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REPORT ON EXPLORATION ON THE

MACKINTOSH EL 2/70 DURING THE PERIOD

JANUARY, 1983 TO APRIL 1984

Distribution

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FIGURES

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POCKET AT REAR

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1. SUMMARY STATEMENT

Drilling of an electromagnetic conductor on the Mackintosh Licence in an area with significant favourable alteration, structure, barytes outcrop and anomalous soil lead geochemistry resulted in 24.4 metres of Que River style base metal sulphides being intersected. As at April 1984, the resource was perceived to have a potential of 5 million tonnes with further increases likely.

2. ABSTRACT

2.1 HELLYER DISCOVERY

The major event in 1983 exploration was the intersection of 24.4 metres of Que River style base metal sulphide grading 12.6% Zn, 4.4% Pb, 0.3% Cu, 157 g/t Ag and 1.9 g/t Au. The prospect 3 km north of Que River mine became known as Hellyer. The initial 3 hole programme was extended, and by the end of April 1984 a total of 8417.8 meteres had been drilled. At this stage a potential resource of 5 million tonnes plus was inferred at Hellyer with the possibility of significantly increasing the tonneage being noted. Grades appear to be similar to or slightly lower than at Que River, with pyrite content higher, banding less prominent and arsenopyrite more common.

2.2 GEOPHYSICS

2.2.1 At Hellyer

A UTEM (University of Toronto Electromagnetics) anomaly at Hellyer was given the highest rating amongst a range of anomalies detected on the licence. MG3, the discovery hole, and the first of a three hole programme, was aimed to intersect the centre of a 600 meter long conductor axis at 140 meters depth. The target formed part of a central more conductive zone. The response had a conductance of >50 siemens(1), not considered significantly lower than that of PQ lens at Que River. A problem with the depth estimates was recognised and as a result the hole was aimed at the deep end of the estimated depth to top.

Subsequent geophysics included EM37, further UTEM, downhole SIROTEM and ground magnetics.

2.2.2 Elsewhere on the licence

The UTEM survey, aimed at finding conductors beneath the considered detection limits of previous IP surveys, produced anomalies other than Hellyer. One of these, the DI anomaly was drilled with inconclusive results. Follow-up work on the other anomalies is continuing. A second UTEM survey covering an area in the south of the licence was conducted in early 1984 revealing some very weak anomalies.

2.3 GEOLOGY

2.3.1 At Hellyer

Surface - Following a theory that folding may be localised by base metal sulphides, surface geologic

1. E. Eadie revised estimate August 1984.

mapping in the Hellyer area, aided by new exposure, confirmed the presence of a previously interpreted anticline. Incompetent altered rocks provide loci for fold development around a nugget-like base metal core. An intense concentration of bright green fuchsite alteration in the nose of this fold was recorded. Fuchsite mantles the top of PQ Lens at the Que River Mine and was therefore recognised as a highly positive indicator. Costeaning in this altered zone exposed a lens of barytes. Pillow lavas were also recognised here.

Drilling - A prominant vertical stringer zone was identified and a lithostratigraphic succession established. A horizontal rather than vertical[2] disposition to the base metal sulphides and enclosing rock units was recognised. The presence of altered dacite ridges and a prominent north-south fault was established.

2.3.2 Elsewhere on the Licence

Geologic mapping focused on the new exposure created by the Hydro Electric Commission (HEC). A programme of structural mapping was begun. New exposure enabled some previous mapping to be revised. New information from the Hellyer drilling has enabled previously

2. Que River Mine ore lenses are vertical

mapped rock names to be re-interpreted and a mapping programme using Hellyer stratigraphic units is underway.

2.4 GEOCHEMISTRY

2.4.1 At Hellyer

C horizon - 80 mesh soil sampling in 1981 had detected major lead anomalies with significant areas >1000ppm Pb. MG1 and MG2 drilled beneath portions of these anomalies aimed at co-incident IP targets. The eye of the Pb anomaly at Hellyer on 10500N was not drilled in favour of testing an IP response and less intense geochemistry on 10200N. Also associated with the area are broad zinc and copper soil anomalies. Gossanous material on 10300N, 5748E assayed 40 ppm Ag. A study of lead isotopes was instituted.

2.4.2 Elsewhere on the Licence

New lines cut for the UTEM survey were sampled and gave a flat response. Channel sampling along the new HEC road gave an elevated response over areas with visible disseminated sulphides.

3. REGIONAL GEOLOGICAL SETTING

The regional geology is depicted on Figure 1 and local geology on Figures 2a and 2b. The Mackintosh Licence covers a portion of the Early to Middle Cambrian calc-alkaline Central Belt Mt Read Volcanics (Corbett, 1981), host to the Que River and Rosebery base metal sulphide and the Mt Lyell copper rich stringer ore bodies. The Mt Read volcanic sequence is a terrestial to shallow marine sequence on the eastern edge of the Dundas Group deep water sediments. The Central Belt Mt Read volcanics are andesitic at Que River and include recently identified pillow lavas at Hellyer. The central belt volcanics are overlain conformably (*) by a sequence of rhyolitic volcanics, volcaniclastics and sediments - the Western Sequence of Corbett.

Deep water Upper Cambrian flysch - like sediments are prominently exposed west of the Mt Read Volcanics. This forms the most extensive part of a complex suite of linearly disposed magmatic and sedimentary rocks. The Cambrian geology is thought by Corbett to be the product of deposition in linear basins and magmatism along deep seated crystal fractures. This system of extensional tectonics is in contrast to the subduction centred plate tectonic model of Solomon and Griffiths (1972).

The late Cambrian Delamerian Orogeny terminated deep water sedimentation in Tasmania (Webby 1978 in Cas 1983) and a regional unconformity marks the start of the shallow marine to fluviatile sediments of the Owen Conglomerate which are conformably overlain by

(:) New evidence at Hellyer

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FIGURE 1.

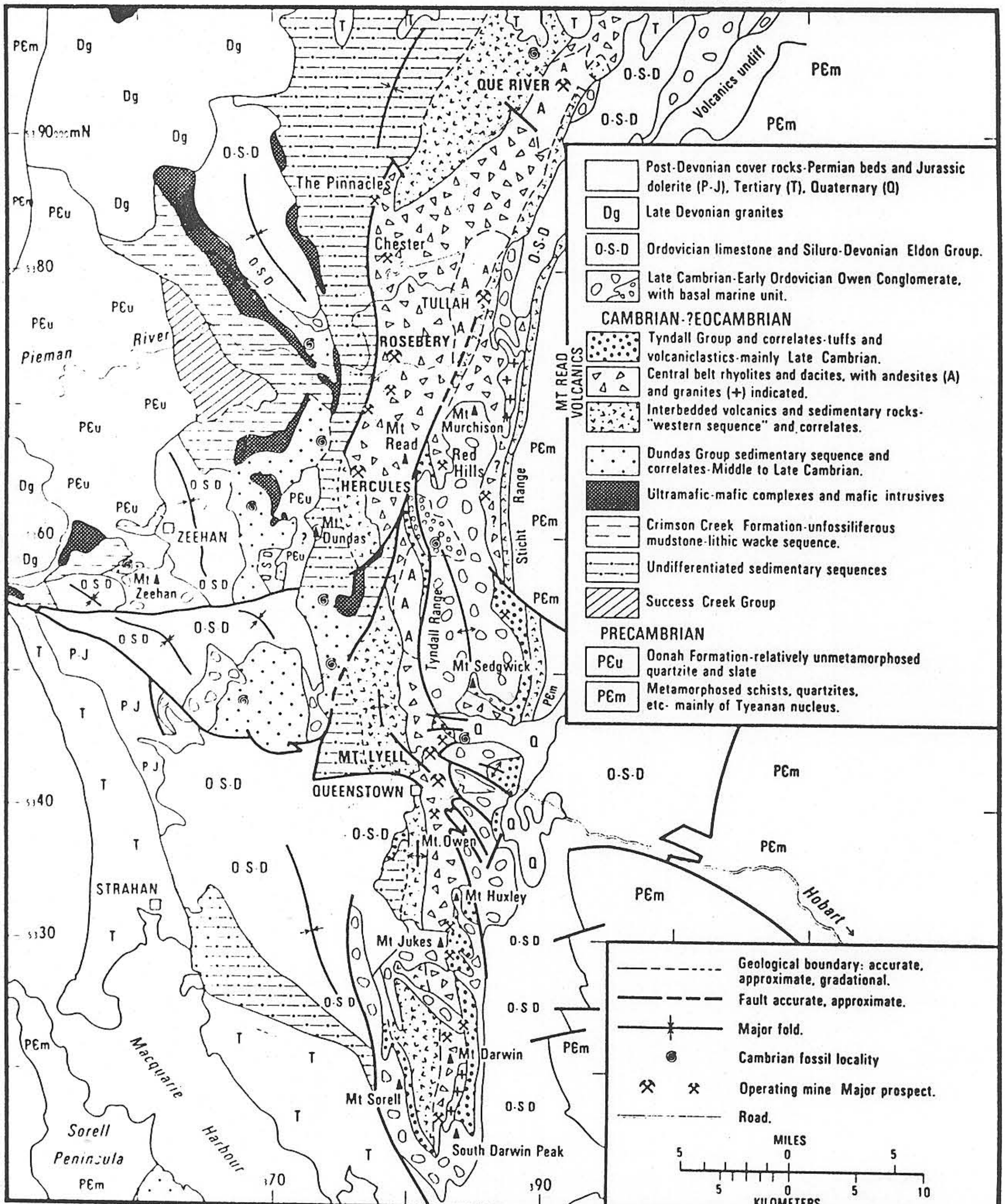
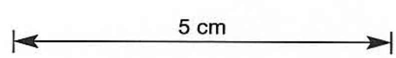


FIG. 1. Geologic map of central western Tasmania showing distribution of the Mt. Read Volcanics and the major mines and prospects within the volcanic belt.



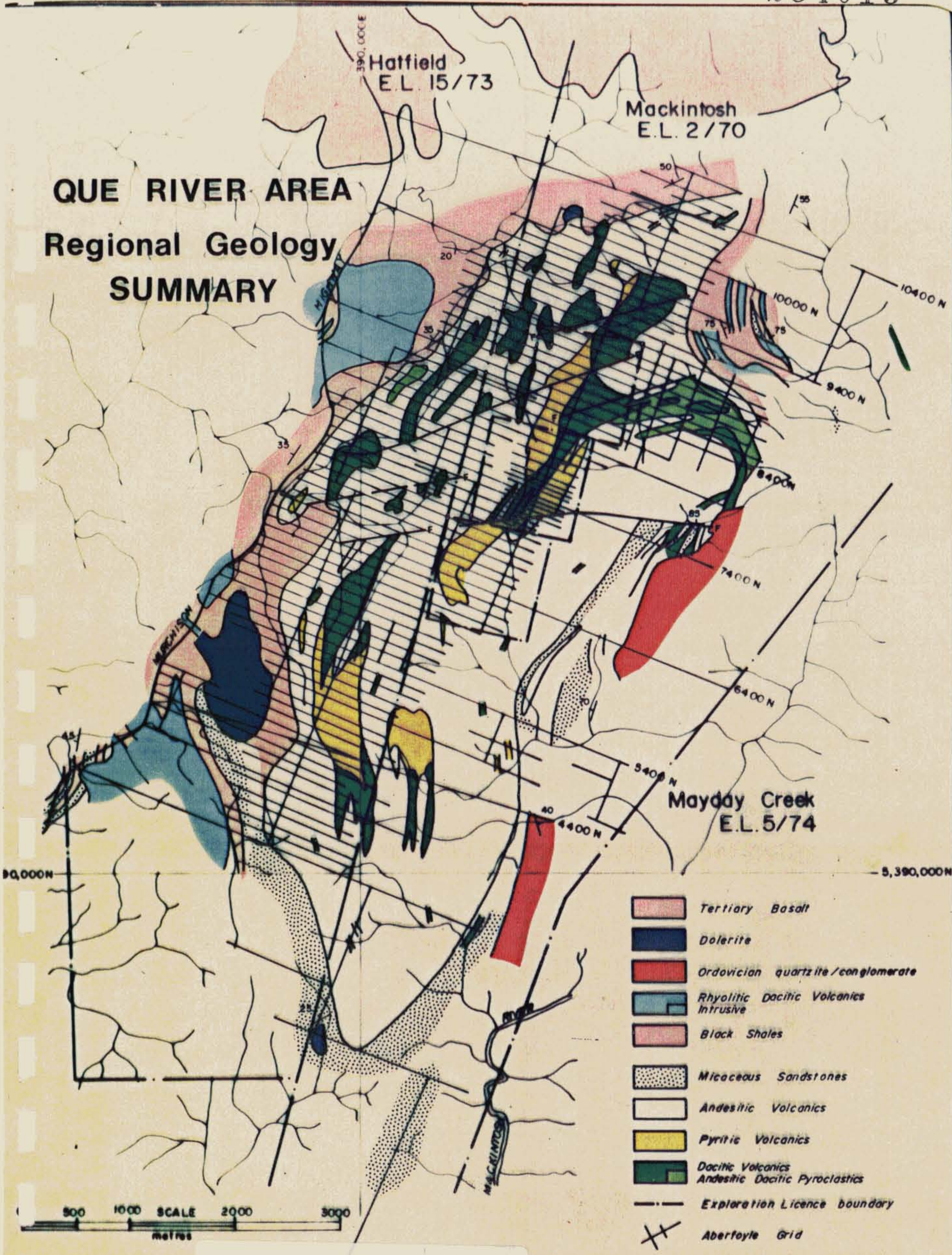


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FIGURE 2a

Aberfoyle Exploration Pty Ltd

Drawn:	J.R.S	NORTH WEST TASMANIA	Location code:
Traced:	J.L.R.	Mackintosh West / Hatfield Licence Areas	Date: May, 1981
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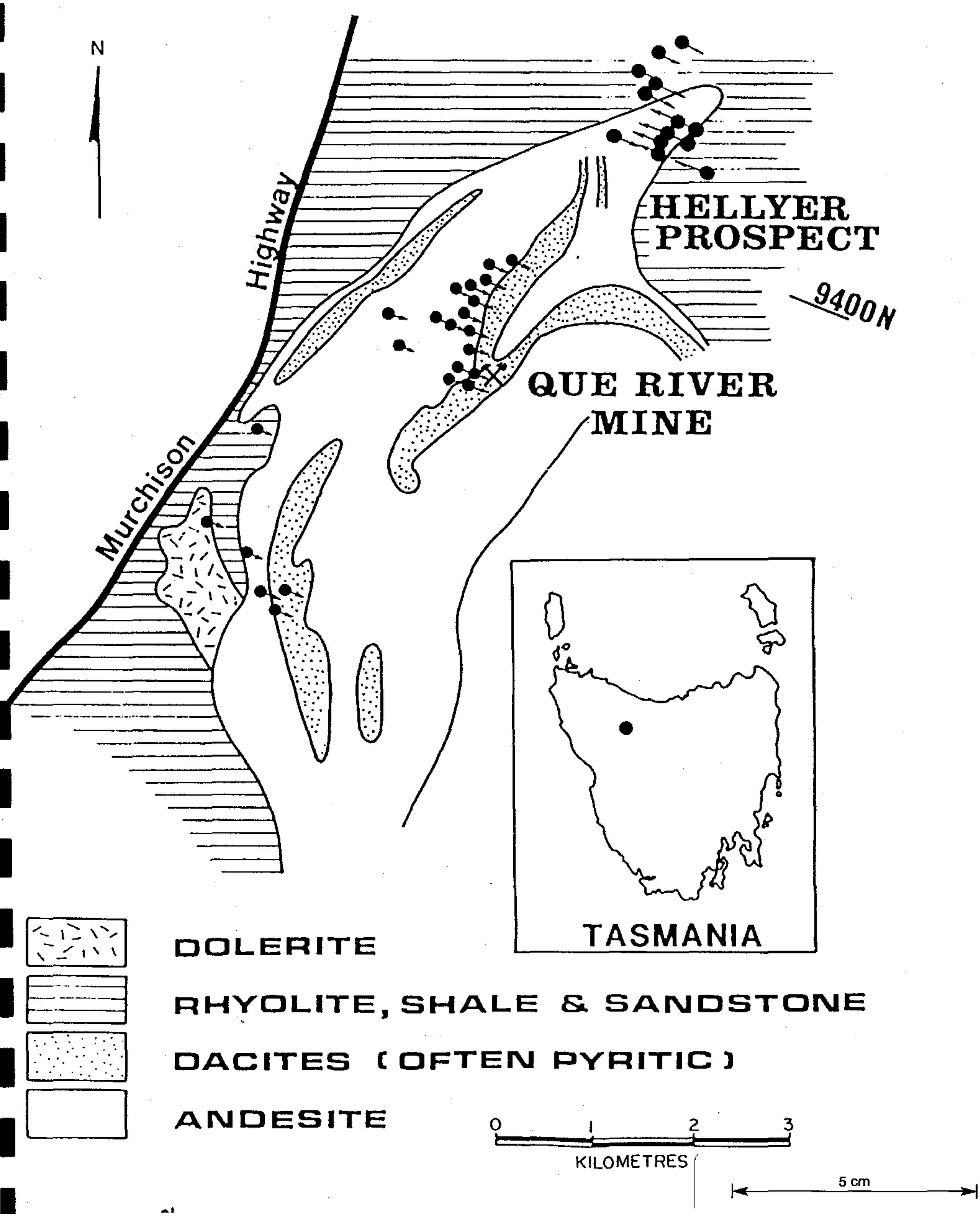
MACKINTOSH - HATFIELD
SUMMARY PLAN



Middle-Late Ordovician Gordon Limestone. These successions are followed conformably by fossiliferous quartz sandstone and mudstone sequences of Silurian-Early Devonian age. Elements of these post-Cambrian successions are exposed along the eastern boundary of the Mackintosh Licence.

The emplacement of Late Devonian-Early Carboniferous granites was followed by a prolonged period of erosion which ended with the regional accumulation of glacio-marine and fresh water sequences of the Parmeneer Super Group.

Tertiary graben development was associated with extrusion of terrestrial basalt flows which blanket the northern portion of the Mackintosh Licence, however, the effects of Pleistocene glaciation in the licence area are minimal.

4. EXPLORATION HISTORY AND PREVIOUS WORK

4.1 Early History

The present Que River Mine is located in the area originally known as `Gold Hill´ or `Golden Mount´. This was explored by Rosebery discoverer Tom McDonald around 1922. Two shafts and several trenches were dug, with a best assay of 2 dwt gold being reported. Q. J. Hederson 1934, 1938 (Acting Field Geologist Mines Dept, Hobart) mapped an area around the old Gold Hill shaft by pitting. An assay of 6 oz 3 dwts/t silver was recorded. Drilling was recommended but no action was taken.

4.2 Early Tenure

There is apparently no record of activity between 1938 and 1958. Rio Tinto Australian Exploration held ground here between 1958 and 1962 (SPL and EL). Mt Costigan Mines transferred title over a EL to Comstaff Pty Ltd (1963-1966). Pickands Mather held ground between 1966 and 1968. In 1970, EL2/70 was granted to Aberfoyle Tin N.L. EL2/70 is subject to a joint venture between Aberfoyle and Paringa Mining and Exploration Co. P.L.C. Involved changes in shares held and ownership occured btween 1971-1974. Current equities are Paringa 10% and Aberfoyle Limited 90%. The location of the present Mackintosh Licence is shown on Figure 3.

4.3 Eafly Aberfoyle Work and Que River Discovery

Initial exploration by Aberfoyle involved regional mapping and stream sediment geochemical sampling. An airborne

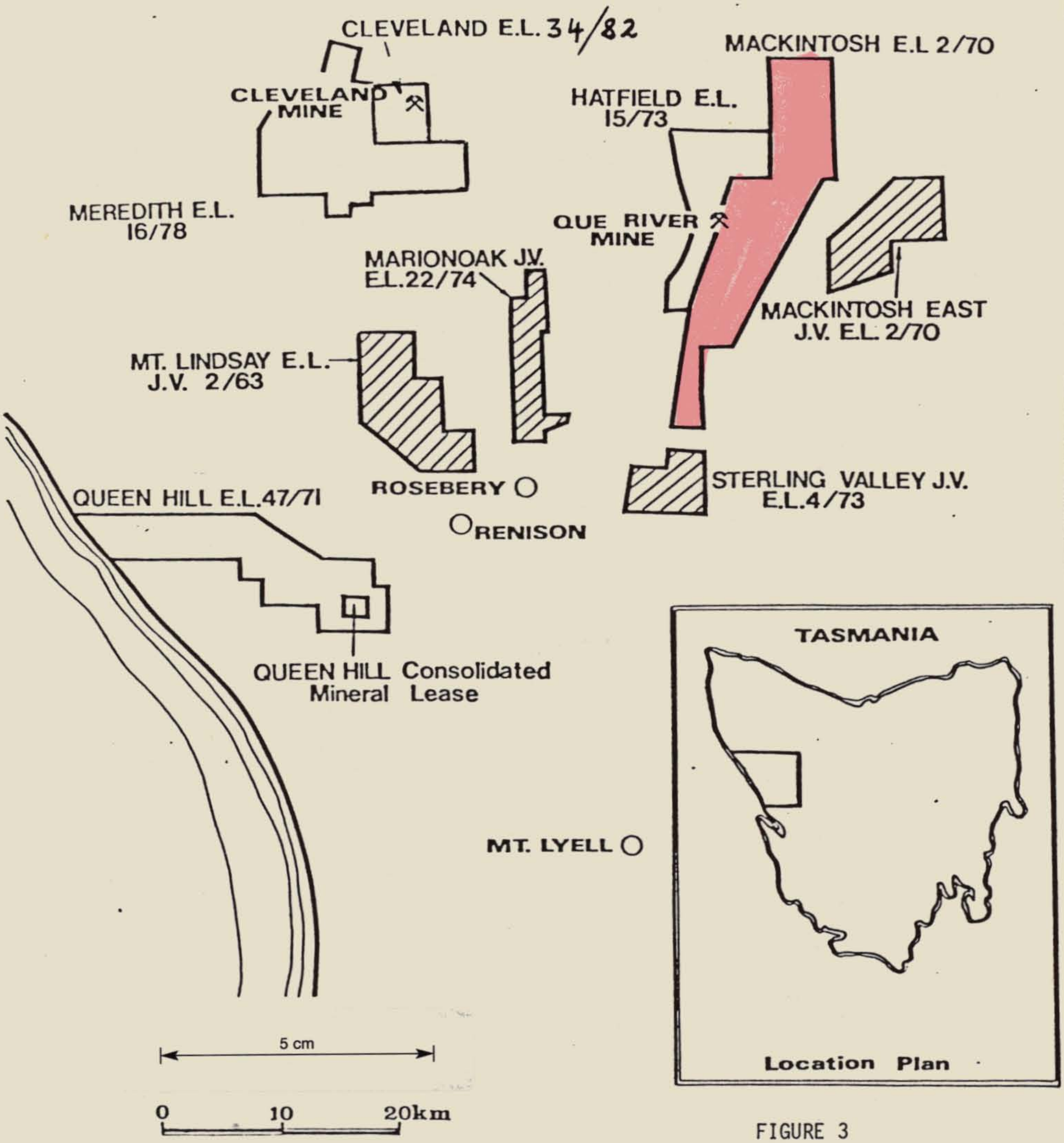


FIGURE 3

Aberfoyle Exploration Pty Ltd

Drawn:	NORTH WEST TASMANIA	Location code:
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Revised by: Date		

electromagnetic survey in 1972 detected Que River's copper rich, sub-cropping S lens in the Gold Hill area. The first hole of a seven hole programme intersected S lens (11.4 metres at 2.1% Cu, 5.1% Pb, 7.3% Zn and 105 g/t Ag). A second hole, aimed at a depth extension of S lens and to test a broad lead soil geochemical anomaly interesected Que river Mine's PQ lens (3.81 metres at 0.86% Cu, 13.72% Pb, 22.03% Zn, 371 g/t Ag, 3.8 g/t Au) below the high geochemistry, but passed below the depth limit of S lens. Subsequent drilling resulted in an ore reserve estimate of 6 million tons, containing 800,000 tons of base metals (Skey and Webster). This was subsequently refined, and the final ((March 1979 - N.T.Duggan) pre-production ore reserve of PQ lens (the principal lens) was 3.56 million tonnes at 0.35%Cu, 7.0% Pb, 12.5% Zn, 171 g/ton Ag and 3.36 g/ton Au.

4.4 Exploration after Que River Discovery

Target Development

Following the discovery of Que River an extensive programme of geologic mapping, soil geochemistry, reconnaissiance and detailed IP geophysics was undertaken. Figure 4 shows the IP coverage to June 1977. Figure 5 shows the 1980-81 IP coverage. Some additional airborne EM - magnetics was flown. Many geochemical anomalies on the Licence had been detected by June, 1977 but significant gaps in the data existed in the north (north of 9100N) east of the Old Mill Site anomaly and in the south and south east (see Figure 6). By the end of 1981 these gaps had been covered east of the Old Mill Site and in the

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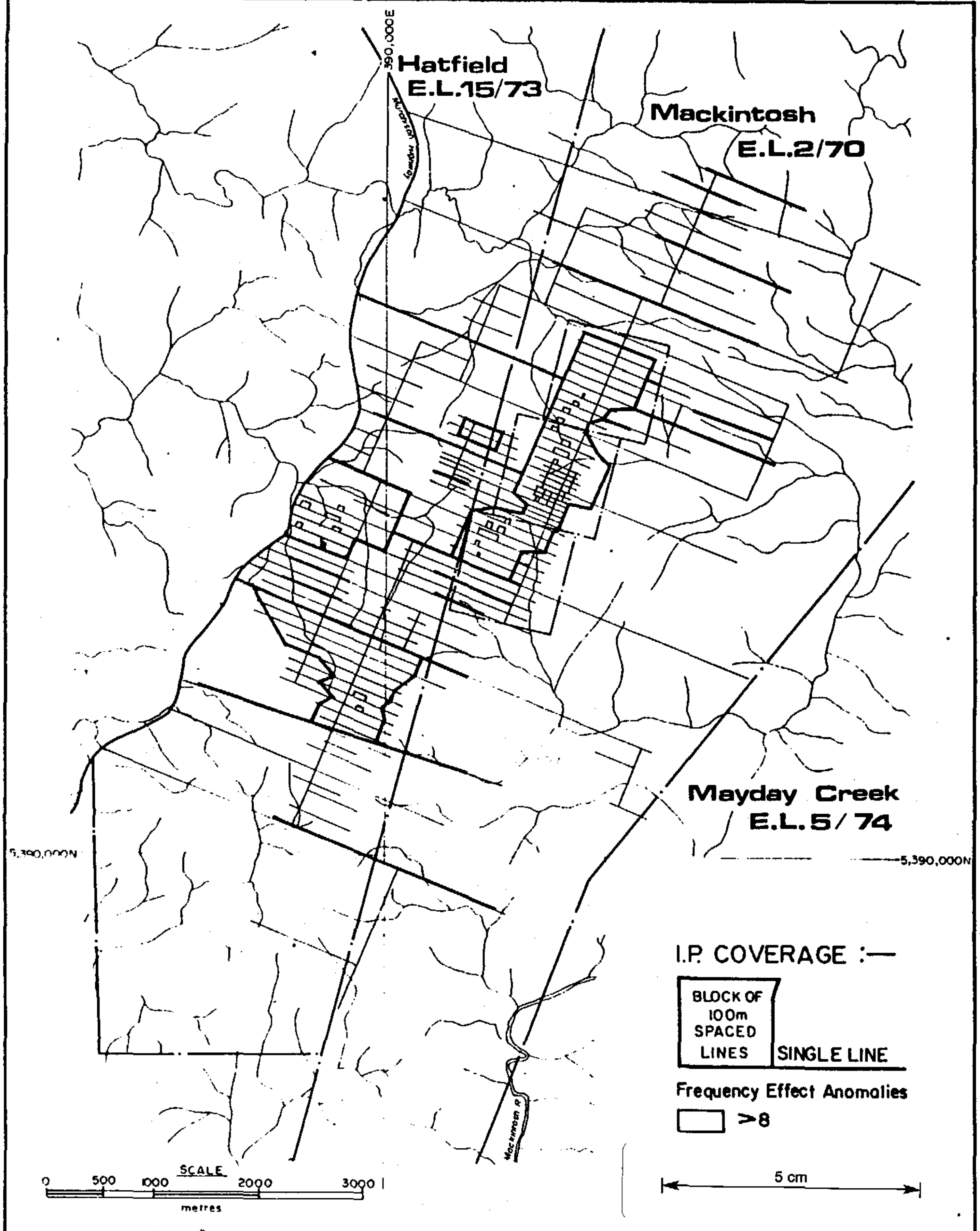


FIGURE 4

Abminco Exploration

Drawn CHY	Mackintosh West / Hatfield Licence Areas	Location code
Traced J D	I.P. coverage to June 1977	Date June 1977
Checked		Scale 1:50,000

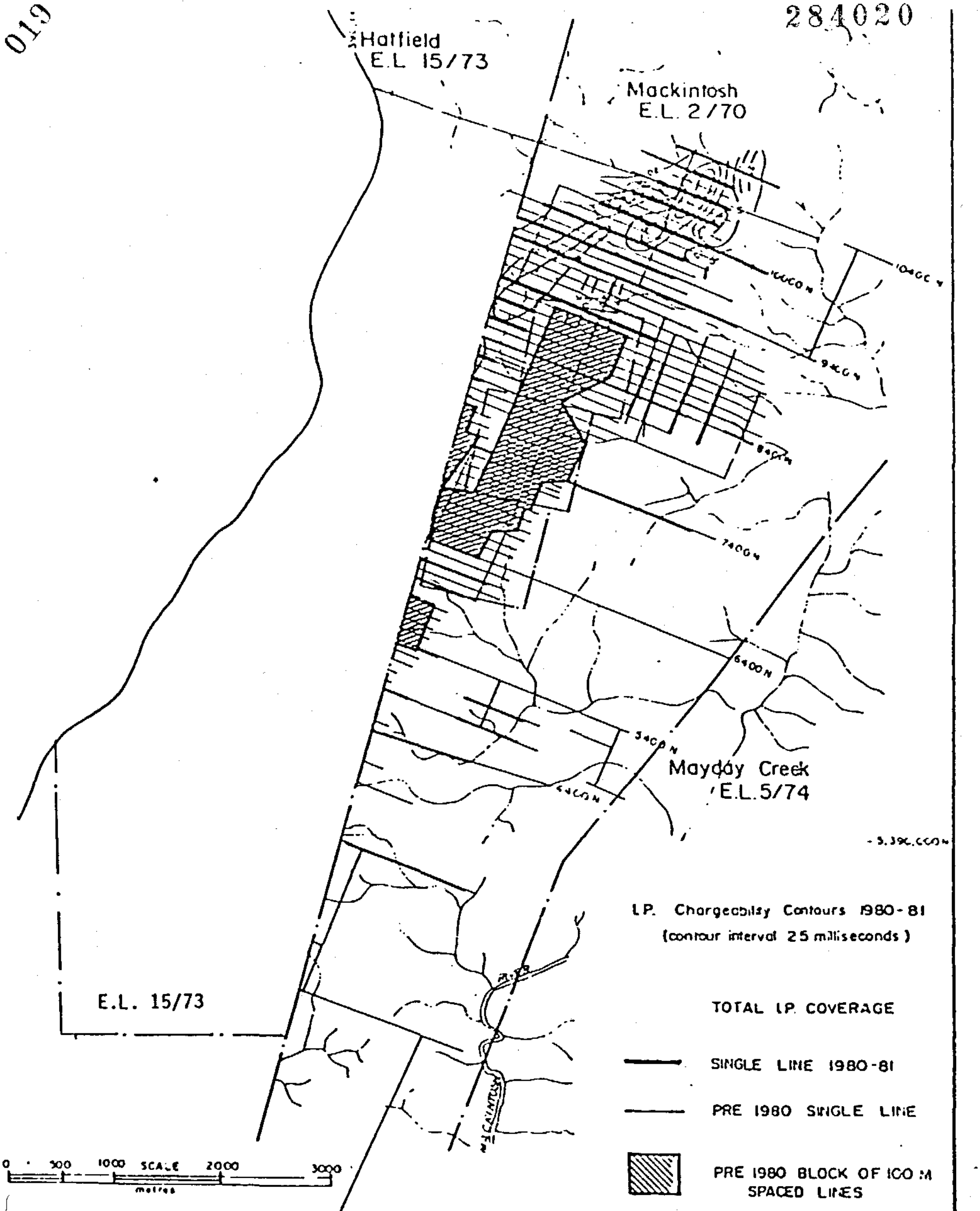
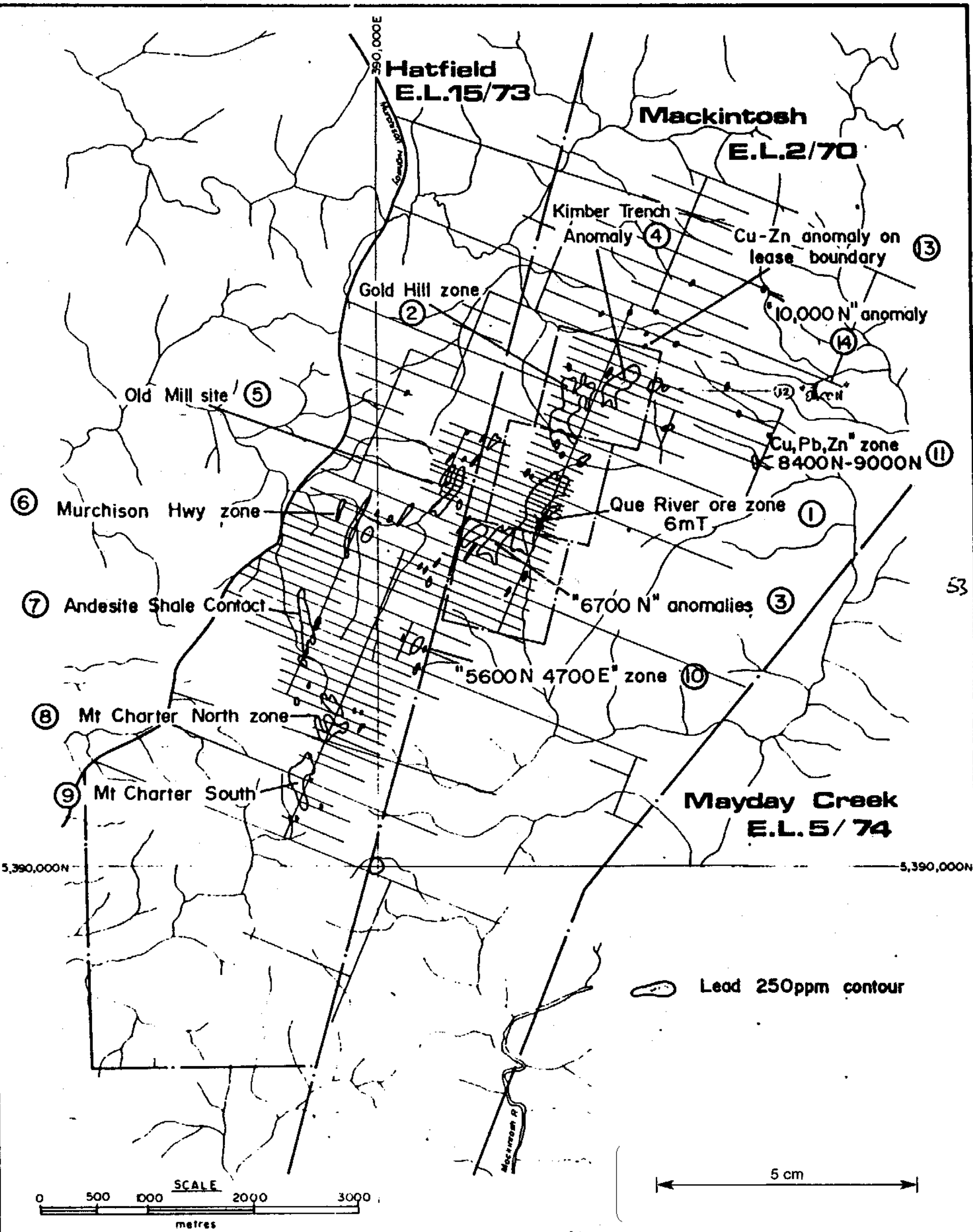


FIGURE 5

Aberfoyle Exploration Pty Ltd

Drawn JRS	NORTH WEST TASMANIA	Location code
Traced JLR	Mackintosh West / Hatfield Licence Areas	Date May 1981
Checked	I.P. COVERAGE 1980-81	Scale 1:50,000

391,500E 284021



53 93300 N

FIGURE 6

Abminco Exploration

Drawn CHY Traced RKY Checked Revised by Date	Mackintosh West / Hatfield Licence Areas Anomalous Geochemistry as at June 1977	Location code Date June 1977 Scale 1:50,000 Plate Nº QR 100

north. Early in 1984 further soil sampling was completed in the south east.

In 1981 the `North End´ Pb-Zn and the `North-East´ Pb anomaly were defined (see Figure 7). Reconnaisance IP with 100 metre spaced dipoles on lines 200 metres apart detected a broad chargeability anomaly from 9700N to 10600N. IP with 50 metre dipole spacing further refined this zone, with 10200N being picked as the line with the strongest response (see drilling below). A further IP anomaly response over the `North East´ Pb anomaly was evident, but confused by the presence of shales.

Drilling

Some targets were tested by drilling without intersecting massive base metal sulphides. Holes drilled:-

1. Mt Charter - 2 holes 1976, 2 holes 1978 - target : geochemistry, IP barytes outcrop.
2. Que River Shale/volcanics contact - 2 shallow holes 1976, 1977 at geochemical/IP target (H1, H2). Folding complications recognised at Murchison Highway zone, but not seen as favourable factor.
3. Old Mill Site - short hole abandoned at 111 metres geochemical/resistivity target.

All the above holes are on the Hatfield Licence. Other holes drilled away from the immediate Que River Mine environment are on the Mining Leases. Targets included a series of holes north of P/Q Lens, the northernmost being under Comstaff´s old `Kimber Trench`. These follow zones of intense alteration, disseminated mineralisation, high geochemistry and anomalous geophysics (IP).

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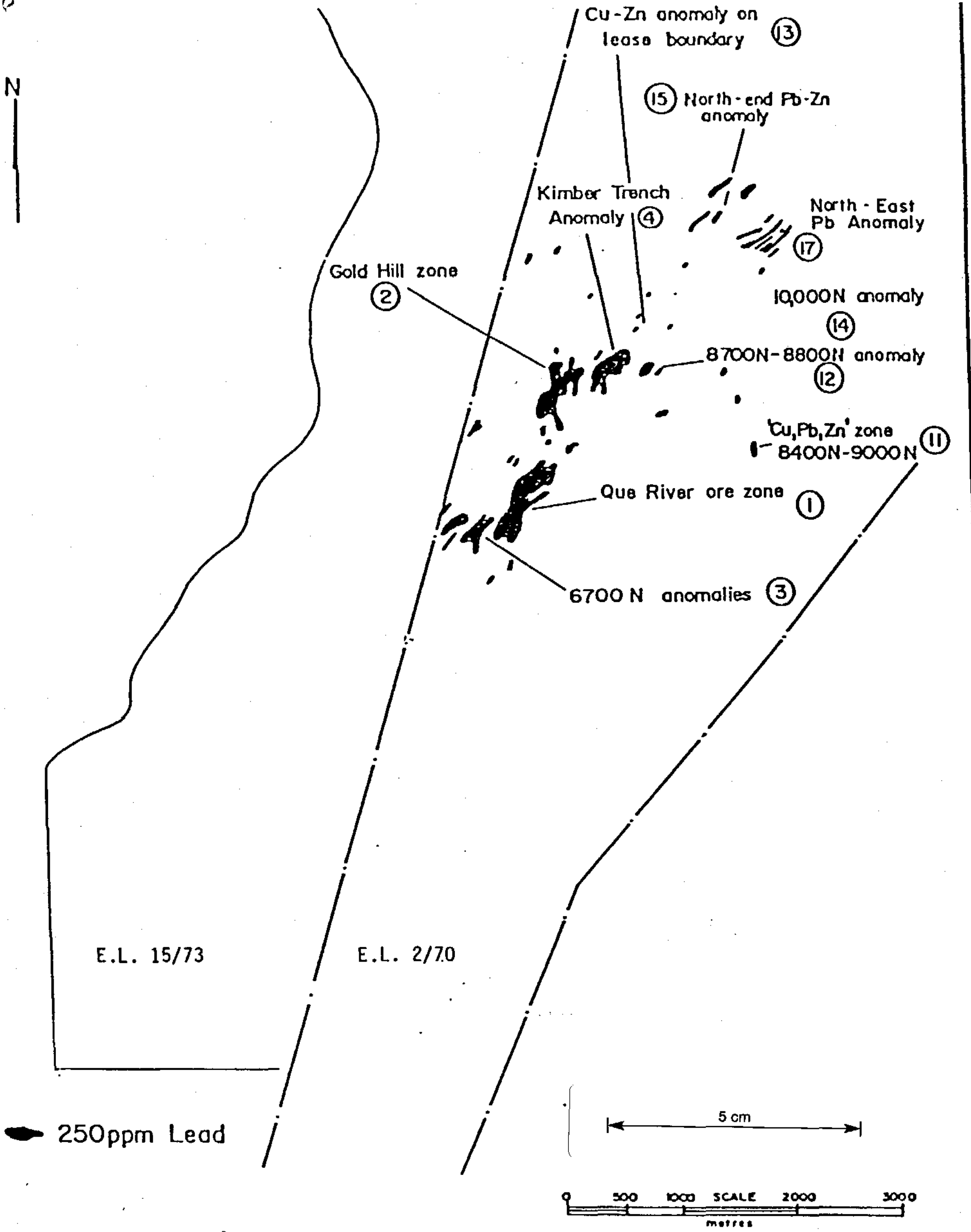

FIGURE 7

Aberfoyle Exploration Pty. Ltd.

Drawn: J R S.	NORTH WEST TASMANIA	Location code:
Traced: RJ.E.	MACKINTOSH / HATFIELD E.L. AREAS	Date: July, 1981
Checked:	Anomalous Geochemistry as at July 1981	Scale: 1:50,000

4. In 1982, an IP target was drilled at the so called Amoeba anomaly on EL 15/78 (Hatfield).
5. In 1982, the combined geochemical and IP targets at the 'North End' and 'North East' anomalies were drilled. HL1 (previously called MG1) was aimed at the maximum IP response which occurred under a less intense tail of the geochemical anomaly. Pyrite with a maximum of 425ppm Cu, 2800 ppm Zn and 920 ppm Pb was intersected in what has since been recognised as a zone of K-feldspar, chlorite, pyrite alteration in the hangingwall of the Hellyer deposit. HL2 (previously called MG2) was stopped in intensely fuchsite altered pillow lavas. This alteration is recognised in the immediate hangingwall (0-100 metres above BMS) at Hellyer.

Research

Under the auspices of the Federal Institute for Geosciences and Natural Resources (BGR) (van den Boom and Washausen) (Finlow-Bates and Stumpfl) various geochemical and mineralogic studies were undertaken. Ca and Na depletion and Si, Fe, Mg and K enrichment in altered rocks was reported. These areas correspond to areas of high lead soil geochemistry and the presence of visible sulphides already detected. A zoning pattern with carbonate rich rocks ringing geochemically anomalous sulphide rich areas was noted. Poor sample distribution hampered the study.

A programme with the CSIRO was instituted in 1981 principally at Que River Mine. More detailed studies confirmed Na and Ca depletion in the footwall at Que River. The occurrence of chlorite (Mg) and Mn in altered rocks is also noted. Various rare earth and immobile element studies fixed the primary geochemical affinities of the rocks at Que River as being andesitic and dacitic. Hydrothermal alteration has resulted in large negative Eu anomalies and a relative depletion of light rare earths. Strontium, oxygen and sulphur isotope studies were conducted and a major lead isotope study was initiated (see 7 Geochemistry). Initial lead isotope work on the 'North End' anomaly suggested that moderately high lead in soil was derived from leaching of the volcanic pile whereas spot highs may represent pockets of higher grade Que River type mineralisation. Homogeneous isotope ratios near HL2 (slate anomaly) were similar to those in P/Q lens at Que River.

5. GEOLOGY

5.1 Introduction

Prior to 1983 most of the prospective volcanic stratigraphy on the Mackintosh Licence had been geologically mapped. Exposure was limited to creeks, a few access tracks and occassional rock fragments in soils and on tree roots. Construction of transmission lines (HEC) continued during 1983 with a second line being cleared through the centre of the volcanic belt on the licence. This enabled a re-evaluation of some of the old mapping, especially that based on very weathered exposure found on cut lines through the rain forest.

In particular, power line construction has exposed the area around the nose of an anticline recognised from the early mapping. Given the interest in the relationship between folds and mineralisation (see structure below) attention was focussed on this most obvious fold during 1983. The detection and delineation of the UTEM conductor here reinforced this approach. Following the intersection of base metal sulphides in HL3 staff resources were diverted to delineation of the Hellyer deposit. With the newly acquired knowledge of Hellyer stratigraphy further mapping is being undertaken and the evaluation work begun in early 1983 continued.

Major exploration away from Hellyer late in 1983 involved the evaluation and drilling of a UTEM response (D1) partly on the Que River Mining Leases. This was done by Que River Mine staff in conjunction with exploration. Section 9 describes this programme. Some further UTEM responses were geologically examined, however, most of this attention was focussed on the adjacent Hatfield Licence.

5.2 Structure

5.2.1 Folding and Base Metal Sulphides

It has been suggested that P/Q lens at the Que River Mine is a synclinal keel structure (Young,1977). This was disputed by Cox (1982) who used vergence relationships between the dominant regional cleavage, (taken to be axial planar to 'regional first generation folds'), and sulphide banding to conclude that PQ lens was west facing throughout its thickness.

Young suggested that synclines may be localised by a primary structural weakness that was also used by the ore solutions. This idea was developed during 1983. More incompetant, plastic altered rocks around base metal sulphides should provide zones around which folding is fixed. There is no need to confine this process to synclines.

The problem of whether or not P/Q lens itself is synclinally folded is not considered to be regionally important. It is possible to have a syncline folded about a base metal core without folding the base metal itself, especially given the high S.G. and competance differences between the massive sulphide rock and the adjacent highly sericitized and chloritized rocks. Folding at Que River may be displaced from P/Q lens itself if Cox's conclusion from the vergence data is accepted. Large variations in sulphide banding disposition as evidenced at Hellyer, coupled with likely distortions in the cleavage close to the heavy more competent base metal sulphides must in any event cast doubt on Cox's interpretation.

5.2.2 Work Done

5.2.2.1 At Hellyer

New exposure confirmed the presence of a prominent anticline. (See Figure 8) More detailed mapping refined the structure - see plate HEL 4X in pocket at rear. A graben-like feature detected in the Hellyer drilling was reflected in northerly dips just west of the immediate nose area of the main fold. The folding appears to have occured around porphyritic dacite ridges pervasively intruded and altered by the stringer zone. A prominent fault was also intersected in the drilling. Structural contours on the base of the sulphide rock (BMS) or the interpreted main ore position suggest a greater vertical displacement in the south relative to the north. Faulting has been mapped at surface, however, none of these displace the shale-volcanics contact. These factors suggest that the fault is pre-shale in age. The apparent fading out of the fault in the north and complex mineralization vertically along the fault, (not all remobilized stringer) can be explained if the fault and the mineralizing event are penecontemporaneous.

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FIGURE 8

It may well be part of a primary strucure that localized the mineralizing system and associated base metal sulphide rock and finally the anticline.

The main anticline is localized around the base metal sulphides, the feeder system and the associated porphyritic dacite ridge. A secondary anticline, traced by the contact between the Que Rive Shale and the Upper Epiclastic Sequence, may reflect a second ridge on to the west of the graben.

The possibility is recognised that apparent folding at surface may at least partly be a reflection of primary palaeogeography.

5.2.2.2 Elsewhere on the Licence

The clearest indication of structure in the volcanics must be obtained from the Que River Shale-lava contacts. By April, 1984 only the anticline at Hellyer had been examined, as it is the clearest and most obvious of the folds. Work is at present underway to define others.

There are at least two prominent cleavages in all the rocks on the licence. These are roughly north-south and are thought to be axial planar to the prominent N-S folding. As a start to defining folding some of these have been recorded. These are presented on

Figure 8. The intersection of these cleavages often produces rod-like structures and some of these are depicted on Figure 8.

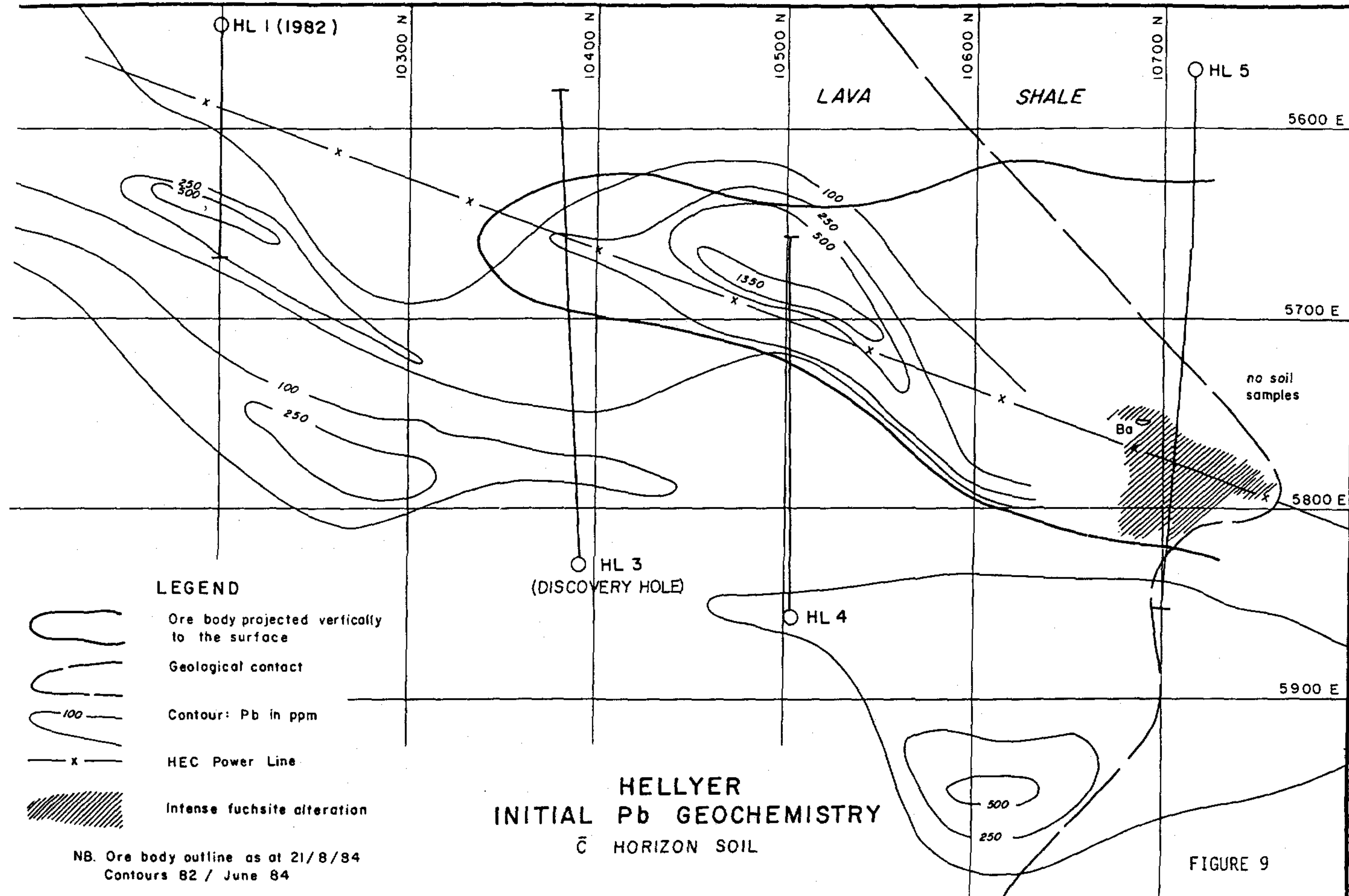
Problems with identifying stratigraphy had not been overcome when Figure 8 was produced. With the new knowledge at Hellyer it may be possible to map stratigraphic units and possibly even some markers (e.g. the fine tuff in the Hangingwall Volcaniclastics). More useful structural work within the volcancis themselves may then be possible.

5.3 Surface Alteration

5.3.1 At Hellyer

A prominent concentration of bright green fuschite spots, (a few millimeters diameter), and pervasive green alteration (fine-grained chlorite and leucoxene) is concentrated in the nose of the anticline within the Pillow Lava Sequence (see Figure 9). This alteration is particularly intense in the inter-pillow areas, and is associated with pyrite pods, and at one site, with white barytes. Gossan at surface close to this alteration is thought to be after these pyrite pods between the pillows. This is distinct from the gossan on 10300N which assayed 43 ppm Ag and other prominent manganifeous gossans.

