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EXPLORATION LICENCE 11/88

GOWRIE PARK

TASMANIA

PROGRESS REPORT FOR THE YEAR ENDED JULY 1, 1989

VOLUME 1

TEXT AND APPENDICES 1-8

MICROFILMED

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1.0 Summary and Conclusions

Exploration by Aberfoyle within the Gowrie Park exploration licence (E.L. 11/88) during 1988/1989 concentrated predominantly on two areas, the Stonebridge prospect (near Paradise) and the Lower Beulah prospect. Only a very limited regional sampling programme was undertaken.

In the Stonebridge area, a grid was established over the Cambrian volcanic rocks. A programme of mapping, sampling and UTEM over this grid failed to detect any base metal targets worthy of follow up.

Rocks located in this area comprise a mixture of felsic intrusive and intermediate extrusives. The discovery of fossils with a Late Middle Cambrian age indicate time equivalence with the Southwell sub-group on the west coast.

A detailed exploration programme in the Lower Beulah area involved gridding, soil sampling, ground magnetics, mapping and sampling. Following this work an alteration target was tested by diamond drilling at the Beulah Barite prospect.

Gridding in the area covers the contact of the Gog Range Greywacke with the Beulah Formation. Rocks located comprise interbedded shales and greywackes of the Gog Range Greywacke and intermediate lavas and volcaniclastics, with minor felsic units, of the Beulah Formation.

The soil sampling programme produced a number of lead and zinc anomalies, which are commonly associated with Beulah Formation rocks close to the contact with Gog Range sediments. The ground magnetic survey indicates that the sediments are magnetically quiet but the Beulah Formation volcanics are quite variable. A possible fault has been interpreted from this data.

Detailed examination of the rocks associated with the Beulah Barite occurrence was undertaken. The Beulah Barite prospect encompasses an old barite mine worked early this century and a strong Pb, Zn soil anomaly close to the Gog Range/Beulah Formation contact.

Rocks located from surface mapping and sampling of previous CRA drillholes in the area comprised strongly hydrothermally altered lavas and volcaniclastics. Drill testing with one diamond drillhole (BB6) aimed at a possible target on the sediment/volcanic contact at a depth below CRA's UTEM coverage. The drillhole deviated considerably, however, and did not intersect the target footwall position. The hole failed to intersect significant mineralisation, but remained in strongly altered lavas and volcaniclastics. This alteration is interpreted to be hangingwall type, suggesting that potential still exists for base metal mineralisation at depth.

Limited regional sampling was undertaken in the licence. Samples of altered lavas and volcaniclastics were collected from both outcrop and a CRA drillhole in the Gowrie Park area. The rocks are interpreted to be probable equivalents of the Tyndall Group i.e. high in the Mt. Read stratigraphic sequence.

Alteration and mineralisation intersected by the CRA programme suggests that the area has potential for base metal mineralisation which should be investigated further.

2.0 Introduction

Exploration licence EL 11/88 was granted to Aberfoyle Resources Ltd. on 1st August, 1988 for ten years, with a required 50% reduction after 5 years. Previously the ground was part of EL 7/73 held up to July, 1987 by CRA Exploration Pty. Ltd.

The Gowrie Park licence (EL 11/88) covers 79 square kilometres approximately 10 km south of Sheffield. The ground covered by the licence extends north from the northern slopes of Mt. Claude and Mt. Roland to the Dasher River in the north and from near Cethana in the west to the Lower Beulah area in the east (refer to plate GP 28).

Previous exploration in the area has centred on the Cambrian volcanic rocks which form part of the northeastern extension of the Mount Read volcanic arc and which cover nearly half the licence (refer to plate GP 28). The Cambrian rocks within the licence comprise three distinct packages referred to as, the Minnow Keratophyre, Gog Range Greywacke and the Beulah Formation (after Jennings, 1979). The stratigraphic sequence has been interpreted by Jennings (1979) as Beulah Formation overlain by the Gog Range Greywacke which is in turn overlain by the Minnow Keratophyre.

The Beulah Formation rocks comprise predominantly intermediate lavas and lava breccias with minor subsidiary dacitic and volcaniclastic units and are interpreted by Jack (1988) to be correlates of the Que-Hellyer package. The Gog Range Greywacke comprises a mixture of greywackes and sediments with only a minor volcanic component. The Minnow Keratophyre rocks comprising predominantly acid volcanic rocks have been interpreted to be correlates of the Tyndall Group (Sise, 1987).

Aberfoyle Resources Limited
EXPLORATION DIVISION
NORTHERN TASMANIA
E.L. 11/88 GOWRIE PARK
LOCATION PLAN & CAMBRIAN GEOLOGY
REVISIONS
Init. Date Init. Date
Location Code :
Scale : As shown
Date : July, 1989
Compiled : SWR
Drawn : SWR, RJE
Traced : RJE
Checked : SWR
Plate No. : GP 28
N
Lake Barrington
SHEFFIELD
DEVONPORT
HOBART
RIVER
MERSEY
Staverton
Gowrie Park
Cethana
Beulah
Mt. Roland
Mt. Vandyke
Mt. Claude
DASHER
5410000m N
430000mE
440000mE
450000mE
0
5 Kms.
5 cm
CAMBRIAN ROCKS (after Jennings, 1979)
€mk Acid volcanics
€gg Greywacke & other sediments
€bf Basalts, andesites & minor dacites
€ Unassigned

No significant mineral deposits have yet been discovered in the area. A number of silver-lead mines were worked in the area around the turn of the century (Jennings, 1979). Barite (635 t) was extracted from a mine in the Lower Beulah area, operated during the period 1911 to 1920 (Jennings, 1979).

CRA exploration in the area centred on the Cambrian volcanic rocks outcropping on the slopes of Mt. Claude and Mt. Roland and also in the Lower Beulah area. Drill testing a number of geophysical, geochemical and geological targets failed to intersect massive sulphides.

CRA relinquished the Sheffield licence (7/73) in July, 1987 and the adjacent Cethana licence (10/76) in February, 1988. A summary of their exploration in the Sheffield and Cethana licences, up to the time of relinquishment, is available in Funnell (1987) and Caithness and von Strokirch (1988) respectively.

Aberfoyle's primary target in the licence is volcanogenic massive sulphides. Exploration in the area since aquiring the Gowrie Park licence initially involved a re-evaluation of the CRA exploration, followed by detailed exploration in those areas that appeared to show most potential. Only very limited regional scale exploration was undertaken.

Detailed work undertaken included combined gridding programmes over parts of the Gowrie Park and adjacent Beulah licences in both the Stonebridge area (near Paradise) and the Lower Beulah areas. This was followed by mapping and geophysical surveying at Stonebridge and an extensive soil sampling, magnetic surveying and mapping programme in the Lower Beulah area. The most advanced exploration undertaken in the licence involved costeaning and diamond drill testing in the vicinity of the Beulah Barite.

10

3.0 Previous Exploration

Previous exploration within the licence is summarised on plate GP 25 and is discussed briefly below.

The earliest recorded exploration in the licence was conducted by prospectors late last century (Jennings, 1979). They located a number of lead-silver prospects in the area (Mt. Roland and Mt. Claude prospects) and economically mined some of these. This style of mineralisation is considered to be related to the Devonian granites found in the area.

In the Lower Beulah area, prospectors located outcropping barite veins with some contamination by base metal sulphides. The barite was mined intermittently by the EZ Co. of Australasia during the period 1911 to 1920, (Jennings, 1979). During this period they extracted 635 t of barite.

Initial systematic exploration within the licence was undertaken by Asarco in 1973 to 1976 when they conducted a regional stream sediment sampling programme. Follow-up of significant anomalies failed to provide encouragment and the licence was subsequently relinquished.

CRA exploration in the licence, up to 1987, was aimed at discovering volcanogenic massive sulphide deposits. They used Asarco's data to establish a number of prospects worthy of further work (Funnell, 1987). This work centred on the Cambrian rocks found on the northern slopes of Mt. Claude and Mt. Roland (Gowrie Park, Mt. Roland and West Mt. Roland grids) and also in the Lower Beulah area (Symonds, Beulah Barite, Beulah Extended and Garden of Eden grids).

Aberfoyle Resources Limited

EXPLORATION DIVISION

NORTHERN TASMANIA

E.L. 11/88 GOWRIE PARK

SUMMARY OF EXPLORATION

REVISIONS			
Init.	Date	Init.	Date

Location Code :

Scale : As shown

Date : July, 1989

Compiled : SWR

Drawn : SWR, RJE

Traced : RJE

Checked : SWR

Plate No. : GP 26

N

5 cm

Lake Barrington

SHEFFIELD

DEVONPORT

HOBART

REGIONAL

1973-76 ASARCO stream sediment sampling

1981 CRA Airborne EM (Dighem)

STONEBRIDGE

1985-87 CRA mapping, soil geochem., trenching

1988-89 ABERFOYLE mapping, UTEM

MT. ROLAND & WEST MT. ROLAND

1982-85 CRA Geochem./Geophysics - 2 drillholes

RIVER

DASHER

MERSEY RIVER

Staverton

Beulah

Gowrie Park

Mt. Roland

Cethana

Mt. Vandyke

Mt. Claude

5410000m N

CETHANA - GOWRIE PARK AREA

1976-86 CRA Geochem./Geophysics - 5 drillholes

0 5 Kms.

430000mE

440000mE

450000mE

CAMBRIAN ROCKS (after Jennings, 1979)

€mk	Acid volcanics
€gg	Greywacke & other sediments
€bf	Basalts, andesites & minor dacites
€	Unassigned

LOWER BEULAH AREA

(BEULAH BARITE)

1911-20 EZ barite mine

1985-87 CRA - Geochem./ Geophysics - 8 drillholes

1988-89 ABERFOYLE
- gridding
- soil geochem
- mapping
- 1 drillhole

6520 42

On the northern slopes of Mt. Claude, CRA undertook a gridding, soil sampling and geophysical programme. Work in this area, termed the Gowrie Park grid, formed part of a more extensive programme along an alteration trend from West Cethana-Cethana-East Cethana, on their adjacent licence (EL 10/76), towards Gowrie Park on licence EL 7/73 (refer to plate GP 26). The programme produced a number of anomalies within the current licence boundary (EL 11/88). Drill testing on the Gowrie Park grid, to 1987, involved five drillholes (77GPC1, [107.1m], 77GPC2 [112.75m], 78GPC3 [94.1m], RD84 GP4 [84.0m] and DD85 GP5 [96.5m]) totalling 494.45m. Summaries of the results of the drilling can be found in Purvis (1978), Temby (1985) and von Strokirch (1986).

Exploration in the Mt. Roland area involved work on two grids (the Mt. Roland and West Mt. Roland)(refer to plate GP 26). Work included mapping, geochemistry and airborne and surface geophysics. The programme resulted in two drillholes DD80 MR1 and RD84 MR2 which failed to intersect massive sulphides. More detailed summaries of the work on these grids can be found in Weber (1983) and Temby (1985).

The Stonebridge prospect, located on the northeastern flanks of Mt. Roland was explored in detail during the period 1985 to 1987 (refer to plate GP 26). Initially, CRA established a grid over a reported barite occurrence (Paradise barite of Jennings, 1979). Soil sampling located an area of anomalous lead and zinc associated with a gossan. Trenching and geophysical surveying failed to detect massive sulphide accumulations and work was abandoned in July, 1987. More detailed discussions of exploration on the Stonebridge prospect can be found in Temby (1985), von Strokirch (1986), Caithness and von Strokirch (1987) and Funnell (1987).

The Lower Beulah area, in the eastern part of the licence, has been the site of an extensive exploration programme by CRA (refer to plate GP 26). An initial grid was established over the Beulah Barite occurrence, in the area of the old barite mine (refer to Jennings, 1979). This grid was termed the Beulah Barite grid which was later extended (Beulah Extended grid)(Temby, 1985). Five drillholes were drilled on this grid aimed at coincident geophysical/geochemical targets (Drillholes PD83 BB1, PD84 BB2, PD84 BB3, DD84 BB4 and DD84 BB5). Descriptions of the results from this drilling programme can be found in Temby (1985) and von Strokirch (1986).

The gridding programme in the area was extended to the east (Garden of Eden grid) and also to the west (Symonds grid). Soil sampling and UTEM in these areas produced two targets followed up with drilling. Drillholes DD86 SM1 and DD86 SM2 on the Symonds grid and DD86 GE1 on the Garden of Eden grid failed to intersect massive sulphide mineralisation (Caithness and von Strokirch, 1987). No further work was recommended for the area.

4.0 1988/1989 Exploration

Exploration in 1988/1989 comprised work in two main areas, this comprised:-

Lower Beulah area

1. Gridding over Beulah Formation rocks in the Lower Beulah area (covering the Beulah Barite occurrence and also further north onto the adjacent Beulah licence).

2. Soil sampling over the established grid.

3. A ground magnetic survey over the barite occurrence.

4. Follow-up mapping and sampling at 1:2,500 scale with 1:10,000 interpretation.

5. Re-interpretation of the CRA data for the Beulah Barite prospect (geophysical and drillhole data).

6. Re-exposing costeans formed by CRA.

7. Diamond drilling.

Stonebridge area

1. Gridding over Cambrian volcanic rocks in the area of the Paradise Barite occurrence.

2. Mapping and sampling at 1:2500 scale with 1:2500 interpretation.

3. UTEM surveying over the grid.

Only very limited regional reconnaissance involving some rock chip sampling was undertaken.

4.1 Lower Beulah Area

4.1.1 Gridding

In August 1988 a grid was established in the Lower Beulah area over parts of both the Gowrie Park and Beulah licences. The combined grid is shown on plate GP6a. The grid was set up by marking points at 200m intervals along Dynans Bridge Road, with the gridlines closed to 100m spacings in the area of the Beulah Barite mine. The north-south gridlines were set-up at 000° AMG (348° mag).

The control points on Dynans Bridge Road were accurately surveyed only after the gridding had commenced with the result that some of the established gridlines were not evenly spaced at 200m.

The grid covers a mixture of cleared forestry land and open farmland with some bush around the Barite mine. This meant that only minor line cutting was required.

4.1.2 Soil Sampling

A soil sampling programme was conducted over the Lower Beulah/Gowrie Park grid from September to November 1988. Samples were taken at 25m intervals. Samples were collected with a power auger from 'C' horizon at depths of generally just less than 1m. Sample locations and results are included as Appendix 1. Samples were analysed for copper, lead, zinc, silver and arsenic.

Image processed plots of the sample analyses were completed in February 1989 and are included as plates GP 29A to 29E. Significant results include a coincident zone anomalous in lead and zinc associated with the Beulah Barite (50700E, 5408700N, max. 980 ppm Pb, 535 ppm Zn). The raw data with sample numbers and results is shown at 1:1,000 scale on plate GP17.

The anomalous zone is,however, only one of a number of areas with strong lead anomalism which lie along a northwesterly trend (refer to plate GP 29B). Of these areas, zinc is also anomalous at ~49600E, 5408900N (max. 705 ppm Pb, 700 ppm Zn) and at ~51200E, 5408700N (max. 445 ppm Pb, 420 ppm Zn).

In the grid on the Gowrie Park licence, copper is rarely anomalous (maximum values are 225 ppm at 49800E, 5408550N and 225 ppm at 51600E, 5408000N). The copper plot (plate GP 29A) shows a broad region of slight highs in the southwest areas of the grid. These slight highs are associated with distinct lows in the lead and zinc geochemistry (plates GP 29B and GP 29C respt). The copper high/Pb, Zn low is defined by a sharp cutoff which trends northwest from ~51000E, 5408000N to 48000E, 5409400N, and then swings ~ grid north.

Silver and arsenic form mainly spot highs, with no significant trends apparent (plates GP 29D and GP 29E). Both silver and arsenic are anomalous in the immediate area of the Beulah barite (6.0 ppm Ag and 94 ppm As). Elsewhere on the grid, weakly anomalous arsenic levels occur at 49000E, 5408750N (31 ppm), at 51000E, 5408500N (46 ppm), and in the easternmost area of the grid (max. 130 ppm). Silver is weakly anomalous at two spots along line 51000E (5408475N max. 2.0 ppm and 5408950N 2.5 ppm).

4.1.3 Ground Magnetic Survey

5.6 line kilometres of ground magnetic surveying was completed on 200m spaced lines in the vicinity of the barite occurrence. Computer contoured results are shown in plate GP13.

(17

Major points of interest are the magnetically 'quiet' zone in the lower half of the sheet, i.e. south of ~ 5408700N. Mapping in this area has indicated that the 'quiet' area comprises sediments of the Gog Range Greywacke. North of ~ 5409000N the survey has indicated that the Beulah Formation lavas are quite variable in magnetic character, though generally quite high (refer also to section 4.1.4.1).

The contact of the sediments with the Beulah Formation lavas is quite well defined by the magnetic survey and trends ~ 300° amg (refer also to section 4.1.4.1 and plate GP5B). A 'linear' from ~50500E, 5408700N to 51300E, 5409000N (i.e. trending 065° amg) has been interpreted as a fault (refer also to plate GP5B).

Interestingly, the Beulah Barite (50700E, 8700N) occurs within the quiet area, but close to the interpreted Gog Range/Beulah Formation contact.

4.1.4 Geology

Following the establishment of the grid and the completion of the soil sampling and magnetic surveying a surface mapping programme was undertaken over the gridded area. Mapping was recorded at 1:2,500 scale for the whole Lower Beulah gridded area (refer to section 4.1.4.1, plates GP25A, B, C and D and Appendix 5 for a list of abbreviations used). More detailed mapping (1:1,000 scale) was undertaken in the immediated area of the Beulah Barite (refer to section 4.1.4.2 and plate GP15). A total of 66 rock chip samples were collected from the area for routine petrological description and/or geochemical analysis (sample locations, descriptions and geochemical results are included as Appendices 2, 3 and 4 respectively).

4.1.4.1 1:2,500 scale

Rocks located in the Lower Beulah area comprise sediments of the Gog Range Greywacke and a mixture of basaltic to andesitic lavas, lava breccias and volcaniclastic units of the Beulah Formation. Only very minor felsic lavas and volcaniclastics have been located (refer to Appendices 2 to 4 and plates GP25A to D).

The Gog Range sediments comprise a mixture of orange greywackes, brown mudstones and grey to black shales. The greywackes are typically medium to coarse grained and are derived from pelitic metamorphics (based on the presence of mica flakes and common rounded quartz fragments) and some felsic volcanics. The shales are very fine grained and are occasionally micaceous. Pyritic shales and greywackes were reportedly intersected in CRA drillholes SM1 and SM2 (Caithness and von Strokirch, 1987).

The Beulah formation rocks are dominated by intermediate lavas and lava breccia. The least altered basalts and andesites commonly contain abundant plagioclase, augite and occasionally hornblende and/or olivine phenocrysts (samples 428035, 428048). These are considered to be very similar to the Hellyer intermediate rocks.

The lava breccias are typically andesitic to basaltic and usually comprise a mixture of intermediate lava fragments and subordinate felsic fragments (e.g. samples 428038, 513414, 515348).

Felsic units located in the area are fine-grained yellow-brown lavas (e.g. 515350), lava breccias (e.g. 515360) and some volcaniclastics (e.g. 513465).

The presence of pumpellyite, minor prehnite and occasionally epidote in some of the fresher basalts suggests a regional metamorphic overprint to a grade of prehnite-pumpellyite, very similar to that observed in the Que-Hellyer Volcanics.

Hydrothermal alteration visible within the area comprises sericite, haematite, calcite, fuchsite and rarely pyrite or epidote/quartz alteration.

Haematite alteration is quite common in the intermediate rocks associated with the Beulah Barite and also slightly to the north (e.g. sample 428047). Sericite alteration is widespread, with nearly all the volcanic rocks showing some degree of sericitisation (e.g. samples 513414 and 513415). More intense sericite alteration has affected the rocks in the immediate area of the Beulah Barite (refer to section 4.1.4.2).

Fuchsite spotting is not common in the Lower Beulah area but it has been observed in the felsic lava located on Dynans Bridge Road (sample 515350, plate GP25A) and is quite commonly associated with calcite alteration around the barite occurrence (refer to section 4.1.4.2).

Calcite alteration is common in the vicinity of the barite and can be very intense (refer to 4.1.4.2). Calcite alteration has also been observed in an andesitic lava breccia on Dynans Bridge Road (sample 515348) and with chlorite, quartz and haematite in a felsic rock from Dawkins Road (sample 515353, plate GP25A).

Pyrite alteration is generally quite rare in the area but it has been observed in basalts north of Dawkins Road (sample 515351) and with some sericite altered rocks in the vicinity of the barite (refer to 4.1.4.2).

Epidote/quartz alteration is a rare form of hydrothermal alteration observed in the Lower Beulah area. Two samples display this type of alteration. A sample of andesite? from Dawkins Road shows intense epidote/quartz alteration to produce an epidosite (sample 515352), while an andesite from Dynans Bridge Road contains patches of localised epidote/quartz alteration (sample 515349).

Geochemical analyses of rocks from the Lower Beulah grid area are shown in Appendix 4. The highest basemetal values obtained for rock chip samples were for those in the immediate vicinity of the barite occurrence (refer to section 4.1.4.2). Away from the Beulah Barite occurrence, the highest lead value for a rock chip was 310 ppm (with 615 ppm Zn) for a specular haematite rock. The highest zinc value observed was 1025 ppm for an andesitic lava breccia or lithic tuff (428038), just off Dynans Bridge Road, near an area of anomalous soil geochemistry (plates GP 29B and 29C).

Interestingly, the samples collected from along Dynans Bridge Road and north to Dawkins Road all show a distinct enrichment in zinc relative to lead. These samples (refer to Appendices 2 to 4) comprise a mixture of intermediate to felsic lithologies displaying a variety of alteration styles. One of these samples, a gossanous quartz-haematite-chlorite-calcite altered felsic rock (515353) has a quite high copper value (560 ppm) with 0.075 ppm Au.

