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ANNUAL REPORT
ON
EXPLORATION ACTIVITIES ~~WITHIN~~
WITHIN E.L. 49/82 BEULAH
NORTH TASMANIA
FOR THE PERIOD 30/8/83 TO 29/8/84

BY

R.M. VIVIAN

July, 1984

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1. SUMMARY

This report details the results of exploration in E.L. 49/82 at Beulah, Northern Tasmania during the twelve months to August 29, 1984.

Exploration during this period has concentrated on evaluating the economic potential of the acid-intermediate volcanics, which are confined to the southernmost part of the E.L. near Beulah, for massive sulphide mineralisation (Figure 1).

The work programme comprised an initial regional stream sediment geochemical survey to relocate and confirm anomalies re-interpreted from past exploration activities in the area. This was accompanied by geological mapping at 1:25 000 scale over selected parts of the Sheffield 1:63 360 geological sheet and an airborne electromagnetic survey totalling 360 line kilometres.

Anomalies located during the geochemical survey related to units of basic - intermediate pyroclastics and epiclastic sediments. Best values were 2145 ppm Pb, 430 ppm Zn, 120 ppm Cu in localised fractures with associated minor quartz veining from Anomaly 1 (see Section 8.2.2). All other anomalies were interpreted as having a similar origin, that is, weak Pb, Zn mineralisation structurally controlled and confined to minor shears/fractures within the host rock. These could represent leakages from more deep-seated massive sulphide bodies.

The geological mapping identified a Cambrian intrusive-extrusive complex comprising quartz feldspar hornblende porphyry of rhyolitic/andesitic composition intruded by small bodies of a quartz diorite which in places tend towards gabbro in composition. Weak tourmalinisation and silicification with associated elevated gold, silver and lead values are associated with the intrusives.

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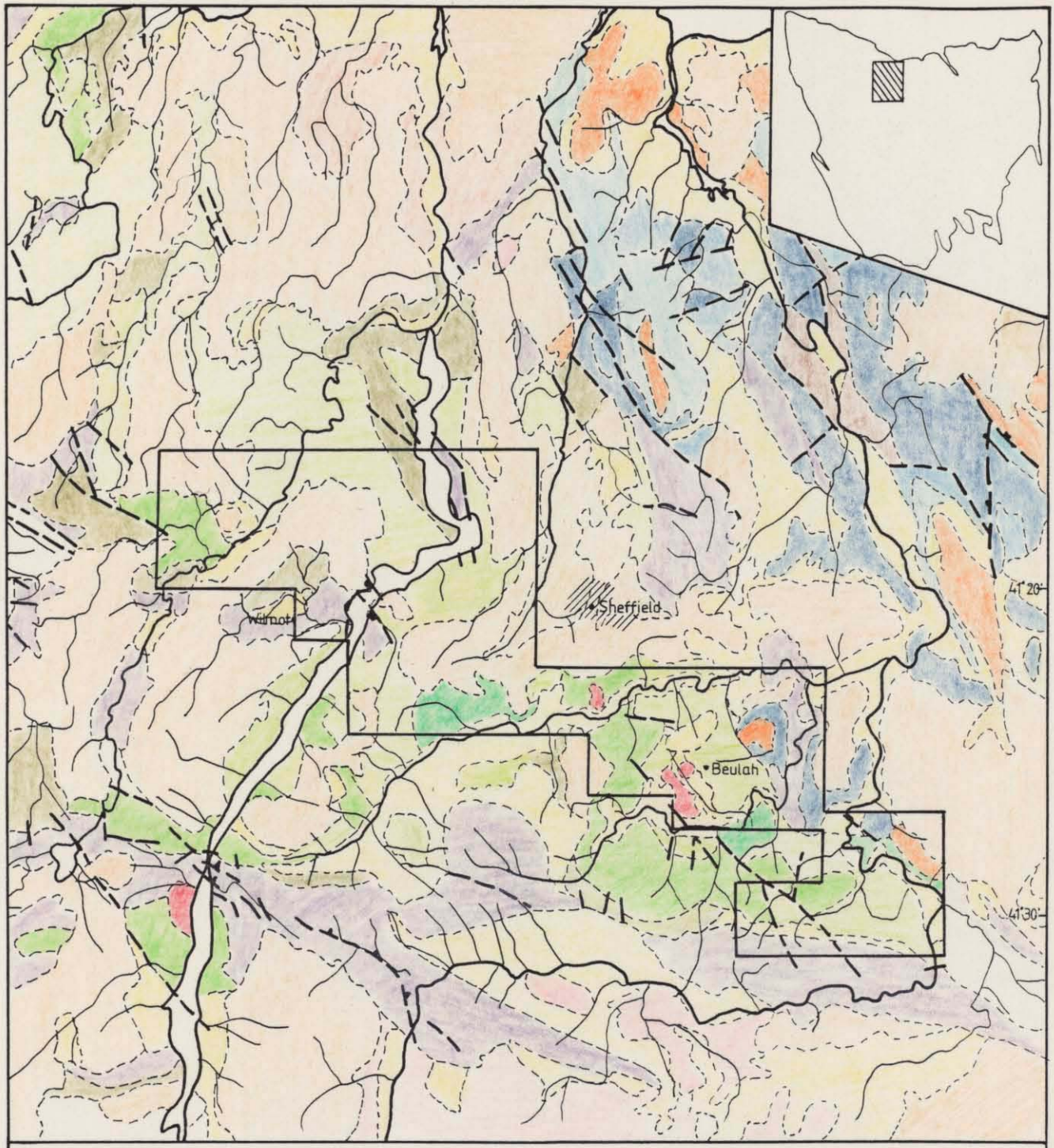

Holocene — Alluvium, sand, gravel and talus

Tertiary — Non-marine sequence
Basalt and related igneous rock types

Triassic
Permian
Upper Carboniferous — Upper glacio-marine sequence of pebbly mudstone, sandstone & limestone
Fresh water sequence with some coal measures
Lower glacio-marine sequence of pebbly mudstone, sandstone, minor limestone, Tasmanian oil shale & basal tillite

Lower Devonian-Silurian Ordovician — Limestone - siltstone
Limestone sequence
Siliceous terrestrial conglomerate marine quartzwacke & siltstone

Cambrian — Fossiliferous greywacke turbidite sequence
Intermediate volcanic & associated rocks
Basic - intermediate volcanic & associated rocks
Unfossiliferous greywacke turbidite sequence

Jurassic — Dolerite & related rock types

Lower Carboniferous Upper Devonian — Dominantly adamellite - granite

5 cm

E.L. 49/82 BEULAH
REGIONAL GEOLOGY OF NORTHERN TASMANIA

SCALE 1: 250,000

146°10' 146°20' 146°30'

FIGURE 1

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The airborne geophysical survey conducted by Dighem Limited detected 82 EM anomalies with a conductor grade of 2 or better (i.e. 75-9 MHOS) (Appendix VI). There were no obvious massive sulphide conductors in the survey area. To date 50 anomalies have been followed-upon the ground. None to date appear to be attributable to significant sulphide mineralisation.

2. CONCLUSIONS AND RECOMMENDATIONS

Exploration activity conducted within E.L. 49/82 during the year to 29 August 1984 has failed to indicate outcropping or near surface volcanogenic massive sulphide mineralisation.

It is recommended that ground follow-up of outstanding EM anomalies be completed. Ground geophysics followed by drilling should then be carried out over areas such as Anomaly 1, which could represent leakage from deep-seated massive sulphide bodies.

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3. INTRODUCTION

E.L. 49/82 Beulah embraces the north eastern extension of a belt of acid- intermediate volcanics and associated sediments (The Mt. Read Volcanics) which are host to massive sulphide mineralisation at Que River, Rosebery and a number of other localities.

Exploration over the past 12 months comprised an initial regional sediment geochemical survey to relocate and confirm anomalies re-interpreted from past exploration activities in the area. This was accompanied by geological mapping at 1:25 000 scale over selected parts of the Sheffield 1:63 360 geological sheet and an airborne electromagnetic survey totalling 360 line kilometres.

3.1 Tenement, Location and Access

Exploration Licence 49/82 Beulah was granted to Amax Australia (Operations) Pty. Limited on 29 August 1983 which later became Austamax Operations Pty. Limited. The annual expenditure commitment is $24,300.

The licence area comprises 243 sq. km. and is situated immediately to the west and south-west of the township of Sheffield and 15 km west of Deloraine, Northern Tasmania. Access to Deloraine is via the Bass Highway some 50 km west of Launceston.

The licence area itself is well serviced by sealed roads in areas of open farming country and by formed gravel Forestry logging roads in the more rugged and thickly forested areas.

3.2 Climate, Vegetation, Physiography

The Sheffield area enjoys a temperate climate with the summer months between November and March recording temperatures rising to a mean of 22°C in February from a low of 6°C during the winter months.

Average rainfall is approximately 1140 mm and is in general higher in the elevated country of the south and south-western portions of the area. Wettest months are July and August which record a mean of 160 mm for the two months.

Thick eucalypt rain forest with myrtle and sassafras are restricted to areas of high rainfall. They are best developed on the flanks of the Gog Range and along the gorges of the Wilmot and Forth Rivers. In the central and over much of the northern margin of the area the rich basalt soils have been cleared for crop and dairy farming. Elsewhere stunted eucalypt forest with light undergrowth is common. Plantations of pines have been established within the Beulah and Gog Range areas.

The physiography of the E.L. is dominated along the south-eastern margin of the Licence boundary by the east-west trending Gog Range. It forms part of a prominent mountain range which extends to the west and of which Mt. Roland (1231 m a.s.l.) forms the highest elevation in the district. The land falls away to the north from the range where it is dissected by the north east and northerly flowing Wilmot, Forth and Mersey Rivers. These rivers have incised down through Tertiary basalt into Palaeozoic rocks to form rugged hill landforms adjacent to the rivers with the basalt now occupying the interfluve areas.

4. PREVIOUS WORK

Prior to the granting of E.L. 49/82 the only systematic base metal exploration carried out in the area was by Asarco (Australia) Pty. Limited from 1973 to 1976. Their exploration work comprised a regional stream sediment geochemical programme which delineated ten prospective areas (one of which lies within E.L. 49/82). These were evaluation by gridding, rock and soil geochemistry and geological mapping. No drill targets were identified from this exploration phase (References 2 & 8).

In 1965 B.H.P. Limited undertook an airborne magnetic survey for magnetite mineralisation over a large area of northern central Tasmania, including part of the present E.L. area, with little success (References 1, 3, 4, & 5).

5. REGIONAL GEOLOGY (Figure 1.)

Cambrian rocks represent the oldest sediments within E.L. 49/82 and comprise a complex pile of chert, greywacke and volcanic material about 4000 m thick that are considered to be deposited in and around an actively developing basin, the Fossey Mountain Trough. It is approximately 80 km long, 32 km wide, trends NW-SE and is centred on Sheffield. To the north it is bounded by the Precambrian Forth Block and to the south by the Cradle Mountain Block.

The Cambrian succession comprises initial sedimentation of chert (Barrington Chert) within the axial portion of the trough. Deposition of basic lavas and pyroclastic breccias (Beulah Formation) along its flanks then occurred;. Concomitant with this deposition, uplift along the axis of the trough produced a tectonic ridge, the Barrington Ridge, from which chert shed to contaminate sediments of the Beulah Formation. Thick sequences of greywacke turbidites (Gog Range Greywacke) then deposited during a pause in vulcanism. While the source for this material is considered largely to be the Barrington Ridge, the presence of rounded quartzite and mica schist pebbles suggests a Precambrian source area perhaps located in the areas marginal to the basin.

Acid-intermediate lavas and pyroclastics of the Minnow Keratophyre succeed the Gog Range Greywacke. The boundary between the two formations is transitional and is characterised by interfingering of both sedimentary and volcanic rocks near the boundary. Intrusives form small outcrop areas within the Beulah and Gog Range areas. These rocks are granites and microgranodiorites and are Devonian in age within the former area while a spatial relationship to extrusives of probably co-magmatic affinity and associated alteration indicates a Cambrian age for the hybrid mafic intrusives in the latter area.

Ordovician rocks of the terrestrial Roland Conglomerate and Moina Sandstone origin unconformably overly the Cambrian System. They are common in the Wilmot and Gog Range areas.

Permian Basal Bed rocks are confined to the south-eastern portion of the E.L. to the east of Beulah and comprise pebbly mudstone and conglomerate unconformable over both Cambrian Beulah Formation andesites and Ordovician rocks.

Extensive basalt flows covered the region during the Tertiary Period. These have been weathered back to isolated remnants which crown topographically higher areas. Surficial deposits and talus derived from Ordovician and Tertiary rocks constitute the deposits of the Quarternary.

Fine grained granites and microgranodiorites intrude Gog Range Greywacke sedimentary rocks in the vicinity of Beulah. Total magnetic contour maps indicate than many of the isolated intrusives outcrop are part of the same stock which shallowly intruded the sedimentary rocks. Economic mineralisation is not associated with these intrusives.

Jurassic dolerite crops out only in the south-eastern portion of the area where it is predominantly associated with Permian rocks. This association and its relatively wide outcrop area suggests the dolerite is in the form of sills. Smaller elongate to circular bodies of dolerite occur wholly within Ordovician and Cambrian rocks and may represent a situation where erosion of Permian rocks has exposed finger roots to the sill sheets.

6. STRUCTURE

Essentially the structure of the Sheffield sheet describes a region that has been tectonically unstable since the late Precambrian. Cambrian and Ordovician sediments were initially deformed into a series of broad east-west trending folds. Superimposed upon these structures were a set of major north-west trending folds which tend to follow the outline of the margin of the stable Precambrian nucleus.

In some localities a marked axial plane cleavage which does not penetrate the unconformably overlying Ordovician rocks is developed in Cambrian rocks. These features indicate that an intensive period of deformation preceded erosion and subsequent Ordovician sedimentation. This deformational event appears to correlate with the Jukesian movements in western Tasmania.

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7. GEOLOGY OF THE GOG RANGE AREA

Field work comprising geological mapping, rock and stream sediment geochemistry was undertaken particularly in the vicinity of the Gog Range in the SE sector of E.L. 49/82. This area was considered from the occurrence of Cambrian acid-intermediate volcanics and associated sediments to be highly prospective for massive sulphide mineraliation.

This programme was largely undertaken by Austamax Staff and was supplemented by field work conducted by consultant geologist Roger Poltock of R. Poltock Geological Pty. Limited. The reader is referred to his report in Appendix VIII which amalgamates all regional work completed in the Gog Range Area.

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8. REGIONAL GEOCHEMISTRY

8.1 Introduction

The southern region of the E.L. was covered by the Asarco stream sediment survey of 1973. The density of two samples/km^2 they attained would classify their programme as a detailed survey. Ten anomalies defined by the survey were subject to varying intensities of follow-up work, but no economic mineralisation was discovered (References 2 & 8).

Repetition of this survey, even at greater density and analysing for a greater range of elements was considered unlikely to reveal new targets for exploration. A more sensitive reinterpretation of the existing data was instead undertaken. Initial statistical treatment of the data proved unsatisfactory due to the diversity of lithologies in the surveyed areas and the tendency to highlight only those anomalous results previously recognised and followed-up.

Instead an empirical approach was adopted whereby metal values were chosen which would outline 'secondary' anomalies besides highlighting the known 'primary' anomalies. Such secondary anomalies may indicate essentially blind economic mineralisation, weak outcropping mineralisation of assorted genesis, or alternatively, such lithologies as shales with abnormal metal contents.

Metal values chosen were:

For the first order : Cu-50 ppm, Pb-50 ppm, Zn-160ppm
For the second order: Cu-36 ppm, Pb-38 ppm, Zn-92 ppm

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The salient points of all anomalies outlined by the reinterpretation are listed in Table 1. Anomalies which lie within Austamax's E.L. and which warranted further limited exploration are Austamax anomalies 1, 4, East Gog Range, 12 and 13. Work completed on these anomalies is described in the following section. All relevant assay results are tabled in Appendices I to IV inclusive. Petrographical descriptions are contained in Appendix V. Rock chip and stream sediment sample locations are shown on Plates 1 and 2.

8.2 Anomalies

8.2.1 East Gog Prospect

Gog 1:25 000 Sheet; grid reference 555 057

Check stream sediment sampling variously at 100m and 50m intervals was undertaken in two creeks determined by Asarco's 1973 regional geochemical survey to be moderately anomalous in base metal values. The resampling assay results (see Appendix II) confirmed previous results and indicated that the source for the anomaly lies in the divide between the two creeks.

As creek, ridge and spur traverses within the drainages' catchment area failed to identify any outcropping mineralisation or structure as the source of the anomaly the divide was gridded and soil auger sampled.

TABLE 1.

AUSTAMAX GEOCHEMICAL ANOMALIES

ANOMALY	ELEMENTS		LITHOLOGY *	COMMENTS	PRIOR-ITY
	FIRST ORDER	SECOND ORDER			
1	Zn, Pb, CxZn	CxCu	Ebf	Cohesive, lithologically restricted	B
2A, 2B	Pb, +-Cu	Zn, Cu, CxCu, CxZn	Egg?	Probably reflects 'squib' mineralisation or possible lithological continuity between Gog & Mt Roland anomalies	C
3A, 3B	Zn, Pb		Egg	Probably associated with weak baryte mineralisation	C
4	Pb, Zn, CxZn		Egg	Strong, single point anomaly	
5	Pb, Zn, +-Cu	CxCu	Emk	Possible, Cethana-style volcanogenic mineralisation	B
6	CxZn	Cu, Pb, Zn	Emk	As above	B
7	Pb, Zn, CxZn		Egg	Possible vein Pb mineral-isation as at Mt. Claude	C
8A	Cu, Zn, CxCu, CxZn		Egg	Strong, single point anomaly	
9	Cu, CxCu, CxZn		Egg	Possible vein-style miner-alisation	C
10	Zn, CxCu	CxZn	Egg	Strong, single point anomaly	C
11	Zn, Cu, CxCu		Egg	Probably similar to the Wilmot anomaly	B
12	Pb, Zn, CxZn		Egg	Possible vein-style Pb mineralisation	B
13	Cu, CxCu, CxZn		Egg, Or	Strong, single point anomaly	C
East Gog	Pb, Zn, CxCu,	Cu	Egg	Limited follow-up	B

* Symbols from Sheffield 1:63,360 geological map

Priority Rating A - Good Potential
B - Moderate Potential
C - Low Potential

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8.2.1.1 Geology

The geology of the gridded area consists of a greywacke turbidite sequence of feldspathic greywacke, shale, siltstone and micaceous sandstone. These sediments strike NW-SE with a subvertical dip. Lensoidal interbeds of intermediate crystal tuffs occur within the sediments (Plan No. 1). Outcrop exposures of the volcanic are poor and in general are less than 2 m thick and not persistent along strike. Available evidence favours a subaqueous depositional environment for the volcanics.

Siliceous, massive sandstone and conglomerate boulder scree (Roland Conglomerate) mantle the top of the divide in the north-west of the grid area. A small circular body of Jurassic dolerite, probably a plug, occurs in the northern part of the area.

8.2.1.2 Soil Geochemistry

A total of 168 soil samples were collected by power auger from B and C horizon material over 2.6 line km of the survey grid. Samples were collected at 50 m intervals to better define descrete anomalous areas located during the initial sampling.

All samples were analysed for copper, lead, zinc, silver, iron, and cold extractable (Cx) copper on minus mesh material. Arsenic was assayed for in some of the samples. From each sample location sufficient material was also taken for bulk gold analysis. Iron was analysed as an indicator of pyrite and as a possible lithological marker.

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Assay results for copper, lead, zinc, arsenic, gold and cold extractable copper and zinc are tabled in Appendix III, and copper, lead, zinc coutoured intervals are presented in Plan Nos. 2, 3 and 4. Rock geochemistry results are tabled in Appendix IV.

Copper and zinc values throughout the grid are generally low and describe two distributions. One, characterised by coincident elevated copper and zinc values, is centred on 1200E/975N and reflects the higher background zinc and copper content of the dolerite plug located in this area.

The other appears as a broad area of low metal values in the north-western part of the grid reflecting the geochemistry of Roland Conglomerate scree which covers much of this area.

In the eastern and southern sections of the grid anomalies determined by visual inspection as being those values greater than 200 ppm lead identify two discrete dispersion zones centred on 600N/1000E and 800N/1200E (Plan No. 3). Zinc values are coincident and broader in distribution, no doubt a result of the relative mobility of zinc with respect to lead (Plan No. 4).

Broadening dispersal trains to the south and north of the anomaly areas indicate they are the sources for anomalous stream sediment metal values detected in the creeks to the west and east.

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Outcrop exposure is very poor in the Pb, Zn anomaly areas; no mineralisation is evident in auger rock chip samples. Rock geochemical results from available outcrop are uniformly low in metal values.

Bulk gold samples taken at 100 m intervals along lines 1000E and 1200E returned non-significant results. Iron and silver soil geochemistry show no obvious distribution pattern related to the anomaly areas, though higher iron values (greater than 5%) predominate in northern part of lines 1200E and 1400E. All arsenic values are below the limit of detection (i.e. 1 ppm).

Exceptionally high cold extractable metal to total metal ratios are found to characterise samples taken over the grid downslope from the point anomalies and strongly suggests a hydromorphic dispersion halo about the anomalies.

8.2.1.3 Conclusion

The work completed at the East Gog prospect suggests weak primary mineralisation within a particular lithological unit such as a carbonaceous shale. The high Cx metal values in both soil samples and stream sediment samples; the wide areal extent of Cx metal values in stream sediments argues for a hydromorphic component emanating from this mineralisation. Given the above and the low level of geochemical results no further work is warranted on the prospect.

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8.2.2 Anomaly 1

Sheffield 1:25 000 topographical sheet; grid reference 495 115.

Anomaly 1 is a first order Zn, Pb, CxZn anomaly and forms a cohesive and lithologically restricted dispersion defined by 4 anomalous drainages.

The more anomalous values are located in two forks of a creek that drain easterly of a north-south elongate hill area approximately 2km in length.

Basic to intermediate rocks of the Beulah Formation crop out sporadically in the area. These include fine grained vesicular augite andesite in which occur small areas of andesitic breccia, and a dark grey porphyritic lava. Apart from veins of carbonates occupying tension gashes, the andesites are not altered.

The source for one of the anomalous drainages was located in the northern arm of the creek. This is an area of weak quartz veining less than 1-2 cm wide containing anomalous levels of base metals developed in well fractured and cleaved andesite. Best values (in sample no. 6408) were Pb - 2145 ppm, Zn - 430 ppm, Cu - 120 ppm. Cleavage direction is 127° magnetic; dip is subvertical. Quartz veining can be traced sporadically over about 80 m and trends subparallel to cleavage direction. It is apparent that the cleavage is the expression of an air photo interpreted shear passing through the mineralised area.

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Sources to the anomalous base metal values found in the other three drainages were not located due to lack of rock exposure. It can be only inferred because their metal values are of the same order of magnitude as the drainage described above that they reflect similar weak mineralisation associated with structures in the andesite. They could, however, reflect leakages from a deep-seated massive sulphide body.

8.2.3 Anomaly 4

Sheffield 1:25 000 topo. sheet; grid reference 540 130.

A single point first order Cu, Pb anomaly. Geochemical resample results were of moderate interest and field checking indicates the drainage geology consists entirely of blocky, well jointed, fresh quartz feldspar porphyry of the Minnow Keratophyre Formation. No sulphide mineralisation, alteration or structural control that might explain the anomaly was evident. The cause of the anomaly is probably localised seepage enrichment at the base in slope of the drainages.

8.2.4 Anomaly 5

Sheffield 1:25 000 topo. sheet, grid reference 467 106.

A single point first order Cu, Pb, Zn sediment anomaly. Geochemical follow-up results indicate a hydromorphic source to the anomaly and warrants no further interest.

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8.2.5 Anomaly 12

Wilmot 1:25 000 topo. sheet, grid reference 345 162.

A first order Pb, Zn, CxZn anomaly which assayed 240 ppm Cu, 150 ppm Pb, 280 ppm Zn (Asarco 1976).

Field work comprised examination of drainages and head water area upstream of the original anomaly. Grey shales, siltstones, minor slates and interbedded greywacke of the Gog Range greywacke crop out over much of the area. One road cutting exposes a fine grained acid volcanic rock. The rock has undergone intense silica alteration and is cut by rare, barren-looking dogtooth quartz veins less than 1 cm thick.

Three stream sediment and rock chip samples where appropriate were taken. Assay results were not encouraging and work was discontinued in this area.

8.2.6 Anomaly 13

Wilmot 1:25 000 topo sheet, grid reference 345 189.

First order Cu, CxCu, CxZn values form a strong single point anomaly. Field inspection indicated that the anomalous creek is formed on a fault structure between Ordovician and Cambrian rocks. The elevated drainage values evidently reflect leakage mineralisation along this fault and are therefore considered insignificant.

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8.2.7 West Mersey River Anomaly

Gog 1:25 000 topo. sheet, grid reference 572047.

Resampling of Asarco's moderately Pb, Zn anomalous creeks directly draining eastwards into the Mersey River confirm the existence of one anomalous creek. (Sample No. A6465 to A6470, Appendix II).

It is characterised by a peak Pb value of 280 ppm supported by 990 ppm Zn and a dispersion train of elevated Pb, Zn values over 150 m downstream from this anomalous sample location.

The source for the anomaly is located on the north of the creek and was found to be a prominent nine metre wide bluff face much silicified and fractured with weak to moderate limonite and boxworks after pyrite. Irregular quartz stringers occur subparallel to the fractures. Though alteration has destroyed original rock textures it appears that the host is a quartz-rich volcanoclastic forming part of the extensive body of volcanics cropping out along the base of the Gog Range.

Best metal values returned from rock chip samples taken across the bluff face was 900 ppm Pb, 800 ppm Zn, 25 ppm Cu, 3.2 ppm Ag and 50 ppm As (sample no. A6492). These fractures represent a minor, weakly mineralised shear that trends SSE-WNW across the creek.

To test the continuity and strength of mineralisation bedrock auger samples were collected

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on 10 m centres from two ridge traverses bounding the bluff on either side of the creek (sample nos A6537 to A6569). Geochemical results indicate that the mineralisation does not persist across the creek. It is possible that this shear-hosted mineralisation represents leakage from a deep-seated massive sulphide source. This possibility should be checked with ground geophysics.

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9. AIRBORNE GEOPHYSICS

9.1 Introduction

During January 1984 a combined electromagnetic/ magnetic survey totalling 360 line kms was flown by Dighem Limited within the south-eastern segment of the E.L. area, south of Sheffield. This area was selected for the geophysical coverage as it contains a large proportion of the intermediate-acid volcanics known in the E.L. area.

A VH-BQT Lama turbine helicopter flew the area at an average airspeed of 115 km/h on 250 m line spacings with an EM bird height of approximately 42 m. Analogue equipment recorded four channels of EM data at approximately 900 Hz, two channels of EM data at approximtely 7200 Hz, two ambient EM noise channels, two channels of magnetics (coarse and fine count), and a channel of radio altitude. Digital equipment recorded the EM data with a sensitivity of 0.2 ppm and the magnetic field to one nT.

9.2 Interpretation of Results

Survey results are detailed in Appendix 6 - Dighem Limited Report no. 368. All EM anomalies detected during the survey are listed in Appendix B of that report. To facilitate interpretation and ground follow-up of EM anomalies, geological maps were overlain onto the 1:10 000 scale magnetic, resistivity and EM maps contained in the report.

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9.2.1 Electromagnetics

Five hundred and one electromagnetic anomalies were generated by the survey and are summarised in Table 2 with respect of conductance grade, range and source.

Of these anomalies the majority are characterised by very low conductance (i.e. <5 mhos or grade 1 category) and are mainly designated by the symbol 'H', i.e. are broad EM repsonses from poorly conductive material.

A few weak, possible bedrock ("B") conductors associated with low resistivity were defined by Dighem Limited and are detailed in pages I-6 to I-8 of Dighem Limited's report. There are no obvious massive sulphide conductors in the survey area.

Comparison with geological maps indicates that many of the EM point ("H") anomalies can be connected as well defined linear features that are subparallel to bedding directions and are hence interpreted as being probably related to weakly conductive lithologies such as graphitic or carbonaceous shales. Sediments of the Gog Range Greywacke Formation show this characteristic particularly well. On the other hand rocks of the Minnow Creek Keratophyre are characterised by a paucity of EM anomalies. EM anomalies are well distributed through the areas of Beulah Formation andesites but do not show any apparent trend or linearity.

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TABLE 2.
SUMMARY OF EM ANOMALIES

CONDUCTOR GRADE	CONDUCTANCE RANGE	NUMBER OF RESPONSES
6	> 99 MHOS	0
5	50-99 MHOS	0
4	20-49 MHOS	7
3	10-19 MHOS	23
2	5- 9 MHOS	52
1	< 5 MHOS	404
X	INDETERMINATE	15
TOTAL		501

CONDUCTOR MODEL	MOST LIKELY SOURCE	NUMBER OF RESPONSES
B	DISCRETE BEDROCK CONDUCTOR	45
H	ROCK UNIT OR THICK COVER	389
E	EDGE OF WIDE CONDUCTOR	11
L	CULTURE	49
?	QUESTIONABLE	2
(BLANK)		5
TOTAL		501

Anomalies designated by the symbols "C" or "E" relate to cultural features and edge of conductor sources and are not considered significant. Therefore, apart from those exceptions mentioned in the next section they were not systematically investigated by ground follow-up surveys.

9.2.2 EM Anomaly Ground Follow-up Results

Initial ground follow-up of EM anomalies was concerned with geological appraisal of each anomaly so as to determine its significance in terms of further follow-up.

A subjective selection method was adopted whereby those anomalies with a conductor grade of 2 (i.e. 5-9 mhos) or greater were only considered worthy of follow-up. This method has the effect of deleting the majority of non-significant anomalies while protecting from discard a higher grade anomaly perhaps mis-identified as an "L", "H", or "E" source anomaly.

On this basis 82 anomalies of grade 2 or higher comprised the follow-up programme. To date 56 of these anomalies have been investigated. In addition to this 11 grade 1 anomalies located proximate to some of the above were also followed-up as a matter of course. A priority rating of good, medium, or poor potential was assigned to each anomaly. Appendix 7 summarises the follow-up results.

The vast majority of anomalies were found to relate to broad bedrock conductors, namely

258030

029

dolerite and basalt cover in the north-eastern and north-western sections of the survey area. The remainder of the anomalies are located in sediments of the Gog Range Greywacke. No obvious reasons for these anomalies were noted from close examination of available outcrop exposure; all geochemical results from rocks sampled at anomaly sites were negative.

9.2.3 Magnetics

Total field magnetics strongly define the dominant lithologies within the region. These are typified by characteristic magnetic amplitude intervals, namely:

- Gog Range Greywacke rocks by low, monotonously flat amplitudes (<61800 to 61960 nT)

- Beulah Formation andesites, by an area of generally high amplitudes showing rapid variability (>62000 to 62800 nT)

- Minnow Keratophyre volcanics, by moderate amplitudes that show uniform variations within the range of 61980 to 62360 nT. Small discrete areas showing greater than about 62610 nT appear to characterise intrusive rocks.

Enhanced magnetic linear trends defined by ridges of relatively high magnetic values are apparent within the region, are sinuous in shape and trend north-west to south-east and to a lesser extent west to east. Their apparent conformity to the boundaries of lithologic units and known bedding directions suggest them

to be lithologically related. Displacements and terminations of trend lines have in same cases been used to map inferred faults.

Strong enhanced magnetic trend lines are also evident within the Minnow Keratophyre volcanics and are thought to have a relationship similar to that for the magnetics to intrusive rocks.

No obvious relation between EM and enhanced magnetic trends occur in the region though the north-west corner of Sheet 1 does show alternating subparallel trend lines of magnetics and EM values.

9.2.4 Resistivity

On sheet 2 the broad area of greater than 100 ohm metres between flight lines 40 and 59 correlates with known Cambrian geology. Steep gradients characterise the unconformable boundary between Ordovician rocks and Cambrian Gog Range Greywacke rocks in the northern part of the sheet. Widespread areas of low values (less than about 100 ohm-m) are apparent and are interpreted as patterns typical of broad conductors i.e. conductive overburden. More commonly these relate to Tertiary basalts and Jurassic dolerites in the north-east section of the sheet but also reflect smaller areas of transported Owen Conglomerate scree and rubble scattered throughout the area.

A number of discrete conductors generally appearing as elongated lows occur within the survey area and are interpreted to define conductive trends in the bedrock, which in all

cases is Gog Range Greywacke. In most sediment cases low order EM anomalies are coincident and form a medial trend line through the lows. They are:

- Anomalies 58B - 60B - 61B - 63B - 64C

  These single line EM anomalies define a W-E trending area of low conductance over 1.5 km long with some indication that it extends further west.

- Anomalies B69 - A70 - A71

  A south-east trending area extending over 400 metres.

- Anomalies 59E - 60C

  A 250 m long, south-east trending conductance trough.

- Anomalies 45B - 46C - 47B - 48C

  A broad area of low resistivity extending ESE over approximately 700 m. This anomaly lies outside the E.L. boundary.

A number of field traverses across each of the anomalies indicate the most likely cause for the anomalies are narrow, continuous units of graphite shales within greywacke sandstones of the Gog Range Greywacke.

On Sheet 1, EM anomalies are again coincident with areas of low resistivity though rather than describing narrow troughs the resistivity

lows are broad more open structures. They appear to reflect the more uniformly composed and massive rock units of the Minnow Keratophyre and Tertiary basalts versus the interbedded units of the Gog Range Greywacke predominant on Sheet 2.

The major structure of interest is located in the north-west corner of the sheet and comprises a large resistivity low approximately bounded by the 100 nT contour line.

Anomaly 5D-9E, anomalies 11F-12F, 11G-14I lie within this area and are described on page I-6 of Appendix I of the Dighem report.

Ground follow-up shows basalt cover to occupy much of the area and a low priority rating is assigned to all of these anomalies as tabled in Appendix VII.

9.3 Conclusion

The Dighem airborne geophysical survey detected a few weak, possible bed rock electromagnetic conductors. These, in addition to 56 of the 82 anomalies with conductor grade 2 or better were followed-up by ground geological investigation and, where appropriate, by rock chip geochemistry.

None of the anomalies were found to be related to surface or near surface mineralisation.

10. EXPENDITURE STATEMENT

I, Janice M. Campbell of 38 St. Thomas Street, Bronte in the State of New South Wales do solemnly and sincerely declare that this is a true statement of expenditures for Project No. 604, Beulah E.L. 49/82 for the period 30th August 1983 to 29th August 1984.

Publications, Maps, Reports & Memb.	$ 1,051
Consultants	18,000
Contractors (except drilling)	38,836
Drafting Services & Supplies	490
Assaying and Analysis	4,980
Office Rent	2,098
Office & Office Equip. Maintenance	270
Telephone, Telex & Telegraph	719
Postage, Shipping & Freight	376
Stationery & Office Supplies	297
Field Materials	261
Car Hire & Taxis	754
Air Travel	1,077
Lodgings, Meals & Entertainment	1,951
Vehicles - Maintenance	2,454
Allocated Salaries Incl. Fringe	39,028
Allocated Overheads	16,409
Expenditures for the Year Ending 29th August, 1984	$129,051

And I make this solemn declaration conscientiously believing the same to be true and by virtue of the provisions of the Oaths Act, 1900.