Black manganese and white chalcedonic silica occur close to the centres of high C horizon soil Pb geochemistry. Bright red weathering of volcanics


HL 1 (1982)
10300 N
10400 N
10500 N
10600 N
10700 N
HL 5
LAVA
SHALE
5600 E
5700 E
5800 E
5900 E
100
250
300
500
1350
no soil samples
Ba
HL 3
(DISCOVERY HOLE)
HL 4
LEGEND
Ore body projected vertically to the surface
Geological contact
Contour: Pb in ppm
HEC Power Line
Intense fuchsite alteration
NB. Ore body outline as at 21/8/84
Contours 82 / June 84
HELLYER
INITIAL Pb GEOCHEMISTRY
C̄ HORIZON SOIL
FIGURE 9

around high soil geochemistry is also noted. The significance of these features is yet to be resolved.

5.3.2 Elsewhere on the Licence

Highly altered pyritic areas are identified in many places on the licence (see Mac 71a). Most of these are associated with areas which can be interpreted as being in the Stringer Zone. The D zone and the Que River Mine area itself may fall into this category. Some green fuschite containing alteration and veins of intense chloritisation may be associated with this type of alteration.

5.4 Lithology

5.4.1 At Hellyer (Surface)

Pillow lavas were initially recognised at Hellyer in the highly fuchsite altered area, but were later found to be more extensive. Characteristic shapes are apparent with interpillow areas containing chert, pyrite and a concentration of fuchsite alteration. Other rock units at Hellyer are described in Section 8 - Hellyer Prospect Drilling Detail. Mapping on the Hellyer area is presented on plates HEL 4X and HEL 4W in pocket at rear.

5.4.2 Elsewhere on the Licence

New mapping is in progress over areas of recently created exposure using the stratigraphy developed for

Hellyer. Many of the strongly weathered pale coloured rock units originally identified as dacite are now recognised as highly altered andesite. A boldly outcropping unit of andesite lava breccia with prominent vesicular dacite blocks is mapped as a belt extending west of the Que River Mine (Plate Mac 71a). Some new mapping is included on QR 81H and QR81G in pocket at rear.

6. GEOPHYSICS (modified from report by E. T. Eadie and J. Silic)

6.1 Introduction

Testing at Que River after its discovery selected I.P. as the best geophysical method to use as it responded to the supposedly less conductive sphalerite-rich PQ lens. Other methods (especially the early EM) only respond to the outcropping and more conductive copper-rich S lens. Extensive IP work, principally time domain IP, culminated with the completion in 1981 of a major IP survey. It was concluded at this stage that any conductors in the top 50 meters of the prospective volcanics would have been detected.

In 1979, UTEM, a fixed transmitter broad band EM system, was tested at Que River. At early times of 0.1 milliseconds the dominant response was due to the copper-rich S lens. At moderate times and later a relatively greater response was due to the PQ lens.

In 1983 a major UTEM survey was undertaken. The position of the loops and the orientation of the reading lines is shown in Figures 10a and b. The anomalies detected were rated and are listed as Appendix 1 in Section 6.5. A report on the Mackintosh Hatfield UTEM Survey and a Review of the IP.

The most prominent anomaly detected in the 1983 UTEM survey was the one over Hellyer. Following the discovery intersection, further UTEM, downhole SIROTEM and ground magnetics were undertaken in the Hellyer area.

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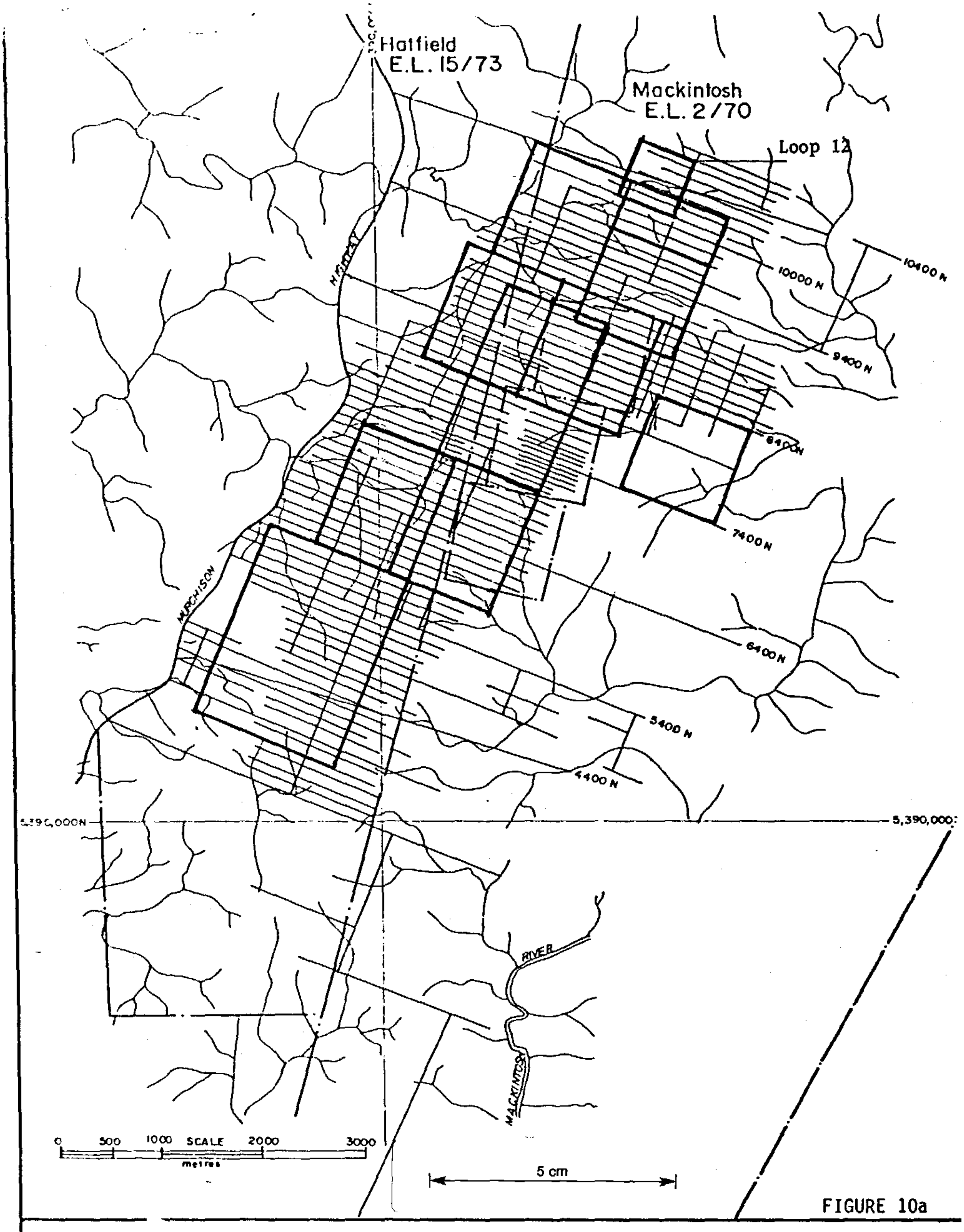

FIGURE 10a

Aberfoyle Exploration Pty Ltd

Drawn JRS	NORTH WEST TASMANIA	Location code:
Traced JLR	Mackintosh West / Hatfield Licence Areas	Date: May, 1981
Checked	ORIENTATION OF	Scale 1:50,000

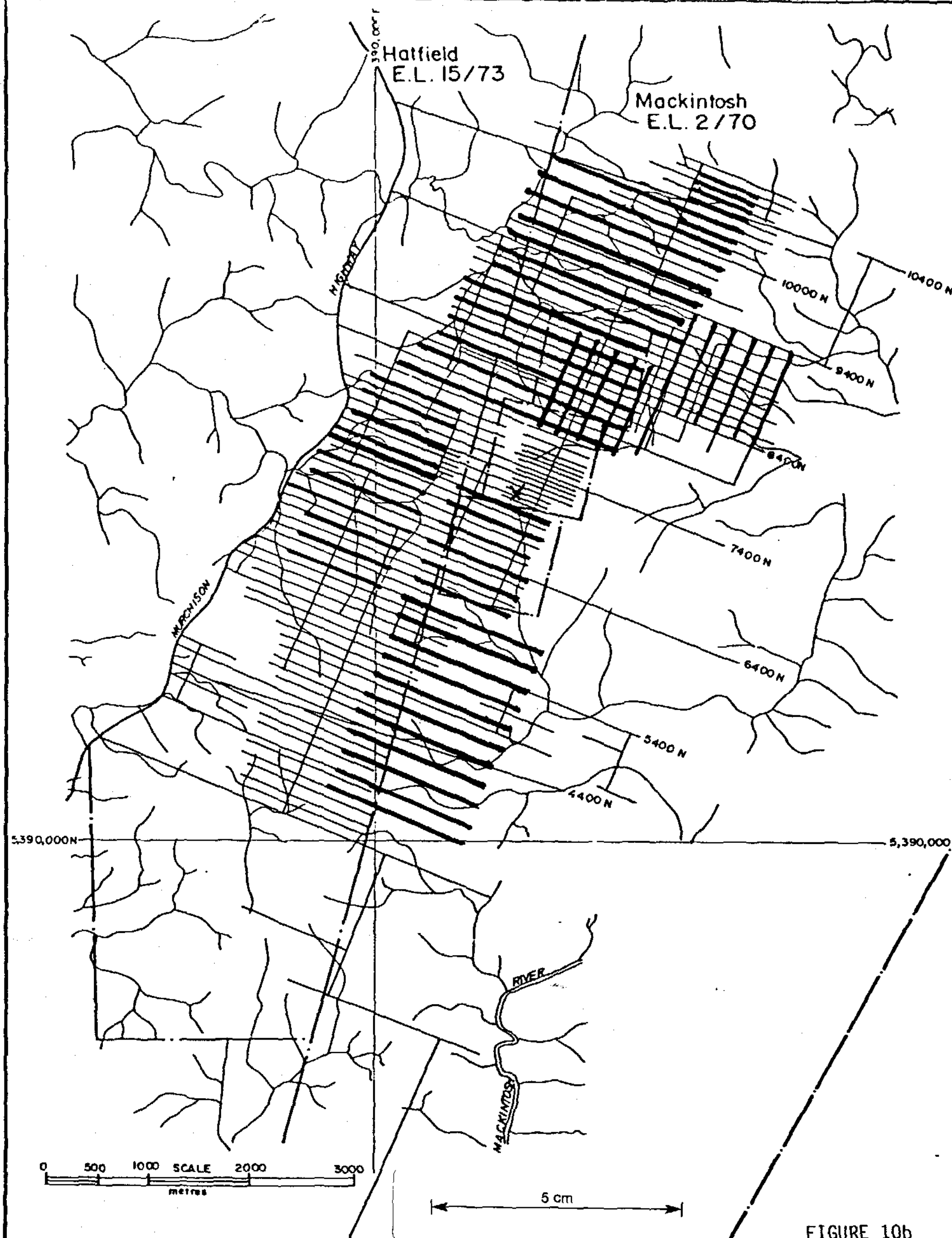

FIGURE 10b

Aberfoyle Exploration Pty Ltd

Drawn: J.R.S	NORTH WEST TASMANIA	Location code:
Traced: J.L.R.	Mackintosh West / Hatfield Licence Areas	Date: May, 1981
Checked:	Lines Read by UTEM - 1983	Scale: 1:50,000
Revised by: Date		Plate No

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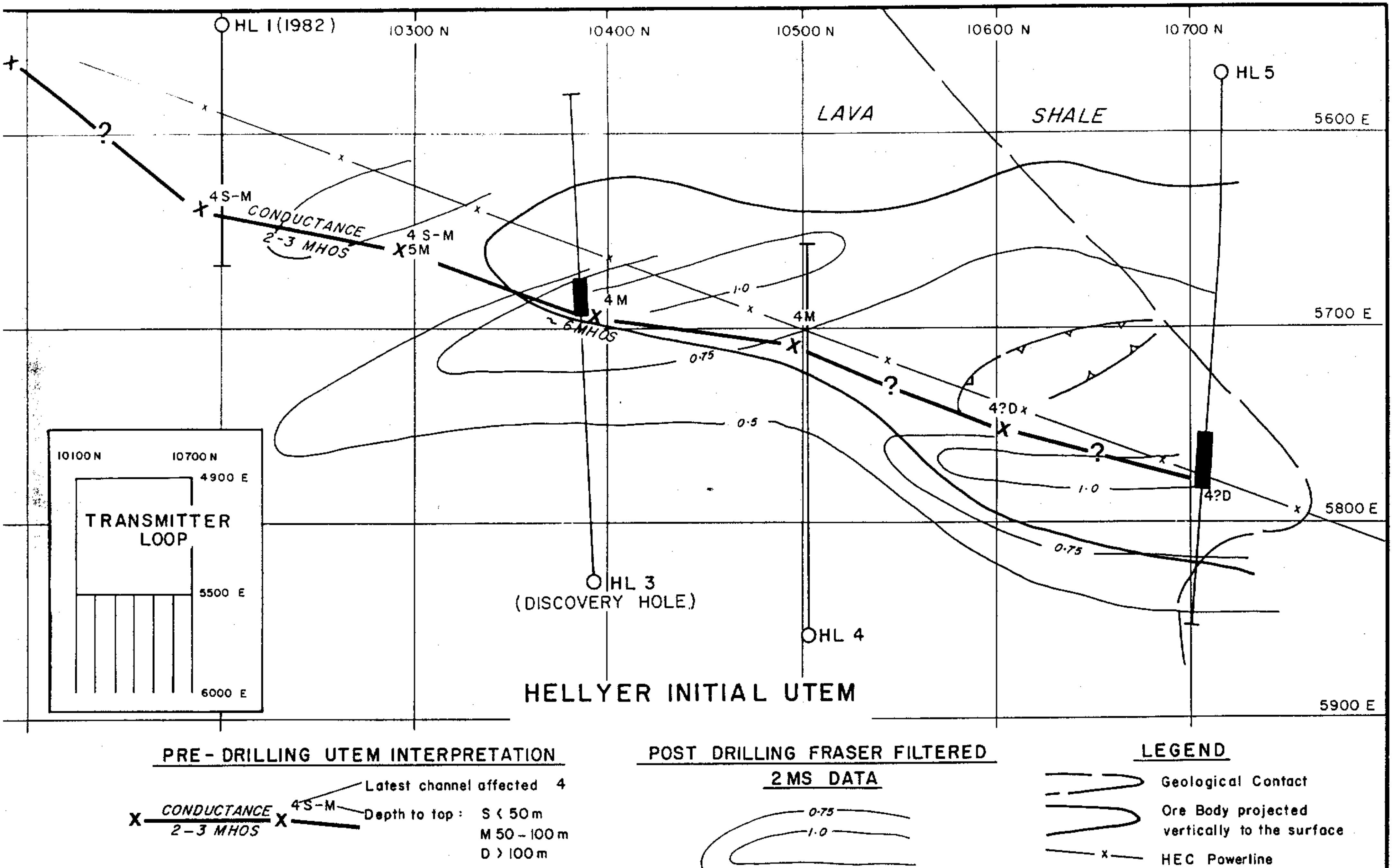

FIGURE 11

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6.2 At Hellyer

During 1983, UTEM survey Loop 10, the northernmost loop was extended to include the IP anomaly drilled on 10200N by MG1. A strong response was recognised. Following this a further loop was placed to the north (loop 12) and a conductor was recognised on all the lines from 10400N to 10700N. The UTEM profiles for these lines are presented in Section 6.6. Figure 11 (Facing) depicts the originally interpreted conductor axis with a conductivity high on 10400N. This formed the target of the discovery drill hole. The conductor axis picked from the 2 ms data can be determined accurately, (Figure 12). Selected Fraser filtered and point normalized data for line 10400N is presented in Figure 13. Filtering and use of a logarithmic scale enhances the more important late time channels. Host rock currents affect early times and the ore deposit is obscured. Late time channels are relatively unaffected.

The early data was interpreted assuming a near vertical conductor. The 1ms data shows a positive to negative cross over which is often indicative of a near vertical body (see Figure 14). In the light of the sub-horizontal disposition to the ore body this response can be explained by host rock currents flowing into the top of the ore body. The 2 ms data shows a positive-negative-positive response typical of induction in a flat lying conductor. It is only on 10400N that this effect is observed, however, and the axis position essentially corresponds to the thickened eastern edge of the conductor.

FIG 12 FRASER FILTER OF 2MS UTEM RESPONSE, GEOCHEM & INITIAL DRILLING

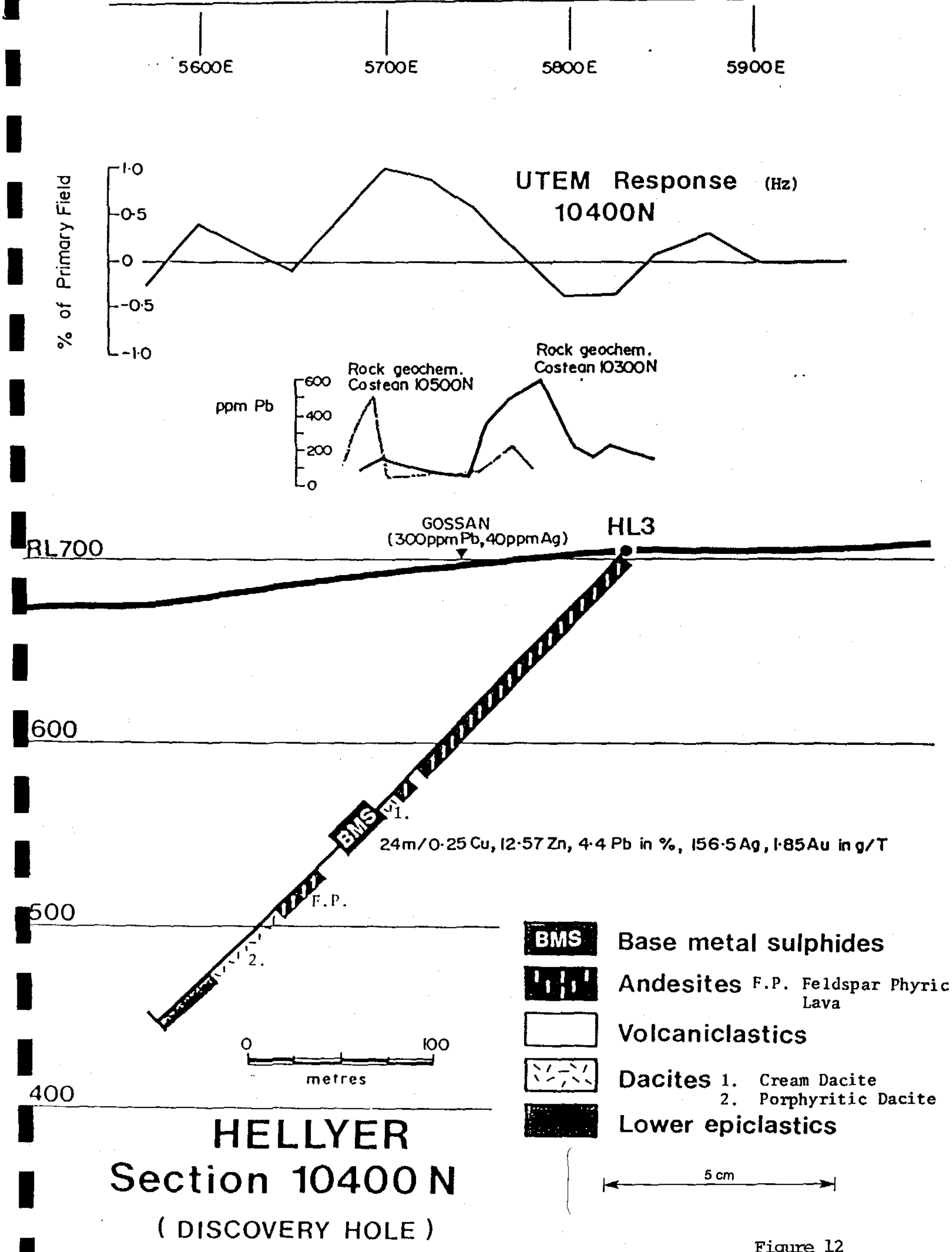

Figure 12

HELLYER

FILTERED UTEM DATA

10400 N

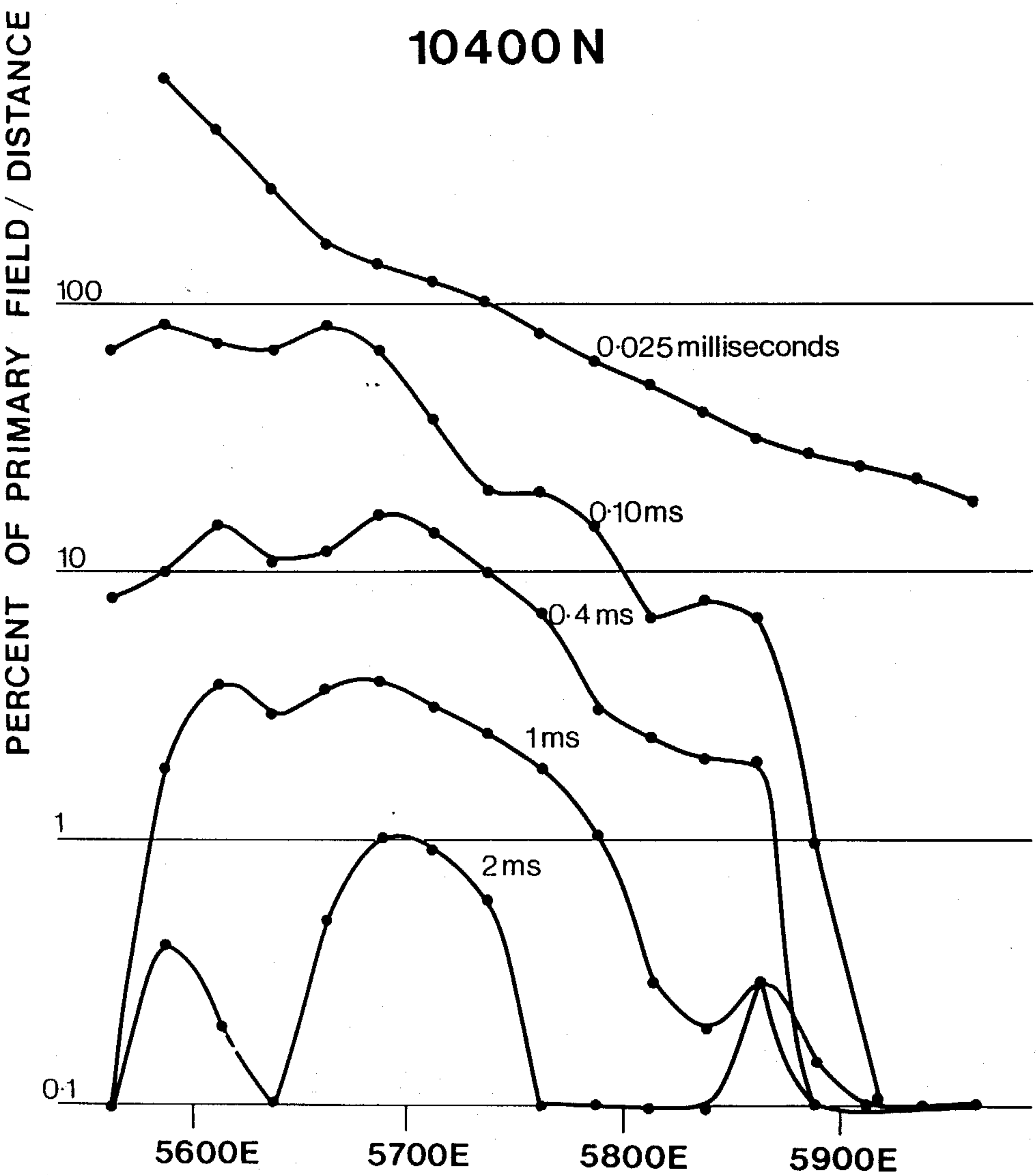

FIGURE 13

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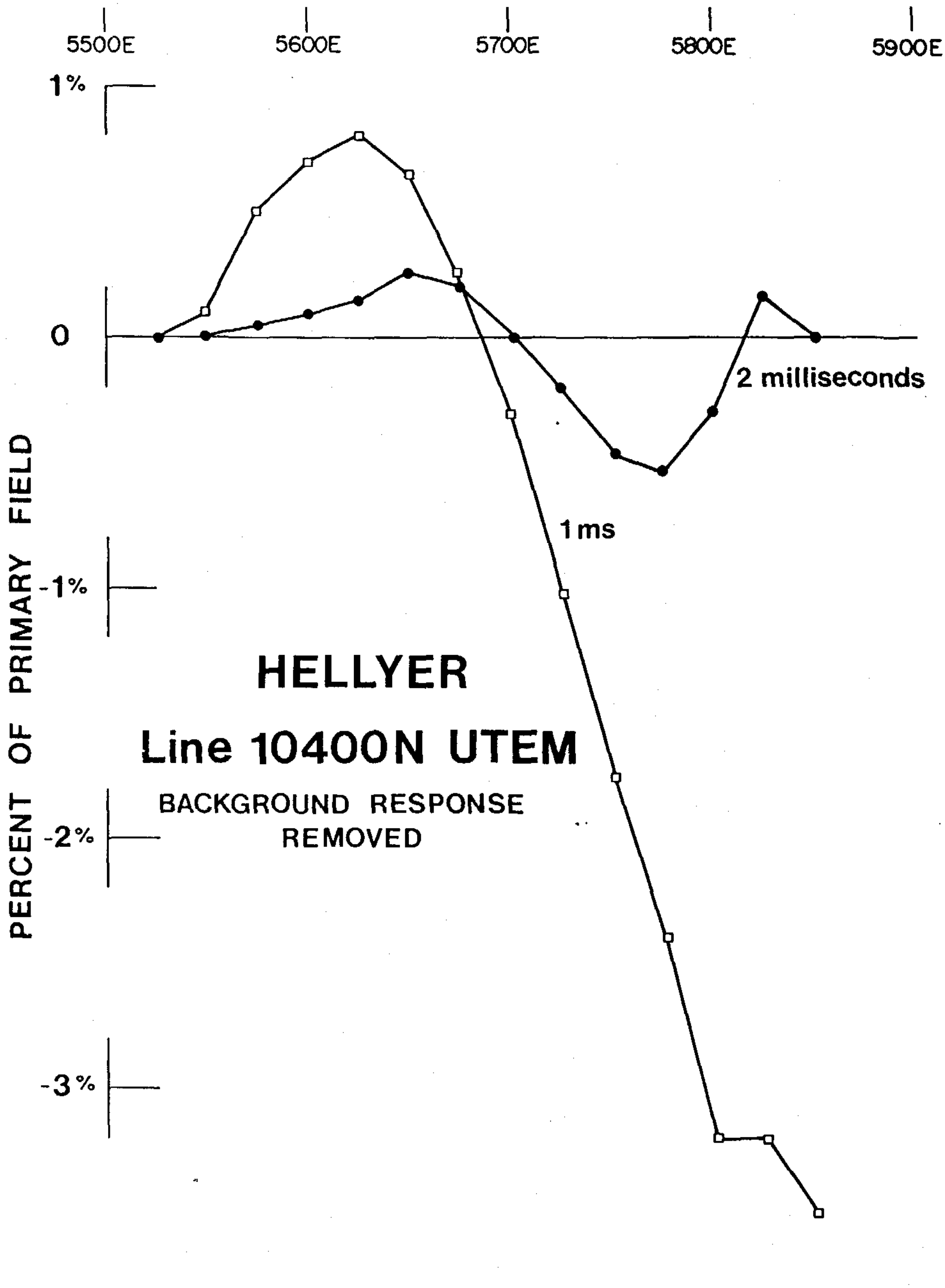


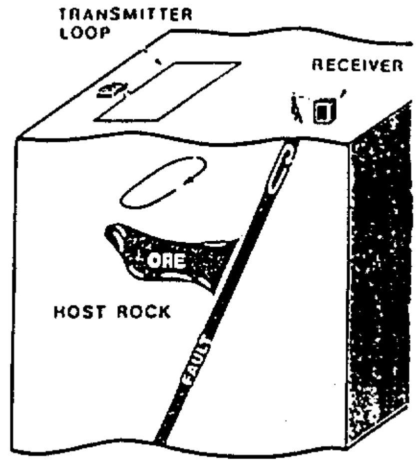
FIGURE 14

Depth to top estimates at Hellyer are difficult as at Hellyer amplitudes of the channel profiles cannot be used since these are dominated by current channelling. Using the shape of the profiles, depth estimates were given which turn out to be slightly shallow. However, the problem was recognised in the initial drilling, and MG3 was sited to intersect the deeper limit of the depth to top (again vertical target assumed).

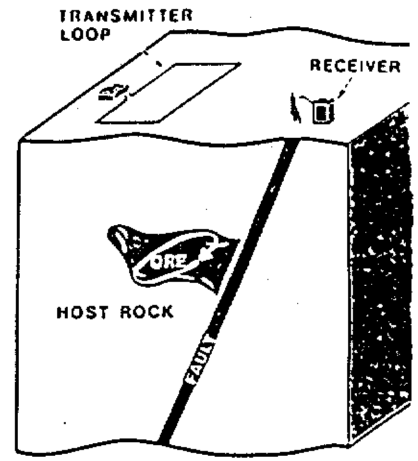
Knowing the shape of the ore body from the drilling, and using computer modelling, a conductance of >50 siemens is estimated for the Hellyer deposit. The apparant contradiction of this high conductance, and the relatively small response of the UTEM can be explained by computer modelling. A long pencil-like shape with depth to top less than or close to the width gives a small amplitude response, even with a relatively large conductance.

Further UTEM, EM37 and downhole SIROTEM were conducted at Hellyer. The wiring and subsequent commissioning of the HEC power line has severely hampered subsequent work.

The UTEM was laid with the leading edge parallel to the power line. Although not yet electrified, the wires were a great source of noise. Vertical component results for early times are shown in Figure 15 and for late times in Figure 16. The outcropping shale unit is highlighted at early times while at late times the ore deposit is outlined.



EARLY TIME (0-0.1 MILLISECONDS)
CURRENT FLOW IN HOST ROCK AND
SHALLOW CONDUCTORS



LATE TIME (1.5-5 MILLISECONDS)
CURRENT FLOW IN BEST CONDUCTORS
ONLY

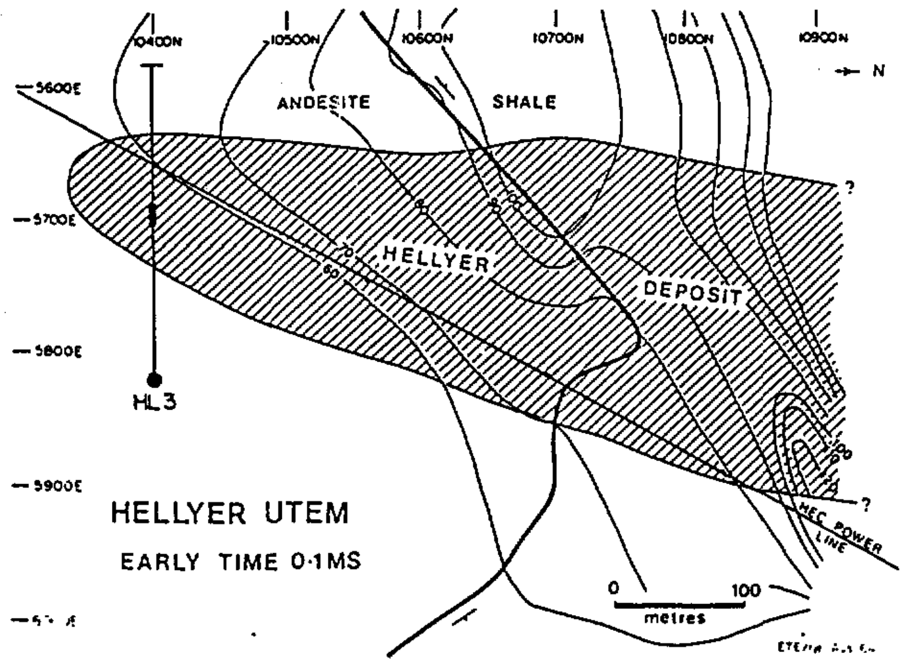


FIGURE 15: EARLY TIME CHANNEL (0.1 MS) FROM
POST-DRILLING UTEM (Hz)

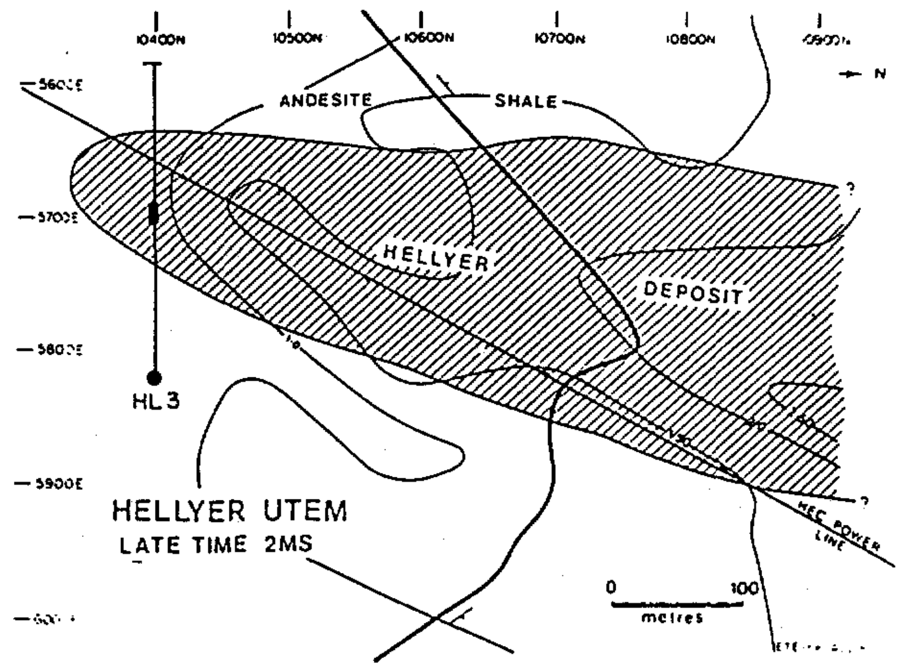


FIGURE 16: LATE TIME CHANNEL (2 MS) FROM
POST-DRILLING UTEM (Hz)

Neither the EM37 nor the Newmont EP system (tested by Newmont) could get meaningful surface data because of interference from the power line.

Downhole SIROTEM results for MG (HL) 3 are depicted on Figure 17.

Other geophysics conducted at Hellyer included a ground magnetic survey which produced essentially featureless results.

6.3 Elsewhere on the Licence

Other anomalies on the licence are listed, evaluated and described in Section 6:5 and are tabulated in Appendix 1 in that section.

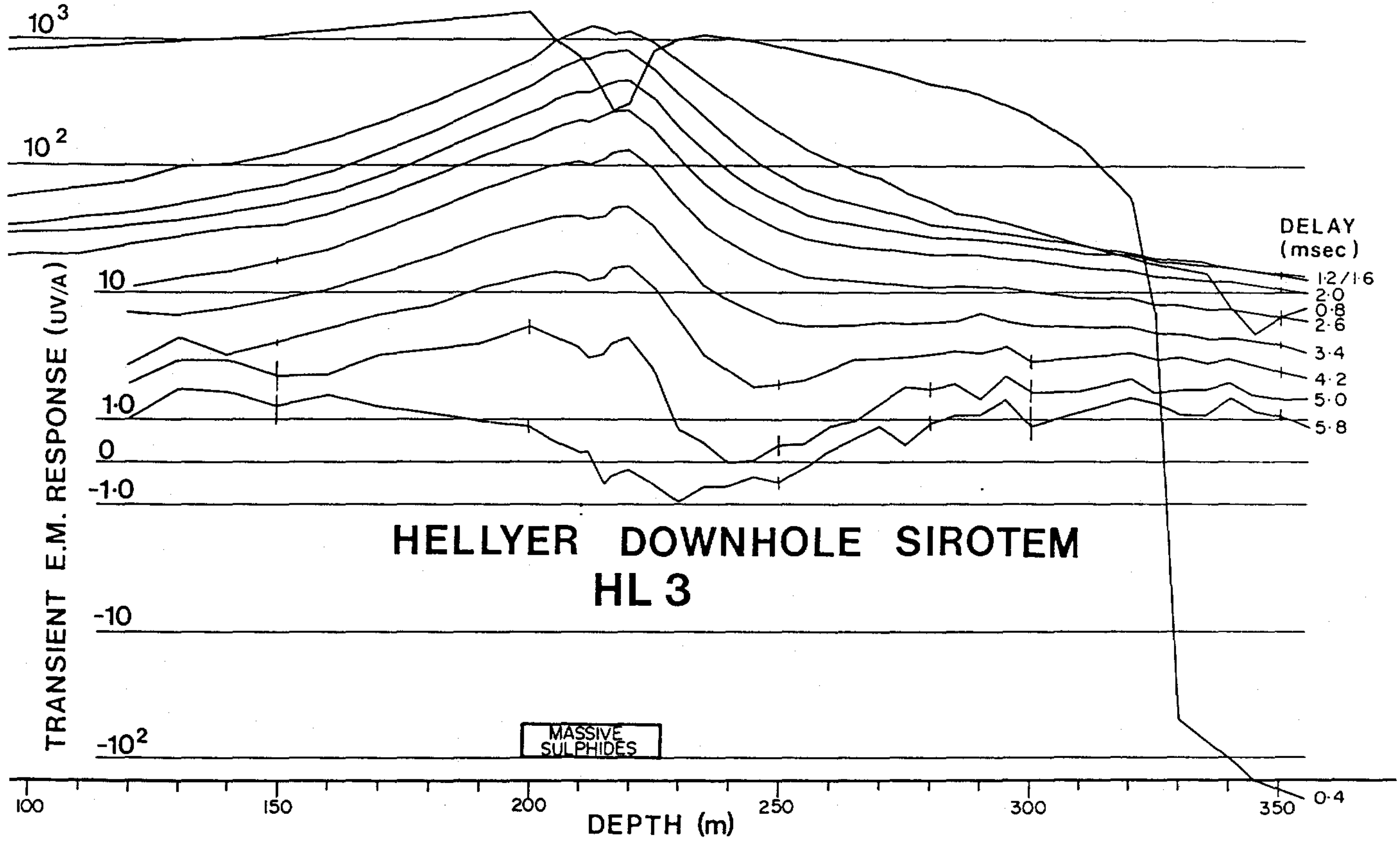


FIGURE 17

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6.5 REPORT ON THE MACKINTOSH HATFIELD UTEM SURVEY AND A REVIEW I.P. - E.T. EADIE

APPENDIX 1 - CLASSIFICATION OF ANOMALIES

APPENDIX 2 - PRELIMINARY INTERPRETATION OF THE NORTHERN QUE RIVER UTEM ANOMALY

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REPORT ON THE MACKINTOSH HATFIELD UTEM SURVEY AND A REVIEW OF THE I.P.

E T EADIE

REPORT ON THE MACKINTOSH HATFIELD UTEM SURVEY AND A REVIEW OF THE I.P.

INTRODUCTION

The 1983 and the 1979 UTEM data has now been interpreted and all of the conductors axes have been marked on the 1:10,000 map and the appropriate 1:2,500 maps. Along with the position of the axes, an estimation of the depth to the top of the body is included on the map, and the number of the latest channel affected by the conductor.

Each conductor has been labelled on the maps. The conductors are then discussed with reference to their EM and IP characteristics in Appendix I where the main interpretational details are given. A classification system based on the recommended method of follow up summarizes the Appendix.

Several of the zones require more discussion than was included in Appendix I. More detailed interpretation and recommendations for these zones follow below.

CLASSIFICATION I

Zone A1

The follow up of this zone is past the stage where geophysics will help, particularly because there is now a power line running over it. The interpretation report to help with the original drilling is included as Appendix II.

Zone A2

Zone A2 was tested a few years ago by DDH MG1 which encountered mostly pyrite. A more recent, deeper test of the same line also failed to encounter significant base metal sulphides. Any more follow up of this zone to the south should be by drilling because of the location of the new HEC power lines, which limits any further electrical geophysical work.

Zone A4

A4 is a difficult anomaly to interpret because the IP and EM do not agree. Certainly, the northern part of the zone has been drilled during the deep test of Zone A2 (intense alteration and some sulphides were discovered). However the southern part could be an extention of this weak anomaly on L10200N as suggested by the EM, or it could be a southern extention of Zone A6 (shales?) as suggested by the IP. This ambiguity should be able to be resolved by geological mapping and a review of the geochemistry.

Zone I3

The best part of both the IP and the EM of this zone has been drilled and explained by earlier holes that encountered mostly pyrite with some low values of Zn and Pb. A deeper rich zone that is shielded from the EM by the shallow zone is a possibility. However there is no geophysical indication of this.

CLASSIFICATION II

Zone A5

This zone should now actually be part of Classification I because a drill hole tested it in conjunction with a deeper test of the section on Line 10400N. Strong alteration with some pyrite explain the anomaly.

Zone D1

This well-defined but weak (approx 1 mho) conductor should be drilled because of its interesting position geologically and geochemically. More EM to detail the zone would have been convenient but unfortunately a new power line makes this impossible. Therefore drilling is the only viable option. Two drill hole sites are recommended, because the results from any one hole can be very misleading (eg. MG1 or MG4). The dip of the body can not be determined because no UTEM detailing has been done, and the quality of the data on some lines is adversely affected by the proximity to older powerlines. It will be assumed therefore that the body is vertical or close to it, and that the direction from which the holes are drilled, is not important.

First drill hole - to intersect Line 9100N, 5375E at a depth of 75 metres or more.

Second drill hole - to intersect Line 8900N, 5310E at a depth of about 100 metres or more. The accuracy of this axis (25 m) is worse than further north because of the location of a noise-generating power line between the loop and the stations and because the station interval is 50 metres instead of 25 metres as on Loop 12.

CLASSIFICATION III

Zone E

Closer spaced, better quality EM data is necessary on this anomaly before it can be interpreted properly. The follow up grid has already been cut in preparation for further work, probably with the EM 37 unit.

Zone G2

The major part of G2 apparently coincides with a known fault which could explain the anomaly. On close analysis of the geology of the southern, better part of the zone, it was obvious that this area corresponds with the shale contact. Therefore this zone should be re-classified as type IV. No further geophysics is necessary, but a complete understanding of the geology is required.

Zone G3

This zone is possibly quite highly conductive but the data can not be trusted because it is so noisy. A small three line grid at 100 metre spacing covered with horizontal loop EM (Max Min) will resolve this problem. This grid has already been cut in preparation for the work.

Zone H2

The poor quality, widely spaced data from the first UTEM survey is not good enough to adequately define this weak, but interesting zone. Previous drilling in the area needs to be correlated with the existing EM results before further EM work (UTEM or EM 37) is carried out.

Zone H3

This is another zone that can not be properly interpreted because of poor data quality. The first step in the follow up procedure should be to investigate the geology of the immediate area. If this is at all interesting, the zone should be covered with either UTEM or EM 37 at a 100 metre line spacing. The loop should be placed approximately 200 metres from the zone.

Zone I1

As with the other zones, closer spaced EM data is necessary on this complicated anomaly before it can be interpreted properly. The follow up grid has already been cut in preparation for a detailed EM 37 survey.

Zone J1

The 1979 UTEM loop was not in a very good position to get interpretable data from this zone. In spite of the fact that the anomaly is probably caused by shale, the complexity of the response suggests that it merits more definition at closer line spacing with either UTEM or the EM 37.

CLASSIFICATION IV

These zones have all been fairly well defined by the UTEM survey, and are mostly high amplitude, quickly decaying anomalies, this suggests large, shallow, poorly conductive bodies. However they are all suspected to be caused by the contact of shale with the volcanics except for D2. Some of them may warrant drilling after a close geological inspection is completed. In particular A6 could be somehow related to the Hellyer deposit.

CLASSIFICATION V

The definition of the classification in Appendix I is an adequate explanation in all cases.

CONCLUSIONS

The UTEM response of the Que River ore deposit was sharper and stronger than anything seen during the 1983 survey. The Hellyer response was almost as strong as that at Que River but the greater depth to the Hellyer deposit and the greater interference from the surrounding rock units (shale and much pyrite) made it much more difficult to interpret. None of the other responses on the grid appear to be as strong as Que River or Hellyer, although in some cases (E, G3, H3, J2) it is difficult to say this with confidence because of the poor quality of the UTEM results.

Based on the characteristics of the UTEM data alone (strength and size of anomaly) the following priority list would be given to the zones:-

1) Que River (earlier survey)
2) A1 (Hellyer)
3) A6 (shale?)
4) C1 (shale?)
5) I1
6) D1
7) E
8) J2 (shale)

After this come all of the other zones from Classifications III and IV.

The test work on Zones E and I1 that will be done in the near future with the EM 37 unit (another large loop time domain system, slightly different from UTEM) will show whether this unit is better, similar or worse than the UTEM system for this particular environment. It will definitely be more sensitive to poor conductors than UTEM, but it might then cause the same problem as IP in not being able to differentiate between barren pyrite and base metal sulphides.

Once the relative effectiveness of UTEM and EM 37 has been determined, the rest of the prospective area around Que River should be covered by the more appropriate system.

Another aspect of the follow up of all of the anomalies of interest that has not yet been mentioned is magnetics. In this environment, magnetics should be considred to be an integral part of a geological inspection of an area because of its usefulness as a mapping tool. Where possible, zones of interest should be covered with magnetics at a 100 metre (or 50m) line spacing and a station interval of 10 metres. In time the whole of the Que River area should be covered with magnetics.

CLASSIFICATION OF THE VARIOUS ANOMALIES

There are 34 different anomalies described in the following pages. These can be divided into the five following groups.

I zones that have been drilled, are being drilled or already have drill hole locations planned for them - A1, A2, A4 and I3.

II zones that should be drilled straight off - A5 and D1.

III zones that need more geophysics, a detailed geological inspection, a thorough examination of the soil geochemistry characteristics and drilling, if appropriate - E, G2, G3, H2, H3, I1 and J1.

IV zones that do not need any more geophysics, but that need a detailed geological inspection and a review of the soil geochemistry in the area; if necessary drilling should be considered if geological information can not be obtained in any other way - A6, B, C1, D2, F and J2.

V zones of the lowest priority that should have a geological inspection and a review of the geochemistry in the area; a line of soil geochem over each zone should be considered if there is no old data - A3, C2, C3, C4, D3, D4, D5, G1, H1, H4, H5, H6, H7, I2 and I4.

[illegible]	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
12	H	10300N, 5650E to 10700N, 5825E	Varies from moderate response at south end to questionable in north; 2-6 MHOS	Good chargeability anomaly at south end; none to north (could be hidden by effect of shales)	See earlier memo which interpreted this zone for drilling; shale contac and plunge of body make interpretat difficult at the north end; body is open to north; could be continuous into zone A2 to south; follow up by drilling (in progress)
12	H	9700N, 5325E to 10200N, 5650E	Weak, but well-defined responses; correlation from line to line is questionable to south.	Good I.P. anomaly to south but becomes small and shallow in the central part and good again to the north.	Drill hole MG1 intersected pyrite o line 10200N; Could be a continuation of zone A1; Follow up by drilling because posit of new power line makes more EM and impossible and geology and geochem known to be interesting.
10	H	9900N, 5225E	Very weak, poorly defined, single line anomaly	Very weak shallow anomaly with no depth extent.	Follow up by geological inspection and review of geochem.
, 12	H	9700N, 5875E to 10200N, 5750E	Very weak, especially to south, with questionable line to line correlation.	Strong I.P. to south but dies to nothing in north.	I.P. suggests that E.M. trend may n be correct; Suggests that southern part of anomaly trends more easterly and li with zone A6 (shales?); Drilling A2 on L10200N will intersect A4; Follc up south end by geological inspecti and review of geochem.

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LOOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
12	H	10400N, 5825E	Questionable one line anomaly; Made more difficult to interpret by distortion by surrounding anomalies	No I.P. response	This shallow (<50m) anomaly should be drilled during a deep test of zc A1 on L10400E.
12	G, H	10300N, 6000E to 10700N, 5975E	Complex response to south but better and well-defined to north; caused by a large moderately conductive body.	Huge I.P. response that suggests this zone continues to the south, possibly as far as line 9700N (Zone A4) or further.	This highly anomalous body has alwa been assumed to be graphitic shale although this has never been conclusively shown; Follow up by a very detailed geolog ical inspection (drilling if necessary) and a review of the geochem.
9	H	9300N, 4725E to 10100N, 4775E	Very well-defined (exception on L9300N & 9700N) but weak response good indication of a dip to the west or else a very wide body extending to the west; high amplitudes suggest a big body.	Good suggestion of this anomaly to north (lines do not properly cover it) but weaker to the south.	Very similar to other anomalous zo that have been assumed to be shale (A6, C1); This does not fit in ver well with known geology so it need investigating; Follow up by detai geological inspections (drilling i necessary) and a review of the geochem.
8	G, H	9325N, 6000E to 9275N, 7000E	Very well-defined moderately conductive (1-2 MHOS) large body; it either dips to the north or is thick in that direction.	No I.P. coverage except for L9400N run parallel to the body; this suggest a chargeability anomaly in the right vicinity.	Another response that suggests a shale contact but could also be sulphides either totally or in par Follow up by detailed geological inspection (drilling if necessary) and a review of the geochem.

LOOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
10	G, H	9100N, 5975E	Questionable one line, weak response.	No I.P. coverage.	Follow up by a geological inspecti and a review of the geochem.
8	H	8825N, 6000E to 8875N, 6200E	Very weak response over two (?) lines.	No I.P. coverage.	East-west strike (fault?) follow by a geological inspection and a review of the geochem.
8	H	8725N, 7000E	Very weak, but well-defined one line anomaly	No I.P. coverage.	Open to East? Follow up by a geological inspection and a revie of the geochem.
6, 10	H	8700N, 5225E to 9300N, 5400E	Weak (∿1mho) but very well-defined conductor.	Excellent, broad I.P. anomaly with the best part very close to conductor axis on all lines.	Presence of anomalous E.M. with I in a geologically and geochemical interesting zone make this a good target; geology and geochem are v interesting; more geophysics is impossible because of a new power line so drilling is recommended o L9100N.

LOOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
6	A, H	7900N, 5225E to 8500N, 5175E	Weak, questionable response.	Very good I.P. anomalies are offset to the west; this could be due to mischaining or possibly the EM is picking up the eastern edge of a wide zone; one particulary good I.P. anomaly is on L8400N, 5050E; there is an associated resistivity low.	Possible weak strike extension of D1; open to south; cultural inter ference in area; I.P. anomaly on L8400N, 5050E is abnormally good No UTEM on this line; this zone s be followed up by a detailed geo-logical investigation (drilling i necessary) and a review of the ge
6, 10	A, H	7900N, 5575E to 9300N, 5725E	Weak, questionable response.	Wherever there is coverage (a few lines only) there is a weak chargeability anomaly.	Open to south; follow up by geolc inspection and a review of the ge
7	A	8275N, 5400E to 8250N, 6000E	Reasonable looking but very weak conductor.	No proper I.P. coverage.	Open to east; Runs perpendicula other conductors (fault?); follow by geological inspection and a r of the geochem.
7	A	7925N, 5600E to 7875N, 6000E	Very weak and questionable conductor.	No I.P. coverage.	Open to east; runs perpendicular other conductors (fault?); follow by geological inspection and a r of the geochem.

LOOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
11	B	7500N, 4000E to 7900N, 4025E	Weak, fairly well-defined response that appears to plunge to north; data is noisy because of nearby power line.	Very large I.P. anomaly expecially on lines 7800N, 7900N, 8000N, 8100N, (Line 7500N and 7700N not covered and L7400 & 7600N not impressive.)	E.M. conductor is consistently on ' western edge of the I.P., this cou: by only apparent due to different ; or it could be that one edge of th sulphide zone is massive; in any ca it is clear that HAI did not hit t best part of the zone either along strike or section; follow up by cl spaced EM lines and drilling.
11	B	7500N, 3325E to 7900N, 3575E	Very sharp (shallow) weak response; near end of line so anomaly is not very well-defined.	Partial I.P. coverage on L7600N only; substantial anomaly suggested.	Open in both directions; very clos to interpreted shale contact but amplitudes of both EM and I.P. response is less than those seen a other shale contacts (zones A6, B, follow up by a detailed geological inspection (drilling is necessary) a review of the geochem.
2	B	6800N, 4075E	Single line; very weak anomaly; its position near to the power line makes it suspicious.	Weak diffuse chargeability anomaly.	Could be a cultural feature; follo up by a geological inspection and a review of the geochem.
2, 11	B, C	6200N, 3475E to 7100N, 3875E	Data in this area is very noisy because of the proximity to power lines; very long, weak questionable anomaly; there is only a hint of a conductor on each line.	Wide and good I.P. anomaly associated with conductor on southern lines; no correlation in central area; no I.P. coverage to north.	Zone is open to south and IP sugge that it continues; most of anomaly could be related to a mapped fault however southern end is very interesting and possibly quite complicat the noisy data (because of power li and the wide line spacing (200m) ma a proper interpretation impossible; possible a fault extension of zone more detailed EM data necessary on south end.