Barium values are elevated in the area around the barite occurrence but are not anomalous elsewhere (maximum 1650 ppm, sample 515347 from Dynans Bridge Road). Calcium values of the rocks are low for unaltered rocks and typically around 3-4% for moderately calcite alterated rocks (e.g. samples 515348, 515349). The epidosite sample (515352) shows one of the highest calcium values of 6.3%. Calcite altered rocks in the vicinity of the Beulah Barite contain up to 7.6% CaO.

4.1.4.2 1:1,000 scale (Beulah Barite area)

While a slightly more regional scale of exploration was undertaken in the Lower Beulah area, a fairly detailed examination of the rocks in immediate area of the Beulah Barite was undertaken. Initial work was based on the recognition of a number of indicators which suggested that the area was a potential site for an economic volcanogenic massive sulphide occurrence.

The barite mine (discussed in chapters 2 and 3) is located in strongly altered Beulah Formation rocks very close to the contact with the Gog Range Greywacke.

Lead isotope analysis of samples of the altered Beulah Formation basalts and the barite was undertaken by Graham Carr of SIROTOPE in 1988 (refer to Jack, 1988). Carr considered that the isotopic ratios indicated that the barite veining was similar to that of the Voyager 2 prospect at Elliot Bay. He also considered that the isotopic signature of the Beulah Formation basalts was "consistent with derivation from Cambrian hydrothermal fluids similar to those responsible for the formation of the massive sulphide deposits of the region" (Carr, 1988 in Jack, 1988).

Following the above study, CRA drillholes from the Beulah Barite prospect were sampled (samples 428020 to 428033, Appendices 2 to 4). It is considered that the drillholes intersected strongly altered lavas and volcaniclastic rocks of the Beulah Formation (Jack, pers. comm., 1988), rather than the sandstones and other sediments as logged by CRA (Temby, 1985). Petrological descriptions (Appendix 3) confirmed Jack's interpretation.

Important information obtained from the reassessment of the CRA drilling is as follows:-

1) The Gog Range sediment/Beulah Formation contact (intersected in BB4) is conformable.

2) The contact is actually a gradational 'zone' over ~40m (estimated ~ 30m true thickness).

3) The gradational 'zone' comprises a mixture of intercalated sediments (predominantly fine grained grey to black shales) and lavas (predominantly andesitic), with minor volcaniclastic units (refer to Appendices 2, 3 and 4).

4) The lavas are strongly hydrothermally altered. Dominant alteration styles are moderate to intense sericite alteration, moderate to intense carbonate (calcite) alteration $\pm$ common fuchsite spotting (thought to be detrital remnants of an alteration zone by CRA) and variable haematite alteration. Less common alteration styles observed included weak chlorite alteration, very minor pyrite alteration and rare silicification (e.g. BB4 157m, sample 428022).

Jack considered that despite the lack of any significant mineralisation intersected by the CRA drillholes, the prospect showed significant potential for hosting a volcanogenic massive sulphide deposit.

Following this interpretation a detailed surface mapping programme was undertaken in the area. The old barite mine shaft and adit were mapped and sampled and two costeans, re-exposing old CRA tracks, were excavated in the area (refer to plate GP15).

Strong weathering of most of the rocks observed at the surface combined with strong alteration and a strong cleavage meant that accurate determination of rock types in the field was difficult. To aid in mapping, a total of 28 rock chip samples were collected from the prospect for geochemical and petrological analysis (refer to Appendices 2 to 4). The location of these samples is shown on plate GP15.

Rocks located in the area comprise Gog Range sediments in the south of the prospect with variably altered Beulah Formation rocks to the north. The costeans in the area have exposed a range of rock types.

The lower costean, close to Sweetwater Creek, has been cut close to, and approximately parallel with, the sediment/volcanic contact and subsequently exposes both sedimentary and volcanic units. This 'mixture' corresponds with the gradational 'contact zone' intersected in CRA drillhole BB4. The upper costean, however, does not expose any sediments, only lavas and volcaniclastics of the Beulah Formation.

The Gog Range sediments in the prospect comprise greywackes and shales as described for the areas of the Lower Beulah grid (refer to section 4.1.4.1). Importantly, the sediments are occasionally hydrothermally altered, with sericite, carbonate, silica and rarely haematite alteration observed (refer to plate GP15).

Beulah Formation rocks in the area comprise predominantly andesitic lavas, minor crystal lithic volcaniclastics and rare felsic lavas and volcaniclastics.

Where the alteration is sufficiently weak to allow recognition and accurate description of the andesitic lavas, they are typically plagioclase and hornblende and/or augite porphyritic (e.g. samples 513433, 39,55 and 62). Based on the textures evident within thin sections, the petrologist Dr. A. Crawford considered that some of these samples could be shallow intrusive dykes or necks rather than extrusive lava flows (refer to Appendices 2 to 4). Lava breccias (e.g. 513459, 513460) contain lava? fragments within a fine grained lava matrix.

Felsic lavas located in the prospect are a feldspar-phyric rhyodacitic or dacitic lava (e.g. 515276). The volcaniclastic rocks from the prospect are a quartz phyric-vitric crystal tuff (e.g. samples 513464, 513465).

Alteration styles visible in the prospect are similar to that described for the CRA drillholes, namely an intense sericite-calcite$^{\pm}$fuchsite alteration with occasional haematite, chlorite and pyrite alteration. A simplified interpretation showing the calcite alteration and barite mineralisation for the area is shown in plate GP19.

The dominant form of mineralisation observed in the prospect is barite veining. The veins are up to ~ 30cm wide and occur in the cleavage of the strongly altered volcanic rocks. The barite veins comprise massive barite with some sulphide minerals, mainly galena and pyrite with some sphalerite and chalcopyrite (sample 513434, Appendix 3).

Many of the barite samples (samples 513434, 35 and 513466 to 51346) have high lead values (up to 5.7% Pb) with associated elevated silver grades (max. 96 ppm) (refer to Appendix 4). Zinc values for the barite veins with elevated lead and silver are generally low (max. 300 ppm). Not all of the barite veins contain high lead and silver with low zinc, however, sample 513469 contains only 5 ppm Pb, 12 ppm Ag with 100 ppm Zn and 575 ppm Cu.

Other forms of mineralisation observed in the area comprise disseminated chalcopyrite and pyrite in a sericitic lava (513470), with common haematite in many of the samples. Importantly, the haematite is not a surficial weathering effect but is a hydrothermal feature. This is confirmed by samples 515272 and 515274 which are haematite veined felsic lavas with barite crystals overgrowing the haematite.

4.1.5 Reinterpretation of CRA Geophysics

The CRA UTEM survey data from the Lower Beulah area was reviewed. The data quality was considered to be of an acceptable standard. No conductors attributable to massive sulphide accumulations could be detected (Silic, pers. comm., 1989). The anomalous responses drilled by CRA are interpreted to be due solely to lithological contrasts.

4.1.6 Diamond Drilling

The alteration visible in CRA's drillholes and at surface was identified as being similar to that which occurs in the hangingwall at Hellyer. A diamond drillhole was proposed to test a possible target near the sediment/volcanic contact, beneath the peak soil anomaly and at a depth below UTEM detection.

It was noted that the CRA drilling had been aimed at shallow UTEM conductors (refer to section 4.1.5) and only one hole (BB4) had tested the sediment/volcanic contact beneath the barite. This hole had been read with DHEM by CRA with no offhole conductors detected. The DHEM survey for BB4 did not provide a complete coverage of the hole, however, due to "the hole being caved halfway down" (von Strokirch, 1986).

A detailed interpretation of the prospect geology showing where the proposed hole (BB6) was aimed is shown in plate GP20.

After drilling had commenced, the hole deviated considerably into the cleavage and subsequently failed to intersect a target footwall position. A surface trace of the drillhole is shown on plate GP17. Two sections showing an east-west section of BB6 and a north-south section with the CRA drillholes BB2 and BB4 and a projection of BB6 are shown on plates GP23 and GP24 respectively.

The drill log and survey information for BB6 are included as Appendix 6. The drillhole failed to intersect significant mineralisation, but remained in moderately to strongly altered Beulah Formation rocks. A summary log of the drill hole is as follows:-

0-139m	Mixed zone of fine-grained andesitic and dacitic lavas (often containing lava fragments) and minor volcaniclastic units. The lavas are weakly fuchsite spotted, moderately to strongly sericite altered and occasionally strongly haematite altered. Minor disseminated pyrite occurs with chlorite to give a 'crackle' texture from 82.7-88.5m and 95-97m.
139-148m	Packed polymict volcaniclastic unit. Weakly sericite altered with trace disseminated pyrite.
148-190m	Predominantly pale yellow brown dacite lavas and lava breccias. Weakly fuchsite/sericite/ silica altered, with pyrite 'crackle' from 176-179m.

190-211m Transition zone from dacitic lavas and lava breccias to massive fine grained green andesite or basalt with minor fragments. Weak silica ± haematite alteration.

211-257.6m Massive fine grained green basalt lava. Variable fuchsite/calcite alteration (strong calcite from 215-256m), weak chlorite 'wisps'.

257.6-261m Massive fine-grained yellow brown dacite lava.

261-326.3m Massive green basalt lava to lava breccia. Minor homogenous lava fragments appear from 295m and become abundant near 326.3m (probable flow margin). Weakly calcite altered with traces of disseminated pyrite. Fragment rich areas are moderately to strongly haematite altered.

326.3(sharp contact)-400m(E.O.H.) Massive fine grained green andesite/basalt lava with minor lava breccias. Variable weak calcite/haematite alteration with strongly developed disseminated pyrite from 348-350.5m.

The rocks intersected appear to be initially a mixture of intermediate and felsic lavas and volcaniclastics followed by more massive basaltic lavas (refer to Appendix 6 and plates GP23 and 24). No intrusive rocks as noted at the surface (refer to section 4.1.4.2) were intersected in the drillhole. Occasional small rounded quartz filled vesicles in the lavas indicate that they are probably extrusive.

The alteration observed in the drillhole comprises a mixture of variable intensity haematite, sericite, and calcite with minor pyrite, fuchsite and rare chlorite alteration (refer to Appendix 6 and plates GP23 and 24).

The only mineralisation intersected by the hole was very minor barite veining occasionally containing minor pyrite crystals. Some disseminated pyrite occurs in the strongly calcite altered basalts near the end of the hole. Minor haematite ± calcite also occurs in small veinlets throughout the lower half of the hole (refer to Appendix 6 and plates GP23 and 24).

No geochemical or petrological data is yet available for the drillhole. Geophysical surveying with DHEM is planned for the hole in an attempt to detect any offhole conductors at the target position.

4.2 Stonebridge Area

4.2.1 Introduction

The Stonebridge area is located to the northeast of Mt. Roland. The potential of the area was highlighted by the presence of calc-alkaline volcanics, the lack of UTEM coverage and the presence of barite mineralisation and a haematitic gossan. A lead isotope study by SIROTOPE of the host rocks (G271762 Haematitic-quartz gossan and 271764 green rhyolite) from about the Paradise barite was undertaken (Carr, 1987).

The work to date has included a programme of gridding to facilitate access to the area. a subsequent 1:2,500 scale mapping programme and UTEM survey was conducted.

4.2.2 Gridding

The Stonebridge grid (30km) was completed during February, 1989 to allow access to examine the outcropping calc-alkaline volcanics (plate GP14 a,b,c,d). The east west grid lines were established at 200m spacings at 270 AMG (258 mag.), using Dawsons Road as a baseline.

The eastern portion of the grid was established over open pasture but extends westward into partially logged forestry land towards the foot of Mt. Roland. Consequently 7.5km of line cutting was required.

4.2.3 Geology

A programme of geological mapping at 1:2,500 scale and geological sampling was undertaken over the Stonebridge grid. A total of 12 rock chip samples were collected for geochemical analysis and 13 for petrographic description (refer to plates GP14 a,b,c,d and Appendices 2 to 4).

4.2.3.1 Cambrian

Feldspar Phyric Andesitic Lapilli volcaniclastic (C_{Alv})

Two separate masses of an orange-red-grey feldspar phyric andesitic volcaniclastic with minor intercalated andesitic lavas or shallow intrusives occur along the western margin of the mapped area. Shallow intrusive bodies such as P513403 a grey sericitised hornblende plagioclase phyric holocrystalline andesite.

Andesitic - Basaltic Porphyritic Lavas (C_{Al})

A number of grey green andesitic - basaltic feldspar augite phyric lava bodies occur throughout the mapped area. The lavas are interpreted as overlying the basal andesitic volcaniclastic. The lavas have a somewhat distorted surface expression as a result of the disruptive affect of the large volume acid porphyry intrusive.

All four samples P428081, P428083, P513402 and P513408 were petrographically similar. A grey to grey green porphyritic andesite to basaltic andesite lavas with phenocrysts of plagioclase and augite. Sample P428091 was more acidic being a brown-grey dacitic lava with abundant feldspar phenocrysts, with minor chloritised pyroxene phenocrysts in a vitrophyric groundmass.

Fossiliferous Grey Dolomitic Shale (C_{sh})

Towards the north of the grid three elongate grey dolomitic shale bodies were identified. Although outcrop was limited abundant float of poorly to well bedded shale with intercalated domolitic shale was observed.

A highly significant sample P428100 of fine grained grey brown poorly bedded shale was taken at 442134E, 12200N. The shale was derived from the erosion of a pelitic source.

The most significant factor is the presence of trilobite casts and moulds within the shale.

A subsequent sampling programme by Dr. K. D. Corbett and study by J. B. Jago (Appendix 8) has restricted the age limit of the sediments to between late Middle Cambrian (similar to the Que River Shale) and very late Middle Cambrian (similar to the Tyndall Group, Cradle Mountain Link Road). This places the Stonebridge volcanic package as a time equivalent to the Southwell subgroup.

4.2.3.2 Tertiary (T_b)

Basalt flows rest unconformably upon the Cambrian basement and extends westward across the mapped area.

4.2.3.3 Quaternary (Q_{cl})

A scree of talus covers the southern portion of the mapped area. The talus is composed of numerous fragments of Moina sandstone and Roland conglomerate derived from spoiling down the northeastern slopes of Mt. Roland.

4.2.3.4 Intrusives

Rhyolotic - Granodioritic Porphyry (C_p)

Intruding and disrupting much of the volcanosedimentary sequence is an extensive mass of red-green rhyolitic to granodioritic porphyry. A porphyritic body with abundant hornblende, biotite and plagioclase phenocrysts within a holocrystalline feldspar rich groundmass. (P428099, P513409).

Dolerite (Dol.)

A minor doleritic or dyke was identified intruding the sequence at 442042E 11600N. A dark grey-green holocrystalline fine grained dolerite with only minor feldspar and augite phenocrysts (P428093).

Dacitic - Rhyolitic Intrusive (C_1)

A commonly weathered massive buff brown rhyolitic to dacitic intrusive commonly with phenocrysts of recrystallised quartz, sericitised plagioclase and biotite (P271764).

4.2.3.5 Metamorphism

The basal sequence has been subjected to low grade prehnite-pumpellyite to lower greenschist facies metamorphism with a degree of secondary recrystallisation of quartz observed along with the formation of secondary minerals such as epidote, sphene, leucoxene, prehnite and chlorite.

4.2.3.6 Alteration

Only minor ?hydrothermal alteration was identified, though a strong secondary overprint was apparent throughout the sequence.

Sericite, fuchsite, calcite altered patches were observed within the felsic lava or volcaniclastic (P513363) at 42255E 12200N. Minor calcite, sericite replacement of plagioclase was observed within the dolerite intrusive (P428093).

The andesitic lava (P428081) at 42250E 10400N has a strongly sericitised and recrystallised groundmass. A possible pyrite, chlorite with minor chalcopyrite overprint was noted within the dacitic-andesitic lavas to the south of the area (P428091, P513402).

4.2.3.7 Mineralisation

Only minor basemetal mineralisation has previously been identified within the Stonebridge area. CRAE expended a great amount of time and effort examining the Paradise gossan in an effort to determine its origin (Funnell, 1987). The gossan represents the most significant basemetal mineralisation located to date. It was concluded that the mineralisation was localised along a fault structure within what is now highly weathered rhyolitic-dacitic material.

The only other reported zone of mineralisation was the minor trenching undertaken over the Paradise barite occurrence at 42259E 11994N (Blake, 1928).

A further minor gossanous occurrence was located at 44255E 12200N.

Pyrite was observed lining fractures and disseminated throughout the dacitic lava located at 442210E 11000N. The pyrite was commonly associated with chloritic patches and possibly represents an alteration phase (P428091). Pyrite was also noted commonly lining fractures within an andesitic lava at 442160E 10800N. Pyrite was also observed along with chalcopyrite and minor haematite as blebs associated with chlorite patches within the lava (P513402).

At 442420E 10880N (P428099) a pervading quartz haematite stockwork was observed within the diorite. The grainshapes suggest that the haematite was not developed after pyrite, although minor pyrite cubes were noted along fracture surfaces.

4.2.3.8 Structure

Only limited structual data was obtained during 1:2,500 scale mapping, plates GP14 a,b,c,d.

Bedding

The contact observed within a cutting on a logging track to the west of the grid suggests that the basal andesitic volcaniclastic has a steep westerly attitude.

A dip obtained from a black shale outcrop to the north of the grid suggests that the shales dip eastwards under the Tertiary basalt cover.

Cleavage

A reasonably strong northwest-southeast regional cleavage was observed throughout the north of the area with a slight variation towards an east-west trend to the south. The cleavage facings vary from mild to steep north-northeasterly to south-southwesterly facing.

4.2.4 Geochemistry

Rock Chip Geochemistry

Only limited rock chip sampling has been undertaken during the mapping programme. In total, 12 rock chips were submitted for analysis.

The sample locations with field descriptions and analytical results are included herewith as Appendices 2 and 4 and plates GP14 a,b, and c.

Sampling of the gossan exposed on Dawsons Road at 42423E, 10380N returned anomalous values ranging from 275 - 1500 ppm Cu, 2850 - 21700 ppm Pb, 425 - 850 ppm Zn, <0.5 - 42 ppm Ag, 100 - 1100 ppm As and 0.019 - 0.512 ppm Au.

A sample of the quartz-haematite stockwork (P428094) only returned anomalous values for Cu (760 ppm). Selective sampling of haematite veinlets (G428404) returned highly elevated copper values of 5250 ppm and a very slight elevation in zinc (120 ppm) and gold (0.314 ppm).

No basemetal elevation was noted within the gossanous sample taken at 44255E, 12200N (sample G515363).

4.2.5 Geophysics

A 30 km UTEM survey was conducted over the Stonebridge grid. The loop locations and resultant survey profiles are included here as part of Appendix 7.

The survey failed to detect any conductive bodies worthy of follow-up. A more detailed assessment of the data is included in J. Silic's report on the survey, Appendix 7.

4.3 Regional

Only a limited regional sampling programme was undertaken on the licence. A total of 13 samples were collected for petrological description (12 samples) and/or geochemical analysis (7 samples).

Samples were collected from a logging road off Paradise Road (428039) and from the slopes of Mt. Roland and Mt. Claude. Parts of the latter area have previously been explored by CRA to the drilling stage (Gowrie Park grid), so some samples of drill core were collected.

4.3.1 Paradise Road

Only one sample (428039) was collected from this area (refer to plate GP5B. The sample has been described by the petrologist as a plagioclase + augite + quartz phyric andesite lava. The geochemical analysis (Appendix 4), however, provides a Ti/Zr ratio of 9 which suggests a more dacitic to rhyodacitic composition. This indicates the sample is probably a felsic unit of the Minnow Keratophyre.

The only alteration reported for the sample is development of epidote and pumpellyite, with minor haematisation of fragments.

4.3.2 Mt. Roland Area

Six samples of Cambrian rocks (428040 to 428045) were collected from the northwestern slopes of Mt. Roland, east of Gowrie Park (refer to Appendices 2 to 4 and plate GP5A). Four lithologies were sampled, a mafic crystal-lithic tuff and three sedimentary units ranging from a fine-grained siltstone to a greywacke and a conglomerate.

The mafic crystal-lithic tuff (samples 428040 and 428044) comprises plagioclase, augite and some resorbed quartz phenocrysts with minor lithic fragments. Sample 428044 contains common fragments of broken quartz phenocrysts.

Alteration is due to devitrification and, in 428044, also to common replacement by sericite.

The sediments sampled from the area comprise a metamorphic detritus dominated fine grained siltstone and a greywacke and conglomerate derived from mixed felsic and andesitic volcanic rocks.

4.3.3 Mt. Claude Area

Six samples have been collected from the northern slopes of Mt. Claude, from CRA's old Gowrie Park grid (samples 428017 to 428019 and 515277 to 515279, refer to Appendices 2 to 4 and plate GP5A).

The surface samples comprise a deformed quartz sandstone and a quartz-phyric vitric tuff (a gossanous sample of this was submitted for analysis) (refer to Appendix 3). The quartz sandstone has been recrystallised and silicified and contains sericite and occasionally altered pyrite euhedra. A strong mylonitic texture suggests proximity to a major fault. The volcaniclastic unit comprises broken quartz phenocrysts, strongly sericitised feldspar phenocrysts and common fragments of devitrified glass. The sample is strongly foliated due to ?tectonic deformation.

Geochemical analysis (Appendix 4) indicates that only the gossanous sample, 515278, contains weakly anomalous base metal values (715 ppm Zn and 100 ppm Pb).

Three samples from CRA drillhole GPC3 (refer to plate GP5A) were submitted for petrology and geochemistry (refer to Appendices 2 to 4). The samples comprise two rhyolitic lavas, one strongly altered, and an altered feldspar-quartz phyric volcaniclastic.

The rhyolitic lavas contain quartz phenocrysts in a fine-grained devitrified matrix. Sample 428017 is strongly silica, sericite and carbonate altered. Both samples contain veins of galena rimmed by calcite.