Subscribed and declared at Sydney)
this 22nd day of November One)
thousand nine hundred and eighty)
four before me:

Janice M. Campbell

A Justice of the Peace

11. REFERENCES

1. AMEG, Aeromagnetic Survey, Sheffield Area, North Central Tasmania for B.H.P. Ltd., 1966. T.M.D. Company Report No. Q29/7

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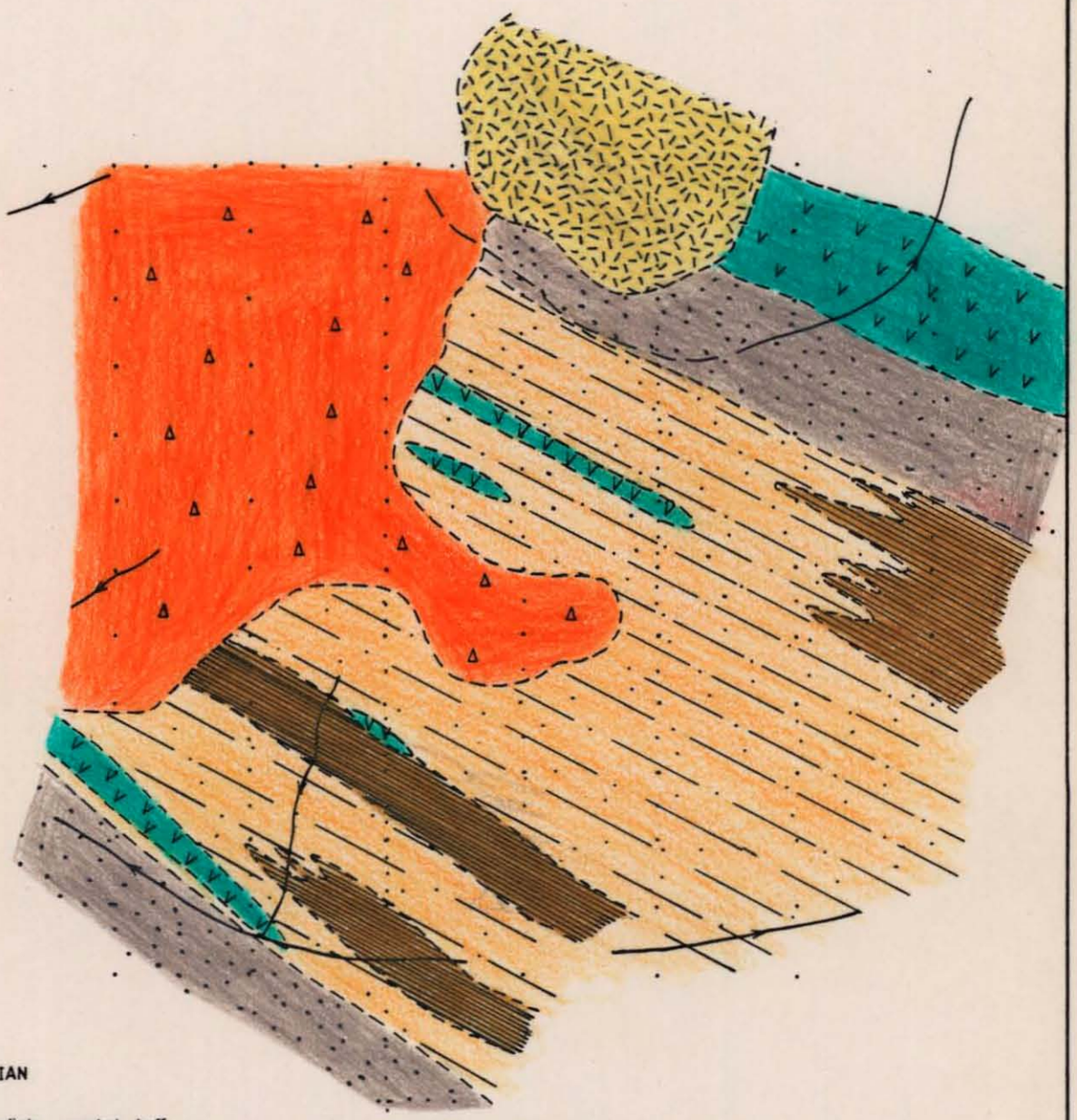
035

258036

800 E 1000 E 1200 E 1400 E

5 cm

1000 N
800 N
600 N
400 N
200 N



0 25 50 75 100 m

CAMBRIAN

Intermediate crystal tuff

Shale siltstone minor greywacke

Micaceous sandstone coarse grained greywacke

Feldspathic greywacke interbedded shales and siltstones

QUATERNERY

Owen Conglomerate (massive siliceous sandstone conglomerate) talus

JURASSIC

Dolerite

Inferred geological boundary

Creek

AMAX AUSTRALIA LIMITED

BARRINGTON E.L. 49/82

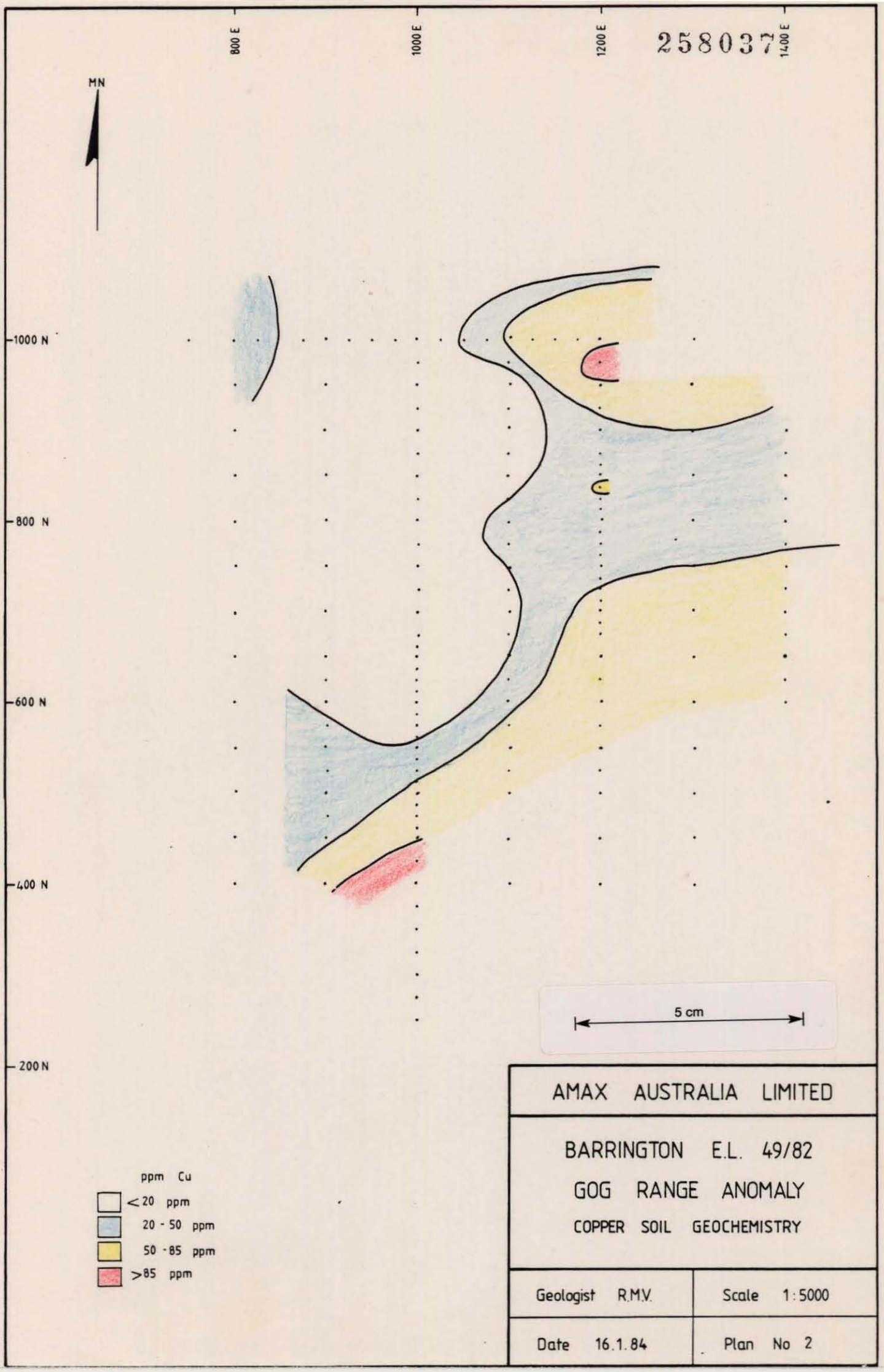
GOG RANGE ANOMALY

GEOLOGY

Geologist R.M.V.	Scale 1:5000
Date 16.1.84	Plan No 1

036

258037



AMAX AUSTRALIA LIMITED

BARRINGTON E.L. 49/82

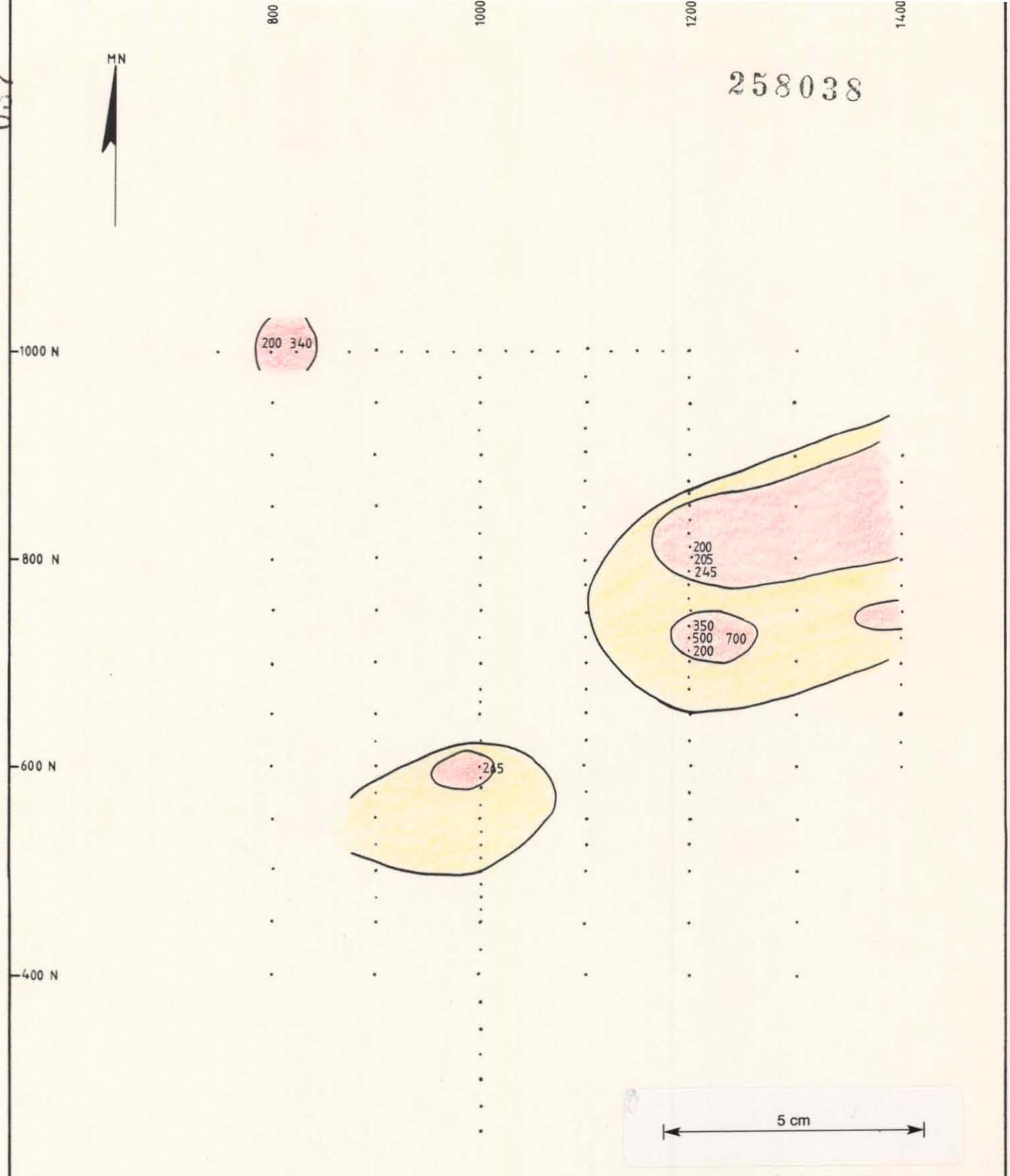
GOG RANGE ANOMALY

COPPER SOIL GEOCHEMISTRY

Geologist R.M.V.	Scale 1:5000
Date 16.1.84	Plan No 2

037

258038



ppm Pb

- < 35 ppm
- 35 - 100 ppm
- > 100 ppm

all values greater than 200 ppm are shown

AMAX AUSTRALIA LIMITED

BARRINGTON E.L. 49/82

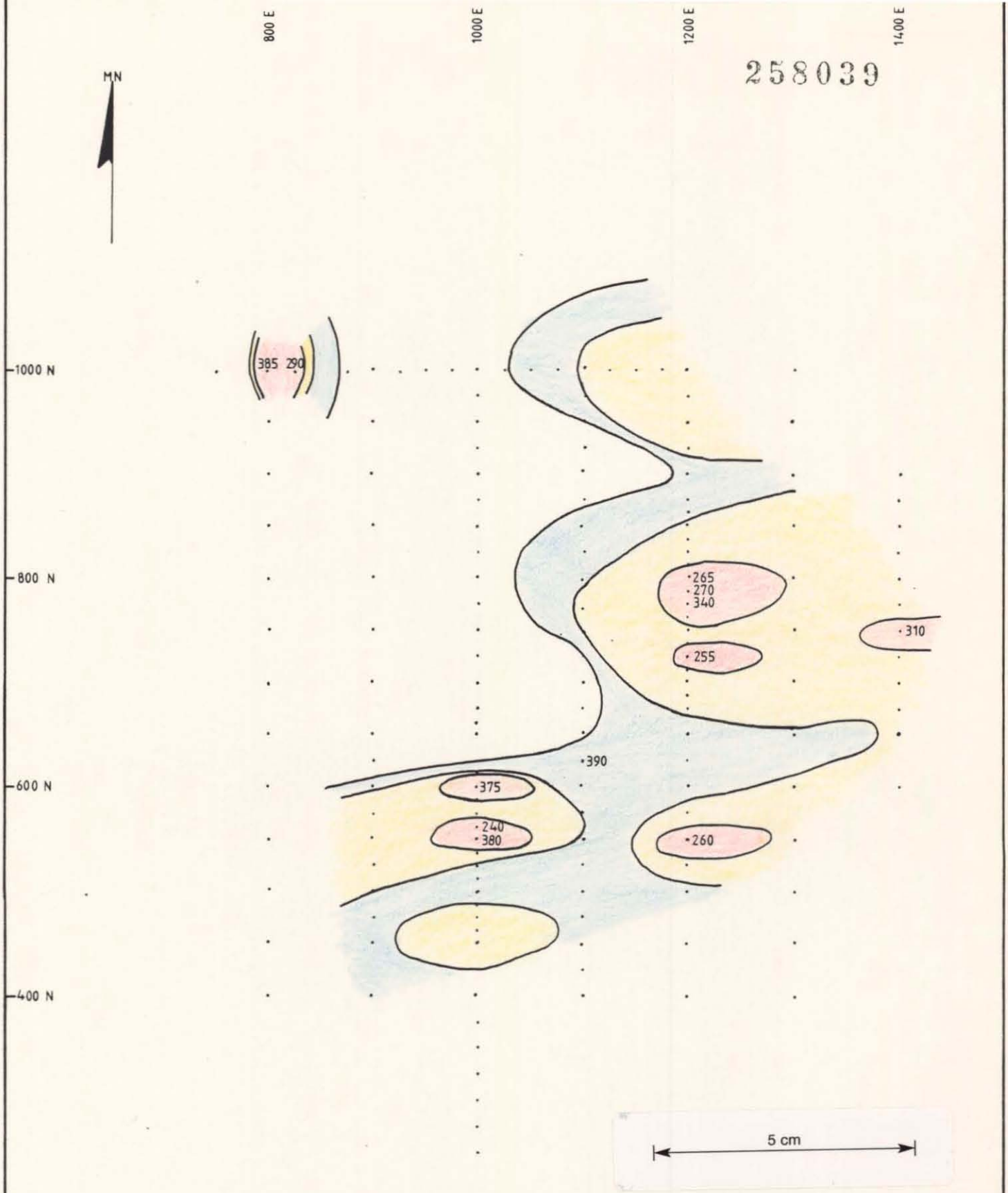
GOG RANGE ANOMALY

LEAD SOIL GEOCHEMISTRY

Geologist R.M.V.	Scale 1:5000
Date 16.1.84	Plan No 3

028

258039



ppm Zn

- < 35 ppm
- 35 - 100 ppm
- 100 - 200 ppm
- > 200 ppm

all values greater than 200ppm are shown

AMAX AUSTRALIA LIMITED

BARRINGTON E.L. 49/82

GOG RANGE ANOMALY

ZINC SOIL GEOCHEMISTRY

Geologist R.M.V.	Scale 1:5000
Date 16.1.84	Plan No 4

258040

AMAX AUSTRALIA (OPERATIONS) PTY LTD

E.L. 49/82 BEULAH

ROCK & STREAM SEDIMENT SAMPLE LOCATIONS

GOG SHEET

84-2306 vol 1-2. Plate 2

3313

SCALE 1:25 000

1 millimetre represents 25 metres

E.L. LOCALITY MAP

Adapted from Lands Departments Tasmania 1:25,000 Series

258041

AMAX AUSTRALIA (OPERATIONS) PTY LTD

E.L. 49/82 BEULAH

ROCK & STREAM SEDIMENT SAMPLE LOCATIONS

SHEFFIELD SHEET

84-2306 Plate 1

3312 vol 1-2

Samples A6449 – A6453

GRID CONVERGENCE 0.4

GRID/MAGNETIC ANGLE 12.3

Built up area with commercial centre

Roads maintained for continuous public use: Primary road. Route number; Secondary road. Route number; Minor road. Route number; Other roads. Bridge; Vehicular track. Gate (sealed / unsealed)

Roads of restricted use or access

Walking track. Bridge

Railway. Station

Light railway

Power transmission line and pylon positions

Building. Feature of special interest. Ruin. Mine (totally / house)

Post office. Police station. Fire station. School

SCALE 1:25 000

1 millimetre represents 25 metres

Caravan park. Camping ground

Rubbish disposal area. Cemetery

Trigonometric station. Spot elevation

Contour with value. Depression contour

Quarry or open cut mine

Broken rocky surface

Dense forest. Medium forest

Low dense vegetation. Distinctive grass

Orchard. Pine plantation

Windbreak

Swamp. Land subject to flooding

Waterfall. Rapids

Indefinite shoreline or floodbank. Levee

Tidal rocks or ledge. Offshore rock

Lighthouse. Exposed wreck

Sand. Tidal reef

Saline coastal flat. Tidal flats

Jetty. Launching ramp

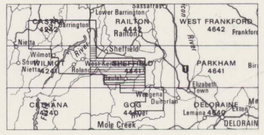
A 6452 SEDIMENT SAMPLE NUMBERS

A 6595 BULK GOLD SEDIMENT SAMPLE NUMBERS

A 6570 ROCK CHIP SAMPLE NUMBERS

5 cm

E.L. LOCALITY MAP



Adapted from Lands Department's Tasmania 1:25,000 Series

258042

AMAX AUSTRALIA (OPERATIONS) PTY LTD

E.L. 49/82 BEULAH

E.M. GROUND FOLLOW UP SURVEY

SHEFFIELD SHEET

84-2306 vol 1-2. Plate 3

3314

SCALE 1:25 000

1 centimetre represents 25 metres

BOUNDARIES shown on this map are NOT authoritative. For full particulars please consult the Registrar-General's Department or the Lands Department.
Property and land parcel boundaries are shown as of June 1981.
Areas within proclaimed towns or less than two hectares are not depicted. To give a land parcel reference, prefix parcel number with municipal number.

ANOMALY GRADE	E.M. GRADE SYMBOL	CONDUCTANCE RANGE (MHOS)
4		20 – 49
3		10 – 19
2		5 – 9
1		<5

E.L. LOCALITY MAP

Adapted from Lands Department's Tasmania 1:25,000 Series

258043

AMAX AUSTRALIA (OPERATIONS) PTY LTD

E.L. 49/82 BEULAH

E.M. GROUND FOLLOW UP SURVEY

GOG SHEET

84-2306 vol 1-2. Plate 4

3315

1 : 25000

SCALE 1:25 000

1 millimetre represents 25 metres

BOUNDARIES shown on this map are NOT authoritative. For full particulars please consult the Registrar General's Department or the Lands Department

Property and land parcel boundaries are shown as at May 1981

Areas within proclaimed towns or less than two hectares are not depicted. To give a land parcel reference prefix parcel number with municipal number.

ANOMALY GRADE	E.M. GRADE SYMBOL	CONDUCTANCE RANGE (MHOS)
4		20 – 49
3		10 – 19
2		5 – 9
1		<5

E.L. LOCALITY MAP

Adopted from Lands Department's Tasmania 1:25,000 Series

039

258044

APPENDIX I

REGIONAL ROCK CHIP & SOIL GEOCHEMICAL RESULTS

MICROFILMED

5 cm

040

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area SHEFFIELD 1 : 25000 Property or Prospect BEULAH - ANOMALY 1

Date: 22 September 1983 Collected by: A. STEWART, R. VIVIAN, D.ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location		Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Mn	As	Fe%	Au
		SHEFFIELD 1 : 25000									
A6401	Basalt - Anomaly 1	4961	1061	10	15	125	0.5	1000	15	5.15	x
A6402	ditto	4959	1040	20	15	120	0.5	1350	1	5.35	x
A6403	Float d. green andesite	5000	1080	25	695	420	4.5	1800	15	5.95	x
A6404	Disseminated pyrite basic volcanic	5000	1080	20	145	440	1.0	1500	6	5.60	x
A6405	Rhyolite o/c " " "	5020	1090	15	15	15	x	85	6	1.70	x
A6406	Pyrite " " "	4981	1136	25	10	100	1.0	1150	2	5.60	x
A6407	Workings " " "	4974	1137	35	45	305	x	615	4	5.95	x
A6408	" brown andesite + open fracture qtz-	4970	1117	120	2145	430	1.0	1150	2	6.50	x
A6409	" lined & limonite crate	"	"	20	25	205	0.5	615	2	6.40	x
A6410	" "	"	"	180	125	325	1.0	2050	4	9.65	x
A6411	" "	"	"	20	35	265	x	1750	6	6.30	x
A6412		4964	1102	10	5	25	x	210	x	1.35	x
A6413		"	"	10	5	25	x	200	x	3.05	x
A6414		4971	1128	5	5	15	x	250	x	9050	x

M.P. - FORM 2

25804

5 cm

041

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: Gog 1 : 25000 — Property or Prospect: BEULAH EL 39/83 - South Mersey River

Date: 14 November 1983 — Collected by: R. VIVIAN & D. ELLIS — Sample Batch No. — Analyses by: ANALABS

Sample No.	Description	Location		Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Ba	Au	Fe%	Comments
A6435	fawny-chocolate rock with coarse feldspar	532	075	45	25	195	x	380	x	8.50	
	phenocrysts showing trachytic texture (weathered)										
A6436	well cleaved Mn-stained geothite stained	537	074	65	315	215	x	340	x	10.0	near shallow
	gossaneous rock with irregular qtz veins										workings
A6437	pink to mauve schistose rock; light brown qtz	536	074	45	35	45	x	100	x	6.55	
	schist, fresh grey schist with streaked quartz										
	phenocrysts										
A6438	rusty coloured rock, sacchroidal texture.	532	072	30	45	120	x	55	x	3.25	
	tuffaceous ? (fresh variety, l. brown)										
A6439	highly weathered, red-orange, purple brown	530	070	40	155	25	0.5	125	x	3.05	
	coloured rock. Coarse texture, quartz phenocrysts										
	crystal tuff (Minnow Keratophyre)										

M.P. - FORM 2

2580469

042

5 cm

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area Gog 1 : 25000 Topo Property or Prospect BEULAH

Date: 14 November 1983 Collected by: D. ELLIS & R. VIVIAN Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Ba	Mn	Fe%	Comments
A6440	highly argillised rock, possibly a porphyritic	5098 0560	40	75	65	x	160	425	3.95	
	rhyolite.	Field Ref. 12								
A6441	porphyritic rhyolite	5102 0642	45	35	30	0.5	170	355	5.10	resampled
		Field Ref. 13								as A6471

M.P. - FORM 2

25804

5 cm

043

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area BURNIE

Property or Prospect BEULAH

Date: NOVEMBER 1983 Collected by: R. VIVIAN Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Mn / Ag	Fe% / As	K% / Na%	Comments
A6471	pale grey fine-med.gr. porphyritic rhyolite	Gog plantation 1 : 10000	40	x	35	275 / x	3.80 / x	3.00 / 1.36	intrusive
	feldspars altered, chloritised biotite. Minor	Field Ref. 13							
	iron oxide staining along fractures								
A6472	grey, argillised porphyritic felsite: siliceous	Field Ref. 16							similar to A6471 argillic alterat.
	rock, breccia frags.(3 mm) and flow texture								is low-temp. hydro mal. Intrusive
A6473	fine-med.gr. qtz phenocrysts in dense, aphamitic	Field Ref. 9	30	x	40	155 / 0.1	2.60 / x	3.77 / 1.71	probably intrusiv
	pink groundmass - porphyritic rhyolite								
A6474	as above	Field Ref. 10	35	5	40	160 / x	2.90 / x	3.57 / 1.46	
A6475	white, opaque vein material qtz; subparallel to	Field Ref. 17	35	x	30	185 / 0.1	1.55 / x	0.09 / 0.02	
	strike of greywacke								
A6476	dark grey green lithic crystal tuff; elongated	Field Ref. 18	25	30	400	3550 / 0.1	4.85 / x	1.97 / 1.83	lithic fragments t
	mafics (flow texture); rounded fragments of qtz								15mm ie lapilli siz
	porphyritic acid volcanics								
A6477	fine med. grained porphyritic rhyolite	Field Ref. 7	15	x	95	305 / 0.1	3.15 / x	3.75 / 1.41	as per A6473

M.P. - FORM 2

25804 8

5 cm

044

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area

Property or Prospect: BEULAH

Date: Collected by: Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Au	Cu	Pb	Zn	Mn / Ag	Fe% / As	K% / Na%	Comments
A6478	Porphyritic rhyolite, dark grey qtz feldspar	Field Ref. 19	x	20	95	50	1150 / 0.3	2.00 / x	2.40 / 0.36	maybe similar to
	phenocrysts in brown-green dense, glossy ground-									A6473 : extrusive
	mass,weathers to orange pink feldspars+qtz phenos									
A6479	dark, green, fine grained andesite ± fine dots	Field Ref. 20		15	x	225	3000 / 0.1	3.65 / x	1.25 / 2.85	
	of pyrite									
A6480	dark green coarse grained crystal tuff	Field Ref. 56	x	20	155	275	1600 / 0.2	3.95 / x	1.97 / 1.83	
A6481	sheared, altered ? greywacke									
	(orange brown fine sandy well weathered reel)	location: MG20 peg Rd								
A6482A	metarhyolite, mauve, moderately highly weathered	Field ref. 3								
	phenos in sandy textured groundmass									
A6482B	altered porphyry ferruginised, argillised	Field Ref. 2								med. gr. intrusive
	feldspar & qtz phenos in clayey groundmass.									
	Mauve coloured.									
A6483	yellow brown qtz tuff + FeOx stained fractures	Field Ref. 21	x	500	1000	190	460 / 5.0	655 / x	4.65 / 0.08	
A6483A	orange brown-purple-dark green basic volcanic	Field ref. 22	x	80	635	185				
	(highly ? altered)									

M.P. - FORM 2

23804 9

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

045

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 6 February 1984 Collected by: D. ELLIS & R. VIVIAN Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Au	Cu	Pb	Zn	Mn / Ag	Fe% / As	K% / Na%	Comments
				Analyses (ppm unless otherwise stated)						
A6484	Tonalite, medium-coarse grained hydromorphic	Field Ref. 23	x	25	5	55	405 / 0.1	3.15 / x	0.86 / 2.80	hybrid rock part
	texture; altered (sericite) feldspar phenocrysts.									gabbroic and granitic
	Hb as needles									
A6485	Feldspar-qtz-tuff, feldspar phenos to 5 mm; small qtz phenos in greenish tan (olive) fine grained	Field Ref. 24A		20	x	225	890 / x	3.30 / x	3.20 / 0.56	
	ground mass									
A6485A	lithic crystal tuff, lithic frags mudstone;	Field Ref. 24		30	50	30	35 / 0.3	5.40 / x	0.14 / 0.12	
	abundant chlorite									
A6486	Flow banded rhyolite	Field Ref. 25		20	x	70	120 / 0.1	3.50 / x	3.50 / 0.56	
A6487	finely laminated sediment, possibly carbonaceous	Field Ref. 26		55	180	95	45 / 0.8	2.05 / x	3.07 / 0.07	note:Cu,Pb,Zn are elevated vs volcanics
A6489	crystal lithic tuff	between S.S A3384 and 86		Cu	Pb	Zn	Ag	As		etc
		Field Ref. 1 W. Gog Creek		10	x	110	0.1	x		
A6490A	crystal tuff or reworked tuff (i.e. volcanomick	Field Ref. 4 W. Gog Creek		15	40	165	0.2	x		
	sandstone), light green; fine medium grained; chloritised									
A6491	altered porphyritic andesite; grey-green, chlorit.feldspar phenos in flow orientated	Field Ref. 5 W. Gog Creek		70	30	930	0.3	50		deuteric alteration hybrid extrusive
	groundmass + <1% fine dissem. sulphides									mafic + acid/interm

M.P. - FORM 2

25805O

5 cm

046

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area Gog 1 : 25000 Property or Prospect BEULAH

Date: 8 February 1984 Collected by: R. VIVIAN & D. ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	As	Au	Comments
A6492	Rock chip (grab) samples - cream silicified rock	north side of creek	25	900	800	3.2	50	x	bluff face is about
	vague tuff texture, much fractured; red brown	prominent creek near A6466							9 m wide & highly
	limonitic stained & FeOx boxwork; irregular qtz	(stream sed.)							silic.
	stringes subparallel to fractures								
A6492	cream silicified rock cut by hair fractures.	5718 0470 Gog 1 : 25000	10	185	110	0.2	x		ditto
	FeOx stained or filled by columnar qtz. I fine								
	metallic specks-sulphides or muscovite ?								
A6493	tuff, silic. & cut by fractures and qtz veins to	O/c near s.s. A6467	10	75	140	0.1	x	x	
	1 cm width. FeOx stained.								
A6493A	qtz vein material & FeOx lined fractures in	ditto	10	55	165	0.1	50		
	altered (silic) tuff								

M.P. - FORM 2

5 cm

258051

047

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 8 February 1984 Collected by: R. VIVIAN & D. ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	As	Au	Comments
A6494	1) Fe stained tuff ± ½ cm qtz veins	5718 0470	25.	25	245	0.1	x		rock material from
	2) silic. (hornsfelsic) Vx - cut by qtz vein(½cm)								creek at A6466
	& chlorite (½ cm) vein. Some FeOx assoc'd with								
	qtz veining								
	3) d. green f. gr. felted rock ± yellow brown								
	FeOx qtz veins								
A6494A	as per A6492A	as per A6492A	15	235	300	0.1	50	x	
A6495	as per A6493 ± heavily FeOx stained		10	20	120	0.1	x		grab sample
A6496	terracota red - yellow brown med. gr. qtz tuff	Gog Range Rx #21 reassay of	150	775	195	x	x	x	
A6496A	+ fractures, waxy d. green veinlets + FeOx stains	anom. Pb. (# A6483)	140	1650	185	x	x		
A6497			80	520	205	x	x	x	

M.P. - FORM 2

25803

5 cm

048

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 :25000 Property or Prospect BEULAH

Date: Collected by: D. ELLIS & R. VIVIAN Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	As / Ba	Fe%	Comments
A6533	Strongly cleaved volcanic; limonite stained	West on ridge from	90	40	200	0.5	9 / 45	11	
	fractures	mineralised bluff							
A6533A	light grey-green volcanic, v. fine aligned Hb	LH side hill upstream from	10	15	65	x	19 / 45	2.15	
	laths, hydraulic fractured (limonite	bluff							
	stained)								

M.P. - FORM 2

5 cm

25803

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

049

1:250,000 Sheet Area: SHEFFIELD TOPO 1 : 25000 — Property or Prospect: BEULAH - ANOMALY 1

Date: 23 May 1984 — Collected by: DAVID ELLIS — Sample Batch No. — Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Au	As		Comments
A6570	CHIP SAMPLE ACROSS RHYOLITE		5	10	10	0.017	4		
A6571			10	5	5	x	6		
A6571A			5	5	5	x	5		
A6572			10	5	45	x	3		
A6572A			5	x	20	x	3		
A6573			10	5	10	x	6		
A6573A			10	10	20	x	23		
A6574			5	x	15	x	5		
A6574A			10	x	55	x	5		
A6575			10	x	15	x	9		
A6576			10	x	45	x	4		
A6577			20	5	115	x	6		
A6578			15	10	165	x	3		
A6579			20	5	10	x	8		
A6579A			20	5	15	x	10		
A6580			40	15	10	x	7		
A6581			10	10	10	x	7		
A6582			60	15	180	x	4		

M.P. - FORM 2

2580541

5 cm

050

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: SHEFFIELD 1 : 25000 — Property or Prospect: BEULAH - ANOMALY 1

Date: 23 May 1984 — Collected by: D. ELLIS — Sample Batch No. — Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Au	As		Comments
A6583			20	20	5	x	8		
A6584			5	x	5	x	4		
A6585			x	x	5	x	1		

M.P. - FORM 2

5 cm

25805

051

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 16 April 1984 Collected by: D. ELLIS & M. SAVAGE Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Mn	Fe%	COLD EXTRACT As/Ba	Cu	Zn
A6537	Auger soil samples 10 m spacing north to south	GOG Topo 5722 0467	80	40	45	x	310	2.65	18/85	15	10
A6538			105	70	70	x	120	3.80	19/85	20	15
A6539			80	70	70	x	180	3.00	18/80	10	10
A6540			70	80	110	x	275	3.90	14/75	20	30
A6541			75	70	125	x	365	4.65	24/85	20	25
A6542			95	80	85	x	180	5.10	8/85	15	15
A6543			95	35	70	x	530	5.95	13/90	15	15
A6544			95	25	85	x	320	5.40	15/75	20	20
A6545			80	20	485	x	1050	6.45	13/70	40	485
A6546			120	85	145	x	1450	6.55	12/140	40	55
A6547	Auger soil samples 10 m spacing north to south	Gog Topo 5717 0480	20	20	35	x	75	2.05	6/45	10	10
A6548			15	15	40	x	65	2.70	8/85	5	10
A6549			5	x	25	x	35	1.15	7/50	x	5
A6550			5	x	15	x	35	8600	4/35	5	5
A6551			75	5	60	x	55	4.85	7/25	10	5
A6552			45	5	70	x	190	3.50	8/50	10	10
A6553			25	x	45	x	55	2.65	8/40	10	10
A6554			25	10	50	x	80	3.35	15/35	10	20

M.P. - FORM 2

5 cm

25805

052

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 18 April 1984 Collected by: D. ELLIS & M. SAVAGE Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Mn	Fe%	COLD EXTRACT As/Ba	Cu	Zn
A6555	Auger soil samples	Gog Topo	60	15	70	x	220	3.90	8/35	15	15
A6556			10	10	45	0.5	1500	2.45	8/220	x	10
			10	x	45	0.5	95	3.40	8/25	5	10

M.P. - FORM 2

5 cm

23803

053

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: SHEFFIELD TOPO 1 : 25000 — Property or Prospect: BEULAH - ANOMALY 1

Date: 18 April 1984 — Collected by: D. ELLIS & R. VIVIAN — Sample Batch No. — Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Au / As	Ba	Comments
A6558	Composite grab sample of vein and quartz	Topo 4970 1118	10	30	40	x	x / 7	25	30 m North-west o
	fracture in andesite								shallow excavation
A6559	ditto	ditto	35	70	325	x	x / 4	95	ditto
A6560	ditto	ditto	120	215	310	x	x / 8	120	Shallow excavatio Northwest hill
A6561	Well cleaved ferruginous andesite	Topo 4950 1120	30	40	385	x	x / 13	85	2nd hill northwes of excavation
A6562	Fine grained dark ~~bu~~ish grey porphyritic lava	Topo 4950 1158	5	10	105	x	x / 5	45	
	consisting of black augite phenocrysts in ground								
	mass of opaque ? haematite and chloritised								
	feldspar crystals								
A6563	Green, fine grained augite andesite consisting	Topo 4956 1140	30						
	of <1 mm irregular augite phenocrysts and								
	larger plagioclase phenocrysts in groundmass								
	of plagioclase crystals. Green colouration is								
	due to chlorite alteration								

M.P. - FORM 2

5 cm

25838

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: SHEFFIELD TOPO 1 : 25000 Property or Prospect: BEULAH - ANOMALY 1