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COOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
11	B	7100N, 3575E	A very good single line conductor if the very, very noisy data is to be trusted.	No I.P. coverage.	Follow up by more detailed EM (Max Min?), geological inspection and a review of geochem.
1	A, D	6600N, 5275E to 6800N, 5200E	Weak, but apparently well defined anomaly (on L6600N) among very noisy data (close to mine).	Coverage does not quite extend far enough on most lines but there is no hint even of an anomaly on any lines.	Not particularly interesting excep for its position in relation to th Que River ore deposit; follow up b a geological inspection and a revi of the geochem.
1	A, D	6600N, 4875E to 6800N, 4925E	Weak, poorly defined anomaly among very noisy date (close to mine).	Good, but wide and complicated I.P. anomalies.	I.P. shows that this zone is too complicated to be defined with E.M coverage every 200m; More detailed E.M. is necessary.
3	D	5200N, 5875E to 5600N, 5650E	Weak to moderate (?) anomaly but it is very far from the loop and therefore the data is noisy and questionable.	No I.P. coverage.	Better, more detailed E.M. data is necessary.

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OOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
3	D	5400N, 5400E to 5800N, 5375E	Very weak and very questionable.	No I.P. coverage.	Follow up by geological inspection and a review of the geochem.
3	D	5600N, 5175E to 5800N, 5125E	Weak but well-defined on L5600N to very weak and questionable on L5800N.	No I.P. coverage.	Follow up by a geological inspectic and a review of the geochem.
3	D	5600N, 4775E to 6200N, 4875E	Very weak anomaly; looks like it could be a contact.	I.P. has a broad weak zone coincident on line 6200N only.	I.P. suggests that L6200N is part (zone H2 and that rest of zone H6 sl be ignored; however the EM does no: agree; Follow up by geological inspection and review of the geoch(step after this would be more EM i: interesting.
3	D, L	3800N, ∿ 5200E to 5400N, ∿ 5000E	Large wide zone of slightly anomalous conductivity.	Very weak broad anomalous zone corresponding with EM interpretation on the few lines where IP is done (5100N and 5400N).	Probably caused by a slightly pyri' geological unit; follow up by a geological inspection and a review of the geochem.

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LOOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
1979 UTEM	C	5200N, 4375E to 5800N, ~4200E	Complicated zone of multiple conductors, which are moderately good at two locations, 5600N, 4225E and 5800N, 4175E; line to line correlation is impossible without closer spaced lines.	A weak I.P. anomaly coincides with the EM except that it seems to get weaker to the north instead of stronger as the EM indicate; the older IP data suggests that zone Il is the western, most conductive edge of a broad IP zone.	Should be detailed with further EM work at 100 metre line spacing; since the anomaly is open to the no coverage should be extended in that direction.
.979 UTEM 3	C, D	5400N, 4600E to 5800N, 4625E	Response hard to interpret because it is so far from the 1979 loop and too close to loop 3; it is clear that it is a weak response.	A resistivity low corresponds with the EM but little or no chargeability anomaly.	Probably represents a geological contact; follow up by a geological inspection and a review of the geochem.
1979 UTEM	C	4400N, 4325E to 4800N, 4400E	Weak but well-defined response particularly on line 4400N.	Very good IP anomaly closely associated with EM.	Assuming that the geological dip is near vertical or to the west, and t the UTEM grid is properly tied in t the drill holes, then this anomaly been drilled by Holes MC1 and MC2 a has been proven to be caused by pyr no further work is warranted unless is still of great geological intere if this is so, detailed EM should b carried out on 100 m line spacing.
.979 UTEM	C	4600N, 4075E to 4800N, 4125E	Weak, questionable anomaly.	Coincident weak I.P. anomaly on line 4600N but not 4800N.	Follow up by a geological inspecti and a review of the geochem.

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LOOP	MAP (1:2500)	LOCATION	E.M. RESPONSE	I.P. ASSOCIATION	COMMENTS
1979 UTEM	C	4200N, 3975E	Broad, moderately conductive zone that appears to be open to the south.	I.P. suggests that it simply marks the eastern edge of the shale package.	Open to south? Possibly another s conductor? Follow up by more EM (Max Min?), geological inspection a review of the geochem.
1979 UTEM	C	4200N, 3775E to 4800N, 3775E	Moderate strength broad anomaly that is poorly defined because of its position close to, and beneath the loop.	No I.P. coverage.	Open to south; very similar to all of the other shale responses; foll up by a detailed geological inspection (drilling if necessary) a review of the geochem.

ABERFOYLE

29 June, 1983 ETE:jj

John Sise Tom Eadie

Burnie Hawthorn'

EHS, DW Mark. 2000R.

Preliminary Interpretation of the Northern Que River UTEM Anomaly

Introduction

This note summarizes the interpretation of the most immediately important anomalies located during the past summer's UTEM survey. The purpose of this report is to aid in the drilling of this interesting area.

Figure 1 is a compilation map of the UTEM anomalies. The main zone has a strike length of at least 300 meters and could extend for more than 600 meters. The low estimated conductance of 2-6 mhos is not significantly less than the conductance of the Que River ore deposit in spite of the fact that Lamontagne originally estimated the conductance of the deposit to be a great deal higher. The body appears to be plunging gently to the north, with a depth to top of less than 25 meters in the south (Line 10100N) and greater than 100 meters to the north (Line 10600N).

Limitations of the Present Interpretation

The most glaring limitation of this interpretation is the imprecision of the depth determination. This can be remedied to some extent by reprocessing of the data, which will be done soon, but the necessary computer is still in transit from Canada. By ensuring that the drill holes intersect the location of the conductor at the deep end of the estimated depth to top, this problem is overcome.

Two other limitations of the present interpretation can be overcome only by placing a UTEM loop to the east and obtaining more data. With the present information, neither the dip nor the shape of the body can be determined, although there is a vague suggestion of a steep dip to the east.

However, the most important parameter of all, the location of the conductor axis can be determined to within about 25 meters, and therefore drill holes can be located reasonably accurately.

Conclusions

The location of the conductor axis (± 25 meters) and the depth to top (± 25 meters) on the most interesting lines are as follows:

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Line #	Location	Depth at top (M)
10300N	5675E	50
10400N	5710E	75
10500N	5725E	75
10600N	5775E	100
10700N	5725E	100

It should be noted that this conductive trend has been drilled on one of the weaker lines (10200N) with hole MG1. Pyrite was encountered, with minor Pb/Zn.

Geophysically, the best line to drill is 10400N because the conductivity is the highest and it is right in the centre of the conductive zone. Because there is a slight hint of a dip to the east, the hole should be drilled from this direction unless geological evidence suggests otherwise. The hole should intersect the conductive axis as indicated above at a depth between 100 and 150 meters. The reason for not wanting to drill it any deeper than 150 meters is because the depth extent of the conductor is not known.

Follow-up drilling will depend on the success of the first hole. A test on Line 10500N is recommended before going any further north. If the source of the anomaly is not intersected in the first hole, the conductor should be redrilled from the west.

....

E. T. Eadie

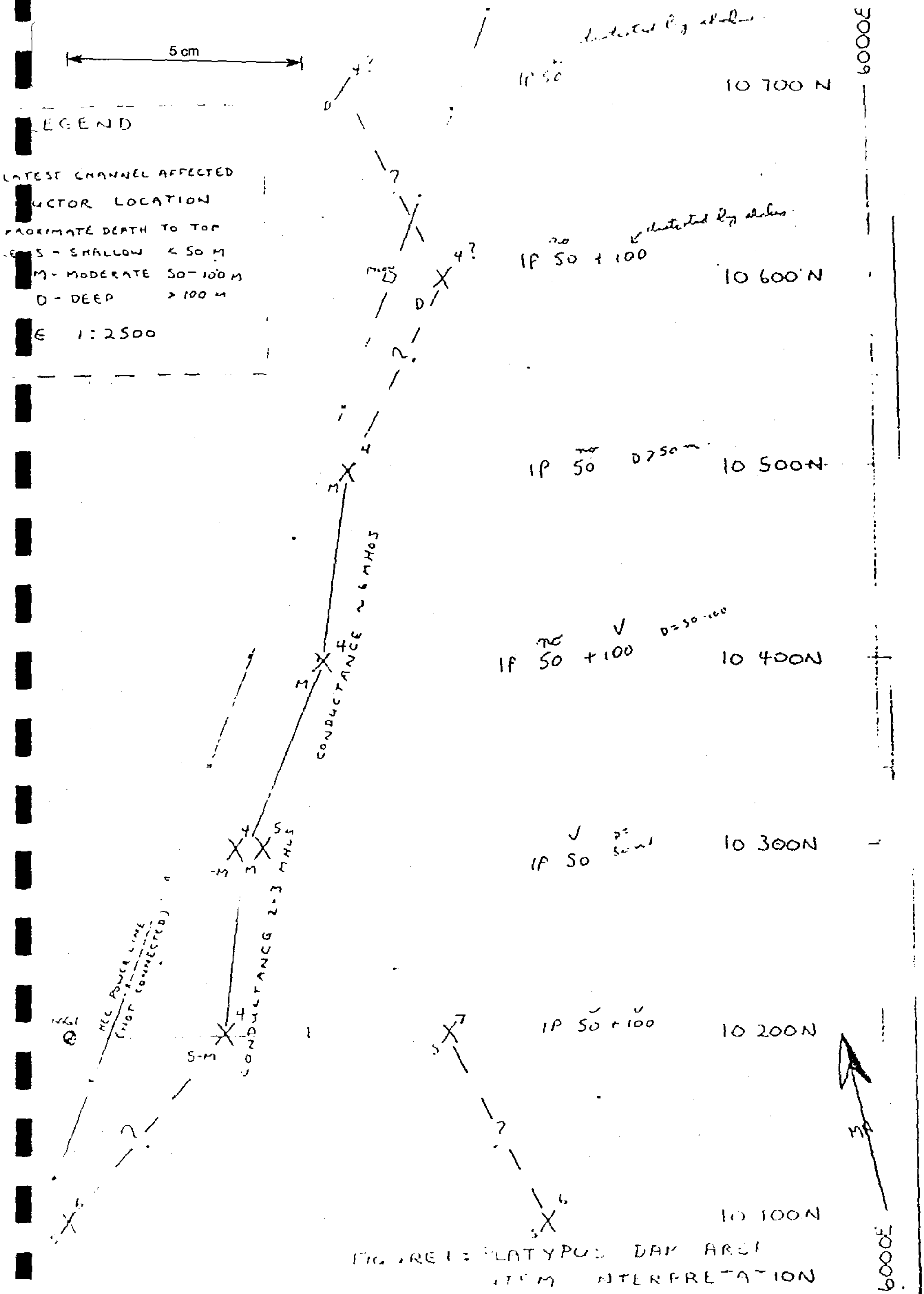
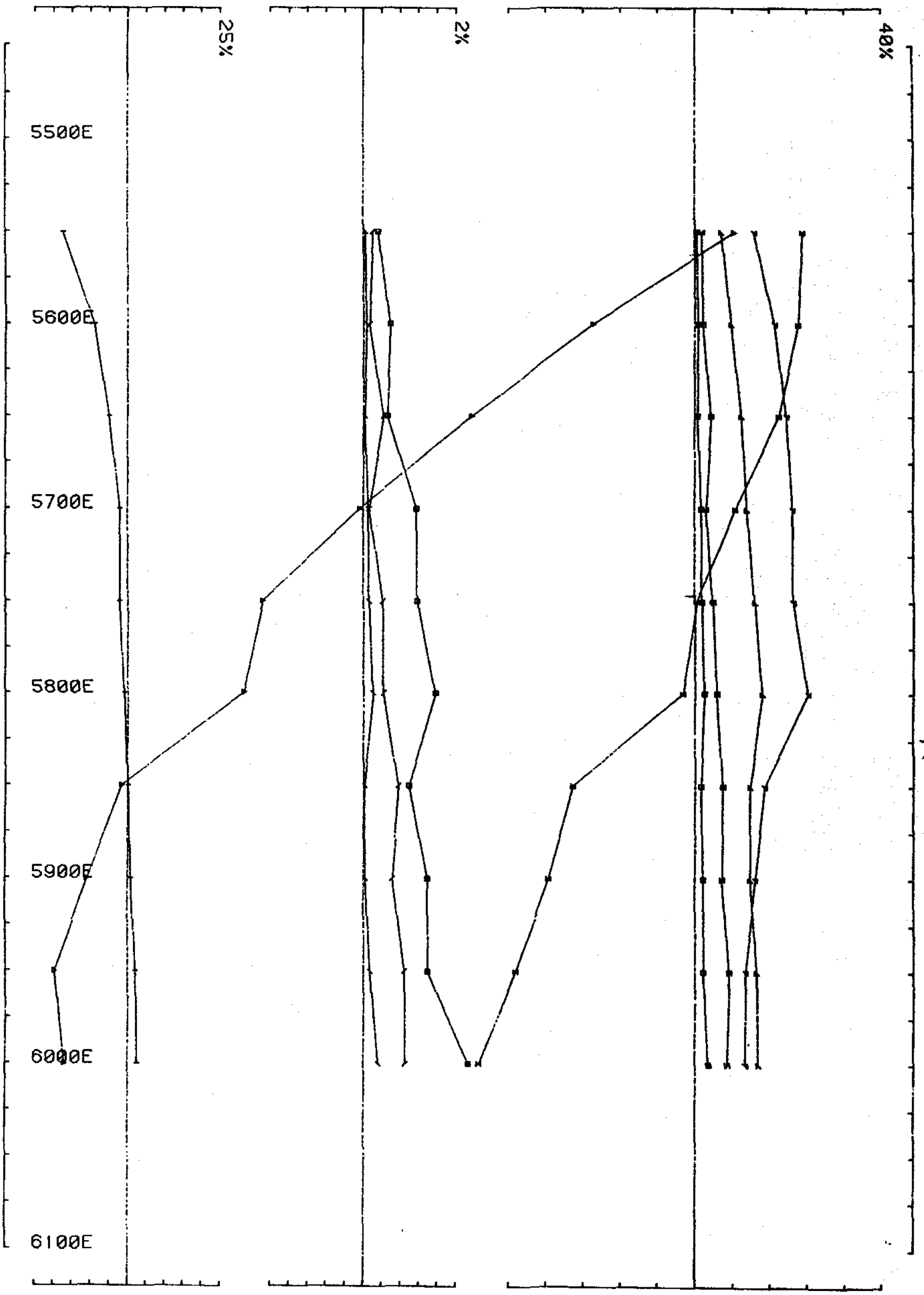
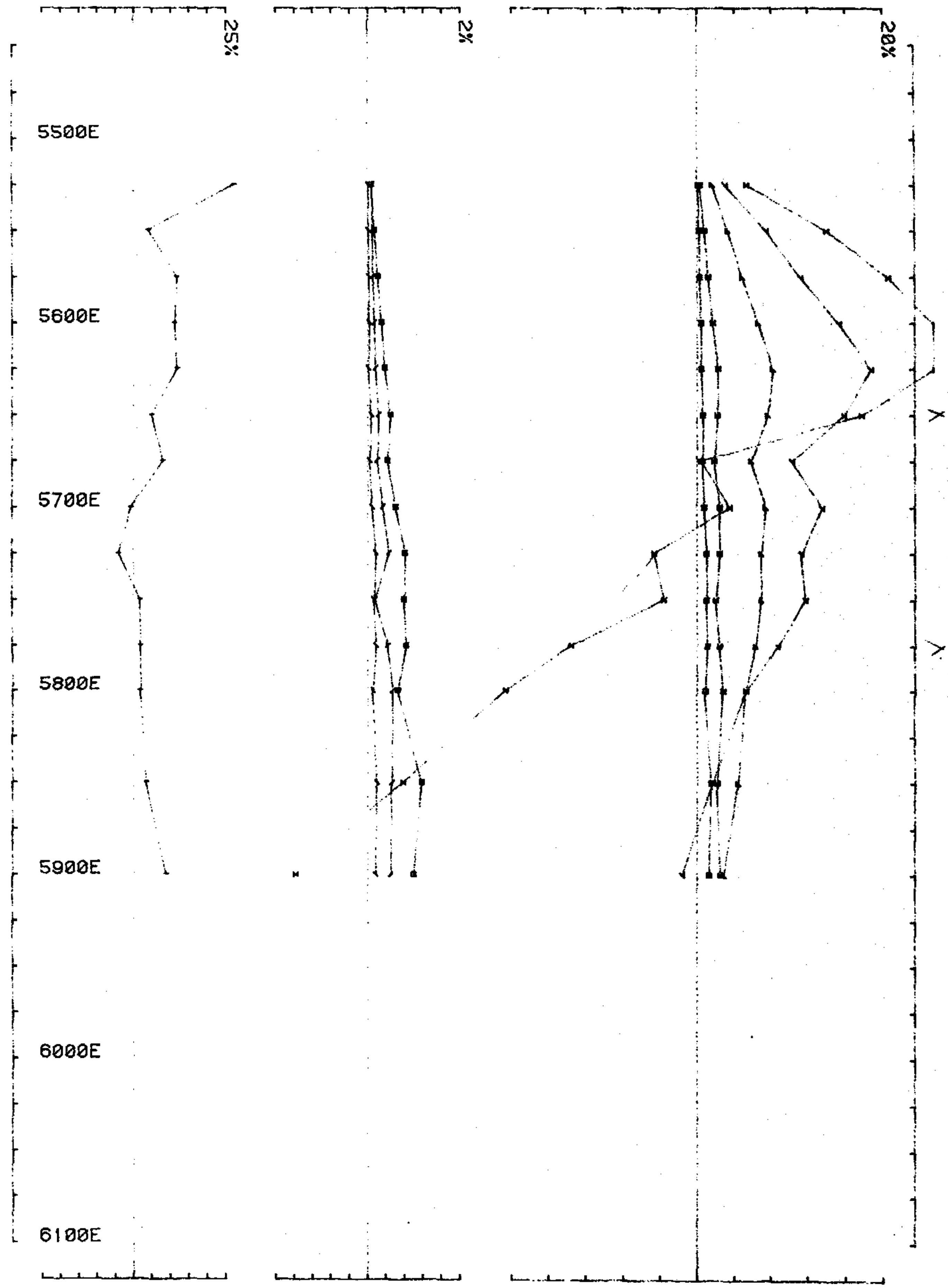


FIGURE 1: PLATYPUS DAM AREA
UTEM INTERPRETATION

6.6 LOOP 12 UTEM PROFILES



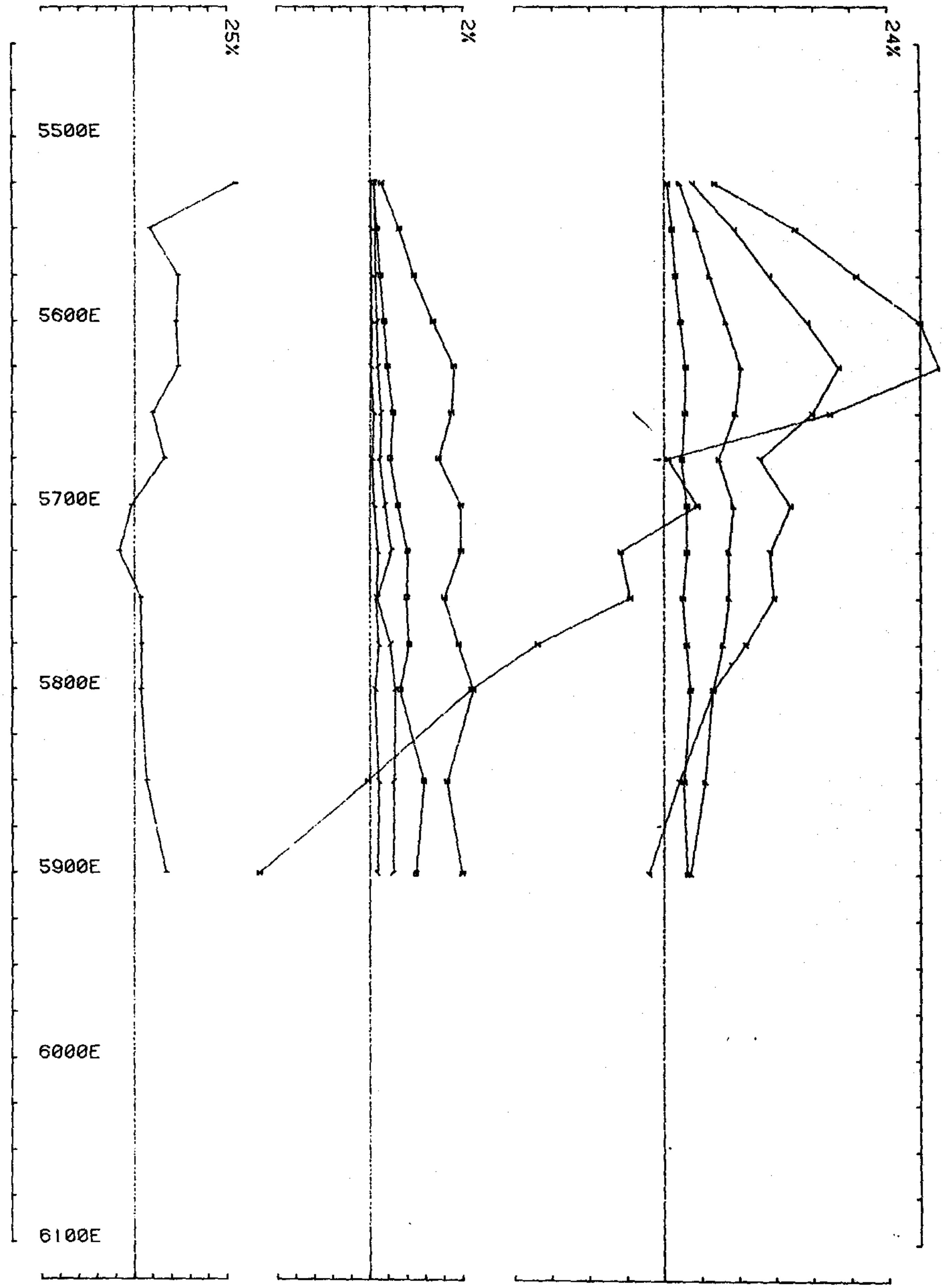
Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26.1
Loopno 0012 Line 10100N component Hz secondary Ch 1



Area QUE RIVER PROSPECT   ABERFOYLE EXPLORATION PTY LTD   Job 3001   freq(hz) 26 J

Loopno 0012 Line 10200N component Hz secondary Ch 1

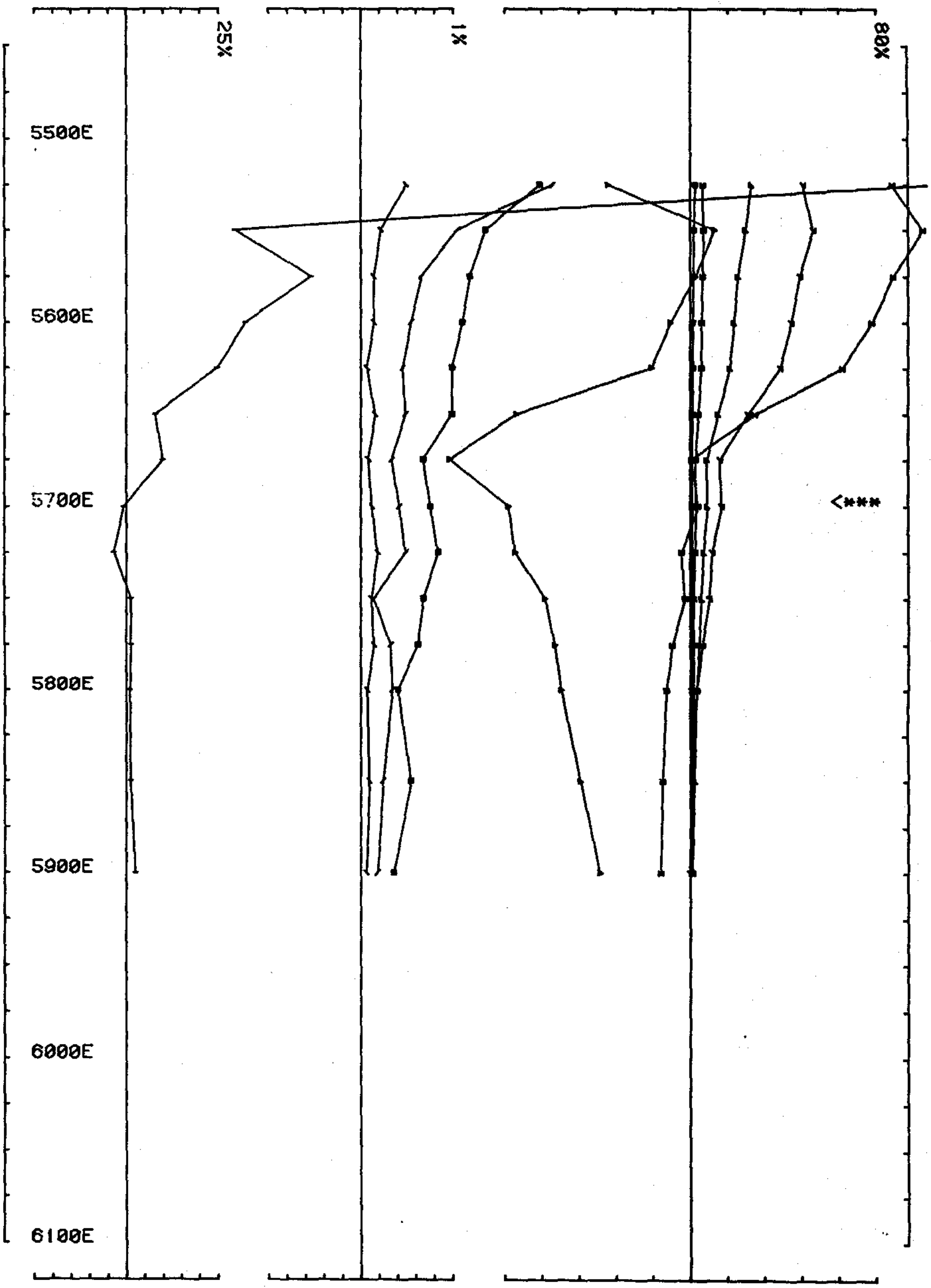
284074



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10200N component Hz secondary Ch 1

074

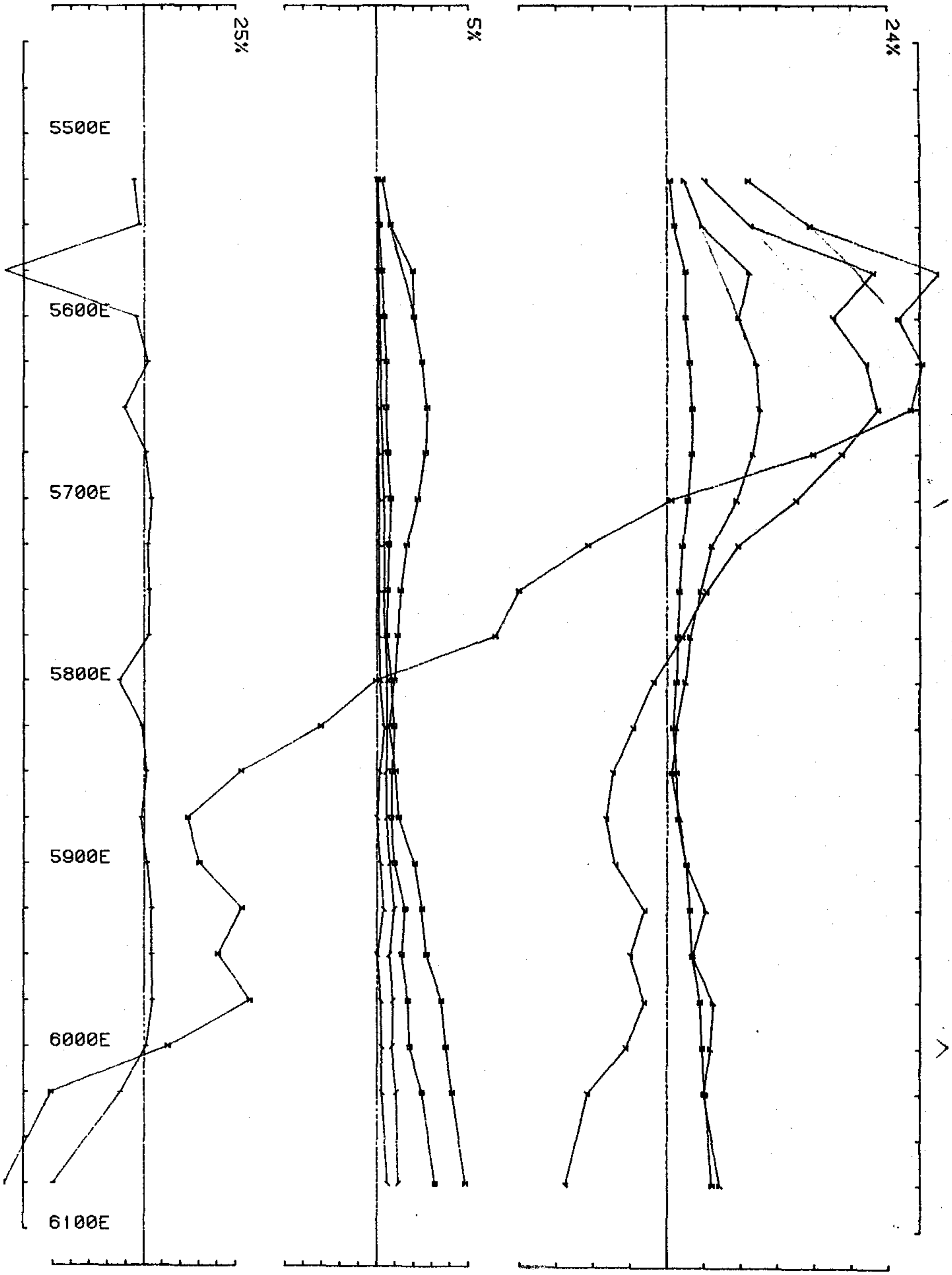
284075



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10200N component Hz secondary Ch 1

075

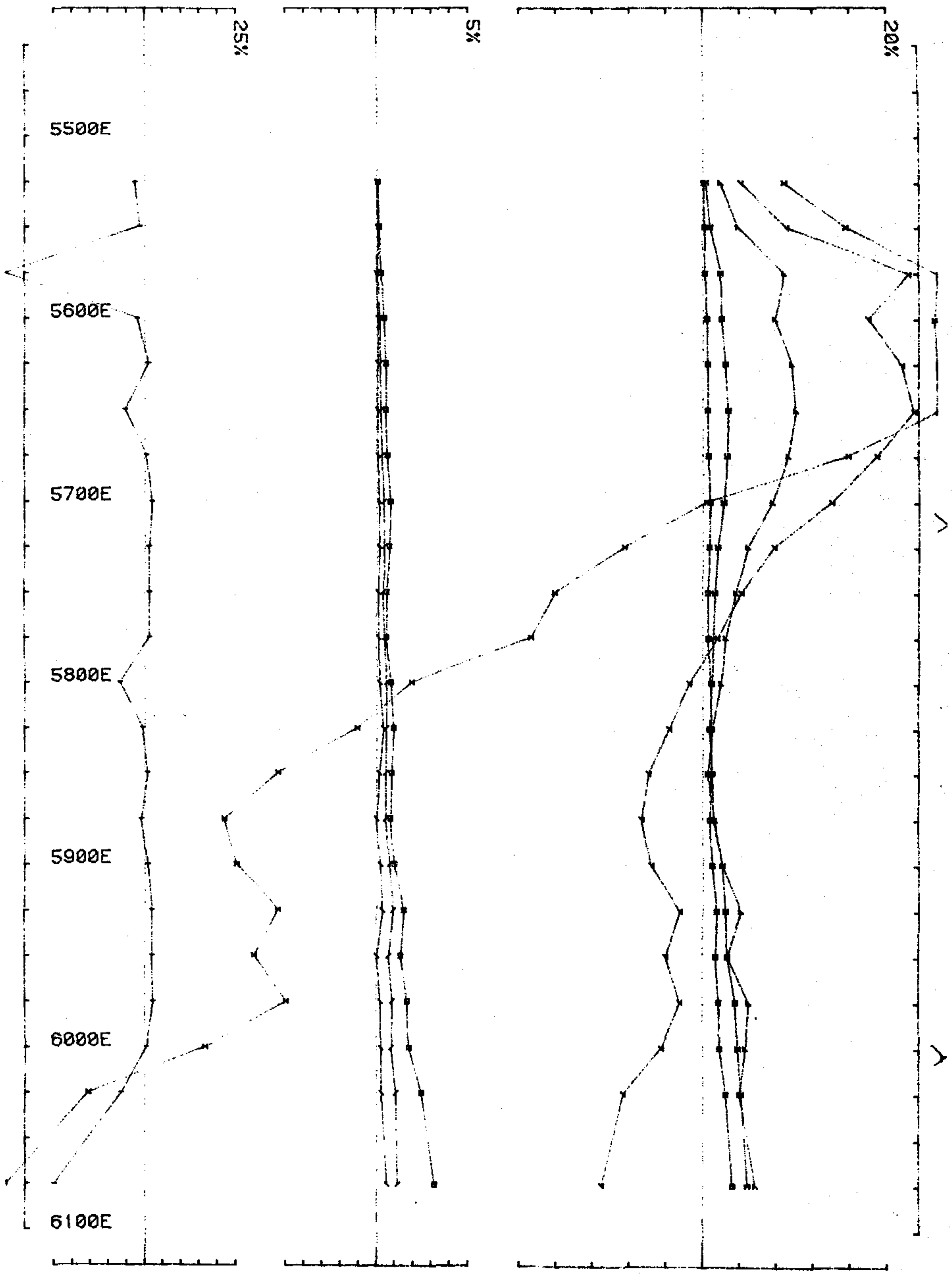
284076



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10300N component Hz secondary Ch 1

076

284077

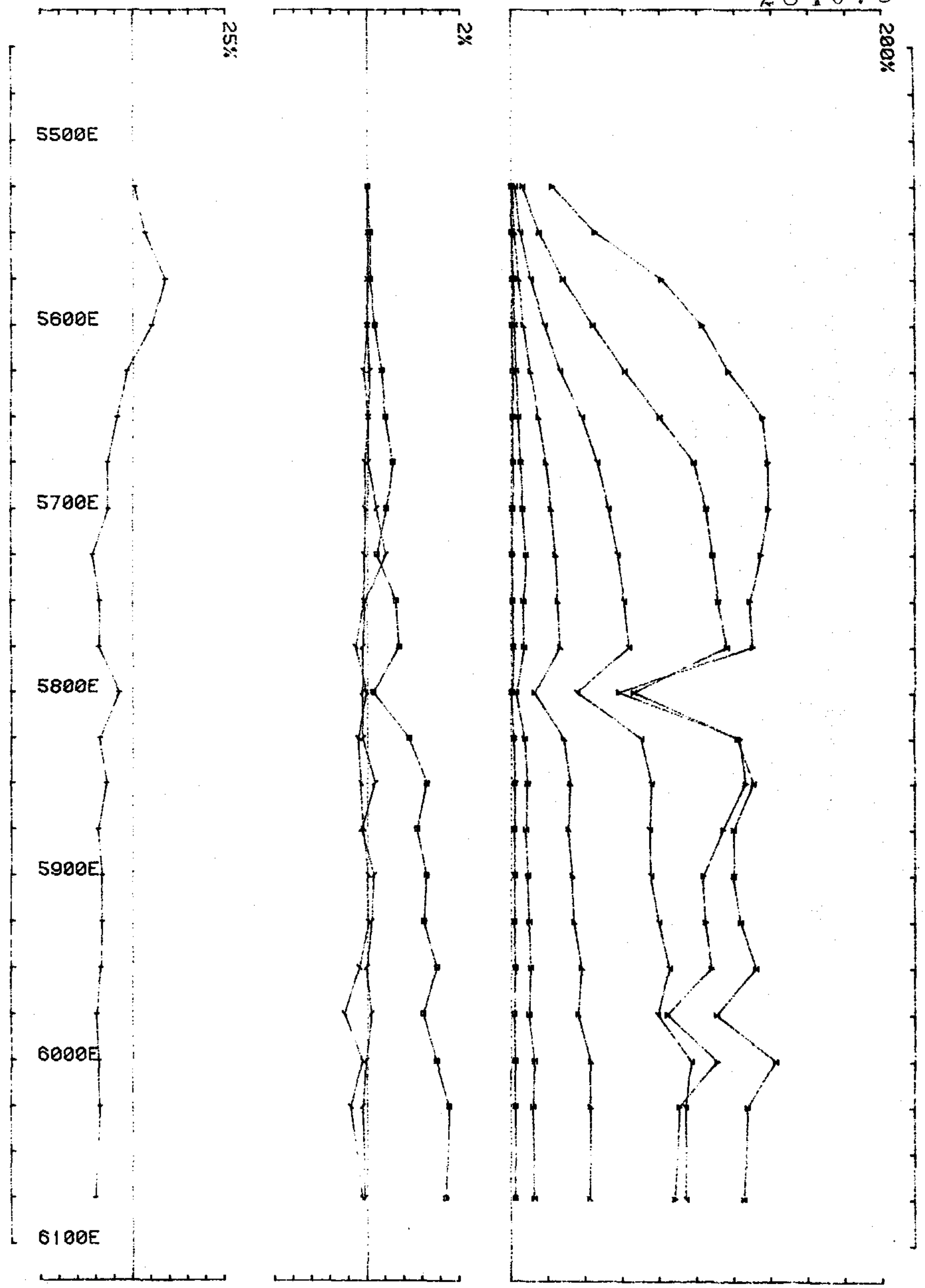


Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26

Loopno 0012 Line 10300N component Hz secondary Ch 1

077

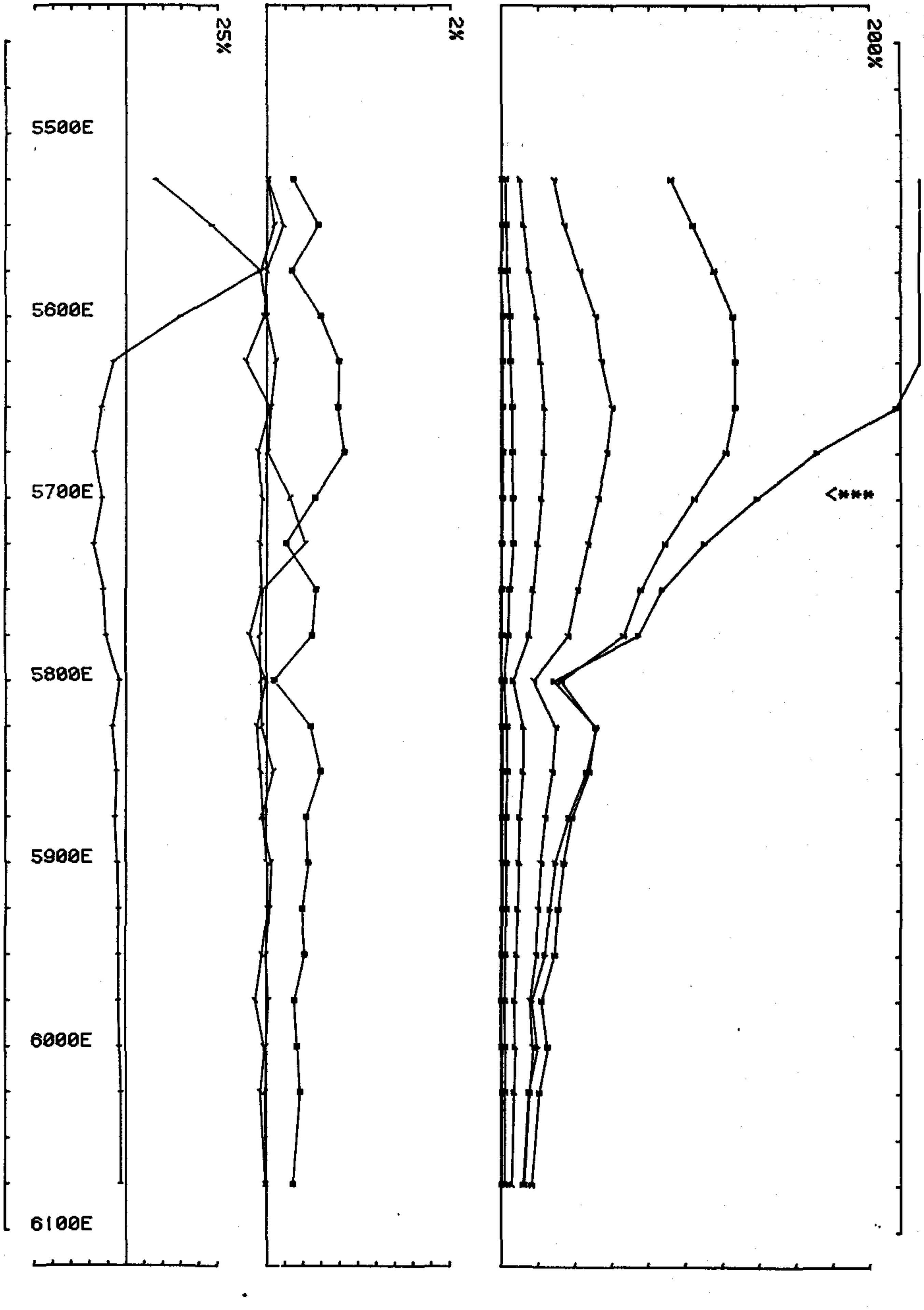
284078



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26 J
Loopno 0012 Line 10300N component Hx secondary Ch 1

078

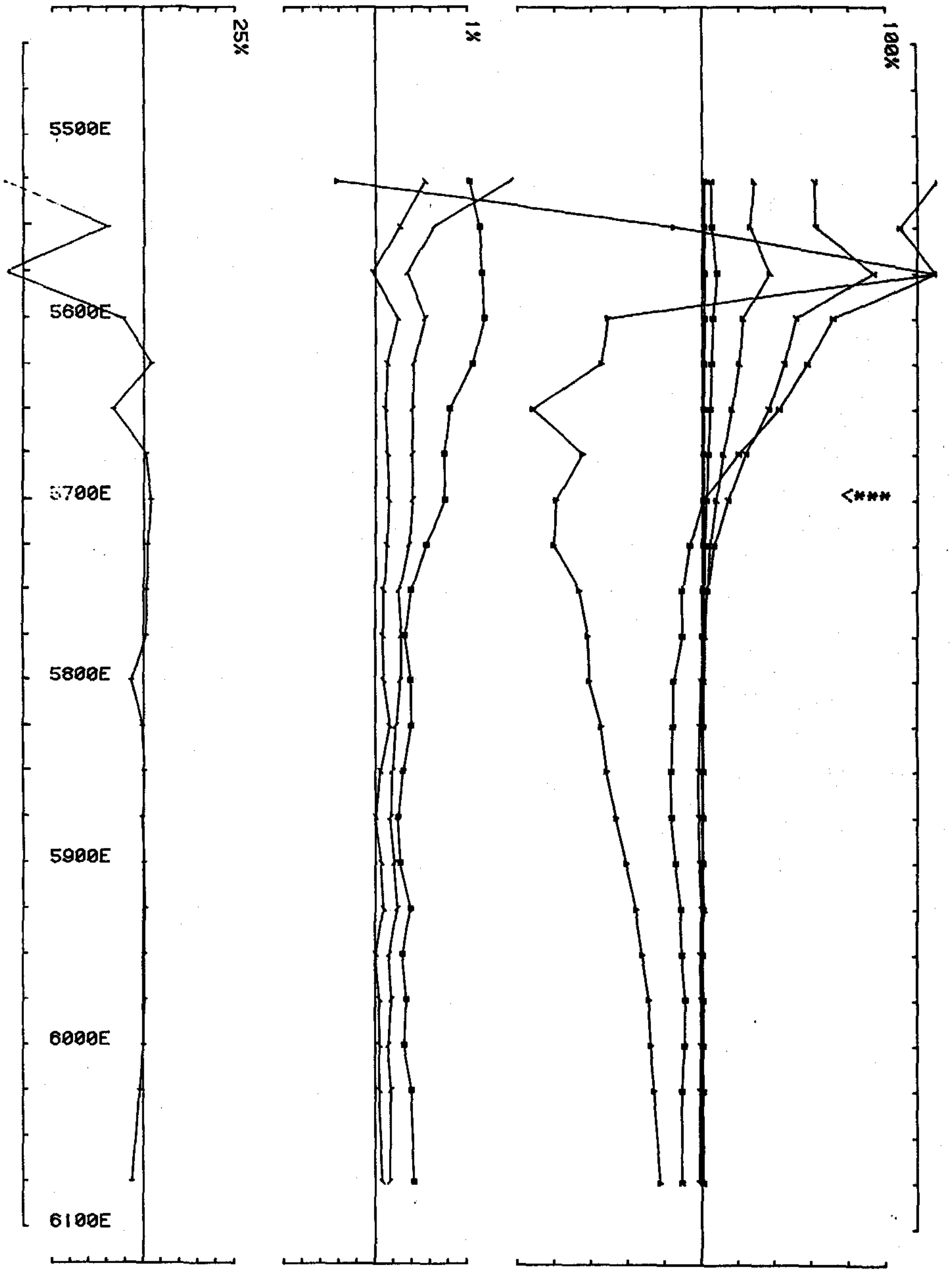
284079



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26 J
Loopno 0012 Line 10300N component Hx secondary Ch 1

07.