The volcaniclastic unit (428018) is a rhyolitic, porphyritic lithic tuff. Alteration comprises sericitisation and silicification. The sample contains common disseminated pyrite euhedra.

5.0 Discussion and Interpretations

No regional interpretation of the geology in the licence was undertaken. The previous interpretation (Jennings, 1979) considered that the Beulah Formation intermediate volcanic rocks are overlain by Gog Range sediments, which are in turn overlain by the acid volcanics of the Minnow Keratophyre.

Based on very limited sampling of some Cambrian units on the slopes of Mt. Roland and Mt. Claude (formed of Ordovician Owen Conglomerate correlates) it would appear that the Cambrian units in this area are possible equivalents of the Tyndall Group on the west coast. The volcaniclastics sampled from the Mt. Claude and Mt. Roland areas are considered by Dr. A. Crawford to be a possible equivalent of the Jukes Breccia or basal Owen Conglomerate. In support of this interpretation, the rocks appear to be very similar to units of the Tyndall Group seen north of Hellyer (McNeill, pers. comm., 1989).

An important discovery (for palaentologists and stratigraphers) was the presence of identifiable fossils within Cambrian rocks at the Stonebridge prospect. The trilobites and agnostid trilobites indicate a Late Middle Cambrian age for the rocks. This suggests that the rocks are time equivalents to the Tyndall Group or Southwell Sub-group on the Cradle Mt. Link Road. Many of the volcano-sedimentary rocks at Stonebridge appear to be intruded by an extensive mass of porphyry, however, which must therefore be a younger unit.

The presence of strong hydrothermal alteration with some stringer mineralisation, intersected by CRA drilling, in the Gowrie Park area indicates that the area has potential for massive sulphide mineralisation and further exploration is required. The presence of hydrothermal mineralisation in rocks interpreted to be high in the Mt. Read stratigraphic sequence in unusual, however, and has not previously been observed for equivalent rocks on the west coast.

Extensive exploration in the Stonebridge area has failed to locate any positive indications of base metal mineralisation.

1) No UTEM response attributable to massive sulphide conductors were detected.

2) All favourable soil geochemical anomalies have previously been followed up by CRA.

3) Only minor hydrothermal alteration (weak sericite, calcite and fuchsite) was noted in one gossanous sample from the area. The location of this sample suggests that there may be some potential to the east of the area examined, beneath the Tertiary basalt cover.

4) Lead isotope work on the Paradise barite host, while not equivocal, tended to support a Queen Hill Devonian style for the mineralisation.

5) The quartz-haematite stockwork observed in the diorite has anomalous copper and slightly elevated gold values within the haematite rich veins which could be of future potential.

Exploration in the Lower Beulah area has provided a number of encouraging results. Interpretation of the geology in the area is shown on plates GP5B and GP20 which have been discussed earlier (refer to chapter 4). The soil sampling survey indicates that a number of areas close to the Gog Range sediment/Beulah Formation contact are anomalous in lead, zinc and occasionally arsenic.

Mapping of the Beulah Formation rocks on the Lower Beulah grid suggests that most of the felsic rocks and volcaniclastic units located in this area are associated with the Gog Range/Beulah Formation contact (i.e. the greatest variety of volcanic rocks in the area are visible close to the contact). Further work should be undertaken in order to determine if any potential 'ore horizons' can be located close to this contact.

Significantly, the strongly hydrothermally altered lavas associated with the Beulah Barite are located close to the sediment/volcanic contact. Diamond drill testing of a potential target at the contact in this area failed to intersect significant mineralisation. No footwall position was intersected, but the hydrothermal alteration observed is interpreted to be hangingwall style alteration. The prospect must therefore, still be considered to have significant potential for base metal mineralisation at depth.

6.0 Recommendations

A number of favourable indicators exist which show that the Cambrian rocks on the licence have potential for hosting massive sulphide accumulations. An extensive exploration programme should be continued with the following aims:-

Regionally,

- All the Cambrian volcanic rocks should be mapped and sampled. Emphasis should be placed on obtaining stratigraphic and structual information where possible.

- A detailed, broad, geochemical and petrographic analysis of Cambrian rocks within the licence be undertaken in order to compare them with known Mt. Read volcanic rocks and to determine possible correlations of these rocks within the established Mt. Read volcanic sequence.

  Emphasis should also be placed on comparing similar rock units within the licence to establish the validity of the current three stratigraphic groupings.

  Limited samples collected during the study by D. J. Jack should be supplemented by further samples collected from all of the Cambrian rocks.

- Combined with the above, a regional database of geochemical analyses should be established. This would assist in lithogeochemical analysis (based on elements such as Cr, Ti and Zr), and would allow recognition of any anomalous results that might be similar to the anomalous 'core lava' above the Hellyer massive sulphide deposit.

- Exploration should be undertaken over the Cambrian rocks outcropping to the north and northwest of Mt. Roland and Mt. Claude. CRA's exploration in these areas should be reassessed with a mapping and sampling programme to determine which areas shows the greatest potential for hosting massive sulphides.

Stonebridge Area

- Exploration to date has failed to return any positive indications of base metal mineralisation. No further work is recommended for this area.

Lower Beulah Area

- Further detailed examination of the Beulah Formation rocks on the Lower Beulah grid is required. Special attention should be paid to the rocks close to the contact with the Gog Range Greywacke (i.e. along the known anomalous soil geochemistry 'horizon').

- The above examination should include UTEM surveys in the areas not previously covered by CRA (i.e. north of Dynans Bridge Road).

- Mapping should be undertaken to improve the stratigraphic and structual interpretation of this area.

Beulah Barite Prospect

- Further detailed work should be undertaken in the immediate vicinity of the Beulah Barite to accurately define a possible footwall position and determine the potential for massive sulphide accumulations.

- Samples of pyrite and barite from the Beulah Barite prospect (and possibly regional samples) should be submitted for sulphur isotope analysis to allow a comparison with the data available for known mineralisation on the west coast. This would assist in defining the mineralisation styles observed.

- Hydrothermally altered samples from the Beulah Barite prospect (possibly including regional samples) should be submitted for geochemical analysis to allow determination of an alteration index. This value can then be compared with values for known alteration styles from the Que River-Hellyer area to determine the validity of using this method in this area and to assist in prospect evaluation.

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APPENDIX 1

Soil Sampling Locations and Geochemical Results.

(all results in ppm, 0.3 for Ag and 3 for Pb indicates below detection limit)

(Analysis by ANALABS)

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LINE	EAST	NORTH	SAMPLE	Cu	Pb	Zn	Ag	As
				(results in ppm)				
47600E	47600.0	8800.0	485010	65	10	60	0.3	9
47600E	47600.0	8825.0	485011	85	20	55	0.3	13
47600E	47600.0	8850.0	485012	95	10	65	0.3	10
47600E	47600.0	8875.0	485013	50	20	25	0.3	13
47600E	47600.0	8900.0	485014	85	20	50	0.3	6
47600E	47600.0	8925.0	485015	100	20	65	0.3	8
47600E	47600.0	8950.0	485016	85	25	60	0.3	7
47600E	47600.0	8975.0	485017	100	20	60	0.3	9
47600E	47600.0	9000.0	485018	40	5	80	0.3	7
47600E	47600.0	9025.0	485019	45	15	55	0.3	7
47600E	47600.0	9050.0	485020	40	15	60	0.3	9
47600E	47600.0	9075.0	485021	35	15	80	0.3	13
47600E	47600.0	9100.0	485022	25	5	70	0.3	6
47600E	47600.0	9125.0	485023	25	15	65	0.3	6
47600E	47600.0	9150.0	485024	5	5	50	0.3	7
47600E	47600.0	9175.0	485025	5	10	55	0.3	6
47600E	47600.0	9200.0	485026	3	20	95	0.3	5
47600E	47600.0	9225.0	485027	30	10	60	0.3	10
47600E	47600.0	9250.0	485028	15	25	110	0.3	4
47600E	47600.0	9275.0	485029	5	15	85	0.3	2
47600E	47600.0	9300.0	485030	10	15	85	0.3	2
47600E	47600.0	9325.0	485031	5	20	85	0.3	2
47600E	47600.0	9350.0	485032	15	25	120	0.3	2
47600E	47600.0	9375.0	485033	15	20	75	0.3	10
47800E	47800.0	8950.0	485122	55	25	100	0.3	26
47800E	47800.0	8975.0	485123	55	25	95	0.3	27
47800E	47800.0	9000.0	485124	90	25	100	0.3	26
47800E	47800.0	9025.0	485125	30	15	80	0.3	18
47800E	47800.0	9050.0	485126	80	35	115	0.3	11
47800E	47800.0	9075.0	485127	85	25	100	0.3	12
47800E	47800.0	9100.0	485128	95	25	140	0.3	9
47800E	47800.0	9125.0	485129	20	15	55	0.3	14
47800E	47800.0	9150.0	485130	25	20	65	0.3	11
47800E	47800.0	9175.0	485131	20	15	55	0.3	10
47800E	47800.0	9200.0	485132	5	5	50	0.3	7
47800E	47800.0	9225.0	485133	30	5	90	0.3	6
47800E	47800.0	9250.0	485134	50	10	45	0.3	4
47800E	47800.0	9275.0	485135	70	15	105	0.3	8
47800E	47800.0	9325.0	485137	5	25	85	0.3	3
47800E	47800.0	9350.0	485138	20	35	120	0.3	5
47800E	47800.0	9375.0	485139	10	35	115	0.3	4
47800E	47800.0	9400.0	485140	5	30	85	0.3	6
48200E	48200.0	9050.0	485330	60	15	90	0.3	16
48200E	48200.0	9075.0	485331	5	3	35	0.3	5
48200E	48200.0	9100.0	485332	20	3	55	0.3	11
48200E	48200.0	9125.0	485333	15	10	35	0.3	9
48200E	48200.0	9150.0	485334	30	3	45	0.3	4
48200E	48200.0	9175.0	485335	80	15	75	0.3	10
48200E	48200.0	9200.0	485336	75	5	60	0.3	13
48200E	48200.0	9225.0	485337	60	10	115	0.3	11
48200E	48200.0	9250.0	485338	10	10	50	0.3	3
48200E	48200.0	9275.0	485339	15	15	80	0.3	5
48200E	48200.0	9300.0	485340	20	25	100	0.3	5
48200E	48200.0	9375.0	485343	70	5	95	0.3	6
48600E	48600.0	8800.0	485530	90	15	105	0.3	7
48600E	48600.0	8825.0	485531	105	3	85	0.3	13
48600E	48600.0	8850.0	485532	120	15	110	0.3	14
48600E	48600.0	8875.0	485533	20	3	50	0.3	1
48600E	48600.0	8900.0	485534	90	35	135	0.3	12
48600E	48600.0	8925.0	485535	40	10	55	0.3	4
48600E	48600.0	8950.0	485536	50	10	100	0.3	6
48600E	48600.0	8975.0	485537	35	5	60	0.3	4
48600E	48600.0	9025.0	485539	15	15	55	0.3	8
48600E	48600.0	9050.0	485540	30	20	70	0.3	3
48600E	48600.0	9075.0	485541	25	30	110	0.3	4
48600E	48600.0	9100.0	485542	15	20	75	0.3	2
48600E	48600.0	9125.0	485543	15	30	110	0.3	2
48600E	48600.0	9150.0	485544	15	30	125	0.3	6
48600E	48600.0	9175.0	485545	75	10	140	0.3	1
48600E	48600.0	9200.0	485546	30	15	125	0.3	2
48600E	48600.0	9225.0	485547	35	30	165	0.3	5
48600E	48600.0	9250.0	485548	40	10	105	0.3	4
48600E	48600.0	9275.0	485549	55	20	135	0.3	7
48600E	48600.0	9300.0	485550	25	210	190	0.3	4
48600E	48600.0	9325.0	485551	3	10	280	0.3	4
48600E	48600.0	9350.0	485552	10	30	325	0.3	4
48800E	48800.0	8600.0	485640	55	50	120	0.3	12
48800E	48800.0	8625.0	485641	40	35	95	0.3	12
48800E	48800.0	8650.0	485642	40	30	90	0.3	11
48800E	48800.0	8675.0	485643	30	60	120	0.3	12
48800E	48800.0	8700.0	485644	40	35	115	0.3	9
48800E	48800.0	8725.0	485645	40	55	285	0.3	10
48800E	48800.0	8750.0	485646	40	35	200	0.3	10
48800E	48800.0	8775.0	485647	35	40	225	0.3	9
48800E	48800.0	8800.0	485648	60	15	115	0.3	20
48800E	48800.0	8825.0	485649	60	15	85	0.3	17
48800E	48800.0	8850.0	485650	75	15	100	0.3	15
48800E	48800.0	8875.0	485651	85	60	190	0.3	13
48800E	48800.0	8900.0	485652	60	30	185	0.3	7
48800E	48800.0	8925.0	485653	65	35	110	0.3	11
48800E	48800.0	8950.0	485654	70	35	120	0.3	16
48800E	48800.0	8975.0	485655	70	35	105	0.3	14

48800E	48800.0	9000.0	485656	50	25	90	0.3	9
48800E	48800.0	9025.0	485657	50	30	85	0.3	14
48800E	48800.0	9050.0	485658	60	130	210	0.3	15
48800E	48800.0	9075.0	485659	30	20	165	0.3	16
48800E	48800.0	9100.0	485660	60	50	200	0.3	8
48800E	48800.0	9125.0	485661	35	50	215	0.3	15
48800E	48800.0	9150.0	485662	25	30	135	0.3	1
48800E	48800.0	9175.0	485663	25	20	100	0.3	.5
48800E	48800.0	9200.0	485664	20	45	205	0.3	3
48800E	48800.0	9225.0	485665	25	35	150	0.3	2
48800E	48800.0	9250.0	485666	20	80	155	0.3	1
48800E	48800.0	9275.0	485667	25	140	360	0.3	1
48800E	48800.0	9300.0	485668	30	155	330	0.3	1
48800E	48800.0	9325.0	485669	35	45	200	0.3	5
48800E	48800.0	9350.0	485670	30	60	190	0.3	3
48800E	48800.0	9375.0	485671	35	70	210	0.3	2
49000E	49000.0	7500.0	484552	85	35	75	0.3	7
49000E	49000.0	7525.0	484553	75	75	40	0.3	7
49000E	49000.0	7550.0	484554	60	35	65	0.3	8
49000E	49000.0	7575.0	484555	85	40	50	0.3	9
49000E	49000.0	7600.0	484556	75	35	65	0.3	11
49000E	49000.0	7625.0	484557	40	30	40	0.3	16
49000E	49000.0	7650.0	484558	60	20	40	0.3	9
49000E	49000.0	7675.0	484559	85	40	85	0.3	13
49000E	49000.0	7700.0	484560	85	30	55	0.3	9
49000E	49000.0	7725.0	484561	70	15	35	0.3	8
49000E	49000.0	7750.0	484562	80	15	45	0.3	15
49000E	49000.0	7775.0	484563	75	25	40	0.3	13
49000E	49000.0	7800.0	484564	40	15	40	0.3	9
49000E	49000.0	7825.0	484565	40	15	45	0.3	9
49000E	49000.0	7850.0	484566	30	40	65	0.3	11
49000E	49000.0	7875.0	484567	95	30	125	0.3	8
49000E	49000.0	7900.0	484568	65	15	105	0.3	6
49000E	49000.0	7925.0	484569	45	20	85	0.3	6
49000E	49000.0	7950.0	484570	60	55	85	0.3	10
49000E	49000.0	7975.0	484571	50	25	70	0.3	7
49000E	49000.0	8000.0	484572	70	50	105	0.3	11
49000E	49000.0	8025.0	484573	40	20	45	0.3	6
49000E	49000.0	8050.0	484574	70	45	125	0.3	8
49000E	49000.0	8075.0	484575	50	10	55	0.3	8
49000E	49000.0	8100.0	484576	60	15	40	0.3	8
49000E	49000.0	8125.0	484577	60	15	45	0.3	14
49000E	49000.0	8150.0	484578	65	30	55	0.3	8
49000E	49000.0	8175.0	484579	70	20	60	0.3	9
49000E	49000.0	8200.0	484580	75	20	60	0.3	7
49000E	49000.0	8225.0	484581	70	30	60	0.3	10
49000E	49000.0	8250.0	484582	80	30	145	0.3	8
49000E	49000.0	8275.0	484583	105	40	100	0.3	6
49000E	49000.0	8300.0	484584	115	30	75	0.3	14
49000E	49000.0	8325.0	484585	75	30	60	0.3	10
49000E	49000.0	8350.0	484586	55	15	50	0.3	10
49000E	49000.0	8375.0	484587	65	25	50	0.3	9
49000E	49000.0	8400.0	485760	60	25	45	0.3	6
49000E	49000.0	8425.0	485761	65	25	40	0.3	13
49000E	49000.0	8450.0	485762	100	25	50	0.3	5
49000E	49000.0	8475.0	485763	120	45	80	0.3	2
49000E	49000.0	8500.0	485764	60	30	80	0.3	2
49000E	49000.0	8525.0	485765	85	45	120	0.3	6
49000E	49000.0	8550.0	485766	25	15	105	0.3	3
49000E	49000.0	8575.0	485767	80	30	145	0.3	3
49000E	49000.0	8600.0	485768	65	30	130	0.3	4
49000E	49000.0	8625.0	485769	90	25	85	0.3	14
49000E	49000.0	8650.0	485770	90	15	175	0.3	10
49000E	49000.0	8675.0	485771	75	20	80	0.3	10
49000E	49000.0	8700.0	485772	90	20	85	0.3	11
49000E	49000.0	8725.0	485773	35	10	30	0.3	10
49000E	49000.0	8750.0	485774	70	40	45	0.3	31
49000E	49000.0	8775.0	485775	55	25	40	0.3	12
49000E	49000.0	8800.0	485776	85	15	45	0.3	11
49000E	49000.0	8825.0	485777	60	25	40	0.3	10
49000E	49000.0	8850.0	485778	35	15	30	0.3	6
49000E	49000.0	8875.0	485779	65	20	40	0.3	10
49000E	49000.0	8900.0	485780	110	25	60	0.3	9
49000E	49000.0	8925.0	485781	105	25	75	0.3	8
49000E	49000.0	8950.0	485782	155	30	125	0.3	10
49000E	49000.0	8975.0	485783	95	20	145	0.3	9
49000E	49000.0	9000.0	485784	90	25	160	0.3	5
49000E	49000.0	9025.0	485785	80	25	130	0.3	4
49000E	49000.0	9050.0	485786	75	15	65	0.3	9
49000E	49000.0	9075.0	485787	50	20	45	0.3	5
49000E	49000.0	9100.0	485788	35	10	50	0.3	7
49000E	49000.0	9125.0	485789	45	20	145	0.3	6
49000E	49000.0	9150.0	485790	45	25	120	0.3	10
49000E	49000.0	9175.0	485791	35	40	135	0.3	9
49000E	49000.0	9200.0	485792	15	30	130	0.3	5
49000E	49000.0	9225.0	485793	3	5	60	0.3	3
49000E	49000.0	9250.0	485794	35	185	475	0.3	10
49000E	49000.0	9275.0	485795	35	240	410	.5	7
49000E	49000.0	9300.0	485796	15	110	370	0.3	22
49000E	49000.0	9325.0	485797	45	130	210	.5	31
49000E	49000.0	9350.0	485798	40	135	275	1.0	9
49000E	49000.0	9375.0	485799	35	105	315	0.3	11
49200E	49200.0	7500.0	484590	55	30	45	0.3	7
49200E	49200.0	7525.0	484591	85	25	55	0.3	7
49200E	49200.0	7550.0	484592	85	45	60	0.3	9
49200E	49200.0	7575.0	484593	90	35	70	0.3	12