Date: 13 April 1984 Collected by: D. ELLIS & R. VIVIAN Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Au / As	Ba	Comments
A6564	Green-grey crystal tuff (lava) weakly fractured.	Topo 4970 1154	30	10	110	x	x / 4	110	
	Fractures carbonate & FeOx lined rare pyrite								
	clots through rock matrix								
A6565	Yellow green finely granular epidote rock cut	Topo 5014 1070	30	55	50	x	x / 8	25	
	by minor epidote veinlets and a rock coarsely								
	crystalline in acicular epidote or ? penninite								
A6566	Highly altered fine grained yellow brown rock	ditto	5	40	30	x	x / 7	20	
	cut by 2 cm wide quartz vein containing a soft,								
	cream. fibrous mineral <2 mm wide central to the								
	vein								

M.P. - FORM 2

5 cm

2380959

055

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: Sheffield Topo 1 : 25000 — Property or Prospect: BEULAH - ANOMALY 1

Date: 13 April 1984 — Collected by: D. ellis & R. vivian — Sample Batch No. — Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Au / As	Ba	Comments
A6567	Aletred rock as above with epidote aggregates	Topo 5014 1070	20	60	45	x	x / 3	55	
	and "sweat" quartz veins								
A6568	Cream rhyolite breccia - highly siliceous rock	Topo 5020 1092	25	5	15	x	0.032 / 8	30	
A6568A	cut by MnOx & FeOx lined fractures and by		20	10	15	x	0.010 / 8	30	
	moderate quartz veinlets some chips show shared								
	textures								
A6569	Composite rock sample; highly altered	Topo 5020 1198	75	30	25	1.0	x / 13	25	
	(sericitised) rhyolite cut by subparallel FeOx								
	stained fractures & quartz veinlets 3 mm wide.								
	One rock is rotten abundant disseminated								
	arsenopyrite								

M.P. - FORM 2

5 cm

25806

056

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 :25000 Property or Prospect BEULAH

Date: 31 May 1984 Collected by: D. ELLIS Sample Batch No. ? Analyses by: ANALABS

Sample No.	Description	Location	Au(1)	Au(2)	Au(3)	Dry Wt Kg	%Cn	Cu / Ag	Cu(1) Cu	As	Ag
A6586	BULK GOLD STREAM SEDIMENTS	GOG TOPO 44550 08720	0.16	2.0	250	8.0	0.167	4 / x	1	x	x
A6587	" " " "	44480 09640	x	x	x	7.9	0.172	35 / 0.6	2	x	x
A6588	" " " "	46490 09120	0.39	4.4	590	7.6	0.114	282 / 3.4	14	x	x
A6589	" " " "	46860 08830	x	x	x	7.5	0.148	6 / 0.2	4	x	x
A6590	" " " "	48570 08710	x	x	x	6.7	0.150	14 / 0.2	9	x	x
A6591	" " " "	48590 07180	x	x	x	8.0	0.180	85 / 1.2	14	x	x
A6592	" " " "	51150 08800	x	x	x	8.0	0.160	44 / 0.4	7	x	x
A6593	" " " "	53300 08100	x	x	x	7.3	0.182	17 / 0.2	3	x	x
A6594	" " " "	53320 07950	x	x	x	8.0	0.148	131 / 1.6	6	x	x
A6595	" " " "	54890 07200	x	x	x	7.6	0.153	89 / 1.2	4	x	x
A6596	" " " "	55260 07440	x	x	x	7.5	0.162	122 / 1.8	12	x	x
A6597	" " " "	56630 06740	0.09	1.2	145	8.4	0.177	276 / 3.0	10	x	x
A6598	" " " "	53980 06070	x	x	x	7.8	0.181	32 / 0.8	1	x	x
A6599	" " " "	ANOMALY 1 50280 10970	x	x	x	7.4	0.146	10 / 0.1	4	x	x
A6600	" " " "	" " 50180 10860	x	x	x	6.6	0.158	9.4 / 1.2	7	x	x
	collected at 100 m intervals										

M.P. - FORM 2

25806

5 cm

057

APPENDIX II

REGIONAL STREAM GEOCHEMICAL RESULTS

258062

058

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH - GOG RANGE ANOMALY

Date: 2 June 1983 Collected by: R. VIVIAN & L. SPENCER Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Ba	As	Cu	Pb	Zn	Ag	Comments
A3373	Stream sediment	Topo Gog 557 053	90	9	55	95	90	0.5	
A3374	" "	" " 558 053	50	24	10	5	25	x	
A3375	" "		85	13	30	25	90	0.5	
A3376	" "		100	12	50	30	165	0.5	
A3377	" "	" " 559 054	100	9	30	25	125	x	
A3378	" "	" " 561 055	115	10	40	35	150	x	
A3379	" "	" " 562 055	95	11	35	35	170	x	
A3380	" "	" " 563 057	120	10	50	30	210	x	
A3381	" "	" " 564	160	7	55	55	530	0.5	
A3382	" "	" " 564 059	120	10	45	20	240	x	
A3383	" "	" " 552 053	65	13	35	35	70	0.5	
A3384	" "	" " 551 056	180	12	50	50	170	x	
A3385	" "	" " 551 055	120	12	55	75	130	x	
A3386	" "	" " 551 058	155	11	35	40	205	0.5	
A3387	" "	" " 550 059	185	8	30	40	325	x	
A3388	" "	" " 549 059	185	9	35	40	295	x	
A3389	" "	" " 548 059	215	8	20	40	325	0.5	
A3390	" "	" " 548 061	205	7	30	50	420	x	

M.P. - FORM 2

2580963

5 cm

059

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 2 June 1983 Collected by: R. VIVIAN & L. SPENCER Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Ba	As	Cu	Pb	Zn	Ag	Comments
A3391	Stream sediment	Gog Topo 549 064	165	5	20	30	230	x	
A3392	" "	" " 549 066	180	5	20	40	325	x	
A3393	" "	" " 548 067	165	8	30	35	330	x	
A3394	" "	" " 547 067	100	3	10	5	75	0.5	

M.P. - FORM 2

5 cm

2580694

060

SU

SAMPLE RECORD

1:250,000 Sheet Area GOG 1 : 25000

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

Property or Prospect: BEULAH - GOG RANGE ANOMALY

Date: 17 October 1983 Collected by: R. VIVIAN & D. ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location		Analyses (ppm) Cu	Pb	Zn	Ag	Cold Extractable Cu	Zn	Comments
A6415	Stream sediment	5637	0610	60	80	715	x	30	370	East Ck
A6416	" "	5631	0609	50	95	740	0.5	35	415	"
A6417	" "	5625	0612	40	70	445	x	25	200	"
A6418	" "	5622	0614	75	85	515	x	50	270	"
A6419	" "	5615	0616	50	40	120	x	35	60	"
A6420	" "	5614	0610	40	130	890	x	30	520	"
A6421	" "	5609	0608	40	155	955	x	30	625	"
A6422	" "	5604	0604	55	190	1050	x	40	680	"
A6423	" "	5600	0600	35	155	620	x	25	365	"
A6424	" "	5510	0557	60	110	425	x	35	170	West Creek
A6425	" "	5518	0558	80	105	535	x	45	240	"
A6426	" "	5524	0556	95	95	425	x	50	180	"
A6427	" "	5532	0553	95	125	645	x	55	310	"
		CASTRA 1 : 25000 TOPO								Paloona
A6428	" "	3642	2783	30	25	150	x			"
A6429	" "	3628	2772	10	30	125	x			"
A6430	" "	3620	2774	15	85	230	x			"
A6431	" "	3510	2700	30	20	250	x			"

M.P. - FORM 2

5 cm

?

258065

061

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area SHEFFIELD 1 : 25000 Property or Prospect BEULAH E. 49/82

Date: 14 November 1983 Collected by: D. ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location		Analyses (ppm) Cu	Pb	Zn	Ag	Cold Extractable % Cu	% Zn	Minus 80# pH
A6449	Stream sediment Anomaly 5	4670	1058	50	25	100	x	30	65	6.0
A6450	ditto	4680	1056	20	15	80	x	10	55	6.2
A6451	ditto	4680	1062	45	30	80	x	25	45	6.8
A6452	ditto	4538	1301	10	60	180	x	5	90	6.0
A6453	ditto	4543	1302	10	55	145	x	5	60	6.2

M.P. - FORM 2

5 cm

2580666

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

062

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: GOG 1 : 25000 — Property or Prospect: BEULAH

Date: 22 December 1983 — Collected by: D. ELLIS — Sample Batch No. — Analyses by: ANALABS

Sample No.	Description	Location		Analyses (ppm unless otherwise stated) Au	Cu	Pb	CxZn/Zn	Ag	Fe	Mn	Ba/CxCu	sieved to minus 80# pH
A6454	Stream sediments	5735	0518	x	40	40	150/235	x	-	-	220/25	6.0
A6455	miscellaneous creeks eastward flowing into	5694	0507	x	65	25	70/150	x	-	-	225/40	6.2
A6456	Mersey River	5660	0490	x	30	55	130/200	x	-	-	195/20	6.0
A6457		5654	0462	x	10	50	65/105	x	-	-	140/10	6.3
A6458		5652	0466	x	15	35	40/105	x	-	-	115/10	6.2
A6459		5642	0484	x	20	65	95/170	x	-	-	150/20	6.2
A6460		5644	0490	x	100	65	170/265	0.5	-	-	310/70	6.3
A6461		5756	0416	x	15	20	45/115	x	-	-	230/10	
A6462		5745	0414	x	15	65	40/110	x	-	-	265/15	
A6463		5736	0476	x	30	65	220/355	0.5	-	-	340/20	
A6464		5730	0474	x	30	65	210/320	x	-	-	345/20	
A6465		5721	0470	x	25	65	255/375	x	-	-	395/20	
A6466		5714	0472	x	30	280	745/990	x	-	-	505/20	
A6467		5705	0473	x	25	85	310/520	x	-	-	410/20	
A6468		5688	0468	x	25	110	175/345	x	-	-	295/20	
A6469		5682	0462	x	15	55	65/165	x	-	-	180/10	
A6470		5675	0455	x	35	130	215/470	x	-	-	235/25	
	Detection				5	5	5	0.5	50	5	5/5	

M.P. - FORM 2

2580671

5 cm

063

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area 60G 1 : 25000 Property or Prospect BEULAH

Date: 27 March 1984 Collected by: DAVID ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location		Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	As	Cx Cu	Cx Zn
A6523	stream sediment	57160	063250	55	25	75	x	7	30	30
A6524	" "	57100	061700	35	10	55	x	5	15	15
A6525	" "	54600	06950	65	10	105	x	10	40	50
A6526	" "	54630	06900	65	20	130	x	8	45	65
A6527	" "	54540	06830	90	20	150	x	8	60	65
A6528	" "	54450	06740	65	15	160	x	10	35	75

45

M.P. - FORM 2

5 cm

290868

064

258009

APPENDIX III

EAST GOG GRID - SOIL GEOCHEMISTRY

065

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 23 January 1984 Collected by: R. VIVIAN - D. ELLIS Sample Batch No. Analyses by: ANALABS

Sample No.		Description	Location	Analyses (ppm unless otherwise stated)						Cold Extract	
				Cu	Pb	Zn	Fe%	Ag	As	Cu	Zn
900 E	450 N	Soil Auger Samples - Gog Range Grid		40	35	130	2.90	0.2	x	15	25
"	475 N			25	25	85	2.35	0.3	x	10	15
"	500 N			25	30	115	2.45	0.2	x	10	30
"	525 N			40	85	150	3.35	0.2	x	10	25
"	550 N			70	30	145	2.85	0.1	x	10	20
"	575 N			40	75	160	3.10	0.2	x	10	25
"	600 N			10	10	30	1.75	0.8	x	x	x
"	625 N			x	x	10	1650	0.2	x	x	x
"	650 N			x	5	20	5450	0.2	x	x	x
1000 E	462 N			55	15	85	3.55	0.1	x	15	15
"	487 N			95	30	115	3.80	0.1	x	15	20
"	512 N			50	30	90	2.05	0.2	x	5	15
"	537 N			35	50	150	3.05	0.1	x	5	25
"	562 N			20	90	240	2.95	0.1	x	5	100
"	587 N			45	125	135	2.85	0.2	x	10	20
"	612 N			30	20	70	3.35	0.2	x	5	20
"	662 N			x	10	20	2.20	0.1	x	x	x
"	675 N			x	15	20	1.15	0.1	x	x	x

M.P. - FORM 2

5 cm

25807

066

SAMPLE RECORD

GOG 1 : 25000

1:250,000 Sheet Area

AMAX IRON ORE CORPORATION

(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

Property or Prospect: BEULAH

Date: 23 January 1984 Collected by: R. VIVIAN & C. ROSE Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated)						Cold Extract	
			Cu	Pb	Zn	Fe%	Ag	As	Cu	Zn
1100 E	500 N SOIL AUGER SAMPLES		70	30	115	3.90	0.1	x	20	45
"	525 N		40	40	90	2.75	0.2	x	5	15
"	550 N		60	40	110	3.50	0.1	x	15	25
"	575 N		45	35	70	3.10	0.2	x	10	10
"	600 N		20	15	30	1.55	0.2	x	x	x
"	625 N		85	175	390	5.15	0.1	x	10	30
"	700 N		5	15	35	1.85	0.2	x	x	x
"	725 N		5	15	25	7650	0.2	x	x	x
"	750 N		10	35	70	1.35	0.1	x	x	5
"	775 N		35	240	215	3.95	0.2	x	5	25
"	800 N		40	10	55	4.35	0.2	x	x	10
"	825 N		20	15	50	3.35	0.2	x	x	5
"	850 N		15	40	80	3.75	0.1	x	5	25
"	875 N		5	10	30	2.00	0.1	x	x	5
"	900 N		x	10	5	1700	0.2	x	x	x
"	925 N		5	15	20	2250	0.1	x	x	x
"	950 N		5	5	20	8250	0.1	x	x	x
"	975 N		40	15	100	7.45	0.2	x	15	20

M.P. - FORM 2

25801

5 cm

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

067

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area 60G 1 : 25000 Property or Prospect BEULAH

Date: 23 January 1984 Collected by: R. VIVIAN & C. ROSE Sample Batch No. Analyses by: ANALABS

Sample No.		Description	Location	Analyses (ppm unless otherwise stated)						Cold Extract	
				Cu	Pb	Zn	Ag	Fe%	As	Cu	Zn
1200 E	687 N	SOIL AUGER SAMPLES		30	50	100	0.2	3.10	x	5	10
"	712 N			30	200	115	0.3	3.00	x	10	20
"	737 N			30	350	175	0.4	4.00	x	10	30
"	762 N			50	150	650	0.2	5.20	x	10	50
"	787 N			35	245	270	0.3	5.25	x	15	50
"	812 N			40	200	185	0.4	4.80	x	10	30
"	837 N			55	75	170	0.2	11.5	x	15	35
"	862 N			25	15	85	0.3	3.45	x	5	20

M.P. - FORM 2

5 cm

25807?2

068

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 17 February 1984 Collected by: D. Ellis - R. Vivian Sample Batch No. Analyses by: ANALABS

APPENDIX - GOG RANGE ANOMALY
SOIL GEOCHEMISTRY RESULTS

Sample No.		Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Fe%		Gold Extract Cu	Zn
1400 E	600 N	SOIL AUGER SAMPLES	GOG RANGE GRID	55	25	105	x	4.10		35	65
"	625 N			75	40	165	x	5.55		40	110
"	650 N			40	25	90	x	3.10		20	50
"	675 N			80	15	95	x	5.20		50	55
"	700 N			55	20	105	x	5.00		30	45
"	725 N			55	70	160	x	6.10		30	100
"	750 N			80	165	310	x	7.00		45	150
"	775 N			45	50	110	x	3.25		20	40
"	800 N			45	95	125	x	4.55		10	30
"	825 N			40	175	160	x	5.25		15	45
"	850 N			40	135	125	x	3.95		15	35
"	875 N			30	125	170	x	3.40		15	65
"	900 N			45	585	265	x	5.40		15	80
1200 E	725 N	A0 0-10 cm humus & choc. soil		50	660	195	0.5	4.50		10	40
"	"	B1 -0.7 m d. brown clay		45	670	180	0.5	4.35		15	50
"	"	B2 -1.2 m ditto		45	700	185	0.5	4.70		15	55
"	"	C -1.6 m d. brown clay with rock frags. weathered		40	590	170	0.5	3.95		20	75

M.P. - FORM 2

5 cm

2580243

069

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG RANGE 1 : 25000 Property or Prospect BEULAH

Date: 10 December 1983 Collected by: D. ELLIS & M. SAVAGE Sample Batch No. Analyses by:

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Fe%	Mn	Ba	Au
1000 N	750 E SOIL AUGER SAMPLES		15	30	90	0.5	3.00	80	60	x
"	800 E		25	200	385	0.5	6.75	1750	215	x
"	825 E		20	340	290	1.0	6.00	2550	220	x
"	875 E		5	15	30	0.5	1.45	45	50	x
"	900 E		5	10	25	0.5	1.50	50	55	x
"	925 E		5	10	30	x	1.60	40	50	x
"	950 E		15	15	30	x	1.55	25	75	x
"	975 E		15	15	25	x	1.40	50	65	x
"	1000 E		15	15	30	x	2.25	55	60	x
"	1025 E		15	20	35	x	2.80	60	60	x
"	1050 E		20	10	45	x	3.90	95	50	x
"	1075 E		30	10	60	x	2.95	95	85	x
"	1100 E		60	10	110	0.5	9.55	445	90	x
"	1125 E		65	15	105	x	10.0	430	65	x
"	1150 E		50	15	110	x	9.70	455	60	x
"	1175 E		60	15	105	x	11.0	290	65	x
1000 E	200 N		60	25	65	0.5	2.55	45	45	x
"	225 N		50	20	55	x	2.85	130	45	x

M.P. - FORM 2

5 cm

258074

070

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 10 December 1983 Collected by: D. ELLIS & M. SAVAGE Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Cu	Pb	Zn	Ag	Fe%	Mn	Ba	Au	Cold Extract Cu	Cold Extract Pb	Cold Extract Zn
		Analyses (ppm unless otherwise stated)										
1000 E	250 N SOIL AUGER SAMPLES	60	25	75	x	2.35	195	55	x			
"	275 N	75	25	90	x	3.10	50	70	x			
"	300 N	85	35	85	x	4.10	45	75	x			
"	325 N	90	15	55	x	4.55	90	55	x			
"	350 N	85	30	50	x	7.40	360	60	x			
"	375 N	95	20	50	x	5.20	50	50	x			
"	400 N	55	10	60	x	4.50	235	50	x			
"	425 N	85	15	100	x	4.90	655	55	x			
"	450 N	85	35	105	x	6.80	765	65	x			
"	475 N	80	30	120	x	4.05	115	50	x			
"	500 N	55	35	75	x	3.70	790	65	x	20	20	10
"	525 N	25	45	90	0.5	2.65	330	75	x	15	20	10
"	550 N	35	70	380	x	3.70	870	100	x	20	35	60
"	575 N	5	55	195	x	2.40	835	65	x	15	40	45
"	600 N	65	265	375	x	5.10	775	90	x	20	130	30
"	625 N	15	5	30	x	1.55	195	50	x	25	x	20
"	650 N	5	10	30	x	1.85	30	55	x			
"	675 N	5	10	20	x	2.05	25	15	x			

M.P. - FORM 2

5 cm

258075

071

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 10 December 1983 Collected by: D. ELLIS & M. SAVAGE Sample Batch No. Analyses by: ANALABS

Sample No.		Description		Analyses (ppm unless otherwise stated)								Cold Extract		
				Cu	Pb	Zn	Ag	Fe%	Mn	Ba	Au	Cu	Pb	Zn
1000 E	700 N	SOIL AUGER SAMPLES		5	15	30	x	2.70	25	35	x			
"	725 N			5	10	25	x	2.15	30	30	x			
"	750 N			x	x	5	x	2000	65	20	x	15	x	5
"	775 N			x	5	10	x	2150	20	20	x			
"	800 N			5	15	25	x	2.25	35	50	x			
"	825 N			5	10	25	1.0	2.35	40	45	x			
"	850 N			5	15	15	0.5	1.70	25	45	x			
"	875 N			5	15	25	1.0	2.10	25	55	x			
"	900 N			10	15	30	1.0	2.05	30	65	x			
"	925 N			5	10	30	x	1.40	40	80	x			
"	950 N			5	10	25	1.0	1.25	45	65	x			
"	975 N			5	5	25	0.5	1.10	40	60	x			
1200 E	500 N			70	45	90	1.0	5.25	435	65	x			
"	525 N			70	30	120	1.0	5.55	1600	105	x			
"	575 N			70	65	260	1.0	5.45	870	80	x			
"	600 N			80	30	140	1.0	5.25	670	45	x			
"	625 N			55	25	85	0.5	4.65	1250	55	x	20	x	10
"	650 N			80	20	50	1.0	5.60	220	50	x	20	15	10

M.P. - FORM 2

5 cm

25 80 76

072

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: 10 December 1983 Collected by: D. ELLIS - M. SAVAGE Sample Batch No. Analyses by: ANALABS

Sample No.		Description		Analyses (ppm unless otherwise stated)								Cold Extract		
				Cu	Pb	Zn	Ag	Fe%	Mn	Ba	Au	Cu	Pb	Zn
1200 E	675 N	SOIL AUGER SAMPLES		55	75	120	1.0	5.35	1550	30	x	20	35	10
"	700 N			50	95	150	1.0	4.65	745	30	x	15	40	10
"	725 N			60	500	255	1.5	6.40	2350	70	x	20	280	15
"	750 N			20	70	105	1.0	3.95	1200	50	x	20	45	10
"	775 N			30	95	340	1.5	6.55	445	165	x	15	45	15
"	800 N			40	205	265	1.5	6.85	1300	105	x	15	115	20
"	825 N			40	135	160	1.0	6.90	2950	100	x	20	105	20
"	850 N			35	110	160	1.0	9.15	2950	60	x	25	80	20
"	875 N			10	10	40	1.0	1.85	305	60	x	20	x	10
"	900 N			20	15	50	1.0	2.35	85	145	x	15	x	5
"	925 N			65	10	130	0.5	9.90	1750	105	x			
"	950 N			50	10	120	1.0	9.60	1400	115	x			
"	975 N			105	5	155	1.0	11.5	310	135	x			
"	1000 N			50	15	110	0.5	11.0	1150	70	x			
"	1025 N			55	10	115	1.0	10.0	415	80	x			
"	1050 N			75	10	120	1.0	9.50	435	125	x			
"	1075 N			20	5	40	0.5	1.80	140	70	x			
"	1100 N			15	5	30	0.5	2.30	130	75	x			

M.P. - FORM 2

5 cm

25802

073

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area GOG 1 : 25000 Property or Prospect BEULAH

Date: Collected by: D. ELLIS & M. SAVAGE Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Au (1) µg/gmZn					Comments
1000 N	800 E BULK SAMPLES		X					
"	900 E		0.06					
200 N	1000 E		0.31					
300 N	"		x					
400 N	"		0.07					
500 N	"		0.20					
600 N	"		0.13					
700 N	"		0.15					
800 N	"		0.08					
900 N	"		0.05					
1000 N	"		x					
500 N	1200 E		0.41					
700 N	"		0.21					
600 N	"		0.09					
900 N	"		x					
1000 N	"		x					
1100 N	"		0.04					

M.P. - FORM 2

25807 8

5 cm

074

APPENDIX IV

EAST GOG GRID - ROCK GEOCHEMISTRY

075

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area

Property or Prospect: BEULAH

Date:

Collected by: R. VIVIAN

Sample Batch No.

Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Fe% / Mn	As	Ba Na K
A6498A	Gossan. d. red brown rock limonite stained	1350 E/725 N Gog	70	35	160	x	26.5 / 370	13	Gog Grid
	sheared texture probably volcanic								
A6499	Porphyry. d. grey closely packed fine gr.	1400 E/950 N Gog	25	50	490	x	3.90 / 2750	3	Gog Grid
	feldspar phenos ± amygdales								
A6499A	l.tan fine gr. weath. feldspar phenos crowded.	G Gog grid	30	80	440	x	3.80 / 2250	3	similar but weathe
	feldspar porphyry								ed version of A6599
A6500	purple weath. volcanoclastic large clasts to	J Gog grid	25	5	25	0.5	3.10 / 140	3	
	1 cm white clayey material & green mudstone ?								
A6500A	red. fine gr. highly weath. volcanic	583 N/1000 E H	65	300	180	0.5	7.35 / 2650	12	crystal tuff ?
A6501	siliceous volcanic sheared red/white mottled	980 E/650 N E	15	5	40	x	7.30 / 1250	2	
	FeOx stained.								
L	brown micaceous sst. (cleaved)								

M.P. - FORM 2

5 cm

2580080

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

White: Office
Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area

Property or Prospect BEULAH

Date: Collected by: Sample Batch No. Analyses by: ANALABS

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Fe% / Mn	As	Comments
A6501	Lithic xrystal tuff. green. chlor. fine gr.	800E/1000N	1						andesitic
	matrix feld. phenos. large qtz phenos & clasts								
A6501A	red-brown mottled h. weath. rock. sheared/cleaved		20	x	80	x	6.00 / 215	4	
	texture qtz eyes -- porphyritic rhyolite								
A6502	yellow brown FeOx stained rock slightly cleaved	810E/1000N	50	20	115	x	26.0 / 150	15	
	& porous texture								
									Ba specimen
A6534	Red-yellow brown rock, much fractured and	1200E 836N	80	20	150	x	2.15 /	2	50 stored
	weathered, Mn and limonite (boxwork) lined								
	fractures								

M.P. - FORM 2

5 cm

258081

077

APPENDIX V

PETROGRAPHY

258082

078

Central Mineralogical Services

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

The Resident Geologist
AMAX Exploration (Aust.) Inc.
5, Osborne Avenue
LAUNCESTON / TAS. 7250

15th February, 1984

REPORT CMS 84/1/29

YOUR REFERENCE:	Submission Sheet Ref. 24 - 1 - 84
DATE RECEIVED:	25th January, 1984
SAMPLE NOS.:	10 Samples
SUBMITTED BY:	---
WORK REQUESTED:	Petrology

H.W. Fander, M. Sc.

073

REPORT CMS 84/1/29

Ten rock samples were received for petrological study; thin-sections were prepared of all rocks, with an extra section for A 6482, which consisted of two different rock types. The offcuts were subjected to potash stain tests as routine procedure, to aid identification of K-feldspars or K-silicate glass, and to assist interpretations. The rocks are briefly described in the accompanying tables.

Summary

The suite comprises igneous rocks, one or two tuffs, and a possible altered greywacke; the rocks are affected by varying degrees of alteration, which determines, to some extent, the level of confidence of interpretations.

The igneous rocks include intrusive porphyritic rhyolites and felsites, two rather strange ?hybrid types, a meta-rhyolite, and a completely argillised "porphyry". Classification of these rocks relies heavily on ratios of feldspar species present and, since some of these are argillised or sericitised, the classifications are necessarily broad. Samples A 6484 and A 6491A are classified as intermediate, but both are believed to be hybrids resulting from the mixing of acid and basic material.

The tuffs comprise a fairly well-defined lithic-crystal tuff (A 6476) and a rock (A 6490A) which may be a reworked tuff or volcanomict sandstone rather than a true pyroclastic.

The "altered greywacke" may be tuffaceous in part, or may contain clastic particles of fine tuff/ash, but is really too severely altered for a confident interpretation.

No sulphides were detected, though the deuteric alteration affecting many of the rocks may well be accompanied by pyrite and/or other sulphides.

H.W. Fander, M. Sc.

258084

258085

CENTRAL MINERALOGICAL SERVICES 080

Sample No.	Rock Type - Composition	Fabric	Minor Minerals	Comments
A6471 (T.S. 48784)	Porphyritic Rhyolite. Phenocrysts of orthoclase and of corroded quartz, in a groundmass of fine felted plagioclase needles and shreds of chloritised biotite with quartz.	Phenocrysts up to 5 mm; groundmass uniform, faintly orientated, fine-grained.	Small vugs filled with clear K-feldspar (adularia), chlorite. Leucoxenised opaques.	Feldspar phenocrysts partly sericitised. Parts of rock brown due to oxidation of chlorite. Rock is intrusive, could be a rhyodacite (toscanite).
A6472	Argillised Porphyritic Felsite. Completely argillised feldspar phenocrysts, a few small corroded quartz phenocrysts, in an argillised felsitic groundmass of quartz and sericite.	Relict medium-grained felsitic textures. Some phenocrysts are fragmentary. Random fabric.	Fine oxidised mica (?biotite-chlorite). Quartz veins. Pervasive Fe-staining.	Argillic alteration is low-temperature hydrothermal. Rock broadl similar to A6471, also intrusive, but exact composition not known.
A6473	Porphyritic Rhyolite. Completely sericitised feldspar phenocrysts, embayed quartz crystals, a few K-feldspar crystals, in a fine felted K-feldspar groundmass with chlorite.	Matted-parallel textures with overprint of felsitic patches. Random phenocrysts.	A few chloritised ?hornblende crystals. Matted chlorite aggregates (deuteric). Fe-staining.	Selective sericitisation/chloritisation of plagioclase phenocrysts. Rock perhaps closer to quartz-trachyte than rhyolite. Probably intrusive.
A6476	Lithic-Crystal Tuff. Small and large fragments of altered intermediate lavas and of vitric tuffs, crystals and fragments of andesine, augite, quartz, K-feldspar. Chloritised matrix.	Poorly-sorted, weakly bedded. Lithic fragments up to 15 mm, i.e. lapilli size.	Fragments of chloritised basic glass. Fine carbonate associated with chloritisation.	Source rocks mostly intermediate to basic, coarsely-crystalline, but lithic fragments much more diverse. Post-depositional chloritisation.
A6478	Porphyritic Rhyolite. Small phenocrysts of quartz and of albite, generally in clusters set in a fine felsitic, cloudy groundmass of quartz and K-feldspar, with fine chlorite.	Phenocrysts are strongly stressed. Parts of groundmass have fine glassy/shard-like textures.	Patches and veinlets of fine granular epidote. Leucoxenised primary opaques.	May be extrusive, as suggested by groundmass textures. Composition was sodi-potassic, may be related to A6473. Epidote is deuteric.
A6481	Sheared, Altered ?Greywacke. Closely-packed small stretched ovoid grains of impure chert, shale, carbonaceous siltstone and shale; interstitial fine quartz, limonitic clay, mica flakes.	Well-sorted;clastic textures preserved. Well-bedded with superimposed shearing.	Crosscutting goethite veinlets.	Rock is severely altered and most components difficult to recognise, but grains apparently mostly sedimentary rocks, with possible reworked ?tuffs.
A6482A	Metarhyolite. Stressed, fractured quartz and sericitised feldspar phenocrysts in a schistose groundmass of fine sericite flakes, quartz splinters, and ultrafine leucoxene.	Strongly schistose, with stressed phenocrysts. Possible relict flow-banding.	Selective iron-staining of some patches, ?altered biotite.	Rock was broadly rhyolitic. Feldspar phenocrysts were sericitised after shearing, though groundmass already altered (before shearing).
A6482B	Altered Porphyry. Scattered argillised, ferruginised feldspar phenocrysts, whole and fragmentary quartz crystals, in a groundmass of clays and limonite, ultrafine hematite.	Random distribution and orientation of phenocrysts. Strutureless groundmass.	Isolated, relatively large euhedral zircon crystals.	Poorly-preserved relict features suggest a medium-grained intrusive of acid composition. Contrasts with A. No shearing.

258086

CENTRAL MINERALOGICAL SERVICES 081

Sample No.	Rock Type - Composition	Fabric	Minor Minerals	Comments
A6484	Tonalite. Fairly closely-packed phenocrysts of partly argillised andesine, partly uralitised augite; medium-grained interstitial granular quartz (20 %), K-feldspar (10 %).	Phenocrysts up to 5 mm. Random orientation. Groundmass averages 0.3 mm grainsize.	Conspicuous primary magnetite. Secondary chlorite and epidote. Apatite.	Quite possibly a hybrid rock, composed of a coarse gabbroic assemblage and a late, finer-grained granitic assemblage. Overall composition is tonalitic.
A6490A	"Crystal Tuff". Composed mainly of subangular oligoclase-andesine fragments, with minor rounded quartz, lithic grains (rhyolite cp. A6478, others), augite; chloritised throughout.	Closely-packed; well-sorted, but lithic grains generally coarser. Weakly bedded.	Fine pale green clinozoisite throughout. Detrital, leucoxenised opaques.	May not be a true tuff, but rather reworked material, i.e. volcanomict sandstone; main source was rock similar to A 6484.
A6491A (T.S. 48793)	Altered Porphyritic ?Andesite. Phenocrysts of andesine, augite, chloritised ?orthopyroxene or olivine, in a very fine cloudy felsitic groundmass (now secondary quartz).	Some flow-orientation of phenocrysts and groundmass. Phenocrysts are corroded.	A few strongly corroded quartz phenocrysts or xenocrysts. Leucoxenised oxide opaques.	Believed to be a hybrid rock, perhaps extrusive, composed of mafic and intermediate/acid assemblages (cp. A6484). Deuterically altered.

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APPENDIX VI

DIGHEM III SURVEY OF SHEFFIELD AREA, TASMANIA

REPORT NO. 368

258088 REPORT NO. 368

083

DIGHEM^{III} SURVEY

OF THE

SHEFFIELD AREA, TASMANIA

FOR

AMAX AUSTRALIA LTD.

BY

DIGHEM LIMITED

TORONTO, CANADA
MARCH 6, 1984

D.C. FRASER
PRESIDENT

084

258089

SUMMARY AND RECOMMENDATIONS

A total of 360 km of survey was flown in January 1984, over a property held by Amax Australia Ltd. near Sheffield, Tasmania.

The survey outlined a few weak bedrock conductors associated with areas of low resistivity. These anomalies may warrant further investigation using appropriate surface exploration techniques. The resistivity map may also yield target areas for exploration when the maps are compared to known geological and/or geochemical information. Due to the numerous cultural features in the survey area, any interpreted bedrock conductors, which occur close to cultural sources, should be confirmed as bedrock conductors prior to drilling.

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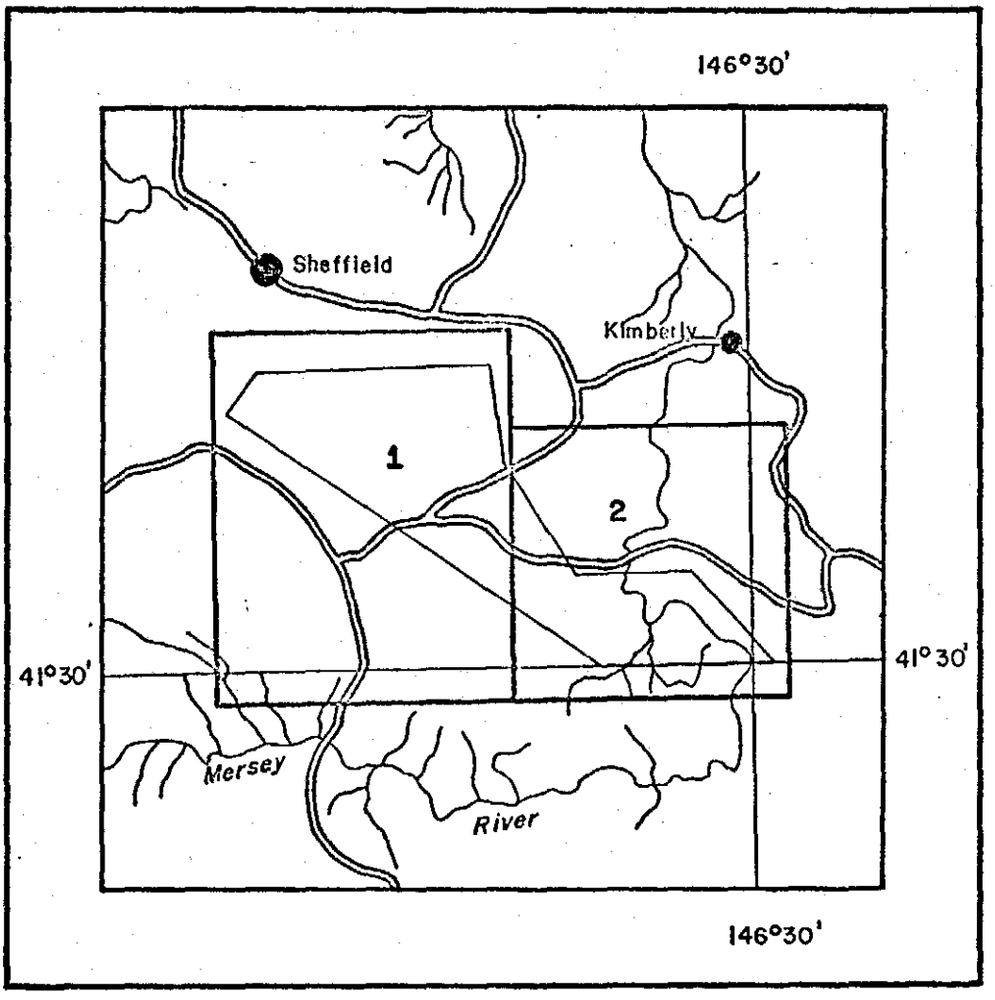
LOCATION MAP



Scale 1 : 250,000

Figure 1

The Survey Area

5 cm

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INTRODUCTION

A DIGHEM^{III} survey totalling 360 line-km was flown with a 250 m line-spacing for Amax Australia Ltd., from January 6 to 7, 1984, in the Sheffield area of Tasmania (Figure 1).