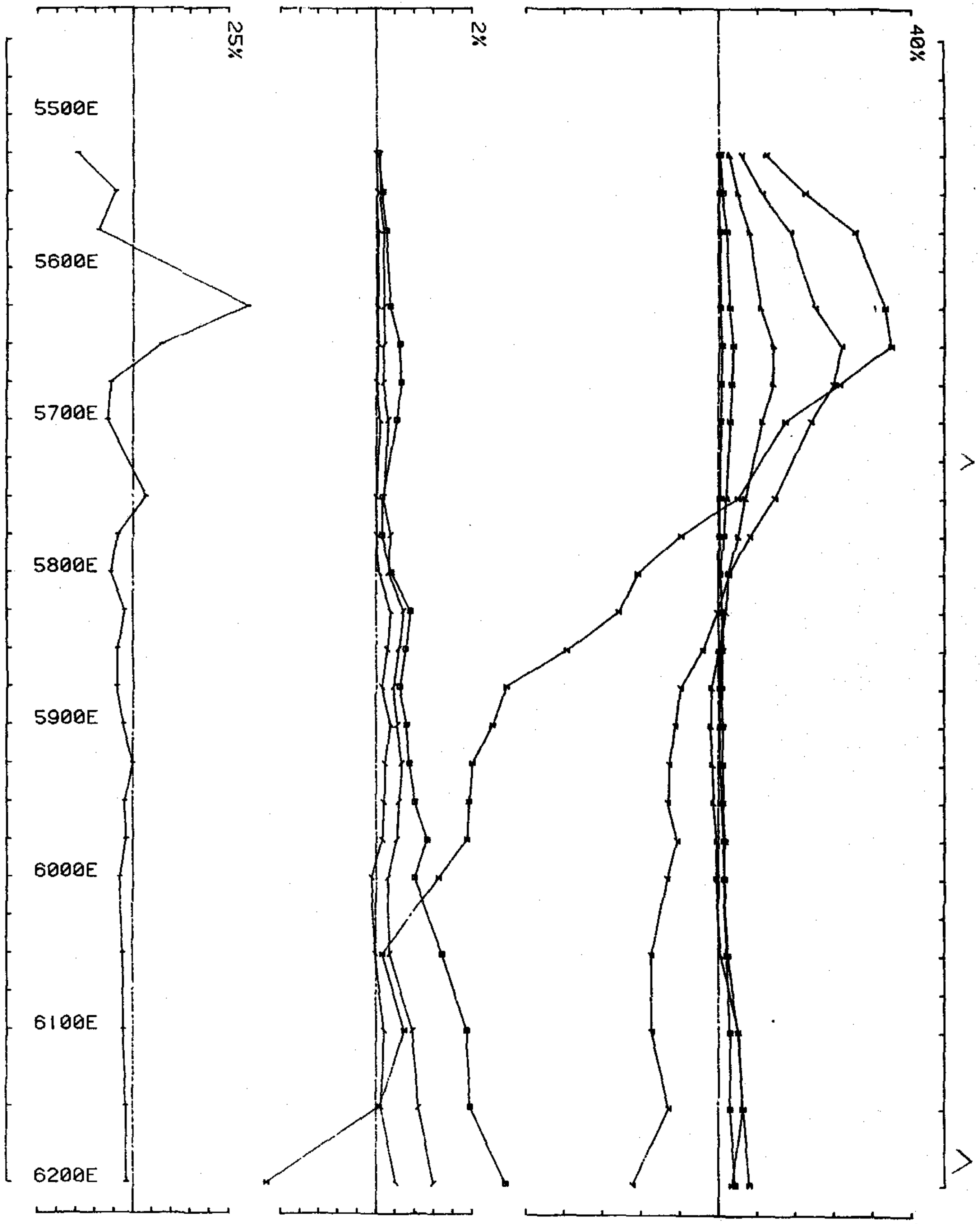
284080



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10300N component Hz secondary Ch 1

080

284081

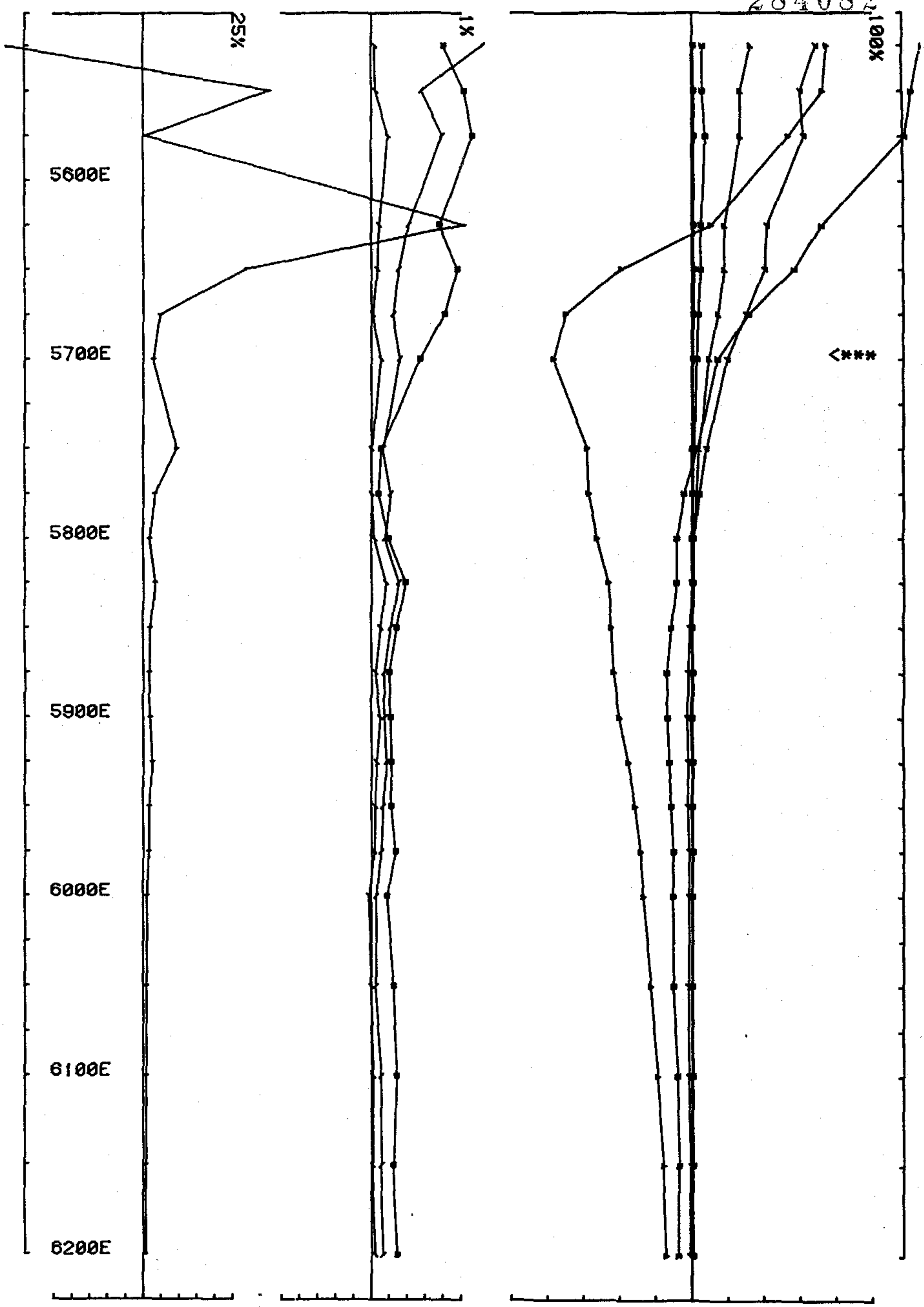


Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26

Loopno 0012 Line 10400N component Hz secondary Ch 1

081

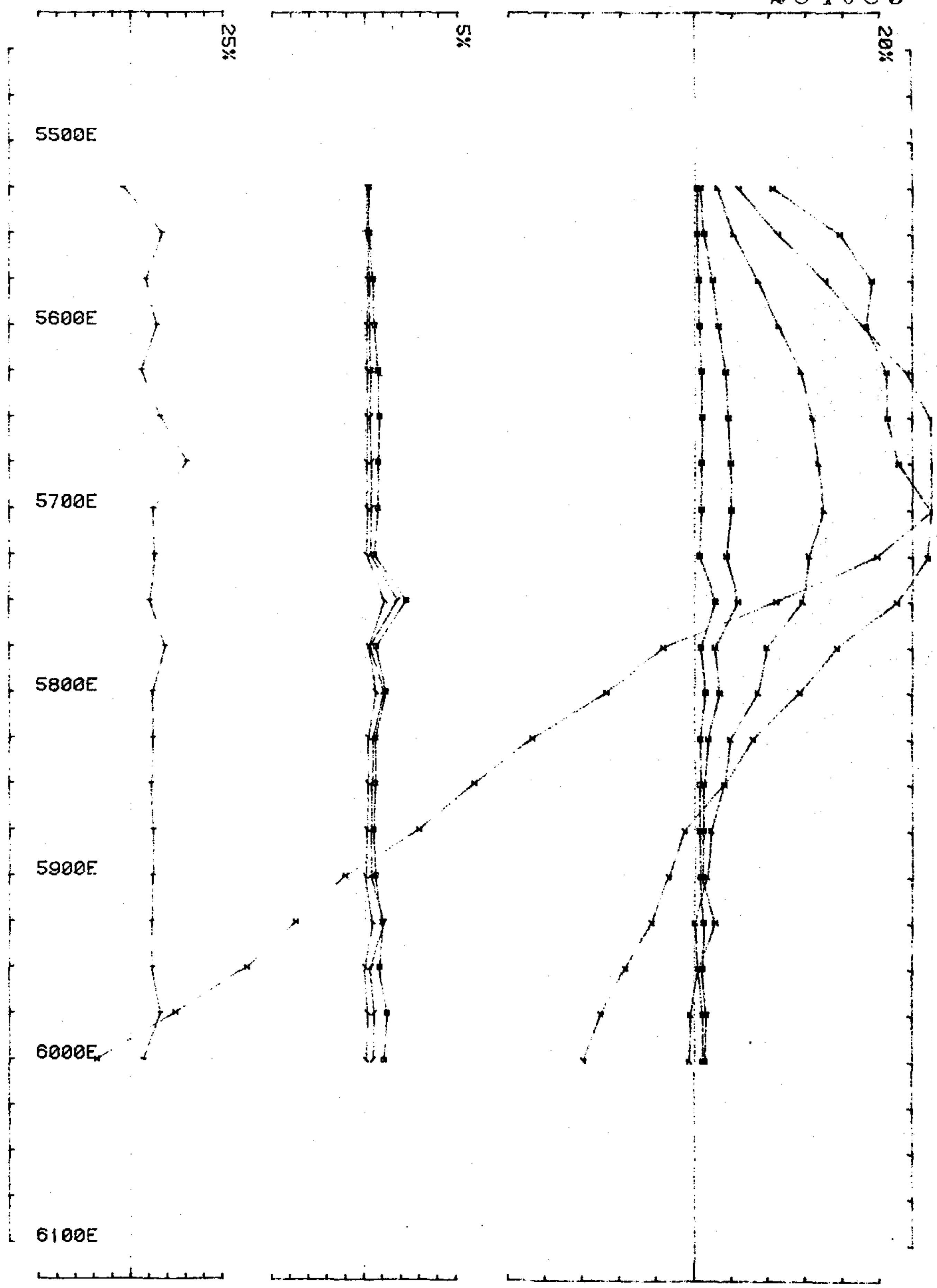
284082



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26 [illegible]
Loopno 0012 Line 10400N component Hz secondary Ch 1

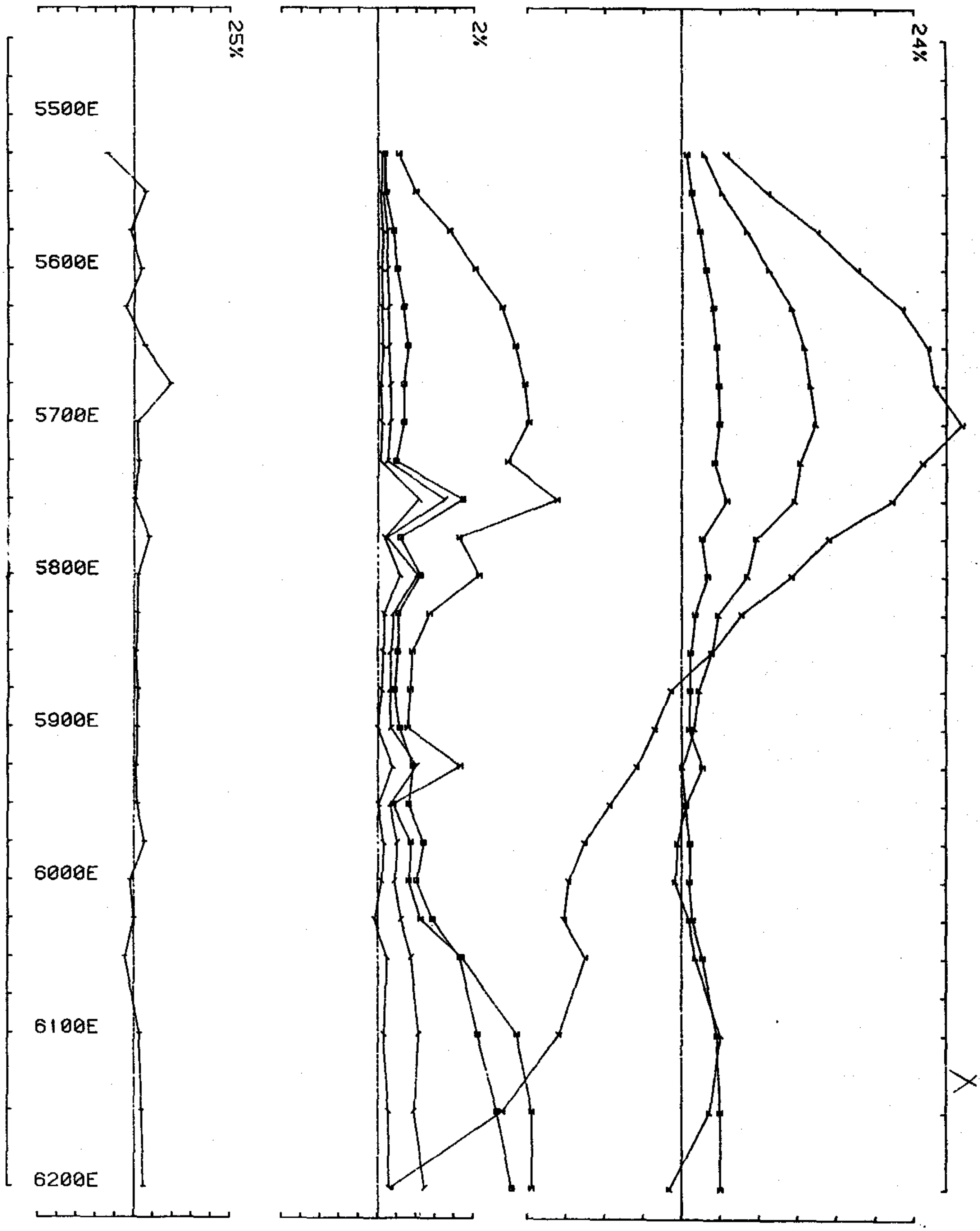
082

284083



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10500N component Hz secondary Ch 1

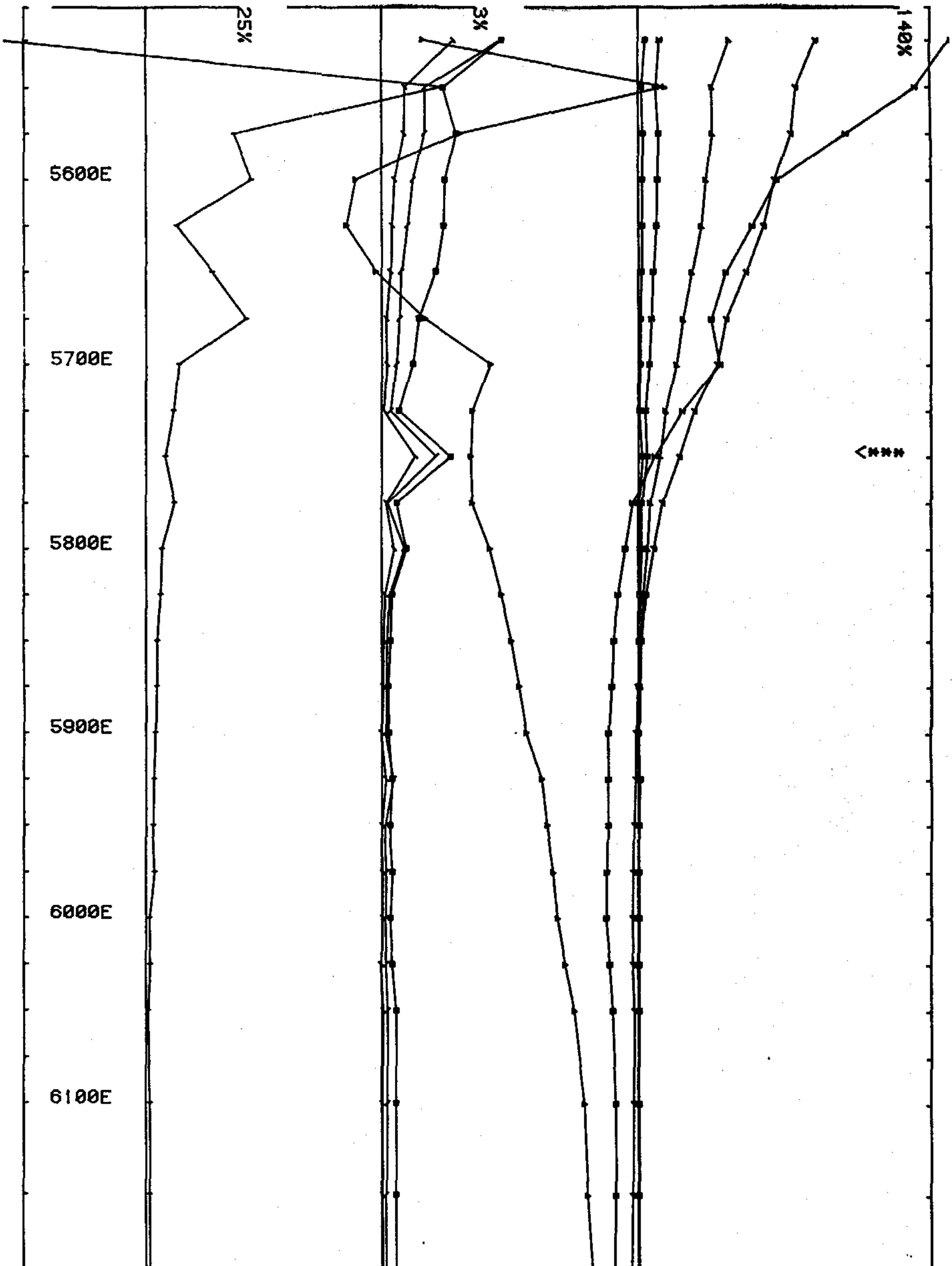
284084



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26 J
Loopno 0012 Line 10500N component Hz secondary Ch 1

084

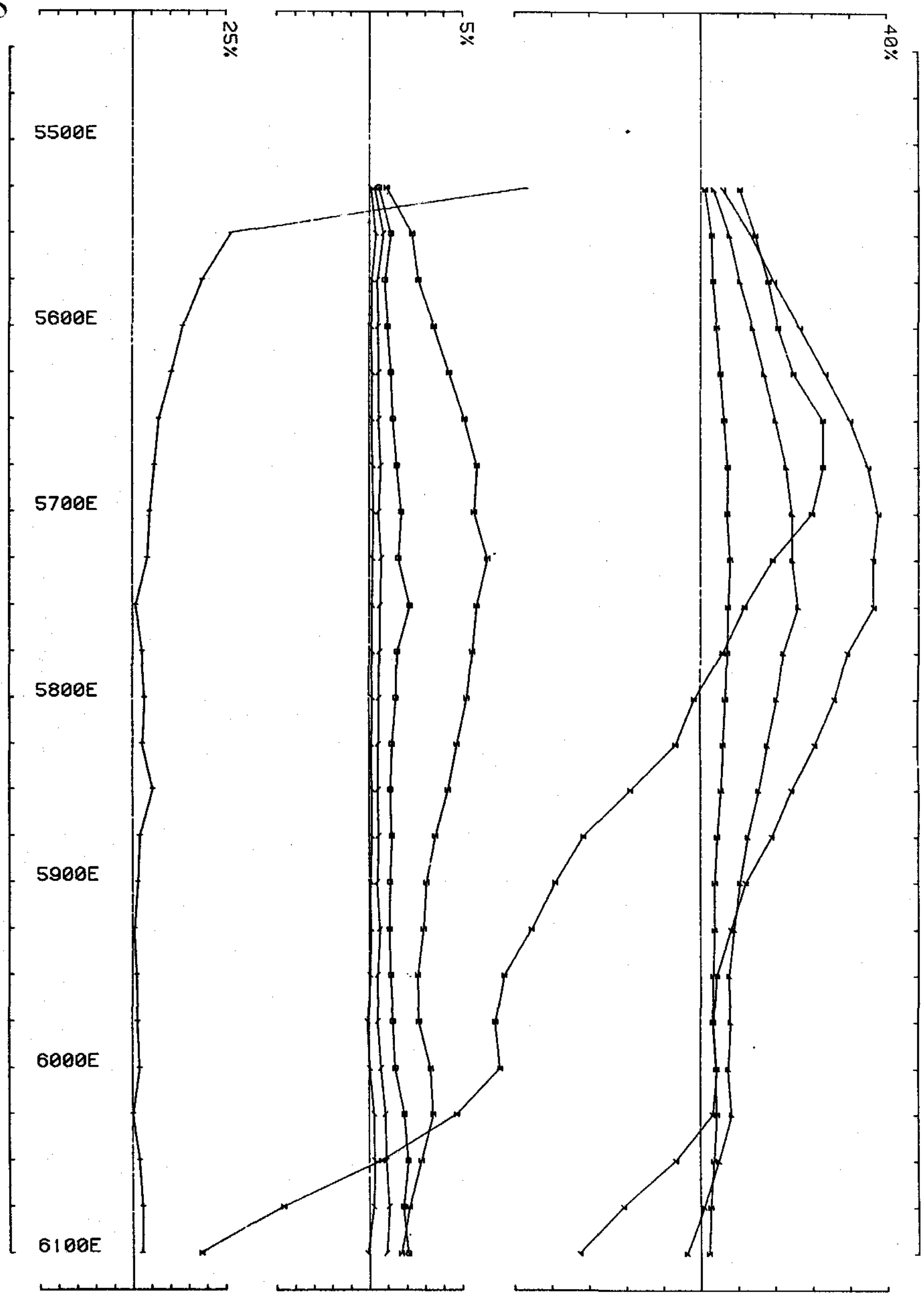
284085



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10500N component Hz secondary Ch 1

085

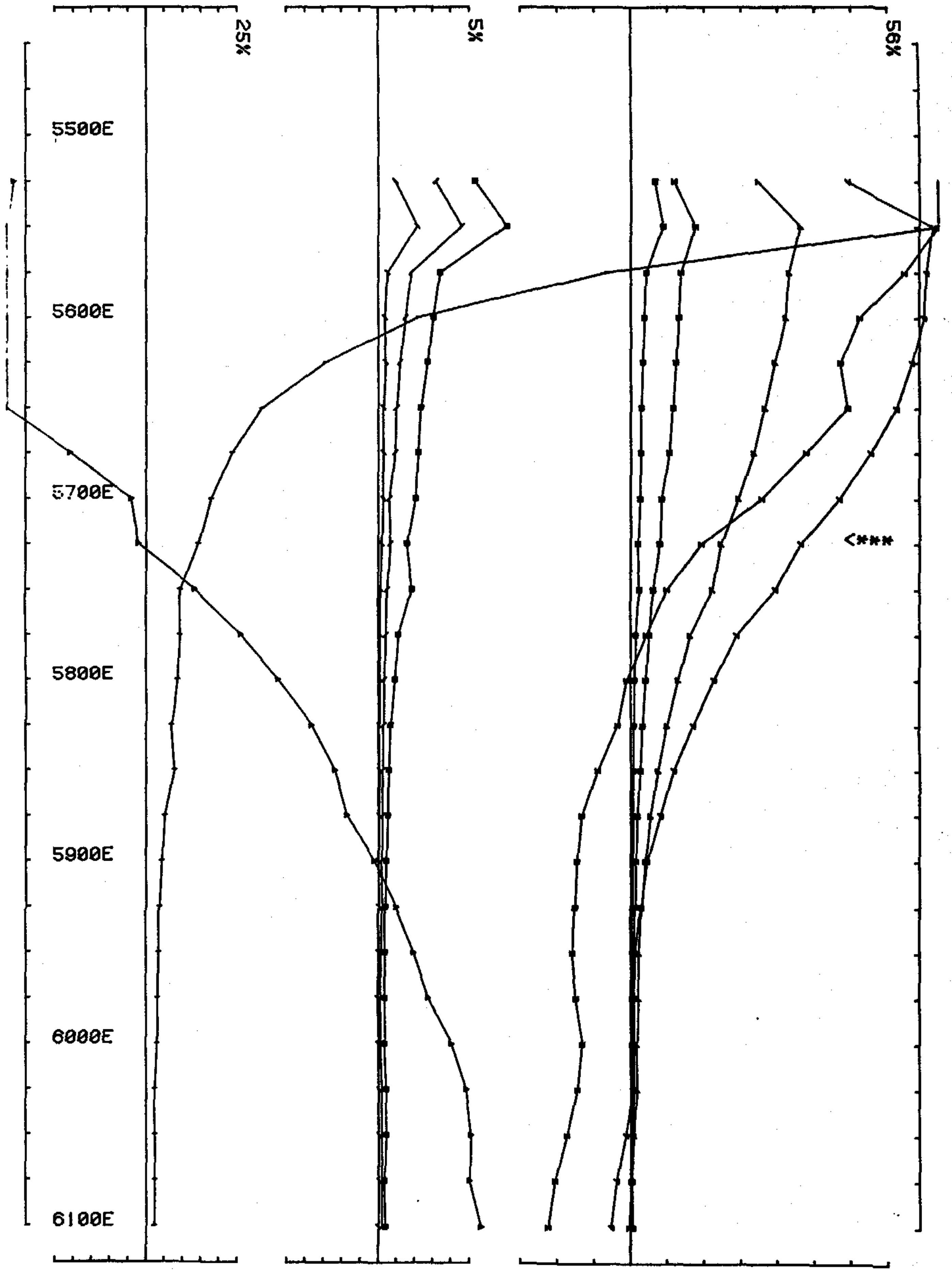
284086



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26.1
Loopno 0012 Line 10600N component Hz secondary Ch 1

086

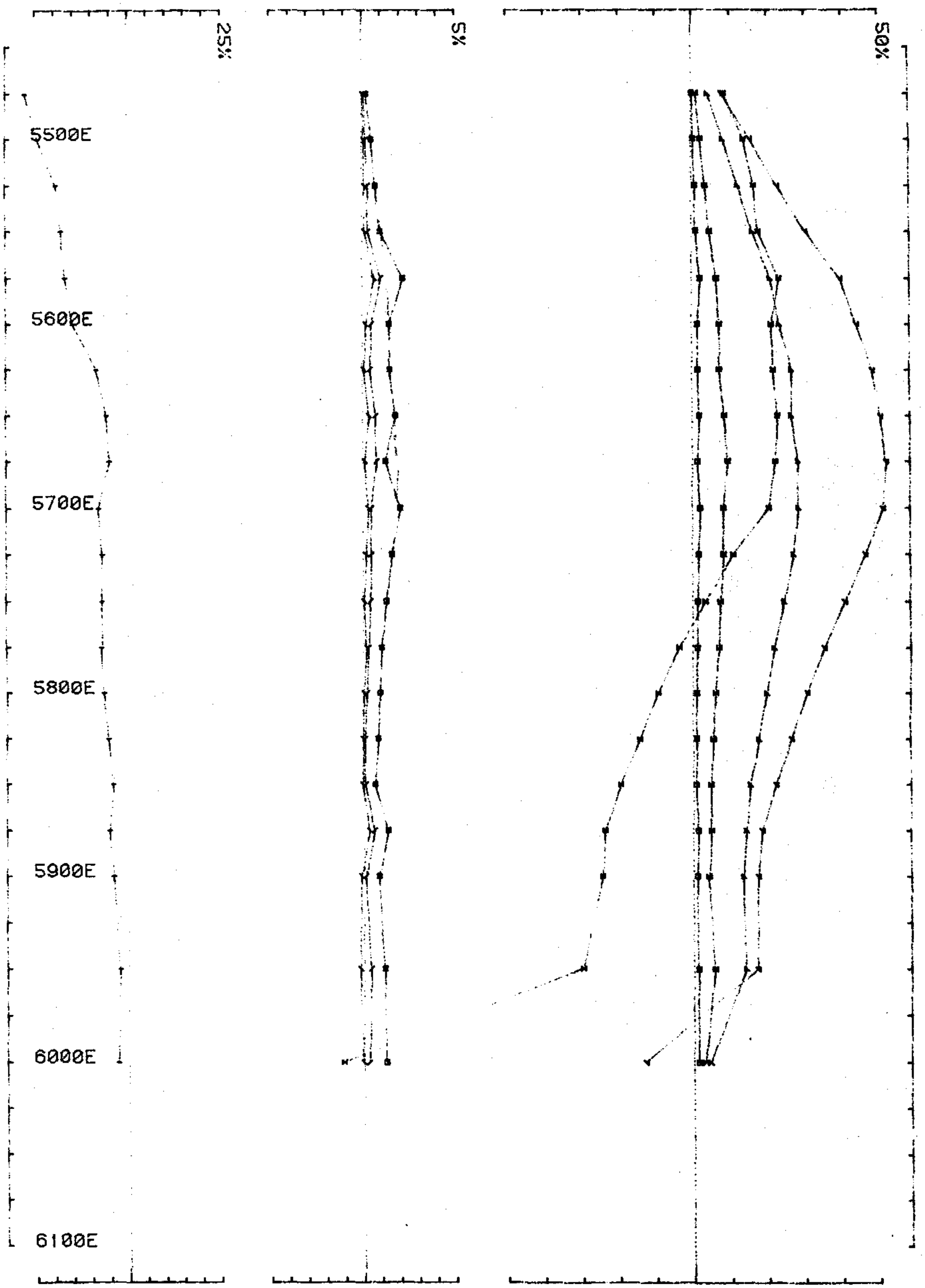
284087



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26.1
Loopno 0012 Line 10600N component Hz secondary Ch 1

087

284088

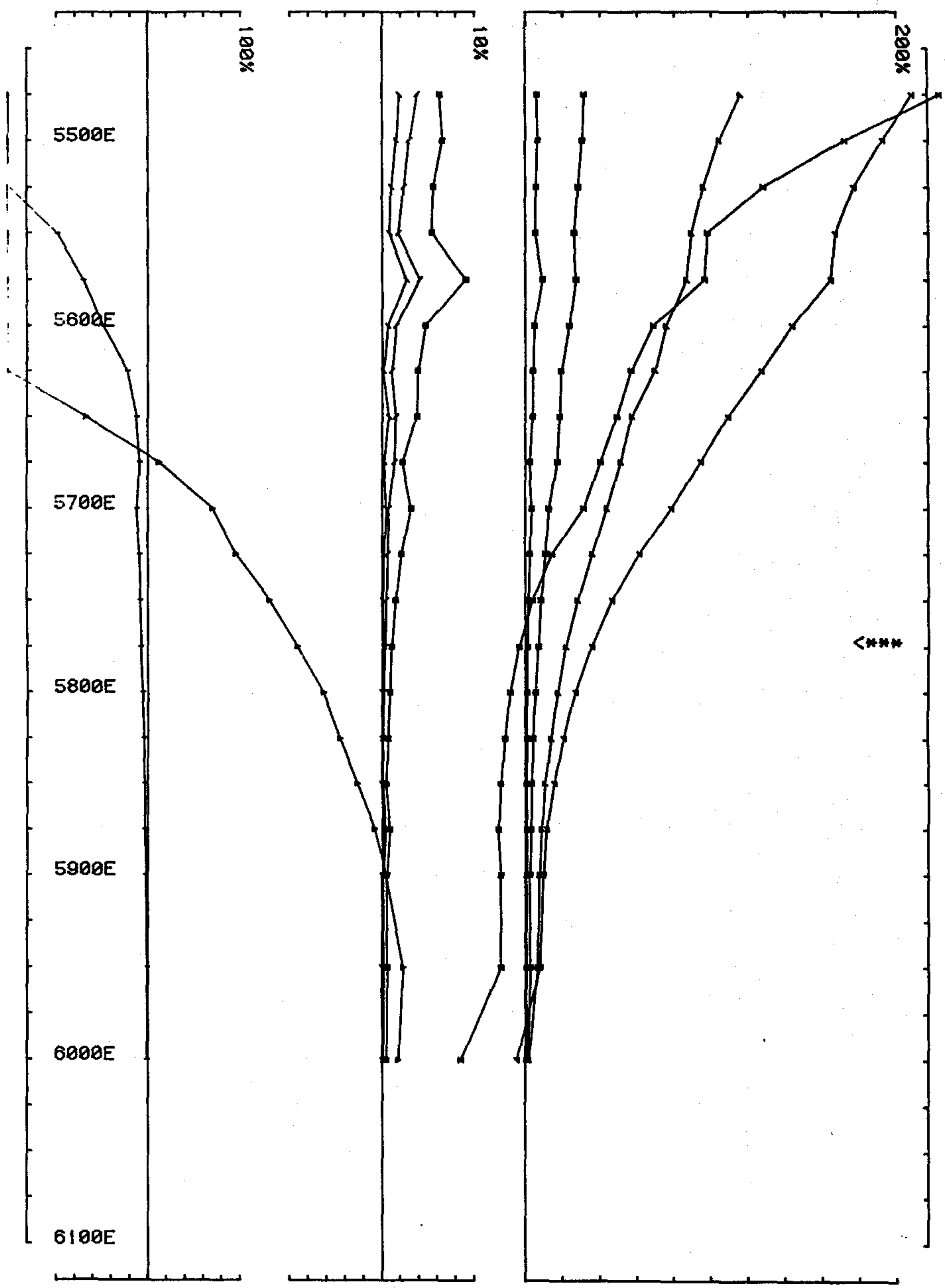


Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26 J

Loopno 0012 Line 10700N component Hz secondary Ch 1

088

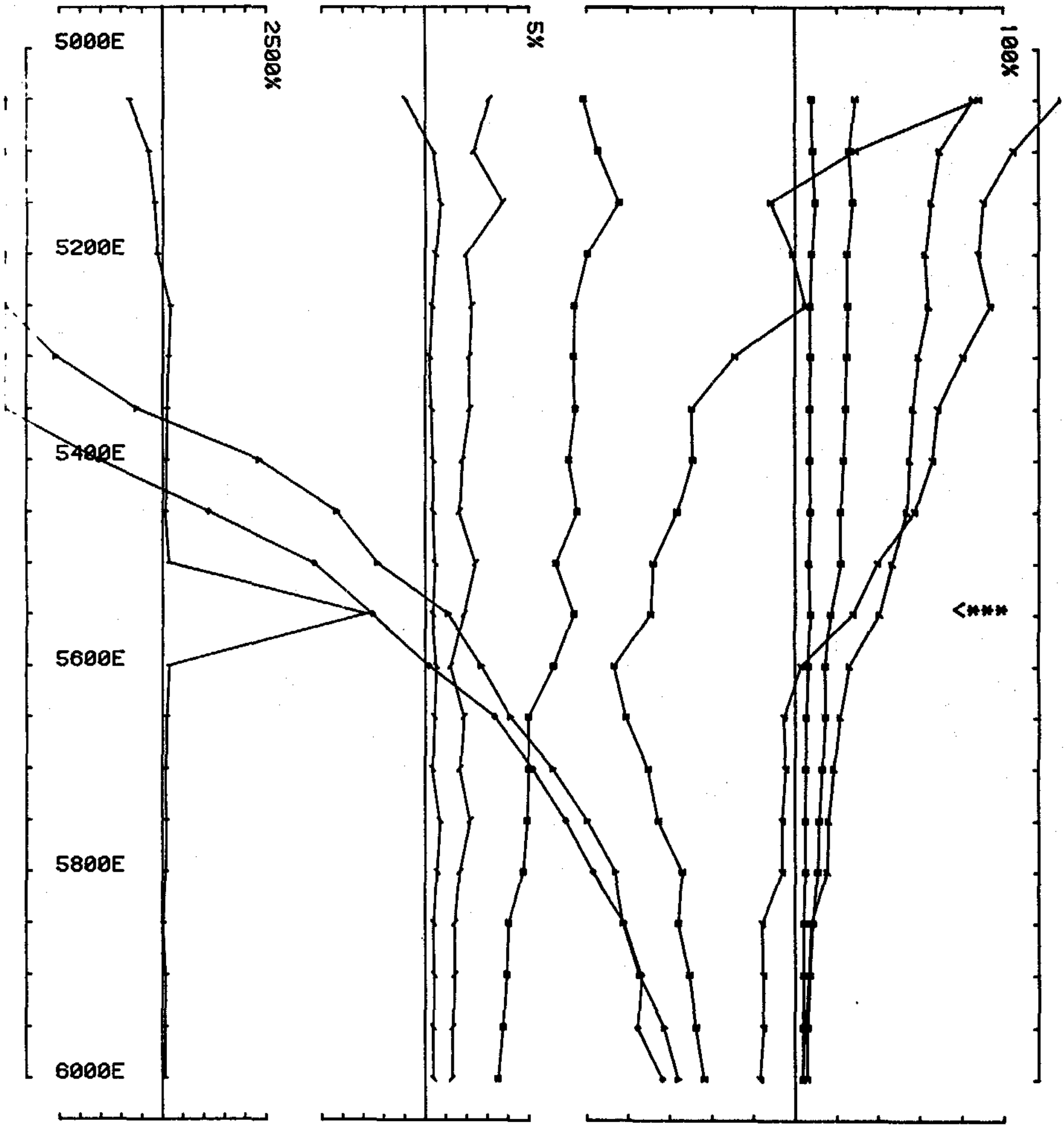
284089



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26
Loopno 0012 Line 10700N component Hz secondary Ch 1

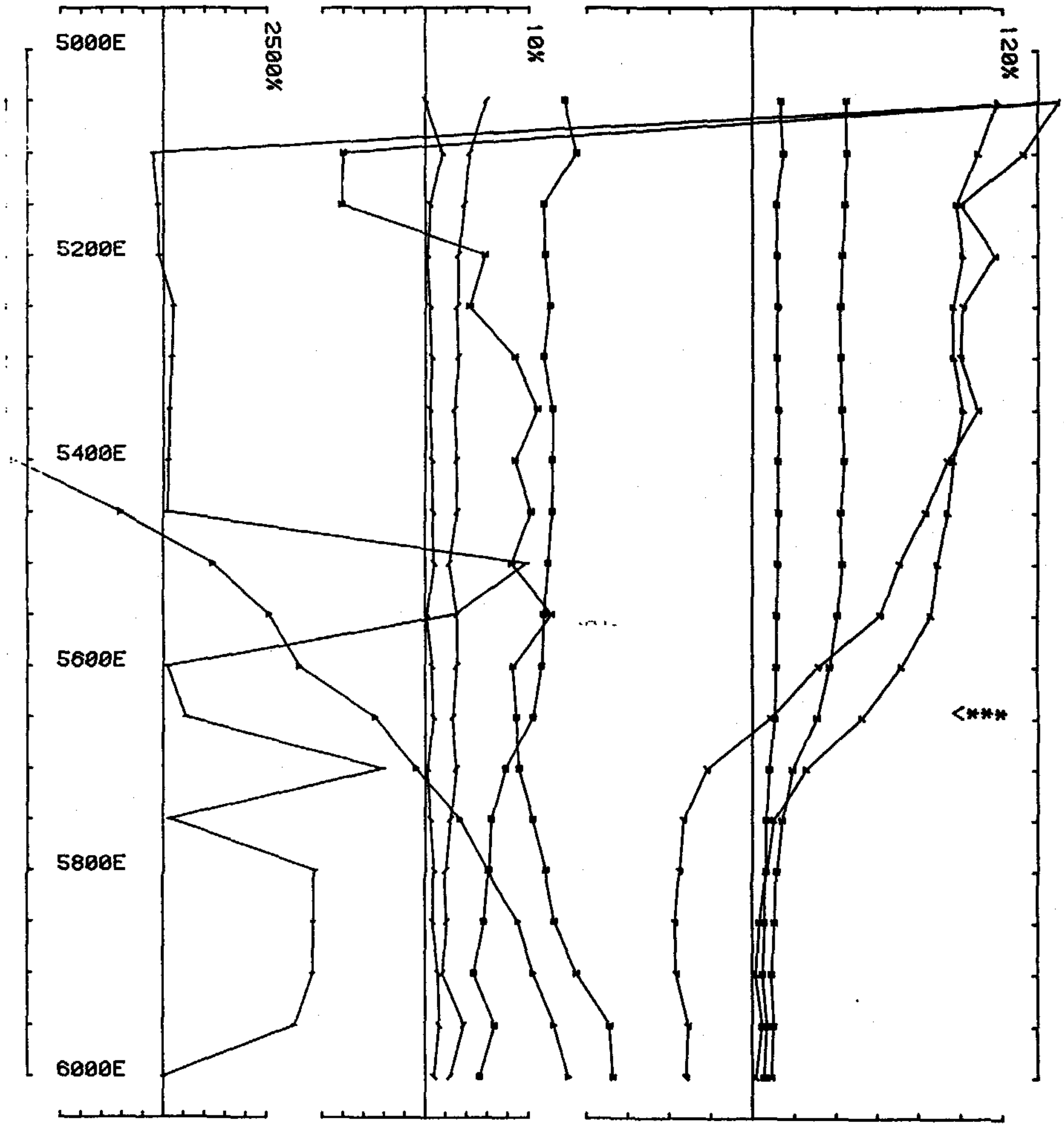
089

284090



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26 |
Loopno 0010 Line 10100N component Hz secondary Ch 1

284091

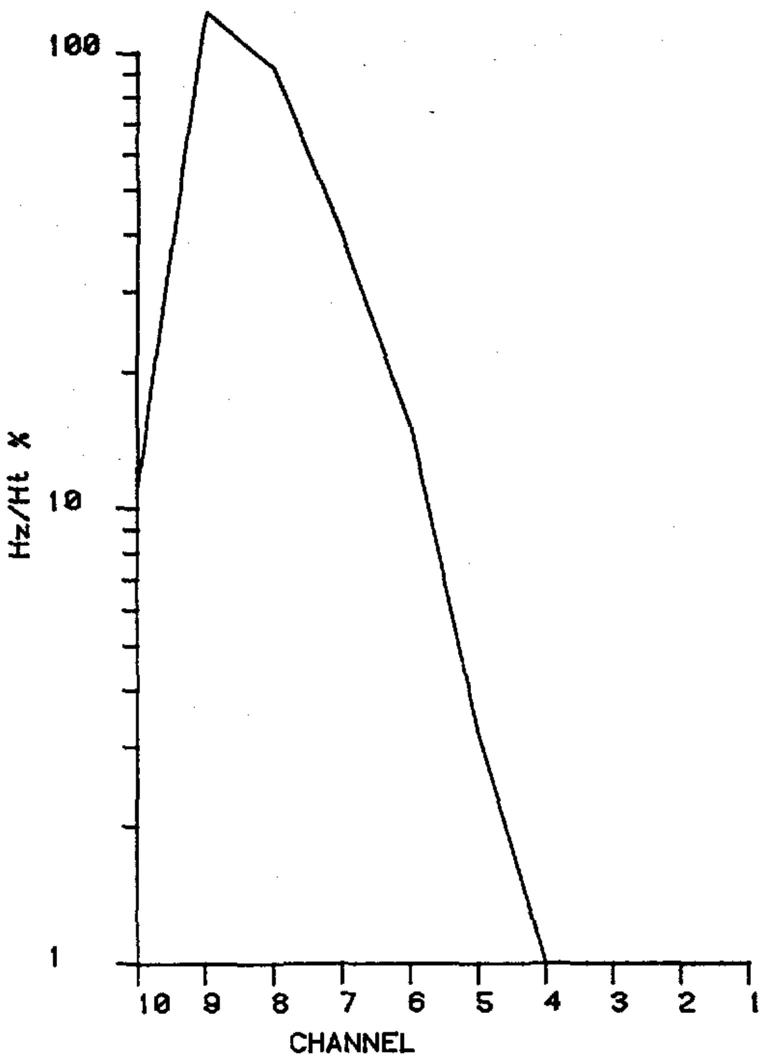


Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD Job 3001 freq(hz) 26.1
Loopno 0010 Line 10300N component Hz secondary Ch 1

Area QUE RIVER PROSPECT   ABERFOYLE EXPLORATION PTY LTD   operator ART

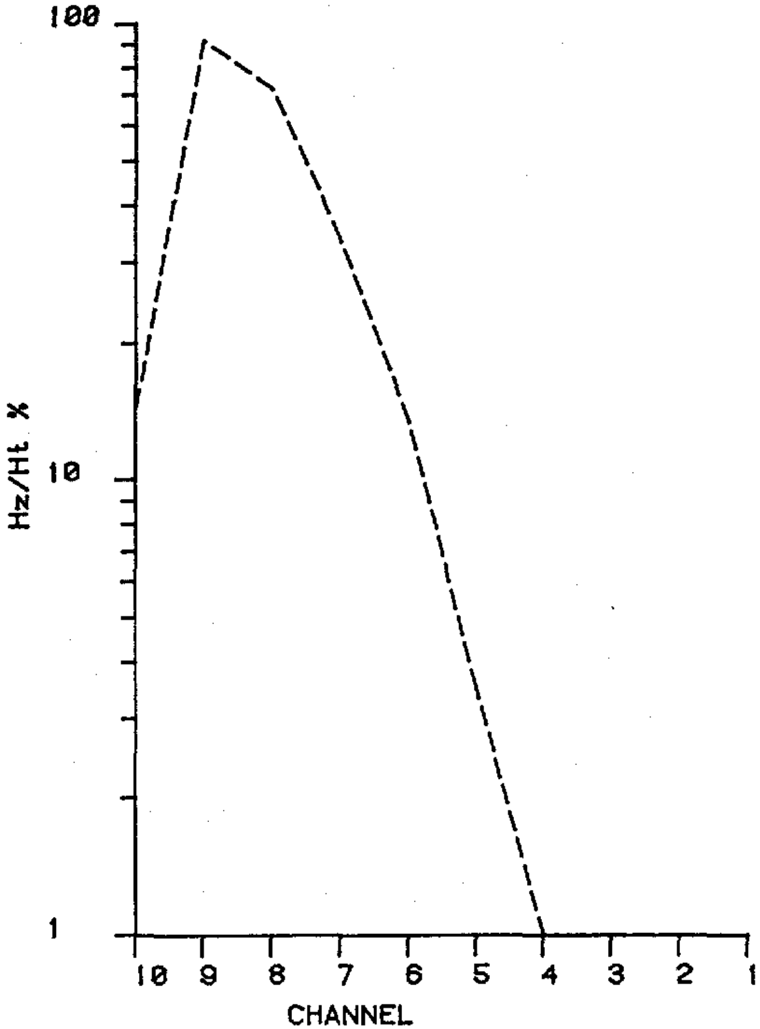
freq(hz) 26.2296 Loopno 0012

Line 10400N   station 5650-5900E component   Hz



284092

Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD operator ART
freq(hz) 26.2296 Loopno 0012
Line 10500n station 5750e component Hz



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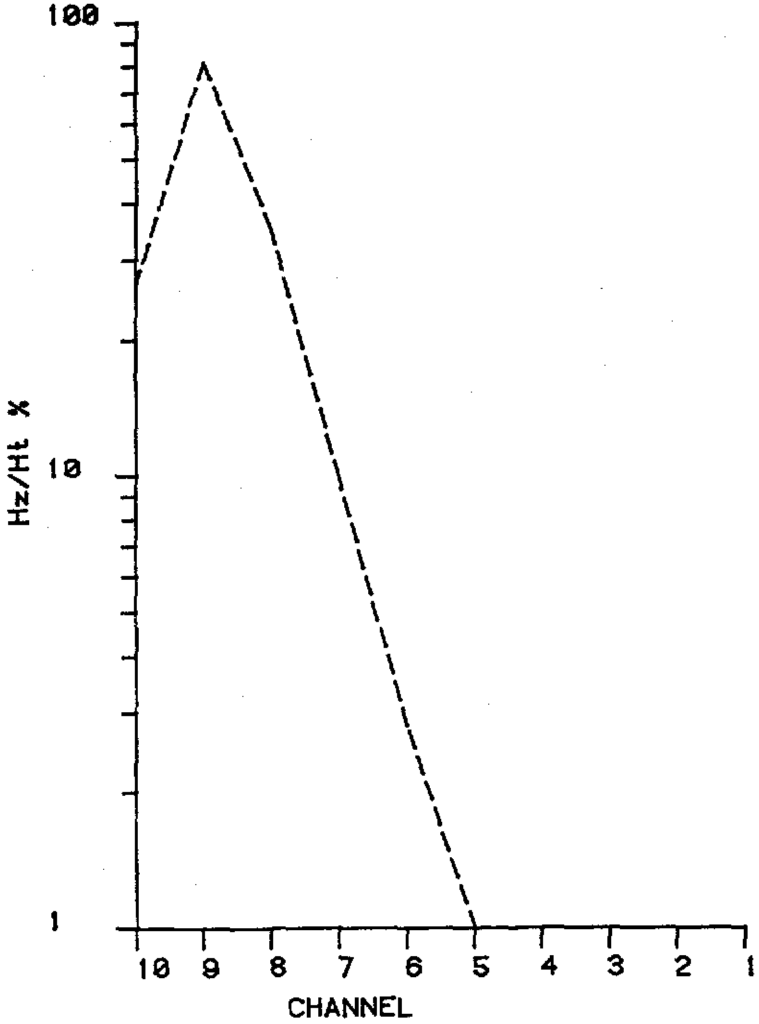
Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD operator ART
freq(hz) 26.2296 Loopno 0012
Line 10200N station 5625-5675E component Hz



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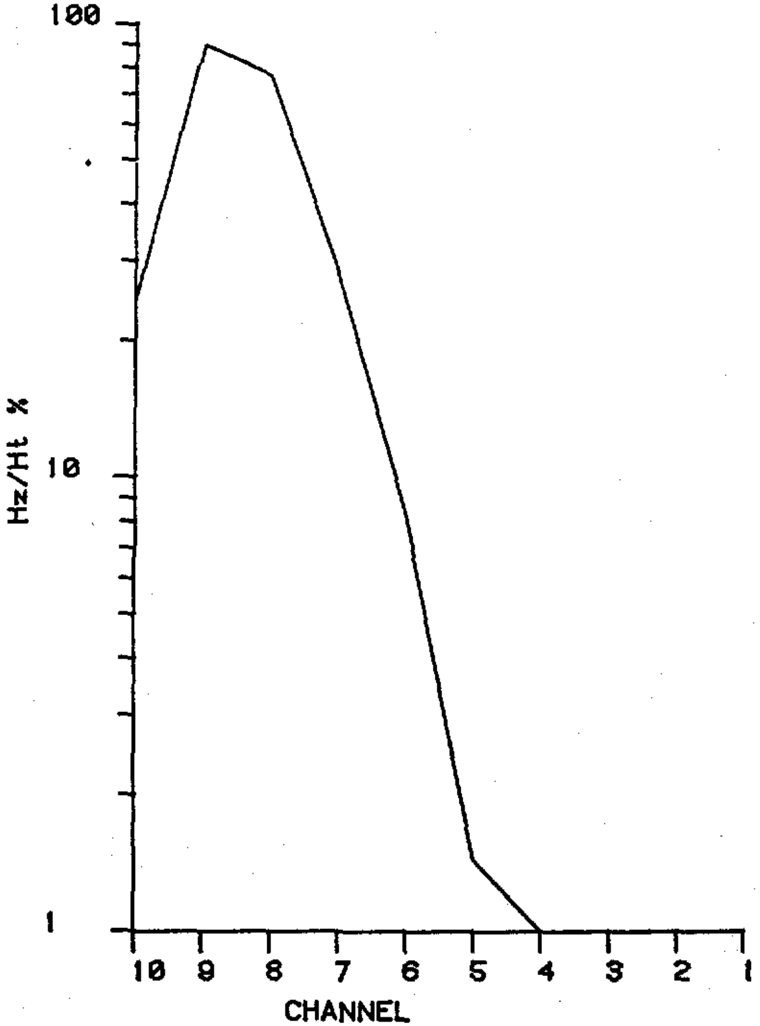
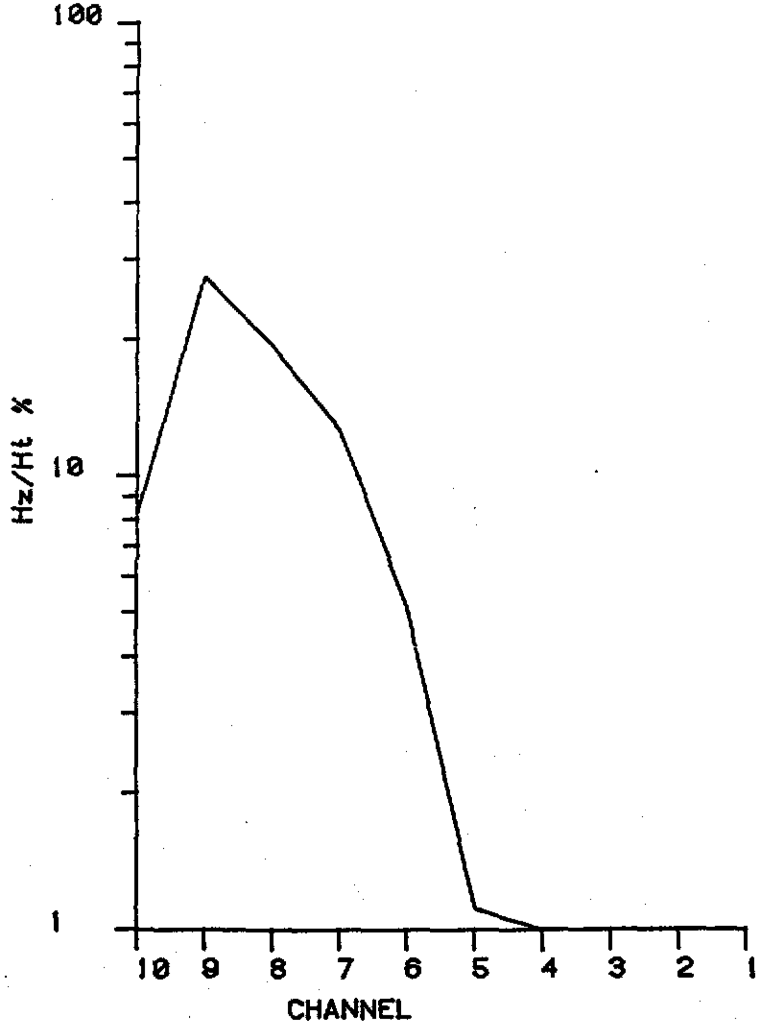
Area QUE RIVER PROSPECT ABERFOYLE EXPLORATION PTY LTD opera
freq(hz) 26.2296 Loopno 0012
Line 10300N station 5650-5875E component Hz



Area QUE RIVER PROSPECT ABERFOYLE EXPLORATIO
freq(hz) 26.2296 Loopno 0012
Line 10300N station 5700-5775E component Hz



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7. GEOCHEMISTRY

7.1 Introduction

Work completed in the period covered by this report included :-

1. C horizon Pb soil sampling along new UTEM cut lines in the south (Plate 71b).
2. Channel sampling along HEC road (Plate 71b in pocket at back).
3. Lead and sulphur isotope work.

All soil samples are C horizon. Soil sieved to -80 mesh.

7.2 At Hellyer

Several costeans in the area of the 1981 C horizon soil Pb anomaly were rock chip sampled. These results are plotted on plate HEL4X. Some high assays were obtained, but these appear to be very spotty (as was the C horizon Pb geochemistry). A gossan on 10300N, 5775E gave an assay of 43 ppm Ag. Pb assays for these costeans were in the range 155 ppm Pb to 620 ppm Pb. Cu and Zn assays in the costeans were unremarkable for the region.

The 1981 C horizon Pb soil geochemistry is shown on Figure 9 with the surface projection of the Hellyer ore body (as at 8/84) superimposed. It is thought that the surface geochemistry reflects remobilised sphalerite and galena in quartz carbonate veins. However, an upthrown eastern part of the ore body intersected since April projects up plunge to surface around the eye of the Pb anomaly. Leakage along the prominent north-south fault may also play a part.

7.3 <u>Elsewhere on the Licence</u>

Channel rock chip sampling along the HEC road is shown on plate MAC78 (in pocket at rear). The very poddy nature of high values is reflected by the samples close to a pyrite pod which assayed (265171) 90501 ppm Cu, 1425 ppm Pb, 3150 ppm Zn and 43 ppm Ag. The channel assay for the corresponding area assayed 130 ppm Cu 335ppm Pb, 255ppm Zn and 1.5ppm Ag (265377).

S isotope analyses of the above pyrite pod in highly altered (stringer zone? rocks) (19210N 5140E - 265171) gave δS^{34}_{cpy} value of +4.4‰ which is a value slightly lower than anything yet measured for S lens - the copper rich lens at Que River. Subsequent lead isotope work gave the following results :-

	208/206	207/206	206/204	207/204	208/204	Pb ppm
265171	2.0805	0.8499	18.375	15.617	38.229	930

Again, this `lies within the range for Hellyer mineralisation´.

Lines cut for the 1984 UTEM survey in the south were soil sampled and the results are still being processed. There were, however, no startling anomalies. The steep nature of the topography in this region may have affected the nature of the soil geochemistry.

An interpillow pyrite pod (265168) 10700N 5740E had a sulphur isotope determination done by the CSIRO. $\delta^{34}S_{cpT}$ was at +9.1‰ which is slightly on the high side of the `massive sulphide related´ pyrite. A lead isotope determination on this sample gave the following results (B. Gulson):-

Pb	208/206	207/206	206/204	207/204	208/204	Pb ppm
265168	2.0817	0.8507	18.370	15.627	38.241	78

This lies `within the range for the Hellyer mineralization and could be interpreted as coming from the same source´ (Gulson July 84).

Further Pb isotope work by B. Gulson will be reported on in the next report.

Costeaning and soil/rock sampling in the area of the `slate anomaly´ near MG2 did not reproduce the previous 1981 high C horizon Pb anomaly. As much of this anomaly occurs in a button grass bog, where there may be a possibility of hydromorphic effects, a costean was dug to bed rock was rock chip sampled and the adjacent button grass bog was also re-sampled. Th scale of the anomaly was not reproduced in either the bog or bed rock samples. Re-sampling exactly on the original line is not possible owing to earthworks at the MG2 drill site. There seems to be a problem with the very spotty nature of soil anomalies on the licence as a whole.

8. HELLYER PROSPECT DRILLING DETAIL

8.1 Introduction

The stratigraphic column presented here Figure 18 (Hel 23) is based on macroscopic core logging. To April, 1984 only preliminary thin section work has been undertaken. (Fander Appendices 14.1)

Based on the geology around Que River Mine, it was assumed in the early stages of drilling that the base metal sulphides were lensoidal and vertical like Que's PQ lens. Holes aimed at vertical extensions intersected stringer mineralization at depth. At the same time sub-horizontal correlations of lithostratigraphic units became evident. It was, however, the end of 1983, with all drilling for the year completed, before a formal programme to test for a sub-horizontal disposition of the ore body and enclosing lithologies was agreed upon. Drilling early in 1984 confirmed this interpretation.