49200E	49200.0	7600.0	484594	70	35	60	0.3	11
49200E	49200.0	7625.0	484595	85	45	80	0.3	11
49200E	49200.0	7650.0	484596	70	25	60	0.3	11
49200E	49200.0	7675.0	484597	50	25	60	0.3	8
49200E	49200.0	7700.0	484598	45	20	70	0.3	10
49200E	49200.0	7725.0	484599	25	25	65	0.3	6
49200E	49200.0	7750.0	484600	55	35	75	0.3	8
49200E	49200.0	7775.0	484601	75	40	75	0.3	14
49200E	49200.0	7800.0	484602	40	35	55	0.3	10
49200E	49200.0	7825.0	484603	75	40	65	0.3	7
49200E	49200.0	7850.0	484604	30	35	65	0.3	5
49200E	49200.0	7875.0	484605	85	15	120	0.3	11
49200E	49200.0	7900.0	484606	55	10	75	0.3	9
49200E	49200.0	7925.0	484607	90	25	60	0.3	11
49200E	49200.0	7950.0	484608	80	10	55	0.3	11
49200E	49200.0	7975.0	484609	110	65	90	0.3	13
49200E	49200.0	8000.0	484610	85	15	105	0.3	5
49200E	49200.0	8025.0	484611	100	35	90	0.3	14
49200E	49200.0	8050.0	484612	70	20	90	0.3	7
49200E	49200.0	8075.0	484613	70	10	65	0.3	8
49200E	49200.0	8100.0	485890	60	40	50	0.3	6
49200E	49200.0	8125.0	485891	105	25	65	0.3	6
49200E	49200.0	8150.0	485892	55	25	40	0.3	2
49200E	49200.0	8175.0	485893	110	40	50	0.3	2
49200E	49200.0	8200.0	485894	110	40	55	0.3	2
49200E	49200.0	8225.0	485895	100	40	45	0.3	10
49200E	49200.0	8250.0	485896	35	35	55	0.3	3
49200E	49200.0	8275.0	485897	60	35	55	0.3	6
49200E	49200.0	8300.0	485898	65	25	50	0.3	4
49200E	49200.0	8325.0	485899	110	40	60	0.3	4
49200E	49200.0	8350.0	485900	95	35	55	0.3	5
49200E	49200.0	8375.0	485901	120	40	50	0.3	7
49200E	49200.0	8400.0	485902	100	45	60	0.3	10
49200E	49200.0	8425.0	485903	140	35	85	0.3	2
49200E	49200.0	8450.0	485904	100	30	95	0.3	.5
49200E	49200.0	8475.0	485905	110	45	135	0.3	.5
49200E	49200.0	8500.0	485906	115	35	60	0.3	4
49200E	49200.0	8525.0	485907	75	30	50	0.3	2
49200E	49200.0	8550.0	485908	105	45	80	0.3	16
49200E	49200.0	8575.0	485909	95	35	60	0.3	8
49200E	49200.0	8600.0	485910	115	50	75	0.3	11
49200E	49200.0	8625.0	485911	105	40	50	0.3	6
49200E	49200.0	8650.0	485912	45	30	45	0.3	4
49200E	49200.0	8675.0	485913	85	40	45	0.3	4
49200E	49200.0	8700.0	485914	100	50	45	0.3	3
49200E	49200.0	8725.0	485915	100	40	55	0.3	6
49200E	49200.0	8750.0	485916	70	35	50	0.3	5
49200E	49200.0	8775.0	485917	70	35	65	0.3	1
49200E	49200.0	8800.0	485918	85	40	60	0.3	5
49200E	49200.0	8825.0	485919	60	35	60	0.3	4
49200E	49200.0	8850.0	485920	125	40	60	0.3	9
49200E	49200.0	8875.0	485921	100	40	65	0.3	5
49200E	49200.0	8900.0	485922	120	40	75	0.3	9
49200E	49200.0	8925.0	485923	105	40	70	0.3	7
49200E	49200.0	8950.0	485924	100	40	55	0.3	4
49200E	49200.0	8975.0	485925	80	40	65	0.3	8
49200E	49200.0	9000.0	485926	150	35	60	0.3	5
49200E	49200.0	9025.0	485927	75	35	105	0.3	9
49200E	49200.0	9050.0	485928	70	35	80	0.3	7
49200E	49200.0	9075.0	485929	60	45	100	0.3	3
49200E	49200.0	9100.0	485930	65	170	280	0.3	6
49200E	49200.0	9125.0	485931	95	335	215	0.3	3
49200E	49200.0	9150.0	485932	35	90	165	0.3	5
49200E	49200.0	9175.0	485933	40	175	210	0.3	3
49200E	49200.0	9200.0	485934	20	65	140	0.3	4
49200E	49200.0	9225.0	485935	45	50	90	0.3	6
49200E	49200.0	9250.0	485936	20	45	115	0.3	3
49200E	49200.0	9300.0	485938	40	95	230	1.5	5
49200E	49200.0	9325.0	485939	45	165	325	0.3	9
49200E	49200.0	9350.0	485940	45	140	235	0.3	10
49200E	49200.0	9375.0	485941	35	150	310	0.3	4
49400E	49400.0	7500.0	484616	85	30	105	0.3	7
49400E	49400.0	7525.0	484617	50	20	80	0.3	7
49400E	49400.0	7550.0	484618	70	5	50	0.3	5
49400E	49400.0	7575.0	484619	65	10	50	0.3	7
49400E	49400.0	7600.0	484620	65	10	50	0.3	8
49400E	49400.0	7625.0	484621	75	65	90	0.3	20
49400E	49400.0	7650.0	484622	65	20	45	0.3	14
49400E	49400.0	7675.0	484623	80	15	50	0.3	16
49400E	49400.0	7700.0	484624	55	15	45	0.3	8
49400E	49400.0	7725.0	484625	70	10	45	0.3	17
49400E	49400.0	7750.0	484626	65	10	50	0.3	10
49400E	49400.0	7775.0	484627	55	15	60	0.3	6
49400E	49400.0	7800.0	484628	55	15	50	0.3	10
49400E	49400.0	7825.0	484629	60	20	55	0.3	12
49400E	49400.0	7850.0	484630	70	10	55	0.3	14
49400E	49400.0	7875.0	484631	80	20	40	0.3	6
49400E	49400.0	7900.0	484632	70	5	35	0.3	7
49400E	49400.0	7925.0	484633	45	20	100	0.3	9
49400E	49400.0	7950.0	484634	30	15	105	0.3	15
49400E	49400.0	7975.0	484635	60	20	125	0.3	5
49400E	49400.0	8000.0	484636	35	3	100	0.3	4
49400E	49400.0	8025.0	484637	70	10	115	0.3	4
49400E	49400.0	8050.0	484638	70	10	115	0.3	7
49400E	49400.0	8075.0	484639	70	15	110	0.3	4
49400E	49400.0	8100.0	484640	40	20	110	0.3	8
49400E	49400.0	8125.0	484641	55	15	65	0.3	9

49400E	49400.0	8150.0	484642	80	15	55	0.3	6
49400E	49400.0	8175.0	484643	70	20	60	0.3	9
49400E	49400.0	8200.0	484644	75	10	50	0.3	16
49400E	49400.0	8225.0	484645	60	10	50	0.3	12
49400E	49400.0	8250.0	484646	35	10	40	0.3	8
49400E	49400.0	8275.0	484647	60	15	45	0.3	8
49400E	49400.0	8300.0	486030	35	110	130	0.3	10
49400E	49400.0	8325.0	486031	100	15	50	0.3	9
49400E	49400.0	8350.0	486032	80	10	50	0.3	5
49400E	49400.0	8375.0	486033	90	10	55	0.3	8
49400E	49400.0	8400.0	486034	100	15	55	0.3	8
49400E	49400.0	8425.0	486035	75	10	70	0.3	5
49400E	49400.0	8450.0	486036	100	15	65	0.3	9
49400E	49400.0	8475.0	486037	95	15	45	0.3	10
49400E	49400.0	8500.0	486038	80	15	45	0.3	4
49400E	49400.0	8525.0	486039	80	15	50	0.3	6
49400E	49400.0	8550.0	486040	100	10	130	0.3	14
49400E	49400.0	8575.0	486041	90	3	45	0.3	13
49400E	49400.0	8600.0	486042	60	3	50	0.3	10
49400E	49400.0	8625.0	486043	85	15	70	.5	6
49400E	49400.0	8650.0	486044	75	3	55	0.3	9
49400E	49400.0	8675.0	486045	70	5	50	0.3	8
49400E	49400.0	8700.0	486046	105	5	55	0.3	15
49400E	49400.0	8725.0	486047	85	3	50	0.3	10
49400E	49400.0	8750.0	486048	95	3	55	0.3	8
49400E	49400.0	8775.0	486049	75	3	55	0.3	10
49400E	49400.0	8800.0	486050	70	10	55	0.3	10
49400E	49400.0	8825.0	486051	90	10	75	0.3	8
49400E	49400.0	8850.0	486052	65	10	55	0.3	9
49400E	49400.0	8875.0	486053	95	10	100	0.3	6
49400E	49400.0	8900.0	486054	110	10	70	0.3	5
49400E	49400.0	8925.0	486055	80	5	85	0.3	5
49400E	49400.0	8950.0	486056	105	20	95	0.3	5
49400E	49400.0	8975.0	486057	55	5	55	0.3	7
49400E	49400.0	9000.0	486058	50	10	90	0.3	10
49400E	49400.0	9025.0	486059	45	10	70	0.3	11
49400E	49400.0	9050.0	486060	65	20	150	0.3	11
49400E	49400.0	9075.0	486061	50	25	160	0.3	11
49400E	49400.0	9100.0	486062	75	80	230	0.3	12
49400E	49400.0	9125.0	486063	30	20	405	2.5	7
49400E	49400.0	9150.0	486064	25	20	140	0.3	10
49400E	49400.0	9175.0	486065	30	55	145	0.3	5
49400E	49400.0	9200.0	486066	25	25	125	.5	5
49400E	49400.0	9225.0	486067	20	20	120	0.3	5
49400E	49400.0	9250.0	486068	25	30	220	1.0	4
49400E	49400.0	9275.0	486069	65	140	440	.5	9
49400E	49400.0	9300.0	486070	40	990	435	0.3	7
49400E	49400.0	9325.0	486071	35	125	240	0.3	8
49400E	49400.0	9350.0	486072	35	310	275	.5	7
49400E	49400.0	9375.0	486073	30	70	290	0.3	7
49600E	49600.0	7500.0	484650	65	35	75	0.3	13
49600E	49600.0	7525.0	484651	60	15	80	0.3	9
49600E	49600.0	7550.0	484652	110	30	120	0.3	10
49600E	49600.0	7575.0	484653	95	35	95	0.3	13
49600E	49600.0	7600.0	484654	80	30	75	0.3	8
49600E	49600.0	7625.0	484655	60	5	60	0.3	7
49600E	49600.0	7650.0	484656	70	25	130	0.3	6
49600E	49600.0	7675.0	484657	50	25	90	0.3	9
49600E	49600.0	7700.0	484658	45	10	65	0.3	9
49600E	49600.0	7725.0	484659	30	20	65	0.3	3
49600E	49600.0	7750.0	484660	20	5	45	0.3	3
49600E	49600.0	7775.0	484661	80	15	70	0.3	7
49600E	49600.0	7800.0	484662	65	20	55	0.3	9
49600E	49600.0	7825.0	484663	55	25	50	0.3	12
49600E	49600.0	7850.0	484664	95	35	115	0.3	14
49600E	49600.0	7875.0	484665	60	15	75	0.3	6
49600E	49600.0	7900.0	484666	80	25	95	0.3	14
49600E	49600.0	7925.0	484667	75	15	95	0.3	14
49600E	49600.0	7950.0	484668	70	20	85	0.3	10
49600E	49600.0	7975.0	484669	80	20	65	0.3	11
49600E	49600.0	8000.0	484670	70	20	55	0.3	11
49600E	49600.0	8025.0	484671	80	20	50	0.3	17
49600E	49600.0	8050.0	484672	60	15	50	0.3	8
49600E	49600.0	8075.0	484673	70	15	60	0.3	13
49600E	49600.0	8100.0	484674	65	15	50	0.3	12
49600E	49600.0	8125.0	484675	55	20	45	0.3	10
49600E	49600.0	8150.0	484676	60	20	50	0.3	10
49600E	49600.0	8175.0	484677	60	20	45	0.3	7
49600E	49600.0	8200.0	484678	70	20	50	0.3	12
49600E	49600.0	8225.0	484679	85	15	55	0.3	15
49600E	49600.0	8250.0	484680	75	10	55	0.3	13
49600E	49600.0	8275.0	484681	45	20	40	0.3	8
49600E	49600.0	8300.0	484682	35	10	40	0.3	6
49600E	49600.0	8325.0	484683	65	20	60	0.3	15
49600E	49600.0	8350.0	484684	40	20	45	0.3	9
49600E	49600.0	8375.0	484685	80	20	65	0.3	11
49600E	49600.0	8400.0	486160	95	20	85	0.3	13
49600E	49600.0	8425.0	486161	85	20	85	0.3	11
49600E	49600.0	8450.0	486162	105	25	90	0.3	18
49600E	49600.0	8475.0	486163	90	30	70	0.3	10
49600E	49600.0	8500.0	486164	75	20	70	0.3	12
49600E	49600.0	8525.0	486165	95	35	95	0.3	13
49600E	49600.0	8550.0	486166	75	20	65	0.3	10
49600E	49600.0	8575.0	486167	55	10	35	0.3	6
49600E	49600.0	8600.0	486168	85	30	50	0.3	14
49600E	49600.0	8625.0	486169	50	10	45	0.3	10
49600E	49600.0	8650.0	486170	120	20	70	0.3	20

49600E	49600.0	8675.0	486171	80	20	80	0.3	10
49600E	49600.0	8700.0	486172	60	15	45	0.3	9
49600E	49600.0	8725.0	486173	100	20	75	0.3	12
49600E	49600.0	8750.0	486174	45	25	75	0.3	10
49600E	49600.0	8775.0	486175	55	15	45	0.3	9
49600E	49600.0	8800.0	486176	50	10	80	0.3	8
49600E	49600.0	8825.0	486177	25	5	50	0.3	5
49600E	49600.0	8850.0	486178	70	20	70	0.3	12
49600E	49600.0	8875.0	486179	15	80	80	0.3	9
49600E	49600.0	8900.0	486180	35	705	700	0.3	5
49600E	49600.0	8925.0	486181	65	75	140	0.3	12
49600E	49600.0	8950.0	486182	65	35	120	0.3	10
49600E	49600.0	8975.0	486183	45	85	190	0.3	6
49600E	49600.0	9000.0	486184	20	35	265	0.3	4
49600E	49600.0	9025.0	486185	30	40	130	0.3	4
49600E	49600.0	9050.0	486186	20	25	90	0.3	6
49600E	49600.0	9100.0	486188	40	35	115	0.3	8
49600E	49600.0	9125.0	486189	30	30	105	0.3	5
49600E	49600.0	9150.0	486190	30	35	190	0.3	7
49600E	49600.0	9175.0	486191	35	235	545	0.3	5
49600E	49600.0	9200.0	486192	30	140	575	0.3	6
49600E	49600.0	9225.0	486193	40	180	170	0.3	8
49600E	49600.0	9250.0	486194	85	75	265	0.3	9
49600E	49600.0	9275.0	486195	35	315	135	0.3	22
49600E	49600.0	9300.0	486196	100	70	170	0.3	12
49600E	49600.0	9325.0	486197	75	25	110	0.3	9
49600E	49600.0	9350.0	486198	50	35	150	0.3	10
49600E	49600.0	9375.0	486199	50	130	130	0.3	10
49800E	49800.0	7500.0	484688	80	25	100	0.3	12
49800E	49800.0	7525.0	484689	75	20	105	0.3	4
49800E	49800.0	7550.0	484690	50	25	55	0.3	7
49800E	49800.0	7575.0	484691	70	20	70	0.3	7
49800E	49800.0	7600.0	484692	45	15	105	0.3	7
49800E	49800.0	7625.0	484693	65	50	45	0.3	5
49800E	49800.0	7650.0	484694	70	20	45	0.3	16
49800E	49800.0	7675.0	484695	80	20	50	0.3	15
49800E	49800.0	7700.0	484696	95	25	50	0.3	14
49800E	49800.0	7725.0	484697	80	20	75	0.3	11
49800E	49800.0	7750.0	484698	85	25	95	0.3	13
49800E	49800.0	7775.0	484699	75	15	75	0.3	12
49800E	49800.0	7800.0	484700	100	35	105	0.3	17
49800E	49800.0	7825.0	484701	30	20	60	0.3	5
49800E	49800.0	7850.0	484702	20	10	60	0.3	5
49800E	49800.0	7875.0	484703	15	10	50	0.3	6
49800E	49800.0	7900.0	484704	10	10	45	0.3	2
49800E	49800.0	7925.0	484705	10	3	45	0.3	2
49800E	49800.0	7950.0	484706	10	3	60	0.3	30
49800E	49800.0	7975.0	484707	10	10	55	0.3	4
49800E	49800.0	8000.0	484708	10	15	75	0.3	2
49800E	49800.0	8025.0	484709	15	85	70	0.3	2
49800E	49800.0	8050.0	484710	10	10	65	0.3	2
49800E	49800.0	8075.0	484711	15	20	55	0.3	3
49800E	49800.0	8100.0	484712	65	30	70	0.3	16
49800E	49800.0	8125.0	484713	80	20	50	0.3	12
49800E	49800.0	8150.0	484714	65	15	45	0.3	10
49800E	49800.0	8175.0	484715					
49800E	49800.0	8200.0	484716	55	25	60	0.3	11
49800E	49800.0	8225.0	484717	60	15	50	0.3	9
49800E	49800.0	8250.0	484718	60	15	50	0.3	9
49800E	49800.0	8275.0	484719	65	20	45	0.3	6
49800E	49800.0	8300.0	484720	75	15	50	0.3	10
49800E	49800.0	8325.0	484721	80	15	50	0.3	14
49800E	49800.0	8350.0	484722	95	20	45	0.3	12
49800E	49800.0	8375.0	484723	125	25	65	0.3	9
49800E	49800.0	8400.0	484724	95	20	65	0.3	9
49800E	49800.0	8425.0	484725	70	15	45	0.3	10
49800E	49800.0	8450.0	484726	55	15	40	0.3	13
49800E	49800.0	8475.0	484727	50	15	50	0.3	9
49800E	49800.0	8500.0	486290	70	3	40	0.3	5
49800E	49800.0	8525.0	486291	65	5	70	0.3	9
49800E	49800.0	8550.0	486292	225	50	130	0.3	11
49800E	49800.0	8575.0	486293	95	10	55	0.3	16
49800E	49800.0	8600.0	486294	100	15	60	0.3	5
49800E	49800.0	8625.0	486295	105	10	60	0.3	26
49800E	49800.0	8650.0	486296	130	25	75	0.3	11
49800E	49800.0	8675.0	486297	100	20	80	0.3	8
49800E	49800.0	8700.0	486298	65	5	110	0.3	5
49800E	49800.0	8750.0	486300	40	20	70	0.3	7
49800E	49800.0	8775.0	486301	65	10	90	0.3	10
49800E	49800.0	8800.0	486302	20	175	45	0.3	3
49800E	49800.0	8825.0	486303	40	280	175	.5	5
49800E	49800.0	8850.0	486304	20	55	65	1.0	2
49800E	49800.0	8875.0	486305	35	265	175	0.3	6
49800E	49800.0	8900.0	486306	35	350	190	0.3	12
49800E	49800.0	8925.0	486307	45	280	260	0.3	9
49800E	49800.0	8950.0	486308	30	200	225	0.3	10
49800E	49800.0	8975.0	486309	30	50	185	0.3	4
49800E	49800.0	9000.0	486310	30	20	115	0.3	3
49800E	49800.0	9025.0	486311	20	20	90	0.3	5
49800E	49800.0	9050.0	486312	30	30	125	.5	6
49800E	49800.0	9075.0	486313	35	25	120	0.3	5
49800E	49800.0	9100.0	486314	30	30	120	0.3	6
49800E	49800.0	9125.0	486315	30	50	130	0.3	8
49800E	49800.0	9150.0	486316	30	15	95	0.3	6
49800E	49800.0	9175.0	486317	30	20	135	0.3	8
49800E	49800.0	9200.0	486318	35	40	120	0.3	8
49800E	49800.0	9225.0	486319	20	30	150	0.3	5

49800E	49800.0	9250.0	486320	35	60	165	.5	12
49800E	49800.0	9275.0	486321	20	5	90	0.3	2
49800E	49800.0	9300.0	486322	45	45	125	0.3	7
49800E	49800.0	9325.0	486323	75	15	150	0.3	8
49800E	49800.0	9350.0	486324	90	25	130	0.3	8
49800E	49800.0	9375.0	486325	30	30	110	0.3	4
50000E	50000.0	7500.0	484730	35	15	45	0.3	6
50000E	50000.0	7525.0	484731	35	10	40	0.3	7
50000E	50000.0	7550.0	484732	80	20	45	0.3	7
50000E	50000.0	7575.0	484733	125	45	60	0.3	11
50000E	50000.0	7600.0	484734	115	25	50	0.3	9
50000E	50000.0	7625.0	484735	120	45	65	0.3	7
50000E	50000.0	7650.0	484736	95	30	50	0.3	11
50000E	50000.0	7675.0	484737	65	30	35	0.3	10
50000E	50000.0	7700.0	484738	85	25	40	0.3	12
50000E	50000.0	7725.0	484739	60	35	50	0.3	16
50000E	50000.0	7750.0	484740	75	35	50	0.3	9
50000E	50000.0	7775.0	484741	35	15	35	0.3	8
50000E	50000.0	7800.0	484742	40	20	70	0.3	6
50000E	50000.0	7825.0	484743	20	10	90	0.3	1
50000E	50000.0	7850.0	484744	15	5	65	0.3	20
50000E	50000.0	7875.0	484745	15	10	65	0.3	3
50000E	50000.0	7900.0	484746	65	50	60	0.3	7
50000E	50000.0	7925.0	484747	70	20	50	0.3	7
50000E	50000.0	7950.0	484748	65	20	45	0.3	17
50000E	50000.0	7975.0	484749	75	25	45	0.3	14
50000E	50000.0	8000.0	484750	60	15	40	0.3	9
50000E	50000.0	8025.0	484751	70	15	40	0.3	8
50000E	50000.0	8050.0	484752	95	15	45	0.3	12
50000E	50000.0	8075.0	484753	100	20	45	0.3	12
50000E	50000.0	8100.0	484754	45	25	60	0.3	9
50000E	50000.0	8125.0	484755	70	30	55	0.3	8
50000E	50000.0	8150.0	484756	65	20	50	0.3	9
50000E	50000.0	8175.0	484757	45	25	55	0.3	6
50000E	50000.0	8200.0	484376	40	5	105	0.3	8
50000E	50000.0	8225.0	484377	70	10	90	0.3	10
50000E	50000.0	8250.0	484378	70	15	80	0.3	9
50000E	50000.0	8275.0	484379	85	10	105	0.3	9
50000E	50000.0	8300.0	484380	75	25	105	0.3	9
50000E	50000.0	8325.0	484381	90	10	75	0.3	10
50000E	50000.0	8350.0	484382	60	10	60	0.3	8
50000E	50000.0	8375.0	484383	60	15	60	0.3	11
50000E	50000.0	8400.0	484384	40	10	45	0.3	6
50000E	50000.0	8425.0	484385	50	15	70	0.3	5
50000E	50000.0	8450.0	484386	45	15	45	0.3	8
50000E	50000.0	8475.0	484387	65	10	50	0.3	8
50000E	50000.0	8500.0	484388	80	15	60	0.3	7
50000E	50000.0	8525.0	484389	70	5	75	0.3	10
50000E	50000.0	8550.0	484390	40	3	55	0.3	8
50000E	50000.0	8575.0	484391	50	5	65	0.3	8
50000E	50000.0	8600.0	484392	50	10	80	0.3	9
50000E	50000.0	8625.0	484393	35	5	60	0.3	7
50000E	50000.0	8650.0	484394	60	15	115	0.3	8
50000E	50000.0	8675.0	484395	65	10	120	0.3	70
50000E	50000.0	8700.0	486410	15	90	140	0.3	19
50000E	50000.0	8725.0	486411	15	130	155	0.3	14
50000E	50000.0	8750.0	486412	15	175	110	0.3	5
50000E	50000.0	8775.0	486413	15	115	95	0.3	5
50000E	50000.0	8800.0	486414	5	40	110	0.3	4
50000E	50000.0	8825.0	486415	5	85	135	0.3	9
50000E	50000.0	8850.0	486416	10	145	130	0.3	16
50000E	50000.0	8875.0	486417	20	155	125	0.3	16
50000E	50000.0	8900.0	486418	15	115	100	0.3	14
50000E	50000.0	8925.0	486419	20	70	140	0.3	13
50000E	50000.0	8950.0	486420	15	80	115	0.3	13
50000E	50000.0	8975.0	486421	40	170	130	0.3	18
50000E	50000.0	9000.0	486422	25	35	100	0.3	11
50000E	50000.0	9025.0	486423	50	50	145	.5	7
50000E	50000.0	9050.0	486424	50	40	75	.5	7
50000E	50000.0	9075.0	486425	60	25	105	.5	9
50000E	50000.0	9100.0	486426	45	45	105	0.3	11
50000E	50000.0	9125.0	486427	30	35	105	0.3	6
50000E	50000.0	9150.0	486428	20	25	80	0.3	4
50000E	50000.0	9175.0	486429	55	45	125	0.3	10
50000E	50000.0	9200.0	486430	40	45	100	0.3	6
50000E	50000.0	9225.0	486431	70	460	180	0.3	14
50000E	50000.0	9250.0	486432	30	45	185	.5	6
50000E	50000.0	9275.0	486433	70	50	190	0.3	14
50000E	50000.0	9300.0	486434	130	40	230	0.3	15
50000E	50000.0	9325.0	486435	60	35	150	0.3	21
50000E	50000.0	9350.0	486436	95	25	90	0.3	8
50000E	50000.0	9375.0	486437	35	40	130	0.3	8
50200E	50200.0	7500.0	484760	25	3	35	0.3	5
50200E	50200.0	7525.0	484761	30	5	40	0.3	5
50200E	50200.0	7550.0	484762	100	20	70	0.3	11
50200E	50200.0	7575.0	484763	90	15	75	0.3	10
50200E	50200.0	7600.0	484764	75	15	70	0.3	10
50200E	50200.0	7625.0	484765	90	35	175	0.3	11
50200E	50200.0	7650.0	484766	70	35	90	0.3	8
50200E	50200.0	7675.0	484767	65	20	100	0.3	8
50200E	50200.0	7700.0	484768	55	35	80	0.3	9
50200E	50200.0	7725.0	484769	85	40	70	0.3	16
50200E	50200.0	7750.0	484770	75	40	125	0.3	11
50200E	50200.0	7775.0	484771	75	25	130	0.3	9
50200E	50200.0	7800.0	484772	10	15	60	0.3	4
50200E	50200.0	7825.0	484773	55	70	155	0.3	5