The VH-BQT Lama turbine helicopter flew at an average airspeed of 115 km/h with an EM bird height of approximately 42 m. Ancillary equipment consisted of a Sonotek PMH 5010 magnetometer with its bird at an average height of 27 m, a Sperry radio altimeter, a Geocam sequence camera, RMS GR33 analog recorder, Sonotek SDS 1200 digital data acquisition system and a DigiData 1130 9-track 800-bpi magnetic tape recorder. The analog equipment recorded four channels of EM data at approximately 900 Hz, two channels of EM data at approximately 7200 Hz, two ambient EM noise channels (for the coaxial and coplanar receivers), two channels of magnetics (coarse and fine count), and a channel of radio altitude. The digital equipment recorded the EM data with a sensitivity of 0.2 ppm and the magnetic field to one nT.

Appendix A provides details on the data channels, their respective sensitivities, and the flight path recovery procedure. Noise levels of less than 2 ppm are generally maintained for wind speeds up to 35 km/h. Higher winds may cause the system to be grounded because excessive

bird swinging produces difficulties in flying the helicopter. The swinging results from the 5 m^2 of area which is presented by the bird to broadside gusts. The DIGHEM system nevertheless can be flown under wind conditions that seriously degrade other AEM systems.

It should be noted that the anomalies shown on the electromagnetic anomaly map are based on a near-vertical, half plane model. This model best reflects "discrete" bedrock conductors. Wide bedrock conductors or flat-lying conductive units, whether from surficial or bedrock sources, may give rise to very broad anomalous responses on the EM profiles. These may not appear on the electromagnetic anomaly map if they have a regional character rather than a locally anomalous character. These broad conductors, which more closely approximate a half space model, will be maximum coupled to the horizontal (coplanar) coil-pair and are clearly evident on the resistivity map. The resistivity map, therefore, may be more valuable than the electromagnetic anomaly map, in areas where broad or flat-lying conductors are considered to be of importance.

In areas where magnetite causes the inphase components to become negative, the apparent conductance and depth of EM anomalies may be unreliable.

SECTION I: SURVEY RESULTS

CONDUCTORS IN THE SURVEY AREA

The survey covered an elongated grid with 360 km of flying, the results of which are shown on two map sheets. Table I-1 summarizes the EM responses on the these sheets with respect to conductance grade and interpretation.

The electromagnetic anomaly map shows the anomaly locations with the interpreted conductor shape, conductance and depth being indicated by symbols. Direct magnetic correlation is also shown if it exists. The strike direction and length of the conductors are indicated when anomalies can be correlated from line to line. When studying the map sheets for follow-up planning, consult the anomaly listings appended to this report to ensure that none of the conductors are overlooked.

A number of cultural sources, such as powerlines, metal fences and buildings, occur within the survey area. These cultural sources may influence the resistivity and electromagnetic anomaly patterns but can usually be identified on the profiles due to their characteristic signatures. Such anomalies are identified on the EM maps with the interpretive symbol "L".

TABLE I-1

368 SH.1 SHEFFIELD

CONDUCTOR GRADE	CONDUCTANCE RANGE	NUMBER OF RESPONSES
6	> 99 MHOS	0
5	50-99 MHOS	0
4	20-49 MHOS	6
3	10-19 MHOS	24
2	5- 9 MHOS	52
1	< 5 MHOS	404
X	INDETERMINATE	15
TOTAL		501

CONDUCTOR MODEL	MOST LIKELY SOURCE	NUMBER OF RESPONSES
B	DISCRETE BEDROCK CONDUCTOR	45
H	ROCK UNIT OR THICK COVER	389
E	EDGE OF WIDE CONDUCTOR	11
L	CULTURE	49
?	QUESTIONABLE	2
(BLANK)		5
TOTAL		501

(SEE EM MAP LEGEND FOR EXPLANATIONS)

The survey area primarily yielded broad EM responses from poorly conductive material. These anomalies are characterized on the EM maps by the symbol "H", for half space. The resistivity contour maps portray such broad EM responses in a more appropriate fashion. The resistivity maps are better suited to illustrating conductive trends than the EM maps, for this survey area. Variations within the range of 10 to 8,000 ohm-m occur in the resistivity values.

The half space EM anomalies may reflect thick conductive cover, rock weathering, or simply poorly conductive geologic formations. A good example of the latter is the conductive zone that runs from EM anomaly 37C* to 42E. This zone is moderately resistive (approximately 300 ohm-m) and parallels the magnetic trends. A number of similar low resistivity trends occur which might aid geologic mapping.

The total field magnetic and enhanced magnetic maps are often quite different in this survey area, as each highlights features of a different scale. The magnetic map shows regional trends in a much superior fashion. However, local features and cross-structures are often more evident

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* i.e., anomaly C on Line 37.

on the enhanced map. As an example of the latter, compare the enhanced magnetic trend on sheet 1, from fiducial 3480 on line 17, to fiducial 2486 on line 26. As another example, refer to sheet 2 from fiducial 3243 on line 46, to fiducial 1512 on line 64.

Magnetite within the bedrock has occasionally caused the inphase channels to yield negative responses, e.g., see channel CPI(900)* of line 31. A number of such occurrences indicates that the EM field penetrated the bedrock strongly.

There are no obvious massive sulphide conductors in the survey area. There are, however, a number of possible bedrock conductors which are described below. EM anomalies are characterized by "B" for bedrock, "H" for the broad patterns of a half space, and "L" for culture such as a powerline or fence. The use of "?" as in "B?", "L?", etc., warns that there is some uncertainty in the categorization. The following three ambiguities should be kept in mind when studying the EM maps:

1. The use of "L" indicates that the anomaly has features incompatible with a broad source. The use of this

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* Coplanar inphase at 900 Hz.

symbol shows that we believe the anomaly reflects a culture line source. However, if a field check shows an absence of culture, then the anomaly may well be caused by a broad conductor.

2. The use of "B" indicates that the anomaly has features incompatible with a broad source. The use of this symbol shows that we believe the anomaly reflects a bedrock conductor. However, if a field check shows the presence of culture, then the anomaly probably is caused by it.

3. A fence grounded to conductive ground can "gather" current flowing within the ground. The effect of this current gathering is to make the ground (or half space) simply appear to be more conductive. This can produce anomalies having the appearance of being due to broad conductive features; hence they are often characterized as "H" or "H?". If field follow-up of an "H" or "H?" anomaly shows that it coincides with a fence, then the anomaly reflects both the fence and the underlying conductive ground.

Sheet 1

The great majority of anomalies on sheet 1 are categorized as "H" for half space. The designation "E"

implies the anomaly coincides with the edge of a broad conductor where a conductivity contrast occurs. Both "H" and "E" anomalies are usually not interesting targets but might aid geologic mapping.

A few bedrock conductors may exist. Anomalies designated "B?" are as follows:

Anomaly 5D-9E — The conductor has a length of 1.2 km and has a maximum conductance grade of 2 (meaning its conductivity-thickness product is moderately poor). It coincides with a resistivity low so it is fairly well defined. It parallels trends on both the magnetic and enhanced magnetic maps which reinforces the likelihood of the conductor having a source within the bedrock.

Anomalies 11F-12F, 11G-14I — A pair of conductors exist having strike lengths of 500 and 1,000 m, and a conductance grade of 1. They correlate with a broad resistivity low but run across the trends on

the magnetic map. Consequently, there is a fair possibility that the conductor axes, as tentatively drawn on the EM map, may be incorrect.

Anomalies 26T-27M, 26V-28M — Two conductors, 400 and 800 m in length, have conductance grades of 1. They tend to parallel the enhanced magnetic trends but not the magnetic and resistivity trends.

Anomalies 7B, 11E, 14B, 30C, 30N, 31G — These single-line anomalies are all of conductance grade 1. Anomaly 30C is associated with a well-defined enhanced magnetic anomaly which is not resolved on the magnetic map. There is a possibility that 30C is caused by culture.

The resistivity drops rapidly to 10 ohm-m at the north end of line 34 and on neighbouring lines. The EM responses are quite broad, perhaps indicating that a wide conductive rock unit bounds this portion of the survey area.

Sheet 2

As for sheet 1, most of the anomalies are categorized as "H" for half space. The only possible bedrock targets appear to occur with a low resistivity zone in the northeast quadrant. These are as follows: 65E-68G, 65F-68I, 69G-72D, 70I-71I, 71F, 72E, 731E, 74G-75E, 75B-76D. Conductance grades vary from 1 (poor) to 4 (moderately high). The low resistivity zone encompasses all these conductors. Within this large zone, the resistivity drops to 10 ohm-m, compared to a mean value of perhaps 200 ohm-m outside the zone. The zone probably reflects a large conductive rock unit. The conductors within this unit may consist of horizons with increased conductivity.

A major interference problem occurs in the vicinity of the possible bedrock conductors. This resulted from heavy powerline radiation. Fortunately, the 7200 Hz channels were fairly immune to the radiation, thereby allowing the resistivity to be defined. Nevertheless, the selection and line-to-line correlation of the bedrock anomalies is very tenuous. The correlation in many places does not parallel magnetic trends, rendering such correlations suspect.

SECTION II: BACKGROUND INFORMATION

ELECTROMAGNETICS

DIGHEM electromagnetic responses fall into two general classes, discrete and broad. The discrete class consists of sharp, well-defined anomalies from discrete conductors such as sulfide lenses and steeply dipping sheets of graphite and sulfides. The broad class consists of wide anomalies from conductors having a large horizontal surface such as flatly dipping graphite or sulfide sheets, saline water-saturated sedimentary formations, conductive overburden and rock, and geothermal zones. A vertical conductive slab with a width of 200 m would straddle these two classes.

The vertical sheet (half plane) is the most common model used for the analysis of discrete conductors. All anomalies plotted on the electromagnetic map are analyzed according to this model. The following section entitled **Discrete conductor analysis** describes this model in detail, including the effect of using it on anomalies caused by broad conductors such as conductive overburden.

The conductive earth (half space) model is suitable for broad conductors. Resistivity contour maps result from the

use of this model. A later section entitled **Resistivity mapping** describes the method further, including the effect of using it on anomalies caused by discrete conductors such as sulfide bodies.

Geometric interpretation

The geophysical interpreter attempts to determine the geometric shape and dip of the conductor. This qualitative interpretation of anomalies is indicated on the map by means of interpretive symbols (see EM map legend). Figure II-1 shows typical DIGHEM anomaly shapes and the interpretive symbols for a variety of conductors. These classic curve shapes are used to guide the geometric interpretation.

Discrete conductor analysis

The EM anomalies appearing on the electromagnetic map are analyzed by computer to give the conductance (i.e., conductivity-thickness product) in mhos of a vertical sheet model. This is done regardless of the interpreted geometric shape of the conductor. This is not an unreasonable procedure, because the computed conductance increases as the electrical quality of the conductor increases, regardless of its true shape. DIGHEM anomalies are divided into six

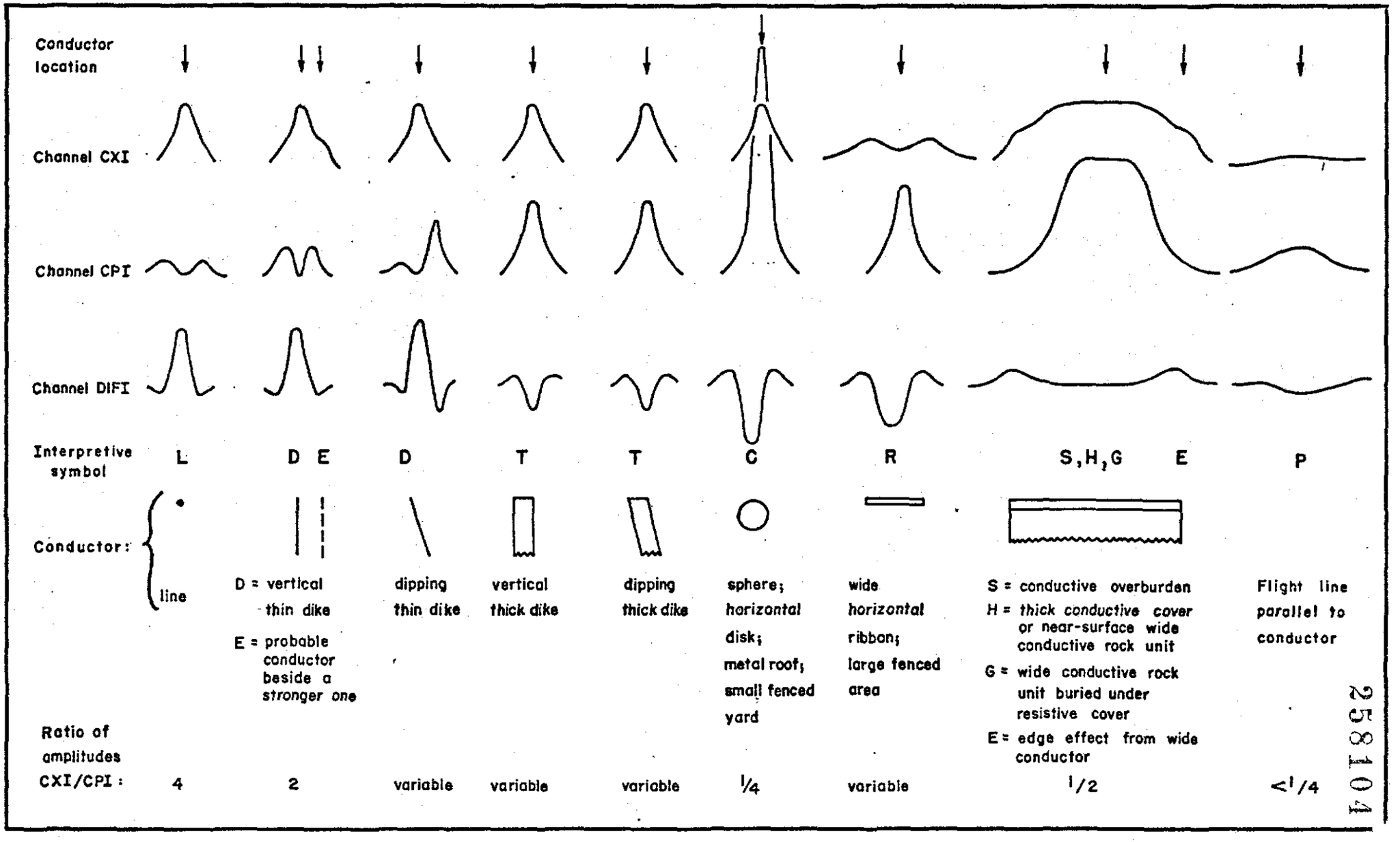

Figure II -1 Typical DIGHEM anomaly shapes

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grades of conductance, as shown in Table II-1. The conductance in mhos is the reciprocal of resistance in ohms.

Table II-1. EM Anomaly Grades

Anomaly Grade	Mho Range
6	> 99
5	50 - 99
4	20 - 49
3	10 - 19
2	5 - 9
1	< 5

The conductance value is a geological parameter because it is a characteristic of the conductor alone; it generally is independent of frequency, and of flying height or depth of burial apart from the averaging over a greater portion of the conductor as height increases.[1] Small anomalies from deeply buried strong conductors are not confused with small anomalies from shallow weak conductors because the former will have larger conductance values.

Conductive overburden generally produces broad EM responses which are not plotted on the EM maps. However, patchy conductive overburden in otherwise resistive areas

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[1] This statement is an approximation. DIGHEM, with its short coil separation, tends to yield larger and more accurate conductance values than airborne systems having a larger coil separation.

can yield discrete anomalies with a conductance grade (cf. Table II-1) of 1, or even of 2 for conducting clays which have resistivities as low as 50 ohm-m. In areas where ground resistivities can be below 10 ohm-m, anomalies caused by weathering variations and similar causes can have any conductance grade. The anomaly shapes from the multiple coils often allow such conductors to be recognized, and these are indicated by the letters S, H, G and sometimes E on the map (see EM legend).

For bedrock conductors, the higher anomaly grades indicate increasingly higher conductances. Examples: DIGHEM's New Insco copper discovery (Noranda, Canada) yielded a grade 4 anomaly, as did the neighbouring copper-zinc Magusi River ore body; Mattabi (copper-zinc, Sturgeon Lake, Canada) and Whistle (nickel, Sudbury, Canada) gave grade 5; and DIGHEM's Montcalm nickel-copper discovery (Timmins, Canada) yielded a grade 6 anomaly. Graphite and sulfides can span all grades but, in any particular survey area, field work may show that the different grades indicate different types of conductors.

Strong conductors (i.e., grades 5 and 6) are characteristic of massive sulfides or graphite. Moderate conductors (grades 3 and 4) typically reflect sulfides of a less massive character or graphite, while weak bedrock conductors

(grades 1 and 2) can signify poorly connected graphite or heavily disseminated sulfides. Grade 1 conductors may not respond to ground EM equipment using frequencies less than 2000 Hz.

The presence of sphalerite or gangue can result in ore deposits having weak to moderate conductances. As an example, the three million ton lead-zinc deposit of Restigouche Mining Corporation near Bathurst, Canada, yielded a well defined grade 1 conductor. The 10 percent by volume of sphalerite occurs as a coating around the fine grained massive pyrite, thereby inhibiting electrical conduction.

Faults, fractures and shear zones may produce anomalies which typically have low conductances (e.g., grades 1 and 2). Conductive rock formations can yield anomalies of any conductance grade. The conductive materials in such rock formations can be salt water, weathered products such as clays, original depositional clays, and carbonaceous material.

On the electromagnetic map, a letter identifier and an interpretive symbol are plotted beside the EM grade symbol. The horizontal rows of dots, under the interpretive symbol, indicate the anomaly amplitude on the flight record. The

vertical column of dots, under the anomaly letter, gives the estimated depth. In areas where anomalies are crowded, the letter identifiers, interpretive symbols and dots may be obliterated. The EM grade symbols, however, will always be discernible, and the obliterated information can be obtained from the anomaly listing appended to this report.

The purpose of indicating the anomaly amplitude by dots is to provide an estimate of the reliability of the conductance calculation. Thus, a conductance value obtained from a large ppm anomaly (3 or 4 dots) will tend to be accurate whereas one obtained from a small ppm anomaly (no dots) could be quite inaccurate. The absence of amplitude dots indicates that the anomaly from the coaxial coil-pair is 5 ppm or less on both the inphase and quadrature channels. Such small anomalies could reflect a weak conductor at the surface or a stronger conductor at depth. The conductance grade and depth estimate illustrates which of these possibilities fits the recorded data best.

Flight line deviations occasionally yield cases where two anomalies, having similar conductance values but dramatically different depth estimates, occur close together on the same conductor. Such examples illustrate the reliability of the conductance measurement while showing that the depth estimate can be unreliable. There are a

number of factors which can produce an error in the depth estimate, including the averaging of topographic variations by the altimeter, overlying conductive overburden, and the location and attitude of the conductor relative to the flight line. Conductor location and attitude can provide an erroneous depth estimate because the stronger part of the conductor may be deeper or to one side of the flight line, or because it has a shallow dip. A heavy tree cover can also produce errors in depth estimates. This is because the depth estimate is computed as the distance of bird from conductor, minus the altimeter reading. The altimeter can lock onto the top of a dense forest canopy. This situation yields an erroneously large depth estimate but does not affect the conductance estimate.

Dip symbols are used to indicate the direction of dip of conductors. These symbols are used only when the anomaly shapes are unambiguous, which usually requires a fairly resistive environment.

A further interpretation is presented on the EM map by means of the line-to-line correlation of anomalies, which is based on a comparison of anomaly shapes on adjacent lines. This provides conductor axes which may define the geological structure over portions of the survey area. The absence of

conductor axes in an area implies that anomalies could not be correlated from line to line with reasonable confidence.

DIGHEM electromagnetic maps are designed to provide a correct impression of conductor quality by means of the conductance grade symbols. The symbols can stand alone with geology when planning a follow-up program. The actual conductance values are printed in the attached anomaly list for those who wish quantitative data. The anomaly ppm and depth are indicated by inconspicuous dots which should not distract from the conductor patterns, while being helpful to those who wish this information. The map provides an interpretation of conductors in terms of length, strike and dip, geometric shape, conductance, depth, and thickness (see below). The accuracy is comparable to an interpretation from a high quality ground EM survey having the same line spacing.

The attached EM anomaly list provides a tabulation of anomalies in ppm, conductance, and depth for the vertical sheet model. The EM anomaly list also shows the conductance and depth for a thin horizontal sheet (whole plane) model, but only the vertical sheet parameters appear on the EM map. The horizontal sheet model is suitable for a flatly dipping thin bedrock conductor such as a sulfide sheet having a thickness less than 10 m. The list also shows the

resistivity and depth for a conductive earth (half space) model, which is suitable for thicker slabs such as thick conductive overburden. In the EM anomaly list, a depth value of zero for the conductive earth model, in an area of thick cover, warns that the anomaly may be caused by conductive overburden.

Since discrete bodies normally are the targets of EM surveys, local base (or zero) levels are used to compute local anomaly amplitudes. This contrasts with the use of true zero levels which are used to compute true EM amplitudes. Local anomaly amplitudes are shown in the EM anomaly list and these are used to compute the vertical sheet parameters of conductance and depth. Not shown in the EM anomaly list are the true amplitudes which are used to compute the horizontal sheet and conductive earth parameters.

X-type electromagnetic responses

DIGHEM maps contain x-type EM responses in addition to EM anomalies. An x-type response is below the noise threshold of 3 ppm, and reflects one of the following: a weak conductor near the surface, a strong conductor at depth (e.g., 100 to 120 m below surface) or to one side of the flight line, or aerodynamic noise. Those responses that

have the appearance of valid bedrock anomalies on the flight profiles are indicated by appropriate interpretive symbols (see EM map legend). The others probably do not warrant further investigation unless their locations are of considerable geological interest.

The thickness parameter

DIGHEM can provide an indication of the thickness of a steeply dipping conductor. The amplitude of the coplanar anomaly (e.g., CPI) increases relative to the coaxial anomaly (e.g., CXI) as the apparent thickness increases, i.e., the thickness in the horizontal plane. (The thickness is equal to the conductor width if the conductor dips at 90 degrees and strikes at right angles to the flight line.) This report refers to a conductor as thin when the thickness is likely to be less than 3 m, and thick when in excess of 10 m. Thin conductors are indicated on the EM map by the interpretive symbol "D", and thick conductors by "T". For base metal exploration in steeply dipping geology, thick conductors can be high priority targets because many massive sulfide ore bodies are thick, whereas non-economic bedrock conductors are often thin. The system cannot sense the thickness when the strike of the conductor is subparallel to the flight line, when the conductor has a shallow dip, when

the anomaly amplitudes are small, or when the resistivity of the environment is below 100 ohm-m.

Resistivity mapping

Areas of widespread conductivity are commonly encountered during surveys. In such areas, anomalies can be generated by decreases of only 5 m in survey altitude as well as by increases in conductivity. The typical flight record in conductive areas is characterized by inphase and quadrature channels which are continuously active. Local EM peaks reflect either increases in conductivity of the earth or decreases in survey altitude. For such conductive areas, apparent resistivity profiles and contour maps are necessary for the correct interpretation of the airborne data. The advantage of the resistivity parameter is that anomalies caused by altitude changes are virtually eliminated, so the resistivity data reflect only those anomalies caused by conductivity changes. The resistivity analysis also helps the interpreter to differentiate between conductive trends in the bedrock and those patterns typical of conductive overburden. For example, discrete conductors will generally appear as narrow lows on the contour map and broad conductors (e.g., overburden) will appear as wide lows.

The resistivity profile (see table in Appendix A) and the resistivity contour map present the apparent resistivity using the so-called pseudo-layer (or buried) half space model defined in Fraser (1978)[2]. This model consists of a resistive layer overlying a conductive half space. The depth channel (see Appendix A) gives the apparent depth below surface of the conductive material. The apparent depth is simply the apparent thickness of the overlying resistive layer. The apparent depth (or thickness) parameter will be positive when the upper layer is more resistive than the underlying material, in which case the apparent depth may be quite close to the true depth.

The apparent depth will be negative when the upper layer is more conductive than the underlying material, and will be zero when a homogeneous half space exists. The apparent depth parameter must be interpreted cautiously because it will contain any errors which may exist in the measured altitude of the EM bird (e.g., as caused by a dense tree cover). The inputs to the resistivity algorithm are the inphase and quadrature components of the coplanar coil-pair. The outputs are the apparent resistivity of the

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[2] Resistivity mapping with an airborne multicoil electromagnetic system: Geophysics, v. 43, p. 144-172.

conductive half space (the source) and the sensor-source distance. The flying height is not an input variable, and the output resistivity and sensor-source distance are independent of the flying height. The apparent depth, discussed above, is simply the sensor-source distance minus the measured altitude or flying height. Consequently, errors in the measured altitude will affect the apparent depth parameter but not the apparent resistivity parameter.

The apparent depth parameter is a useful indicator of simple layering in areas lacking a heavy tree cover. The DIGHEM system has been flown for purposes of permafrost mapping, where positive apparent depths were used as a measure of permafrost thickness. However, little quantitative use has been made of negative apparent depths because the absolute value of the negative depth is not a measure of the thickness of the conductive upper layer and, therefore, is not meaningful physically. Qualitatively, a negative apparent depth estimate usually shows that the EM anomaly is caused by conductive overburden. Consequently, the apparent depth channel can be of significant help in distinguishing between overburden and bedrock conductors.

The resistivity map often yields more useful information on conductivity distributions than the EM map. In

comparing the EM and resistivity maps, keep in mind the following:

(a) The resistivity map portrays the absolute value of the earth's resistivity. (Resistivity = 1/conductivity.)

(b) The EM map portrays anomalies in the earth's resistivity. An anomaly by definition is a change from the norm and so the EM map displays anomalies, (i) over narrow, conductive bodies and (ii) over the boundary zone between two wide formations of differing conductivity.

The resistivity map might be likened to a total field map and the EM map to a horizontal gradient in the direction of flight[3]. Because gradient maps are usually more sensitive than total field maps, the EM map therefore is to be preferred in resistive areas. However, in conductive areas, the absolute character of the resistivity map usually causes it to be more useful than the EM map.

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[3] The gradient analogy is only valid with regard to the identification of anomalous locations.

Interpretation in conductive environments

Environments having background resistivities below 30 ohm-m cause all airborne EM systems to yield very large responses from the conductive ground. This usually prohibits the recognition of discrete bedrock conductors. The processing of DIGHEM data, however, produces six channels which contribute significantly to the recognition of bedrock conductors. These are the inphase and quadrature difference channels (DIFI and DIFQ), and the resistivity and depth channels (RES and DP) for each coplanar frequency; see table in Appendix A.

The EM difference channels (DIFI and DIFQ) eliminate up to 99% of the response of conductive ground, leaving responses from bedrock conductors, cultural features (e.g., telephone lines, fences, etc.) and edge effects. An edge effect arises when the conductivity of the ground suddenly changes, and this is a source of geologic noise. While edge effects yield anomalies on the EM difference channels, they do not produce resistivity anomalies. Consequently, the resistivity channel aids in eliminating anomalies due to edge effects. On the other hand, resistivity anomalies will coincide with the most highly conductive sections of conductive ground, and this is another source of geologic

noise. The recognition of a bedrock conductor in a conductive environment therefore is based on the anomalous responses of the two difference channels (DIFI and DIFQ) and the two resistivity channels (RES). The most favourable situation is where anomalies coincide on all four channels.

The DP channels, which give the apparent depth to the conductive material, also help to determine whether a conductive response arises from surficial material or from a conductive zone in the bedrock. When these channels ride above the zero level on the electrostatic chart paper (i.e., depth is negative), it implies that the EM and resistivity profiles are responding primarily to a conductive upper layer, i.e., conductive overburden. If both DP channels are below the zero level, it indicates that a resistive upper layer exists, and this usually implies the existence of a bedrock conductor. If the low frequency DP channel is below the zero level and the high frequency DP is above, this suggests that a bedrock conductor occurs beneath conductive cover.

Channels REC1, REC2, REC3 and REC4 are the anomaly recognition functions. They are used to trigger the conductance channel CDT which identifies discrete conductors. In highly conductive environments, channel REC2

is deactivated because it is subject to corruption by highly conductive earth signals. Similarly, in moderately conductive environments, REC4 is deactivated. Some of the automatically selected anomalies (channel CDT) are discarded by the geophysicist. The automatic selection algorithm is intentionally oversensitive to assure that no meaningful responses are missed. The interpreter then classifies the anomalies according to their source and eliminates those that are not substantiated by the data, such as those arising from geologic or aerodynamic noise.

Reduction of geologic noise

Geologic noise refers to unwanted geophysical responses. For purposes of airborne EM surveying, geologic noise refers to EM responses caused by conductive overburden and magnetic permeability. It was mentioned above that the EM difference channels (i.e., channel DIFI for inphase and DIFQ for quadrature) tend to eliminate the response of conductive overburden. This marked a unique development in airborne EM technology, as DIGHEM is the only EM system which yields channels having an exceptionally high degree of immunity to conductive overburden.

Magnetite produces a form of geological noise on the inphase channels of all EM systems. Rocks containing less than 1% magnetite can yield negative inphase anomalies caused by magnetic permeability. When magnetite is widely distributed throughout a survey area, the inphase EM channels may continuously rise and fall reflecting variations in the magnetite percentage, flying height, and overburden thickness. This can lead to difficulties in recognizing deeply buried bedrock conductors, particularly if conductive overburden also exists. However, the response of broadly distributed magnetite generally vanishes on the inphase difference channel DIFI. This feature can be a significant aid in the recognition of conductors which occur in rocks containing accessory magnetite.

EM magnetite mapping

The information content of DIGHEM data consists of a combination of conductive eddy current response and magnetic permeability response. The secondary field resulting from conductive eddy current flow is frequency-dependent and consists of both inphase and quadrature components, which are positive in sign. On the other hand, the secondary field resulting from magnetic permeability is independent of frequency and consists of only an inphase component which

is negative in sign. When magnetic permeability manifests itself by decreasing the measured amount of positive inphase, its presence may be difficult to recognize. However, when it manifests itself by yielding a negative inphase anomaly (e.g., in the absence of eddy current flow), its presence is assured. In this latter case, the negative component can be used to estimate the percent magnetite content.

A magnetite mapping technique was developed for the coplanar coil-pair of DIGHEM. The technique yields channel "FEO" (see Appendix A) which displays apparent weight percent magnetite according to a homogeneous half space model.[4] The method can be complementary to magnetometer mapping in certain cases. Compared to magnetometry, it is far less sensitive but is more able to resolve closely spaced magnetite zones, as well as providing an estimate of the amount of magnetite in the rock. The method is sensitive to 1/4% magnetite by weight when the EM sensor is at a height of 30 m above a magnetitic half space. It can individually resolve steeply dipping narrow magnetite-rich bands which are separated by 60 m. Unlike magnetometry, the EM magnetite method is unaffected by remanent magnetism or magnetic latitude.

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[4] Refer to Fraser, 1981, Magnetite mapping with a multi-coil airborne electromagnetic system: Geophysics, v. 46, p. 1579-1594.

The EM magnetite mapping technique provides estimates of magnetite content which are usually correct within a factor of 2 when the magnetite is fairly uniformly distributed. EM magnetite maps can be generated when magnetic permeability is evident as indicated by anomalies in the magnetite channel FEO.

Like magnetometry, the EM magnetite method maps only bedrock features, provided that the overburden is characterized by a general lack of magnetite. This contrasts with resistivity mapping which portrays the combined effect of bedrock and overburden.

Recognition of culture

Cultural responses include all EM anomalies caused by man-made metallic objects. Such anomalies may be caused by inductive coupling or current gathering. The concern of the interpreter is to recognize when an EM response is due to culture. Points of consideration used by the interpreter, when coaxial and coplanar coil-pairs are operated at a common frequency, are as follows:

1. Channels CXS and CPS (see Appendix A) measure 50 and 60 Hz radiation. An anomaly on these channels shows

that the conductor is radiating cultural power. Such an indication is normally a guarantee that the conductor is cultural. However, care must be taken to ensure that the conductor is not a geologic body which strikes across a power line, carrying leakage currents.

2. A flight which crosses a line (e.g., fence, telephone line, etc.) yields a center-peaked coaxial anomaly and an m-shaped coplanar anomaly.[5] When the flight crosses the cultural line at a high angle of intersection, the amplitude ratio of coaxial/coplanar (e.g., CXI/CPI) is 4. Such an EM anomaly can only be caused by a line. The geologic body which yields anomalies most closely resembling a line is the vertically dipping thin dike. Such a body, however, yields an amplitude ratio of 2 rather than 4. Consequently, an m-shaped coplanar anomaly with a CXI/CPI amplitude ratio of 4 is virtually a guarantee that the source is a cultural line.

3. A flight which crosses a sphere or horizontal disk yields center-peaked coaxial and coplanar anomalies with a CXI/CPI amplitude ratio (i.e., coaxial/coplanar) of 1/4. In the absence of geologic bodies of this geometry, the most likely conductor is a metal roof or

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5 See Figure II-1 presented earlier.

small fenced yard.[4] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

4. A flight which crosses a horizontal rectangular body or wide ribbon yields an m-shaped coaxial anomaly and a center-peaked coplanar anomaly. In the absence of geologic bodies of this geometry, the most likely conductor is a large fenced area.[4] Anomalies of this type are virtually certain to be cultural if they occur in an area of culture.

5. EM anomalies which coincide with culture, as seen on the camera film, are usually caused by culture. However, care is taken with such coincidences because a geologic conductor could occur beneath a fence, for example. In this example, the fence would be expected to yield an m-shaped coplanar anomaly as in case #2 above. If, instead, a center-peaked coplanar anomaly occurred, there would be concern that a thick geologic conductor coincided with the cultural line.

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[4] It is a characteristic of EM that geometrically identical anomalies are obtained from: (1) a planar conductor, and (2) a wire which forms a loop having dimensions identical to the perimeter of the equivalent planar conductor.

6. The above description of anomaly shapes is valid when the culture is not conductively coupled to the environment. In this case, the anomalies arise from inductive coupling to the EM transmitter. However, when the environment is quite conductive (e.g., less than 100 ohm-m at 900 Hz), the cultural conductor may be conductively coupled to the environment. In this latter case, the anomaly shapes tend to be governed by current gathering. Current gathering can completely distort the anomaly shapes, thereby complicating the identification of cultural anomalies. In such circumstances, the interpreter can only rely on the radiation channels CXS and CPS, and on the camera film.

TOTAL FIELD MAGNETICS

The existence of a magnetic correlation with an EM anomaly is indicated directly on the EM map. An EM anomaly with magnetic correlation has a greater likelihood of being produced by sulfides than one that is non-magnetic. However, sulfide ore bodies may be non-magnetic (e.g., the Kidd Creek deposit near Timmins, Canada) as well as magnetic (e.g., the Mattabi deposit near Sturgeon Lake, Canada).