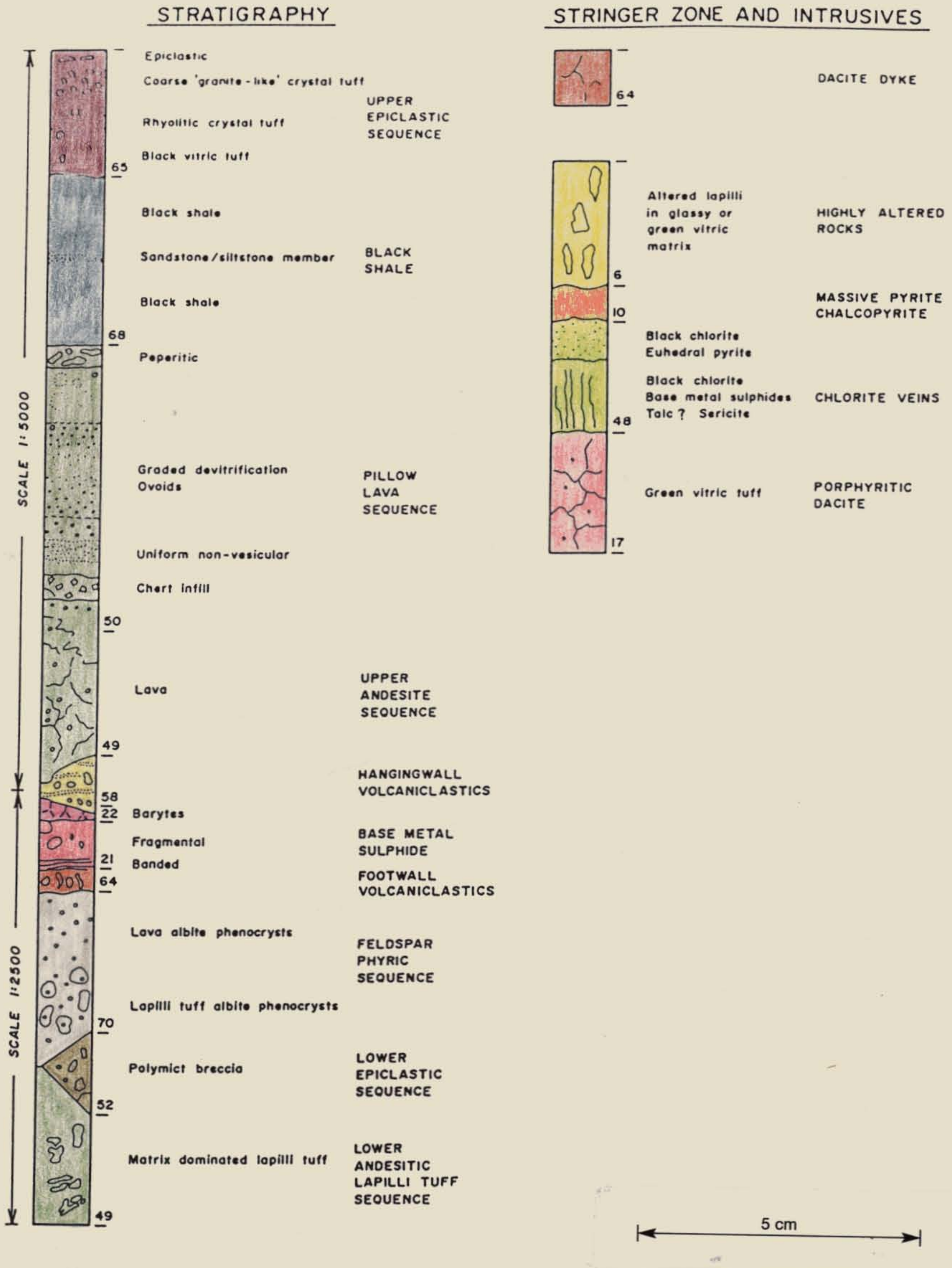
8.2 Summary

At Hellyer, Porphyritic Dacite ridges, heavily altered and intruded by a stringer zone cross cut and intrude a sequence of lavas. The lavas are overlain by black shale, rhyolitic crystal tuffs and epiclastics. Base metal sulphide rock occurs in the lava sequence immediately below and as a lateral equivalent of a distinctive tuff unit.

A **Stratigraphic Summary** is presented, as Figure 18 and an **Idealised Cross Section** - as Figure 19. A **Plan Projection** of

099

284100 Figure 18

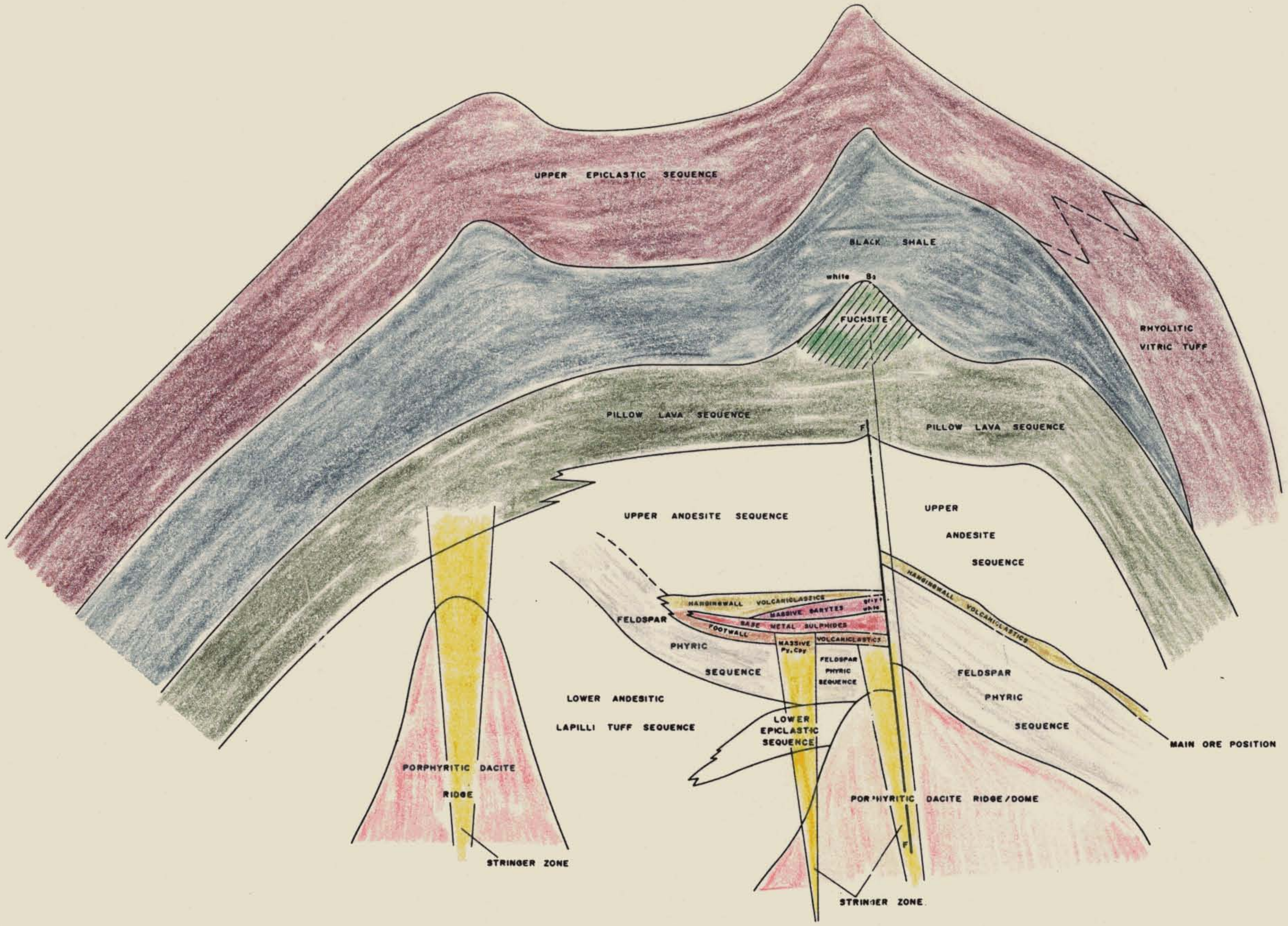


Aberfoyle Exploration Pty Ltd

Drawn. D.J.J.	HELLYER PROSPECT	Location code K 55/6/44
Traced. G.L.C.		Date June 1984
Checked D.J.J.	FIGURE 18 – STRATIGRAPHIC SUMMARY	Scale As shown
Revised by: Date		Plate Nº Hel 23

100

284101



100 0 100 200 metres

Aug. 1984 NB: This represents the cross-section as seen at the end of April 1984. Subsequent drilling has shown the BMS to be thicker with a distinct keel-shape. BMS have also been intersected in the main ore position on the east side of the fault.

5 cm

FIGURE 19

Aberfoyle Exploration Pty Ltd

NORTH WEST TASMANIA

HELLYER PROSPECT

IDEALIZED CROSS-SECTION

REVISIONS			
Init	Date	Init	Date

Compiled:	DJJ
Drawn:	DJJ
Traced:	GLC
Checked:	DJJ
Plate No:	Hel. 24

Location Code: K55/6/44 | Scale: As shown | Date: June, 1984 the drilling to date is presented as Figure 20. **Summary Assay Results** are tabulated in Table A. **Summary Drill Hole Logs** are included in section 8.3.

8.2.1 Some key aspects of the Hellyer geological setting obtained from drilling are :

(1) Sub-horizontal, north plunging volcanic sequence. Broad anticlinal fold.

(2) Prominent fault truncates ore in east - stratigraphy upthrown east of fault, particularly in the south.

(3) No base metal sulphide rock found east of the fault as at April 1984 but ore position and stringer zone intersected.

(4) Sequence cross cut by porphyritic dacite ridges and stringer zone.

8.2.2 In summary the principle stratigraphic elements are:

Upper Epiclastic Sequence - Rhyolitic brown to black crystal tuffs with varying black vitric matrix content. Intercalated black shale and epiclastic with shale and other volcanic fragments.

Que River Shale - Massive to finely laminated carbon rich black mudstone. Minor siltstone/sandstone.

Pillow Lava Sequence - Interpillow chert, black shale, pyrite and fuchsite near the BMS. Green to grey,

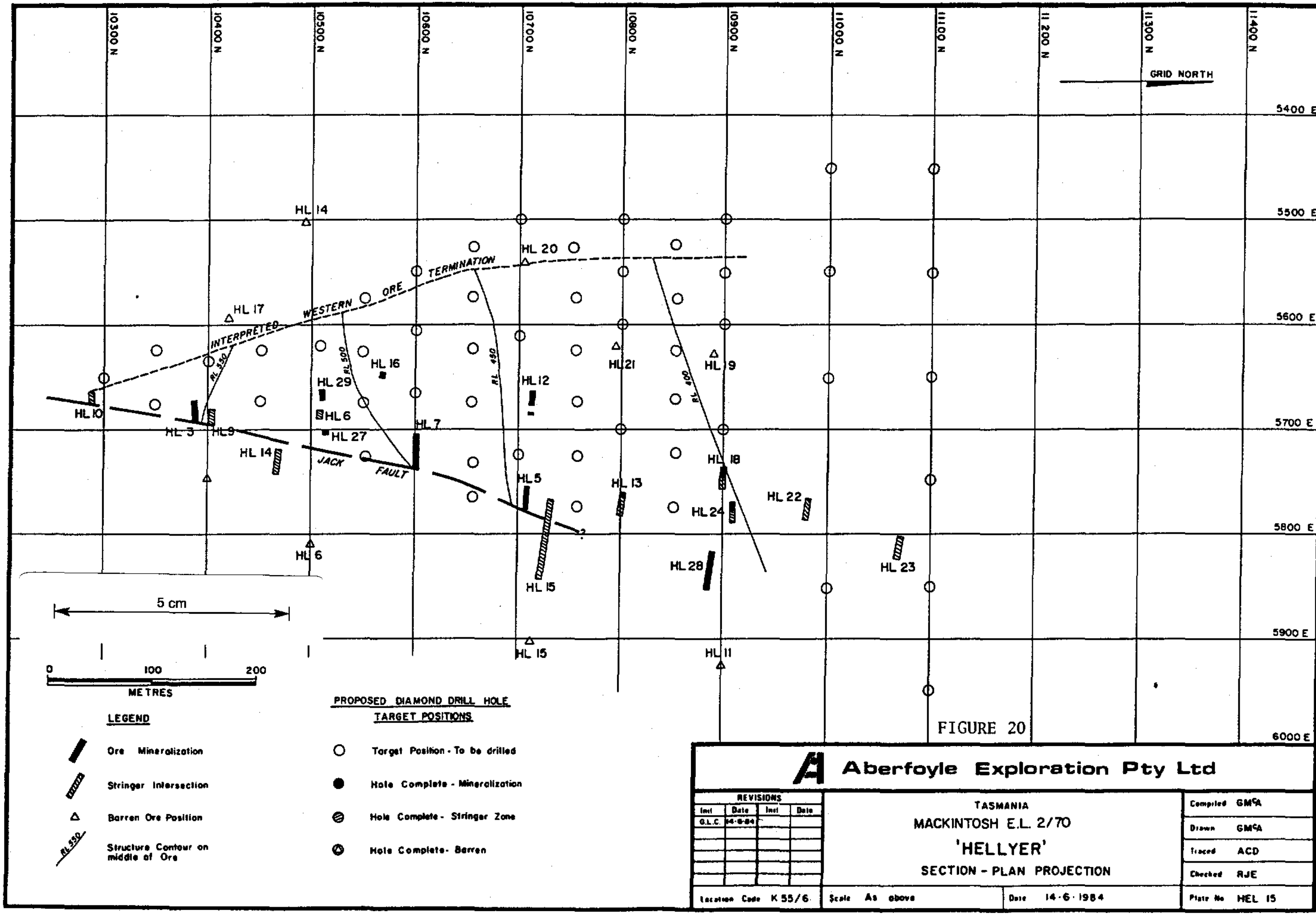

10300 N
10400 N
10500 N
10600 N
10700 N
10800 N
10900 N
11000 N
11100 N
11 200 N
11300 N
11400 N
GRID NORTH
5400 E
5500 E
5600 E
5700 E
5800 E
5900 E
6000 E
INTERPRETED WESTERN ORE TERMINATION
JACK FAULT
RL 550
RL 500
RL 450
RL 400
HL 3
HL 5
HL 6
HL 7
HL 9
HL 10
HL 11
HL 12
HL 13
HL 14
HL 15
HL 16
HL 17
HL 18
HL 19
HL 20
HL 21
HL 22
HL 23
HL 24
HL 27
HL 28
HL 29
5 cm
0
100
200
METRES
LEGEND
Ore Mineralization
Stringer Intersection
Barren Ore Position
Structure Contour on middle of Ore
PROPOSED DIAMOND DRILL HOLE TARGET POSITIONS
Target Position - To be drilled
Hole Complete - Mineralization
Hole Complete - Stringer Zone
Hole Complete - Barren
Aberfoyle Exploration Pty Ltd
REVISIONS
Init
Date
G.L.C.
14-6-84
TASMANIA
MACKINTOSH E.L. 2/70
'HELLYER'
SECTION - PLAN PROJECTION
Compiled GMcA
Drawn GMcA
Traced ACD
Checked RJE
Location Code K 55/6
Scale As above
Date 14-6-1984
Plate No HEL 15

FIGURE 20

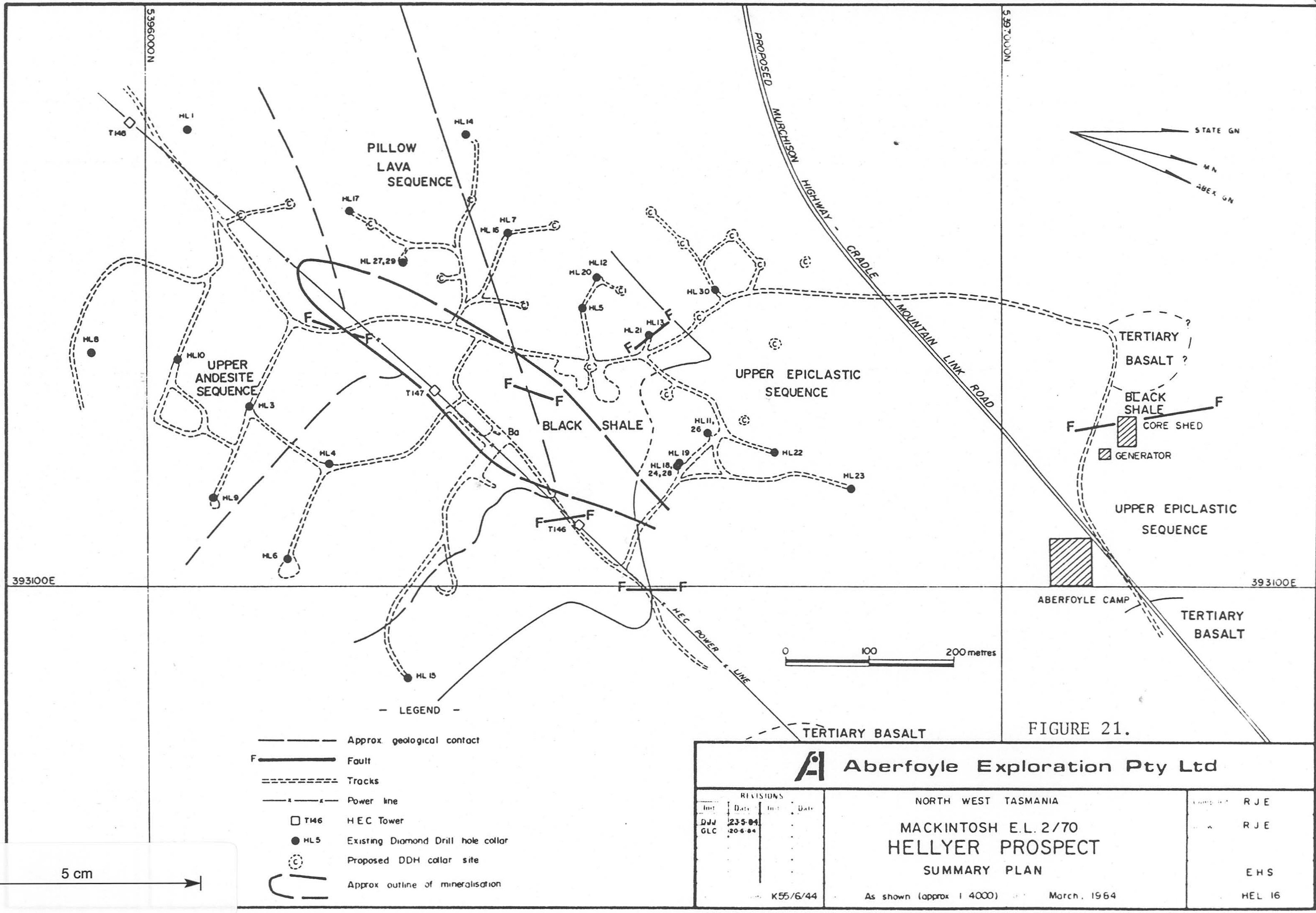


FIGURE 21.

5 cm

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TABLE A

Hole No	Interval from (m)	Interval to (m)	Length (m)	Ba (%)	Cu (%)	Pb (%)	Zn (%)	Ag (g/t)	Au (g/t)	s.g.
HL3	200.4	224.8	24.4	0.6	0.3	4.4	12.6	157	1.9	4.6
HL5	289.75	335.4	45.65	4.2	0.3	5.4	8.4	87	3.2	4.3
includes:	289.75	299.7	9.95	15.7	0.1	1.6	2.1	115	3.0	3.9
	299.7	328.8	29.1	1.7	0.3	7.1	11.2	90	3.7	4.7
	328.8	335.4	6.6	1.3	0.2	1.7	2.2	26	0.6	3.5
HL6	391.9	405.1	13.2	0.4	2.0	0.9	1.4	17	0.3	3.9
includes:	395.93	399.75	3.82	0.1	5.0	0.1	0.1	40	0.3	4.6
HL7	260.88	303.00	42.12	16.4	0.2	4.0	8.0	125	3.3	4.4
includes:	260.88	281.5	20.62	26	0.2	3.0	4.3	101	1.8	4.3
	281.5	303.0	21.5	6.8	0.2	4.9	11.4	146	4.6	4.6
HL8	267.2	269.0	1.8	1.2	0.03	0.8	0.9	9	0.6	
HL9	331.3	354.85	23.55	0.1	0.1	0.1	0.2	5	0.2	
HL10	179.9	197.00	17.1	0.2	0.04	0.6	0.9	6	0.1	
HL12	260.00	322.0	62.0	0.3	0.15	3.0	4.9	62	0.8	
includes:	262.0	279.5	17.5	0.5	0.4	6.3	9.3	49	1.1	
	300.9	304.9	4.0	0.1	0.2	12.0	18.7	557	3.2	
	319.6	322.0	2.4	0.1	0.3	5.8	11.3	62	0.3	
HL13	319.3	326.0	6.5	0.4	1.0	1.9	4.1	48	0.6	
	326.0	357.0	31.0	1.8	0.3	1.1	1.5	10	0.4	
HL14	549.8	599.33	49.53	0.3	0.1	0.7	1.2	8	0.2	2.96
HL15	410.0	464.0	54.0	0.2	0.2	0.7	1.4	11	0.1	2.99
HL16	243.4	250.78	7.38	0.2	0.18	9.2	15.0	262	2.5	4.68
HL17	118.9	120.3	1.4	0.3	0.0	0.0	1.3	1	0.0	3.09
HL18	273.90	293.85	19.95	0.1	0.4	7.8	13.3	214	3.1	4.3
	293.85	348.0	54.15	0.04	0.1	1.4	2.2	5	0.1	3.1

vesicular. Zones with graded deVitrification ovoids mirrored on chloritic areas. Also uniform non vesicular units. Peperitic, especially at contact with black shale. Minor black shale units.

Upper Andesite Sequence - Vesicular green lava. Prominent in south and east of fault.

Hangingwall Volcaniclastic Sequence - Polymict breccia/lithic tuff or fine bedded green/grey tuff. Large flow banded dacite blocks in tuff matrix. Lateral equivalent of base metal sulphide rock. Distinctive marker unit.

Sulphide Rock (Base Metal Sulphide-BMS) - Coarsely crystalised barytes top. Fragmental appearance. Pyrite rich. Sphalerite, galena intergrown with pyrite and mostly fine-gained. Some banded brown sphalerite, pyrite, galena especially towards base and on edges of unit.

Footwall Volcaniclastic Sequence - Polymict/lithic tuff with strung out pumice-like fragments.

Feldspar Phyric Sequence - A distinctive grey lava/lapilli tuff with striking albite phenocrysts.

Lower Epiclastic Sequence - Confined to south. Polymict breccia.

Lower Andesite Lapilli Tuff Sequence - Green lapilli tuff.

8.2.3 Stringer Zone

Black Chlorite Veins - May contain coarse recrystallised Gn, Sp, Py, Cpy. Often only euhedral finely disseminated Py. Up to several meters thick.

Sericitized Highly Altered Rock - Primary textures nearly obliterated - grades into prophyritic dacite. Aligned fragments.

Silicified Rock - Glassy silicification. Aligned fragments.

Chalcopyrite - Pyrite Rock - Coarse massive Cpy Py.

8.3.4 Porphyritic Dacite Ridge (`vent unit´)

Light green. Distinctive autobrecciated appearance. Geochemically elevated base metals. Highly altered.

8.3.5 Veining

All the hangingwall rocks are pervasively veined with white quartz-carbonate veins.

8.3.6 Alteration

Position	Type
Immediate BMS hangingwall and in patches up to 100m above BMS	Fuchsite Light green sericite, leucoxene fine-grained chlorite
Hangingwall	Pink K-Feldspar ± green chlorite ± pyrite
Footwall	Stringer zone type.

8.3 Hellyer Prospect Diamond Drilling Summaries

A tabulation of Hellyer diamond drilling hole details, geology and mineralisation follows overleaf.

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HELLYER PROSPECT
DIAMOND DRILLING SUMMARIES

D J JACK

HELLYER PROSPECT – Diamond drilling summary

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL1	10205.0	5543.2	637.5	89	-45E	3.2.82	17.2.82	179.2	179.2	10200N	0.0 - 179.2 Upper Andesite lava (EOH) 85.4 - 179.2 pink Si/K alteration 84.4 - 96.4 Si/K/Py/chlorite alteration.		
HL2	10252.2	6294.8	686.3	269	-45W	23.2.82	5.3.82	156.8	336.0	10200N	0.0 - 88.21 Que River Sequence 0.0 - 84.25 Rhyolitic volcanics 84.25-88.21 Black shale 88.21-156.8 (EOH) Pillow Lava Sequence. Intense green fuchsite alteration		
HL3	10393.5	5827.5	705	270	-45W	20.7.83	10.8.83	358	694	10400N	0.0 - 138.5 Upper Andesite lava 138.5-140.5 bedded tuff 140.5-166.2 breccia intense pink Si/K/chlorite/Py alteration 166.2-172 Hanging Wall Volcaniclastics 172 Main Ore Position 172-180.1 Feldspar phyric lava/breccia. 180.1-188 Polymict volcani-clastics (feldspar phyric lava and pumice-like fragments 188-195.5 Feldspar phyric 'dacite' breccia. 195.5-197.7 Fault. 197.7-200.4 Glassy polymict lithic lapilli tuff. 200.4-224.8 Massive base metal sulphides 224.8-240.7 Footwall pumiceous volcaniclastics. 240.7-269 Feldspar Phyric Sequence. 269-313 Porphyritic Dacite Sequence. 313-358.0 Lower polymict Epiclastic Sequence.	540 to 559	200.4-224.8 m: 24.4 m of 0.6% Ba 0.3% Cu 4.4% Pb 12.6% Zn 157 g/t Ag 1.9 g/t Au (s.g: 4.6)

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL4	10504.3	5855.1	716	270	-45W	13.8.83	29.8.83	271	965	10500	0.0-54 Pillow Lava Sequence 54-189.6 Andesite lava intense pink Si/K chlorite, Py alteration 169.3-185. 189.6-198.8 Hanging Wall Volcaniclastic Sequence. Py 80, 193.3-194.7 minor barytes 192.5-193.3 Chert, sericite, Si/K alteration 198.8-203.2 Fault zone 203.2-271 (EOH) Andesite lava		
HL5	10716.4	5569.2	685	90	-50E	30.8.83	23.9.83	441.6	1406.6	10700N	0.0-82.7 Que River Sequence black shale 82.7-91.0 Highly vesicular andesitic breccia Py 60. 91.0-289.5 Pillow Lava Sequence including green/grey alteration 278.4-289.5 with intense green fuchsite 282.9-284.5 289.5-289.75 Fault 289.75-292.5 Py in glassy quartz 292.5-299.75 Grey and white barytes 299.75-330.2 Massive base metal sulphide. 330.2-338.0 Py in silica matrix including 330.2-335.2 major shearing and faulting subsidiary Gn Sph minor barytes. Intense sericite/chlorite alteration. 338.0-391.9 Lower Andesite lapilli Tuff/breccia Sequence Heavily chloritized and pyritized. 391.9-439.0 Porphyritic Dacite Vent Unit and andesite breccia 439.0-441.6 EOH Lower Andesitic lapill Tuff Sequence. Intense stringer chlorite Py Gn Sph	contact zone 430 to 463	Revised intervals 289.75-335.4 m (45.65m): 4.2% Ba 0.3% Cu 5.4% Pb 8.4% Zn 87 g/t Ag 3.2 g/t Au (s.g: 4.3) includes 289.75-299.7m (9.95 m) 15.7% Ba 0.1% Cu 1.6% Pb 2.1% Zn 115 g/t Ag 3.0 g/t Au (s.g: 3.9) 299.7-328.8m (29.1m) massive sulphide interval 1.7% Ba 0.3% Cu 7.1% Pb 11.2% Zn 90 g/t Ag 3.7 g/t Au (s.g: 4.7) 328.8-335.4 m (6.6 m) 1.3% Ba 0.2% Cu 1.7% Pb 2.2% Zn 26 g/t Ag 0.6 g/t Au (s.g: 3.5)

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL6	10500	5977	711.6	270	-45W	24.9.83	15.10.83	484.0	1890.6	10500	0.0-96 Pillow Lava Sequence. 96-184.2 Andesite lava 184.2-193 Breccia. Pink Si/K Py, chlorite 193-225 Andesite lava 225-234.6 Hanging Wall polymict Volcaniclastics. 234.6 Main Ore Position 234.6-301.25 Feldspar Phyric lava Sequence. 301.25-355.8 Porphyritic Dacite Vent Unit. 355.8-358 Fault zone. 358-360.2 Porphyritic Dacite Vent Unit. 360.2-367 Lower polymict epiclastics. 367-391.9 Porphyritic Dacite Vent Unit chlorite, talc, minor fuchsite, pumice-like stretching stringer alteration 371.5-391.9 391.9-399.75 Massive pyrite, Chalcopyrite 399.75-403.8 Chlorite 403.8-453 Porphyritic Dacite Vent Unit with variably intense stringer alteration. 431.5-433.5 Faulting and shearing. 453-466.9 Grey dacite intrusion 466.9-481.7 Lower polymict Epiclastic Sequence 481.7-484 Lower Andesitic lapill Tuff Sequence - altered.	429 to 435	391.9-405.1m (13.2m): 0.4% Ba 2.0% Cu 0.9% Pb 1.4% Zn 17.4 g/t Ag 0.3 g/t Au (s.g: 3.9) includes: 395.93-399.75m (3.82m) massive sulphide interval 0.1% Ba 5.0% Cu 0.1% Pb 0.1% Zn 40 g/t Ag 0.3 g/t Au (s.g: 4.6)
HL7	10602	5521	689.3	90	-45E	30.9.83	12.10.83	346.6	2237.2	10600	0.0-38.2 Que River Sequence black shale. 38.2-38.7 Highly vesicular contact zone. 38.7-260.7 Pillow Lava Sequence. 257-260.7 alteration. 260.7-260.9 Hanging Wall Volcaniclastics		

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL7 cont											26Ø.9-3Ø2.8 Massive base metal sulphides 26Ø.9-281 Massive barytes richtop. 3Ø2.8-3Ø4.5 Faulting and shearing. 3Ø4.5-3Ø8.5 Footwall pumiceous volcaniclastics 3Ø8.5-346.6 (EOH) Feldspar Phyric lava/breccia Sequence. altered 3Ø8.5 - 323.8.	481 to 5Ø7	mineralised zone 26Ø.88-3Ø3.ØØm (42.12m) 16.4% Ba Ø.2% Cu 4.Ø% Pb 8.Ø% Zn 125 g/t Ag 3.3 g/t Au (s.g: 4.4) includes: 26Ø.88-281.5Øm (2Ø.62m) 26.Ø% Ba Ø.2% Cu 3.Ø% Pb 4.3% Zn 1Ø1 g/t Ag 1.3 g/t Au (s.g: 4.3) 281.5-3Ø3.Ø m (21.5m) massive sulphide interval 6.8% Ba Ø.2% Cu 4.9% Pb 11.4% Zn 146 g/t Ag 4.6 g/t Au (s.g: 4.6)
HL8	1Ø193.4	5835.6	697.Ø	27Ø	-45W	13.1Ø.83	28.1Ø.83	39Ø.Ø	2627.6	1Ø2ØØ	Ø.Ø-235 Upper Andesite lava Sequence. 1Ø9-114 pink Si/K, Py alteration. 114-235 patchy pink Si/K alteration. 235-241 Hanging Wall Volcaniclastics. 241 Main Ore Position 241-246.8 Feldspar Phyric Sequence. 246.8-248.5 Andesitic lapilli tuff. 248.5-25Ø.8 Lower polymict epi-clastics. 25Ø.8-3Ø9.8 Porphyritic Dacite Vent Unit including prominent stringer alteration and mineral-isation.		

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D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL 8 (cont)											309.8-356 Lower polymict epi-clastics 356-357.7 Porphyritic Dacite Vent Unit. 357.7-366 Mixed zone. 366-390 (EOH) Feldspar Phyric Sequence (partly vesicular)		
HL9	10394.5	5941.7	703.8	270	-45W	14.10.83	26.10.83	439.0	3066.2	10400	0.0-245.4 Upper Andesite Sequence. 0-194.2 lava 194.2-245.4 lapilli tuff 68.0-95.0 pink Si/K/Py chlorite alteration. 245.4-265.5 Hanging Wall Volcaniclastics. 265 Main Ore Position 265.5-275.4 Dacite 275.4-288 Feldspar Phyric Sequence. 288-314.5 Mixed porphyritic Dacite Vent Unit and andesitic lapilli tuff. 314.5-373.2 Stringer Zone mineralisation and alteration. Fault zone 320.6-321.3 336.42-337.63 355 373.2 373.2-388.3 Porphyritic Dacite Vent Unit matrix in mixed unit. 388.3-395.6 Lower polymict epi-clastics - altered. 395.6-411.6 Porphyritic Dacite Vent Unit. 411.6-414.5 Lower polymict epi-clastics - altered. 414.5-439.0 (EOH) Lower andesitic lapilli tuff.		
HL10	10292.1	5806.6	692.3	270	-45W	27.10.83	3.11.83	293.2	3359.4	10300	0.0-179.0 Upper Andesite Sequence. 61-74 Si/K/chlorite/Py alteration. 127.8-179 Si/K alteration 50.5-50.7 Massive Py 59.5-61.5 gossan. 179.0-179.9 Fault. 179.9-197 Stringer mineralisation and alteration.		

284114

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL10 (cont)											197-211.3 Porphyritic Dacite Vent Unit. 211.3-223.9 Stringer lapilli tuff. 223.9-293.2 (EOH) Feldspar Phyric Sequence.		
HL11	10917.2	5645.2.	681.7	90	-50E	29.10.83	8.11.83	418.0	3777.4	10900	0.0-174.4 Que River Sequence. 0.0-73.3 epiclastic 73.3-174.4 Black shale 174.4-382.0 Pillow Lava Sequence. 382.0-418.0 (EOH) K/Si/chlorite breccia.		
HL12	10720	5529	684.3	92	-55E	4.11.83	21.11.83	Aban-doned 357	4134.4	10700N	0.0-78.0 Que River Sequence black shale 78.0-96.0 Contact zone 78.0-93.0 mixed black shale/ volcanics. 83.0-96.0 highly vesicular andesite breccia. 96.0-167 Pillow Lava Sequence 167-238.5 Upper Andesite lava 238.5-260 Hanging Wall Volcaniclastics. 260-279.5 Base metal sulphide 279.5-301 Pyritic stringer lapilli tuff. 301-304.9 Base metal sulphide 304.9-319.6 Stringer lapilli tuff. 319.6-322 Base metal sulphide 322-336 Stringer lapilli tuff highly altered. 336-342 Chlorite/carbonate rock. 342-349 Stringer lapilli tuff highly altered. 349-357.0 (EOH) Chlorite/carbonate rock.	- 392 to 464 - 425 to 428.5	260.0-322.0 (62.0m) 0.3% Ba 0.15% Cu 3.0% Pb 4.9% Zn 62 g/t Ag 0.8 g/t Au includes: 262.0-279.5 (17.5m) 0.5% Ba 0.4% Cu 6.3% Pb 9.3% Zn 49 g/t Ag 1.1 g/t Au 300.9-304.9 (4.0m) 0.1% Ba 0.2% Cu 12% Pb 18.7% Zn 557 g/t Ag 3.2 g/t Au 319.6-322.0 (2.4m) 0.1% Ba 0.3% Cu 5.8% Pb 11.3% Zn 62 g/t Ag 0.3 g/t Au

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D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL13	10802.94	5570.13	692	85	-51W	9.11.83	21.11.83	475.0	4609.4		0.0-128.3 Que River Sequence black shale 128.3-319.3 Pillow lava Sequence including 168.7-170.3 black shale. 300-319.5 green alteration. 319.3-326 Base metal sulphide 326-343.75 Intense stringer altered lapilli tuff with massive base metal sulphide 332.5-334.25, 337-338.84, 341.9-342.4 white baryte rich 342.4-343.75. Faults 327.4-327.9, 334.25-334.9, 335.1-335.3, 343.75-353.2 Chlorite rock. 353.2-~430 Stringer lapilli tuff matrix dominated. ~430-475.0 EOH Porphyritic Dacite breccia Vent Unit.	410 to 415	319.3-326.0 (6.5m) 0.4% Ba 1.0% Cu 1.9% Pb 4.1% Zn 48 g/t Ag 0.6 g/t Au 326.0-357.0 (31.0m) 1.8% Ba 0.3% Cu 1.1% Pb 1.5% Zn 10 g/t Ag 0.4 g/t Au
HL14	10500.91	5350.16	686.8	91	-50E	22.11.83	9.12.83	601.6	5211	10500	0.0-85.0 Que River Sequence - black shale. 85.0-92.0 Contact zone. 92.0-225.4 Pillow Lava Sequence. 225.4-234.1 Hanging Wall Volcaniclastics. 234.1 Main Ore Position. 234.1-314.1 Feldspar Phyric lava Sequence. 314.1-315.6 Green lava. 315.6-363 Lower polymict Epiclastic Sequence. 363-419.5 Variably stringer altered lower andesitic lapilli tuff. 419.5-421 Lower polymict Epiclastic Sequence. 421-435.4 Intrusive dacite. 435.4-539.8 Lower Andesite lapilli Tuff/lava Sequence. 539.8-553.5 Porphyritic Dacite breccia Vent Unit. 553.5-572.2 Stringer Zone. 572.2-578.8 Porphyritic Dacite Vent Unit. 578.8-601.6 EOH Stringer Zone altered porphyritic Dacite Vent Unit. Faulting 599.2-600.8		549.8-599.33 (49.53 m) 0.3% Ba 0.1% Cu 0.7% Pb 1.2% Zn 8 g/t Ag 0.2 g/t Au (s.g: 2.96)

28416

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL15	10694.25	6050.10	693.2	277	-56W	29.11.83	15.12.83	526.4	5737.4	10700	0.0-107.0 Que River Sequence - black shale. 107.0-~200 Pillow Lava Sequence. 200-242.5 Pillow Lava Sequence/ Upper Andesite lava. 242.5-253.3 Si/K/chlorite/Pyrite breccia. 253.3-263.3 Hanging Wall Volcaniclastics. 263.3-361.2 Feldspar Phyric lava/ breccia Sequence. 309-311.4 Green lava. 361.2-395 Porphyritic Davite Vent Unit. 395-511 Stringer lapilli tuff, alteration and mineralisation. Minor porphyritic Dacite Vent Units. Faults 484.4 - 486 486.5 - 487.2 505.6 - 506.6 509.6 - 510.3 510.7 - 511 511 - 526.4 Lower Andesitic lapilli Tuff Sequence.		410.0-464.0 (54.0 m) 0.2% Ba 0.2% Cu 0.7% Pb 1.4% Zn 11 g/t Ag 0.1 g/t Au (s.g: 2.99)
HL16	10602	5520	689.3	90	-56W	11.1.84	23.1.84	283.4	6020.8	10500N	0.0-34.6 Que River Sequence - black shale. 34.6-37.6 Contact zone. 37.6-241.2 Pillow Lava Sequence. 241.2-243.4 Hanging Wall Volcaniclastics. 243.4-250.78 Base metal sulphide. 250.78-253.35 Footwall pumiceous volcaniclastics. 253.35-254.2 Base metal sulphide. 254.2-271.3 Footwall volcaniclastics including porphyritic Dacite Vent Unit fragments. 271.3-283.4 EOH Polymict unit grades into Feldspar Phyric breccia Sequence.	475 to 484	243.3-250.78 (7.38 m) 0.2% Ba 0.2% Cu 9.2% Pb 15.0% Zn 262 g/t Ag 2.5 g/t Au (s.g: 4.68)

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL17	10421.32	5564.25	672.77	90	-75W	24.1.84	31.1.84	169.7	6190.5	10400N	0.0-67.2 Upper Andesite Sequence. 67.2-113.2 Pillow Lava Sequence. 113.2-130.4 Hanging Wall Volcaniclastics. Including 117.5-120.3 Main Ore Position. 130.4-151.5 Porphyritic Dacite Vent Unit. 151.5-152.3 Polymict tuff - possible hanging wall volcaniclastics. 152.3-169.7 EOH Feldspar Phyric lapilli tuff/breccia Sequence. Altered.		118.9-120.5 (1.4m) 0.3% Ba 0.0% Cu 0.0% Pb 1.3% Zn 1 g/t Ag 0.0 g/t Au (s.g: 3.09)
HL18	10900.9	5694.5	686.4	81	-80	1.2.84	11.2.84	374.6	6565.1	10900N	0.0-170.1 Que River Sequence. 0-21.2 Black shale 21.2-31.8 Epiclastic 31.8-170.1 Black shale 170.1-171.5 Contact zone 171.5-263.5 Pillow Lava Sequence. 263.5-273.9 Hanging Wall Volcaniclastics 273.9-293.8 Base metal sulphides. 288-293.8 talc <10% 293.8-374.6 Stringer zone. Includes non stringer base metal sulphides 320.6-324	397 to 416.7 367.2 to 370.6	273.90-293.85 (19.95m) 0.1% Ba 0.4% Cu 7.8% Pb 13.3% Zn 214 g/t Ag 3.1 g/t Au (s.g: 4.3) 293.85-348.0 (54.15m) 0.04% Ba 0.1% Cu 1.4% Pb 2.2% Zn 5 g/t Ag 0.1 g/t Au (s.g: 3.10)

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL19	10900.5	5687.1	686	261	-79	12.2.84	22.2.84	351.6	6916.7	10900N	0.0-170.1 Que River Sequence. 0.0-13.5 Black shale 13.5-41.7 Epiclastic 41.7-170.1 Black shale. 170.1-188.7 Pillow Lava Sequence. 188.7-191.8 Black shale. 191.8-201.3 Pillow Lava Sequence. 201.3-215.4 Hanging Wall Stringer alteration 201.3-211.8. 215.4-226.6 Stringer Zone. 226.6-227.7 Fault zone. 227.7-230.8 Hanging Wall Volcaniclastics? 230.8-245.7 Feldspar Phyric lava Sequence. 245.7-287.3 Pillow Lava Sequence. 287.3-299.5 Stringer Zone. 299.5-351.6 EOH Feldspar Phyric lava/breccia Sequence.		
HL20	10712.6	5526.4	683.8	109.8	-87	16.2.84	23.2.84	268.5	7185.2		0.0-79.3 Que River Sequence - Black shale. 79.3-145.0 Pillow Lava Sequence. 145.0-196.5 Andesite lapilli tuff highly altered. 196.5-203.9 Porphyritic Dacite Vent Unit. 203.9-222.6 Feldspar Phyric - porphyritic Dacite Vent Unit mixture. 222.6-268.5 EOH Feldspar Phyric lava/breccia.		

D.H. No.	CO-ORDINATES NORTH	EAST	ELEV-ATION	GRID BRG	ANGLE	COMMENCE	COMPLETE	DEPTH m	CUMULATIVE METRES	SECTION	GEOLOGY/MINERALISATION	RL OF INTERSECTION	INTERSECTION
HL21	10802.7	5569.2	690.4	84.5	-73	21.2.84	1.3.84	298.3	7483.5		0.0-95.4 Que River Sequence - Black shale. 95.4-205.0 Pillow Lava Sequence. 191.9-194 Faulting. 205.0-298.3 EOH Feldspar Phyric lava breccia Sequence.	492	205-206.8m 40% Py with minor CO3-Sp-Gn veining only.
HL22	10999.1	5641.2	684.0	88.5	-69.2	23.2.84	12.3.84	514.5	7998.0	11000N	0.0-40.8 Epiclastic. 40.8-64.7 Que River Shale. 64.7-90.8 Epiclastic. 90.8-276.1 Que River Shale. 276.1-439.6 Pillow Lava Sequence including: 331.4-382.5 Chlorite rich stringer alteration with minor base metal veinlets. 439.6-445.5 Hanging Wall Volcan-iclastic Sequence. 445.5-514.5 EOH Sericite-pyrite altered Feldspar Phyric Sequence.		
HL23	11100.7	5639.8	675.0	87.7	-71.6	2.3.84	30.5.84	592.5	8590.5	11100N	0.0-69.1 Epiclastic. 69.1-93.5 Que River Shale. 93.5-116.5 Epiclastic. 116.5-265.6 Que River Shale. 265.6-412.6 Pillow Lava Sequence extensive fuchsite alteration. 412.6-414.9 Major fault zone. 414.9-449.6 Highly altered zone (chlorite/carbonate/sericite/pyrite) 449.6-459.5 Porphyritic dacite 459.5-539.5 Highly altered zone as above. Minor stringer base metals 471-539.5 539.5-568.0 Highly altered zone. 568.0-592.5 Uncorrelated poly-mict epiclastic unit minor stringer base metals 471.7-545.4 m. EOH 11062N, 5850E 123 RL.		
HL24	10900.9	5694.5	686.4		-71	22.5.84	4.6.84	382.4	8972.9	10900N	0-57.0 Upper Epiclastic sequence. 57.0-176.4 Que River Shale 176.4-253.3 Pillow Lava Sequence.		

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8.4 Description (refer Appendix 1 for petrological/mineralogical description)

8.4.1 Stratigraphy

Units are described starting with the stratigraphically lowest (oldest), intersected in the drilling at Hellyer.

8.4.1.1 Lower Andesitic Lapilli Tuff Sequence (thickness >25 metres)

The unit has been intersected in some of the deeper holes, but its thickness has not yet been established. Generally a green matrix dominated lapilli tuff, the rock is differentiated at present partly by its stratigraphic position rather than by any striking macroscopic features. Lapilli often have a jigsaw or exploded appearance with a brownish matrix forming in excess of 50% of the rock. (HL9 414.5 - 439.0) Lapilli are vesicular in HL15 (511-526.4).

8.4.1.2 Lower 'Epiclastic' (thickness 0-35+ metres) T/S 265424 - 265429

This unit varies rapidly in thickness and is confined around 10400N to a wedge(?) west of a prominent fault. The unit is highly polymict and poorly sorted with a great variety of angular volcanic fragments. These include vesicular andesite recognisable from the Upper Andesite Sequence, various porphyritic trachytes from the Feldspar Phyric Sequence, rhyolitic fragments, glassy lavas and various highly altered unnamed volcanic fragments. Matrix constitutes ~20% of the rock and consists primarily of quartz sericite but also contains silicified pumice and obsidian fragments. This unit is thought to be some sort of local mass flow.

8.4.1.3 Feldspar Phyric Sequence
(thickness 30-65+ metres) T/S 265417

This is a macroscopically distinctive unit. Its grey colour and prominent white albite phenocrysts are striking. The unit varies from a uniform lava to lapilli tuff to breccia. Thin section descriptons by W. Fander (Appendix 1) describe lavas of similar composition (porphyritic sodic trachytes) but different fabrics.

Most rocks included in this group are uniform and distinctive. Others have albite phenocrysts (macroscopic), and are therefore included but have other variations. These more problematic rocks include :-

(i) the cream/pink breccia in HL3 and HL9 east of the fault. The unit has albite phenocrysts in HL3 (T/S 265414) and includes `quartzose types verging on sodic rhyolites'. It occurs with clear Feldspar Phyric Sequence in HL9.

(ii) the intersection in HL15.

(iii) intersections that are mixed with stringer zone.

8.4.1.4 Footwall Volcaniclastics
(thickness ~10 metres)

This unit characteristically contains pumice-like fragments, drawn out fragments of trachyte (fiamme ?) (T/S 265416). The unit can be polymict and then the pumice-like fragments distinguish it from the Hangingwall Volcaniclastics.

8.4.1.5 Main Ore Position - Massive Base Metal Sulphides(thickness 0-20+ metres)
T/S 258002 - 258028

Where massive base metal sulphides are absent, the Main Ore Position is interpreted at the transition from Hangingwall Volcaniclastics to Feldspar Phyric Sequence. Colloform banding in pyrite around volcanic fragments is taken as further supporting evidence.

Massive sulphides are conformable with the subhorizontal stratigraphy. In HL5, 7 and 13 there is a prominent barytes top. The barytes is absent in HL12 and in some of the intersections drilled after the period covered by this report.

The massive base metal sulphide is pyrite rich, (note high SG's in assay results) and is mostly unbanded, on a large macroscale, with a fragmental appearance. Colloform banding and radial textures can be discerned macroscopically in individual fragments (1/4 - 2 cm scale). W. Fander points out that radial and concentric textures, well defined framboids and colloform banding in pyrite are characteristic of low temperature accretionary processes.

Millimeter scale lensoid cracks are common. These are filled with glassy quartz and are interpreted to be shrinkage cracks.

Pyrite appears to have crystallized out first, followed by sphalerite and galena. Galena is frequenty locally remobilized. Pyrite is frequently intergrown with colourless to very pale grey sphalerite, and or galena, making visual estimates of grade difficult.

Some macroscale banding does occur, most commonly with brown sphalerite. e.g. the high grade brown sphalerite, pyrite, galena in HL12 at the base of the base metal sulphides.

Chalcopyrite occurs as coarse patches and more commonly as small inclusions in the sphalerite.

Some intersections contain fair amounts of arsenopyrite, particularly towards the top of the base metal sulphides. Arsenopyrite appears to have formed in bands contemporaneously with the other sulphides. (see Fander).

The major gangue mineral is silica mostly as glassy quartz within shrinkage cracks. Glassy quartz rich, base metal poor intersections near the top of the base metal sulphides sometimes contain significant gold (~3 g/ton - HL5 258008). Most gold is, however, associated with high base metal values. Other gangue includes minor amounts of chlorite and white quartz carbonate. The presence of fibrous talc T/S 258020 has yet to be confirmed.(1)

8.4.1.6 Hangingwall Volcaniclastic (thickness 1-20m)
Immediately above the base metal sulphides is a highly polymict poorly sorted unit called the Hangingwall Volcaniclastics. The unit is highly variable but the combination of characteristics is distinctive. Frequently a tuff contains large blocks of (flow banded?) cream dacite. Elsewhere only bedded/vitric tuff is present.

The unit can be a highly polymict lithic lapilli tuff with fragments of cream brown dacite, assorted green and grey volcanic fragments, pyrite fragments, feldspar phyric fragments and rare base metal sulphide fragments. It is suggested that this unit may be the equivalent of the mixed clastic/chemical unit above the black ore in the Kuroko deposits (the tetsusekiei). Thickness varies from near zero where

1. XRD suggests this is sericite (Aug 84)

there is a significant barytes intersection to >20 metres where there is no barytes. (Does the barytes grade into this unit?)

8.4.1.7 Upper Andesite Sequence (thickness 0-150m+)
This is a uniform green andesite with numerous white quartz carbonate filled vesicles and veinlets. The rock becomes highly brecciated in places with volcanic fragments set in white quartz carbonate matrix. Numerous white quartz carbonate veinlets form a stockwork in the unit. These veinlets sometimes contain coarse (recrystallized?) galena and sphalerite. The petrology suggests that it may be trachybasalt-basalt rather than andesite (small augite crystals in groundmass of fibrous plagioclase and devitrified glass T/S 265402). Alteration, particularly K-feldspar alteration, complicates the picture.

8.4.1.8 Pillow Lava Sequence (thickness ~240 metres)
Above, and grading into the Upper Andesite Sequence is a sequence of rocks called the Pillow Lava Sequence.

Pillows are exposed at surface around the nose of the broad anticline stratigraphically above the Upper Andesites. Other volcanics previously mapped at surface as containing chert or black shale are probably also pillow lavas. Pillows from ~30 cm to 1 metre across are delineated at surface by shape, chert borders, and less clearly by an occasional concentration of vesicles on the edges. In the nose of the broad anticlinal feature there is a concentration of bright green fuchsite/leucoxene - ultrafine chlorite alteration and this together with pods of sulphide and white barytes is concentrated between the pillows. The contact with the Que River black shale above is very pyritic in patches. Within this contact zone a dramatic pyritic pillow with a clear concentration of vesicles on the edge, and with surface quench patterns has recently been found as an unweathered remnant in a costean across this contact.

In drill core the following zones have been identified:-

(a) contact zone highly vesicular - sometimes highly pyritic - this often contains a mixed volcanics/black shale component with 'peperitic' textures reflecting the waning stages of volcanism in mudstone.

    The contact is clearly conformable. Weathering at the contact does occur in HL5, but in other holes the contact is fresh and clearly gradational. Weathering in HL5 is thought to be due to recent groundwater movement. The highly vesicular volcanics at the contact in HL5 may have sheared locally providing easy access for a present day aquifer.

(b) the contact zone grades into a zone with numerous round grey areas on the scale of the drill core, sometimes with a suggestion of concentration of vesicles on the edges.

(c) highly distinctive graded devitrification ovoids often mirrored on more chloritic areas are widely distributed in the sequence but are broadly concentrated below zone b above.

(d) grey chert occurs as vein - like areas and as infill in brecciated areas.

(e) black shale coarsening to bedded siltstone/sandstone occurs within the pillow lava sequence (HL12, 13) and peperitic textures continue well into the lavas in patches.

(f) the unit includes a uniform green lava mostly non vesicular, but sometimes with black chlorite filled vesicles. The unit occurs in flows? 2 - 10 metres thick increasing in frequency and thickness with depth.

8.4.1.9 Que River Sequence (thickness $\geq$ 260 metres)

(a) Que River Shale (thickness ~150 metres)

This is a finely laminated carbonaceous shale.