50200E	50200.0	7850.0	484774	50	35	120	0.3	10
50200E	50200.0	7875.0	484775	20	40	150	0.3	29
50200E	50200.0	7900.0	484776	15	25	75	0.3	6
50200E	50200.0	7925.0	484777	55	25	125	0.3	11
50200E	50200.0	7950.0	484778	95	35	110	0.3	15
50200E	50200.0	7975.0	484779	80	45	90	0.3	13
50200E	50200.0	8000.0	484780	115	35	100	0.3	12
50200E	50200.0	8025.0	484781	60	30	75	0.3	8
50200E	50200.0	8050.0	484782	60	25	95	0.3	13
50200E	50200.0	8075.0	484783	75	35	60	0.3	12
50200E	50200.0	8100.0	484784	55	40	110	0.3	9
50200E	50200.0	8125.0	484785	80	35	45	0.3	10
50200E	50200.0	8150.0	484786	55	25	55	0.3	8
50200E	50200.0	8175.0	484787	65	40	65	0.3	12
50200E	50200.0	8200.0	484398	115	15	70	0.3	12
50200E	50200.0	8225.0	484399	90	15	70	0.3	11
50200E	50200.0	8250.0	484400	50	5	75	0.3	9
50200E	50200.0	8275.0	484401	50	3	75	0.3	7
50200E	50200.0	8300.0	484402	30	3	70	0.3	5
50200E	50200.0	8325.0	484403	30	5	60	0.3	3
50200E	50200.0	8350.0	484404	40	10	75	0.3	8
50200E	50200.0	8375.0	484405	45	20	135	0.3	9
50200E	50200.0	8400.0	484406	45	25	155	0.3	19
50200E	50200.0	8425.0	484407	70	10	110	0.3	14
50200E	50200.0	8450.0	484408	45	20	85	0.3	9
50200E	50200.0	8475.0	484409	25	20	135	0.3	6
50200E	50200.0	8500.0	484410	65	10	125	0.3	13
50200E	50200.0	8525.0	484411	40	20	115	0.3	29
50200E	50200.0	8550.0	484412	55	30	125	0.3	94
50200E	50200.0	8575.0	484413	40	15	95	0.3	16
50200E	50200.0	8600.0	484414	70	15	70	0.3	18
50200E	50200.0	8625.0	484415	30	3	40	0.3	26
50200E	50200.0	8650.0	484416	25	15	55	0.3	36
50200E	50200.0	8675.0	484417	35	10	60	0.3	30
50200E	50200.0	8700.0	486520	20	20	150	0.3	6
50200E	50200.0	8725.0	486521	30	80	130	0.3	5
50200E	50200.0	8750.0	486522	25	90	85	0.3	4
50200E	50200.0	8775.0	486523	20	40	95	0.3	5
50200E	50200.0	8800.0	486524	20	15	90	0.3	6
50200E	50200.0	8825.0	486525	15	20	75	0.3	9
50200E	50200.0	8850.0	486526	15	125	75	0.3	13
50200E	50200.0	8875.0	486527	15	25	70	0.3	9
50200E	50200.0	8900.0	486528	25	20	85	0.3	8
50200E	50200.0	8925.0	486529	30	110	115	0.3	7
50200E	50200.0	8950.0	486530	35	20	110	0.3	8
50200E	50200.0	8975.0	486531	20	20	100	0.3	10
50200E	50200.0	9000.0	486532	35	20	75	0.3	11
50200E	50200.0	9025.0	486533	55	15	85	0.3	14
50200E	50200.0	9050.0	486534	60	65	110	0.3	7
50200E	50200.0	9075.0	486535	35	40	110	0.3	11
50200E	50200.0	9100.0	486536	70	95	180	.5	8
50200E	50200.0	9125.0	486537	75	50	240	0.3	8
50200E	50200.0	9150.0	486538	60	45	155	0.3	9
50200E	50200.0	9175.0	486539	75	55	210	0.3	8
50200E	50200.0	9200.0	486540	80	25	145	0.3	16
50200E	50200.0	9225.0	486541	75	25	165	.5	12
50200E	50200.0	9250.0	486542	110	75	140	0.3	11
50200E	50200.0	9275.0	486543	105	45	145	0.3	12
50200E	50200.0	9300.0	486544	80	15	105	0.3	6
50200E	50200.0	9325.0	486545	65	15	70	0.3	7
50200E	50200.0	9350.0	486546	115	15	80	0.3	7
50200E	50200.0	9375.0	486547	65	15	95	0.3	8
50400E	50400.0	7500.0	484790	30	45	70	0.3	4
50400E	50400.0	7525.0	484791	110	30	70	0.3	7
50400E	50400.0	7550.0	484792	85	35	85	0.3	7
50400E	50400.0	7575.0	484793	95	30	60	0.3	9
50400E	50400.0	7600.0	484794	130	70	80	0.3	7
50400E	50400.0	7625.0	484795	110	60	80	0.3	8
50400E	50400.0	7650.0	484796	70	25	45	0.3	11
50400E	50400.0	7675.0	484797	90	15	50	0.3	13
50400E	50400.0	7700.0	484798	115	40	60	0.3	22
50400E	50400.0	7725.0	484799	75	45	115	0.3	12
50400E	50400.0	7750.0	484800	65	30	125	0.3	12
50400E	50400.0	7775.0	484801	60	35	95	0.3	9
50400E	50400.0	7800.0	484802	70	35	100	0.3	8
50400E	50400.0	7825.0	484803	95	40	65	0.3	11
50400E	50400.0	7850.0	484804	90	35	60	0.3	14
50400E	50400.0	7875.0	484805	85	35	50	0.3	7
50400E	50400.0	7900.0	484806	95	35	40	0.3	10
50400E	50400.0	7925.0	484807	70	35	45	0.3	15
50400E	50400.0	7950.0	484808	100	35	90	0.3	8
50400E	50400.0	7975.0	484809	80	25	50	0.3	10
50400E	50400.0	8000.0	484810	110	30	55	0.3	13
50400E	50400.0	8025.0	484811	50	25	45	0.3	9
50400E	50400.0	8050.0	484812	140	45	65	0.3	11
50400E	50400.0	8075.0	484813	105	25	60	0.3	18
50400E	50400.0	8100.0	484814	90	15	70	0.3	13
50400E	50400.0	8125.0	484815	120	35	60	0.3	14
50400E	50400.0	8150.0	484816	90	30	70	0.3	12
50400E	50400.0	8175.0	484817	115	30	75	0.3	14
50400E	50400.0	8200.0	484420	115	25	60	0.3	15
50400E	50400.0	8225.0	484421	80	15	70	0.3	9
50400E	50400.0	8250.0	484422	50	3	40	0.3	8
50400E	50400.0	8275.0	484423	75	15	75	0.3	7
50400E	50400.0	8300.0	484424	90	15	95	0.3	18
50400E	50400.0	8325.0	484425	85	3	70	0.3	6
50400E	50400.0	8350.0	484426	105	20	65	0.3	14

50400E	50400.0	8375.0	484427	90	15	80	0.3	9
50400E	50400.0	8400.0	484428	75	10	65	0.3	6
50400E	50400.0	8425.0	484429	75	10	75	0.3	9
50400E	50400.0	8450.0	484430	45	10	75	0.3	9
50400E	50400.0	8475.0	484431	85	20	140	0.3	14
50400E	50400.0	8500.0	484432	45	25	170	0.3	22
50400E	50400.0	8525.0	484433	55	25	160	0.3	43
50400E	50400.0	8550.0	484434	20	95	355	0.3	7
50400E	50400.0	8575.0	484435	65	85	185	0.3	11
50400E	50400.0	8600.0	484436	60	105	230	0.3	17
50400E	50400.0	8625.0	484437	60	230	95	0.3	20
50400E	50400.0	8650.0	484438	25	50	150	0.3	3
50400E	50400.0	8675.0	484439	10	105	220	0.3	5
50400E	50400.0	8700.0	486630	10	35	85	0.3	8
50400E	50400.0	8725.0	486631	10	15	70	0.3	7
50400E	50400.0	8750.0	486632	5	30	105	0.3	9
50400E	50400.0	8775.0	486633	5	20	75	0.3	8
50400E	50400.0	8800.0	486634	20	40	80	0.3	8
50400E	50400.0	8825.0	486635	25	65	90	0.3	8
50400E	50400.0	8850.0	486636	20	65	95	0.3	8
50400E	50400.0	8875.0	486637	25	15	65	0.3	8
50400E	50400.0	8900.0	486638	25	40	90	0.3	9
50400E	50400.0	8925.0	486639	40	15	85	1.0	11
50400E	50400.0	8950.0	486640	20	15	55	.5	4
50400E	50400.0	8975.0	486641	70	125	165	1.5	9
50400E	50400.0	9000.0	486642	40	120	195	1.0	5
50400E	50400.0	9025.0	486643	40	60	115	1.0	7
50400E	50400.0	9050.0	486644	45	60	120	1.5	9
50400E	50400.0	9075.0	486645	55	65	160	1.5	7
50400E	50400.0	9100.0	486646	50	50	195	1.0	7
50400E	50400.0	9125.0	486647	45	35	175	1.0	6
50400E	50400.0	9150.0	486648	30	15	80	.5	1
50400E	50400.0	9175.0	486649	30	15	85	1.0	5
50400E	50400.0	9200.0	486650	30	20	155	1.0	1
50400E	50400.0	9225.0	486651	40	40	135	.5	2
50400E	50400.0	9250.0	486652	20	20	100	.5	4
50400E	50400.0	9275.0	486653	40	20	95	1.0	2
50400E	50400.0	9300.0	486654	45	60	170	1.0	1
50400E	50400.0	9325.0	486655	30	30	115	1.0	4
50400E	50400.0	9350.0	486656	25	45	90	1.0	4
50400E	50400.0	9375.0	486657	40	10	95	1.0	3
50600E	50600.0	7500.0	484820	30	20	50	0.3	6
50600E	50600.0	7525.0	484821	35	15	55	0.3	9
50600E	50600.0	7550.0	484822	10	15	45	0.3	4
50600E	50600.0	7575.0	484823	75	30	110	0.3	6
50600E	50600.0	7600.0	484824	50	20	110	0.3	6
50600E	50600.0	7625.0	484825	80	25	100	0.3	7
50600E	50600.0	7650.0	484826	45	15	55	0.3	8
50600E	50600.0	7675.0	484827	50	35	55	0.3	12
50600E	50600.0	7700.0	484828	75	30	105	0.3	12
50600E	50600.0	7725.0	484829	80	30	60	0.3	15
50600E	50600.0	7750.0	484830	90	20	45	0.3	17
50600E	50600.0	7775.0	484831	70	20	40	0.3	10
50600E	50600.0	7800.0	484832	85	15	55	0.3	11
50600E	50600.0	7825.0	484833	65	10	40	0.3	10
50600E	50600.0	7850.0	484834	55	15	50	0.3	8
50600E	50600.0	7875.0	484835	90	20	65	0.3	15
50600E	50600.0	7900.0	484836	70	20	60	0.3	11
50600E	50600.0	7925.0	484837	70	20	55	0.3	8
50600E	50600.0	7950.0	484838	95	20	55	0.3	10
50600E	50600.0	7975.0	484839	90	15	55	0.3	28
50600E	50600.0	8000.0	484840	100	15	50	0.3	15
50600E	50600.0	8025.0	484841	90	20	40	0.3	12
50600E	50600.0	8050.0	484842	60	15	40	0.3	9
50600E	50600.0	8075.0	484843	100	25	80	0.3	12
50600E	50600.0	8100.0	484844	85	15	95	0.3	11
50600E	50600.0	8125.0	484845	95	15	65	0.3	11
50600E	50600.0	8150.0	484846	80	25	60	0.3	10
50600E	50600.0	8175.0	484847	80	10	90	0.3	9
50600E	50600.0	8200.0	484442	20	25	120	0.3	7
50600E	50600.0	8225.0	484443	20	25	120	0.3	20
50600E	50600.0	8250.0	484444	35	25	90	0.3	13
50600E	50600.0	8275.0	484445	35	20	75	0.3	12
50600E	50600.0	8300.0	484446	25	20	100	0.3	8
50600E	50600.0	8325.0	484447	95	25	85	0.3	10
50600E	50600.0	8350.0	484448	60	30	85	0.3	8
50600E	50600.0	8375.0	484449	25	20	75	0.3	11
50600E	50600.0	8400.0	484450	20	15	75	0.3	8
50600E	50600.0	8425.0	484451	30	20	70	0.3	11
50600E	50600.0	8450.0	484452	50	20	80	0.3	10
50600E	50600.0	8475.0	484453	25	25	95	0.3	8
50600E	50600.0	8500.0	484454	45	55	240	0.3	12
50600E	50600.0	8525.0	484455	30	980	535	6.0	10
50600E	50600.0	8550.0	484456	10	100	195	0.3	5
50600E	50600.0	8575.0	484457	25	45	110	0.3	6
50600E	50600.0	8600.0	484458	35	60	110	0.3	3
50600E	50600.0	8625.0	484459	30	110	190	0.3	5
50600E	50600.0	8650.0	484460	95	25	90	0.3	5
50600E	50600.0	8675.0	484461	60	70	100	0.3	3
50600E	50600.0	8750.0	486742	10	3	60	0.3	6
50600E	50600.0	8775.0	486743	10	3	65	0.3	6
50600E	50600.0	8800.0	486744	30	60	105	0.3	7
50600E	50600.0	8825.0	486745	35	70	105	0.3	5
50600E	50600.0	8850.0	486746	45	75	135	0.3	7
50600E	50600.0	8875.0	486747	45	80	135	0.3	11
50600E	50600.0	8900.0	486748	65	3	85	0.3	9
50600E	50600.0	8925.0	486749	100	3	60	0.3	3

50600E	50600.0	8950.0	486750	100	3	65	0.3	6
50600E	50600.0	8975.0	486751	105	3	80	0.3	9
50600E	50600.0	9000.0	486752	85	40	120	0.3	8
50600E	50600.0	9025.0	486753	45	3	105	0.3	5
50600E	50600.0	9050.0	486754	90	3	125	0.3	4
50600E	50600.0	9075.0	486755	30	3	110	0.3	4
50600E	50600.0	9100.0	486756	30	65	100	0.3	5
50600E	50600.0	9125.0	486757	35	60	120	0.3	9
50600E	50600.0	9150.0	486758	35	60	95	0.3	6
50600E	50600.0	9175.0	486759	45	30	150	0.3	5
50600E	50600.0	9200.0	486760	45	35	115	0.3	3
50600E	50600.0	9225.0	486761	50	3	100	0.3	5
50600E	50600.0	9250.0	486762	30	5	100	0.3	6
50600E	50600.0	9275.0	486763	40	10	105	0.3	6
50600E	50600.0	9300.0	486764	40	3	140	0.3	7
50600E	50600.0	9325.0	486765	50	30	140	0.3	7
50600E	50600.0	9350.0	486766	50	50	125	0.3	6
50600E	50600.0	9375.0	486767	40	70	140	0.3	8
50800E	50800.0	7500.0	484850	10	3	90	0.3	7
50800E	50800.0	7525.0	484851	40	20	55	0.3	10
50800E	50800.0	7550.0	484852	25	3	60	0.3	10
50800E	50800.0	7575.0	484853	10	3	45	0.3	8
50800E	50800.0	7600.0	484854	10	3	40	0.3	4
50800E	50800.0	7625.0	484855	10	3	40	0.3	3
50800E	50800.0	7650.0	484856	70	3	50	0.3	7
50800E	50800.0	7675.0	484857	100	15	60	0.3	7
50800E	50800.0	7700.0	484858	85	35	60	0.3	11
50800E	50800.0	7725.0	484859	95	15	80	0.3	13
50800E	50800.0	7750.0	484860	65	10	65	0.3	10
50800E	50800.0	7775.0	484861	90	15	60	0.3	7
50800E	50800.0	7800.0	484862	750	20	40	0.3	8
50800E	50800.0	7825.0	484863	100	30	35	0.3	13
50800E	50800.0	7850.0	484864	120	30	50	0.3	11
50800E	50800.0	7875.0	484865	100	20	65	0.3	9
50800E	50800.0	7900.0	484866	135	30	85	0.3	13
50800E	50800.0	7925.0	484867	45	15	50	0.3	10
50800E	50800.0	7950.0	484868	55	15	120	0.3	10
50800E	50800.0	7975.0	484869	85	20	100	0.3	21
50800E	50800.0	8000.0	484870	110	30	95	0.3	10
50800E	50800.0	8025.0	484871	100	40	70	0.3	15
50800E	50800.0	8050.0	484872	65	15	100	0.3	7
50800E	50800.0	8075.0	484873	95	30	80	0.3	10
50800E	50800.0	8100.0	484874	105	30	95	0.3	23
50800E	50800.0	8125.0	484875	90	25	85	0.3	9
50800E	50800.0	8150.0	484876	65	25	90	0.3	6
50800E	50800.0	8175.0	484877	100	25	115	0.3	11
50800E	50800.0	8200.0	484464	30	20	80	0.3	6
50800E	50800.0	8225.0	484465	40	25	100	0.3	9
50800E	50800.0	8250.0	484466	65	30	80	0.3	10
50800E	50800.0	8275.0	484467	90	20	100	0.3	7
50800E	50800.0	8300.0	484468	70	25	100	0.3	12
50800E	50800.0	8325.0	484469	100	30	115	0.3	17
50800E	50800.0	8350.0	484470	70	20	90	0.3	7
50800E	50800.0	8375.0	484471	75	20	130	0.3	9
50800E	50800.0	8400.0	484472	65	20	110	0.3	12
50800E	50800.0	8425.0	484473	50	25	80	0.3	18
50800E	50800.0	8450.0	484474	55	20	90	0.3	7
50800E	50800.0	8475.0	484475	75	25	95	0.3	10
50800E	50800.0	8500.0	484476	65	15	115	0.3	5
50800E	50800.0	8525.0	484477	50	60	155	0.3	5
50800E	50800.0	8550.0	484478	40	75	225	0.3	10
50800E	50800.0	8575.0	484479	95	55	270	0.3	5
50800E	50800.0	8600.0	484480	55	180	145	0.3	8
50800E	50800.0	8625.0	484481	60	125	185	0.3	12
50800E	50800.0	8650.0	484482	45	85	135	0.3	9
50800E	50800.0	8675.0	484483	70	120	145	0.3	9
50800E	50800.0	8700.0	486850	15	65	105	0.3	5
50800E	50800.0	8725.0	486851	15	55	135	0.3	6
50800E	50800.0	8750.0	486852	50	260	110	.5	8
50800E	50800.0	8775.0	486853	25	45	60	0.3	5
50800E	50800.0	8800.0	486854	20	25	160	0.3	7
50800E	50800.0	8825.0	486855	15	50	70	0.3	9
50800E	50800.0	8850.0	486856	10	40	55	.5	7
50800E	50800.0	8875.0	486857	25	40	75	0.3	14
50800E	50800.0	8900.0	486858	10	25	40	0.3	7
50800E	50800.0	8925.0	486859	20	30	70	0.3	6
50800E	50800.0	8950.0	486860	80	20	115	0.3	7
50800E	50800.0	8975.0	486861	20	30	100	0.3	5
50800E	50800.0	9000.0	486862	80	10	95	0.3	5
50800E	50800.0	9025.0	486863	35	10	55	0.3	3
50800E	50800.0	9050.0	486864	50	35	110	0.3	3
50800E	50800.0	9075.0	486865	40	20	55	0.3	4
50800E	50800.0	9100.0	486866	35	30	80	0.3	3
50800E	50800.0	9125.0	486867	20	20	35	0.3	4
50800E	50800.0	9150.0	486868	40	20	50	0.3	1
50800E	*50800.0*	*9175.0*	*486869*	*20*	*30*	*40*	*0.3*	2
50800E	50800.0	9200.0	486870	30	30	35	0.3	3
50800E	50800.0	9225.0	486871	45	20	55	0.3	2
50800E	50800.0	9250.0	486872	25	15	45	0.3	3
50800E	50800.0	9275.0	486873	40	10	50	0.3	4
50800E	50800.0	9300.0	486874	40	10	55	0.3	4
50800E	50800.0	9325.0	486875	40	15	55	0.3	8
50800E	50800.0	9350.0	486876	55	10	60	0.3	4
50800E	50800.0	9375.0	486877	45	5	60	0.3	7
51000E	51000.0	7500.0	484880	95	25	85	0.3	13
51000E	51000.0	7525.0	484881	125	30	100	0.3	10