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH*. M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 27	(FLIGHT 4)											
M 2341 B?	2	11	1	15	76	86	1	0	1	42	172	5
N 2330 H?	5	13	5	15	76	20	3	0	1	34	103	0
O 2324 B?	5	26	9	29	147	163	2	0	1	28	88	0
P 2320 H?	2	14	6	25	38	110	1	0	1	40	219	2
LINE 28	(FLIGHT 4)											
A 2185 H	3	9	8	17	59	51	3	16	1	69	78	36
B 2194 H	0	3	0	6	27	41	1	10	1	48	118	29
C 2201 H	2	5	5	11	45	36	2	13	1	51	56	35
D 2219 H	0	3	0	6	29	43	1	0	1	29	329	6
F 2232 H	1	4	1	7	34	38	1	6	1	37	169	16
G 2244 H	1	16	5	33	137	202	2	0	1	17	82	4
H 2253 E	2	23	5	39	159	246	1	0	1	28	156	1
I 2262 H	2	11	5	2	33	83	2	11	1	33	64	6
J 2273 H	0	7	3	14	72	48	3	0	1	21	24	10
K 2276 H	4	11	12	20	45	52	4	0	2	37	44	10
L 2282 H	0	6	4	12	48	47	2	11	1	52	67	36
M 2291 B?	1	6	2	9	38	41	1	1	1	50	286	7
N 2295 H	0	4	0	6	15	54	1	0	1	25	380	2
LINE 291	(FLIGHT 4)											
A 2175 H	2	9	4	15	54	103	1	5	1	35	89	19
B 2163 H	0	4	2	7	35	36	2	7	1	66	98	46
D 2146 H	0	2	0	2	8	23	1	3	1	121	1035	0
E 2143 H	0	2	0	3	10	30	1	8	1	29	753	3
F 2136 H	0	6	1	8	36	71	1	0	1	21	178	2
G 2128 H	2	17	3	23	95	161	1	2	1	14	405	0
H 2100 H	4	8	12	17	61	38	3	4	1	32	41	18
J 2089 H	6	9	12	21	60	41	3	0	1	24	31	12
N 2064 L	134	138	133	131	280	266	22	0	5	19	6	5
LINE 30	(FLIGHT 4)											
A 1824 H	2	8	6	14	68	65	2	22	1	67	163	28
B 1840 H?	3	9	5	18	76	63	2	15	1	61	274	19
C 1869 B?	6	19	7	13	72	100	3	3	1	35	168	2
D 1878 H	3	6	1	13	50	79	1	7	1	21	181	4
F 1889 L	9	10	12	18	35	14	7	19	1	62	168	22
H 1896 H	2	10	2	17	73	130	1	0	1	18	114	3
K 1919 L?	9	29	21	45	150	138	3	0	1	17	12	8
L 1921 H	7	22	15	33	155	132	4	0	1	24	64	0
N 1933 B?	8	15	12	41	144	103	4	12	2	50	38	26

.* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 30	(FLIGHT 4)											
Q 1943 H	7	13	14	30	78	40	4	0	2	33	41	7
R 1948 L	140	138	137	142	313	300	22	0	5	0	6	0
LINE 31	(FLIGHT 4)											
A 1808 H	2	5	2	10	44	38	2	15	1	54	102	36
B 1801 H	1	2	0	4	16	31	1	0	1	33	244	10
E 1757 L	0	6	0	8	7	81	1	0	1	47	765	0
F 1749 H	1	6	0	12	56	97	1	0	1	20	147	3
G 1736 B?	4	25	10	38	65	170	2	0	1	25	164	0
H 1734 L?*	6	12	4	38	65	91	2	0	1	31	87	2
I 1727 H	2	11	4	19	81	55	3	0	1	25	24	13
J 1718 H	9	18	15	34	108	73	4	0	2	31	34	8
K 1712 H	8	16	10	23	67	77	2	1	1	36	58	21
L 1709 L	115	112	112	105	234	224	22	0	5	0	6	0
LINE 32	(FLIGHT 4)											
A 1487 H	2	3	1	7	26	39	1	6	1	49	243	25
B 1489 H	0	2	1	4	13	29	1	18	1	54	229	31
C 1502 H	1	4	3	6	25	31	1	0	1	28	102	10
D 1519 H	1	9	1	14	43	123	1	0	1	18	169	1
E 1527 H	0	12	1	23	86	125	1	2	1	16	140	1
F 1549 L	1	6	0	2	8	4	1	8	1	83	863	6
H 1561 L	24	41	3	20	77	102	5	7	1	23	359	0
I 1575 L	10	31	15	4	45	104	5	10	1	30	89	3
K 1584 H	24	16	63	66	83	47	17	0	3	24	11	8
M 1594 H	4	19	0	46	90	155	1	0	1	26	91	0
N 1600 L	152	157	157	160	351	280	23	0	5	9	6	0
LINE 33	(FLIGHT 4)											
A 1465 H	1	2	2	6	27	24	2	8	1	35	182	13
B 1455 H	1	19	3	33	129	222	1	0	1	17	76	3
C 1441 H	0	3	1	6	19	54	1	0	1	22	239	2
D 1431 H	0	5	1	7	31	61	1	0	1	23	264	1
E 1420 H	2	2	3	15	47	79	2	19	1	36	685	0
F 1410 L	1	16	6	16	25	108	1	0	1	34	209	0
G 1408 H?	4	16	1	18	65	70	2	2	1	21	106	5
H 1397 L	9	27	1	15	44	137	2	4	1	37	663	0
I 1395 H	2	7	1	15	28	137	1	0	1	21	250	3
J 1384 H?	16	27	40	42	111	43	9	0	3	29	13	11
LINE 34	(FLIGHT 4)											
A 1282 H	0	2	1	3	6	27	1	0	1	33	1482	0

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 34	(FLIGHT 4)											
D 1306 H	0	3	1	6	29	27	2	24	1	56	106	38
E 1311 H	1	4	3	5	22	26	1	0	1	36	159	15
F 1329 H	1	3	1	6	16	56	1	7	1	41	532	15
G 1336 H	0	6	0	9	37	71	1	0	1	18	295	0
J 1357 H?	1	11	2	16	54	119	1	0	1	18	167	0
M 1369 H	0	5	0	12	19	112	1	0	1	22	345	1
O 1380 H	11	18	31	37	86	29	8	11	3	46	21	25
P 1384 H	11	22	36	37	99	50	5	0	2	21	9	13
LINE 35	(FLIGHT 4)											
A 1249 H	1	7	2	10	37	63	1	8	1	45	155	25
B 1237 H	0	2	0	3	6	34	1	5	1	35	1582	5
D 1224 H	0	7	0	14	36	106	1	0	1	19	326	0
E 1204 H	0	3	0	4	12	47	1	0	1	21	869	0
F 1193 H	0	2	0	3	13	20	1	0	1	39	383	9
LINE 36	(FLIGHT 4)											
A 1111 H	2	2	2	3	15	12	2	32	1	60	164	38
B 1139 H	1	2	1	3	11	33	1	0	1	19	965	0
D 1147 L?	1	8	1	9	44	47	1	0	1	41	623	0
E 1152 H	0	5	0	7	24	48	1	0	1	57	787	0
F 1165 H	0	4	0	5	12	60	1	0	1	17	904	0
G 1175 H	2	4	2	8	40	30	2	0	1	35	83	17
H 1181 L	3	6	2	3	9	25	3	27	1	109	228	54
LINE 37	(FLIGHT 4)											
A 1047 H	1	2	0	3	10	16	1	13	1	44	340	17
B 1040 H	0	2	0	3	15	24	1	23	1	61	380	33
C 1034 H	0	4	0	5	20	37	1	6	1	43	453	16
D 1015 L?	0	4	0	7	11	50	1	0	1	20	1021	0
E 1010 H	0	4	0	5	39	25	3	0	1	25	155	4
F 1005 L?	0	7	0	5	3	7	1	0	1	70	846	0
G 1001 H	0	3	0	6	34	42	1	3	1	20	200	1
H 988 H	1	4	0	5	24	20	2	12	1	72	119	49
LINE 38	(FLIGHT 4)											
A 895 H	0	2	1	4	14	20	1	22	1	64	222	40
B 903 H	0	3	1	4	26	39	1	13	1	50	261	26
C 912 H	2	3	2	4	25	33	1	10	1	41	308	17
D 921 H?	0	4	0	6	7	65	1	0	1	4	1726	0
E 935 H	1	6	1	11	68	21	9	3	1	19	113	2

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	COAXIAL 900 HZ		COPLANAR 900 HZ		COPLANAR 7200 HZ		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
ANOMALY/ FID/INTERP	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
LINE 38	(FLIGHT 4)											
F 957 H	1	2	2	3	19	27	1	10	1	55	88	36
LINE 391	(FLIGHT 6)											
A 1922 H	1	2	0	3	11	12	1	34	1	61	162	39
B 1931 H	1	1	1	2	12	13	1	30	1	65	308	38
C 1940 H	2	4	0	5	29	38	1	9	1	40	269	17
E 1953 H	0	5	0	7	20	69	1	0	1	20	449	0
G 1968 H	1	2	0	3	18	21	1	8	1	21	222	0
H 1973 H	1	11	0	17	67	134	1	0	1	16	126	0
LINE 401	(FLIGHT 6)											
A 1840 H	2	2	1	6	20	23	1	23	1	66	193	42
B 1818 H	1	8	0	13	46	101	1	0	1	25	189	6
C 1806 H	0	4	0	6	36	42	1	1	1	21	166	3
D 1802 H	0	2	0	4	30	35	1	13	1	29	161	11
E 1793 L?	0	7	0	4	26	51	1	0	1	33	695	0
LINE 41	(FLIGHT 4)											
A 543 H	0	4	3	8	33	44	1	0	1	36	118	17
B 527 H	1	3	0	3	14	23	1	12	1	51	352	24
C 515 H	0	7	1	10	50	66	1	0	1	23	114	6
LINE 42	(FLIGHT 4)											
A 388 H	0	2	0	4	11	33	1	5	1	37	862	7
C 407 H	1	4	2	9	33	43	1	0	1	29	128	11
D 419 H	2	3	2	4	9	37	1	10	1	55	506	27
E 425 H	1	2	1	2	9	20	1	11	1	55	568	24
LINE 43	(FLIGHT 4)											
A 363 H	0	2	0	4	13	25	1	2	1	17	616	0
B 347 H	1	2	2	4	22	13	3	15	1	33	212	11
C 343 H	2	4	2	8	18	49	1	0	1	26	254	5
D 333 H	0	2	0	3	8	20	1	17	1	56	425	28
LINE 44	(FLIGHT 3)											
A 3413 H	2	6	1	17	35	96	1	0	1	26	214	5
B 3415 H	0	7	0	12	22	80	1	1	1	25	248	6
C 3419 H	1	4	2	11	17	44	1	0	1	30	249	8
D 3426 H	0	1	2	2	7	15	1	15	1	57	286	30
LINE 45	(FLIGHT 3)											
B 3363 H	1	4	2	8	25	58	1	0	1	37	218	15

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH*. M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 38	(FLIGHT 4)											
A 963 H	1	3	1	5	21	14	2	20	1	71	109	49
LINE 391	(FLIGHT 6)											
A 1981 H	1	1	0	2	15	12	2	15	1	29	206	7
B 1987 H	0	3	0	5	21	29	1	22	1	53	221	30
LINE 401	(FLIGHT 6)											
A 1794 L?	0	7	0	4	26	51	1	1	1	21	197	3
B 1782 H	0	8	0	14	61	67	2	0	1	30	71	14
LINE 41	(FLIGHT 4)											
A 507 L	1	9	2	10	52	49	1	0	1	36	639	0
B 499 H	0	2	0	4	18	30	1	0	1	26	318	3
D 479 H	1	2	2	5	21	14	2	0	1	61	60	41
LINE 42	(FLIGHT 4)											
A 436 H	0	11	1	22	94	124	2	0	1	18	96	2
B 445 H	0	9	2	13	66	86	1	0	1	17	441	0
C 460 H	0	3	1	6	22	41	1	18	1	65	205	42
D 474 H	0	3	1	5	20	27	1	0	1	63	164	38
E 478 H	1	1	2	4	16	1564	1	0	1	61	44	43
LINE 43	(FLIGHT 4)											
B 312 H	0	5	0	13	32	43	1	0	1	16	169	0
C 307 H	0	7	0	9	41	76	1	0	1	16	168	0
D 302 H	0	5	0	9	50	25	4	1	1	17	131	0
LINE 44	(FLIGHT 3)											
A 3434 H	1	2	1	4	12	28	1	18	1	60	333	34
B 3451 H	1	2	1	1	14	16	1	0	1	23	204	0
C 3455 H	0	2	0	5	8	44	1	0	1	27	362	1
LINE 45	(FLIGHT 3)											
A 3349 H	0	2	0	3	11	22	1	20	1	59	239	35
B 3341 H	2	4	2	5	17	34	1	16	1	61	237	36
C 3323 H	0	3	0	5	17	29	1	0	1	27	206	4
LINE 46	(FLIGHT 3)											
A 3239 H	0	4	0	10	35	69	1	5	1	29	232	9
B 3255 H	0	2	1	4	11	23	1	16	1	50	286	25
C 3261 H	1	3	0	4	15	23	1	7	1	47	269	22

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 46	(FLIGHT 3)											
D 3273 H	0	7	0	10	53	56	2	0	1	20	118	2
LINE 47	(FLIGHT 3)											
B 3172 H	2	6	2	10	40	58	1	15	1	50	149	31
C 3158 H	0	4	0	5	16	38	1	0	1	29	302	5
D 3139 H	0	2	0	6	31	10	6	3	1	29	157	8
LINE 48	(FLIGHT 3)											
A 3051 H	0	3	0	8	25	64	1	0	1	19	436	0
B 3067 H	1	3	1	4	12	38	1	6	1	34	673	8
C 3088 H	1	2	1	3	16	16	1	21	1	68	168	44
D 3103 H	0	4	0	6	20	44	1	0	1	21	286	0
E 3117 H	2	6	3	18	62	1621	1	0	1	37	86	18
LINE 49	(FLIGHT 3)											
A 3003 H	2	2	2	2	12	22	1	6	1	44	332	18
B 2985 H	2	5	0	7	17	63	1	0	1	21	410	0
D 2971 H?	2	1	0	2	7	3	3	18	1	128	50	108
LINE 50	(FLIGHT 3)											
A 2934 H	2	2	2	2	11	16	1	20	1	62	405	33
B 2959 H	0	1	0	2	7	15	1	5	1	43	488	14
LINE 51	(FLIGHT 3)											
A 2739 H	0	3	0	3	12	26	1	7	1	55	560	23
LINE 52	(FLIGHT 3)											
A 2690 H	2	2	1	2	7	13	1	18	1	85	466	50
C 2700 H	2	4	1	7	23	53	1	0	1	24	327	0
E 2718 H	2	1	2	3	13	21	7	63	1	210	178	131
F 2720 H	2	2	2	3	13	19	1	0	1	55	322	26
LINE 53	(FLIGHT 3)											
A 2624 H	1	3	0	3	10	21	1	21	1	77	317	49
B 2617 H	1	3	2	5	28	32	1	10	1	51	133	31
C 2596 H	1	1	1	3	10	21	1	12	1	71	359	42
LINE 55	(FLIGHT 3)											
A 2488 H	2	4	1	5	26	42	1	10	1	53	213	29
B 2471 H	1	1	0	3	12	8	2	38	1	49	262	25
C 2465 H	3	3	2	4	15	39	1	0	1	22	327	0

* ESTIMATED DEPTH MAY BE UNRELIABLE BECAUSE THE STRONGER PART OF THE CONDUCTOR MAY BE DEEPER OR TO ONE SIDE OF THE FLIGHT LINE, OR BECAUSE OF A SHALLOW DIP OR OVERBURDEN EFFECTS.

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	COAXIAL 900 HZ		COPLANAR 900 HZ		COPLANAR 7200 HZ		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
ANOMALY/ FID/INTERP	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
LINE 56	(FLIGHT 3)											
A 2355 H	2	2	0	4	15	29	1	6	1	50	501	20
B 2385 H	1	2	1	4	14	17	1	0	1	41	296	14
C 2402 H	1	2	1	2	12	14	1	33	1	52	191	31
D 2408 H	1	3	1	5	21	29	1	0	1	23	240	1
LINE 57	(FLIGHT 3)											
A 2299 H?	0	2	3	22	12	11	1	22	1	64	524	31
C 2274 H	1	3	0	3	13	13	1	27	1	62	352	34
D 2245 H	0	12	0	21	92	170	1	3	1	15	471	0
E 2240 H	0	9	0	12	26	128	1	0	1	16	469	0
LINE 58	(FLIGHT 3)											
A 2138 H	0	2	0	4	6	9	1	34	1	60	1282	22
B 2166 H	2	4	1	5	30	27	2	24	1	57	197	34
C 2186 H	0	8	0	13	46	114	1	0	1	16	311	0
E 2202 H?	3	8	0	12	50	69	1	0	1	18	183	0
G 2211 H	1	3	2	5	29	33	1	0	1	56	120	34
LINE 59	(FLIGHT 3)											
B 2098 H	0	2	0	4	7	11	1	23	1	54	190	31
D 2082 H	0	2	0	3	13	33	1	16	1	51	407	25
E 2074 H	0	12	0	19	74	134	1	0	1	19	183	1
F 2060 H?	0	8	0	12	28	114	1	0	1	18	430	0
G 2052 H	6	6	11	17	53	22	7	27	1	60	85	27
H 2047 H	6	11	10	24	40	13	4	13	1	57	55	28
LINE 60	(FLIGHT 3)											
A 1960 H	2	2	0	3	10	21	1	22	1	61	450	33
B 1978 H	1	3	0	3	10	13	1	21	1	61	260	34
C 1992 H	1	10	0	16	70	117	1	0	1	15	144	0
E 2014 H	2	13	6	18	62	57	2	0	1	53	63	23
LINE 61	(FLIGHT 3)											
A 1917 H	0	3	0	4	13	19	1	25	1	71	328	43
B 1900 H	1	7	1	9	34	50	1	17	1	53	148	33
C 1882 H	0	4	0	5	19	46	1	0	1	29	279	6
F 1857 H	3	6	4	15	54	34	3	13	1	41	87	24
G 1848 H	6	9	14	18	53	59	7	6	2	45	44	17
H 1845 H	11	10	19	18	60	45	11	0	3	46	17	23
LINE 621	(FLIGHT 3)											
A 1750 H	1	1	1	2	8	16	1	9	1	49	283	22

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 621	(FLIGHT 3)											
B 1772 H	1	7	1	7	33	66	1	0	1	21	270	0
D 1788 H	3	10	6	18	73	70	2	10	1	43	62	28
E 1798 H	3	7	6	10	20	12	3	0	4	46	12	24
LINE 63	(FLIGHT 3)											
A 1554 H	2	2	2	2	12	23	1	6	1	57	383	28
B 1571 H	4	5	3	6	36	60	5	34	1	105	138	59
C 1577 H	0	3	2	4	17	15	1	17	1	64	212	39
D 1594 H	5	21	6	48	192	185	3	0	1	14	38	2
E 1605 H	3	9	13	19	49	65	1	0	1	27	31	14
G 1610 H	5	11	15	18	50	21	5	0	3	42	14	20
LINE 64	(FLIGHT 3)											
A 1518 H	1	3	0	3	3	20	1	8	1	66	476	37
B 1507 H	2	3	1	4	17	33	1	11	1	42	256	19
C 1499 H	3	4	1	6	27	52	1	15	1	46	208	25
D 1494 H	0	4	0	5	15	30	1	14	1	51	255	27
E 1485 H	0	11	0	19	73	117	1	0	1	21	153	4
F 1477 H	0	6	0	11	47	54	1	0	1	17	191	0
I 1465 H	37	45	31	40	86	35	11	0	4	23	8	9
J 1462 H	20	43	111	112	338	120	12	0	1	18	11	10
LINE 65	(FLIGHT 3)											
A 1384 H	2	4	4	8	30	29	2	20	1	52	92	34
B 1389 H	3	4	4	6	32	30	2	15	1	54	93	35
C 1398 H?	3	7	3	7	31	55	3	25	1	75	129	35
D 1407 H	1	5	2	8	33	32	2	1	1	32	94	14
E 1424 B?	49	74	124	138	380	70	33	0	2	15	5	9
F 1428 B?	24	18	34	27	225	88	19	0	4	28	10	10
H 1440 L	95	96	99	104	254	131	19	151	5	191	7	177
LINE 66	(FLIGHT 3)											
A 1325 H	3	3	3	4	25	12	3	29	1	64	44	48
B 1319 H	3	3	2	3	25	21	2	17	1	54	57	38
C 1311 H	2	7	2	7	33	51	1	10	1	43	79	27
E 1286 B?	41	44	69	82	318	137	14	0	3	22	12	6
F 1283 L	34	20	89	128	328	304	15	0	2	14	37	0
H 1279 B?	6	53	77	97	163	181	6	0	3	30	12	13
I 1276 L	25	44	77	43	220	110	15	0	8	29	2	16
LINE 67	(FLIGHT 3)											
B 1185 H	2	6	2	6	11	50	1	6	1	62	178	40

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 67	(FLIGHT 3)											
C 1196 H	5	7	4	11	47	48	2	13	1	50	68	34
F 1216 H	4	4	3	8	24	26	1	23	1	53	99	35
I 1228 B?	23	48	37	58	27	56	7	0	1	27	87	0
K 1233 B?	84	86	88	117	195	138	17	0	4	26	9	11
LINE 68	(FLIGHT 3)											
A 1152 H	0	2	1	6	17	27	1	16	1	63	353	35
B 1139 H	2	5	3	14	63	30	5	17	1	50	55	34
C 1131 H	4	3	4	7	28	34	1	20	1	50	81	34
D 1119 H	5	12	5	16	66	62	2	6	1	43	77	26
G 1108 B?	31	27	34	40	204	178	14	0	2	41	26	18
I 1104 B?	51	31	42	86	94	69	16	0	1	16	49	0
LINE 69	(FLIGHT 3)											
B 1023 H	2	2	2	3	15	15	1	27	1	67	160	44
D 1044 H	4	5	4	8	39	40	2	0	1	24	104	6
E 1051 H	8	8	6	15	56	35	3	23	1	56	43	42
G 1059 B?	14	61	28	57	120	52	4	0	2	35	28	12
LINE 70	(FLIGHT 3)											
A 946 H	2	4	3	6	26	18	2	12	1	60	120	38
B 921 H	0	3	3	4	15	9	2	23	1	70	96	49
D 915 H	11	9	3	18	71	111	1	2	1	38	73	23
F 908 B?	28	21	71	82	92	26	15	0	1	0	176	0
I 903 B?	28	49	51	80	50	71	8	8	1	34	88	8
LINE 71	(FLIGHT 3)											
A 806 H	2	1	1	3	14	14	1	19	1	54	164	31
B 820 H	0	4	1	8	32	44	1	0	1	28	160	8
F 841 B?	36	64	55	99	227	281	8	0	2	31	29	10
G 843 B?	27	51	101	109	48	98	12	0	6	44	4	30
I 848 B?	30	46	69	83	68	32	11	0	1	0	228	0
LINE 72	(FLIGHT 3)											
A 764 H	1	2	0	2	9	11	1	34	1	64	266	38
B 739 L	21	14	15	19	16	41	14	1	2	40	49	12
D 732 B?	9	13	27	23	20	40	9	6	2	42	22	20
E 730 B?	9	13	27	23	20	50	9	0	2	23	46	0
LINE 731	(FLIGHT 6)											
A 1615 H	0	4	0	5	20	24	1	17	1	51	211	28

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 731	(FLIGHT 6)											
B 1609 H	0	3	0	4	23	37	1	8	1	40	199	19
C 1600 H	4	7	5	12	56	43	3	8	1	30	248	0
D 1592 L?	7	38	31	7	204	139	6	16	1	51	62	24
E 1590 B?	10	27	30	22	204	139	7	0	2	23	41	0
LINE 74	(FLIGHT 3)											
A 624 H	1	3	1	4	11	25	1	6	1	56	502	25
B 617 H	2	8	0	13	35	74	1	0	1	25	242	4
C 607 H	6	20	11	50	213	213	2	0	1	22	98	0
D 599 L	28	32	32	27	78	54	13	2	2	35	27	13
G 594 B?	4	7	11	15	57	70	5	11	2	28	30	5
LINE 75	(FLIGHT 3)											
A 523 H	1	16	3	29	112	157	2	0	1	15	68	1
B 537 B?	20	26	43	9	156	79	19	7	2	37	21	16
D 541 L	50	64	55	60	52	132	13	4	2	29	23	11
E 542 B?	12	46	55	60	118	132	7	0	1	20	78	0
LINE 76	(FLIGHT 3)											
A 470 H	1	2	1	4	14	18	1	26	1	54	167	33
B 463 H	3	8	3	14	66	92	2	0	1	28	236	0
D 451 B?	8	26	10	35	83	12	3	0	2	27	30	2
F 447 L	22	32	45	22	50	24	14	0	1	9	359	0

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The magnetometer data are digitally recorded in the aircraft to an accuracy of one nT (i.e., one gamma). The digital tape is processed by computer to yield a total field magnetic contour map. When warranted, the magnetic data also may be treated mathematically to enhance the magnetic response of the near-surface geology, and an enhanced magnetic contour map is then produced. The response of the enhancement operator in the frequency domain is illustrated in Figure II-2. This figure shows that the passband components of the airborne data are amplified 20 times by the enhancement operator. This means, for example, that a 100 nT anomaly on the enhanced map reflects a 5 nT anomaly for the passband components of the airborne data.

The enhanced map, which bears a resemblance to a downward continuation map, is produced by the digital bandpass filtering of the total field data. The enhancement is equivalent to continuing the field downward to a level (above the source) which is 1/20th of the actual sensor-source distance.

Because the enhanced magnetic map bears a resemblance to a ground magnetic map, it simplifies the recognition of trends in the rock strata and the interpretation of

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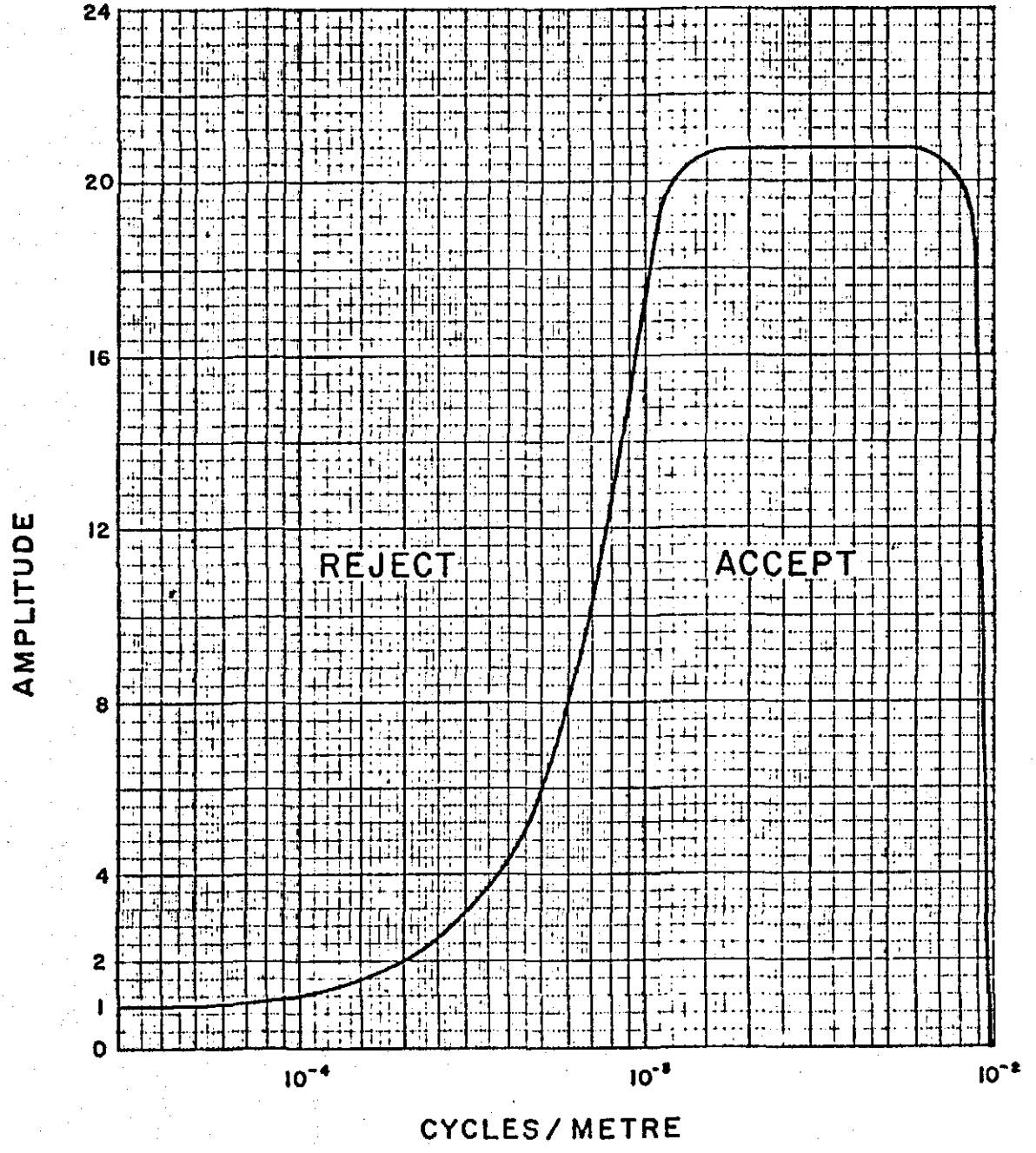

Figure II-2 Frequency response of magnetic enhancement operator.

geological structure. It defines the near-surface local geology while de-emphasizing deep-seated regional features. It primarily has application when the magnetic rock units are steeply dipping and the earth's field dips in excess of 60 degrees.

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MAPS ACCOMPANYING THIS REPORT

Eight map sheets accompany this report:

Electromagnetic Anomalies	2 map sheets
Resistivity	2 map sheets
Total Field Magnetics	2 map sheets
Enhanced Magnetics	2 map sheets

Respectfully submitted,
DIGHEM LIMITED

D.C. Fraser
President

Y DCF-379

APPENDIX A

THE FLIGHT RECORD AND PATH RECOVERY

Both analog and digital flight records were produced. The analog profiles were recorded on chart paper in the aircraft during the survey. The digital profiles were generated later by computer and plotted on electrostatic chart paper at a scale of 1:10,000. The digital profiles are listed in Table A-1.

In Table A-1, the log resistivity scale of 0.03 decade/mm means that the resistivity changes by an order of magnitude in 33 mm. The resistivities at 0, 33, 67, 100 and 133 mm up from the bottom of the digital flight record are respectively 1, 10, 100, 1,000 and 10,000 ohm-m.

The fiducial marks on the flight records represent points on the ground which were recovered from camera film. Continuous photographic coverage allowed accurate photo-path recovery locations for the fiducials, which were then plotted on the geophysical maps to provide the track of the aircraft.

The fiducial locations on both the flight records and flight path maps were examined by a computer for unusual helicopter speed changes. Such speed changes may denote

an error in flight path recovery. The resulting flight path locations therefore reflect a more stringent checking than is normally provided by manual flight path recovery techniques.