The unit is never crossbedded, has minor sandy and siltstone members and contains fossils described elsewhere. (Jago J. B. Roy Soc Pal Vol III Sept 1977) At surface the unit weathers grey in parts and to black carbon rich units elsewhere. All drill core has been in black carbon rich material. The unit contains varying amounts of fine-grained pyrite, particularly towards the base.

(b) `Epiclastic´ (thickness ~110 meters)
Intercalated with the black shale is a unit loosely described as an `epiclastic´. The unit is highly polymict and variable. Fragments of black shale, various volcanics including rare mineralized fragments and minor pyrite fragments form a distinctively textured rock which constitutes a significant part of the unit. Often the unit is a coarsely crystalline feldspar quartz crystal tuff. Here the rock has a `granite-like´ texture with prominent pink K-feldspar quartz and plagioclase crystals. Elsewhere, the unit has sparse coarser (~1 cm) feldspar crystals in a black vitric matrix.

8.4.1.10 The Stringer Zone

The stringer zone cross cuts the stratigraphy and is sub-vertical. It has several components:-

(a) Black chlorite veinlets and veins from a few centimeters to several meters thick. These may consist of massive black chlorite with disseminated ~2mm subhedral to euhedral pyrite crystals and have no associated base metals (see HL6 and HL14). They may contain significant patches of disseminated medium to coarse-grained galena and sphalerite (see HL 18, 19, 22). Patches may attain 10% combined metals. In places significant amounts of carbonate occur with this rock. These carbonate containing varieties are the same as the chlorite carbonate rocks at Que River Mine. (Que River's ClCo).

(b) Coarse chalcopyrite and fine-grained pyrite in a chlorite matrix (HL6 391.9 - 399.75).

(c) Rocks dominated by glassy quartz.

(d) Extreme sericite alteration which is sometimes very soapy (XRD suggests that this is sericite and not talc).

(e) Matrix dominated rocks usually with very prominently aligned lapilli. The matrix may be glassy silica rich, or it may be the so-called 'Porphyritic Dacite', macroscopically distinctive, microscopically a drawn out sericitized glass.

8.4.1.11 Intrusives

These rocks clearly cross cut the stratigraphy.

(a) The Porphyritic Dacite (`vent unit´)

The name comes from identical rocks at Que River Mine. At Hellyer this unit is closely associated with the Stringer Zone into which it can grade, becoming the matrix to sparse lapilli. Typically the rock has an autobrecciated appearance, with millimeter sized subhedral phenocrysts, now sericite or talc, millimeter diameter quartz filled vesicles, and a distinctive green colour. The colour is due to ultrafine chlorite and TiO_2 released from the glass to form common small leucoxene grains. The rock may consist of lapilli and matrix, both Porphyritic Dacite, but with different textures. Less commonly it has a pronounced foliation - Que River Mine´s ex Streaky Pyroclastics.

(b) Dacite

A cream/brown rock with a fractured appearance and pyrite infill in the fractures cross cuts the stratigraphy in HL6 ad HL14.

8.4.2 Alteration

8.4.2.1 Mineralogic

(a) In the Hangingwall at Hellyer

The most prominent alteration in the hangingwall is manifest in a breccia consisting of pink K-feldspar/silica fragments in a matrix of dark green chlorite. Pyrite occurs with the chlorite, but also as hairline fractures in the pink K-feldspar fragments.

In the immediate hangingwall, (eg HL 5, 7) there is a zone a few meters thick with a pervasive light green alteration. Within this altered zone, there is dramatic bright green fuchsite in HL5.

There is pervasive fracturing and brecciation of volcanics in the hangingwall with white quartz - carbonate (dolomite) infill. Within these fractures are bright pink fragments, the intensity of the pink being proportional to the degree of K alteration.

There is relatively minor sericitization of all the rocks.

(b) <u>In the Footwall at Hellyer</u>

The major alteration is associated with the stringer zone described above. There is a possibility that the albite phenocrysts in the Feldspar Phyric Sequence represent sodium enrichment in the footwall.

8.4.2.2 <u>Geochemical</u>

Drill core from MG3, 4 and 5 was ground and analysed for a suite of elements. The results are presented as Table B.

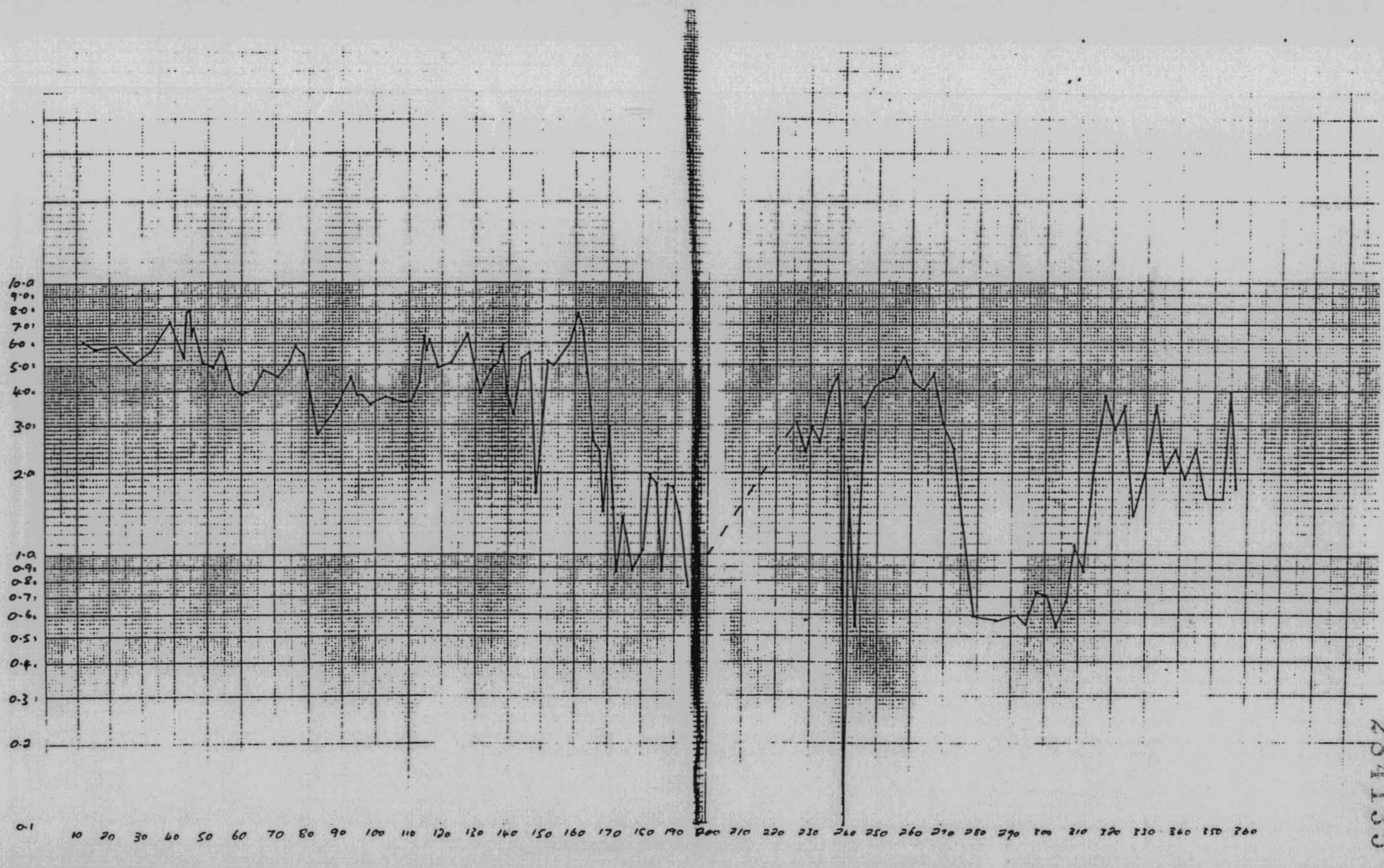
Arsenic levels appear to rise in the immediate hangingwall of base metal sulphides. In the absence of Base Metal Sulphides the Main Ore Position is identifiable geochemically by elevated arsenic and base metals. A geochemically anomalous zone within the Pillow Lava Sequence occurs in HL5 between 150 and 160 meters.

TABLE B

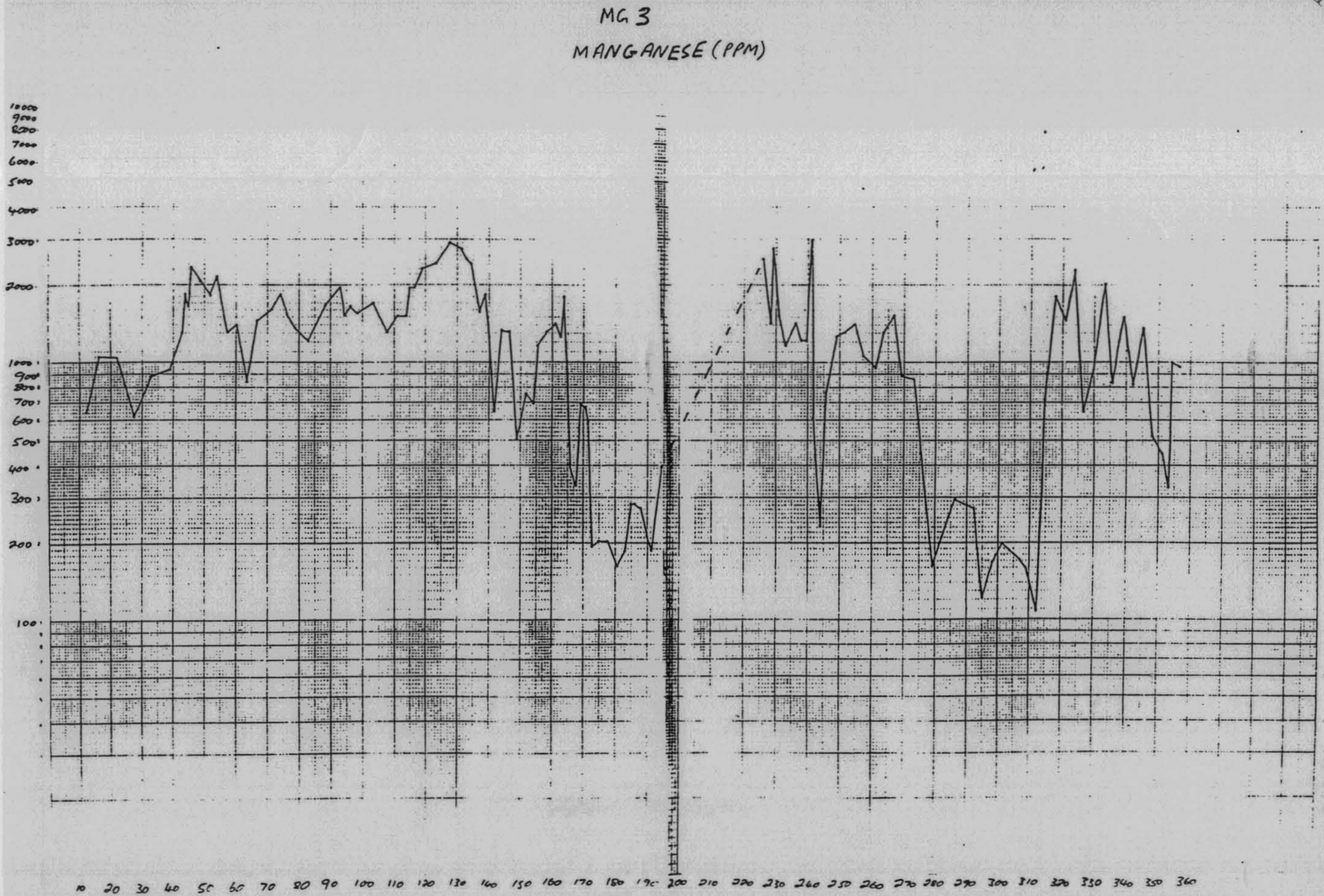
134

MG 3

IRON(%)



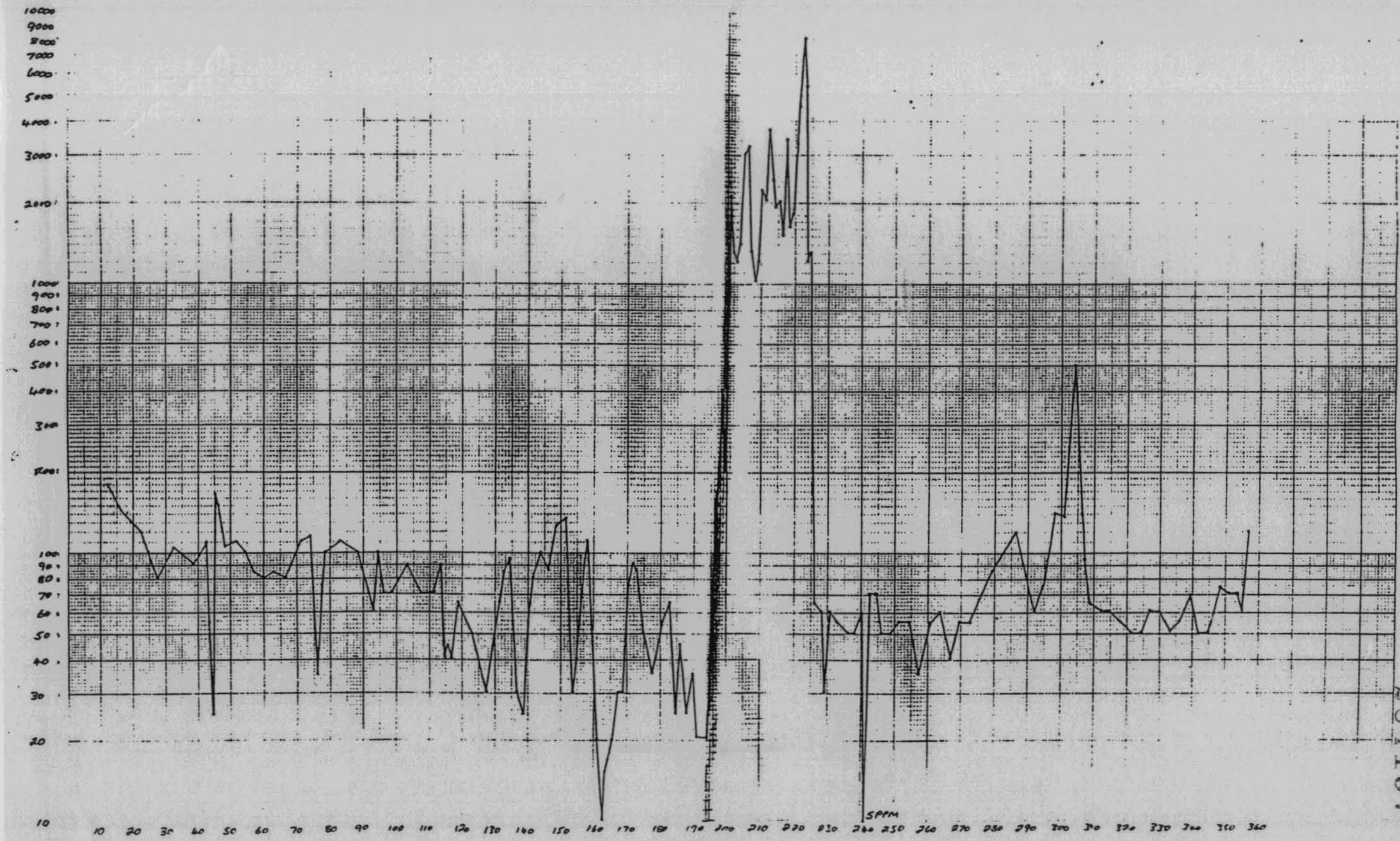
284135


MG 3
MANGANESE (PPM)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
900
800
700
600
500
400
300
200
100
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350 360

284136

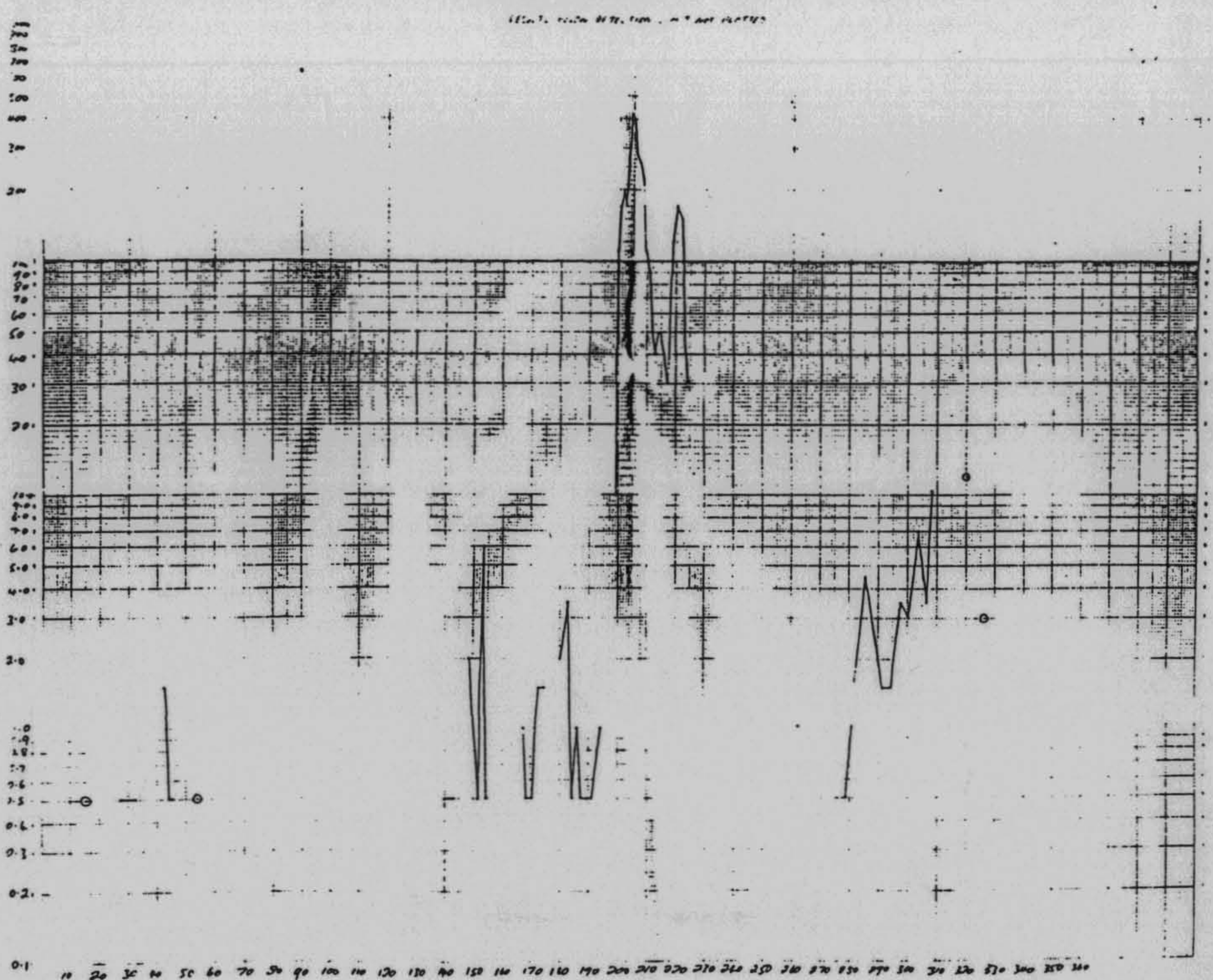
MG 3

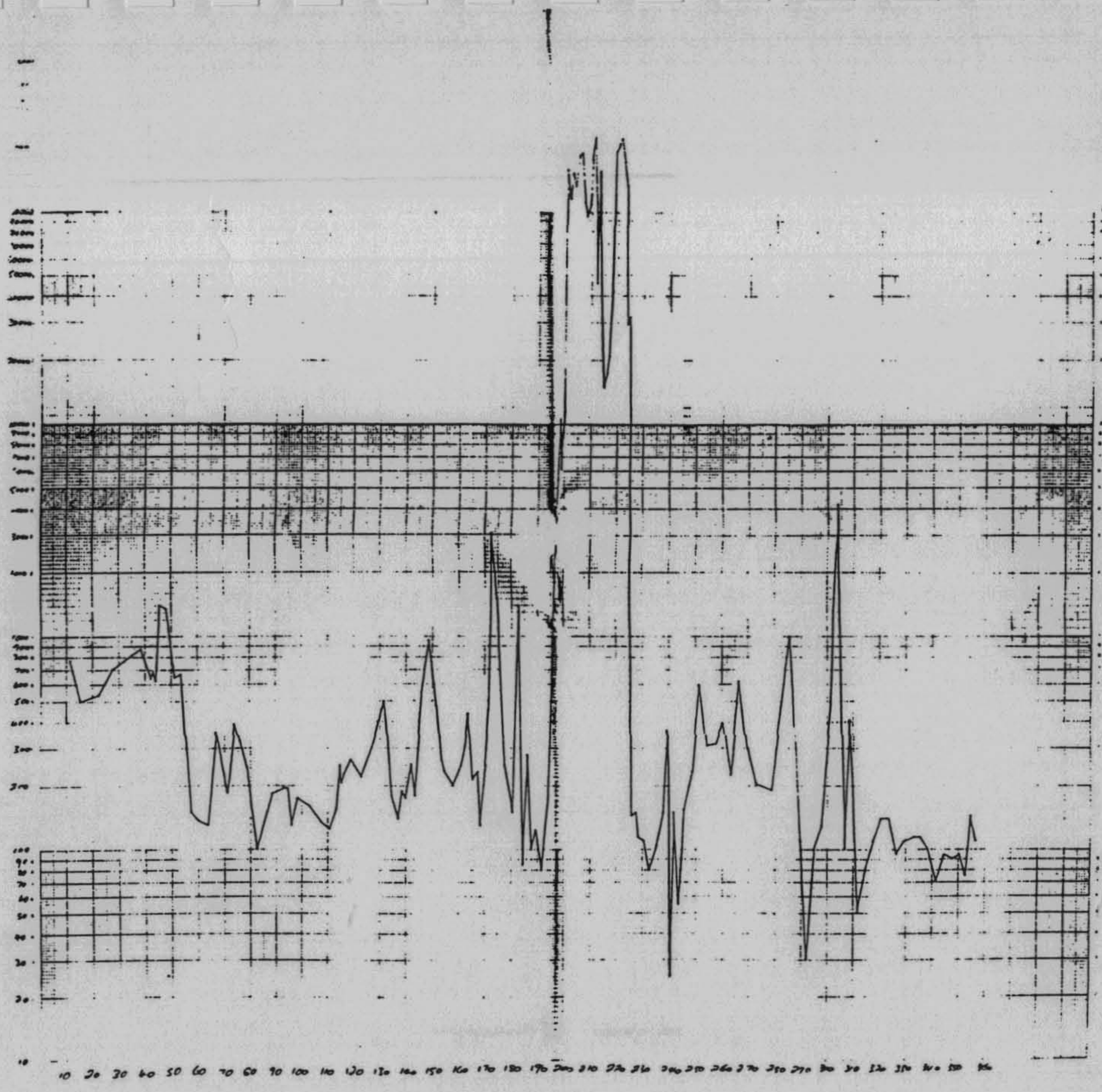
COPPER (PPM)



MG3

SILVER (G/T)

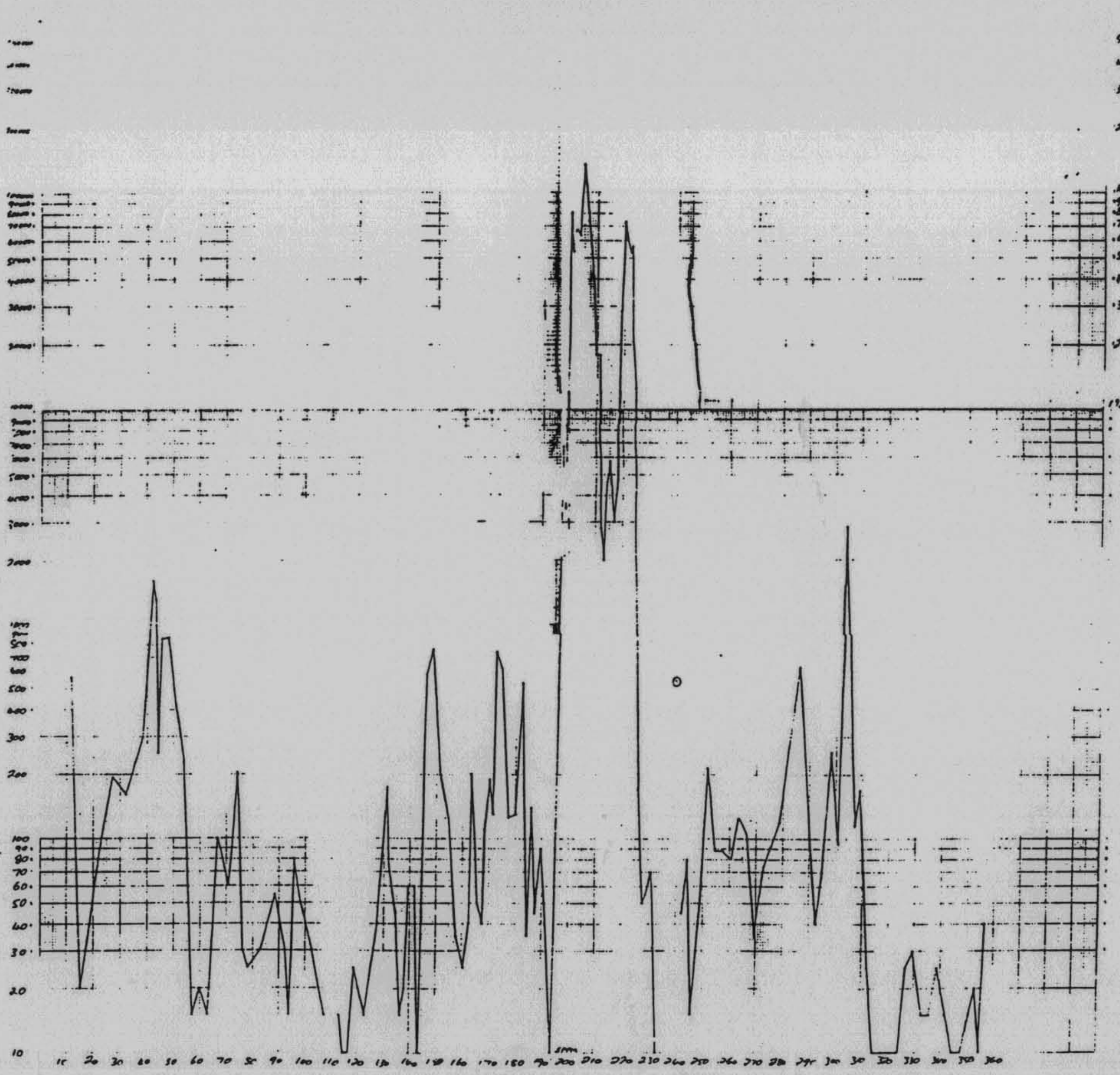



10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350

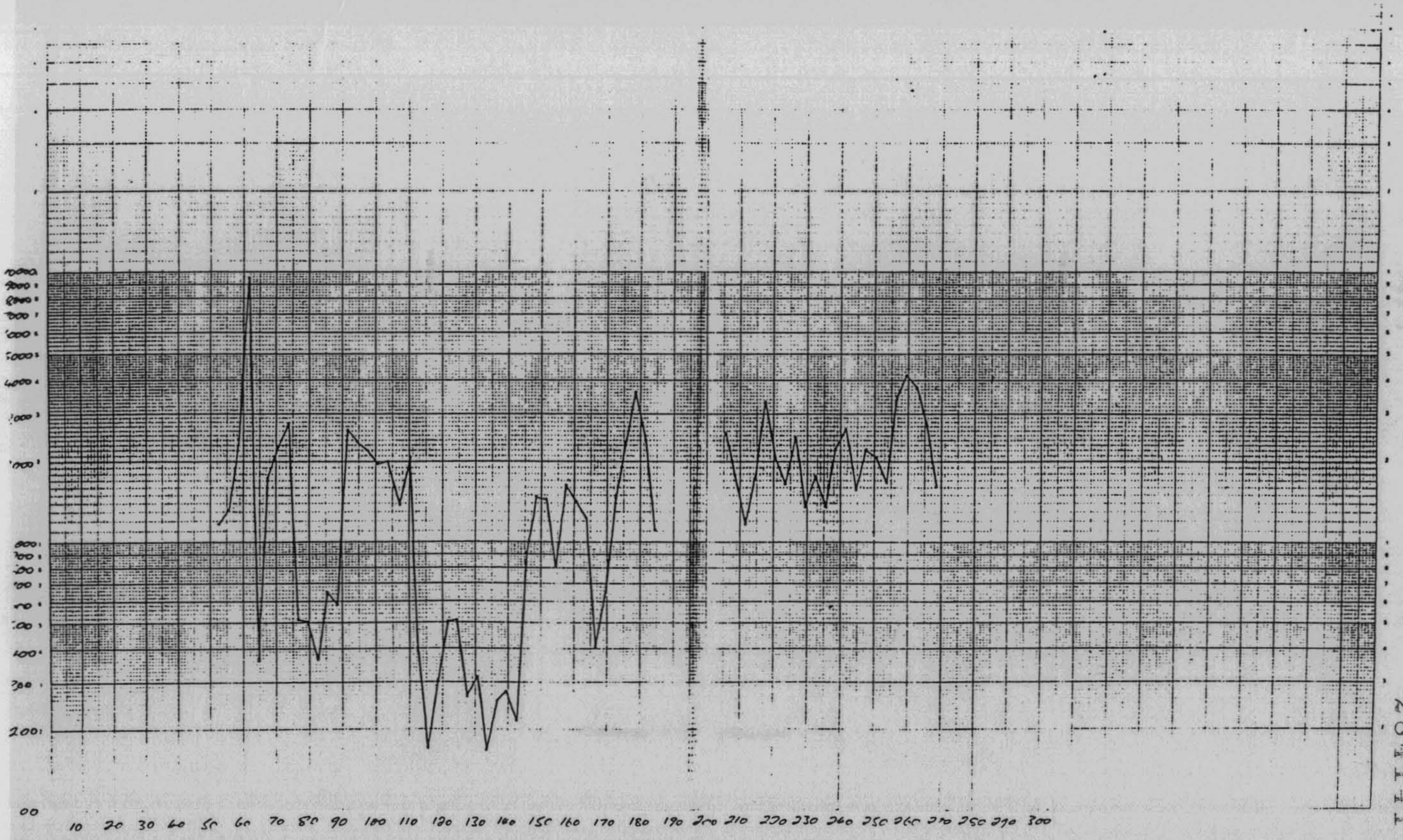
MG3
ZINC (PPM)

MG, ...D.. (ppm)

RESULTS BELOW DETECTION LIMITS NOT PLOTTED



MG4
BARIUM (PPM)

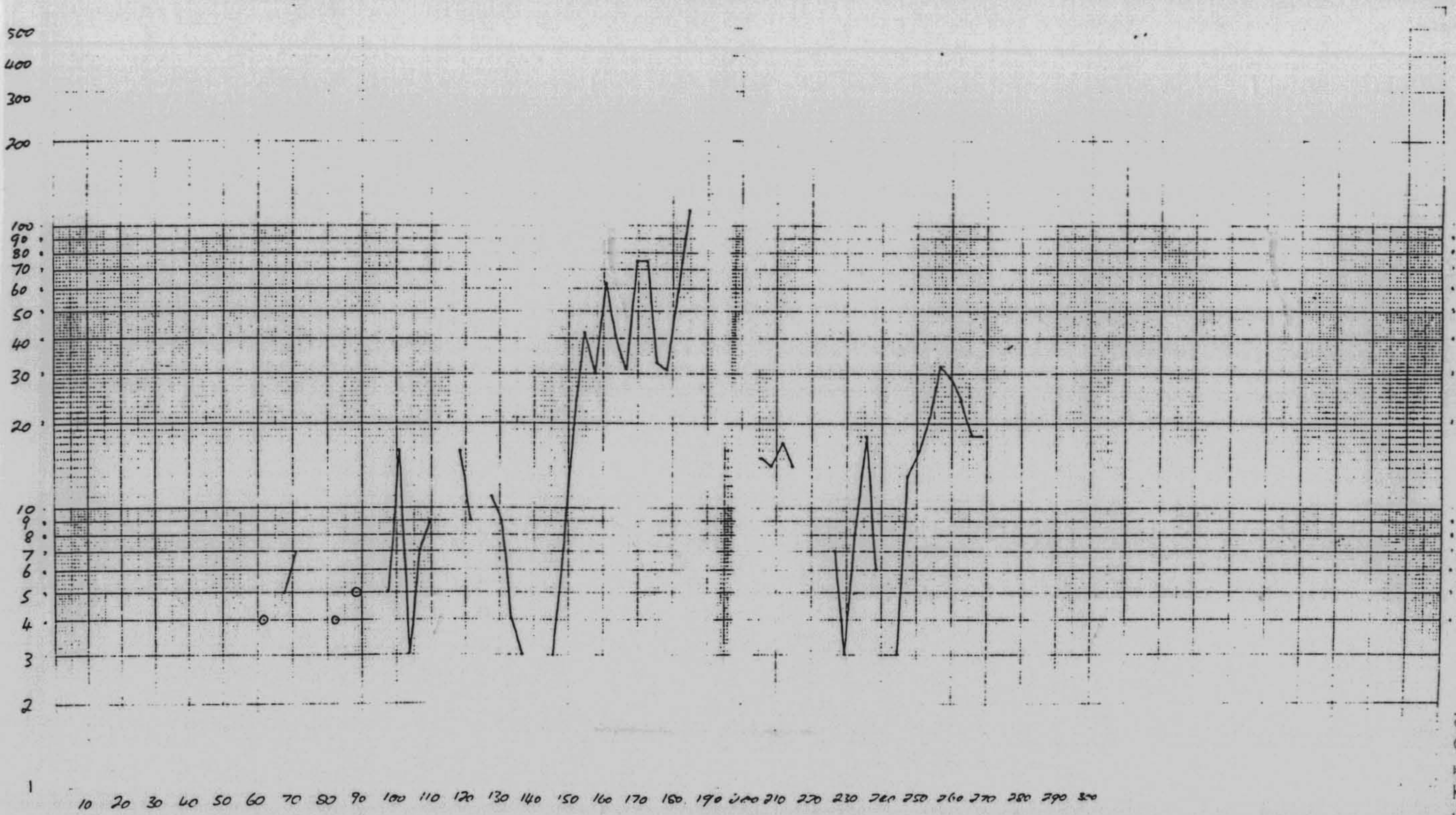


2841

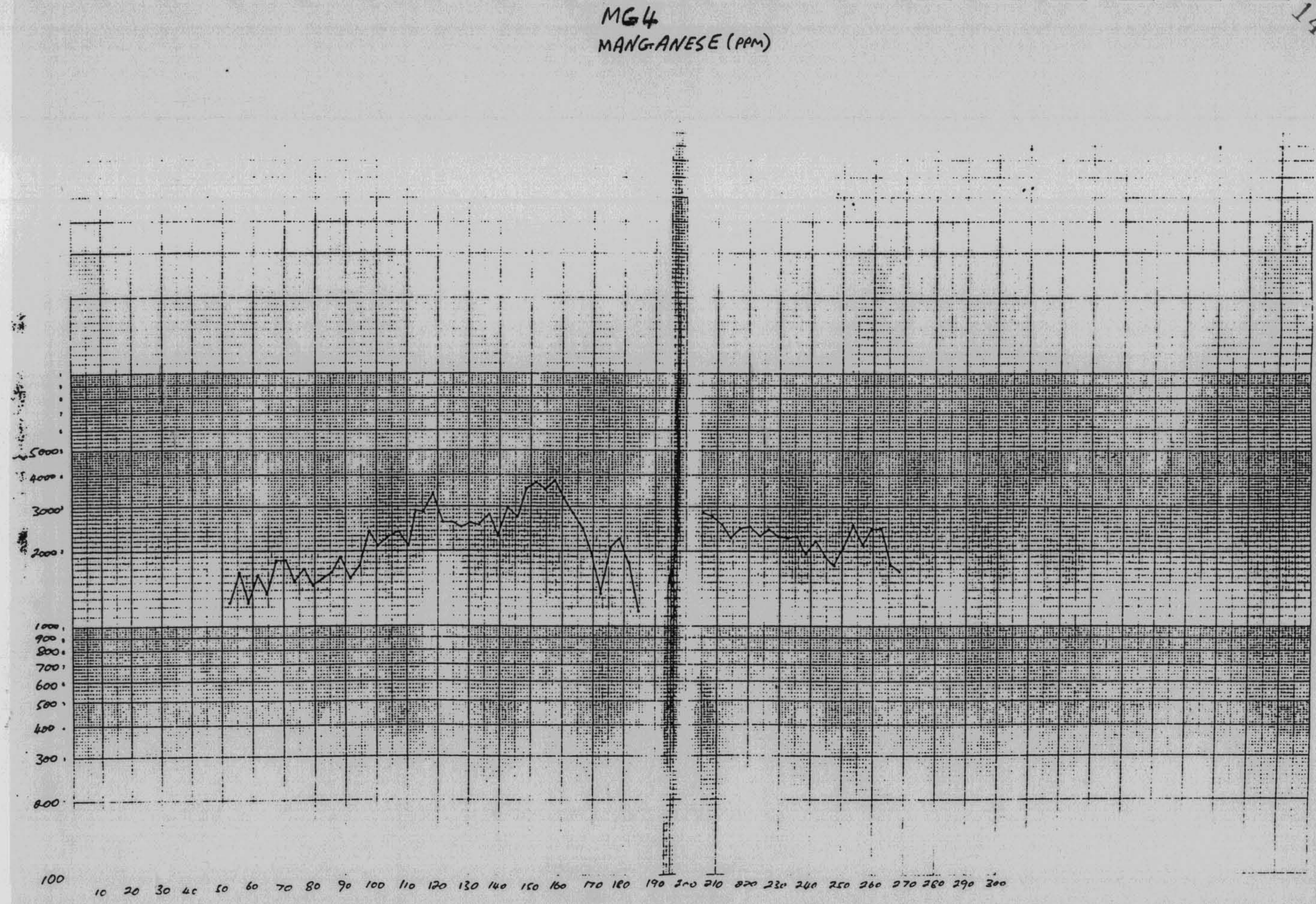
MG4

ARSENIC (PPM)

RESULTS BELOW DETECTION LIMIT NOT PLOTTED



142



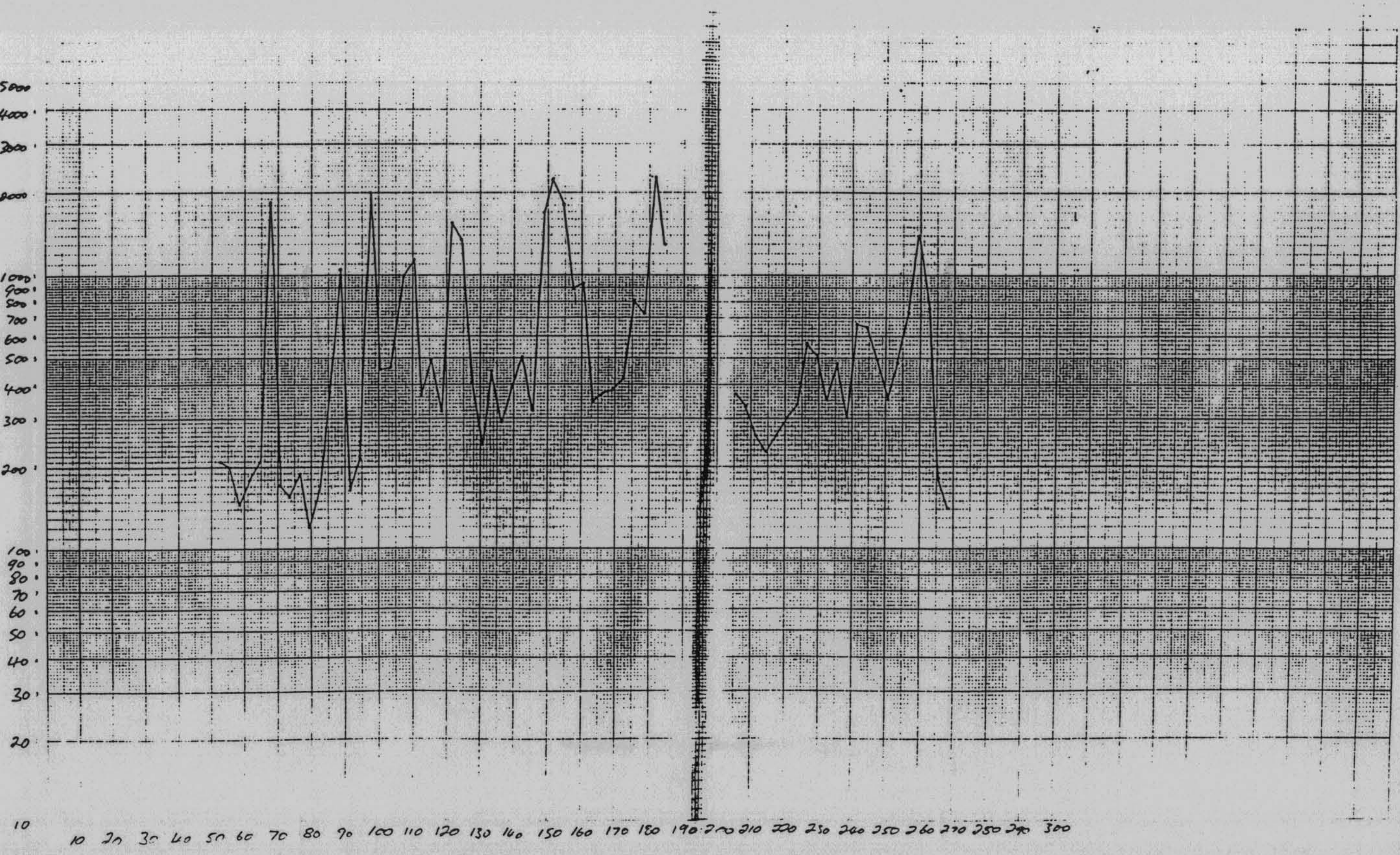
MG4
MANGANESE (PPM)
5000
4000
3000
2000
1000
900
800
700
600
500
400
300
200
100
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300

28443

143

MG4

ZINC (PPM)

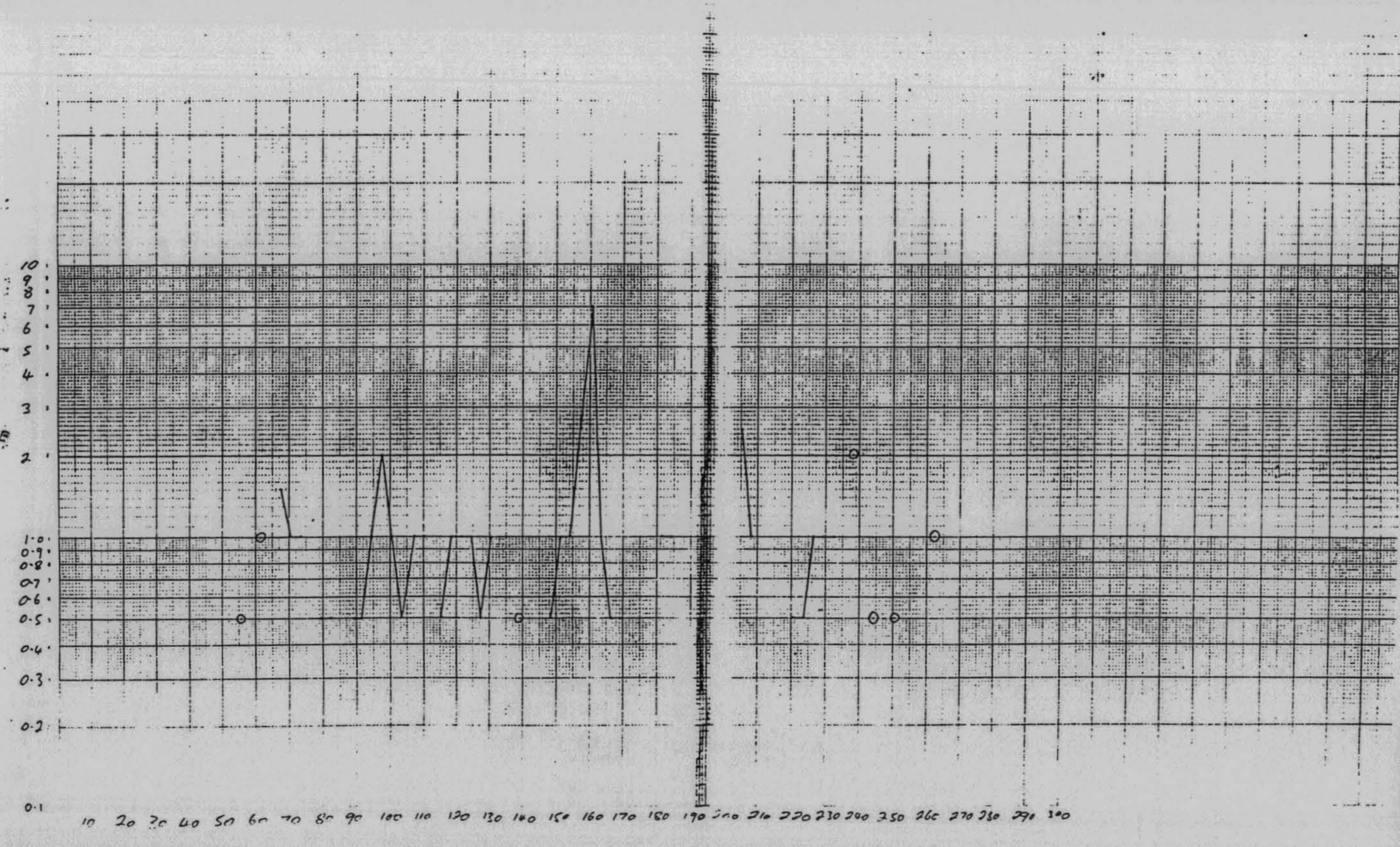


28414

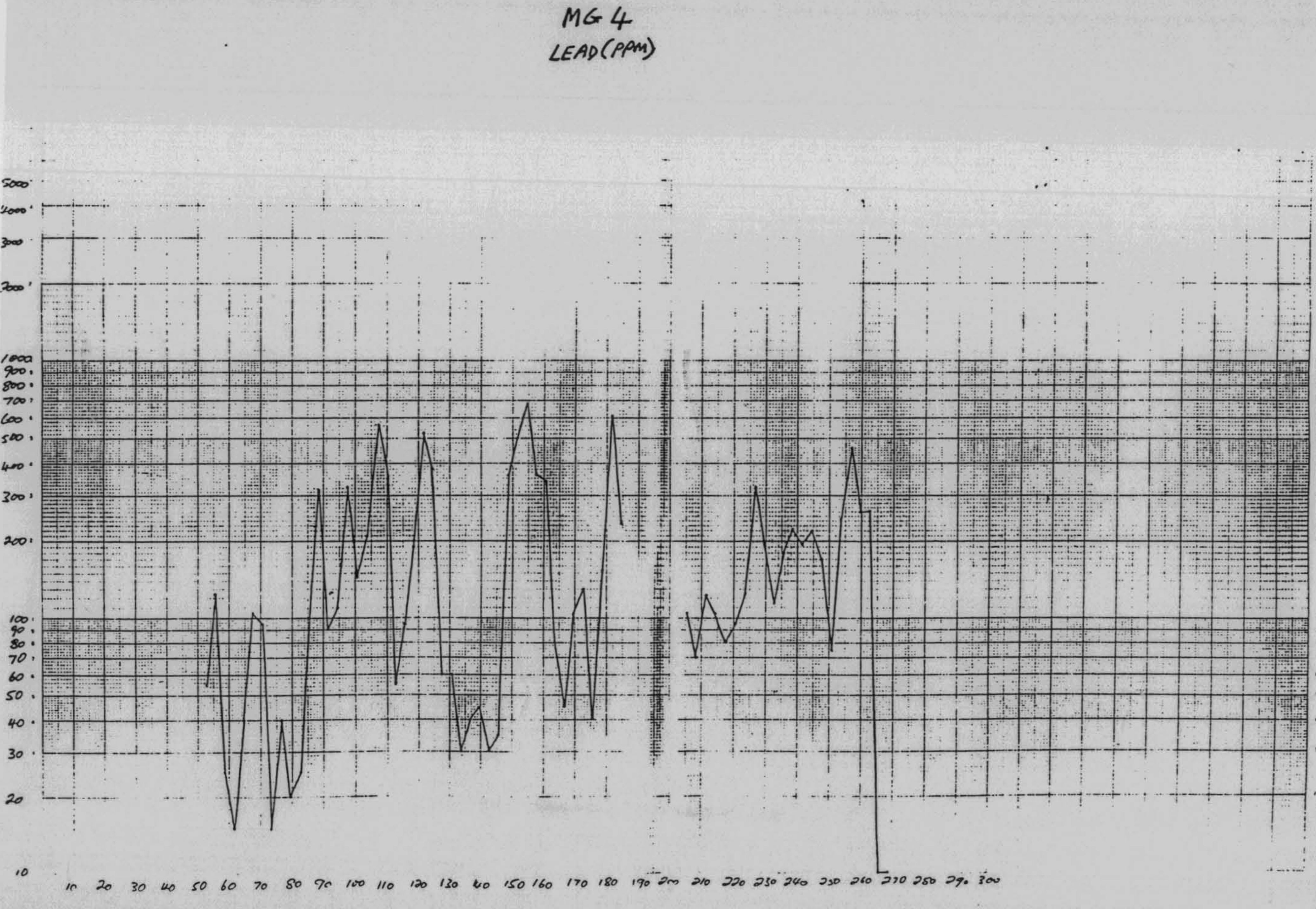
MG4

SILVER (G/T)

RESULTS BELOW DETECTION LIMIT NOT PLOTTED

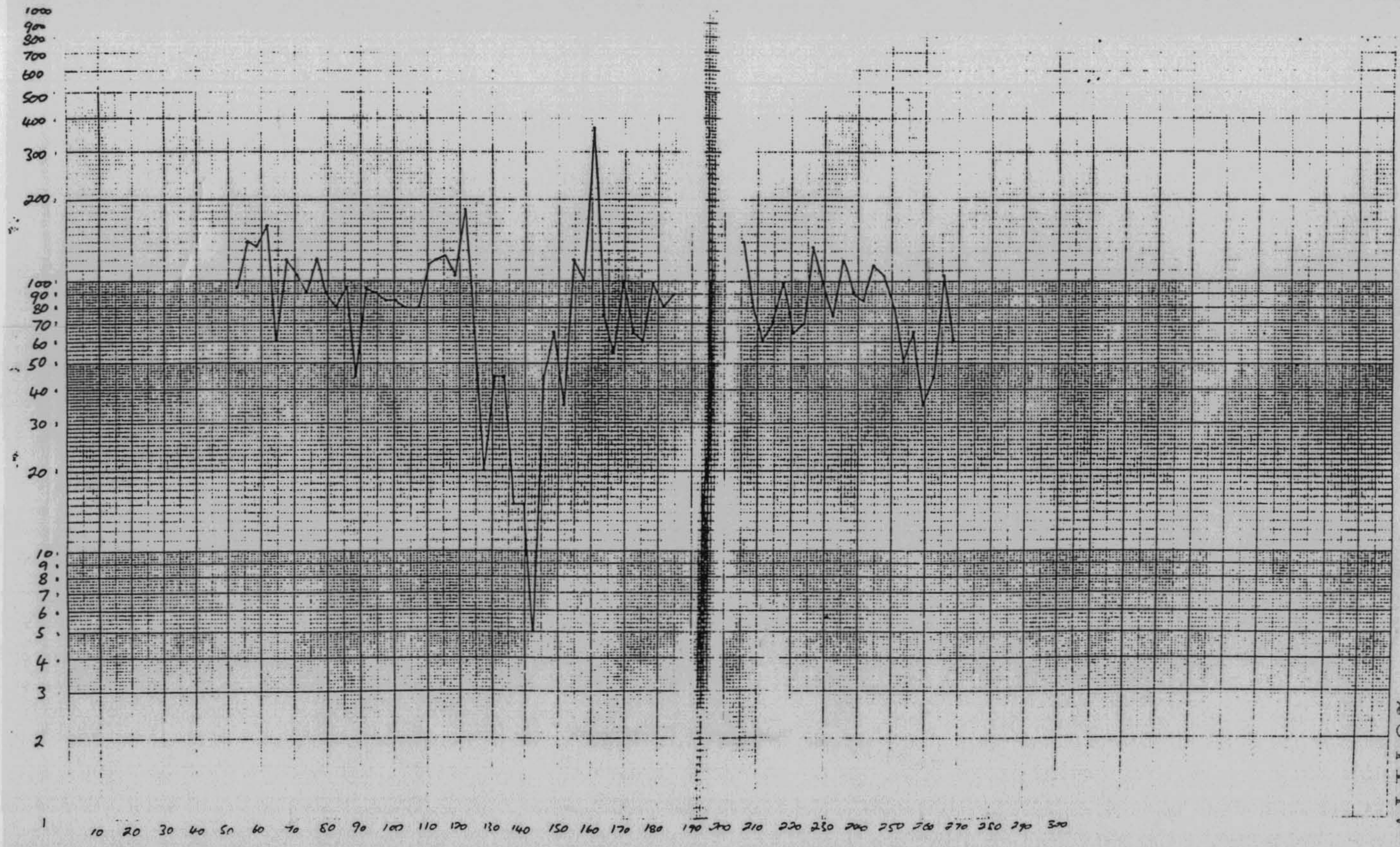


2841145


MG 4
LEAD (PPM)
5000
4000
3000
2000
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300