51000E	51000.0	7550.0	484882	125	25	70	0.3	8
51000E	51000.0	7575.0	484883	90	25	60	0.3	12
51000E	51000.0	7600.0	484884	85	20	55	0.3	10
51000E	51000.0	7625.0	484885	35	20	35	0.3	7
51000E	51000.0	7650.0	484886	45	30	35	0.3	10
51000E	51000.0	7675.0	484887	65	25	40	0.3	13
51000E	51000.0	7700.0	484888	60	25	40	0.3	12
51000E	51000.0	7725.0	484889	45	20	35	0.3	10
51000E	51000.0	7750.0	484890	40	30	35	0.3	12
51000E	51000.0	7775.0	484891	40	30	30	0.3	11
51000E	51000.0	7800.0	484892	40	20	35	0.3	13
51000E	51000.0	7825.0	484893	45	20	30	0.3	11
51000E	51000.0	7850.0	484894	45	15	35	0.3	13
51000E	51000.0	7875.0	484895	60	15	45	0.3	13
51000E	51000.0	7900.0	484896	55	20	40	0.3	11
51000E	51000.0	7925.0	484897	65	15	55	0.3	12
51000E	51000.0	7950.0	484898	70	15	70	0.3	13
51000E	51000.0	7975.0	484899	75	15	80	0.3	15
51000E	51000.0	8000.0	484900	40	20	50	0.3	9
51000E	51000.0	8025.0	484901	55	25	80	0.3	9
51000E	51000.0	8050.0	484902	60	25	135	0.3	6
51000E	51000.0	8075.0	484903	70	35	140	0.3	5
51000E	51000.0	8100.0	484904	80	15	55	0.3	9
51000E	51000.0	8125.0	484905	75	20	60	0.3	7
51000E	51000.0	8150.0	484906	90	30	75	0.3	10
51000E	51000.0	8175.0	484907	105	30	70	0.3	9
51000E	51000.0	8200.0	484486	70	20	110	0.3	5
51000E	51000.0	8225.0	484487	30	25	50	0.3	6
51000E	51000.0	8250.0	484488	45	20	70	0.3	3
51000E	51000.0	8275.0	484489	55	30	75	0.3	9
51000E	51000.0	8300.0	484490	55	35	70	0.3	8
51000E	51000.0	8325.0	484491	55	30	65	0.3	9
51000E	51000.0	8350.0	484492	45	25	60	0.3	11
51000E	51000.0	8375.0	484493	65	45	80	0.3	7
51000E	51000.0	8400.0	484494	100	45	85	0.3	10
51000E	51000.0	8425.0	484495	85	55	85	0.3	8
51000E	51000.0	8450.0	484496	60	45	85	0.3	12
51000E	51000.0	8475.0	484497	60	200	130	2.0	28
51000E	51000.0	8500.0	484498	60	445	150	2.0	46
51000E	51000.0	8525.0	484499	15	35	210	0.3	8
51000E	51000.0	8550.0	484500	60	185	125	0.3	10
51000E	51000.0	8575.0	484501	40	90	120	0.3	11
51000E	51000.0	8600.0	484502	5	45	65	0.3	4
51000E	51000.0	8625.0	484503	100	265	125	0.3	26
51000E	51000.0	8650.0	484504	30	85	85	0.3	11
51000E	51000.0	8675.0	484505	15	55	85	0.3	6
51000E	51000.0	8700.0	483000	25	70	155	0.3	3
51000E	51000.0	8725.0	483001	20	65	150	0.3	6
51000E	51000.0	8750.0	483002	25	140	100	0.3	5
51000E	51000.0	8775.0	483003	20	40	125	0.3	5
51000E	51000.0	8800.0	483004	15	45	65	0.3	5
51000E	51000.0	8825.0	483005	25	50	80	.5	5
51000E	51000.0	8850.0	483006	20	50	75	0.3	7
51000E	51000.0	8875.0	483007	25	75	140	0.3	5
51000E	51000.0	8900.0	483008	25	95	90	.5	6
51000E	51000.0	8925.0	483009	25	70	85	.5	7
51000E	51000.0	8950.0	483010	60	55	160	2.5	6
51000E	51000.0	8975.0	483011	40	50	145	1.5	5
51000E	51000.0	9000.0	483012	20	30	100	1.5	7
51000E	51000.0	9025.0	483013	35	45	90	1.0	6
51000E	51000.0	9050.0	483014	25	50	75	0.3	10
51000E	51000.0	9075.0	483015	45	40	155	0.3	13
51000E	51000.0	9100.0	483016	105	20	80	0.3	8
51000E	51000.0	9125.0	483017	60	15	70	0.3	.5
51000E	51000.0	9150.0	483018	90	15	60	.5	.5
51000E	51000.0	9175.0	483019	75	10	60	.5	3
51000E	51000.0	9200.0	483020	60	10	50	0.3	.5
51000E	51000.0	9225.0	483021	90	10	65	0.3	2
51000E	51000.0	9250.0	483022	55	5	60	0.3	.5
51000E	51000.0	9275.0	483023	120	10	50	1.0	3
51000E	51000.0	9300.0	483024	90	10	45	.5	6
51000E	51000.0	9325.0	483025	95	10	50	0.3	4
51000E	51000.0	9350.0	483026	70	5	60	0.3	2
51000E	51000.0	9375.0	483027	55	20	60	0.3	3
51200E	51200.0	7500.0	484910	20	15	45	0.3	5
51200E	51200.0	7525.0	484911	20	10	65	0.3	5
51200E	51200.0	7550.0	484912	25	10	60	0.3	5
51200E	51200.0	7575.0	484913	20	15	105	0.3	4
51200E	51200.0	7600.0	484914	100	25	95	0.3	7
51200E	51200.0	7625.0	484915	75	15	140	0.3	10
51200E	51200.0	7650.0	484916	85	20	120	0.3	6
51200E	51200.0	7675.0	484917	80	20	40	0.3	12
51200E	51200.0	7700.0	484918	85	25	65	0.3	11
51200E	51200.0	7725.0	484919	105	30	65	0.3	12
51200E	51200.0	7750.0	484920	60	10	50	0.3	12
51200E	51200.0	7775.0	484921	95	25	45	0.3	8
51200E	51200.0	7800.0	484922	75	35	45	0.3	21
51200E	51200.0	7825.0	484923	60	25	45	0.3	8
51200E	51200.0	7850.0	484924	55	25	35	0.3	10
51200E	51200.0	7875.0	484925	60	20	30	0.3	9
51200E	51200.0	7900.0	484926	95	20	45	0.3	12
51200E	51200.0	7925.0	484927	85	40	55	0.3	12
51200E	51200.0	7950.0	484928	90	25	40	0.3	12
51200E	51200.0	7975.0	484929	85	20	55	0.3	14
51200E	51200.0	8000.0	484930	85	15	250	0.3	6
51200E	51200.0	8025.0	484931	115	25	105	0.3	16
51200E	51200.0	8050.0	484932	50	20	100	0.3	12

51200E	51200.0	8075.0	484933	35	15	85	0.3	7
51200E	51200.0	8100.0	484934	40	15	80	0.3	8
51200E	51200.0	8125.0	484935	70	15	125	0.3	13
51200E	51200.0	8150.0	484936	65	15	90	0.3	6
51200E	51200.0	8175.0	484937	60	15	110	0.3	4
51200E	51200.0	8200.0	484508	70	15	80	0.3	10
51200E	51200.0	8225.0	484509	45	15	90	0.3	8
51200E	51200.0	8250.0	484510	115	50	150	0.3	7
51200E	51200.0	8275.0	484511	50	15	75	0.3	11
51200E	51200.0	8300.0	484512	70	10	65	0.3	6
51200E	51200.0	8325.0	484513	65	35	75	0.3	3
51200E	51200.0	8350.0	484514	65	240	175	0.3	14
51200E	51200.0	8375.0	484515	55	60	55	0.3	8
51200E	51200.0	8400.0	484516	25	110	115	0.3	10
51200E	51200.0	8425.0	484517	55	115	105	0.3	11
51200E	51200.0	8450.0	484518	60	55	95	0.3	12
51200E	51200.0	8475.0	484519	50	30	90	0.3	21
51200E	51200.0	8500.0	483110	30	115	50	0.3	13
51200E	51200.0	8525.0	483111	10	40	60	0.3	4
51200E	51200.0	8550.0	483112	35	230	50	0.3	6
51200E	51200.0	8575.0	483113	15	185	70	0.3	5
51200E	51200.0	8600.0	483114	20	80	155	0.3	7
51200E	51200.0	8625.0	483115	15	50	80	0.3	13
51200E	51200.0	8650.0	483116	10	55	110	0.3	9
51200E	51200.0	8675.0	483117	60	100	420	0.3	16
51200E	51200.0	8700.0	483118	120	300	340	0.3	17
51200E	51200.0	8725.0	483119	75	280	245	0.3	13
51200E	51200.0	8750.0	483120	35	45	95	0.3	10
51200E	51200.0	8775.0	483121	25	35	105	0.3	8
51200E	51200.0	8800.0	483122	25	35	105	0.3	7
51200E	51200.0	8825.0	483123	45	45	165	0.3	10
51200E	51200.0	8850.0	483124	30	35	150	0.3	8
51200E	51200.0	8875.0	483125	35	35	160	0.3	8
51200E	51200.0	8900.0	483126	30	50	110	0.3	7
51200E	51200.0	8925.0	483127	30	40	120	0.3	9
51200E	51200.0	8950.0	483128	25	40	140	0.3	14
51200E	51200.0	8975.0	483129	25	40	130	0.3	6
51200E	51200.0	9000.0	483130	50	45	130	0.3	11
51200E	51200.0	9025.0	483131	25	25	130	0.3	5
51200E	51200.0	9050.0	483132	55	50	130	0.3	12
51200E	51200.0	9075.0	483133	50	40	135	0.3	8
51200E	51200.0	9100.0	483134	25	40	145	0.3	5
51200E	51200.0	9125.0	483135	40	40	105	0.3	8
51200E	51200.0	9150.0	483136	45	60	135	0.3	18
51200E	51200.0	9175.0	483137	40	55	130	0.3	11
51200E	51200.0	9200.0	483138	40	45	135	0.3	10
51200E	51200.0	9225.0	483139	40	50	140	0.3	9
51200E	51200.0	9250.0	483140	15	20	100	0.3	6
51200E	51200.0	9275.0	483141	50	35	90	0.3	8
51200E	51200.0	9300.0	483142	30	45	150	0.3	7
51200E	51200.0	9325.0	483143	45	40	85	0.3	9
51200E	51200.0	9350.0	483144	30	35	120	0.3	10
51200E	51200.0	9375.0	483145	50	45	145	0.3	15
51400E	51400.0	7500.0	484940	100	15	100	0.3	5
51400E	51400.0	7525.0	484941	60	10	60	0.3	5
51400E	51400.0	7550.0	484942	65	15	60	0.3	7
51400E	51400.0	7575.0	484943	90	25	65	0.3	8
51400E	51400.0	7600.0	484944	85	15	45	0.3	7
51400E	51400.0	7625.0	484945	60	20	50	0.3	15
51400E	51400.0	7650.0	484946	65	30	45	0.3	10
51400E	51400.0	7675.0	484947	70	35	45	0.3	9
51400E	51400.0	7700.0	484948	75	20	45	0.3	12
51400E	51400.0	7725.0	484949	80	20	45	0.3	11
51400E	51400.0	7750.0	484950	65	20	50	0.3	10
51400E	51400.0	7775.0	484951	50	15	35	0.3	9
51400E	51400.0	7800.0	484952	65	20	40	0.3	10
51400E	51400.0	7825.0	484953	55	20	40	0.3	10
51400E	51400.0	7850.0	484954	75	20	70	0.3	13
51400E	51400.0	7875.0	484955	70	25	125	0.3	10
51400E	51400.0	7900.0	484956	65	40	145	0.3	13
51400E	51400.0	7925.0	484957	50	15	105	0.3	7
51400E	51400.0	7950.0	484958	60	20	115	0.3	11
51400E	51400.0	7975.0	484959	80	25	135	0.3	11
51400E	51400.0	8000.0	484960	80	40	110	0.3	11
51400E	51400.0	8025.0	484961	70	25	80	0.3	12
51400E	51400.0	8050.0	484962	70	25	100	0.3	13
51400E	51400.0	8075.0	484963	70	20	115	0.3	7
51400E	51400.0	8100.0	484964	35	80	115	0.3	130
51400E	51400.0	8125.0	484965	75	50	130	0.3	21
51400E	51400.0	8150.0	484966	70	30	115	0.3	15
51400E	51400.0	8175.0	484967	40	35	75	0.3	24
51400E	51400.0	8200.0	484522	105	50	130	0.3	19
51400E	51400.0	8225.0	484523	90	30	95	0.3	4
51400E	51400.0	8250.0	484524	75	55	105	0.3	4
51400E	51400.0	8275.0	484525	55	190	130	0.3	6
51400E	51400.0	8300.0	484526	60	535	180	0.3	16
51400E	51400.0	8325.0	484527	45	100	100	0.3	13
51400E	51400.0	8350.0	484528	35	120	120	0.3	9
51400E	51400.0	8375.0	484529	20	210	125	0.3	10
51400E	51400.0	8400.0	484530	10	65	120	0.3	6
51400E	51400.0	8425.0	484531	75	40	125	0.3	6
51400E	51400.0	8450.0	484532	55	35	65	0.3	4
51400E	51400.0	8475.0	484533	45	135	160	0.3	9
51400E	51400.0	8500.0	483210	25	115	120	0.3	10
51400E	51400.0	8525.0	483211	20	240	110	0.3	11
51400E	51400.0	8550.0	483212	15	65	170	0.3	9
51400E	51400.0	8575.0	483213	85	60	65	0.3	9

51400E	51400.0	8600.0	483214	20	85	135	0.3	5
51400E	51400.0	8625.0	483215	20	55	145	0.3	8
51400E	51400.0	8650.0	483216	80	30	170	0.3	6
51400E	51400.0	8675.0	483217	70	110	225	0.3	16
51400E	51400.0	8700.0	483218	40	35	85	0.3	8
51400E	51400.0	8725.0	483219	55	90	80	0.3	6
51400E	51400.0	8750.0	483220	55	95	75	0.3	8
51400E	51400.0	8775.0	483221	160	40	45	0.3	8
51400E	51400.0	8800.0	483222	135	45	115	0.3	6
51400E	51400.0	8825.0	483223	65	25	75	0.3	7
51400E	51400.0	8850.0	483224	60	30	75	0.3	7
51400E	51400.0	8875.0	483225	135	25	130	0.3	8
51400E	51400.0	8900.0	483226	40	30	95	0.3	6
51400E	51400.0	8925.0	483227	40	20	65	0.3	6
51400E	51400.0	8950.0	483228	50	35	70	0.3	9
51400E	51400.0	8975.0	483229	45	25	60	0.3	10
51400E	51400.0	9000.0	483230	45	25	30	0.3	4
51400E	51400.0	9025.0	483231	35	35	55	0.3	8
51400E	51400.0	9050.0	483232	60	30	65	0.3	17
51400E	51400.0	9075.0	483233	70	30	75	0.3	12
51400E	51400.0	9100.0	483234	45	35	60	0.3	17
51400E	51400.0	9125.0	483235	55	35	60	0.3	14
51400E	51400.0	9150.0	483236	20	15	40	0.3	14
51400E	51400.0	9175.0	483237	15	5	35	0.3	8
51400E	51400.0	9200.0	483238	20	10	40	0.3	9
51400E	51400.0	9225.0	483239	55	20	50	0.3	9
51600E	51600.0	7575.0	513025	75	45	125	0.3	14
51600E	51600.0	7600.0	513026	70	45	115	0.3	14
51600E	51600.0	7625.0	513027	40	20	70	0.3	9
51600E	51600.0	7650.0	513028	30	15	75	0.3	6
51600E	51600.0	7675.0	513029	25	20	90	0.3	7
51600E	51600.0	7700.0	513030	20	20	85	0.3	5
51600E	51600.0	7725.0	513031	15	20	100	0.3	6
51600E	51600.0	7750.0	513032	5	10	145	0.3	2
51600E	51600.0	7775.0	513033	50	10	130	0.3	2
51600E	51600.0	7800.0	513034	5	25	155	0.3	5
51600E	51600.0	7825.0	513035	15	20	95	0.3	6
51600E	51600.0	7850.0	513036	30	35	95	0.3	12
51600E	51600.0	7875.0	513037	90	20	115	0.3	9
51600E	51600.0	7900.0	513038	70	15	130	0.3	9
51600E	51600.0	7925.0	513039	75	10	100	0.3	16
51600E	51600.0	7950.0	513040	80	25	105	0.3	16
51600E	51600.0	7975.0	513041	70	65	85	0.3	28
51600E	51600.0	8000.0	513042	225	25	65	0.3	69
51600E	51600.0	8025.0	513043	60	5	50	0.3	11
51600E	51600.0	8050.0	513044	35	10	80	0.3	12
51600E	51600.0	8075.0	513045	95	3	40	0.3	5
51600E	51600.0	8100.0	513046	65	50	90	0.3	5
51600E	51600.0	8125.0	513047	30	150	95	0.3	8
51600E	51600.0	8150.0	513048	20	140	140	0.3	5
51600E	51600.0	8175.0	513049	20	155	170	0.3	8
51600E	51600.0	8200.0	484536	80	80	155	0.3	9
51600E	51600.0	8225.0	484537	25	160	135	0.3	9
51600E	51600.0	8250.0	484538	40	150	160	0.3	12
51600E	51600.0	8275.0	484539	50	55	155	0.3	11
51600E	51600.0	8300.0	484540	60	60	130	0.3	7
51600E	51600.0	8325.0	484541	25	50	100	0.3	5
51600E	51600.0	8350.0	484542	5	50	55	0.3	5
51600E	51600.0	8375.0	484543	15	40	75	0.3	6
51600E	51600.0	8400.0	484544	25	80	110	0.3	9
51600E	51600.0	8425.0	484545	25	65	190	0.3	7
51600E	51600.0	8450.0	484546	45	40	130	0.3	11
51600E	51600.0	8475.0	484547	85	45	190	0.3	6
51600E	51600.0	8500.0	483280	65	70	95	0.3	2
51600E	51600.0	8525.0	483281	145	75	135	0.3	6
51600E	51600.0	8550.0	483282	180	35	130	0.3	3
51600E	51600.0	8575.0	483283	110	50	250	0.3	6
51600E	51600.0	8600.0	483284	90	70	90	0.3	7
51600E	51600.0	8625.0	483285	60	40	80	0.3	8
51600E	51600.0	8650.0	483286	55	40	85	0.3	3
51600E	51600.0	8675.0	483287	100	30	70	0.3	6
51600E	51600.0	8725.0	483289	60	20	70	0.3	5
51600E	51600.0	8750.0	483290	40	20	50	0.3	4
51600E	51600.0	8775.0	483291	30	20	50	0.3	3
51600E	51600.0	8800.0	483292	75	25	85	0.3	7
51600E	51600.0	8825.0	483293	50	40	105	0.3	4
51600E	51600.0	8850.0	483294	60	40	80	0.3	5
51600E	51600.0	8875.0	483295	65	45	95	0.3	7
51600E	51600.0	8900.0	483296	75	45	105	0.3	8
51600E	51600.0	8925.0	483297	60	35	85	0.3	8
51600E	51600.0	8950.0	483298	20	20	35	0.3	2
51600E	51600.0	8975.0	483299	40	25	65	0.3	6
51600E	51600.0	9000.0	483300	25	20	55	0.3	7
51600E	51600.0	9025.0	483301	65	40	80	0.3	11
51600E	51600.0	9050.0	483302	60	35	75	0.3	12
51600E	51600.0	9075.0	483303	70	25	65	0.3	10
51600E	51600.0	9100.0	483304	15	15	30	0.3	3
51600E	51600.0	9125.0	483305	10	10	25	0.3	2
51600E	51600.0	9150.0	483306	25	25	55	0.3	7
51600E	51600.0	9175.0	483307	90	50	95	0.3	10
51600E	51600.0	9200.0	483308	90	35	85	0.3	14
51600E	51600.0	9225.0	483309	110	45	90	0.3	17
51600E	51600.0	9250.0	483310	130	75	145	0.3	19
51600E	51600.0	9275.0	483311	75	35	90	0.3	10
51600E	51600.0	9300.0	483312	85	40	125	0.3	8
51600E	51600.0	9325.0	483313	35	30	55	0.3	10
51600E	51600.0	9350.0	483314	10	15	30	0.3	3
51600E	51600.0	9375.0	483315	20	10	20	0.3	11