Table A-1. The Digital Profiles

Channel Name	(Freq)	Observed parameters	Scale units/mm
MAG		magnetics	10 nT
ALT		bird height	3 m
CXI	(900 Hz)	vertical coaxial coil-pair inphase	1 ppm
CXQ	(900 Hz)	vertical coaxial coil-pair quadrature	1 ppm
CXS		ambient noise monitor (coaxial receiver)	1 ppm
CPI	(900 Hz)	horizontal coplanar coil-pair inphase	1 ppm
CPQ	(900 Hz)	horizontal coplanar coil-pair quadrature	1 ppm
CPS		ambient noise monitor (coplanar receiver)	1 ppm
CPI	(7200 Hz)	horizontal coplanar coil-pair inphase	1 ppm
CPQ	(7200 Hz)	horizontal coplanar coil-pair quadrature	1 ppm
		Computed Parameters	
DIFI	(900 Hz)	difference function inphase from CXI and CPI	1 ppm
DIFQ	(900 Hz)	difference function quadrature from CXQ and CPQ	1 ppm
REC1		first anomaly recognition function	1 ppm
REC2		second anomaly recognition function	1 ppm
REC3		third anomaly recognition function	1 ppm
REC4		fourth anomaly recognition function	1 ppm
CDT		conductance	1 grade
RES	(900 Hz)	log resistivity	.03 decade
RES	(7200 Hz)	log resistivity	.03 decade
DP	(900 Hz)	apparent depth	3 m
DP	(7200 Hz)	apparent depth	3 m
FEO%	(900 Hz)	apparent weight percent magnetite	0.25%

APPENDIX B

EM ANOMALY LIST

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	COAXIAL 900 HZ		COPLANAR 900 HZ		COPLANAR 7200 HZ		VERTICAL DIKE		HORIZONTAL SHEET		CONDUCTIVE EARTH	
ANOMALY/ FID/INTERP	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	REAL PPM	QUAD PPM	COND MHOS	DEPTH* M	COND MHOS	DEPTH M	RESIS OHM-M	DEPTH M
LINE 1 (FLIGHT 6)												
A 1129 L	41	26	22	6	17	31	29	0	1	159	1035	0
B 1127 L	29	21	31	26	20	55	18	0	57	68	1	65
D 1123 L	0	10	0	72	47	105	2	0	1	4	335	0
F 1120 H	0	18	12	36	133	241	1	0	1	14	98	0
G 1109 E	14	38	41	39	130	79	7	3	1	22	74	0
H 1106 H	19	60	39	102	398	377	5	0	2	20	30	1
I 1103 E	12	26	41	62	241	192	7	11	2	51	26	29
LINE 2 (FLIGHT 6)												
C 1035 L	9	30	25	44	139	300	5	7	2	47	46	22
D 1037 L	8	45	1	41	163	300	1	0	1	17	82	4
F 1046 E	7	43	32	57	289	247	4	4	1	38	152	8
G 1053 H	14	29	33	72	133	66	5	0	2	27	21	8
H 1054 H	17	59	33	37	384	346	5	0	3	27	18	9
I 1056 H	18	64	47	34	389	341	7	4	2	25	21	8
LINE 3 (FLIGHT 6)												
B 1003 H	0	11	2	20	66	144	1	0	1	17	581	0
C 999 H	0	9	0	16	21	107	1	0	1	21	586	0
E 992 E	20	48	51	9	401	364	4	0	1	17	21	8
E' 987 H	9	21	9	34	146	177	3	5	2	21	22	3
F 983 H	20	30	36	47	143	129	9	9	2	24	26	6
G 979 E	10	57	16	89	366	375	2	0	1	20	66	0
H 973 ?	4	9	3	14	51	46	3	0	1	44	110	6
LINE 4 (FLIGHT 6)												
A 905 H?	1	10	1	17	40	141	1	0	1	32	678	0
D 917 E	10	20	20	38	37	39	5	0	1	30	57	4
E 919 H	15	22	41	75	198	120	5	0	1	17	20	8
F 922 H	15	21	28	59	248	347	6	4	2	25	25	5
G 924 H	14	49	20	63	272	427	4	1	2	21	34	3
H 928 H	9	72	23	119	477	557	2	0	1	19	52	0
I 936 H	4	28	11	35	214	268	2	0	1	25	75	1
LINE 5 (FLIGHT 6)												
A 877 H	2	1	2	3	8	12	1	0	1	36	338	7
B 869 H	0	5	5	11	38	26	3	10	1	44	132	24
C 858 H?	5	32	25	50	152	99	3	0	2	35	36	12
D 855 B?	14	27	28	49	174	97	6	1	1	34	52	8
E 850 B?	7	10	11	9	51	56	7	6	1	44	69	12
G 838 H	2	6	4	13	42	31	2	0	1	28	76	10

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 6 (FLIGHT 6)												
A 766 H	0	14	0	21	59	146	1	0	1	32	697	0
B 777 H	0	3	3	12	20	35	1	19	1	48	176	28
D 784 H	3	6	9	21	26	24	2	0	1	34	51	18
F 792 B?	20	79	42	135	520	538	4	0	1	18	40	0
G 800 H	8	32	11	51	254	223	2	2	1	24	100	0
H 807 H	2	13	2	26	69	119	1	0	1	25	118	8
LINE 7 (FLIGHT 6)												
A 739 H	3	7	4	7	35	66	3	3	1	41	239	0
B 734 B?	1	4	8	18	21	61	3	19	1	45	132	12
C 731 H?	3	4	4	2	32	66	1	0	1	19	123	2
D 725 H?	12	27	14	10	68	60	6	5	1	33	58	7
F 719 B?	16	55	22	84	302	50	3	0	2	26	33	4
G 718 H	13	54	31	83	293	192	4	0	2	25	43	3
H 709 H	5	15	14	33	78	39	5	7	1	26	31	15
I 703 H	2	5	3	17	59	51	2	2	1	39	47	25
LINE 8 (FLIGHT 6)												
A 624 H	2	10	4	14	62	70	1	15	1	55	157	20
B 632 H	3	16	7	27	105	82	2	0	1	22	179	0
C 638 H	7	8	10	10	59	38	3	10	1	35	58	21
E 644 L	33	127	83	33	138	181	8	0	9	56	2	44
F 648 B?	24	79	41	96	264	256	5	0	2	26	43	4
G 652 E	7	58	25	71	232	202	3	0	1	20	51	8
H 662 H	7	39	14	71	187	343	2	0	1	23	86	0
I 670 H	9	43	16	74	292	261	2	0	1	23	46	1
LINE 9 (FLIGHT 6)												
A 611 E	0	11	4	28	63	74	1	0	1	35	249	1
B 607 H	3	22	9	52	235	208	1	0	1	20	156	0
C 593 H	2	6	4	14	54	54	2	9	1	41	80	25
E 591 B?	7	2	3	10	33	35	9	25	1	33	179	0
F 587 L	17	26	26	35	163	380	8	6	2	59	28	34
I 581 H?	6	14	9	23	104	79	3	0	1	17	36	5
L 576 H	3	12	2	25	93	103	2	0	1	25	36	12
M 571 H	3	8	4	9	43	26	3	12	1	34	75	6
LINE 10 (FLIGHT 6)												
A 495 L	2	17	5	17	57	75	1	0	1	36	204	0
C 509 L?	1	6	1	5	22	29	1	0	1	56	743	0
D 515 H	0	8	2	10	43	83	1	0	1	32	678	0

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 10	(FLIGHT 6)											
F 521 H	0	4	0	8	18	45	1	1	1	30	311	7
H 529 H	0	4	3	3	22	26	1	9	1	33	337	9
I 539 H	6	56	16	93	396	516	2	0	1	9	194	0
J 548 L?	7	11	3	16	63	111	3	7	1	46	75	15
K 554 L	6	29	2	34	90	112	1	0	1	27	110	0
L 557 L	4	14	7	5	19	30	3	17	1	49	94	17
LINE 11	(FLIGHT 6)											
A 434 H	0	6	0	7	27	54	1	0	1	35	189	14
D 406 H	0	2	0	2	13	8	2	20	1	35	284	10
E 394 B?	0	15	2	30	121	159	2	0	1	18	70	4
F 383 B?	4	16	13	22	108	145	3	10	1	19	85	0
G 381 B?	4	30	13	9	39	279	3	3	1	25	93	0
LINE 12	(FLIGHT 6)											
A 308 H?	1	8	1	11	35	100	1	0	1	37	719	0
B 326 H	1	3	2	3	16	29	1	11	1	69	237	43
C 340 H	2	15	3	29	123	163	2	0	1	18	74	5
D 342 H	1	20	3	36	140	246	1	0	1	17	95	3
E 359 E	5	14	7	25	123	130	2	0	1	19	62	5
F 367 B?	6	31	18	24	57	120	3	8	1	31	81	6
H 369 B?	6	28	15	51	189	176	3	0	1	23	77	0
LINE 13	(FLIGHT 6)											
A 295 H	0	2	0	7	30	44	1	0	1	28	170	6
B 276 H	1	2	0	3	17	17	1	21	1	63	251	37
D 262 H	0	14	0	22	79	58	3	6	1	21	121	5
E 238 B?	4	13	9	25	71	53	3	7	1	50	118	16
F 229 H?	2	6	4	13	45	27	3	0	1	43	40	27
LINE 14	(FLIGHT 4)											
A 3721 ?	0	9	5	20	54	79	1	0	1	25	152	6
B 3725 B?	11	24	14	34	146	139	4	0	1	22	92	0
D 3730 H	0	17	6	25	111	184	1	0	1	16	86	2
E 3753 H	0	6	0	9	46	52	1	14	1	51	161	31
F 3762 H	1	2	0	2	15	20	1	21	1	49	278	25
G 3769 H	1	4	0	8	19	47	1	13	1	43	220	22
H 3780 H	0	3	0	5	21	34	1	0	1	22	384	0
I 3795 B?	3	14	7	27	123	86	2	0	1	29	159	0
J 3805 H	2	5	5	10	40	39	3	0	1	39	215	0
LINE 15	(FLIGHT 4)											
B 3710 L	16	19	12	15	28	47	9	3	1	44	107	9

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 15	(FLIGHT 4)											
C 3705 H	1	9	4	13	45	68	1	0	1	19	117	3
D 3684 H	0	8	0	8	43	57	1	5	1	42	176	21
E 3676 H	0	3	0	2	11	23	1	16	1	54	406	26
F 3670 H	0	2	0	5	22	25	1	23	1	52	259	29
G 3660 H	0	3	0	6	27	48	1	0	1	25	245	4
H 3643 H	3	4	3	6	16	12	2	0	1	42	111	19
LINE 16	(FLIGHT 4)											
A 3538 H?	0	6	0	13	45	76	2	0	1	33	738	0
B 3542 H	0	3	0	6	18	49	1	0	1	23	264	2
C 3556 H	2	6	6	18	89	72	3	15	1	42	56	28
D 3561 H	4	21	8	40	160	143	3	3	1	27	42	15
E 3582 H	2	4	1	8	32	9	8	29	1	50	198	28
F 3590 H	1	4	2	6	23	34	1	16	1	47	149	28
G 3612 H	3	17	6	31	145	141	1	0	1	24	173	0
H 3617 H	2	3	1	5	24	31	1	0	1	23	237	0
I 3627 H	3	11	8	26	117	86	3	0	1	26	36	13
K 3633 H	6	20	16	37	137	156	3	0	1	28	51	3
L 3639 H?	0	5	10	10	28	23	2	0	1	46	43	30
LINE 17	(FLIGHT 4)											
A 3528 H	0	9	0	12	61	85	1	0	1	22	100	5
C 3495 H	2	3	1	7	29	30	1	23	1	71	137	49
D 3491 H	1	7	5	1	9	13	3	23	1	95	603	15
E 3487 H	0	5	0	3	10	15	1	18	1	71	437	39
F 3472 H	1	5	1	9	37	34	2	1	1	30	249	7
G 3466 H	3	8	4	19	91	23	2	6	1	45	190	9
H 3454 H	4	27	9	45	188	233	2	0	1	19	50	7
I 3447 H	1556	10	9	16	53	37	3	7	1	32	31	20
LINE 18	(FLIGHT 4)											
A 3345 H	0	10	0	16	55	87	1	0	1	24	148	7
B 3349 H?	0	9	0	10	31	85	1	4	1	31	618	0
F 3412 H?	2	16	3	21	99	133	1	0	1	24	251	0
G 3419 H	1	13	3	23	106	127	2	0	1	17	76	3
I 3441 H	2	11	8	24	94	115	2	0	1	27	70	12
K 3445 H	6	5	9	9	21	25	9	29	2	47	52	19
LINE 19	(FLIGHT 4)											
A 3331 H	0	7	0	11	42	90	1	0	1	18	207	0
D 3275 H	0	3	0	10	32	29	2	4	1	46	209	22

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH* M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 19	(FLIGHT 4)											
E 3262 H	1	10	1	14	75	83	2	0	1	19	93	4
F 3252 H	0	3	0	4	17	39	1	0	1	32	487	4
LINE 20	(FLIGHT 4)											
B 3110 H	0	5	1	8	28	55	1	4	1	41	255	18
C 3129 H	1	4	1	7	34	26	2	13	1	57	107	37
D 3168 H?	3	14	4	23	118	107	2	0	1	23	221	0
E 3176 H	0	7	2	10	42	61	1	6	1	23	195	5
F 3196 H	7	11	13	25	79	64	3	6	1	44	52	29
LINE 21	(FLIGHT 4)											
A 3067 H	1	2	1	2	9	13	1	21	1	67	381	37
B 3059 H	1	2	1	3	10	32	1	10	1	55	569	25
D 3043 H	0	9	2	13	52	73	1	0	1	25	113	8
E 3018 H	1	5	0	5	14	43	1	0	1	28	154	8
F 3013 H	1	3	1	5	22	43	1	0	1	28	179	8
G 3001 H	0	4	1	8	30	56	1	0	1	33	195	12
H 2983 H	2	4	5	5	29	26	2	20	1	68	123	47
LINE 22	(FLIGHT 4)											
B 2890 H	1	5	0	5	22	39	1	15	1	57	256	33
C 2901 H	0	5	1	8	27	60	1	0	1	24	291	1
D 2905 B?	2	15	2	17	53	154	1	0	1	25	595	0
F 2933 H	1	5	1	9	28	106	1	0	1	26	189	8
G 2936 H	2	5	2	10	27	104	1	0	1	28	200	8
H 2957 H	0	6	2	12	53	62	2	3	1	37	85	21
I 2967 H	0	1	0	5	17	33	1	0	1	24	222	3
LINE 23	(FLIGHT 4)											
A 2863 H	0	1	0	3	8	20	1	17	1	62	857	27
B 2852 L?	2	5	0	2	21	33	2	27	1	131	1035	0
C 2842 H	0	6	0	8	42	67	1	3	1	23	279	3
D 2828 H	1	5	1	8	29	49	1	0	1	24	134	5
G 2811 E	1	4	1	6	28	67	1	0	1	22	246	1
J 2775 H	1	3	0	4	12	8	2	41	1	57	581	26
LINE 24	(FLIGHT 4)											
A 2653 H	0	7	2	11	37	78	1	0	1	24	222	3
C 2663 H?	6	7	1	6	37	62	1	0	1	26	144	8
E 2673 H	10	8	7	6	57	21	11	31	1	49	162	13
F 2678 H	3	15	2	24	98	149	1	0	1	21	72	8

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ANOMALY/ FID/INTERP	COAXIAL 900 HZ REAL PPM	COAXIAL 900 HZ QUAD PPM	COPLANAR 900 HZ REAL PPM	COPLANAR 900 HZ QUAD PPM	COPLANAR 7200 HZ REAL PPM	COPLANAR 7200 HZ QUAD PPM	VERTICAL DIKE COND MHOS	VERTICAL DIKE DEPTH*. M	HORIZONTAL SHEET COND MHOS	HORIZONTAL SHEET DEPTH M	CONDUCTIVE EARTH RESIS OHM-M	CONDUCTIVE EARTH DEPTH M
LINE 24	(FLIGHT 4)											
G 2700 H	3	8	4	9	47	52	3	28	1	85	176	42
I 2712 H	3	15	4	16	39	22	2	0	1	43	176	6
J 2717 H	3	17	7	28	123	136	2	0	1	26	101	0
K 2723 H	3	25	8	43	200	196	1	0	1	25	123	0
LINE 25	(FLIGHT 4)											
A 2637 H	1	5	2	8	42	64	1	14	1	49	149	29
C 2625 L	8	10	39	53	42	58	8	3	98	82	1	80
D 2623 L	5	13	26	53	51	45	5	0	2	62	40	33
F 2620 H	3	15	4	22	125	64	5	3	1	19	49	7
J 2609 H	3	30	15	51	105	170	2	1	1	35	94	8
L 2584 H	4	20	13	41	162	108	2	0	1	32	86	3
M 2582 H	3	4	7	45	201	228	2	0	1	30	89	2
N 2580 H	4	26	12	46	201	228	2	0	1	16	42	4
O 2569 H	0	4	1	5	23	15	2	11	1	67	85	46
LINE 26	(FLIGHT 4)											
A 2424 H	2	6	2	8	40	36	2	20	1	59	86	41
B 2435 H	1	5	2	6	20	22	1	22	1	50	192	28
E 2441 H	6	8	2	16	16	43	3	10	1	46	165	9
F 2446 H	2	29	11	54	195	402	1	0	1	25	125	1
H 2452 L	29	34	0	73	20	46	6	2	1	97	949	5
I 2454 L	29	76	56	38	16	46	9	0	34	118	1	113
J 2456 L	60	76	56	83	20	4	14	0	1	208	1035	0
K 2459 L	61	59	10	68	48	24	11	0	1	70	65	36
O 2471 H	1	6	5	13	46	11	2	6	1	46	300	4
P 2475 L?	2	8	6	27	59	118	2	11	1	35	281	3
Q 2478 H	2	7	4	13	64	96	1	2	1	17	103	3
R 2481 H	1	4	0	8	37	8	1	2	1	36	254	1
S 2496 H	7	51	14	91	370	390	2	0	1	17	92	0
T 2506 B?	4	19	8	31	139	95	2	4	1	47	111	15
U 2517 H	3	7	5	11	31	27	3	6	1	39	106	5
V 2522 B?	2	5	3	7	30	46	1	0	1	23	133	5
LINE 27	(FLIGHT 4)											
A 2412 H	2	6	5	17	66	55	2	16	1	61	150	24
B 2391 H	4	7	1	18	75	85	2	0	1	30	157	0
F 2383 H?	1	8	3	23	67	77	1	0	1	15	360	0
I 2365 H	2	10	4	12	62	69	2	0	1	25	109	8
K 2357 H	4	6	5	3	120	12	7	33	1	29	89	1
L 2352 H	2	12	4	17	73	63	1	0	1	31	82	1

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APPENDIX VII

SUMMARY SHEET OF EM ANOMALY GROUND FOLLOW-UP

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APPENDIX - VII

SUMMARY SHEET OF E.M. ANOMALY GROUND FOLLOW UP

No.	Anomaly No.	Grade	Depth (m)	Comment	Priority Rating
1	D 76	1	2	Jurassic dolerite outcrop; scattered Permian sandstone float	C
2	F 76	3	0	Pasture (basalt)	C
3	B 75	3	16	Scattered Jurassic dolerite outcrop	C
4	D 75	3	0	Basalt float in pasture land; at head of small gully and toe of landship	C
5	E 75	2	0	ditto	C
6	D 74	3	0	No outcrop; uncommon dolerite float near electric fence line CULTURAL ANOMALY	C
7	G 74	2	5	On side of creek in slight gully at edge of basalt scarp	C
8	D 73	2	16	Two intersecting electric fences	C
9	E 73	2	0	No outcrop; located on edge of basalt scarp in low button grass area	C
10	B 72	3	0	Dolerite outcrop; electric fence about 30 m to north. CULTURAL	C
11	D 72	2	6	Boggy ploughed field; cause of anomaly not seen	C
12	E 72	2	0	Base of slope; perhaps weathered (conductive) seepage layer at base of rock unit	C
13	F 71	2	0	Electric fence	C
14	G 71	3	0	Electric fence	C
15	I 71	3	0	Basalt outcrop; anomaly perhaps due to weathered seepage layer	C
16	F 70	3	0	Electric fence nearby; dolerite float	C
17	I 70	2	0	Sheet iron from delapidated hut. CULTURAL	C
18	G 69	1	0	No outcrop; grass paddock; reason for anomaly not known	C
19	G 68	3	0	Electric fence line; cleared paddock	C
20	I 68	3	0	Basalt; pasture land; reason for anomaly not known	C

SUMMARY SHEET OF E.M. ANOMALY GROUND FOLLOW-UP (continued)

No.	Anomaly No.	Grade	Depth (m)	Comment	Priority Rating
40	O 34	2	0	Jurassic dolerite; explanation as per J 33 (no. 42)	C
41	P 33	2	0	ditto	C
42	J 33	2	11	Jurassic dolerite; probably conductive horizontal layer within this rock unit	C
43	I 32	2	10	Partial land; no outcrop or float	C
44	K 32	3	0	Cleared paddock; no outcrop/float	C
45	N 32	4	0	Powerline pylon	C
46	G 31	1	0	Open pasture; reason for anomaly not known	C
47	K 31	1	1	Powerline pylon	C
48	C 30	1	3	Cluster of houses	C
49	F 30	2	19	ditto	C
50	R 30	4	0	Powerline pylon	C
51	N 29	4	0	ditto	C
52	M 28	1	1	Area of dense regrowth vegetation; outcrop is a grey wacke sandstone; reason for anomaly not known	C
53	O 27	1	0	Outcrop is pebbly sandstone with fine grained andesite possibly as a narrow lens in the sediments which may extend west to anomaly V 26; weak quartz veining occurs adjacent to the andesite (Sample no. A6105)	C
54	K 27	2	0	Basalt outcrop in grazing paddock; anomaly probably due to basalt acting as horizontal conductive sheet	C
55 56	M 27 T 26	2 2	0 0	On fence line which is parallel to buried water hose; basalt outcrop; anomaly probably due to grounded conductor. scattered quartz rubble (sample no. A6104)	C

SUMMARY SHEET OF E.M. ANOMALY GROUND FOLLOW-UP (continued)

No.	Anomaly No.	Grade	Depth (m)	Comment	Priority Rating
57	H 26	2	2	Line of electric fences in pastured paddock about 50 m east of plotted anomalies locations	C
58	I 26	2	0		
59	J 26	3	0		
60	K 26	3	0	Cleared paddock; source unknown	C
61	V 26	1	0	Rounded dolerite pebbles (Quaternary alluvials); vein quartz float (sample no. A6107B) in nearby Dasher Creek hornblend andesite with flow texture (sample no. A6107A)	B-C
62	C 25	2	3	Pasture land; no outcrop or float	C
63	D 25	2	0	ditto	C
64	F 25	2	3	ditto	C
65	E 24	3	31	Andesite outcrop; anomaly is located in swampy area at head of gully in which 2 ploughs are dumped - grounded conductor ?	C
67	B 14	1	0	Electric fence	C
68	B 15	1	0	Buried Telecom cable	C
69	B 7	1	19	Pasture land; outcrop is weakly silicied and sericitised andesite (sample No.A6103)	B-C

PRIORITY RATING :

A - Good Potential
B - Medium Potential
C - Low Potential

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APPENDIX VIII

GEOLOGY OF GOG RANGE AREA, CONSULTANT'S REPORT

ROGER POLTOCK GEOLOGICAL PTY. LTD.

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EL 49/82 BEULAH - TASMANIA

GOG RANGE AREA

GEOLOGICAL MAPPING AND ROCK CHIP GEOCHEMISTRY

JULY - AUGUST 1984

FOR AUSTAMAX OPERATIONS PTY. LTD.

BY ROGER POLTOCK GEOLOGICAL PTY. LTD.

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Conclusions and Recommendations

Introduction

Geology - STRATIGRAPHY

- MINERALIZATION

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.1 Sample records and Analytical data

a) Stream sediments - Amax Ba, As, Cu, Pb, Zn, Ag

No. A3373 - 3394

b) Rock - Amax Cu, Pb, Zn, Ag, Ba, Au, Fe

No. A6435 - 6439

- Amax Cu, Pb, Zn, Mn, Ag, Fe, As, K, Na

No. A6471 - 6491

c) Rock - Poltock Cu, Pb, Zn, Ag, Au, As, Sn, W

No. A6108 - 6164

- Analab Report

.2 Petrological Report C.M S. 84/1/29

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REFERENCES

Geological Survey Explanatory Report 1 63,360 Series

Jennings I.B . 1979. Sheffield

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Plate 1 Geological fact - interpretation - sample locations.

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1 & 2 Vegetation - natural plant communities

3 Roland Congolomerate - Gog Range

4 Gog Range - Cambrian Volcanics - Forestry pine plantation

5 Topography of Beulah microgranite

6 Foliated rhyolitic volcanics overlain by Roland Conglomerate scree soil

7 Coarse grained clastics derived from volcanics and Precambrian metamorphics

8 Transported gossan

SUMMARY

This report covers the geological and rock geochemical assessment of the SE section of EL 49/82 in vicinity of Gog Range. Exploration was orientated to base and precious metals in Cambrian volcanics and clastics.

The Cambrian is exposed in a broad E-W trending anticlinal window in basal Ordovician Roland Conglomerate and Moina Sandstone. Cambrian lithologies can be broadly subdivided into

- rhyolitic - gabbroic/intrusive - extrusive volcanic complex which may be associated with the Beulah granites.
- coarse grained epiclastics derived from the above volcanics.
- siltstones, tuffaceous greywackes, interpreted to overly the epiclastics.
- rhyolitic - Precambrian derived volcaniclastics.

Previously the area was part of Asarco's EL 7/73, which was covered by Cu-Pb-Zn stream geochemistry, the main anomalous zone is located 2 km west of EL 49/82. Earlier prospecting located the Beulah Barite mine 2 km north, and Star of the West Gold mine 7 km north west of the work area; no evidence of prospecting activity has been located within this section of the licence.

Current exploration has located three main features:

a) Anomalous Zn associated with fine-medium grained volcaniclastics in the east, sphalerite occurring as scattered blebs < 2 mm. This area has been gridded and covered by soil geochemistry by Amax.

b) Silicification, tourmalinization, brecciation in volcanic porphyries on the western boundary of the E.L. One of four chip samples assayed above detection gold .24 ppm. Limonitic joints from adjacent to similar alteration assayed Pb 1000 and Ag 5 ppm. This alteration is probably associated with intrusives similar to the tonalites outcropping here and the Beulah microgranite, both of which are interpreted to be of Cambrian age.

c) Scattered gossanous occurrences are common, some of these are obviously transported. Minor residual gossans/laterites have no apparent source, possibly being derived from stratigraphic units rather than sulphide mineralization.

CONCLUSIONS AND RECOMMENDATIONS

From past and present geochemical data and mapping, the area doesn't appear to be prospective for volcanogenic base metal sulphides.

The only feature warranting further work is the area of silicification/tourmalinization with anomalous gold, lead and silver. Gold geochemistry to date in this area is limited to minor rock chip sampling, no regional stream geochemistry has been attempted.

INTRODUCTION

Field work was carried out during eight days in July 1984, emphasis placed on mapping and rock geochemistry of Cambrian units. Data is presented on Plate 1. The base plan has been derived from the Forestry Plantation Series 1:10,000 and Lands Department enlargements from 1:25,000.

The work area of 20 km^2 is the SE sector of EL 49/82, centred on Eel Hole Creek, bounded to south by Gog Range and to east by Mersey River. The northern limit of mapping 5,407,000 N, detail on Plate 1 north of here has been copied from Mines Department 1:63360 Sheffield Sheet.

The area is serviced by a system of all weather logging roads, forestry clear felling and pine plantations have been developed on Cambrian lithologies in the west (see Photo 4). Natural plant communities are dominated by open sclerophyll forest, with rain forests restricted to shaded creek gullies (see Photos 1 & 2).

Cambrian lithologies are exposed in a broad anticlinal structure, flanked to north and south by basal Ordovician quartzose sediments (see Plate 1 and Photo 4). The Cambrian has been subdivided into a volcanic complex composed of rhyolitic to gabbroic lavas and intrusives, these are overlain by a mantle of epiclastics which grade upward into a siltstone tuffaceous greywacke sequence.

These subdivisions equate with Minnow Keratophyre and Gog Range Greywacke (see Jennings 1:63360 Sheffield).

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Precambrian basement is not exposed but was a source area for detritus during Cambrian sedimentation.

Post Ordovician age lithologies outcrop in the NE of licence in the Weegena area. These include basal Permian sediments, Jurassic dolerite and Tertiary basalt, none are of consequence in the work area and won't be discussed further. For greater detail see Sheffield 1:63360.

Several phases of sampling have been carried out in EL 49/82:

- Amax No. A3373-94 -80# stream sediments
- Amax No. A6435-39 A6471-91 rock
- Poltock No. A6108-6164 rock

All assaying has been done by Analabs. see Appendix 1 for sample descriptions and analytical data.

Eleven samples were submitted by Amax to C.M.S. for petrological descriptions, nine from the intrusive extrusive complex and two of volcaniclastics (see Appendix 2).

VEGETATATION - NATURAL PLANT COMMUNITIES

Photo 1 Tributary of Eel Hole Creek 453.700E/405.200N

Temperate rain forest, restricted to shaded creek gullies.

Dominants - Eucalyptus sp, Acacia melanoxylon (blackwood) and Atherosperma moschatum (sassafras).

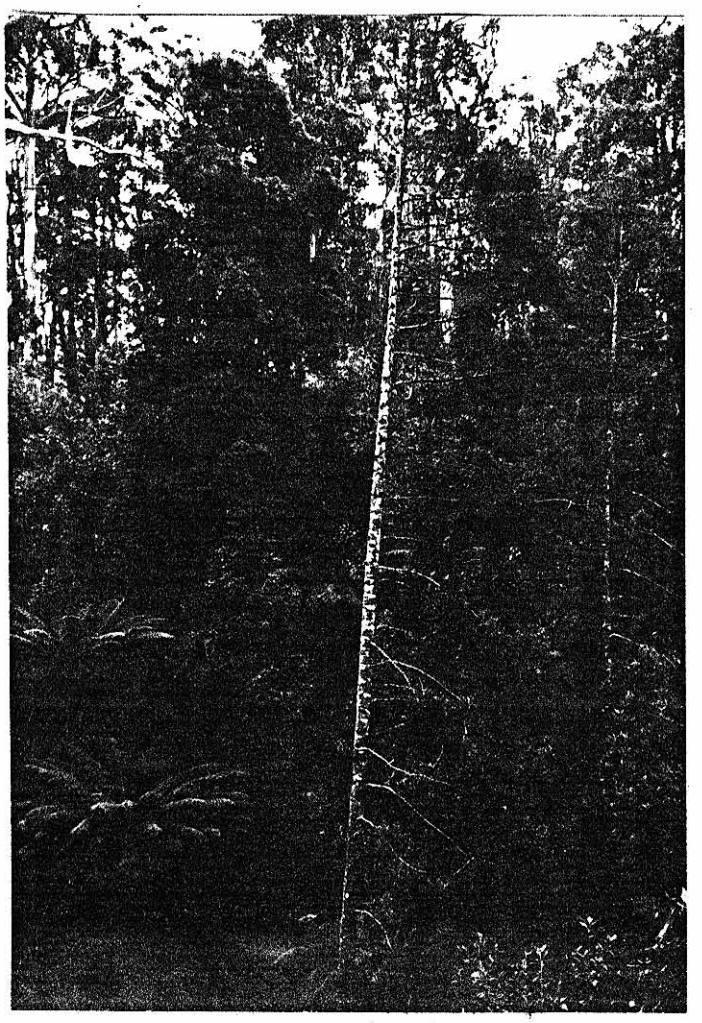
Understory - Olearia sp (broad leaf musk) Dicksonia antartica (manfern).

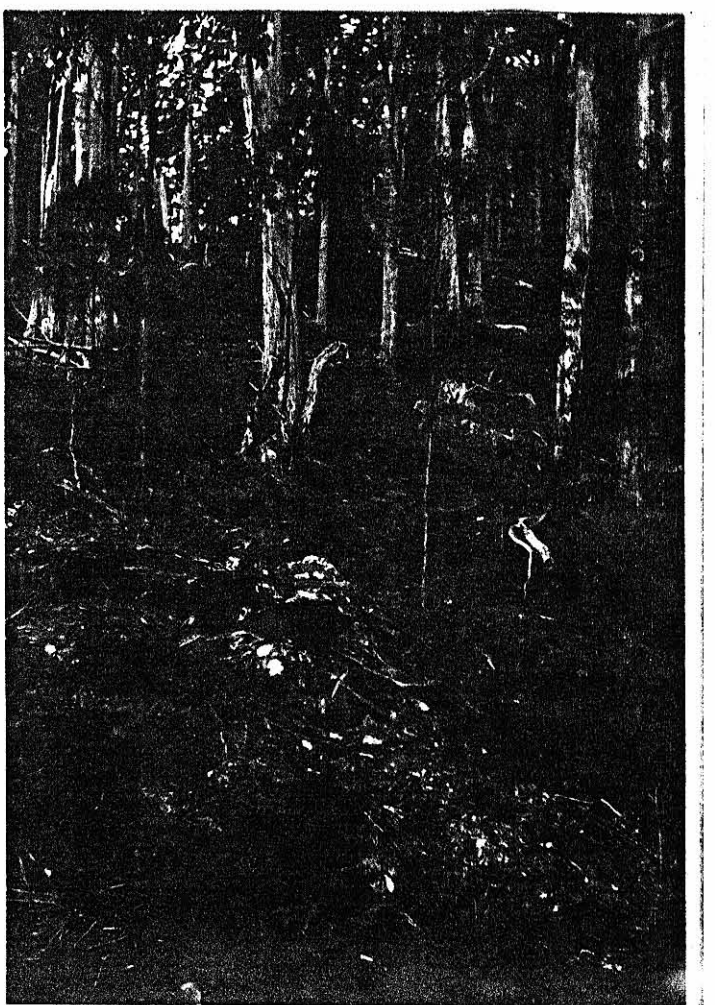
Photo 2 Vicinity A6114 454.400E/405,150N

Dry sclerophyll forest on foliated volcaniclastics

Dominants - Eucalyptus sp

Understory - Exocarpus sp (native cherry), Acacia sp and Banksia marginata, Pteridium (bracken fern).





GEOLOGY

ORDOVICIAN

Roland Conglomerate - Moina Sandstone

These sediments form the northern and southern limits to the prospective Cambrian rocks, occurring as limbs of E-W trending anticline. At Gog Range (see Photo 4), shorter wavelength SE trending and plunging folds are superimposed on this structure (see Plate 1).

The basal conglomerates are of Cambrian-Ordovician age and are composed of coarse Precambrian derived detritus. Locally on Gog Range "the lowest beds are made up of keratophyre boulders." (Jennings, 1979). The conglomerates unconformably overly the volcanics, in the work area this contact is obscurred by conglomerate talus.

The conglomerates are frequently thickly interbedded with coarse sandstones (see Photo 3). Locally bands of a dark detrital mineral tentatively identified as chromite occur in the basal sequence (see A6122).

Extensive talus from the conglomerate and sandstone on the flanks of the Gog Range is the most significant feature attributable to this unit, obscurring Cambrian bedrock (see Photo 6).

CAMBRIAN

The sequence can be subdivided into:

a) acid to intermediate lavas and intrusives with overlying epiclastics which grade upward into siltstone and greywackes.

b) sequence of rhyolitic volcanics and Precambrian derived clastics which outcrop on the flanks of Gog Range.

Rhyolitic - gabbroic intrusives and lavas

This lobe shaped body 5 x 2 km is located in the western part of the mapped area, exposed in a forestry clear felled area (see Photo 4). The dominant rock type is a quartz feldspar hornblend porphyry of rholitic-andesitic composition which in thin section is described as an intrusive (see Appendix 2, No. 6471, 73) but from field evidence is interpreted to be partially extrusive.

Apparently intruding this porphyry are medium grained quartz diorites (tonalites) which in places tend to be gabbroic. Siliceous alteration with anomalous gold and silver lead may be associated with these intrusives.

Pyroclastic products from the volcanic centre are minimal, only a thin veneer of epiclastics being associated with the complex within the mapping area.

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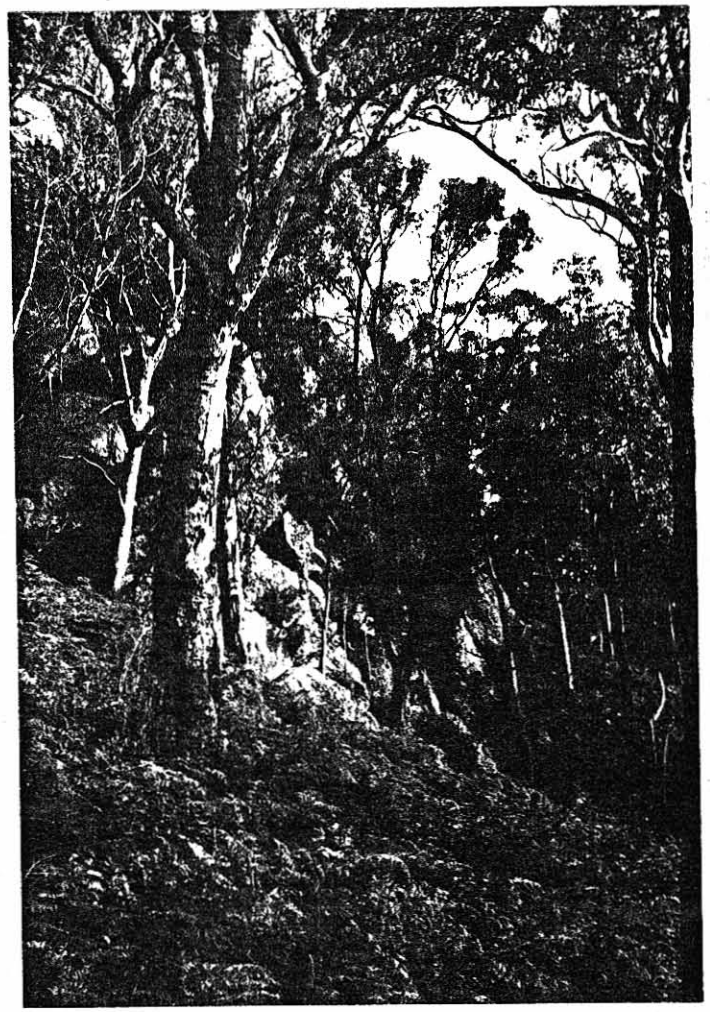
258165

Photo 3 Gog Range vicinity A6122 448 900E/404,900N

Thickly bedded Roland Conglomerate and sandstone, dipping at 30°, base of exposure is close to conglomerate/volcanic contact.

Forest is dominated by Eucalyptus amygdalina (black peppermint) with ground cover of Pteridium (bracken fern). Typical of conglomerate talus slopes.



Tonalite (quartz diorite) - Gabbroic intrusive

Occur as small bodies in the western portion of the work area, straddling the E.L. boundary. Outcrop in the area is poor, the intrusives represented only by scattered blocks of fresh rock. Intrusives are confined to porphyries, none occurring in the clastics. Contact hornfelsing hasn't been recognized.

One thin section of these intrusives has been described by C.M.S.:

A6484 Tonalite "Quite possibly a hybrid rock composed of a coarse gabbroic assemblage and a late finer grained granitic assemblage."

Hand specimens A6144-45 from 2 km ESE of A6484 are of a more gabbroic differentiate, but similar texturally.

It is considered that the Beulah microgranite (Jennings 1979) 7 km to NW is related to these intrusives and is actually Cambrian not Devonian age. Evidence for age:

a) textural similarities in hand specimen of tonalite and Beulah microgranite, the former is closely associated with Cambrian volcanics.

b) Beulah microgranites intrusive contacts only with Cambrian units.

Photo 5 shows dome like Beulah intrusion.

Quartz feldspar hornblende porphyries

These porphyries form the greater part of this complex. Petrological

descriptions A6471-73 C.M.S. describe them as "porphyritic rhyolites-rhyodacites, probably intrusive." From field traverses and hand specimens A6138-39, 6143, 6147-49, some of this body is interpreted to be extrusive:

a) absence of clear transgressive intrusive contacts.

b) contacts conformable with enclosing sediments, a coarse epiclastic always overlying the porphyry

c) Petrological descriptions A6476, 6490A crystal lithic tuffs are interpreted to have been derived from a source similar to the tonalite and porphyry.

d) isolated lenses of siltstone and coarse clastics occur within the porphyry at A6146 (451,400E/405,450N) and 200 m further east.

