIC CONTOURS IN GAMMAS

- >72000 GAMMAS
- 70000 - 72000
- 68000 - 70000
- 66000 - 68000
- 64000 - 66000
- 62000 - 64000
- 60000 - 62000
- 58000 - 60000

5 cm

Shell Metals Div. Rpt No. 08-1060
Drg No. MT24/1020
Scale: 1:1000

McINTYRE MINES (AUST.) PTY. LTD.
KARA TUNGSTEN PROJECT TASMANIA
EASTERN RIDGE
GROUND MAGNETICS Fig 14

NO	BY	DATE	DESCRIPTION

DESIGNED: C.W.
DRAWN: T.B.D.S.
CHECKED:
DATE: Aug 1980
SCALE 1:500
PROJECT No: 21081

705028

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Geophysical Response of the Kara Scheelite Deposit

Shell Company of Australia Limited*
Oakes, G.F.