51800E	51800.0	8000.0	483348	45	10	95	0.3	4
51800E	51800.0	8025.0	483349	60	5	40	0.3	9
51800E	51800.0	8050.0	483350	55	5	40	0.3	3
51800E	51800.0	8075.0	483351	15	20	75	0.3	3
51800E	51800.0	8100.0	483352	30	100	145	0.3	6
51800E	51800.0	8125.0	483353	35	140	170	0.3	6
51800E	51800.0	8150.0	483354	35	225	145	0.3	14
51800E	51800.0	8175.0	483355	30	420	150	0.3	15
51800E	51800.0	8200.0	483356	30	200	145	0.3	12
51800E	51800.0	8225.0	483357	30	80	65	0.3	6
51800E	51800.0	8250.0	483358	30	90	105	0.3	7
51800E	51800.0	8275.0	483359	30	80	80	0.3	7
51800E	51800.0	8300.0	483360	30	65	85	0.3	7
51800E	51800.0	8325.0	483361	35	45	95	0.3	7
51800E	51800.0	8350.0	483362	50	25	150	0.3	6
51800E	51800.0	8375.0	483363	25	25	95	0.3	4
51800E	51800.0	8400.0	483364	25	60	90	0.3	5
51800E	51800.0	8425.0	483365	30	50	120	0.3	5
51800E	51800.0	8450.0	483366	85	65	170	0.3	4
51800E	51800.0	8475.0	483367	100	140	210	0.3	9
51800E	51800.0	8500.0	483368	120	90	175	0.3	6
51800E	51800.0	8525.0	483369	80	45	155	0.3	5
51800E	51800.0	8550.0	483370	45	35	55	0.3	5
51800E	51800.0	8575.0	483371	80	25	90	0.3	5
51800E	51800.0	8600.0	483372	65	35	125	0.3	10
51800E	51800.0	8625.0	483373	85	40	85	0.3	12
51800E	51800.0	8650.0	483374	35	45	70	0.3	13
51800E	51800.0	8675.0	483375	30	20	60	0.3	12
51800E	51800.0	8700.0	483376	45	635	55	0.3	54
51800E	51800.0	8725.0	483377	95	30	60	0.3	19
51800E	51800.0	8750.0	483378	90	30	70	0.3	18
51800E	51800.0	8775.0	483379	55	35	60	0.3	16
51800E	51800.0	8800.0	483380	90	100	185	0.3	23
51800E	51800.0	8825.0	483381	95	45	85	0.3	11
51800E	51800.0	8850.0	483382	105	45	120	0.3	10
51800E	51800.0	8875.0	483383	95	65	120	0.3	17
51800E	51800.0	8900.0	483384	75	35	85	0.3	10
51800E	51800.0	8925.0	483385	70	40	75	0.3	14
51800E	51800.0	8950.0	483386	65	30	70	0.3	11
51800E	51800.0	8975.0	483387	45	25	65	0.3	10
51800E	51800.0	9000.0	483388	15	15	35	0.3	6
51800E	51800.0	9025.0	483389	10	3	15	0.3	2
51800E	51800.0	9050.0	483390	30	20	40	0.3	8
51800E	51800.0	9075.0	483391	45	15	45	0.3	6
51800E	51800.0	9100.0	483392	20	15	35	0.3	6
51800E	51800.0	9125.0	483393	25	20	35	0.3	6
51800E	51800.0	9150.0	483394	15	15	30	0.3	4
51800E	51800.0	9175.0	483395	5	10	20	0.3	3
51800E	51800.0	9200.0	483396	15	25	35	0.3	6
51800E	51800.0	9225.0	483397	5	10	10	0.3	3
51800E	51800.0	9250.0	483398	15	45	50	0.3	15
51800E	51800.0	9275.0	483399	20	40	40	0.3	14
51800E	51800.0	9300.0	483400	65	30	70	0.3	9
51800E	51800.0	9325.0	483401	55	50	55	0.3	7
51800E	51800.0	9350.0	483402	15	45	50	0.3	6
51800E	51800.0	9375.0	483403	5	5	15	0.3	1
52000E	52000.0	8000.0	483428	5	5	55	0.3	3
52000E	52000.0	8025.0	483429	10	5	120	0.3	3
52000E	52000.0	8050.0	483430	15	3	75	0.3	3
52000E	52000.0	8075.0	483431	20	15	110	0.3	3
52000E	52000.0	8100.0	483432	30	25	100	0.3	4
52000E	52000.0	8125.0	483433	20	10	95	0.3	4
52000E	52000.0	8150.0	483434	15	30	90	0.3	7
52000E	52000.0	8175.0	483435	25	25	215	0.3	5
52000E	52000.0	8200.0	483436	30	40	125	0.3	10
52000E	52000.0	8225.0	483437	170	45	140	0.3	9
52000E	52000.0	8250.0	483438	30	35	80	0.3	6
52000E	52000.0	8275.0	483439	30	30	120	0.3	6
52000E	52000.0	8300.0	483440	35	95	125	0.3	6
52000E	52000.0	8325.0	483441	90	55	105	0.3	19
52000E	52000.0	8350.0	483442	95	45	70	0.3	45
52000E	52000.0	8375.0	483443	75	30	60	0.3	13
52000E	52000.0	8400.0	483444	80	30	65	0.3	9
52000E	52000.0	8425.0	483445	150	25	65	0.3	12
52000E	52000.0	8450.0	483446	85	25	65	0.3	7
52000E	52000.0	8475.0	483447	70	30	65	0.3	9
52000E	52000.0	8500.0	483448	35	25	55	0.3	8
52000E	52000.0	8525.0	483449	20	25	45	0.3	9
52000E	52000.0	8550.0	483450	100	30	100	0.3	11
52000E	52000.0	8575.0	483451	80	35	80	0.3	15
52000E	52000.0	8600.0	483452	15	25	50	0.3	7
52000E	52000.0	8625.0	483453	50	30	55	0.3	6
52000E	52000.0	8650.0	483454	85	30	50	0.3	10
52000E	52000.0	8675.0	483455	70	85	65	0.3	76
52000E	52000.0	8700.0	483456	105	70	80	0.3	55
52000E	52000.0	8725.0	483457	60	60	85	0.3	18
52000E	52000.0	8750.0	483458	110	70	240	0.3	22
52000E	52000.0	8775.0	483459	80	45	165	0.3	15
52000E	52000.0	8800.0	483460	90	55	130	0.3	17
52000E	52000.0	8825.0	483461	100	45	95	0.3	16
52000E	52000.0	8850.0	483462	95	50	100	0.3	14
52000E	52000.0	8875.0	483463	55	40	75	0.3	10
52000E	52000.0	8900.0	483464	25	30	40	0.3	13
52000E	52000.0	8925.0	483465	30	30	45	0.3	7
52000E	52000.0	8950.0	483466	50	45	85	0.3	7
52000E	52000.0	8975.0	483467	80	40	70	0.3	10

52000E	52000.0	9000.0	483468	100	50	80	0.3	12
52000E	52000.0	9025.0	483469	70	40	60	0.3	14
52000E	52000.0	9050.0	483470	45	30	45	0.3	8
52000E	52000.0	9075.0	483471	25	30	35	0.3	7
52000E	52000.0	9100.0	483472	75	40	60	0.3	9
52000E	52000.0	9125.0	483473	95	35	85	0.3	22
52000E	52000.0	9150.0	483474	30	20	50	0.3	13
52000E	52000.0	9175.0	483475	15	10	30	0.3	7
52000E	52000.0	9200.0	483476	5	20	30	0.3	6
52000E	52000.0	9225.0	483477	3	5	15	0.3	1
52000E	52000.0	9250.0	483478	3	10	25	0.3	8
52000E	52000.0	9275.0	483479	3	20	25	0.3	7
52000E	52000.0	9300.0	483480	3	3	10	0.3	.5
52000E	52000.0	9325.0	483481	3	3	10	0.3	.5
52000E	52000.0	9350.0	483482	3	3	15	0.3	.5
52000E	52000.0	9375.0	483483	5	5	10	0.3	1
52200E	52200.0	8000.0	483508	15	40	135	0.3	3
52200E	52200.0	8025.0	483509	20	35	90	0.3	5
52200E	52200.0	8050.0	483510	45	60	125	0.3	11
52200E	52200.0	8075.0	483511	75	70	145	0.3	14
52200E	52200.0	8100.0	483512	55	115	140	0.3	11
52200E	52200.0	8125.0	483513	60	115	155	0.3	11
52200E	52200.0	8150.0	483514	30	80	105	0.3	9
52200E	52200.0	8175.0	483515	40	30	95	0.3	7
52200E	52200.0	8200.0	483516	25	35	60	0.3	5
52200E	52200.0	8225.0	483517	45	75	85	0.3	19
52200E	52200.0	8250.0	483518	105	40	90	0.3	20
52200E	52200.0	8275.0	483519	65	40	85	0.3	9
52200E	52200.0	8300.0	483520	65	35	90	0.3	8
52200E	52200.0	8325.0	483521	60	45	80	0.3	9
52200E	52200.0	8350.0	483522	50	40	70	0.3	13
52200E	52200.0	8375.0	483523	45	25	70	0.3	12
52200E	52200.0	8400.0	483524	45	25	65	0.3	12
52200E	52200.0	8425.0	483525	60	25	50	0.3	19
52200E	52200.0	8450.0	483526	35	30	50	0.3	26
52200E	52200.0	8475.0	483527	30	25	45	0.3	15
52200E	52200.0	8500.0	483528	25	25	40	0.3	11
52200E	52200.0	8525.0	483529	25	30	40	0.3	13
52200E	52200.0	8550.0	483530	30	35	55	0.3	26
52200E	52200.0	8575.0	483531	30	30	40	0.3	13
52200E	52200.0	8600.0	483532	45	45	45	0.3	18
52200E	52200.0	8625.0	483533	15	15	30	0.3	7
52200E	52200.0	8650.0	483534	70	30	75	0.3	18
52200E	52200.0	8675.0	483535	80	30	90	0.3	15
52200E	52200.0	8700.0	483536	110	25	85	0.3	16
52200E	52200.0	8725.0	483537	90	20	125	0.3	15
52200E	52200.0	8750.0	483538	120	30	85	0.3	12
52200E	52200.0	8775.0	483539	95	20	95	0.3	14
52200E	52200.0	8800.0	483540	100	40	90	0.3	11
52200E	52200.0	8825.0	483541	75	40	85	0.3	10
52200E	52200.0	8850.0	483542	105	35	85	0.3	14
52200E	52200.0	8875.0	483543	50	30	75	0.3	7
52200E	52200.0	8900.0	483544	35	20	55	0.3	9
52200E	52200.0	8925.0	483545	15	10	25	0.3	3
52200E	52200.0	8950.0	483546	15	10	35	0.3	3
52200E	52200.0	8975.0	483547	40	30	45	0.3	7
52200E	52200.0	9000.0	483548	20	10	35	0.3	5
52200E	52200.0	9025.0	483549	25	15	30	0.3	8
52200E	52200.0	9050.0	483550	15	15	35	0.3	8
52200E	52200.0	9075.0	483551	10	5	20	0.3	2
52200E	52200.0	9100.0	483552	10	15	30	0.3	6
52200E	52200.0	9125.0	483553	15	20	40	0.3	14
52200E	52200.0	9150.0	483554	15	20	35	0.3	9
52200E	52200.0	9175.0	483555	5	5	20	0.3	5
52200E	52200.0	9200.0	483556	5	10	20	0.3	3
52200E	52200.0	9225.0	483557	10	15	30	0.3	4
52200E	52200.0	9250.0	483558	25	30	40	0.3	5
52200E	52200.0	9275.0	483559	25	30	45	0.3	7
52200E	52200.0	9300.0	483560	20	25	40	0.3	5
52200E	52200.0	9325.0	483561	25	20	45	0.3	4
52200E	52200.0	9350.0	483562	10	15	35	0.3	4
52200E	52200.0	9375.0	483563	30	30	50	0.3	5
52400E	52400.0	8000.0	483588	25	20	75	0.3	7
52400E	52400.0	8025.0	483589	40	25	55	0.3	10
52400E	52400.0	8050.0	483590	40	30	65	0.3	8
52400E	52400.0	8075.0	483591	25	25	70	0.3	4
52400E	52400.0	8100.0	483592	25	10	60	0.3	2
52400E	52400.0	8125.0	483593	50	20	75	0.3	2
52400E	52400.0	8150.0	483594	45	15	70	0.3	2
52400E	52400.0	8175.0	483595	70	15	80	0.3	3
52400E	52400.0	8200.0	483596	70	25	80	0.3	4
52400E	52400.0	8225.0	483597	75	15	90	0.3	4
52400E	52400.0	8250.0	483598	110	25	155	0.3	5
52400E	52400.0	8275.0	483599	85	25	90	0.3	4
52400E	52400.0	8300.0	483600	50	15	70	0.3	3
52400E	52400.0	8325.0	483601	25	20	50	0.3	4
52400E	52400.0	8350.0	483602	25	25	55	0.3	3
52400E	52400.0	8375.0	483603	30	25	80	0.3	6
52400E	52400.0	8400.0	483604	40	30	80	0.3	5
52400E	52400.0	8425.0	483605	55	35	50	0.3	12
52400E	52400.0	8450.0	483606	60	40	55	0.3	17
52400E	52400.0	8475.0	483607	55	30	55	0.3	9
52400E	52400.0	8500.0	483608	20	40	40	0.3	8
52400E	52400.0	8525.0	483609	55	30	55	0.3	5
52400E	52400.0	8550.0	483610	45	40	50	0.3	16
52400E	52400.0	8575.0	483611	70	35	60	0.3	14

52400E	52400.0	8600.0	483612	30	35	45	0.3	13
52400E	52400.0	8625.0	483613	65	25	65	0.3	18
52400E	52400.0	8650.0	483614	85	30	60	0.3	13
52400E	52400.0	8675.0	483615	120	45	85	0.3	13
52400E	52400.0	8700.0	483616	85	40	90	0.3	10
52400E	52400.0	8725.0	483617	105	40	80	0.3	10
52400E	52400.0	8750.0	483618	110	55	85	0.3	10
52400E	52400.0	8775.0	483619	160	50	105	0.3	9
52400E	52400.0	8800.0	483620	150	50	80	0.3	23
52400E	52400.0	8825.0	483621	110	35	95	0.3	11
52400E	52400.0	8850.0	483622	45	20	70	0.3	6
52400E	52400.0	8875.0	483623	25	25	50	0.3	4
52400E	52400.0	8900.0	483624	25	15	75	0.3	3
52400E	52400.0	8925.0	483625	25	30	85	0.3	4
52400E	52400.0	8950.0	483626	25	20	90	0.3	5
52400E	52400.0	8975.0	483627	40	700	120	0.3	12
52400E	52400.0	9000.0	483628	65	505	105	0.3	14
52400E	52400.0	9025.0	483629	55	45	90	0.3	10
52400E	52400.0	9050.0	483630	60	50	110	0.3	8
52400E	52400.0	9075.0	483631	55	35	85	0.3	8
52400E	52400.0	9100.0	483632	25	35	65	0.3	7
52400E	52400.0	9125.0	483633	30	35	75	0.3	4
52400E	52400.0	9150.0	483634	25	20	60	0.3	7
52400E	52400.0	9175.0	483635	25	20	60	0.3	6
52400E	52400.0	9200.0	483636	35	25	75	0.3	12
52400E	52400.0	9225.0	483637	30	10	65	0.3	11
52400E	52400.0	9250.0	483638	25	10	60	0.3	10
52400E	52400.0	9275.0	483639	5	10	30	0.3	5
52400E	52400.0	9300.0	483640	15	15	50	0.3	9
52400E	52400.0	9325.0	483641	20	20	55	0.3	10
52400E	52400.0	9350.0	483642	15	10	65	0.3	7
52400E	52400.0	9375.0	483643	5	15	30	0.3	5
52600E	52600.0	8200.0	483668	85	10	80	0.3	15
52600E	52600.0	8225.0	483669	125	20	95	0.3	19
52600E	52600.0	8250.0	483670	45	10	80	0.3	26
52600E	52600.0	8275.0	483671	60	10	95	0.3	14
52600E	52600.0	8300.0	483672	95	10	120	0.3	49
52600E	52600.0	8325.0	483673	85	10	160	0.3	13
52600E	52600.0	8350.0	483674	55	15	130	0.3	20
52600E	52600.0	8375.0	483675	60	20	135	0.3	13
52600E	52600.0	8400.0	483676	40	10	135	0.3	18
52600E	52600.0	8425.0	483677	20	25	50	0.3	7
52600E	52600.0	8450.0	483678	25	30	60	0.3	10
52600E	52600.0	8475.0	483679	40	50	150	0.3	9
52600E	52600.0	8500.0	483680	15	30	40	0.3	6
52600E	52600.0	8525.0	483681	20	25	55	0.3	9
52600E	52600.0	8550.0	483682	25	25	50	0.3	12
52600E	52600.0	8575.0	483683	20	20	45	0.3	13
52600E	52600.0	8600.0	483684	15	20	40	0.3	11
52600E	52600.0	8625.0	483685	25	25	55	0.3	15
52600E	52600.0	8650.0	483686	20	20	45	0.3	12
52600E	52600.0	8675.0	483687	20	20	40	0.3	11
52600E	52600.0	8700.0	483688	15	20	40	0.3	10
52600E	52600.0	8725.0	483689	20	15	45	0.3	8
52600E	52600.0	8750.0	483690	10	20	30	0.3	5
52600E	52600.0	8775.0	483691	10	20	40	0.3	5
52600E	52600.0	8800.0	483692	20	20	40	0.3	9
52600E	52600.0	8825.0	483693	25	15	55	0.3	11
52600E	52600.0	8850.0	483694	20	30	40	0.3	7
52600E	52600.0	8875.0	483695	20	25	50	0.3	10
52600E	52600.0	8900.0	483696	35	25	70	0.3	9
52600E	52600.0	8925.0	483697	30	25	55	0.3	16
52600E	52600.0	8950.0	483698	10	20	35	0.3	10
52600E	52600.0	8975.0	483699	10	10	35	0.3	7
52600E	52600.0	9000.0	483700	15	10	45	0.3	11
52800E	52800.0	8200.0	483718	80	3	120	0.3	3
52800E	52800.0	8225.0	483719	20	10	120	0.3	3
52800E	52800.0	8250.0	483720	45	35	120	0.3	7
52800E	52800.0	8275.0	483721	190	20	100	0.3	12
52800E	52800.0	8300.0	483722	80	3	115	0.3	5
52800E	52800.0	8325.0	483723	65	15	105	0.3	5
52800E	52800.0	8350.0	483724	105	10	130	0.3	7
52800E	52800.0	8375.0	483725	70	5	130	0.3	6
52800E	52800.0	8400.0	483726	115	10	125	0.3	7
52800E	52800.0	8425.0	483727	65	25	140	0.3	9
52800E	52800.0	8450.0	483728	45	20	85	0.3	15
52800E	52800.0	8475.0	483729	30	10	100	0.3	13
52800E	52800.0	8500.0	483730	35	25	60	0.3	10
52800E	52800.0	8525.0	483731	30	10	55	0.3	12
52800E	52800.0	8550.0	483732	30	20	105	0.3	7
52800E	52800.0	8575.0	483733	30	25	115	0.3	17
52800E	52800.0	8600.0	483734	20	10	50	0.3	12
52800E	52800.0	8625.0	483735	10	10	30	0.3	4
52800E	52800.0	8650.0	483736	10	15	25	0.3	5
52800E	52800.0	8675.0	483737	10	15	30	0.3	3
52800E	52800.0	8700.0	483738	10	10	30	0.3	4
52800E	52800.0	8725.0	483739	15	15	40	0.3	3
52800E	52800.0	8750.0	483740	10	15	40	0.3	5
52800E	52800.0	8775.0	483741	10	20	35	0.3	8
52800E	52800.0	8800.0	483742	10	35	40	0.3	12
52800E	52800.0	8825.0	483743	15	25	45	0.3	6
52800E	52800.0	8850.0	483744	25	35	70	0.3	7
52800E	52800.0	8875.0	483745	25	30	75	0.3	8
52800E	52800.0	8900.0	483746	20	35	70	0.3	9
52800E	52800.0	8925.0	483747	15	35	70	0.3	9
52800E	52800.0	8950.0	483748	10	10	30	0.3	4
52800E	52800.0	8975.0	483749	10	15	35	0.3	7

52800E 52800.0 9000.0 483750 15 30 40 0.3 8

APPENDIX 2

Field descriptions and sample locations of rock chip samples submitted for petrological and geochemical analysis.

Samples arranged in the following order:-

1) Lower Beulah area

   - 1:2,500 scale mapping
   - 1:1,000 scale mapping (Beulah Barite area)
   - CRA drillhole samples (Beulah Barite area)

2) Stonebridge area rock chip sampling.

3) Regional rock chip sampling.