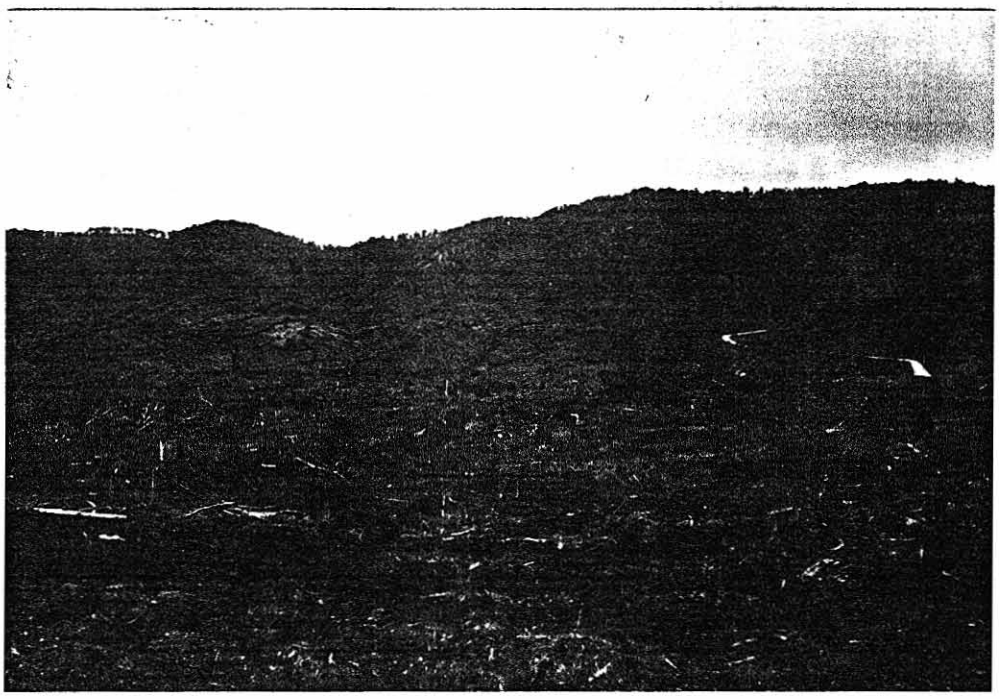
Chloritization and sericitization of feldspar and hornblend phenocrysts is common. Minor pyrite was located at A6143.

Photo 4 View SE from Star of West Road toward Gog Range

Distance Thickly bedded Roland conglomerate on Gog Range.

Centre Young pine plantation on the rhyolitic-gabbroic volcanic complex.

Foreground Low lying area corresponding to siltstone and tuffaceous greywacke.



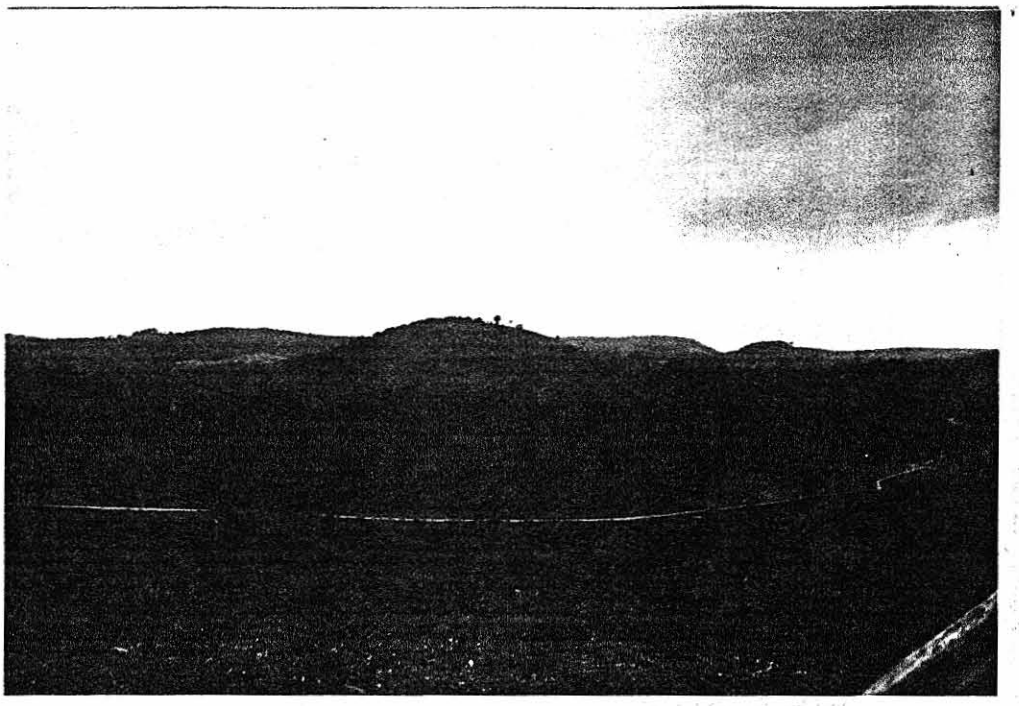


Photo 5 View to NW from A6142 449,600E/406,200N

Centre distance - Beulah microgranite - a dome like intrusive.

Epiclastics

These outcrop in the western part of work area, as a flanking rim around the volcanic complex, the clastics reach maximum thickness of 200 m. Minor rhyolitic-andesitic extrusives A6482 and A6491a occur within the sequence.

These sediments have probably been derived in part from the tonalite intrusives and porphyries (see C.M.S. descrption A6476 and A6490a). This unit can be further subdivided into

a) Coarse grained poorly sorted clastic

This is the dominant type, directly overlying the porphyries. It is composed of a variety of volcanic rock fragments including chloritized volcanic glass. From field observations it was initially considered to be a pyroclastic due to lack of sorting, bedding and the presence of volcanic glass/pumice. Occasionally this rock type can be seen in close association (grading?) with fine grained, bedded volcanclastics. Hand specimens of this type are A6140, 6155-6.

b) Fine-medium grained clastic

These are frequently bedded and may represent a gradational unit from a) to the overlying siltstones and greywackes. Two thin sections have been described A6476 "Lithic crystal tuff" and A6490 "crystal tuff - volcanomict sandstone". These two represent various degrees of reworking of volcanic detritus. Frequently the volcanomict sandstone is thinly interbedded with very fine vitric tuff/siltstone. At A6133 minor blebs of sphalerite occur within these siltstones.

Siltstone - tuffaceous greywacke - pebble conglomerates

This is the most extensive unit in the area, part of the Gog Range Greywacke. The dominant rock type is an interbedded siltstone and fine greywacke, occasionally with local variations:

a) quartz and chert pebble horizons, derived from a Precambrian terrain, e.g. A6135.

b) fine-medium grained quartz sericite volcaniclastic, commonly foliated, e.g. A6137, A6437, former weakly anomalous Zn 300 ppm.

Several airborne E.M. anomalies are associated with these sediments. Nothing of significant was located in field traverses. Pyritic sediments are minor, the E,M, responses are interpreted to be associated with carbonaceous shales.

Rhyolitic - Precambrian derived volcaniclastics

There is interpreted to be a change in volcanism and sedimentation in the southern part of area. Precambrian derived detritus is common (see Photo 7).

Most extensive exposures occur in the east, thin sections haven't been described but hand specimens:

A6115 Quartz and glass rich volcanclastic fine-medium grained.

A6123-4 Rhyolitic pyroclastic or volcaniclastic? - quartz and feldspar crystals with lithics <5 mm, no evidence of reworking.

A6163 Rhyolite fine-medium grained, silicified (abundant narrow quartz veins - no analysis from this area previously sampled by Amax).

In the western area minor exposures occur on talus covered slopes. (see Photo 6).

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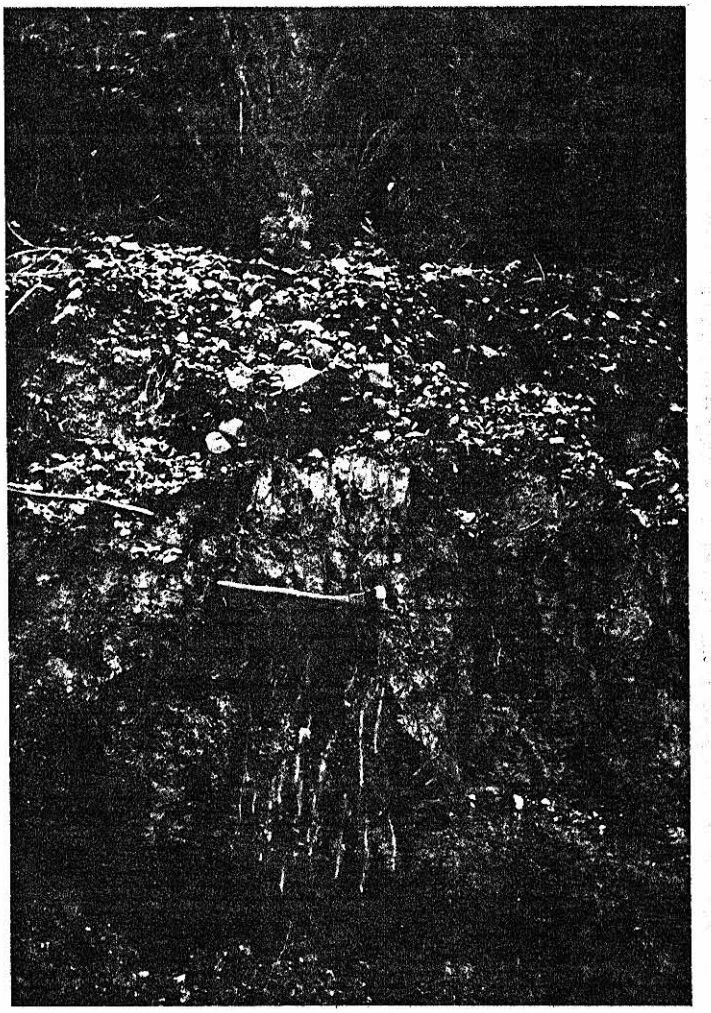
Photo 6 Gregory/Gog Road Junction 449,350E/405,550N

Rhyolite? foliated and deeply weathered - overlain by conglomerate talus soil.

Note - leaching of soil profile.

- heath vegetation typical of acid soils.



169

258174

Photo 7 Gog Road 448,900E 405,700N

Volcaniclastic with abundant quartz and quartzite cobbles.



MINERALIZATION

Silicification - tourmalinization - brecciation

This a very restricted feature occurring only in porphyries located in the western part of the area, straddling the licence boundary. Alteration is most extensive at A6110 - rubble occurring over a 50 x 20 m area, this location is the only site where the country rock - porphyry has been brecciated and rock chips were anomalous .24 g/t Au. The breccia is composed of angular blocks which have been silicified, the interstitial material is fine grained quartz and tourmaline/chlorite. Minor limonitic specks and joints are considered to have formed after pyrite.

At A6159,61,62 alteration is restricted to joints, affecting only a few centimetres of country rock. At A6161 the porphyry has also been intensely chloritized A6483A (see table below).

This alteration is considered to have been generated by the Cambrian tonalite - microgranite intrusives.

ANALYSIS OF SILICA-TOURMALINE ALTERATION

Sample No.	Cu	Pb	Zn	Ag	Au	As	Sn	N	
A6110	80	160	110	x	.24	8	x	38	Brecciation
6159	30	125	55	x	x	11	x	28	Alteration joints only
6161	75	640	105	x	x	20	3	15	" " "
6162	5	65	25	x	x	8	x	59	" " "
6483	500	1000	190	5	-	x	-	-	Limonitic staining on joints
6483A	80	635	185	-	-	-	-	-	Intensely chloritized

Quartz veins and silicification

Veining isn't prominant in the area, occurring as scattered sets in epiclastics and siltstones/greywackes. Most veins are less than 5 cm thick, a silicified shear 0.5 m at A6153. Veins were chip sampled at several locations and found to have slightly elevated Zn, maximum 315 ppm at A6132. A gossanous rock with irregular quartz veins A6436 sampled by Amax Pb 315, Zn 215 ppm located at 453,600E/407,200N.

None of the samples assayed greater than detection limit for gold.

Anomalous Zinc in volcaniclastics

In the eastern mapped area weakly anomalous Zn (225-400 ppm) in rock chips is widespread, this area centred on 455,500E/406,000N has been gridded and soil sampled by Amax.

Minor fine blebs of sphalerite occur in bedded crystal and vitric tuffs (reworked) at A6133 454,750E/406,100N. This style of mineralization isn't considered to be significant.

Gossans and limonitic outcrops

.1 NE corner of licence 449,800E/406,700N - here float blocks of gossanous material are common, outcrop is coarse epiclastics and siltstone/greywacke. Two samples assayed:

A6157	Cu 775	Pb 370	Zn 295	Ag 1.5	As 19 ppm
A6158	Cu 105	Pb 160	Zn 330	Ag .5	As 96 ppm

The latter sample is located outside the licence, downslope from A6157 and may be a transported feature.

.2 A6116, 6117 454,700E/405,100N

A gossanous formation is exposed in a road cutting on Gog No. 6. This is interpreted to be a transported feature formed at the base of slope in an area of impeded drainage. The gossan source is most likely a stratigraphic unit rather than a sulphide zone.

The gossan is approximately 2 m thick, contains blocks of Roland Conglomerate and overlies unconsolidated clays and silts (see Photo 8).

Two samples A6116-17 assayed 165 and 210 ppm Zn and 51 and 40 ppm As, other elements were only background.

.3 A6112, 6113 453,000E/405,300N

This occurrence located in cutting on Gog No. 6 road, A6112 float fragments of gossan, A6113 gossanous veins in a deeply weathered rock which may be an epiclastic. Soils in the area are red brown, the gossans may only relate to this Fe rich stratigraphic unit.

Assays - A6112 Pb 80 Zn 200, A6113 Zn 140 ppm, other elements only background.

.4 Foliated volcaniclastics with limonitic joints

These sampled at A6114, 6125, 6137, limonite possibly forming after weak pyrite sericite alteration, the latter two samples were weakly anomalous in Zn 325 and 300 ppm respectively.

173

258178

Photo 8 Gog No. 6 Road A6117

Transported gossan.

Gossan with large boulders of Roland Conglomerate, overlying grey unconsolidated clay and silt.



258179

Appendix 1 Sample records and Analytical data

a) Stream sediments - Amax Ba, As, Cu, Pb, Zn, Ag

No. A3373 - 3394

SAMPLE RECORD

(MINERALS EXPLORATION DIVISION)

1:250,000 Sheet Area Gog 1:25000 Property or Prospect Beulah Geo RA anomaly

Date: 2 June 1983 Collected by: R Vivian & L Spencer Sample Batch No. Analyses by: Analabs

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Ba	As	Cu	Pb	Zn	Ag	Au	Comments
3373	Stream Sediment	Topo Gog 557 053	90	9	55	95 ✓	90	0.5		
3374	" "	" " 558 053	50	24	10	5	25	x		Zn = 21
3375	" "	" "	85	13	30	25	90	0.5		
3376			100	12	50	30	165	0.5		
3377	" "	" " 559 054	100	9	30	25	125	x		5587 0542
3378	" "	" " 561 055	115	10	40	35	150	x		
3379	" "	" " 562 055	95	11	35	35	170	x		
3380	" "	" " 563 057	120	10	50	30	210 ✓	x		
3381	" "	" " 564	160	7	55	55 ✓	530 ✓	0.5		
3382	" "	" " 564 059	120	10	45	20	240 ✓	x		5636 0582
3383	" "	" " 552 053	65	19	35	35	70	0.5		5524 0530
3384	" "	" " 551 056	180	12	50	50 ✓	170	x		5515 0555
3385	" "	" " 551 055	120	12	55	75 ✓	130	x		5510 0557
3386	" "	" " 551 058	155	11	35	40	205	0.5		5510 0570
3387	" "	" " 550 059	185	8	30	40	325 ✓	x		5505 058
3388	" "	" " 549 059	185	9	35	40	295 ✓	x		5490 059
3389	" "	" " 548 059	215	8	20	40	325 ✓	0.5		5495 059
3390	" "	" " 548 061	205	7	30	50 ✓	420 ✓	x		5485 060

M.P. - FORM 2

2581180

5 cm

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

Yellow: Project Geologist
Green: Sample

176

1:250,000 Sheet Area Gog 1/250000 Property or Prospect Beaver

Date: 2 June 1983 Collected by: R Vivian & L Spencer Sample Batch No. Analyses by: Analabs

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Ba	As	Cu	Pb	Zn	Ag	Au	Comments
13391	Stream Sediment	Gog Topo 549 064	165	5	20	30	290	x		5490 0640
3392	" "	" " 549 066	180	5	20	40	325	x		5490 0659
3393	" "	" " 548 067	165	8	30	35	330	x		5480 0670
3394	" "	" " 547 067	100	3	10	5	75	0.5		

M.P. - FORM 2

2588483

5 cm

177

258182

Appendix 1. Sample records and Analytical data

b) Rock - Amax Cu, Pb, Zn, Ag, Ba, Au, Fe

No, A6435 - 6439

- Amax Cu, Pb, Zn, Mn, Ag, Fe, As, K, Na

No. A6471 - 6491

178

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area Gog 1:25000 Property or Prospect Beulah EL 39/83 Sth Mersey River

Date: 14th November Collected by: David Ellis & Bob Vivian Sample Batch No. Analyses by: Analabs

Sample No.	Description	Gog 1:25,000 Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag	Ba	Au	Fe	Comments
6435	Fawny - chocolate rock with coarse feldspar phenocrysts showing ~~fractured~~ trachytic texture (weathered)	539 079	45	25	195	x	380	x	8.50%	
6436	Well cleaved Mn-stained geothite stained gossaneous rock with irregular qtz veins	537 074	65	315	215	x	340	x	10.0%	near sha[illegible] workings
76437	Pink to mauve schistose rock; light brown quartz schist; fresh grey schist with streaked quartz phenos	536 074	45	35	45	x	100	x	6.55%	
76438	Rusty coloured rock; sacchradial texture. Tuffaceous? (fresh variety: l. brown)	532 072	30	45	120	x	55	x	3.25%	
76439	Highly weathered, red-orange, purple brown coloured rock. Coarse texture; Quartz phenos → crystal tuff. (minnow Keratophyre)	530 070	40	155	25	0.5	125	x	3.05%	

I.P. - FORM 2

258183

5 cm

179

SAMPLE RECORD

(MINERALS EXPLORATION DIVISION)

Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area: BURNIE

Property or Prospect: BEULAH.

Date: 1983 Nov

Collected by: RMV

Sample Batch No.

Analyses by: Analabs.

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Mn / Ag	%Fe / As	%K / %Na	Comments
6471	pale gy f.-m.gr. porphyritic rhyolite	Goe PLANTATION 1610 000	40	x	35	275 / x	3.80 / x	3.00 / 1.36	~~Field Reference~~
	feldspars altered; chloritised biotite.	Field Ref. (13)							
	minor iron oxide staining along fractures.								intrusive
6472	grey, argillised porhyritic felsite								~~[illegible]~~
	siliceous rock; breccia fragments (3mm) and	Field Ref (16)							similar to A6471 argillic alteration. is
	flow texture								low-temp. hydrothermal. intrusive.
6473	fine-medium gr. qtz phenocrysts in	Field Ref (9)	30	x	40	155 / 0.1	2.60 / x	3.77 / 1.71	probably intrusive
	dense, aphanitic pink groundmass — porphyritic								~~texturally similar~~
	rhyolite								
6474	as above	Field Ref. (10)	35	5	40	160 / x	2.90 / x	3.57 / 1.46	
6475	white, opaque vein material qtz as subparallel to strike								
	of greywacke	Field Ref. (17)	35	x	30	185 / 0.1	1.55 / x	0.09 / 0.02	
6476	dark grey green lithic crystal tuff: elongated	Field Ref. (18)	25	30	400	3550 / 0.1	4.85 / x	1.97 / 1.83	lithic fragments to 15 ie. lapilli sized
	mafics (flow texture); rounded fragments of qtz phyric acid								
	volcanics.								
6477	f-med-grained porphyritic rhyolite	Field Ref: (7)	15	x	95	305 / 0.1	3.15 / x	3.75 / 1.41	as per A6473

M.P. - FORM 2

258184

5 cm

SAMPLE RECORD

1:250,000 Sheet Area

(MINERALS EXPLORATION DIVISION)

Property or Prospect

Yellow: Project Geologist
Green: Sampler

Date: Collected by: Sample Batch No. Analyses by:

Sample No.	Description	Location	Au	Cu	Pb	Zn	Mn / Ag	% Fe / As	% K / % Na	Comments
				Analyses (ppm unless otherwise stated)						
6478	Porphyritic rhyolite ; dark grey qtz-feldsp. phenocrysts in brown-green dense, glassy groundmass; weathers to orange-pink feldspars + qtz phenos.	Field Ref (19)	X	20	95	50	1150 / 0.3	2.00 / X	2.40 / 0.36	may be similar to A 6473 : extrusive
6479	dark green, fine grained andesite I fine dots of pyrite	Field Ref. (20)		15	X	225	3000 / 0.1	3.65 / X	1.25 / 2.85	
6480	dark green coarse grained crystal tuff	Field Ref. (56)	X	20	155	275	1600 / 0.2	3.95 / X	1.97 / 1.83	
6481	Sheared, altered ? greywacke (orange brown. fine sandy well weathered rock)	location: MG20 peg Goof Rd								
6482A	Metarhyolite mauve, moderately-highly weathered. fine qtz and feldspar phenos in sandy textured groundmass.	Field ~~[illegible]~~ ref. (3)								
6482B	altered porphyry ferruginised, argillised feldspar & qtz phenos in clayey groundmass. mauve coloured	Field Ref. (2)								med. gr. intrusive
6483	yellow brown Qtz tuff + FeOx stained fractures	Field ref: (21)	X	500	1000	190	460 / 5.0	6.55 / X	4.65 / 0.08	
6483A	orange brown-purple-dark green basic volcanic (highly ? altered).	Field ref. (22)	X	80	635	185				

P. - FORM 2

258185

5 cm

SAMPLE RECORD

AMAX IRON ORE CORPORATION
(MINERALS EXPLORATION DIVISION)

Yellow: Project Geologist
Green: Sampler

1:250,000 Sheet Area

Property or Prospect

Date: Collected by: Sample Batch No. Analyses by:

Sample No.	Description	Location	Au	Cu	Pb	Zn	Mn / Ag	Fe % / As	% K / % Na	Comments
				Analyses (ppm unless otherwise stated)						
46484	Tonalite; medium-coarse grained hypidiomorphic texture; altered (~~argillized~~ sericite) feldspar phenocrysts. Hb as needles.	Field Ref. (23)	X	25	5	55	405 / 0.1	3.15 / X	0.86 / 2.80	hybrid rock part gabbroic and granitic.
46485	Feldspar-qtz-tuff; feldspar phenos to 5mm; small qtz phenos in greenish tan (olive) fine grained ~~matrix~~ groundmass.	Field Ref (24A)		20	X	225	890 / X	3.30 / X	3.20 / 0.56	
46485 A	Lithic crystal tuff; lithic frags mudstone; abundant chlorite	Field Ref (24)		30	50	30	35 / 0.3	5.40 / X	0.14 / 0.12	
46486	Flow banded rhyolite	Field Ref (25)		20	X	70	120 / 0.1	3.50 / X	3.50 / 0.56	
46487	finely laminated sediment, possibly carbonaceous. (speckled metallic grey) texture	" " (26)		55	180	95	45 / 0.8	3.05 / X	3.07 / 0.07	note: Cu Pb Zn are elevated vs volcanic etc.
46489	crystal lithic tuff	between S.S AB384 and 86		Cu	Pb	Zn	Ag	As		
	" "	Field Ref (1) W. Gog creek		10	X	110	0.1	X		
46490A	crystal tuff or reworked tuff (ie. volcanomict sandstone); light green, fine medium grained; chloritised	Field Ref. (4) W. Gog Ck		15	40	165	0.2	X		
		Field Ref. (5) W. Gog Ck.								
46491	altered porphyritic andesite, gy-green, (flow oriented) qtz phenos in groundmass +<1% fine dissem. sulphides (~~galena~~) chlorit feldspar		X	70	30	930	0.3	50		dentritic alteration hydrid ~~rock~~ extrusive mafic + acid / inter

M.P. - FORM 2

5 cm

258186

258187

Appendix 1. Sample records and Analytical data

c) Rock - Poltock Cu, Pb, Zn, Ag, Au, As, Sn, W

No. A6108 - 6164

- Analab Report

SAMPLE RECORD

(MINERALS EXPLORATION DIVISION)

1:250,000 Sheet Area 1:25000 GOG Property or Prospect EL 49/82 BELAH

183

Date: Collected by: POLTOCK Sample Batch No. Analyses by: ANAL

258188

5 cm

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag Au	As	Sn
A6108	Feldspar porphyry - lava + volcaniclastic	GREGORYS ROAD	—	—	—	—	—	
A6109	Lava - chloritized.	" " /Gog N°8	—	—	—	—	—	
A 6110	Breccation + silicify - tourmaline	Greg' Road v.c Gog 8 / Gog 3	80	160	110	x .24	8	x
A 6111	Vol clastic, minor reworking, chloritized glass frags	Gog N° 6 unmed 5th Eel Hole Ck	—	—	—	—	—	
A 6112	Gossan float	" " 350m from " " "	10	80	200	x x	10	
A 6113	Gossan veins in deeply weathered rock	AS Above.	10	45	140	x x	2	
A 6114	Foliated. limonitic, f-m volclastic	1.4km E of above	50	50	120	x x	5	
A 6115	Volclastic med-coarse, quartz-glass rich	550m south A6114.	—	—	—	—	—	
A 6116	Gossan transported	454 800E / 405000N	10	40	165	x x	51	-
A 6117	" "	Gog N° 6 road cutting	10	35	210	x x	40	
A 6118	limonitic joints in volcanic	ASARCO GRID 2km W of EL	—	—	—	—	—	-
A 6119	Gossan lenses in massive rhyolite lava?	" " " "	1700	1150	3650	1.0 x	12	-
A 6120	Qtz felds porphy rhyolite. lava/intrusive	448400E / 406 000 N	—	—	—	—	—	
A 6121	Massive rhyolite - minor chloritization	448 900E / 405150N	35	990	415	1.0 x	19	-
A 6122	Sandstone/conglomerate - dark detrital mineral	448 900E / 405 000N	10	40	115	x x	8	-
A 6123	Rhyolitic tuff - siltstone	456,600E / 404 200N	—	—	—	—	—	-
A 6124	Vol or clastic? massive, foliated, limonitic	300m 5th of above	15	65	115	x x	6	
A 6125	limonite outcrop	100m E of A6123	75	35	325	x x	13	

N.P. - FORM 2

SAMPLE RECORD

(MINERALS EXPLORATION DIVISION)

1:250,000 Sheet Area: 1:25000 GOG. Property or Prospect: EL 49/82 BEULAH.

Date: Collected by: POLTOCK Sample Batch No. Analyses by: ANAL 184

258189

5 cm

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag Au	As	Sn
A 6126	Chert + quartz pebble conglomerate	456 600E / 405 400 N	—	—	—	—	—	—
A 6127	Siltstone / greywacke, dark grey	456 400E / 405 950N	—	—	—	—	—	—
A 6128	Volclastic fine vitric — crystl lithic detr <10 Cm	454 050E / 405 700N	—	—	—	—	—	—
A 6129	As above	150m north of above	—	—	—	—	—	—
A 6130	Coarse volclastic + pt detritus	Eel Hole CK 200m Nth of A6129	—	—	—	—	—	—
A 6131	Pyroclastic or volclastic - lithic, xl	" " 454 200E / 406 150N	—	—	—	—	—	—
A 6132	Qtz veins in A6131 rock type.	454 700E / 406 100 N	15	60	315	x x	1	—
A 6133	Interbedded vitric tuff — med grained xl lithic tuff	50m Nth A6132	—	—	—	—	—	—
A 6134	Mica siltst sandst + quartz pebble cong	Eel Hole CK 500m from Mersey.	—	—	—	—	—	—
A 6135	Chert pebble cong - quartz veining	" " " 400m " "	—	—	—	—	—	—
A 6136	Rhyolitic tuff no evidence reworking	" " " 300m " "	—	—	—	—	—	—
A 6137	Volclastic med grained qtz rich devitrified glass	" " " 200m " "	20	50	300	x x	11	—
A 6138	Qtz feld hb porph - patchy sericitisation	452 300E / 406 100N	—	—	—	—	—	—
A 6139	Qtz feld porph	452 600E / 406 500N	—	—	—	—	—	—
A 6140	Volclastic? abundant lithics, fine vitric ash	452 700E / 406 750N	—	—	—	—	—	—
A 6141	fine-med grained clean siliciclastic sediment.	452 850E / 407 250N	—	—	—	—	—	—
A 6142	Tonalite - intermed to basic intrusive	449 600E / 406 225N	—	—	—	—	—	—
A 6143	Qtz feld hb porph scattered py grains.	451 850E / 405 600N	—	—	—	—	—	—

M.P. - FORM 2

SAMPLE RECORD

1:250,000 Sheet Area 1:25000 Gog | Property or Prospect EL 49/82 BEULAH

Date: | Collected by: POLTOCK | Sample Batch No. | Analyses by: 185 AAL

258190

5 cm

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag Au	As	Sn
A 6144	Deeply weathered, med grained, interm - basic	451 200E, 405 200N	—	—	—	—	—	—
A 6145	" " " " sericitized	451 500E, 405 100N	340	50	185	x x	8	—
A 6146	Pink altstr - crystal lithic tuff	451 350E, 405 450N	—	—	—	—	—	—
A 6147	Weak silicification - qtz hb porph	450 800E 405 900N	—	—	—	—	—	—
A 6148	Qtz hb porph - chloritised	Junction Gog 4 / Gog Rd.	10	20	75	x x	x	—
A 6149	" " "	100m ENE A6148	—	—	—	—	—	—
A 6150	Contact above porph - vol'clastics	451200E / 406 950N.	—	—	—	—	—	—
A 6151	Vol'clastics with flat lying quartz veins	50m Nth of A6150	10	30	160	x x	x	—
A 6152	" " siltstone - coarse grained	150m " of A6150	—	—	—	—	—	—
A 6153	132.40 Silicified shear.	451 550E 407 100N	10	30	120	x x	6	—
A 6154	Quartz veining in volclastics.	100m E of A6153.	—	—	—	—	—	—
A 6155	Qtz hb porph - poorly sorted vol clastic	449 800E / 406 500N	—	—	—	—	—	—
A 6156	Vol' clastic	100m NE A6155	—	—	—	—	—	—
A 6157	Gossan float fragments.	250m NE A6155	775	370	295	1.5 x	19	—
A 6158	Laterite	449 800E / 406 850N	105	160	330	0.5 x	96	—
A 6159	Silicify - tourmaline of joints	449 600E / 405 850N	30	125	55	x x	11	x
A 6160	foliated, weathered - rhyolitic volcanic?	449 350E / 405 550N	5	25	25	x x	15	—
A 6161	Silicify - tourmalin - joints	450 000E / 405 650N	75	640	105	x x	20	3

M.P. - FORM 2

1:250,000 Sheet Area 1:25,000 GOG. Property or Prospect EL 4[redacted]/82 T[redacted]

Date: Collected by: POLLOCK Sample Batch No. 186 Analyses by: ANZ

258191 5 cm

Sample No.	Description	Location	Analyses (ppm unless otherwise stated) Cu	Pb	Zn	Ag Au	As	S
A6162	SILICIFIED - Tourmaline... joints	200m SE A6161	5	65	25	x x	8	x
A6163	Silicified volcanic fine-mid grained	456 900E / 404 700N	—	—	—	—	—	—
A6164	Intermediate lava.	Holloway's Rd 453650E/408500N	—	—	—	—	—	—

M.P. - FORM 2

187

258192

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.
Phone (09) 458 7999 — 52 Murray Road, Welshpool, W.A. 6106 — Telex AA92560

ANALYTICAL REPORT No. 3 1 08 2611

THIS REPORT MUST BE READ IN CONJUNCTION WITH THE ACCOMPANYING ANALYTICAL DATA

Amax Australia Ltd
5 Osborne Avenue
Trevallyn
Launceston TAS 7250

ORDER No.	PROJECT
EL49/82	Beulah

DATE RECEIVED	RESULTS REQUIRED
7.8.84	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
		3	23

ER OW	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: #	REFER TO ANALYSIS SECTION	PREPARATION	METHOD
0	A6110,12,13,14,16,17,19,21,22,24,25,32,37,45,48,51,53,57,58,59,60,61,62	1	2	4	3c 5				Cu Pb Zn Ag			103
									As			114
									Au			329
	6110,59,61,62								Sn			402
									W			401

RESULTS TO: As Above

RESULTS TO:
Roger Paltock
C/- Post Office
Wilmot
Tasmania 7310

REMARKS

STATE OF SAMPLES

whole core	WC
split core	SC
cutting	CU
rock	RO
soil	SO
pulp	PU
water	WA
tissue	TI
stream sediment	SS
heavy mineral	HM

ANALYSIS — PREPARATION

perchloric acid	A1	cold acid	CA
hydrochloric acid	A2	specific sulphide	SS
nitric acid	A3	other mixed acids	MA
aqua regia	A4	alkaline attack	AA
nitric-perchloric	A5	volatilization	VO
HF mixture	A6	ignition	IG
HF under pressure	A7	pressed powder (XRF)	PP
fusion	A8	glass fusion (XRF)	GF

ANALYSIS — METHOD

atomic absorption	AAS
x-ray fluorescence	XRF
spectrophotometry	SPEC
colorimetry	COL
chromatography	CHR
titration	TTN
other chemicals means	CHEM
miscellaneous	MISC
fluorescence	FLUOR
inductively coupled plasma	ICP

AUTHORISED OFFICER

258193

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
185	3.1 08 2611	22.8.84	EL49/82	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	As	Au	Au Ppb		
X1	A 6110	80	160	110	X	8	0.24	-		
X2	A 6112	10	80	200	X	10	X	-		
X3	A 6113	10	45	140	X	2	X	-		
X4	A 6114	50	50	120	X	5	X	-		
X5	A 6116	10	40	165	X	51	X	-		
X6	A 6117	10	35	210	X	40	X	-		
X7	A 6119	1200	1150	3650	1.0	12	X	-		
X8	A 6121	35	990	415	1.0	19	X	-		
X9	A 6122	10	40	115	X	9	X	-		
X10	A 6124	15	65	115	X	6	X	X		
X11	A 6125	75	35	325	X	13	X	-		
X12	A 6132	15	60	315	X	1	X	-		
X13	A 6137	20	50	300	X	11	X	-		
X14	A 6145	340	50	185	X	9	X	-		
X15	A 6148	10	20	75	X	X	X	-		
X16	A 6151	10	30	160	X	X	X	-		
X17	A 6153	10	30	120	X	3	X	-		
X18	A 6157	775	370	295	1.5	19	X	-		
X19	A 6158	105	160	320	0.5	96	X	-		
X20	A 6159	30	125	55	X	11	X	X		
X21	A 6160	5	25	25	X	15	X	-		
X22	A 6161	75	640	105	X	20	X	-		
X23	A 6162	5	65	25	X	8	X	-		
24										
25										

Results in ppm unless otherwise specified
T = element present: but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

258194

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
189	3.1 08 2611	22.8.84	EL45/82	2 OF 2

IE No.	SAMPLE No.	Cu	Pb	Zn	Mo	Ag	Au	Au Rpt		
1	DETECTION	5	5	5	0.5	1	0.012	0.012		
2	DIGESTION									
3	METHOD	103	103	103	103	114	329	329		
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										

Results in ppm unless otherwise specified
T = element present but concentration too low to measure
X = element concentration is below detection limit
– = element not determined

AUTHORISED OFFICER

258195

ANALABS

A division of MacDonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
100	3.1 08 2611B	28.8.84	EL49/82	1 OF 1

TUBE No.	SAMPLE No.	Sn	W							
1	6110	X	38							
2	6157	X	28							
3	6161	3	15							
4	6162	X	59							
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	3	10							
24	DIGESTION									
25	METHOD	401	401							

Results in ppm unless otherwise specified
T = element present, but concentration too low to measure
X = element concentration is below detection limit
— = element not determined

AUTHORISED OFFICER

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Appendix 2

Petrological Report C.M.S. 84/1/29

258197

122

Central Mineralogical Services

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

The Resident Geologist
AMAX Exploration (Aust.) Inc.
5, Osborne Avenue
LAUNCESTON / TAS. 7250

15th February, 1984

REPORT CMS 84/1/29

YOUR REFERENCE:	Submission Sheet Ref. 24 - 1 - 84
DATE RECEIVED:	25th January, 1984
SAMPLE NOS.:	10 Samples
SUBMITTED BY:	---
WORK REQUESTED:	Petrology

H.W. Fander

H.W. Fander, M. Sc.

258198

193

REPORT CMS 84/1/29

Ten rock samples were received for petrological study; thin-sections were prepared of all rocks, with an extra section for A 6482, which consisted of two different rock types. The offcuts were subjected to potash stain tests as routine procedure, to aid identification of K-feldspars or K-silicate glass, and to assist interpretations. The rocks are briefly described in the accompanying tables.

Summary

The suite comprises igneous rocks, one or two tuffs, and a possible altered greywacke; the rocks are affected by varying degrees of alteration, which determines, to some extent, the level of confidence of interpretations.