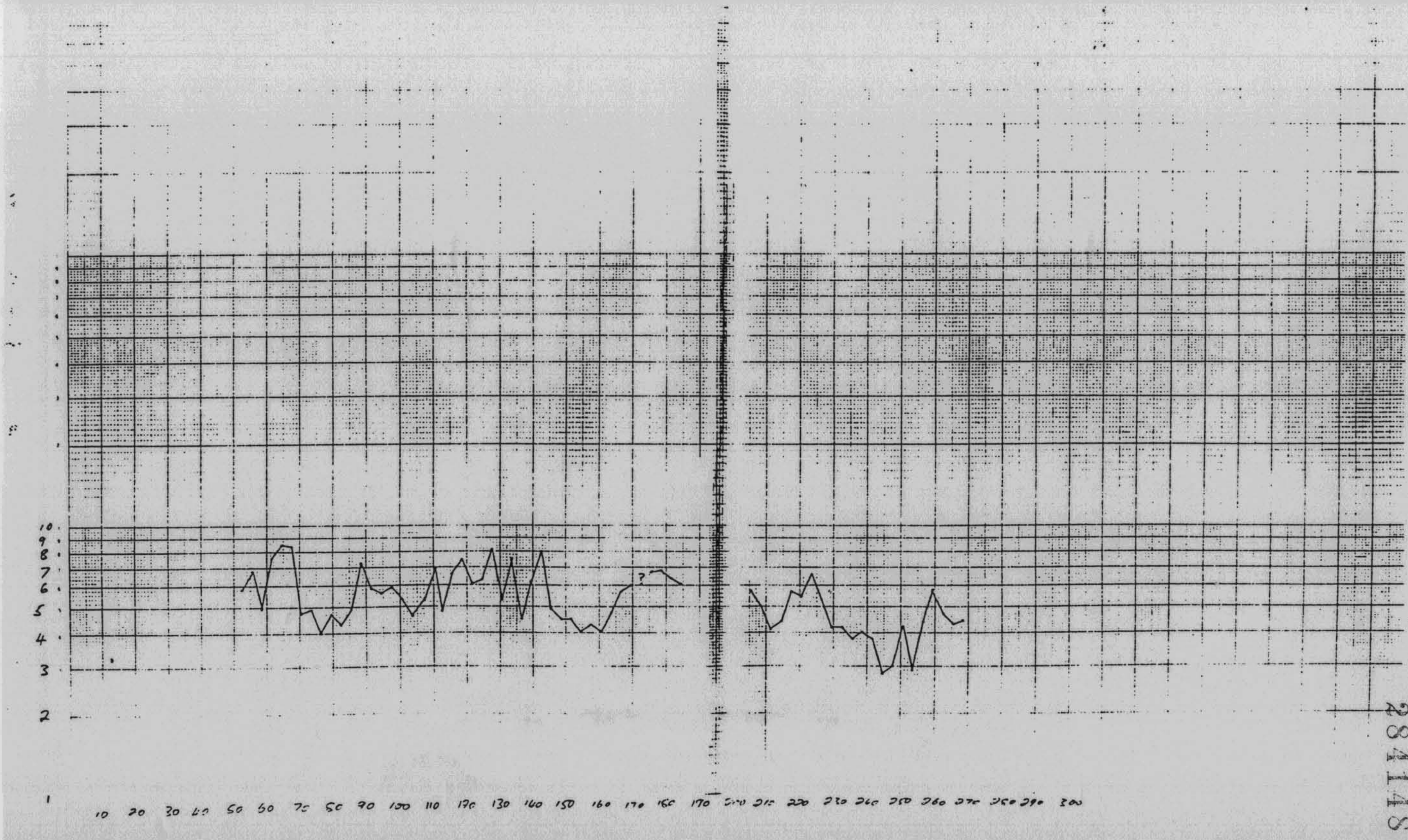
MG 4

COPPER (PPM)

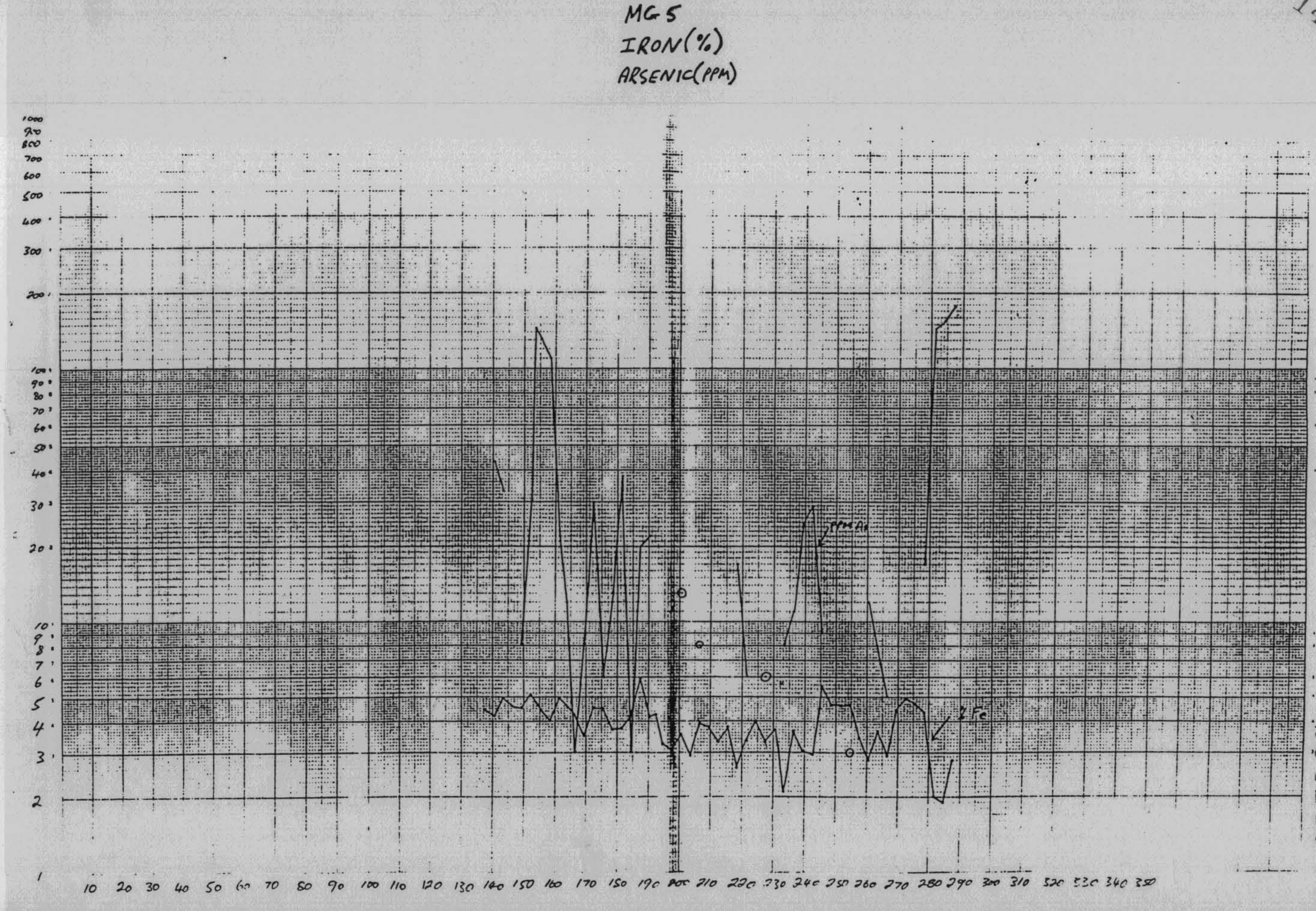


2841147

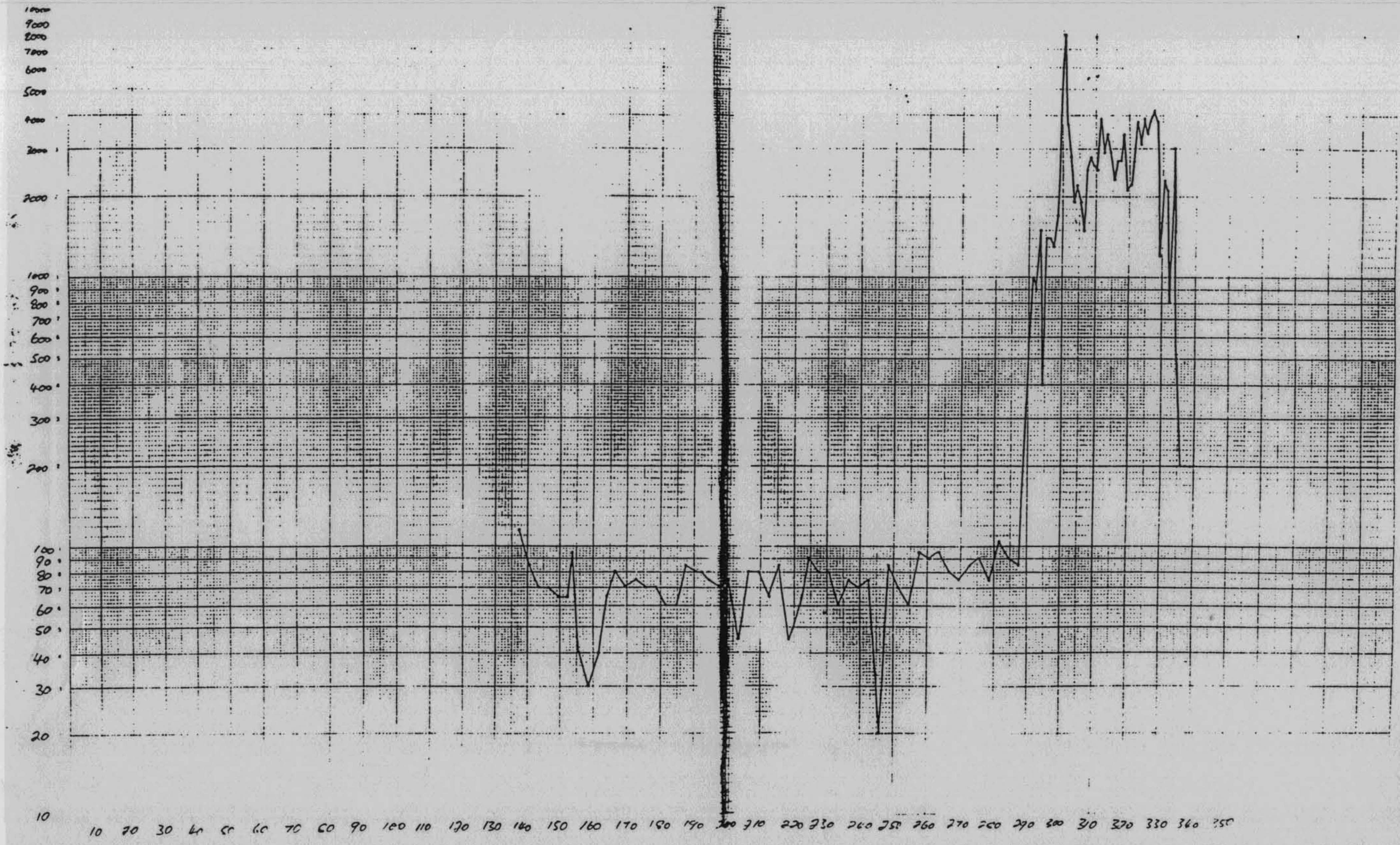
MG4
IRON(%)

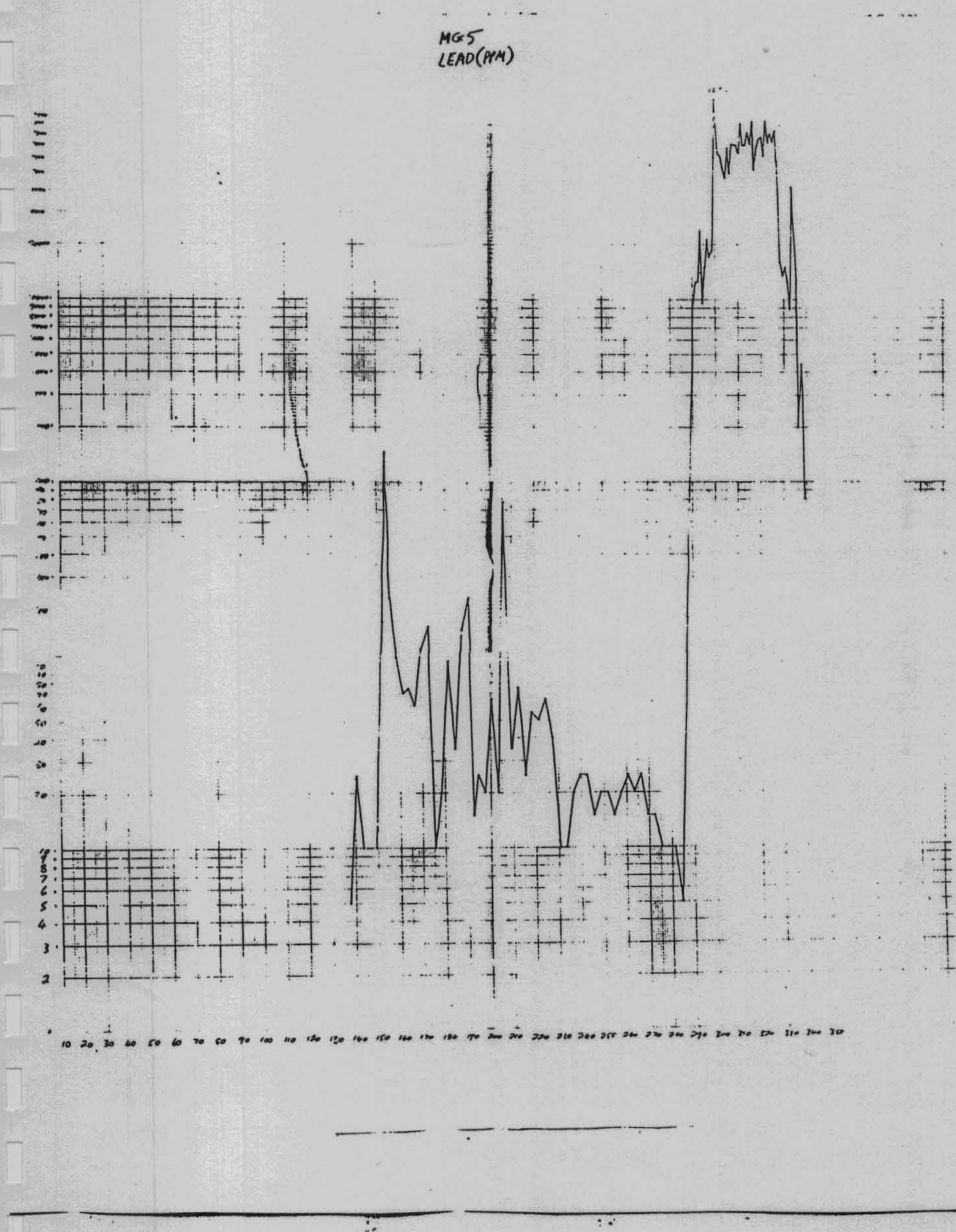


28418


MG5
IRON(%)
ARSENIC(PPM)
1000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
9
8
7
6
5
4
3
2
1
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310 320 330 340 350
PPM As
% Fe

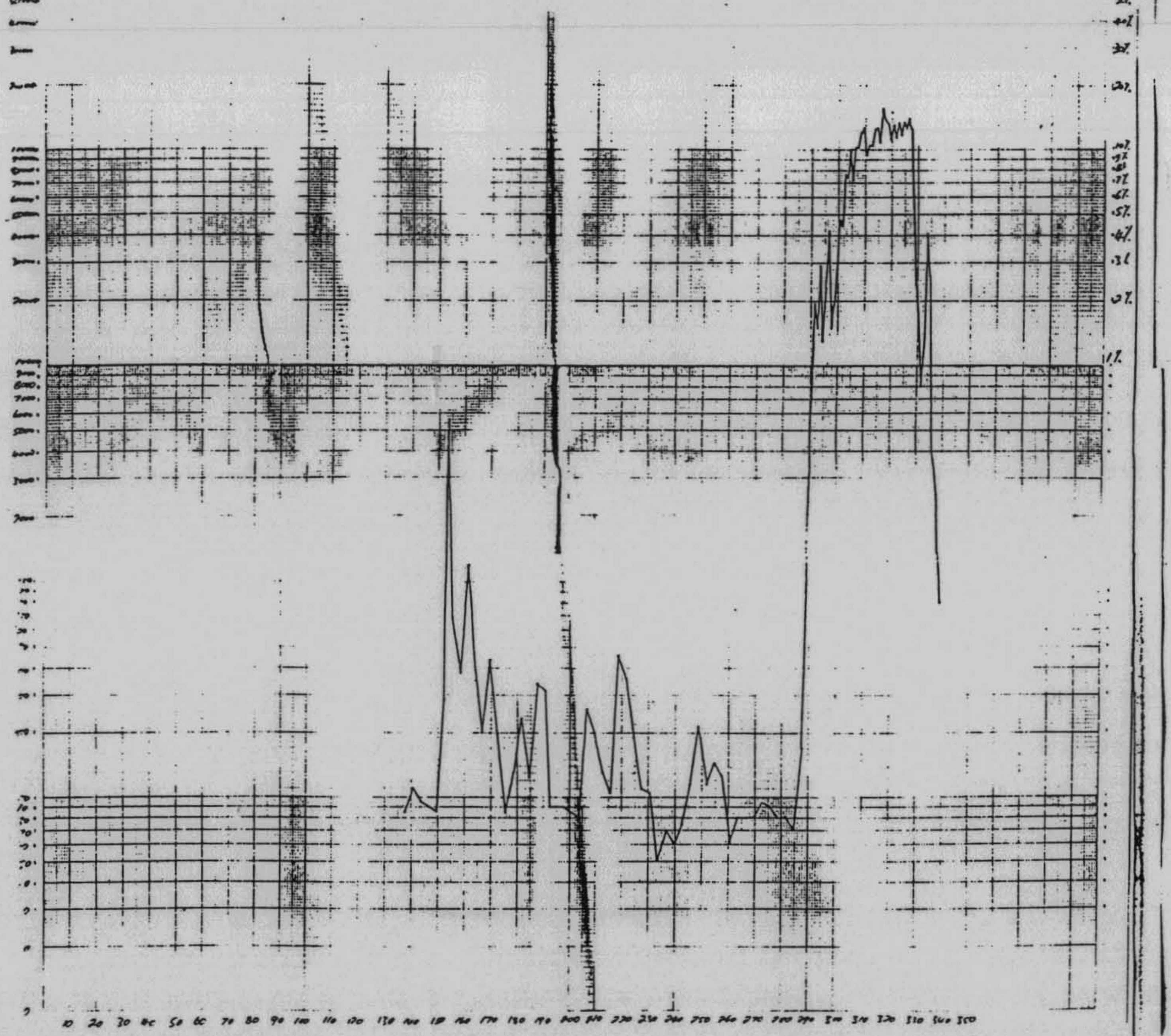
MG 5
COPPER (PPM)



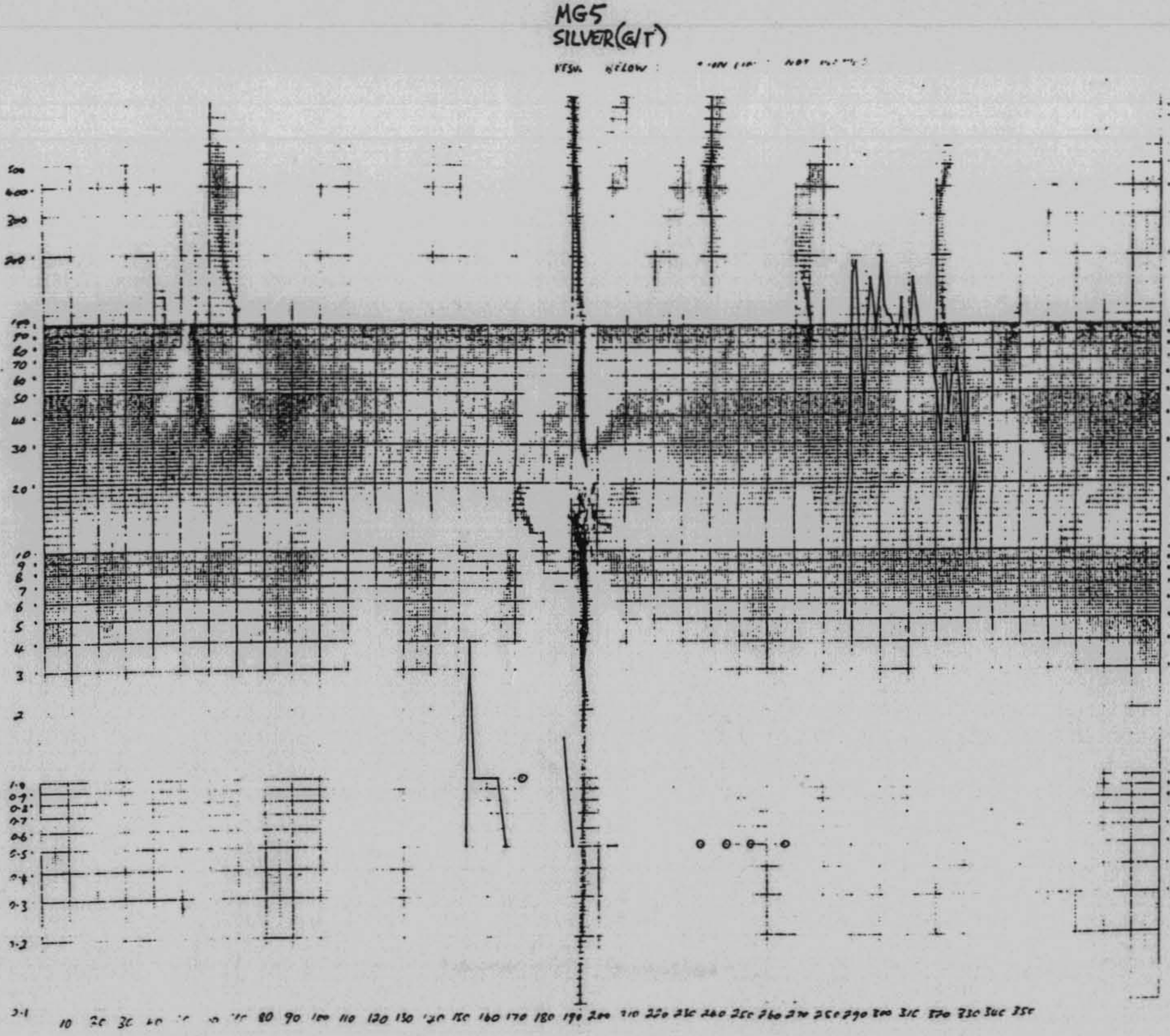

MG5
LEAD(PPM)

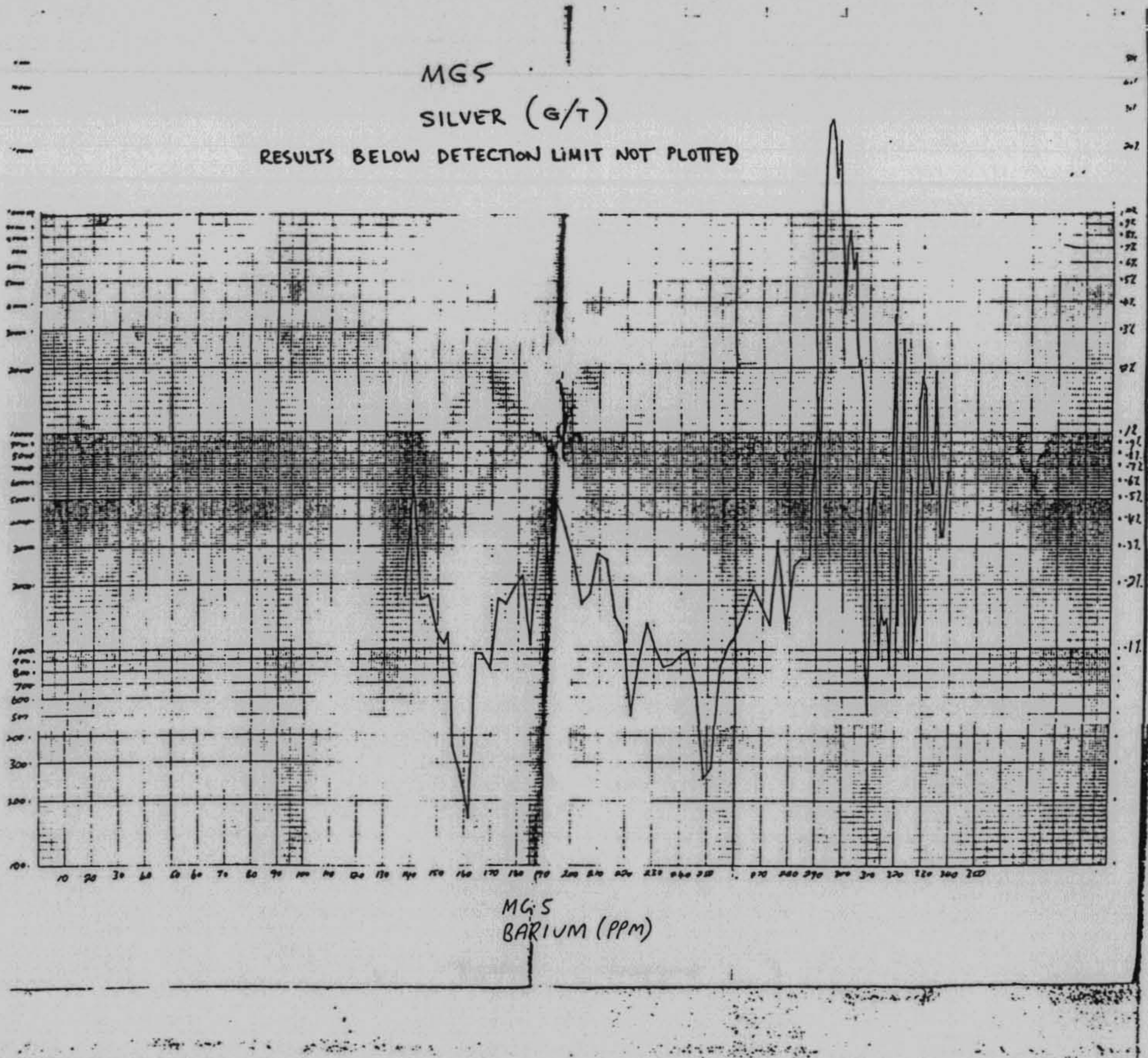
ZINC (ppm)

151



284152


MG5
SILVER(G/T)
10 20 30 80 90 100 110 120 130 150 160 170 180 190 200 210 220 240 250 260 270 290 300 310 320 330 350


MG5
SILVER (G/T)
RESULTS BELOW DETECTION LIMIT NOT PLOTTED
MG5
BARIUM (PPM)

15

284155

9. D1 ZONE DRILLING DETAILS - SUMMARY REPORT

- D. B. WALLACE

ABERFOYLE MEMORANDUM

Date	24 May, 1984	Ref	DBW/hjr
To	D. J. Jack	From	D. B. Wallace
At	Aberfoyle Exploration	At	Que River
Copies to		Keep	

Subject <u>Summary Report on Exploration of the D1 Zone to March 1984</u>

The 1983 UTEM survey over Exploration Licences 2/70 and 15/73 located numerous conductors. A group of five located between Que River Mine and the Hellyer Prospect has been designated to the D Zone. (See Plate Mac 1). Conductors D2, D3, D4 and D5 were considered to be weak questionable responses, (See Appendix 1) and no further work on these is recommended at this time. Conductor D1 was interpreted as a weak, but well defined conductor. The coincidence of this conductor with a zone of broadly anomalous I.P., anomalous Pb geochemistry and favourable geology (sericite, pyrite alteration) warranted further investigation.

A program of costeaning at 200 metre intervals over the conductor was completed in 1983 and totalled 1150 metres. The costeans were then mapped and sampled.

Mapping of the costeans revealed a sequence of sericite carbonate altered, variably brecciated dacitic? lava units with lesser units of sericite silica pyrite altered polymict epiclastics. The pyritic epiclastics coincided well with the axis of the UTEM conductor and were also in contact with Cr mica altered dacitic lavas. This epiclastic and Cr mica altered dacite association is a common feature in and around the P/Q lens mineralisation at the Que River Mine. The presence of anomalous E.M. and I.P. coincided with anomalous geochemistry and favourable Que River type geology encouraged the drilling of three diamond drill holes to test for Que River type base metal mineralisation.

A summary of the drilling results is given below.

..../2

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284157

DDH DA1

Commenced 25/1/1984 Completed 1/2/1984

Location 8894.9N 5117.8E 657.9 R.L.

Dip -45 Degrees Azimuth 090 Degrees G Depth 300.4 metres

DEPTH	GEOLOGY	MINERALISATION
0 - 6	Triconed No Core	
6 - 23.5	Weakly altered polymict epiclastic	
23.5 - 49.0	Felsophyric Andesite Lava	
49.0 - 99.1	Coarse weakly altered polymict epiclastic	
99.1 - 112.8	Weakly altered pumicious polymict volcanoclastic	
112.8 - 128.1	Felsophyric Andesite Lava	
128.1 - 179.8	Medium to coarse polymict pumicious volcanoclastic	
179.8 - 200.8	Variably brecciated altered amygdaloidal dacitic lava	Py 2% as fracture filling
200.8 - 206.2	Altered amygdaloidal dacitic lava	Py 2% as fine veinlets
206.2 - 222.2	Cr mica altered volcanoclastic	Tr Py
222.2 - 232.4	Cr mica altered amygdaloidal porphyritic lava rock	Py Tr - 1%
232.4 - 237.5	Altered gravelly polymictic epiclastic	Py 10-15% Sph Tr
237.5 - 280.3	Variably brecciated altered porphyritic lava rock	Py 1-3%
280.3 - 297.8	Strongly altered polymict volcaniclastic	Py 1%
297.8 - 300.4	Altered lava breccia	Py 2-3%

DDH DA2

Commenced 2/2/1984 Completed 8/2/1984

Location 9107.7N 5499.6E 668.5 R.L.

Dip -45 Degrees Azimuth 270 Degrees G Depth 251.8 metres.

DEPTH	GEOLOGY	MINERALISATION
0 - 7.5	Triconed No Core	
7.5 - 16.0	Variably weathered and altered porphyritic lava	Py 2-3% as veins
16.0 - 18.5	Quartz Vein	
18.5 - 22.1	Altered weakly porphyritic lava	
22.1 - 36.5	Altered, variably brecciated lava	Py to 1%
36.5 - 124.0	Weakly altered porphyritic lava	
124.0 - 132.7	Altered sheared brecciated lava	Py 3%
132.7 - 134.6	Altered polymictic epiclastic	Py 2%
134.6 - 136.6	Altered sheared fractured lava	Py 3-4%
136.6 - 137.6	Altered polymictic epiclastic	Py 4%
137.6 - 147.2	Intensely altered volcanic rock	Py 2%
147.2 - 149.2	Altered polymictic epiclastic	Py 5-8% 10cm slug of Gn 5% Sph 8%
149.2 - 152.4	Altered lava rock	
152.4 - 155.0	Altered pumicious volcanoclastic	Py 5-8%
155.0 - 172.6	Altered polymictic epiclastic	Py 5-10%
172.6 - 178.8	Cr mica altered volcanic	Py 3-5%
178.8 - 226.3	Cr mica altered amygdaloidal lava breccia	Py Tr -2%
226.3 - 237.9	Altered fractured porphyritic lava	Py 3%
237.9 - 251.8	Altered plymictic epiclastic	

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284159

DDH DA3

Commenced 9/2/1983 Completed 20/2/1983

Location 9281.8N 5536.4E 669.3 R.L.

Dip -45 Degrees Azimuth 270 Degrees G Depth 271.7 metres.

DEPTH	GEOLOGY	MINERALISATION
0 - 6.0	Triconed No Core	
6.0 - 19.8	Altered lava breccia	Py 3-5%
19.8 - 28.1	Altered lapilli volcaniclastic	Py 3-5%
28.1 - 32.6	Altered lava breccia	Py 3%
32.6 - 36.1	Altered coarse polymictic epiclastic	Py 5%
36.1 - 52.0	Altered lava breccia with inter-bedded polymict epiclastic	Py 5-10%
52.0 - 69.1	Altered polymict epiclastic	Py 5%
69.1 - 93.5	Altered massive dacite lava	
93.5 - 109.8	Intensely altered volcanic	Py 5%
109.8 - 112.9	Altered dacite lava	
112.9 - 122.9	Intensely altered volcanic	Py 5%
122.9 - 135.6	Altered dacite lava	
135.6 - 142.3	Alternating polymictic epiclastic and intensely altered volcanic	Py 3-8%
142.3 - 151.8	Altered dacitic lava	Py 3%
151.8 - 158.1	Intensely altered volcanic	Py 5-8%
158.1 - 167.5	Altered dacitic lava breccia	Py 5-10%
167.5 - 203.0	Altered dacitic lava	Py 1%
203.0 - 218.7	Altered polymictic epiclastic	Py 3-5%
218.7 - 235.7	Altered lava breccia	Py 5-8% Tr Sph
235.7 - 254.8	Altered massive dacitic lava	
254.8 - 264.5	Altered dacitic lava breccia	Py 5%
264.5 - 267.2	Cr mica altered dacitic lava	
267.2 - 271.7	Altered dacitic lava	

All three holes have been cased with PVC casing for proposed down hole E.M. logging.

All holes have been core ground and samples despatched for Cu, Pb, Zn, Ag, Ba, As and Na analysis. Detailed geological plans and sections of costeans and diamond drill holes are in preparation and await sample analyses.

David Wallace

D. B. WALLACE.

10. EXPENDITURE

The summary of expenditure for Exploration Licence 2/70 (Mackintosh) detailed overleaf, pertains to the 1983 Aberfoyle budget period November 15, 1982 to November 14, 1983 and the 1984 period from November 15, 1983 to April 30, 1984.

Total Expenditure for Reported Period : $1,112,031.40

The required annual commitment for EL 2/70 is currently set at $116,000.00 p.a.

ABERFOYLE EXPLORATION PTY LTD

SUMMARY OF EXPENDITURE

MACKINTOSH WEST EL 2/70

GEOLOGY	
Salaries	83,149.00
Wages	2,286.00
Contractors	12,041.04
Materials	7,858.26
Travelling	2,315.40
Fuel	10,127.15
Communications	634.27
Hiring Costs	6,389.17
District Accommodation	11,164.43
Freight	998.09
Vehicle Costs	12,732.50
Equipment Costs	662.19
GEOLOGY	150,357.50
SURVEY	
Salaries	3,968.00
Wages	3,672.00
Contractors	34,225.00
Materials	1,590.56
District Accommodation	21.83
Vehicle Costs	185.60
SURVEY	43,662.99
GEOPHYSICS	
Salaries	13,491.00
Wages	3,467.00
Contractors	33,070.32
Materials	421.61
Travelling	1,201.32
Fuel	533.85
Hiring Costs	1,133.93
District Accommodation	1,035.48
Freight	185.40
Vehicle Costs	1,610.00
GEOPHYSICS	56,149.91

GEOCHEMISTRY

Salaries	3,008.00
Wages	6,398.00
Contractors	2,178.43
Materials	97.14
Fuel	567.14
Hiring Costs	398.52
District Accommodation	46.37
Vehicle Costs	476.00
GEOCHEMISTRY	13,169.60

TRENCHING

Salaries	276.00
Wages	142.00
Contractors	4,370.00
TRENCHING	4,788.00

DIAMOND DRILLING

Salaries	27,997.00
Wages	30,340.00
Contractors	472,219.26
Materials	70,669.73
Travelling	62.50
Fuel	9,420.54
Communications	898.72
Hiring Costs	5,992.78
District Accommodation	9,098.13
Freight	1,458.32
Vehicle Costs	3,167.60
DIAMOND DRILLING	631,324.58

ASSAYS

Contractors	21,434.38
ASSAYS	21,434.38

ACCESS	
Salaries	412.00
Wages	82.00
Contractors	21,802.50
Materials	46.93
Communications	.60
Vehicle Costs	84.00
Equipment Costs	27.50
ACCESS	22,455.53
TENURE	
Salaries	1,294.00
Travelling	10.40
Tenement Costs	10,150.00
TENURE	11,454.40
LEGAL/JOINT VENTURE COSTS	
Salaries	2,202.00
Tenement Costs	2,472.61
District Accommodation	40.00
LEGAL/JOINT VENTURE COSTS	4,714.61
OTHER SERVICES	
Salaries	1,085.00
Materials	235.83
Travelling	360.10
Communications	5,745.06
Equipment Costs	46.50
OTHER SERVICES	7,472.49
INDIRECT COSTS	
Administration	145,047.41
TOTAL PROJECT COSTS	1,112,031.40

11. CONCLUSIONS

1. Electromagnetic systems such as UTEM, fixed loop SIROTEM, EM37 can detect PQ lens/Hellyer type ore bodies at depths >100 metres.

2. The Hellyer deposit is a moderate conductor with conductances >50 Siemens in spite of the high content of non-conductive sphalerite.

3. The Hellyer deposit is detectable beneath the conductive shales in late time (2 ms) UTEM data. Early time data reflects shallow shale outcrop.

4. The pencil like shape of the Hellyer ore body with depth to top being greater than the width accounts for the relatively small UTEM response.

5. IP is severely affected by black shales.

6. The anticline at Hellyer is localised by the mineralizing system. The tight hinge directly overlies the base metal sulphide and the associated stringer zone and fault. The hinge areas of folds are a good exploration target.

7. Bright green fuchsite and associated green alteration is characteristic of the immediate hangingwall at Hellyer. Its abundant occurrence in pillow lava is a very favourable exploration indicicator.

8. The association of other surface and hangingwall alteration with the deposit is less clear. These include manganese,

bright red alteration, chlorite/pyrite silica//K feldspar and the silver (40 ppm) rich gossan pod on 10300N.

9. Hellyer stratigraphic units should be mappable at surface.

10. The high C horizon soil - 80 mesh Pb geochemistry at Hellyer occurs directly above the deposit.

11. None of the other high soil geochemical responses on the licence should be regarded as spurious. Many have not been tested.

12. High soil geochemistry and to a lesser extent green alteration containing fuchsite are also associated with stringer mineralisation. Where this is identified at surface any target is more likely to be associated with the deeper level Que River type of deposit rather than the slightly higher level Hellyer type.

13. As the exposed lavas have been the primary target in the past, the contact with the Que River Shales, Upper Epiclastic Sequence and micaceous sandstone has often been on the edge of soil geochemical and geophysical sampling progammes. With the knowledge of Hellyer setting, these areas particularly those with associated folding must be seen as being highly prospective.

12 RECOMMENDATIONS

1. A comprehensive programme to fill in the gaps in soil geochemistry, and UTEM, coverage along the Pillow Lava Sequence/Que River Shale contact should be undertaken.

2. Outcrop along tracks and HEC lines should be re-mapped using Hellyer stratigraphic units.

3. The lava-black shale contact should be accurately mapped with the aid of costeans. Areas of folding should be the focus of subsequent detailed geophysics and geochemistry.

4. Existing data at Que River Mine and in the surface mapping around Que River should be reconciled with the new information at Hellyer and in any new mapping.

5. The high soil geochemistry in the Upper Epiclastic Sequence immediately east of Hellyer and MG2 should be the focus of further UTEM. A possible fold near the MG2 collar and fuchsite alteration in the pillow lava should be the target of detailed costeaning and mapping prior to drilling recommendations.

6. Possible folding at 9300N, 6000E (syncline) and near the B1 UTEM response should be investigated by costeaning and mapping.

7. The apparent fold in the far south of the volcanics should be further investigated in spite of the fact that there is apparently no UTEM response or elevated geochemistry there.

8. A study should be made of alteration and geochemical halo patterns at Hellyer. This should be related to the gross

morphology of the rocks, what is known of the palaeo-environment and to the detailed and regional surface mapping.

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14. APPENDICES

14.1 THIN SECTION DESCRIPTIONS - FANDER

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Central Mineralogical Services

CMS
39 Beulah Road
Norwood, S.A. 5067
Telephone 42 5659

Mr. D.J. Jack
Geologist
Aberfoyle Exploration Pty. Ltd.
P.O. Box 952
BURNIE / TAS. 7320

19th October, 1983

REPORT CMS 83/9/21

YOUR REFERENCE:	Letter dated 13.9.1983
DATE RECEIVED:	15th September, 1983
SAMPLE NOS.:	265401 - 265429
SUBMITTED BY:	D.J. Jack
WORK REQUESTED:	Petrology

H.W. Fander, M. Sc.

Copy to:
The Chief Geologist
Aberfoyle Exploration Pty. Ltd.
144, Camberwell Road
HAWTHORN EAST / VIC. 3123

REPORT CMS 83/9/21

Hellyer Prospect DDH Samples 265401 - 265429

Twenty-nine drill core samples from a drill hole 3 km north of Que River mine were received for petrological examination. Thin-sections were prepared, and the offcuts were subjected to potash stain tests, and a few were also carbonate-stained, where appropriate. The rocks are briefly described in the accompanying tables.

Summary

Virtually all the rocks can broadly be classified as volcanics, and most are sub-aerially deposited pyroclastics. The only rock which does not give a clear petrographic evidence of attitude is 265401, which could be in- or extrusive, depending on its relationships with adjacent rocks.

The problems of studying coarse pyroclastics in drill core, where relationships between rock types are confined by the size of the core, are accentuated by the alteration which is so prevalent, especially in this suite. Coarse pyroclastics, by their very nature, are necessarily very variable both laterally and vertically, and it is probably unwise to attach too much importance to the minor variations which must be expected. More significant are factors such as a change in the type or composition of volcanism, e.g. 265422 and 265423 in which more basic material occurs, or 265402-403 representing a different composition and alteration pattern to the other rocks.

A recurring rock type, both as a lava and as pyroclastic fragments, is a distinctive sodic trachyte which seems to consist essentially of sodic feldspar; there is no real evidence that it was ever anything else than a sodic rock, though its composition would normally be regarded with some scepticism.

There is some evidence that a number of the pyroclastics were welded and underwent some flow whilst in a "plastic" state, but this is to be expected in a volcanic pile which was no doubt rapidly deposited near its source. A number of rocks were later sheared, after alteration, which rendered them less competent.

Apart from K-feldspathisation which is confined to two rocks (265402, 265403), the main form of alteration is sericitisation, which affects virtually all the rocks to varying degrees throughout the sequence; silicification is also widespread and it is believed that there is very little primary quartz present in any rock, certainly not at an "essential" level. The only exceptions are the rhyolite and obsidian fragments which seem to occur mainly (or only) in deeper intersections (265424 onwards). Although 265413 has been termed an obsidian because of its distinctive textures, its composition was probably intermediate rather than acid. A younger phase of dolomite and dolomite-quartz veining cuts all other minerals.

Sulphides are dominantly pyrite, which was introduced at an early stage, very probably accompanying sericitisation; the only other readily detectable sulphide is pale sphalerite which seems to belong to the same phase, though in 265405 it occurs as crosscutting, younger veins with galena. The general style of the sulphide occurrences is low-grade hydrothermal and epigenetic; however, since none of the ore intersections were supplied for study, no details of genesis or mineral assemblage can be given.

H.W. Fander, M. Sc.

	Rock Type - Composition	Fabric	Minor Minerals	Comments
265401	Amygdaloidal Quartz-Trachyte. Small random albite laths set in poikilitic K-feldspar patches, minor quartz; small quartz and carbonate amygdales. Fine carbonate, epidote throughout.	Uniform random fabric, no flow-features. Amygdales are small, spherical.	Wide quartz-dolomite veins cutting thin epidotised zones.	Fabric suggests that rock was a shallow or minor intrusive, but could be from interior of a flow as suggested by spherical amygdales.
265402	Basalt. Numerous small fresh augite crystals (microphenocrysts) set in a fine felted groundmass of fibrous plagioclase and devitrified glass, with chlorite, epidote.	Fine flow fabric with good lineation; a few amygdales. Extensively fractured and veined.	Diffuse zones of K-feldspathisation of groundmass. Quartz-dolomite veins. Scattered pyrite.	Groundmass difficutl to determine and rock may be a trachybasalt. Fabric suggests a lava. Subtle K-feldspathisation has not affected the augite.
265403	Trachybasalt Breccia. Irregular fragments composed of augite microphenocrysts in fine plagioclase/K-feldspar groundmass; variably K-feldspathised (pink fragments) and carbonated.	Uniform, random to semi-orientated fabric. Wide veins contain coarse, stressed minerals.	Epidote grains, veinlets. Isolated pale sphalerite patches. Veins with dolomite, pink K-feldspar, green prehnite.	Quite similar to 265402. Isolated amygdales. Sphalerite apparently early postmagmatic. Pinker colour of fragments with increasing K-feldspathisation.
265404	Lithic-Crystal Tuff. Irregular and flame-like fragments of altered volcanics (?albite trachytes), contorted and ?welded, with crystals/fragments of plagioclase; layers of fine ash. Contact with older tuff.	Truncated contact. Larger fragments plastically deformed. Suggestion of grading.	Scattered early-formed pyrite; younger quartz-carbonate-chlorite veins. Pervasive chlorite.	Subaerial tuff, quite probably welded. If grading is valid, then formation youngs downwards, i.e. overturned, but not reliable in isolation.
265405	Pyritised Trachyte Breccia. Trachyte fragments consist entirely of felted albite laths, with a few albite microphenocrysts. Other fragments are very extensively impregnated with pyrite, sericite, chlorite and are unrecognisable.	Generally lensoid fragments with strong flow fabric - possibly flow-brecciated.	Crosscutting quartz veins with pale sphalerite and trace galena - younger than pyrite.	Sodic trachyte may be primary (i.e. not an albitised rock) and correlates with lithic fragments in 265404. Two generations of sulphides.
265406A	Silicified Tuff. Small splinters of quartz and plagioclase (albite) in a featureless microcrystalline quartz matrix with fine carbonate, pyrite, leucoxene throughout.	Fine banding or bedding accentuated by pyrite. Very uniform fine-grained rock.	Detrital mica flakes. Quartz and carbonate veins postdating the pyrite.	Uniformity, and diagenetic changes, suggest subaqueous tuff; no indication of grading. Possibly of mixed origin.
265406B	Altered Tuff. Small quartz and plagioclase splinters, detrital mica flakes in a fine silicified, sericitised matrix with fine pyrite; devitrified glassy fragments.	Well-bedded, very fine-grained; possible weak grading. Irregular contact with coarser rock.	Coarser lithic volcanic grains. Contact with coarse vitric tuff. Carbonate veining cuts pryite.	Similar to 265406A, but passing into coarse, possibly subaerial tuff similar to C. Grading not definite or reliable.
265406C	Vitric Tuff. Generally coarse, deformed/contorted, altered fragments of porphyritic glassy lava; ultrafine quartz-sericite matrix; irregular contact with fine tuff (265406A, B).	Relict flow-like fabric and deformed fragments suggest welding. Grainsizes up to 5 mm.	Fine pyrite throughout in veinlets and disseminated. Quartz-dolomite veins.	Grading absent; contact suggest formation is overturned, but evidence not reliable in isolation. However, see 265404.

Sample	Rock Type - Composition	Fabric	Minor Minerals	Comments
265407	Sericitised, Pyritised Trachyte. Scattered small albite phenocrysts in microcrystalline, extensively sericitised feldspathic groundmass, with conspicuous pyrite and associated pale chlorite.	Alteration obscures details, but suggestion of lava-within-lava, i.e. fine lava flow breccia.	Veins of coarse dolomite with quartz selvedges cutting rock and postdates sericite-pyrite.	Fresh rock thought to have been a sodic trachyte or trachytic lava-breccia, similar to the other sodic trachytes. Low-grade hydrothermal alteration.
408	Sheared, Sericitised Trachyte. Small albite phenocrysts, singly and in clusters, in fine devitrified groundmass with sericite, chlorite; shear zones with extensive sericite development.	Patches with fine flow-features, felted textures, but mostly microcrystalline, featureless.	Shear zones contain conspicuous pale sphalerite, with chlorite. Also quartz-sphalerite veinlets.	Rock closely resembles 265407 and regarded as part of same unit. Some sericite + pyrite is pervasive, pre dating shearing and sphalerite.
409	Lapilli Tuff. A few large fragments of altered porphyritic albite-trachyte in matrix of smaller devitrified lava, porphyry and other fragments, extensively sericitised and pyritised.	Some fragments are 50 mm or more, i.e. bombs. Matrix grains 1-3 mm. Textures obscured by alteration.	Quartz-dolomite veins cut all components. Trace chlorite associated with pyrite.	Section probably not representative because of coarse grainsizes; "bombs" could be reworked material, not necessarily ejectamenta.
410	Trachytic Lava Breccia. Irregular fragments of partly sericitised porphyritic albite-trachyte, with variable fabrics, set in a mass of the same components with fewer phenocrysts.	Mostly microcrystalline, featureless, with subtle differences between components; some felted, "trachytic" patches.	Thin shears with sericite. Pyrite clusters with associated pale chlorite.	Interpretation is tentative; rock may be entirely fragmental, or a mixed pyroclastic-extrusive type, depending on macrofeatures.
411	Altered Lapilli Tuff. Large and small fragments of fresh and altered porphyritic albite-trachyte; extensive sericitisation and deposition of coarse pyrite with pale chlorite.	Smaller fragments are poorly defined due to subsequent alteration. Large fragments up to 30 mm.	Dolomite veinlets traverse all components.	A few large fragments (lapilli) are fresh and are correlatable with other albite-trachytes. Smaller grains are indeterminate.
412	Altered Lapilli Tuff. Large fragments of porphyritic albite-trachyte in matrix of smaller volcanic (altered glassy), quartz, albite grains and fine altered ash, all silicified, argillised.	Unsorted, from ultra-fine to 20 mm, with irregular shapes. Deformed, possibly welded.	Chlorite patches. Fine pyrite throughout. Quartz-carbonate veinlets. Sericite patches.	Similar to 265411; facies of this type naturally show considerable variations, and single thin-section are unlikely to be representative.
413	Altered, Brecciated Obsidian. Scattered, aligned albite phenocrysts in a very fine-grained argillised groundmass; brecciated, with patches of fine quartz, sericite; pyrite clusters.	Well-preserved fine perlitic textures in places. Good flow-banding/brecciation.	Fine pale chlorite associated with pyrite. Rare sphalerite in quartz veinlets.	Relict features indicate a lava rather than pyroclastic rock, but composition not definite; broadly trachytic-rhyolitic.
265414	Agglomerate. Very large blocks of albite-trachyte with albite phenocrysts, variable groundmass; interstitial fine ash with small trachytic fragments and quartz, feldspars.	Mainly large blocks with only minor matrix which is extremely fine-grained. Blocks have different fabric.	Sporadic pyrite and carbonate patches, and minor sericitisation. Traces of chlorite.	Because of large size, shapes of blocks not known. Compositions are strongly sodic, including quartzose types verging on sodic rhyolites.

	Rock Type - Composition	Fabric	Minor Minerals	Comments
265415	Agglomerate. Large block of porphyritic albite-trachyte, weakly sheared and sericitised; matrix of smaller altered felsic volcanic grains with fine altered ash. Conspicuous pyrite.	General weak shearing throughout. Matrix is coarser than in 265414, but large blocks predominate.	Pyrite is fringed with pale fibrous chlorite. Dolomite patches and veins throughout.	Mild shearing accompanied by sericitisation and followed by pyrite emplacements, and later dolomite veining.
416	Altered Tuff-Lava. Small lensoid and drawn-out fragments of trachyte, and of altered phenocrysts, in a strongly flow-banded mass of altered obsidian. Conspicuous pyrite.	Strongly flow-banded, with fine perlitic textures. Small-scale shearing throughout.	Phenocrysts pseudo-morphed by dolomite. Fine pale chlorite and sericite throughout.	Essentially a lava containing cognate xenoliths of the same material, either pyroclastic or formed during flow and incorporated in lava.
417	Lava-Flow Breccia. Intermingled lavas of similar composition, but different fabrics; both are porphyritic sodic trachytes with chlorite-filled amygdales, albite phenocrysts, altered groundmass.	Good "trachytic" fabric, pronounced flow-banding. Variable groundmass textures, amygdales.	Conspicuous fine leucoxene. Carbonate patches, veins. Traces of pyrite.	Petrographic data suggest mixing of two lavas whilst still plastic, probably during extrusion, though possibly as fragments.
418	Sheared Lapilli Tuff. Subparallel streaks, lenses of Na/K trachyte (albite micropheno-crysts in K-silicate groundmass), streaky sericite; large masses of crystalline calcite.	Strong lineation partly due to shearing, partly due to welding and flow(?) or bedding.	Pyrite clusters, with sericite, chlorite, quartz. Pyrite rarely contains sphalerite inclusions.	Interpretation tentative; could be a tuff-lava/lava breccia, but relationships obscured by calcitisation and shearing.
419	Sheared, Altered Vitric Tuff(?). Drawn-out fragments of sericitised glass in a matrix of argillised shards. Lenses or disrupted veins of quartz-pyrite/sphalerite-carbonate-chalcopyrite.	Glassy textures preserved. Textures suggest generally fine/medium-grained rock, possibly welded.	Individual pale sphalerite masses up to 2 mm generally enclosed in pyrite.	Vitric textures are fairly diagnostic, despite alteration. Evidence of welding suggests sub-aerial deposition. Epigenetic sulphides.
420	Sheared, Altered Vitric Tuff(?). Lensoid, drawn-out sericitised glass in an ultrafine quartz-sericite matrix; thin layers of fine quartz splinters. Schistose sericitic shear zones with pyrite.	Marked preferred orientation throughout; some is inherited, possible welding/flow.	Small cloudy leucoxene grains common (TiO_2 released from glass). Ultrafine chlorite.	Quite similar lithology to 265419 within the limitations due to alteration. Shear zones are a light greenish-grey colour due to leucoxene + chlorite.
421	Sheared, Altered Tuff. Now composed mainly of fine schistose sericite with quartz, and minor coarser quartz fragments, occasional lithic grains (?rhyolite); folded pyrite veins.	No relict diagnostic textures. Rock is markedly schistose; some post-vein movement.	Pyrite fringed with fibrous sericite and ?antigorite/chrysotile.	May have been a vitric tuff, but too altered and sheared for accurate classification. Note folding of pyritic veins.
265422	Sheared, Altered Tuff. Streaks of chloritic, sericitic material representing altered lithic and vitric fragments; a few recognisable altered lavas, glass and feldspar fragments.	Variably schistose, depending on extent of alteration and shearing. Some relict features.	Folded, disrupted dolomite veins. Scattered small pyrite grains. Skeletal leucoxene.	Can be broadly categorised with 265421, but clearly contains fragments of intermediate to basic igneous material, possibly basalt and basic glass.

	[redacted]	[redacted]	[redacted]	[redacted]
423	<u>Sheared, Altered Lithic Tuff</u>. Poorly defined fragments of altered intermediate to basic volcanics, now composed of fine chlorite, sericite, quartz; vitric tuff bands, silicified and sericitised.	Variable schistosity, *depending on proportion* of micaceous minerals. Medium-grained.	Leucoxenised oxide opaques in some fragments. Fine pyrite dispersed through rock.	Noticeable increase in chlorite, which suggests more basic constituents. No evidence of trachytic types occurring higher in hole.
424	<u>Agglomerate</u>. Large irregular fragments of porphyritic trachyte, silicified, chloritised and argillised. Matrix of silicified pumice and obsidian fragments, *fine quartz-sericite* cement.	Most fragments, especially larger ones, have highly irregular *outlines*. Unsorted.	Clusters of sulphides (pyrite, marcasite). Sporadic small carbonate patches.	Contrasting compositions of coarser *trachytic fragments and finer* matrix grains of rhyolitic types (obsidians, pumice).
425	<u>Lapilli Tuff</u>. Gravel- and pebble-sized irregular fragments of chloritised scoriaceous ?basalt, trachyte, obsidian/glassy rhyolite and other volcanics, all sericitised and silicified.	Whole rock is streaky and ?flow-textured, with drawn-out fragments. ?Welded.	Pyrite clusters; a few small pale sphalerite patches. Fibrous chlorite/sericite around pyrite.	Alteration has obliterated details, but rock appears welded and flow-structured. Heterogeneous *components, including rhyolitic* material.
426	<u>Sheared, Sericitised Tuff</u>. Most fragments are sheared, sericitised, silicified and *unrecognisable*, with some trachyte/ rhyolite; semi-schistose quartz-sericite matrix.	Brecciated, sheared, stretched fragments. Subparallel shear zones. Medium-grained.	Pyrite clusters with associated carbonate, chlorite, sericite.	Clearly a pyroclastic rock, but details destroyed by alteration and subsequent shearing, and nature of components uncertain.
427	<u>Sheared, Altered Tuff</u>. Poorly defined altered volcanic fragments up to 10 mm, generally silicified and argillised; some were porphyritic trachytes, others glassy lavas.	Original rock mostly medium-grained, i.e. too fine for "lapilli" grade.	Folded, disrupted veins of micro-crystalline chalcedonic quartz. Scattered fine pyrite.	Broadly resembles 265426 and equally indeterminate because of *alteration; components in the* intermediate to acid range.
428	<u>Sheared, Altered Lapilli Tuff</u>. Irregular fragments of relatively unaltered porphyritic sodic trachyte in a semi-schistose fine quartz-sericite matrix with altered volcanics.	Larger fragments less affected by shearing. Some relict shard textures in places.	Small crystals, clusters of pyrite. Sporadic carbonate patches.	Glassy volcanic components more susceptible to alteration and thus more severely affected by subsequent shearing.
265429	<u>Sheared, Sericitised Tuff</u>. A few recognisable larger trachyte fragments and stretched lenses in a generally schistose mass of sericite with interspersed fine quartz.	Strongly schistose *fabric, with relict* flow-structures in places. Mostly fine-grained.	Scattered small pyrite clusters with rims of fibrous chlorite-sericite-?chrysotile.	Originally probably mostly composed of vitric fragments, sheared after alteration to incompetent material. Acid/intermediate composition.

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6th February, 1984

REPORT CMS 83/12/29

YOUR REFERENCE:	Letter dated 20.12.1983
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SAMPLE NOS.:	258002 - 258020
SUBMITTED BY:	D.J. Jack
WORK REQUESTED:	Petrology/Mineralogy

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REPORT CMS 83/12/29

Hellyer Prospect Ore Samples

Nineteen drill core samples were received for petrological and mineragraphic study, with particular reference to metallurgical aspects of the sulphides. The samples comprised selected intersections from MG 3, 5, 6, 7 and MG 12 (MG 13 was submitted separately and will be described in a further report). Thin- and polished sections were prepared of all samples, so as to study gangue and sulphide minerals; many of the intersections are massive or semi-massive sulphides and would thus yield little petrological (as distinct from mineralogical) information. Thin- and polished sections are described in separate tables.

Comments

1. Geological Observations

a. Tectonism.

There is evidence of limited brecciation and deformation of some of the ore; the effects of tectonism are not great. Features such as thin breccia zones which particularly affect brittle minerals such as pyrite, stain-extinction in quartz and barite, deformation of galena, minor recrystallizatio are sporadically present throughout the ore.

More marked effects, such as local development of schistosity in MG 12, are attributable to the incompetent nature of the minerals involved; any local stresses would be"channelled" through incompetent strata, taking the easiest path, and would produce quite marked effects in a restricted zone. Taken in context with the total situation, the phenomenon is very minor.

Whilst some post-ore tectonism is more than likely to have affected the deposit, especially in Devonian times, it is equally likely that purele local movements must have occurred, during deposition and before lithification, because of diagenetic re-adjustments and movements of heavy sulphide layers against light siliceous and argillaceous ones.

b. Evidence of Genesis

Three main types of chemically formed materials occur in these rocks; they are barite, "silica" and sulphides; some of the carbonate is also of this origin, and some of the chloritic and illitic clays may also be chemical rather than clastic.

There is good textural evidence that the barite was formed at an early stage, initially as large crystals, interbanded with sulphides and also forming massive units containing little sulphide. Where sulphides are associated, they are clearly sedimentary, and it may be deduced from all the observations that the barite is sedimentary also.

Where "silica" occurs in these intersections, it is present either as microcrystalline quartz typical of crystallized cherts, or as fibrous-columnar quartz fringes around pyrite which seem to have developed during diagenesis, perhaps under the influence of weak directed pressures in a similar manner to pressure-shadows. In view of the substantial vertical pressures which must have existed in the unconsolidated ore due to the weight of the sulphides, it is hardly surprising that such textures developed, not only in quartz, but also in sulphides (258018 in particular) and micas, where sometimes in the same rock, there is evidence of orientated and unorientated growth. Thus, the forms of silica in the ore are compatible with chemical deposition (followed by diagenetic modification).

Whilst the major sulphides - pyrite, galena and sphalerite - are often disposed as distinct bands or layers which are most easily explained as being of depositional origin, it is the pyrite which gives the clearest textural evidence of mode of formation. This mineral frequently displays all the criteria of low-temperature accretionary processes. Well-defined framboids, radial and concentric textures, colloform-banded structures, are all common and well preserved. In many samples, pyrite is riddled with greigite (-melnikovite, Fe_3S_4?), an unstable Fe sulphide. The colloform and concentric pyrite textures are often intergrown with sphalerite and/or galena, indicating contemporaneous deposition of all three sulphides.

The status of arsenopyrite is not always clear, but in the arsenopyrite-rich intersections from MG 7 there is good evidence that arsenopyrite also formed as distinct bands (some with intraformational folding) contemporaneously with other sulphides; it evidently tends to crystallize more easily than pyrite, since the bands are generally made up of small crystals, though fine spongy patches are also present and are unlike any other arsenopyrite textures known to the author. Thus, despite the time-honoured concept that arsenopyrite is a meso- to hypthermal mineral, its occurrence here demonstrates that a much lower-temperature origin is also possible.

The textures generally shown by the sulphides demonstrate that "pyrite" was probably the earliest sulphide to form, followed (and overlapped) by sphalerite and galena (and the minor sulphides). Subsequently, during diagenesis and lithification, "pyrite" recrystallized (from a hydrous gel form) to crystalline material - accompanied by some shrinkage and microfracturing, and other sulphides were mobilised, especially galena. The end result was a wide variety of generally complex, fine-grained mutual textural intergrowths so characteristic of other deposits of similar genesis, such as Que River.

There is some evidence (258006/7) that the Cu-rich intersections represent remobilised or epigenetic material; it is significant that the pyrite is well-crystallized, with no colloform, framboidal or related textures. However, further Cu-rich occurrences will need to be studied to verify this.

2. Mineralogical Summary

a. Gangue Minerals

Most of the intersections consist of massive sulphides containing only a small proportion of gangue minerals; these include quartz, sericite, chlorite, and carbonate (both calcite and ankerite are present). All the gangue is somewhat sporadically distributed, granular, and embedded in sulphides.

Those intersections representing lower grades or disseminated ore, i.e. containing fewer sulphides, are mainly composed of either barite (as in MG 7) or quartz-sericite/illite (as in MG 12). Some of these may well require a different form of beneficiation, especially if the barite is to be recovered, or if precious-metal values are high.

On the whole, gangue minerals are insignificant in the massive sulphides; the occurrence and distribution of gangue-rich lenses (or other bodies) within the massive sulphides will, however, require further study in order to become familiar with, and prepared for, their compositions and characteristics.

b. Sulphides

In almost all rocks, pyrite is the major sulphide present. Next in abundance is sphalerite, then galena. All others are very sporadic and generally in trace amounts; they include arsenopyrite,chalcopyrite, tetrahedrite (at least two, possibly three distinct varieties), boulangerite and geocronite - all but the last two are quite widespread.

Arsenopyrite is most strongly represented in MG 7, with traces in MG 3 and MG 5; none was detected in the MG 6 and MG 12 intersections examined, but this may be due to sampling problems associated with patchy distribution. It is generally very fine-grained, but does occasionally form larger crystals.

Sphalerite often forms coarse patches, but these are frequently full of very small inclusions of all other sulphides,many of them below the practical limits of liberation. The sphalerite is generally very pale to colourless (very low Fe content). occasionally amber to pale brown (low Fe).

Galena, being particularly mobile, tends to form relatively coarse patches, and veins, which in places are relatively free of other sulphides, but it also occurs as minute blebs and larger shapeless masses intergrown with sphalerite, as well as forming complex intergrowths with pyrite.

At least two varieties of tetrahedrite were identified; it is believed that the colour may in part reflect their Ag content, where the brown variety is thought to contain more Ag (i.e. trending towards freibergite), and the green variety containing little Ag. This is conjectural and needs substantiation by electron-probe microanalysis. It is probable that traces of Ag are also distributed in the (or some of the) galena. Most of the tetrahedrite occurs as small inclusions in galena, but was also detected elsewhere (e.g. in chalcopyrite - 258007).

Chalcopyrite occurs generally as very small inclusions in sphalerite, occasionally as coarser patches, especially in 258007 and in other samples with high Cu contents.

Boulangerite and geocronite, both Pb-Sb sulphides, are merely mineralogical curiosities at this stage, having been identified in only one sample (258012).

No gold was detected at this level of investigation.

H.W. Fander, M. Sc.

le	Rock Type - Composition	Fabric	Minor Minerals	Comments
258002	Banded Quartz-Sulphide Rock. Wide bands of quartz and pyrite crystals; narrower galena-rich bands which are folded, disrupted. Fine chlorite shreds throughout.	Much of the quartz has fibrous textures, surrounding pyrite crystals. Stressed.	Fine shreds, occasional small aggregates, of sericite. Colourless sphalerite.	Rock is traversed by thin breccia zone which veers from semi-conformable to transcurrent, disrupting the galena band; ?late diagenetic.
003	Barite-Sulphide Rock. Wide bands of finely granular amber sphalerite with fine carbonate and thin galena laminae; pyrite and pyrite/sphalerite bands. Lenses of coarse stressed barite crystals.	Some disruption of bands with small-scale faulting. Barite stressed, partly granulated.	Sporadic quartz crystals. Chlorite flakes intergrown with granulated barite.	Evidence of small-scale movement affecting some parts of rock; this suggests diagenetic, pre-lithification movement/adjustment.
004	Massive Sulphides. Dominantly composed of fine colloform-banded pyrite with subordinate pale/colourless sphalerite; scattered inclusions of carbonate and barite.	Good banding on a larger scale, intricate colloform banding on small scale.	A few small patches of clear mosaic quartz with traces of chlorite.	Sulphides are described in a separate table. Very little gangue. The carbonate is believed to be ankerite.
005	Silicified Scoriaceous Breccia. Large and small fragments of highly vesicular, completely silicified, chloritised, sericitised lava, with interstitial clear quartz and small pyrite crystals.	Fragments are rotated, all have very similar textures, structures. Minor fracturing.	Occasional younger crosscutting quartz veinlets.	Some relict textures suggest stretching, welding, flow. Very probably a scoriaceous flow top. Original rock not known, but andesitic/basaltic.
006	Massive Pyrite. Accumulation of well-defined pyrite crystals with interstitial, very pale Mg-chlorite, ultrafine illite; zones of quartz with inclusions of colourless sphalerite.	Absence of colloform or banded features; believed to be recrystallized material.	A few small sericite patches in vein-like quartz zones.	Very pale chlorite is typical of many volcanogenic sulphide deposits. Pyrite is thought to be diagenetically recrystallized.
007	Massive Sulphides. Rock is dominantly composed of massive granular pyrite, chalcopyrite, with random irregular inclusions of quartz and shreds of sericite(-hydromuscovite).	No distinctive structures or textures seen in thin-section; no banding.	A few small carbonate grains. Colourless sphalerite.	Featureless rock in thin-section. Mineral assemblage suggests an epigenetic phase, i.e. younger than bedded sulphides.
008	Pyritic Chert. Irregular masses of very fine-grained and colloform-banded pyrite dotted through a mass of cherty quartz, with colourless sphalerite. Fibrous quartz surrounds pyrite.	Fibrous quartz all has same orientation, but remainder is structureless, fine-grained.	Small wisps of sericite, a few small chlorite patches. Brown sphalerite.	Pyrite, sphalerite and SiO_2 formed contemporaneously as a mixed gel, taking on present form/distribution in diagenesis. Galena younger?
258009	Massive Sulphides. Dominantly composed of massive fine-grained pyrite with intergrown irregular patches of colourless sphalerite. Subparallel fine streaks of calcite occur throughout.	The fairly regular arrangement of carbonate streaks, and their form, suggest shrinkage cracks.	Patches and ragged veins of quartz, probably diagenetic. Stressed barite patches. Trace Fe-chlorite.	The barite probably formed syngenetically with the sulphides and was stressed during diagenesis. Quartz and calcite are diagenetic.

le	Rock Type - Composition	Fabric	Minor Minerals	Comments
258010	Massive Sulphides. Bands and lenses of colourless sphalerite, alternating with pyrite-rich bands with transverse quartz bodies. Sparse fine quartz grains throughout.	Crude but definite banding, lensing and interfingering of pyrite/sphalerite.	A few shreds of pale chlorite in quartz.	Coarser quartz occurs in pyritic bands and lenses, and is thought to represent infilled shrinkage features.
011	Banded Barite-Sulphide Rock. Mostly bands and lenses of amber to colourless sphalerite, alternating with thinner barite-rich and quartz-pyrite bands with scattered sphalerite.	Well-defined layering, coarse to fine. Minor soft-sediment deformation.	Scattered small carbonate patches and crosscutting veinlets.	Barite mostly finely granular, but also porphyroblastic, clearly contemporaneous with the bedded sulphides, perhaps the first to crystallize.
012	Barite-Sulphide Rock. Abundant barite as subparallel platy crystals and fine mosaics; streaks, lenses, irregular grains of pyrite, colourless sphalerite. Lenses of argillaceous chert.	Well-banded/bedded, with noticeable preferred orientation of barite crystals, which are weakly stressed.	A few patches of relatively coarsely-crystalline ankerite. Fine sericite, chlorite shreds.	Large barite crystals formed at an early stage, followed by sulphides, more barite. Weak stress thought to be a diagenetic effect.
013	Barite Rock. Consists almost entirely of barite, as crystals up to 15 mm in length, with interstitial fine mosaic barite, and small sulphide grains causing dark colour.	Barite crystals seem to be randomly orientated; all are weakly stressed.	Fine sericite flakes. Patches, veinlets of carbonate - late-stage microfracture-filling.	Barite evidently crystallized in two stages, firstly as porphyroblasts, then as finer grains with the available sulphides.
014	Massive Sulphides. Intricately intergrown pale sphalerite and pyrite; more pyritic patches contain irregular bodies of finely-granular to fibrous quartz.	Faint preferred orientation (bedding?) due to subparallel pyrite streaks. Microfractured.	Carbonate filling microfractures. Trace chlorite in quartz.	Fairly featureless in thin-section. Evidence of pre-lithification movement, as would be expected.
015	Massive Sulphides. Streaks and irregular interlocking patches of pale sphalerite and fine pyrite; intergranular chlorite flakes, scattered fine carbonate.	Massive, structureless, except for a few subparallel features - probable bedding.	Sporadic small barite crystals; discontinuous quartz stringers.	As above.
016	Massive Sulphides. Dominantly composed of pale amber, granular sphalerite and intergrown pyrite; more pyritic areas contain minor quartz. Fine carbonate inclusions.	Most pyrite/sphalerite is bedded, fine-grained; some pyrite also crosscutting.	A few younger carbonate veinlets.	Clearly some movement of sulphides occurred before consolidation, causing veining. Sulphides described separately.
258017	Massive Sulphides. Patchwork of randomly intergrown pyrite and pale sphalerite, with interstitial patches of barite. Veins of coarse sphalerite crystals with quartz, chlorite, barite.	Structureless, fine-grained, patchy material, except in well-crystallized veins.	Crosscutting carbonate-barite veinlets, randomly orientated.	Veins are straight-sided, clearly younger, with different mineral assemblage; they appear epigenetic, though sphalerite is pale, like host rock sphalerite.

le [redacted]	[redacted] T[redacted] -[redacted] po[redacted] n [redacted]	[redacted] i[redacted]	Mi[redacted] 'ir[redacted] 's [redacted]	[redacted] me[redacted]
018	Quartz-Sericite-Sulphide Rock. Single crystals of pale sphalerite, and composite sulphide lenses/eyes, set in a semi-schistose quartz-sericite mass set in fine quartz-illite.	Sphalerite appears distinctly corroded. Some portions of rock are schistose, others granular.	Coarser columnar quartz, intergrown with calcite.	Strange combination of "schistose and non-schistose textures; perha schistosity is a diagenetic feature, due to directed growth.
019	Quartz-Sericite-Sulphide Rock. Individual patches of generally composite sulphides, set in a semi-schistose mass of sericite-fibrous quartz; intervening patches of fine quartz-illite.	Preferred orientation not metamorphic, but resulting from directed diagenetic growth.	Illite/sericite-rich lenses and streaks.	Very similar type of disseminated ore to 258018, with abundant gangue, especially recrystallized clays.
258020	Sericite-Sulphide Schist. Irregular composite sulphide patches, intricately intergrown with illite/sericite, in a schistose mass of fine illite and very pale Mg-chlorite.	Strong preferred fabric due to dominance of micaceous minerals. Fine-grained.	Fringes of fibrous ?talc around sulphide patches.	Any post-ore tectonic effects would be more pronounced in a roc of this type and may be localised and exaggerated here.

Sample No.	Mineralogy of Sulphides
258 002	Pyrite, galena, sphalerite, brown and green tetrahedrite, minor trace chalcopyrite. Pyrite extensively microfractured, penetrated by, and embedded in, other sulphides. Galena stressed. Brown tetrahedrite may be Ag-bearing variety, occurs in galena as inclusions 50-200 μ. Green variety (normal "tetrahedrite") more widespread, in galena, sphalerite, up to 600 μ. Sphalerite is free of exsolution chalcopyrite. Evidence of post-sulphide stress and some re-organisation.
258 003	Pyrite, sphalerite, galena, arsenopyrite, chalcopyrite, brown tetrahedrite. Banded ore. Pyrite shows colloform textures and pseudomorphs after ?marcasite; banded structure. Sphalerite is coarse, but full of small (mostly < 50 μ) inclusions of pyrite, galena, chalcopyrite, arsenopyrite, forms bands alternating with pyrite. Arsenopyrite as fine spongy patches and as clusters of mostly < 20 μ crystals (occasionally up to 100 μ). Galena sometimes coarse, but mostly very fine; contains 10-50 μ inclusions of brown (?Ag) tetrahedrite. Complexly-intergrown sulphides. No evidence of stress.
258 004	Pyritic section. Dominant pyrite, with sphalerite, galena, chalcopyrite, arsenopyrite. Mostly colloform-banded fine pyrite in a great variety of textures, interbanded with clear sphalerite; also patches of pyrite framboids. Arsenopyrite as small (< 50 μ) crystals encrusting some pyrite bands. Sulphides generally very finely intergrown.
258 005	Scattered pyrite crystals and clusters only.
258 006	Well-formed, relatively large single crystals and clusters of pyrite, with interstitial patches, films, veinlets of sphalerite and galena. No colloform textures; pyrite may be recrystallized.
258 007	Pyrite, chalcopyrite, traces of galena and brown tetrahedrite. Pyrite is massive, well-crystallized, as aggregates of euhedral crystals, but microfractured. Engulfed, veined by chalcopyrite containing small (< 50 μ) inclusions of brown (?Ag) tetrahedrite and galena. Chalcopyrite fairly massive in places.
258 008	Pyrite, minor sphalerite, galena, arsenopyrite, trace green tetrahedrite. Pyrite as clusters of small framboids, as radiating-fibrous, concentric, colloform-banded and other concretionary textures; many concentric forms have alternating thin (< 20 μ) shells of pyrite, sphalerite, galena (and sphalerite-galena). Fibrous-radiating masses may consist of sphalerite and pyrite fibres (possible greigite-melnikovite). Arsenopyrite as euhedral crystals up to 500 μ.
258 009	Pyrite, sphalerite, galena, traces of chalcopyrite and brown tetrahedrite. Pyrite as colloform-banded and framboidal masses, pseudomorphs after ?marcasite, extensively intergrown with melnikovite(-greigite); sphalerite and galena as small to large irregular patches, intricately intergrown with pyrite. Tetrahedrite as < 50 μ inclusions in galena. Chalcopyrite very sparse, < 50 μ grains. No gold detected.
258 010	Pyrite, sphalerite, galena, traces of chalcopyrite and arsenopyrite. Pyrite mostly well-crystallized, but with relict spongy and framboidal textures. Sphalerite mostly coarse, but with numerous small galena, pyrite and chalcopyrite inclusions (many are 5-30 μ). Sporadic fine galena, chalcopyrite. Isolated euhedral arsenopyrite.

Sample No.	Mineralogy of Sulphides
258 011	Sphalerite, galena, pyrite, chalcopyrite, arsenopyrite, brown tetrahedrite. Banded ore. Alternating sphalerite-rich, pyritic, galena, gangue. Galena mostly fairly coarse and free of other sulphides; sphalerite with many small inclusions of all other sulphides; fine pyrite-sphalerite intergrowths. Pyrite ranges from fine spongy patches to small euhedral crystals. Arsenopyrite as euhedral crystals 30-200 μ, mostly in sphalerite. Brown tetrahedrite as inclusions up to 100 μ, but mostly < 50 μ in galena.
258 012	Sphalerite, galena, pyrite, boulangerite (Pb-Sb sulphide), geocronite (Pb-Sb/As sulphide), brown tetrahedrite. Disseminated patches and stringers of sulphides. Thin galena bands relatively free of inclusions; sphalerite full of small blebs, streaks of boulangerite and pyrite. Most pyrite has fine colloform textures with films, fine interstitial patches of geocronite, flanked by coarser geocronite. Brown tetrahedrite as sparse small inclusions in galena. Complex textural associations.
258 013	Pyrite, traces of sphalerite, galena, isolated brown tetrahedrite. Pyrite occurs as small clusters of colloform/radiating-fibrous bodies; the other sulphides are scattered as small grains through the gangue.
258 014	Pyrite, sphalerite, galena, trace arsenopyrite. Some pyrite is recrystallized, pseudomorphous after a prismatic mineral (?marcasite), but most is finely-colloform/concentric, with patchy melnikovite-greigite. Sphalerite as coarse masses, relatively free of other sulphides, and as ultrafine concentric shells with pyrite. Galena as thin shells and microgranular intergrowths with pyrite. Sporadic arsenopyrite crystals, < 50 μ.
258 015	Pyrite, sphalerite, arsenopyrite, galena, trace chalcopyrite. Pyrite in crystal clusters, some with relict fine colloform and framboidal textures. Arsenopyrite in distinct parallel bands of spongy patches and fine crystals, clearly of syngenetic, colloform deposition; ultrafine intergrowths especially with galena. Sphalerite relatively coarse (forming matrix for pyrite, arsenopyrite bands), but with many fine inclusions of pyrite, galena, chalcopyrite.
258 016	Pyrite, sphalerite, galena; traces of arsenopyrite, chalcopyrite. Well-banded ore. Pyritic bands with framboidal, colloform and pseudomorphous textures, intergrown with coarser, granular crystals; finely intergrown galena, sphalerite. Sphalerite bands with patches of relatively coarse galena, as well as fine galena, pyrite, chalcopyrite inclusions. Arsenopyrite occurs sporadically as 20-200 μ crystals, a few larger clusters, in sphalerite, pyrite.
258 017	Pyrite, sphalerite, arsenopyrite, tetrahedrite, galena. Pyrite and arsenopyrite generally intimately intergrown/interbanded, with colloform textures, traversed by galena and tetrahedrite veinlets (mostly < 10 μ). Sphalerite generally coarse; some clear patches, but most is full of pyrite, arsenopyrite crystals. Tetrahedrite ("normal" variety) forms interlocking intergrowths with sphalerite, associated minor galena, and contains traces of fine chalcopyrite. It is almost entirely confined to younger veins (and subsidiary veinlets) of a second generation of sulphides.

Sample No.	Mineralogy of Sulphides
258 018	Sphalerite, galena, pyrite, chalcopyrite, trace tetrahedrite. Large and small single crystals of sphalerite with orientated chalcopyrite inclusions, random pyrite crystals and galena patches, and with "tails" of coarse galena-chalcopyrite intergrowths interfingering with micaceous gangue. A few tetrahedrite patches in galena. Sulphides are not stressed or fractured - directional textures due to growth governed by host rock.
258 019	Pyrite, sphalerite, galena, chalcopyrite. Pyrite generally as clusters of small crystals with finely intergrown galena, sphalerite; pyrite is finely recrystallized. Sphalerite mainly quite coarse, but with small chalcopyrite, pyrite inclusions; patches often flanked by coarser galena and chalcopyrite. Disseminated ore.
258 020	Pyrite, sphalerite, galena, trace chalcopyrite, isolated brown tetrahedrite. Pyrite forms discontinuous clusters of microcrystalline aggregates with very fine interstitial galena and sphalerite. Coarser single crystals of sphalerite occur, with minute exsolution blebs of chalcopyrite; there are also larger galena patches, with rare brown tetrahedrite inclusions up to 200 μ.

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12th March, 1984

REPORT CMS 84/1/25
Supplement

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REPORT CMS 84/1/25

Hellyer Drill Core MG 12, MG 13

A further eight drill core samples were received for petrological and mineragraphic examination. Thin- and polished sections were prepared, and are described in the accompanying table.

Comments :

There is little to add to the previous report in the way of genetic comments; observations on this material confirm previous data. There is further evidence of diagenetic recrystallization of the sulphides, with local brecciation of the pyrite and its subsequent veining by other sulphides; for some reason, this is particularly evident in the chalcopyrite-rich intersections, which suggests that they may have a different relationship to the host rock than the other ore intersections.

The gangue mineralogy is the same as before; most of the sulphides are massive and contain very little gangue. Quartz in various forms is the main gangue, with sporadic carbonates (ankerite, calcite), sericite and chlorite, occasional illite and barite.

Sulphides include conspicuous arsenopyrite in the lower portion of MG 12, but none detected in MG 13, and a new silver mineral, identified with reasonable confidence as owyheeite ($5PbS.Ag_2S.3Sb_2S_3$, with 6-8 % Ag), in the Ag-rich intersections in MG 12. Tetrahedrite, however, is very scarce, and the brown variety was not detected; the green, or "normal", variety tends to occur with chalcopyrite. As before, there is a very wide range of grainsizes and textural relationships between the various sulphides. Melnikovite, an unstable Fe sulphi is present and is a potential source of oxidation problems.

H.W. Fander, M. Sc.

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Photomicrographs

Hellyer Sulphide Intersections (MG 3, 5, 6, 7, 12, 13)

1. 258002 Magnification = 100x

Coarse green tetrahedrite with galena (white), sphalerite (grey), fractured pyrite (pale yellow).

2. 258002 Magnification = 100x

Brecciated pyrite with sphalerite, galena, brown tetrahedrite.

3. 258002 Magnification = 100x

Brown tetrahedrite in galena.

4. 258007 Magnification = 100x

Fractured euhedral pyrite crystals veined by chalcopyrite (yellow containing 50 μ brown tetrahedrite.

5. 258008 Magnification = 100x

General view of pyrite and melnikovite (fibrous); porous areas contain galena.

6. 258008 Magnification = 200x

Colloform, concentric pyrite-melnikovite with galena shells.

7. 258008 Magnification = 500x

Pyrite-melnikovite, with galena, and sphalerite shells.

8. 258011 Magnification = 100x

Typical sphalerite, with small inclusions of pyrite, chalcopyrite galena, and arsenopyrite.

9. 258011 Magnification = 100x

Coarse galena, galena/pyrite intergrowths, sphalerite patches.

10. 258011 Magnification = 100x

Typical "jigsaw" texture of galena-sphalerite, with pyrite and green tetrahedrite in centre.

11. 258015 Magnification = 100x

Bands of spongy fine arsenopyrite intergrown with galena, in sphalerite.

12. 258015 Magnification = 100x
As above.

13. 258016 Magnification = 50x
Banded pyrite-sphalerite-galena ore.

14. 258016 Magnification = 50x
Banded ore; fine framboidal and fibrous pyrite intergrown with sphalerite and galena.

15. 258017 Magnification = 100x
Sphalerite-green tetrahedrite vein with gangue, pyrite.

16. 258018 Magnification = 50x
Sphalerite "eyes" or thick, short lenses, with orientated chalcopyrite inclusions, and coarse "tails" of galena-chalcopyrite.

17. 258020 Magnification = 100x
Microcrystalline pyrite with fine intergranular galena and sphalerite; also coarser patches.

18. 258020 Magnification = 200x
Part of above, showing greater detail.

19. 258022 Magnification = 200x
Abundant spongy arsenopyrite (white) in sphalerite; ultrafine galena.

20. 258022 Magnification = 200x
Owyheeite (greenish, mottled), with arsenopyrite, sphalerite, galena.

21. 258023 Magnification = 100x
Owyheeite patches fringed with pyrite; sphalerite.

22. 258027 Magnification = 100x
Coarsely-crystalline pyrite and galena; sphalerite with fine chalcopyrite blebs.

23. 258028 Magnification = 100x
Fractured pyrite, finely veined with chalcopyrite (yellow), tetrahedrite (greenish-grey).

H.W. Fander, M.Sc.

CENTRAL MINERALOGICAL SERVICES

n	Rock Type - Composition	Fabric	Minor Minerals	Comments
258021	Quartz-Sulphide Rock. Massive and disseminated sulphides, fringed with fibrous quartz and sericite, set in fine cherty quartz with ultrafine illite-sericite flakes.	Faint banding occurs in quartz - relict colloform structures.	Discontinuous bands and patches of pale Mg-chlorite crowded with fine pyrite crystals.	Sulphides have transverse shrinkage-cracks or cross-fractures due to slumping/compaction, filled with silicates. Chlorite from Mg clay.
022	Massive Sulphides. Dominantly pale sphalerite with other sulphide patches; interstitial fine sericite flakes, occasional barite and quartz patches.	Sphalerite often as spheroidal masses with concentric colour zoning. Banded ore.	Isolated small (< 0.2 mm) carbonate grains.	Gangue minerals and sulphides clearly contemporaneous. Sphalerite textures may be inherited from wurtzite (low-temperature ZnS).
023	Massive Sulphides. Dominantly blotchy brown sphalerite, with parallel streaks of other sulphides. Scattered small carbonate, quartz, barite crystals in stringers.	Fine crenulated banding well-developed. Gangue grains 10-500 μ, mostly < 200 μ.	A few sericite flakes.	Brownish colour of sphalerite signifies minor Fe content, contrasting with much paler sphalerite in most other samples.
024	Carbonate-Sulphide Rock. Mostly massive sulphides, in bands and patches, with coarsely crystalline ankerite, fibrous-columnar quartz fringing the sulphides.	Good colloform and framboidal textures. Gangue mostly coarse (> 300 μ), but also as fine veins.	A few chlorite shreds. Minor calcite intergrown with ankerite.	Gangue minerals almost certainly recrystallized, and show epigenetic relationship to the sulphides.
025	Massive Sulphides. Very minor gangue only, as small patches, veinlets, occasional coarser bands of quartz and coarsely-crystalline ankerite.	Crude banding in places; both otherwise massive, structureless	A few shreds of chlorite intergrown with fibrous quartz. Trace sericite.	Gangue is recrystallized, perhaps partly in situ, partly as cross-cutting veins; probably normal diagenetic effects.
026	Chert-Sulphide Rock. Dominantly massive sulphides, with patches of microcrystalline quartz intergrown with sericite representing chert, and clear quartz patches.	Structureless rock with some banding around ovoid chert patches. Veined.	Carbonate-barite veins. Streaks of sericite flakes. Small chlorite aggregates.	Chert is recrystallized, with distinctive textures, originally present as silica nodules. Note barite in veins, i.e. younger.
027	Quartz-Sulphide Rock. Patches of massive sulphides with interspersed quartz-sulphide intergrowths; sulphides cut by carbonate (calcite).	Fine random fractures in sulphides. Fine sulphides in quartz down to 10 μ.	A few small sericite and chlorite aggregates. Larger illite patches.	Post-ore fracturing and calcite veining. Some quartz-sulphide intergrowths are intricate and fine-grained.
258028	Quartz-Sulphide Rock. Abundant coarse, stressed, fractured and partly recrystallized quartz. Sulphides as aggregates of crystals, in bands and thin stringers.	Fairly structureless. Some quartz is stressed, some is not (?younger). Carbonate also stressed.	A few ankerite crystals, sericite and chlorite patches.	Could be remobilised/recrystallized material rather than primary ore; relatively high Cu may be significant.

No.	Mineralogy of Sulphides
258021	Pyrite, sphalerite, galena, chalcopyrite, trace tetrahedrite. Pyrite as small euhedral crystals (20-200 μ) and larger clusters, with small inclusions (< 50 μ) and veinlets/fracture-fillings of galena, sphalerite. Galena patches up to 500 μ. Sphalerite lenses up to 2-3 mm, generally with small inclusions of other sulphides (chalcopyrite, pyrite, galena). Tetrahedrite up to 200 μ in gangue.
58022	Sphalerite, arsenopyrite, pyrite, galena, ?owyheeite. Large areas of coarse sphalerite, with all other minerals as inclusions of various sizes. Spongy masses of fine arsenopyrite abundant; clusters of small pyrite euhedra. Galena as irregular patches 10 μ to 1 mm. ?Owyheeite (a Pb-Ag-Sb-sulphide with 6-8 $\%$ galena) generally intergrown with galena or as patches up to 1 mm, with arsenopyrite inclusions.
58023	Sphalerite, arsenopyrite, pyrite, galena, owyheeite. Similar to 022, with large masses of sphalerite containing abundant, very fine arsenopyrite as spongy patches, sometimes circular, and irregular inclusions of galena as patches (up to 1 mm) and bands, as well as pyrite bands (deformed, folded) with colloform textures; scattered pyrite. Owyhaeite as streaks, often associated with galena. Some arsenopyrite/pyrite zoned intergrowths.
58024	Pyrite, sphalerite, galena, chalcopyrite, melnikovite. Pyrite textures range from collorom, framboid, concentric zoning, radiating-fibrous patches to good crystals. Fine galena/pyrite as concentric shells forming small composite grains, where shells often < 10 μ thick. Framboids are microporous, with sphalerite, galena inclusions < 2 μ in size. Sphalerite as patches full of other sulphides. Fine melnikovite intergrown with pyrite.
58025	Pyrite, sphalerite, galena, chalcopyrite, melnikovite. Very similar to 258024.
026	Pyrite, chalcopyrite, sphalerite, galena. Well-crystallized pyrite up to 1 mm, but microfractured and veined by all other sulphides. Coarsely-crystalline chalcopyrite (up to 2-3 mm or larger, but with pyrite), sphalerite and galena. Complex, intricate mutual intergrowths of galena, sphalerite, chalcopyrite.
027	Pyrite, sphalerite, chalcopyrite, galena, trace melnikovite. Pyrite mostly well-crystallized, coarse, with a few fine pyrite-melnikovite intergrowths. Coarse sphalerite, as large patches, but with small inclusions of all other sulphides. Chalcopyrite ranges from very fine (< 5 μ) to 500 μ. Pyrite microfractured, finely veined with sulphides.
028	Pyrite, chalcopyrite, sphalerite, galena, tetrahedrite. Mainly pyrite, as good crystals, but extensively microfractured, with thin veinlets, of all other sulphides, mostly < 10 μ wide; also coarse interstitial chalcopyrite up to 500 μ.

Central Mineralogical Services

CMS

Mr. D.J. Jack
Geologist,
Aberfoyle Exploration Pty. Ltd.
P.O. Box 952
BURNIE / TAS. 7320

12th March, 1984

REPORT CMS 84/1/25
Supplement

YOUR REFERENCE:	Letter dated 18.1.1984
DATE RECEIVED:	20th January, 1984
SAMPLE NOS.:	258021 - 258028
SUBMITTED BY:	D.J. Jack
WORK REQUESTED:	Petrology/Mineralogy

Copy to:
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144, Camberwell Road
HAWTHORN EAST / VIC. 3123

H.W. Fander, M. Sc.

ELECTRON MICROPROBE ANALYSIS OF TETRAHEDRITES

1. INTRODUCTION

Three polished sections, numbered 48522, 48776 and 48810B, were received for electron microprobe analysis of tetrahedrites for their silver contents. Sample 48522 contained two types of tetrahedrite, sample 48776 a ? owyheeite and sample 48810B more tetrahedrite. The areas to be analysed were marked and, in addition the silver contents, the tetrahedrites were also to be analysed semiquantitatively for Sb, As, Fe, Zn, Hg, Bi, to discover if any compositional differences between the two types of tetrahedrites were present.

2. EXPERIMENTAL PROCEDURE

The three polished sections received were carbon coated, the minerals marked were identified and then analysed for their silver content. The tetrahedrites were also analysed for Sb and As to obtain the Sb/As ratio and the presence and abundance of Zn, Fe, Hg and Bi were also checked.

3. RESULTS

The two types of tetrahedrites present in PS 48522 contained the same amounts of silver, i.e. 3.0 and 3.1%. Their Sb and As contents were also the same: Sb = 28-29% and As = 0.5%. Their Zn and Fe contents were likewise identical (zinc about 7%, iron about 1%). The presence of Hg and Bi was not detected. Hellyer

The ? owyheeite in PS 48776 did not contain any silver and was identified as boulangerite (only Pb, Sb and S were detected). Hellyer

The tetrahedrite in PS 48810B contained 10.2 and 10.4% silver. The Sb and As contents were similar to PS 48522, i.e. high Sb and virtually no As. The iron content was, however, higher and the zinc content lower that in PS 48522. Ann Rivers

19

284198

The Australian
Mineral Development
Laboratories

...ington Street Frewville
South Australia 5063
Phone Adelaide 79 1662
Telex AA82520

Please address all
correspondence to
P.O. Box 114 Eastwood
SA 5063
In reply quote

amdel

5 March 1984

GS 3/501/0

Central Mineralogical Services
39 Beulah Road
NORWOOD S.A. 5067

Attention: Mr H.W. Fander

REPORT GS 6447/84

YOUR REFERENCE:	Order dated 15 February 1984
IDENTIFICATION:	PS 48522, 48776 and 488 10B
MATERIAL:	Three polished sections
DATE RECEIVED:	15 February 1984
WORK REQUIRED:	To determine the silver contents of the tetrahedrites

Investigation and Report by: Peter Schultz

Chief - Geological Services Section: Dr Keith J. Henley
Manager, Mineral and Materials Sciences Division: Dr William G. Spencer

Keith Henley

for Brian S. Hickman
Managing Director

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198

284199

REPORT CMS 84/1/[illegible]

[illegible]

This report presents and discusses the results of various electron-probe microanalyses carried out on Hellyer samples and on tetrahedrite from Que River.

The primary purpose of the analyses was to determine Ag contents of the Hellyer tetrahedrite phases, as well as the Que River material; we were unaware of the work done by CSIRO/Creelman on Que River in this regard, and so to some extent the Que River analyses represent duplication, but this is not wasted, since there are still very few results in existence.

1. Hellyer Tetrahedrite

   a. Two optically different tetrahedrites were described from MG 3 ("brown" and "green"); it was thought that the differences may have been due to varying Ag contents. However, probe analyses showed that both types contained 3.0 - 3.1 % Ag, and that other components (see AMDEL report) were also the same; at this stage, the optical differences have not been satisfactorily explained, but from a metallurgical point of view this may be unimportant.

   b. A mineral tentatively identified as ?owyheeite was detected in MG 12; probe analyses detected no Ag, and the mineral is the optically almost identical boulangerite ($5PbS.2Sb_2S_3$). It is probable that the unusually high Ag contents of 258022/23 are due to tetrahedrite occurring elsewhere in the intersection, and this will be followed up.

2. Que River Tetrahedrite

   Probe analyses of a relatively large tetrahedrite lens (sample 262785, report CMS 84/2/1) gave results of 10.2 % and 10.4 % (two spot analyses); Fe and Zn contents also differed from the Hellyer tetrahedrites.

H.W. Fander, M. Sc.

HATFIELD E.L. 15/73 & MACKINTOSH E.L. 2/70 LOCATION PLAN
WARATAH
LUNA
SAVAGE RIVER
Hatfield
Mackintosh
QUE RIVER
ROSEBERY
SCALE 1:500,000
E.L.15/73
E.L. 2/70
Black Shale
Dolerite
Upper Epiclastic Sequence
Pillow Lava Sequence
HELLYER PROSPECT
Black shale
Black shale with interlayers of rhyolitic lavas and pyroclastics
QUE RIVER MINE AREA
(See QR Plates for further details)
ML 3M/75
ML 2M/75
ML 4M/75
Micaceous sandstone and conglomerate
Black shale and dolerite
MT CHARTER
LAKE MACKINTOSH
Micaceous sandstone
Micaceous sandstone
metres 0 100 200 300 400 500 600 700 800 900 1000 metres
5 cm
— LEGEND —
Andesite - Basalt (lavas, lithic tuffs, agglomerates, lava breccia)
ADP
Andesitic Dacitic Pyroclastic
Cambrian - Intermediate to acid (dacite - rhyolite) lavas and pyroclastics within andesite sequence
Altered (sericite - carbonate - chlorite) and pyritic fragmentals and lavas.
Dacite blocks in lava matrix
284200
Aberfoyle Exploration Pty. Ltd.
Geology EHS, CHY., GOB, JRS
Drown RJE
Traced
DJJ Sept'84
NORTH WEST TASMANIA
Mackintosh EL 2/70 - Hatfield EL 15/73
SUMMARY PLAN
84-2277
002
Location code K55/6/44
Date November, 1982
Scale 1:10,000
Plate No
71a

[redacted]


MACKINTOSH E.L. 2/70
LOCATION PLAN
LUINA
WARATAH
SAVAGE RIVER
Mackintosh
QUE RIVER
ROSEBERY
SCALE 1:500,000
Dolerite
Black Shale
"HELLYER" PROSPECT
Black shale with interlayers of rhyolitic lavas and pyroclastics
QUE RIVER MINE AREA
(See QR Plates for further details)
ML 1M/75
ML 2M/75
ML 4M/75
Micaceous sandstone and conglomerate
E.L. 2/70
Micaceous sandstone
LAKE MACKINTOSH
5 cm
1984 channel sampling along HEC line
1984 25m spacing, C Horizon soil sampling
— LEGEND —
Andesite - Basalt (lavas, lithic tuffs, agglomerates, lava breccia)
ADP
Andesitic Dacitic Pyroclastic
Cambrian - Intermediate to acid (dacite - rhyolite) lavas and pyroclastics within andesite sequence
Altered (sericite - carbonate - chlorite) and pyritic fragmentals and lavas.
Dacite blocks in lava matrix
284201
Aberfoyle Exploration Pty. Ltd.
Geology: EHS, CHY, GOB, JRS
Drawn: R.J.E.
Traced:
Checked:
Revised by: DJJ Date: Sept.'84
NORTH WEST TASMANIA
Mackintosh E.L. 2/70
SUMMARY PLAN
003
84-2277
Location code K55/6/44
Date November, 1982
Scale 1:10,000
Plate No. Mac 71b

[redacted]

FOR DETAILED GEOLOGY, FEATURES ETC IN THIS AREA REFER TO 1 2500 SURFACE OUTCROP GEOLOGY SERIES SHEET QR81H

284202

5 cm

Aberfoyle Exploration Pty Ltd

REVISIONS			
Init	Date	Init	Date

NORTH WEST TASMANIA
84-2277
005
MACKINTOSH E L. 2/70
Rock Chip sampling along road between Hellyer and Que River Mine

Location Code K55/6/44 | Scale 1 2500 | Date: January, 1984

Compiled. E F S.
Drawn: R J E
Traced
Checked.
Plate No MAC 78

RMO 555

Aberfoyle Exploration Pty Ltd

REVISIONS			
Init.	Date	Init.	Date
DJJ	5/84		
GLC	18·6·84		

NORTH WEST TASMANIA

MACKINTOSH E.L. 2/70 007

HELLYER PROSPECT

SURFACE GEOLOGY 84-2277

Compiled: DJJ.
Drawn: D.JJ
Traced: RJE
Checked:

Location Code: K55/6/44
Scale: 1:2500
Date: Sept. 1983
Plate No: HEL 4 (X)

RMO 556


11500 N
11000 N
10500 N
10000 N
9500 N
7500 E
7000 E
6500 E
6000 E
yellow orange rhyolite
green rhyolite
HL 2
Gn
green siliceous volcanic quartz filled vesicles
q vein
bsh
massive characteristic grey unit – rhyolitic quartz feldspar crystal tuff
bsh fg Py
pl s. intense fuch
vesic A intense fuch
vesicular andesite
vesicular andesite yellow weathered
HL15
HL6
HL9
SEE SHEET 4X FOR GEOLOGY DETAILS
Que R Mine G.N
MN
State Grid N
284204
5 cm
WW
Sheet 'Hellyer'
XX
HH
Sheet Que River AA
DD
LL
YY
JJ
BB
Sheet Mt Charter CC
MM
ZZ
RR
7500E
6000 E
4500 E
3000 E
1500E
For Sheets A–V, See QR81 series, Surface Geology
Aberfoyle Exploration Pty Ltd
REVISIONS
Init. Date Init. Date
DJJ 5/84
NORTH WEST TASMANIA
MACKINTOSH E.L. 2/70
006
HELLYER PROSPECT
SURFACE GEOLOGY
84-2277
Compiled: DJJ
Drawn: DJJ
Traced: RJE
Checked:
Location Code: K55/6/44
Scale: 1 : 2500
Date: Sept. 1983
Plate No: HEL.4 (W)

RMO 556


A1
A2
A3
A4
A5
A6
B1
C1
C2
C3
D1
D2
D3
MG1
MG3
MG4
MG5
M.L.3m/75
12
10
9
7
8
6
Index to sheets
G
F
E
K
H
A
D
L
J
B
C
M
7500 E
3000 E
284205
Aberfoyle Exploration Pty Ltd
Drawn by E.H.S.
Traced by R.J.E.
Checked by
REVISED BY DATE
E.H.S. R.J.E. 5/4/76
EHS. R.J.E. 15/6/76
GOB RKY 18/7/78
P.S. R.J.E 19/2/81
D.J.J. R.J.E. 17/6/83
Location code K55/6/44
84-2277
NORTH WEST TASMANIA
004
MACKINTOSH & HATFIELD AREA
QUE RIVER PROSPECT
SURFACE OUTCROP GEOLOGY
Scale 1:2,500
Date October, 1975
Plate QR 81 (h)
5 cm

Aberfoyle Exploration Pty Ltd

Drawn by: E.H.S.	Traced by: R.J.E.	NORTH WEST TASMANIA 008
Checked by		MACKINTOSH & HATFIELD AREA
REVISED BY / DATE: E.H.S. R.J.E. 16/6/76; CHY GOB RKY 18/7/78; R.J.E. 10/7/83		QUE RIVER PROSPECT 84-2277
		SURFACE OUTCROP GEOLOGY
Location code · K55/6/44		Scale: 1:2500 / Date: April, 1976 / Plate · QR 81 G

1:2500 FACT GEOLOGY SERIES
MAP J
H
G
B
A
C
D
L
ZONE A
ZONE B
ZONE C
ZONE D
ZONE E
ZONE F
ZONE G
ZONE H
ZONE I
ZONE J
ZONE K
QUE RIVER MINE AREA
Area not covered by UTEM
ZONE OF ANOMALOUS CONDUCTIVITY
CULTURAL ?
MURCHISON HIGHWAY
MACKINTOSH E.L. 2/70
HATFIELD E.L. 15/73
STATE G.N.
M.N.
MINE G.N.
5397000 N
388000 E
394000 E
5388000 N
392000 E
5389000 N
10500 N
10000 N
9500 N
9000 N
8500 N
8000 N
7500 N
7000 N
6500 N
6000 N
5500 N
5000 N
4500 N
4000 N
3500 N
3000 N
2500 N
2000 N
5500 E
5000 E
4500 E
4000 E
3700 E
3500 E
4200 E
0
500
1000 metres
5 cm
LEGEND
Location of conductor axis
Latest channel to be affected. Generally the lower the number, the better the conductor. If a (?) is included, the conductor is questionable.
Estimated depth to top : S - Shallow >50m
: M - Moderate 50-100m
: D - Deep >100m
Conductor shows apparent continuity from line to
Conductor shows questionable continuity from line to line
Zone of anomalous conductivity
Zone sub - number
GENERAL
Exploration licence boundary
H.E.C. Power line
Mineral lease boundary
1:2500 Fact Geology Sheet series with index letter
N.B. For details on topography & geology refer to Mac. 75 at 1:10,000
284207
Aberfoyle Exploration Pty. Ltd.
Geology : E.T.E.
Drawn : E.T.E.
Traced : R.J.E.
Checked
Revised by: E.T.E Date 28.5.84
NORTH WEST TASMANIA
Mackintosh E.L.2/70- Hatfield E.L.15/73
SUMMARY OF 1982-83 UTEM SURVEY
009
84-2277
Location code: K55/6/44
Date: October, 1983
Scale: 1:10,000
Plate No
Mac. 77