The igneous rocks include intrusive porphyritic rhyolites and felsites, two rather strange ?hybrid types, a meta-rhyolite, and a completely argillised "porphyry". Classification of these rocks relies heavily on ratios of feldspar species present and, since some of these are argillised or sericitised, the classifications are necessarily broad. Samples A 6484 and A 6491A are classified as intermediate, but both are believed to be hybrids resulting from the mixing of acid and basic material.

The tuffs comprise a fairly well-defined lithic-crystal tuff (A 6476) and a rock (A 6490A) which may be a reworked tuff or volcanomict sandstone rather than a true pyroclastic.

The "altered greywacke" may be tuffaceous in part, or may contain clastic particles of fine tuff/ash, but is really too severely altered for a confident interpretation.

No sulphides were detected, though the deuteric alteration affecting many of the rocks may well be accompanied by pyrite and/or other sulphides.

H.W. Fander, M. Sc.

	Rock Type - Composition	Fabric	Minor Minerals	Comments
471 (.S. 784)	Porphyritic Rhyolite. Phenocrysts of orthoclase and of corroded quartz, in a groundmass of fine felted plagioclase needles and shreds of chloritised biotite with quartz.	Phenocrysts up to 5 mm; groundmass uniform, faintly orientated, fine-grained.	Small vugs filled with clear K-feldspar (adularia), chlorite. Leucoxenised opaques.	Feldspar phenocrysts partly sericitised. Parts of rock brown due to oxidation of chlorite. Rock is intrusive, could be a rhyodacite (toscanite).
472	Argillised Porphyritic Felsite. Completely argillised feldspar phenocrysts, a few small corroded quartz phenocrysts, in an argillised felsitic groundmass of quartz and sericite.	Relict medium-grained felsitic textures. Some phenocrysts are fragmentary. Random fabric.	Fine oxidised mica (?biotite-chlorite). Quartz veins. Pervasive Fe-staining.	Argillic alteration is low-temperature hydrothermal. Rock broadly similar to A6471, also intrusive, but exact composition not known.
473	Porphyritic Rhyolite. Completely sericitised feldspar phenocrysts, embayed quartz crystals, a few K-feldspar crystals, in a fine felted K-feldspar groundmass with chlorite.	Matted-parallel textures with overprint of felsitic patches. Random phenocrysts.	A few chloritised ?hornblende crystals. Matted chlorite aggregates (deuteric). Fe-staining.	Selective sericitisation/chloritisation of plagioclase phenocrysts. Rock perhaps closer to quartz-trachyte than rhyolite. Probably intrusive.
476	Lithic-Crystal Tuff. Small and large fragments of altered intermediate lavas and of vitric tuffs, crystals and fragments of andesine, augite, quartz, K-feldspar. Chloritised matrix.	Poorly-sorted, weakly bedded. Lithic fragments up to 15 mm, i.e. lapilli size.	Fragments of chloritised basic glass. Fine carbonate associated with chloritisation.	Source rocks mostly intermediate to basic, coarsely-crystalline, but lithic fragments much more diverse. Post-depositional chloritisation.
478	Porphyritic Rhyolite. Small phenocrysts of quartz and of albite, generally in clusters set in a fine felsitic, cloudy groundmass of quartz and K-feldspar, with fine chlorite.	Phenocrysts are strongly stressed. Parts of groundmass have fine glassy/shard-like textures.	Patches and veinlets of fine granular epidote. Leucoxenised primary opaques.	May be extrusive, as suggested by groundmass textures. Composition was sodi-potassic, may be related to A6473. Epidote is deuteric.
481	Sheared, Altered ?Greywacke. Closely-packed small stretched ovoid grains of impure chert, shale, carbonaceous siltstone and shale; interstitial fine quartz, limonitic clay, mica flakes.	Well-sorted; clastic textures preserved. Well-bedded with superimposed shearing.	Crosscutting goethite veinlets.	Rock is severely altered and most components difficult to recognise, but grains apparently mostly sedimentary rocks, with possible reworked ?tuffs.
482A	Metarhyolite. Stressed, fractured quartz and sericitised feldspar phenocrysts in a schistose groundmass of fine sericite flakes, quartz splinters, and ultrafine leucoxene.	Strongly schistose, with stressed phenocrysts. Possible relict flow-banding.	Selective iron-staining of some patches, ?altered biotite.	Rock was broadly rhyolitic. Feldspar phenocrysts were sericitised after shearing, though groundmass already altered (before shearing).
482B	Altered Porphyry. Scattered argillised, ferruginised feldspar phenocrysts, whole and fragmentary quartz crystals, in a groundmass of clays and limonite, ultrafine hematite.	Random distribution and orientation of phenocrysts. Strutureless groundmass.	Isolated, relatively large euhedral zircon crystals.	Poorly-preserved relict features suggest a medium-grained intrusive of acid composition. Contrasts with A. No shearing.

258199

	Rock Type - Composition	Fabric	Minor Minerals	Comments
484	Tonalite. Fairly closely-packed phenocrysts of partly argillised andesine, partly uralitised augite; medium-grained interstitial granular quartz (20 %), K-feldspar (10 %).	Phenocrysts up to 5 mm. Random orientation. Groundmass averages 0.3 mm grainsize.	Conspicuous primary magnetite. Secondary chlorite and epidote. Apatite.	Quite possibly a hybrid rock, composed of a coarse gabbroic assemblage and a late, finer-grained granitic assemblage. Overall composition is tonalitic.
490A	"Crystal Tuff". Composed mainly of subangular oligoclase-andesine fragments, with minor rounded quartz, lithic grains (rhyolite cp. A6478, others), augite; chloritised throughout.	Closely-packed; well-sorted, but lithic grains generally coarser. Weakly bedded.	Fine pale green clinozoisite throughout. Detrital, leucoxenised opaques.	May not be a true tuff, but rather reworked material, i.e. volcanomict sandstone; main source was rock similar to A 6484.
491A (S. 793)	Altered Porphyritic ?Andesite. Phenocrysts of andesine, augite, chloritised ?orthopyroxene or olivine, in a very fine cloudy felsitic groundmass (now secondary quartz).	Some flow-orientation of phenocrysts and groundmass. Phenocrysts are corroded.	A few strongly corroded quartz phenocrysts or xenocrysts. Leucoxenised oxide opaques.	Believed to be a hybrid rock, perhaps extrusive, composed of mafic and intermediate/acid assemblages (cp. A6484). Deuterically altered.
95				258200

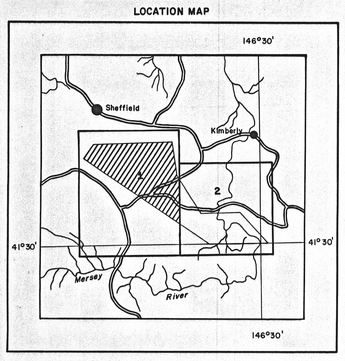
Appendix 3

Sampling and geology outside E.L. 49/82 at Gog Range

3317

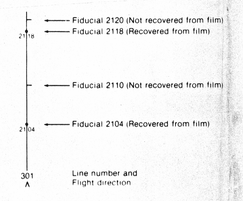


LOCATION MAP



Scale 1 : 250,000

Flight Line



DIGHEM[III] SURVEY

SHEFFIELD AREA, TASMANIA

ELECTROMAGNETIC ANOMALIES

FOR

AMAX AUSTRALIA LTD.

258202

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

3317 SHEET 1

5 cm

8L-2306 vol 2-2.

ANOMALY GRADE	EM GRADE SYMBOL	CONDUCTANCE RANGE (MHOS)
6	●	> 99
5	✱	50—99
4	◉	20—49
3	◎	10—19
2	○	5— 9
1	○	< 5
—	×	Indeterminate

DIGHEM anomalies are divided into six grades of conductivity-thickness product. This product in mhos is a measure of conductance.

anomaly "name" — interpretive symbol

Depth is greater than
· 15 m
⋮ 30 m
⋮ 45 m
⋮ 60 m

Inphase and Quadrature of Coaxial Coil is greater than
· 5 ppm
·· 10 ppm
··· 15 ppm
···· 20 ppm

Interpretive symbol — Conductor ("model")

- B. Bedrock conductor
- S. Conductive cover ("horizontal thin sheet")
- H. Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half space")
- E. Edge of broad conductor ("edge of half space")
- L. Culture, e.g. power line, building, fence

arcs indicate the conductor has a thickness > 10 m

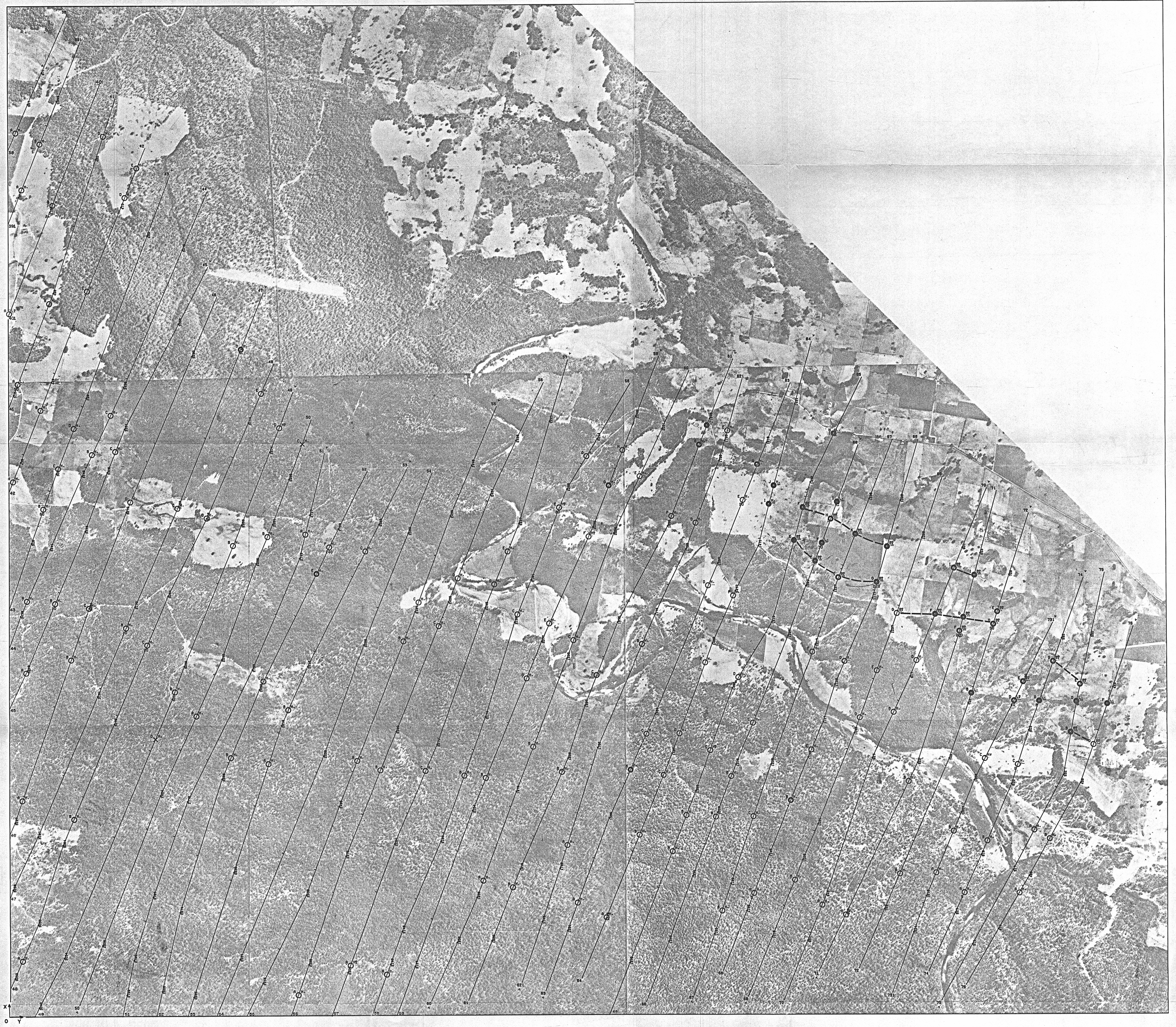


dip direction
magnetic correlation in nT (gammas)
conductor axis
flight line

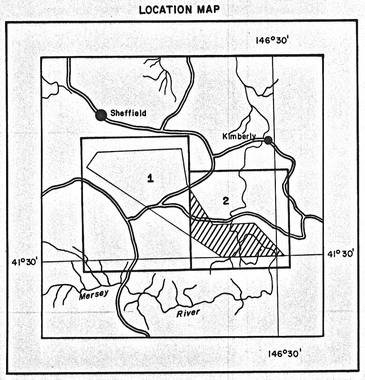
REGISTERED PROFESSIONAL ENGINEER
D. FRASER
PROVINCE OF ONTARIO

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB./84	TM	

3318

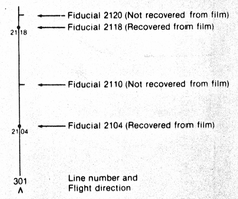


LOCATION MAP



Scale 1 : 250,000

Flight Line



DIGHEM^{III} SURVEY

SHEFFIELD AREA, TASMANIA

ELECTROMAGNETIC ANOMALIES

FOR 258203

AMAX AUSTRALIA LTD.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

3318 SHEET 2

5 cm

8-2306 vol 2-2

REGISTERED PROFESSIONAL ENGINEER D. C. FRASER PROVINCE OF ONTARIO

ANOMALY GRADE	EM GRADE SYMBOL	CONDUCTANCE RANGE (MHOS)
6	●	> 99
5	✹	50—99
4	●	20—49
3	◎	10—19
2	◎	5— 9
1	○	< 5
—	×	Indeterminate

DIGHEM anomalies are divided into six grades of conductivity-thickness product. This product in mhos is a measure of conductance.

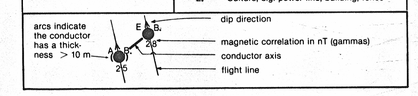
anomaly "name" → C$_1$ ← interpretive symbol

Depth is greater than
· 15 m
⋮ 30 m
⋮ 45 m
⋮ 60 m

Inphase and Quadrature of Coaxial Coil is greater than
· 5 ppm
·· 10 ppm
··· 15 ppm
···· 20 ppm

Interpretive symbol — Conductor ("model")

- B$_1$ Bedrock conductor
- S$_1$ Conductive cover ("horizontal thin sheet")
- H$_1$ Broad conductive rock unit, deep conductive weathering, thick conductive cover ("half space")
- E$_1$ Edge of broad conductor ("edge of half space")
- L$_1$ Culture, e.g. power line, building, fence



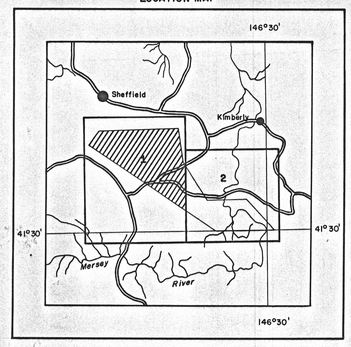
JOB	DATE	DRAWN BY	CHECKED BY
368	FEB. /84	YW	D Fraser

3319



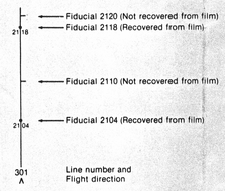
X
0 Y

LOCATION MAP



Scale 1 : 250,000

Flight Line



DIGHEM^{III} SURVEY

SHEFFIELD AREA, TASMANIA

RESISTIVITY

FOR

AMAX AUSTRALIA LTD.

258204

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 1

BL-2306 vol 2-2

3319

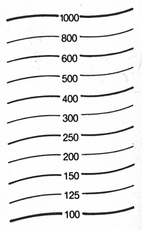
5 cm



REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

LEGEND

Contours in ohm — m
at ten intervals per decade



Note

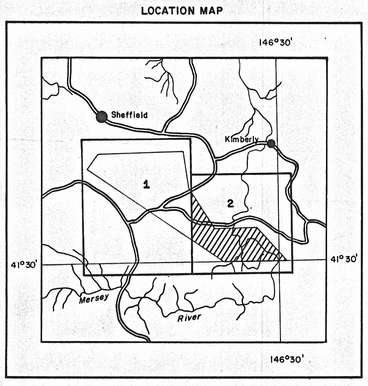
The numbers face in the direction of increasing value.

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB./84		

3320

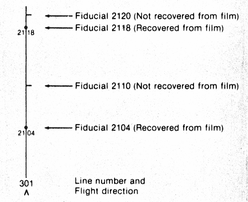


LOCATION MAP



Scale 1 : 250,000

Flight Line



DIGHEM^{III} SURVEY

SHEFFIELD AREA, TASMANIA

RESISTIVITY

258205 FOR

AMAX AUSTRALIA LTD.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

5 cm

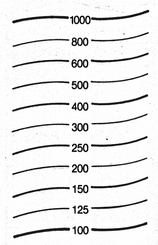
SHEET 2

3320 84-2306 vol 2-2.



LEGEND

Contours in ohm — m
at ten intervals per decade

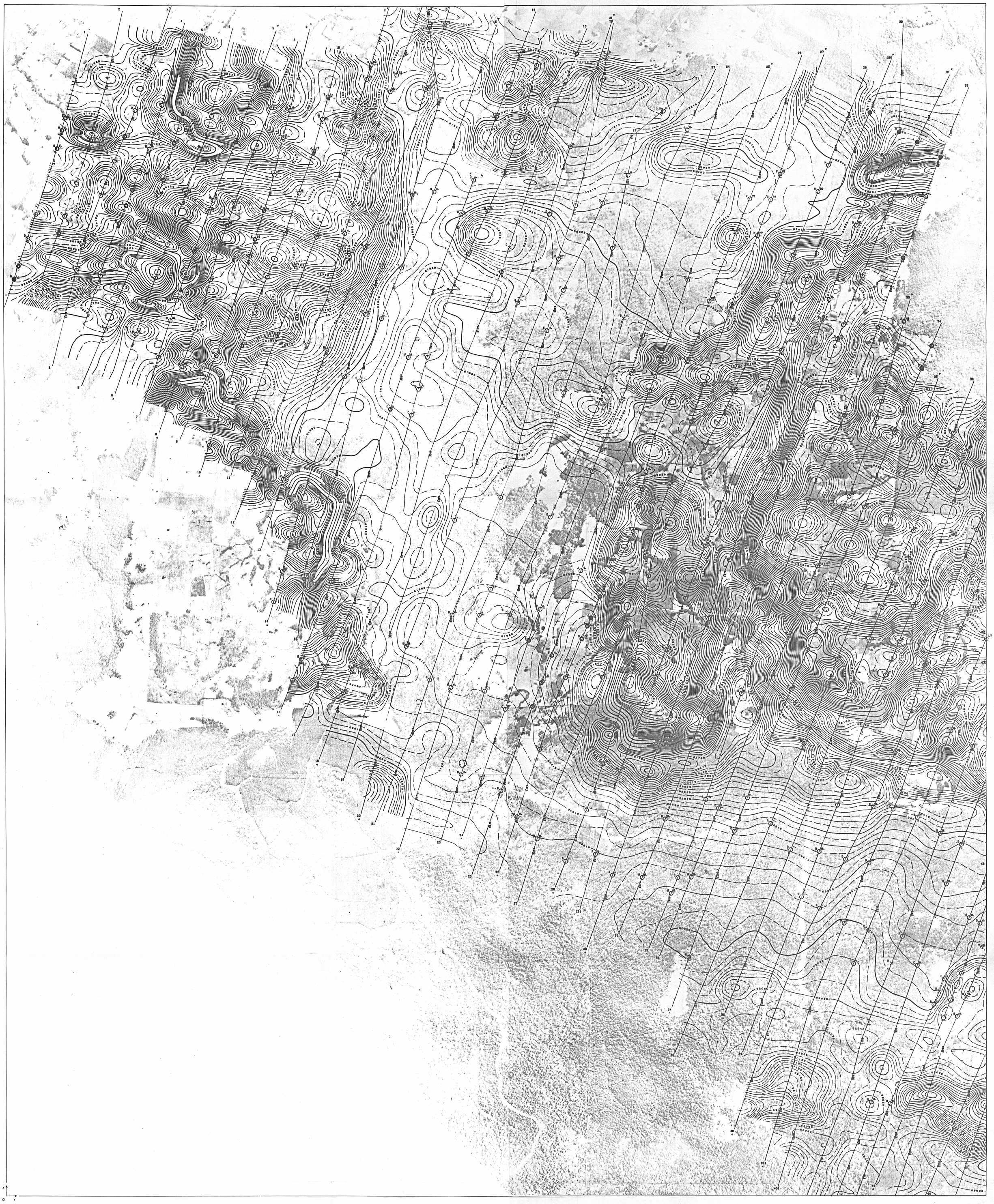


Note

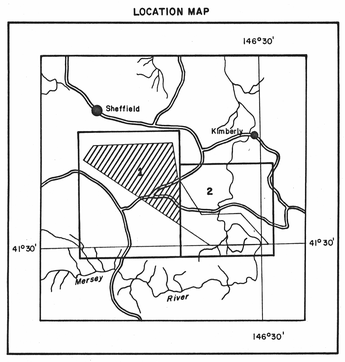
The numbers face in the direction of increasing value.

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB /84	RH	D Fraser

3321



LOCATION MAP



Scale 1 : 250,000

Flight Line

2118 — Fiducial 2120 (Not recovered from film)
Fiducial 2118 (Recovered from film)

Fiducial 2110 (Not recovered from film)

2104 — Fiducial 2104 (Recovered from film)

301 — Line number and Flight direction

DIGHEM[III] SURVEY

SHEFFIELD AREA, TASMANIA

TOTAL FIELD MAGNETICS

FOR 258206

AMAX AUSTRALIA LTD.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

SHEET 1

3321

82-2306 vol 2-2.

5 cm

REGISTERED PROFESSIONAL ENGINEER
D. R. FRASER
PROVINCE OF ONTARIO

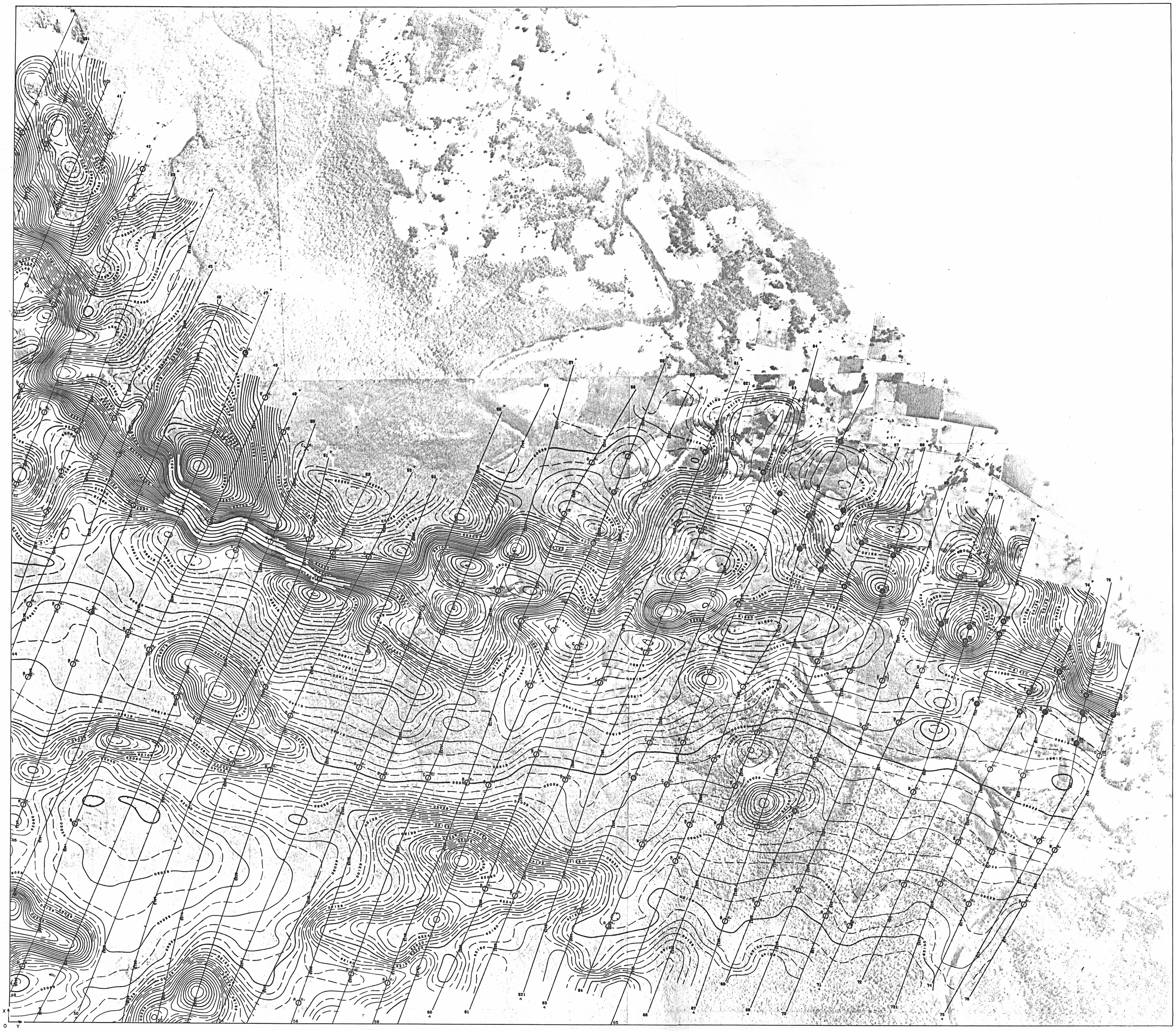
ISOMAGNETIC LINES
(total field)

500	500 nT
100	100 nT
20	20 nT
10	10 nT
	magnetic depression

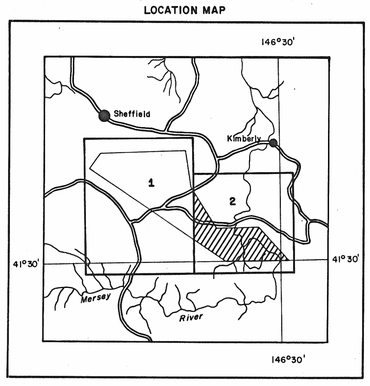
Magnetic Inclination within the survey area: 72°

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB./84	AM	D Fraser

3322

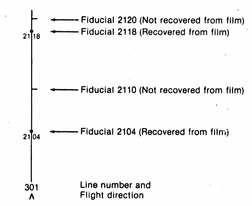


LOCATION MAP



Scale 1 : 250,000

Flight Line



DIGHEM[III] SURVEY

SHEFFIELD AREA, TASMANIA

TOTAL FIELD MAGNETICS

258207

FOR

AMAX AUSTRALIA LTD.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

5 cm

SHEET 2

3322

84-2306 vol 2-2





ISOMAGNETIC LINES
(total field)

500	500 nT
100	100 nT
20	20 nT
10	10 nT
	magnetic depression

Magnetic Inclination within the survey area: 72°

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB /84	FM	DFraser

3323

LOCATION MAP

Scale 1 : 250,000

Flight Line



DIGHEM^{III} SURVEY

SHEFFIELD AREA, TASMANIA

ENHANCED MAGNETICS

258208

FOR

AMAX AUSTRALIA LTD.

Scale 1:10,000

1:2 0 1/2 1 Kilometres

1:4 0 1/4 1/2 Miles

5 cm

SHEET 1

84-2306 vol 2-2 ((3323

ISOMAGNETIC LINES
(enhanced field)

5000	5 000 nT
1000	1 000 nT
200	200 nT
100	100 nT
	magnetic depression

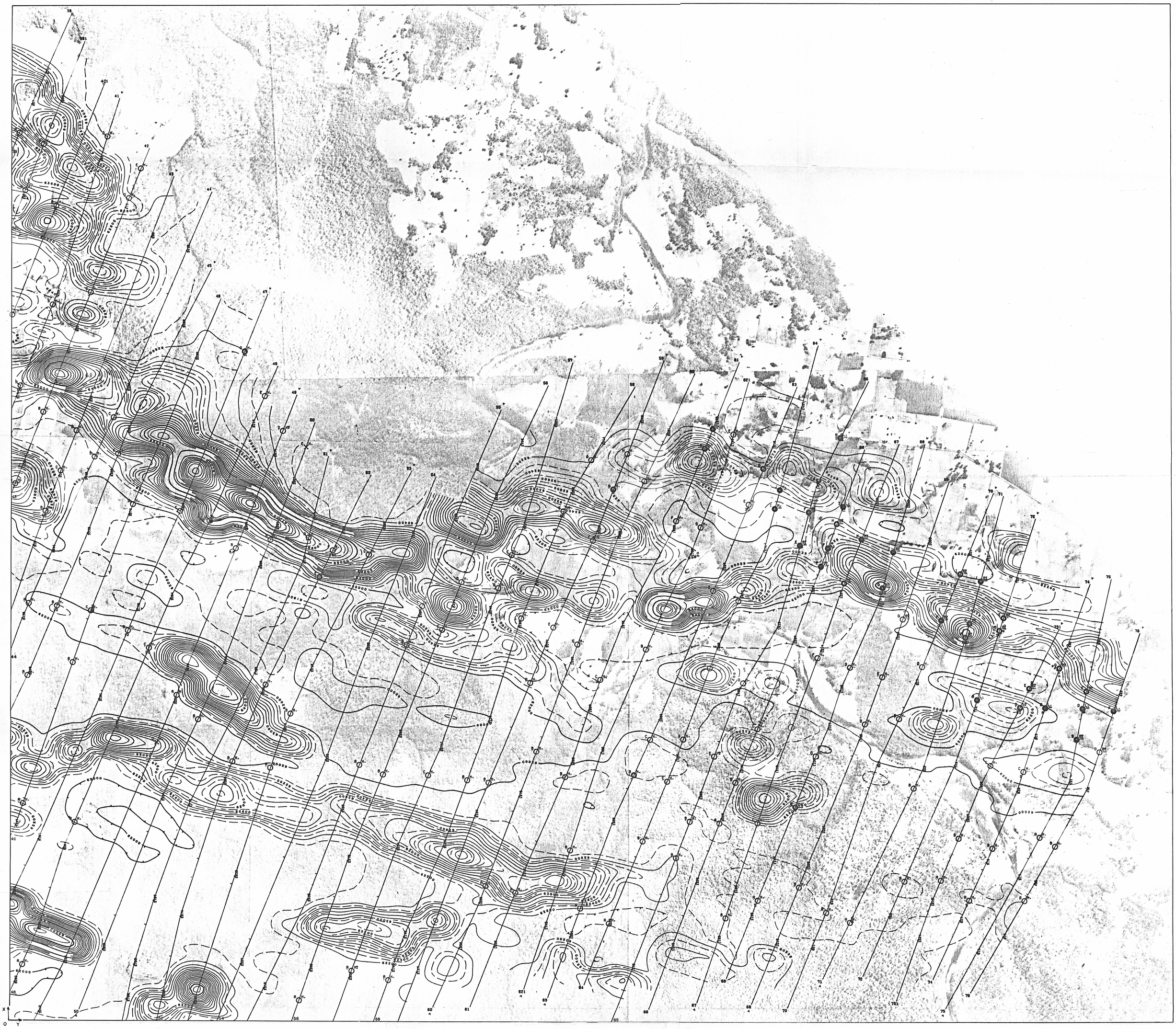


Frequency response of magnetic operator

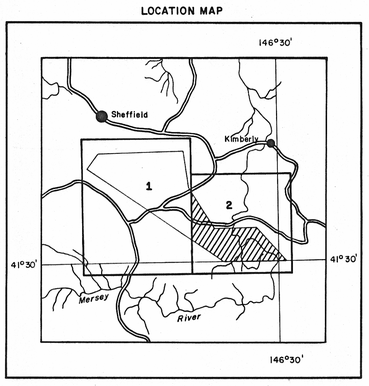
REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB./84	JM	D Fraser

3324

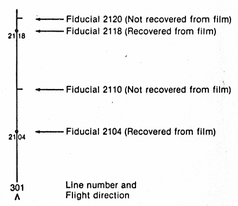


LOCATION MAP



Scale 1 : 250,000

Flight Line



DIGHEM^{III} SURVEY

SHEFFIELD AREA, TASMANIA

ENHANCED MAGNETICS

FOR 258209

AMAX AUSTRALIA LTD.

Scale 1:10,000

1/2 0 1/2 1 Kilometres

1/4 0 1/4 1/2 Miles

5 cm

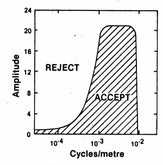
SHEET 2

3324

84-2306 vol 2-2.

ISOMAGNETIC LINES
(enhanced field)

5000	5 000 nT
1000	1 000 nT
200	200 nT
100	100 nT
	magnetic depression



Frequency response of magnetic operator

REGISTERED PROFESSIONAL ENGINEER
D. C. FRASER
PROVINCE OF ONTARIO

JOB	DATE	DRAWN BY	CHECKED BY
368	FEB /84	KM	D Fraser

E.L. 49/82

LOWER BEULAH

LOWER BEULAH ROAD

HARTS HILL

STIR OF THE WEST ROAD

GREENOCK ROAD

DYNANS BRIDGE ROAD

WEEGENA

WEEGENA ROAD

GRIFFITHS ROAD

BEULAH FORMATION

MERSEY

GOG RANGE GREYWACKE

RIVER

LOBSTER RIVULET

HOSE

Creek

Contact Obscured

Fault

Bedded tuffaceous greywacke and coarse glass rich volcaniclastic

Quartz veining

Silicified shear 0.5m wide

Siltstone - greywacke & coarse volcaniclastics

Green float fragments

Volcaniclastic lenses, lack of sorting quartz pebbles

Porphyritic rhyolite - rhyodacite intrusive

Brecciation & silicification with tourmaline / tourmaline

Chloritisation

Tonalite med grained intrusive hybrid gabbroic - granitic phases

Quartz feldspar intrusive porphyritic felsite

Roland Conglomerate lens, scattered outcrops of volcanics

Quartz feldspar porphyry

Deeply weathered serricitised phenocrysts

Siltstone & grand tuff

Scattered pyrite grains

Chert pebble conglomerate lenses

Fine-med grained clean, silicified sediment

Deeply weathered red brown bedrock

Fine-med grained tuffaceous sediments

Deeply weathered serricitised intermediate-basic intrusive

Conglomerate, volcanic and pc detritus

Bedded fine-med grained sediments

Alluvium

Crystal lithic tuff, no evidence remaining grades north into fine crystal tuffs

Porphyritic rhyolite fine glassy-shard like extrusive

Med grained crystal tuff and siltstone

Lithic crystal tuff Source pick intervened basin

Volcaniclastic fine crystal tuff, fine crystal tuff, coarse tuff

Fine-med grained volcaniclastic foliated, lithophile

Transported green & veiner Roland conglomerate series

Tuff or volcaniclastic varying degree reworking equal proportion lithic crystal

Interbedded fine crystal tuff & med crystal lithic tuffs

Gossanous material with irregular quarty veins

Volcaniclastic med grained, quartz rich serricitised glass fragments limonitic joints

Rhyolitic tuff

Miocaenous greywacke & chert pebble conglomerate

Altered porphyritic andesite - extrusive

Crystal tuff - volcaniclastic coarse rock

Metrichrysing, fine banded, sheared

Sheared porphyritic acid, med grained intrusive

Grit - pebble lenses in siltstone

Quartz - chert pebble conglomerate lenses in siltstone

Greywacke greywacke with grit reducing south facing ?

Rhyolite tuff crystal, fine crystal, lithics (5mm) no evidence reworking

Limonitic outcrop

Silicified volcanic fine-med grained

Volcanic or clasts ? rhyolite, foliated limonite joints

Transported green & veiner Roland conglomerate series

med coarse grained quartz - glass rich volcaniclastic

Siltstone

Sample locations: A6164, A6437, A6436, A6437, A6438, A6153, A6152, A6151, A6150, A6156, A6157, A6158, A6485A, A6159, A6485, A6483A, A6160, A6161, A6162, A6163, A6164, A6165, A6166, A6167, A6168, A6169, A6170, A6171, A6172, A6173, A6174, A6175, A6176, A6177, A6178, A6179, A6180, A6181, A6182, A6183, A6184, A6185, A6186, A6187, A6188, A6189, A6190, A6191, A6192, A6193, A6194, A6195, A6196, A6197, A6198, A6199,