P indicates sample submitted for petrology

G indicates sample submitted for geochemical analysis

Lower Beulah Area Rock Chip Samples

(1:2,500 scale mapping)

Sample	Co-Ordinates	Field Description
428034 G	4450130E, 540930N	Red white and brown altered + weathered basalt?
428035 P G	450220E, 5409250N	Grey feldspar-phyric basalt
428037 P	449200E, 5409110N	Polymict intermediate volcaniclastic-lava breccia Green matrix fragments include dacite.
428038 P	449600E, 5408920N	Grey feldspar-phyric intermediate lava breccia.
428046 P G	445145E, 5408780N	Altered lava? Black Mn, white light green.
428047 P G	445145E, 5408780N	Red volcanic, sericite altered.
428048 P G	445050E, 5409080N	Grey lava, epidote-hornblende phenocrysts. Haematite fragments.
513410 G	450435E, 5409080N	Blady quartz and specular haematite.
513411 G	450560E, 5408675N	Highly silica-sericite altered rock.
513412 P	450320E, 5408740N	Altered yellow orange lava, minor fuchsite spotting.
513413 G	450560E, 5408630N	Haematite and silica altered rock (leeched).
513414 P	450110E, 5408790N	Maroon grey feldspar-phyric lava.
513415 P	451550E, 5408762N	Prominent feldspar phenocrysts (volcanic fragments?).
513418 G	449920E, 5408520N	Specular haematite veinlet.

513419	P G	451550E, 5408520N	Maroon feldspar-phyric rock prominent alignment of large elongate feldspars.
513428	P G	450340E, 5409065N	Blady quartz, specular haematite.
513452	G	449250E, 5408150N	Gossan in quartz blow in Gog Range Greywacke.
513463	G	450000E, 5409320N	Specular haematite - quartz rock.
515347	G	448910E, 5409100N	Fine-medium grained, weakly vesicular basalt or andesite lava float (with float of fine grained orange sediment).
515348	P G	449125E, 5409170N	Very fine grained, moderately calcite altered, dark green basalt or andesite ?lava breccia with minor dark fragments.
515349	P G	449210E, 5409170N	Massive medium grained, ?chlorite altered pyroxene + feldspar phyric andesite or basalt lava.
515350	P G	449900E, 5408940N	Massive pale yellow-brown, very weakly haematite altered lava with minor fuchsite spotting and occasional Fe rich (haematite?) veins.
515351	P G	449960E, 5409290N	Massive, brown weathered, weakly feldspar phyric, weakly haematite altered polymict ?volcaniclastic with rare dacitic fragments.
515352	P G	449750E, 5409210N	Fine grained yellow-brown felsic lava, ?dacite.
515353	P G	449510E, 5409420N	Iron stained haematite rich gossanous rock with altered lava? fragments.

Beulah Barite Area Rock Chip Samples

(1:1,000 scale mapping)

Sample	Co-Ordinates	Field Description
428036 P G	445070E, 5408690N	Sheared red, black and white volcaniclastic with lenses of barite.
513433 P G	450765E, 5408583N	Grey sheared volcanic lens in cleavage in weathered orange lava.
513434 P G	450700E, 5408565N	Barite with galena veinlets.
513435 G	450700E, 5408565N	Gossan rich barite with trace galena.
513436 P	450770E, 5408580N	Highly sericitised red and green volcanic schist.
513437 P G	450797E, 5408607N	Bedded grey hornblende-phyric ash volcaniclastic.
513438 G	450800E, 5408612N	Massive red haematite with minor quartz.
513439 P G	45080E, 5408664N	Green lava with green hornblende phenocrysts (see also 513462).
513455 P G	450608E, 5408612N	Yellow and orange sheared volcanic (lava?).
513456 P G	450615E, 5408603N	Eutaxitic volcanic with prominent leisagang rings.
513457 G	450632E, 5408600N	As for 513456.
513458 P	450632E, 5408600N	Haematite altered dacitic lapilli tuff.
513459 P	450735E, 5408619N	Sheared light green sericite and haematite altered volcaniclastic.

513460 P	450785E, 5408653N	Bedded red and orange volcaniclastic.
513461 G	450809E, 5408665N	Gossanous quartz vein.
513462 P	450808E, 5408664N	Green feldspar-phyric lava.
513464 P	450650E, 5408610N	Grey sericite altered barite rock.
513465 P G	450610E, 5408565N	Sericitised volcanic (bedded?, flow banding?, cleavage?) trace pyrite in geochemical sample.
513466 G	450675E, 5408560N	Gossanous barite (float).
513467 G	450700E, 5408665N	Barite gossan and bedded galena.
513468 G	450708E, 5408665N	Baritic gossan.
513469 G	450708E, 5408565N	Barite-minor gossan.
513470 P G	450730E, 5408576N	Sericite schist, trace pyrite.
515272 P G	450729E, 5408705N	Weakly banded ferruginous and baritic ash volcaniclastic bed.
515274 P G	450739E, 5408706N	Altered white and black volcaniclastic.
515276 P	450745E, 5408698N	Orange bedded and graded volcaniclastic.
515360 P G	450450E, 5408480N	White, strongly sericitic, strongly cleaved, fuchsite spotted, moderately calcite altered, volcanic-lastic breccia with minor disseminated pyrite and ?galena.
515361 P G	450450E, 540848N	Maroon coloured haematite altered volcaniclastic breccia.

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Beulah Barite Area CRA Drill-hole Samples

Sample	Co-Ordinates	Field Description
428020 P G	CRA hole BB4 83m	Stringer envelope zone?
428022 P G	CRA hole BB4 157m	Dacite with fuchsite pseudomorphs.
428023 P G	CRA hole BB4 178m	Green intermediate lava.
428024 P	CRA hole GE 37.5m	Red greywacke-volcanic-lastic.
428025 P G	CRA hole GE 86m	"magnetic" andesite, grey intermediate lava?
428026 P G	CRA hole GE 96m	Haematite altered andesite.
428027 P G	CRA hole GE 114m	Dark grey andesite-basalt Haematite veining.
428028 P G	CRA hole GE 151m	Strongly haematized, green, sericite-carbonate altered lava.
428029 P G	CRA hole GE 152m	Green, sericite altered, haematite veined volcanic.
428030 P G	CRA hole GE 181m	Grey hornblende andesite. Haematite spots.
428031 P G	CRA hole GE ~ 93m	Grey andesite. Minor haematite veins. Haematite veins cut off ends of G.
428032 P G	CRA hole BB4 154m	Envelope zone? No pyrite.
428033 P G	CRA hole BB5 75m	Envelope zone? No pyrite, some chlorite in fractures.

Stonebridge Area Rock Chip Samples

Sample	Co-Ordinates	Field Description
271762 G	442259E, 5411994N	Quartz plus haematite (float next to trench).
271764 P G	442259E, 5411994N	Green rhyolite (intrusive?) with occasional fuchsite pseudomorphs. (Paradise trench [CRA]).
271765 G	442423E, 5410380N	Gossan, specular haematite, white silica.
271766 G	442423E, 5410380N	Gossan.
271767 G	442423E, 5410380N	Gossan, specular haematite rich.
428081 P	442250E, 5410400N	Lighter green (weathering) andesite with green ferromagnesian phenocrysts.
428083 P	442162E, 5411200N	Feldspar-phyric andesite.
428091 P G	442210E, 5411000N	Green grey ferro-magnesian porphyritic basalt with accessory pyrrhotite.
428093 P	442042E, 5411600N	Feldspar-phyric crystal crowded green porphyry (intrusive?).
428094 P	442012E, 5411600N	Dacite? Contact metamorphosed bedded siltstone? bedding? Flow banding?
428099 P G	442420E, 5410880N	Pyrrhotite and haematite veined stockwork.
428100 P	442134E, 5412200N	Grey bedded shale.
513402 G	442160E, 5410800N	Grey basalt. Ferro-magnesian porphyritic with accessory pyrrhotite

513403 P	441560E, 5411200N	Prominently feldspar-phyric grey-maroon volcanic (lava) with prominent alignment of feldspars in foliation.
513404 G	442420E, 5410880N	Haematite, pyrrhotite stockwork, selectively sampled veinlet.
513407 G	442423E, 5410380N	Stonebridge gossan.
513408 P G	441772E, 5411200N	Green basalt with prominent ferromagnesian phenocrysts and small feldspar phenocrysts.
513409 P	442358 E, 5410500N	"Granite-like" pink rock with prominent biotite phenocrysts (intrusion?).
515363 P *G	42255E, 5412200N	Massive, white ?dacite lava with fuchsite spotting and weak? chlorite altered patches. (Rock conformably contacts a bedded shale unit). *515363G is an Fe stained, slightly ?gossanous sample of above.

Regional Rock Chip Samples

Sample	Co-Ordinates	Field Description
428017 P G	CRA GPC23 34.5m	Coarse grained quartz feldspar chlorite (after ferromag?) intrusive. Altered siliceous lava (G. Purvis log). Prominent galena veinlet.
428018 P	CRA GPC3 56m	Sericite, silica and pyrite altered volcanic-lastic. Silica-dacite fragments. Pyrite fragments.
428019 P G	CRA CC3 59.3m	Sericite and chlorite altered lava with prominent galena veinlet.
428039 P G	444300E, 5409570N	Feldspar-phyric dark grey lava. Feldspar altering to epidote and pumpellyite. Haematised fragments.
428040 P G	436050E, 5408430N	Dark grey lava breccia, minor feldspar phenocrysts. Trace pyrite as disseminations and in a veinlet.
428041 P	436550E, 5408750N	Polymict lapilli volcaniclastic, feldspar-phyric. Fragments include dacite and vein quartz (base of Owen?).
428042 P	436840E, 5408800N	Grey shale.
428043 P	436520E, 5408770N	Polymict breccia with large vein quartz fragments. Also grey and purple lava fragments in a grey matrix.
428044 P	435700E, 5409000N	Highly altered red, black and green rock. Free quartz.
428045 P G	4368250E, 5408860N	Dark green basalt?

515277 P G	433330E, 5407380N	Orange stained quartz ?vein/rock.
515278 G	433520E, 5407180N	Iron stained "gossanous" volcaniclastic.
515279 P G	433510E, 5407080N	White, sericite altered, quartz volcaniclastic.

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APPENDIX 3

Petrological Descriptions of Rock Chip Samples.

(descriptions provided by Dr. A. Crawford,
University of Tasmania)

SAMPLE: 271764

LOCATION: Paradise Barite Host

SUMMARY: This rock is a thoroughly sericitized and recrystallized formerly glassy plagioclase+biotite-phyric meta-dacite.

HAND SPECIMEN: This is a highly altered, buff coloured meta-volcanic with visible sericitized feldspar phenocrysts.

DESCRIPTION:

This rock is an extensively recrystallized and sericitized plagioclase+biotite-phyric dacite. Determination of the nature of the original groundmass is not possible due to obliteration during sericitization. A few ghost relics of totally sericitized plagioclase phenocrysts are present. Many subrounded patches of multi-crystalline secondary quartz are either derived from recrystallization of primary quartz phenocrysts or recrystallization of quartz-filled vesicles. The general scarcity of vesicles in better preserved lavas from this area argue for the former. This sample contains abundant apatite, and sparse green chlorite + leucoxene pseudomorphs after biotite phenocrysts.

SAMPLE: 428017 (Polished section)

LOCATION: Gowrie Park Cethana GPC3 34.5m

SUMMARY: This rock is a highly altered (silicified, sericitized and carbonated) formerly either aphyric or quartz-phyric glassy rhyolitic lava.

HAND SPECIMEN: This is a very altered volcanic rock made up of small areas of quartz and a green mineral mixture, and cut by diffuse veins of galena.

DESCRIPTION:

This is a difficult sample to 'see through' to the original rocktype. It was probably originally an almost aphyric or quartz-phyric rhyolitic glassy lava. The rock has suffered extensive recrystallization and addition of secondary silica, which forms a relatively coarse-grained patchy mosaic with intimately sutured grain boundaries. The remainder of the rock is divided into diffuse zones characterized by either extensive sericite- or carbonate alteration. Meandering veinlets of monomineralic galena up to 5mm wide are rimmed by euhedral calcite rhombs.

SAMPLE: 428018

LOCATION: Gowrie Park Cethana GPC3 56m

SUMMARY: This rock is a former feldspar+quartz-phyric rhyolitic crystal lithic tuff that has been partially silicified and that contains abundant small pyrite cubes.

HAND SPECIMEN: This is a highly altered grey and light green volcanic in which occasional quartz phenocrysts are visible.

DESCRIPTION:

This rock was originally a feldspar+quartz-phyric rhyolitic crystal lithic tuff. Quartz phenocrysts up to 2mm diameter have recrystallized internally into annealed polycrystalline sub-grains, but have maintained their slightly resorbed subhedral crystal shapes. Former feldspar phenocrysts constitute around 30 modal% of this rock and are totally sericitized stubby blocky prisms. The recrystallized groundmass is texturally variable but composed largely of quartz-albite-sericite intergrowths, probably after glass. A few clearly defined lithic fragments may have been rhyolitic pumice, and have different grainsize and textures to the groundmass of the rest of the rock. The rock is invaded by abundant veinlets of secondary quartz, and contains abundant pyrite cubes to 1mm scattered throughout the rock.

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SAMPLE: 428019 (Polished section)

LOCATION: Gowrie Park-Cethana CC5 59.3m

SUMMARY: This rock is a quartz-phyric meta-rhyolite lava cut by a vein of galena 8mm wide.

HAND SPECIMEN: This sample is a dark, quartz-phyric massive rhyolite lava cut by a narrow vein of galena.

DESCRIPTION:

This is a quartz-phyric rhyolite containing around 5 modal% of rounded and resorbed quartz phenocrysts to 2mm set in a very fine-grained formerly glassy groundmass now devitrified to quartz, albite and probably some small amount of K feldspar. The groundmass is streaked by abundant sericite and subordinate flecks of green chlorite and calcite, and relatively large crystals of zircon and apatite are quite common. An 8mm wide vein of virtually monomineralic galena cuts the rock, and galena has soaked out into the surrounding groundmass, where it occurs as discrete crystals and patches in the albite-quartz-calcite intergrowth.

SAMPLE: 428020

LOCATION: Beulah barite drillcore BB4 83m

SUMMARY: This sample is a thoroughly sericitized and carbonated plagioclase + augite + hornblende-phyric meta-andesite.

HAND SPECIMEN: This is a massive medium grey meta-volcanic with a creamy groundmass typical of extensively carbonated rocks.

THIN SECTION DESCRIPTION:

This rock was originally a plagioclase+augite+hornblende-phyric andesite, but it has been very thoroughly altered to calcite and sericite. Mafic phenocrysts with shapes characteristic of both hornblende and clinopyroxene are replaced by green pleochroic chlorite and calcite, and may have totalled around 10 modal% of the rock. Ghost relics to 2mm long of former plagioclase phenocrysts are entirely sericitized, and stand out because they lack the calcite impregnation which dominates most of the thin section. A 5mm thick veinlet of calcite and green chlorite cuts the rock.

SAMPLE: 428022

LOCATION: Beulah Barite Drillhole BB4 157m

SUMMARY: This rock is a highly altered felsic volcanic totally replaced by sericite and calcite.

HAND SPECIMEN: This buff-cream coloured extensively altered and silicified rock could have been anything.

DESCRIPTION:

This highly altered sample is difficult to diagnose with any certainty. It contains a few ghost outlines of totally sericitized and carbonated feldspar in an even-textured groundmass 75% replaced by intergrown calcite, quartz and sericite. Calcite occurs as dispersed small rhombs, aggregates and veinlets. I think this sample was probably originally a felsic lava.

SAMPLE: 428023

LOCATION: Beulah Barite Drillhole BB4 178m

SUMMARY: This rock is a highly carbonated formerly plagioclase+augite-phyric andesite.

HAND SPECIMEN: This is a massive light grey aphyric carbonated lava.

DESCRIPTION:

This sample is a highly carbonated formerly plagioclase+augite-phyric andesite probably like 428031 or 428025 when fresh. It contains around 5-8 modal% of green chlorite plus minor calcite pseudomorphs after a mafic phenocryst phase with typically augite crystal shapes up to 1mm long. Blocky to more elongate prismatic feldspar phenocrysts are very largely altered to sericite and calcite, and probably constituted around 10 modal% of this rock. The devitrified felsic groundmass is composed of a fine-grained intergrowth of albite and quartz which has been overprinted by calcite plus sericite alteration; minor pale green chlorite occurs intergrown with the sericite.

SAMPLE: 428024

LOCATION: Garden of Eden Drillhole 37.5m

SUMMARY: This rock is a dark, weakly foliated lithic crystal tuff of probably dacitic to andesitic composition.

HAND SPECIMEN: This is a dark red, porous lithic tuff with fragments to 1cm long set in a strongly sericitized and hematitized matrix.

DESCRIPTION:

This sample is a weakly foliated lithic crystal tuff containing stretched angular fragments of dark formerly plagioclase-phyric andesite or dacite in an unusual groundmass containing about 2 modal% of flattened phenocrysts of totally sericitized plagioclase. The lava fragments are vesicular pumice and contain phenocrysts of stretched and flattened sericitized plagioclase and large FeTi oxide grains. The formerly glassy groundmass of these dark fragments is an extremely fine-grained intergrowth of albite, quartz and sericite peppered with opaque 'dust'. The remainder of the rock is a relatively fine-grained mosaic of quartz and albite riddled by sericite, but lacking the dark colouration of the lava fragments; it probably represents devitrified and recrystallized glassy dacitic ash.

SAMPLE: 428025

LOCATION: Beulah Barite Drillcore GE 86m

SUMMARY: This rock is a sparsely plagioclase-phyric meta-andesite.

HAND SPECIMEN: This is massive, dark grey aphyric basalt or andesite which looks quite fresh relative to the other drillcore lavas. It is cut by a single vein of calcite.

DESCRIPTION:

This sample is a sparsely plagioclase-porphyritic andesite containing approximately 1 modal% of albitized plagioclase phenocrysts in a very fine-grained FeTi oxide-rich groundmass. The feldspar phenocrysts are slightly to completely sericitized, and similarly altered more elongate albitized plagioclase microphenocrysts are common. The formerly vitrophyric groundmass has devitrified to fine-grained quartz and albite with abundant green chlorite throughout. Calcite as small rhombs and clear pools is spotted through the groundmass. A weak stylolitic fracture cleavage is defined by concentrations of FeTi oxides, and veins of bladed and fibrous calcite traverse the rock.

SAMPLE: 428026

LOCATION: Garden of Eden Barite Drillhole BB4 96m

SUMMARY: This rock is a highly altered sparsely plagioclase-phyric andesite totally replaced by sericite and calcite, and strongly hematitized.

HAND SPECIMEN: This interesting rock consists of cores of greygreen aphyric lava passing outward into rims with a more pale grey colour typical of intense calcite alteration, and these relic 'fresh' areas have been swamped in red hematitic alteration; calcite veins also post-date the hematite alteration.

DESCRIPTION:

This is a bright red strongly hematitized, sparsely plagioclase-phyric andesite with a weak foliation. It contains around 1 modal% of prismatic feldspar euhedra to 1mm long which are totally sericitized. These are set in a very altered and recrystallized, sheared groundmasss dominated by sericite and hematite. The rock is abundantly veined by ribbon fibre quartz and calcite and contains plenty of pyrite cubes and some green chlorite patches. Carbonate altered areas are preserved amid pervasive hematite alteration. Clearly, calcite veining post-dates hematite alteration.

SAMPLE: 428027

LOCATION: Garden of Eden Barite drillcore

SUMMARY: This rock is a sparsely plagioclase-phyric massive fine-grained andesite

HAND SPECIMEN: This is a dark grey massive sparsely feldspar-phyric lava

DESCRIPTION:

This is a sparsely plagioclase-phyric massive fine-grained andesite virtually identical to 428031, but it lacks the the weak foliation present in the latter. Small prismatic phenocrysts of albitized plagioclase to 0.3mm are partially to completely altered to sericite and calcite. The very fine-grained groundmass is charged with FeTi oxide 'dust' and mottled by green chlorite and sericite.

SAMPLE: 428028

LOCATION: Beulah Barite Drillcore GE 151m

SUMMARY: This rock is a strongly sheared, foliated formerly plagioclase-phyric dacitic breccia which has been strongly sericitized and carbonated.

HAND SPECIMEN: This is a strongly foliated hematite-altered fragmental volcanic with both pink and green flattened clasts; it is cut by a meandering calcite veins.

THIN SECTION DESCRIPTION:

This is a very difficult rock to diagnose. I suggest that it is a sheared, strongly sericitized and carbonated dacitic breccia. Plagioclase phenocrysts are totally sericitized and constitute around 10 modal% of the rock. Groundmass has a fragmental appearance due to domains of differing colour; some areas are quite dark brown due to abundant FeTi oxide 'dust' throughout the devitrified glassy groundmass, whereas other domains are poorly-defined fragments which are lighter coloured, and lack the oxide 'dust'.

The rock has undergone intense shearing, resulting in development of a strong foliation; this has induced extensive coarsening recrystallization of secondary quartz and albite in some veins and augen-like patches. The foliation is defined by the augen-like quartz-albite stringers and a strong sericite development. Calcite veins are common.

SAMPLE: 428029

LOCATION: Garden of Eden Barite Drilhole 152m

SUMMARY: This rock is an extensively carbonated and sericitized slightly foliated felsic lava or tuff.

HAND SPECIMEN: This is a highly altered pale grey-green volcanic cut by veins of chlorite and carbonate.

DESCRIPTION:

This is a difficult rock to diagnose. It is characterized by extensive carbonate alteration and sericitization, and was probably originally a felsic volcanic or tuff. Only a few relic ghosts of plagioclase phenocrysts are evidence of the primary texture, and even these are totally sericitized. Extensive sericite throughout the very fine-grained albite-quartz groundmass defines a weak foliation. A mineralogically zoned vein cuts the rock, and is formed by a green chlorite margin followed internally by sericite with a dark carbonate (dolomite or siderite?) core.

SAMPLE: 428030

LOCATION: Garden of Eden GE 181m

SUMMARY: This sample is a thoroughly carbonated and sericitized hornblende + plagioclase-phyric meta-andesite.

HAND SPECIMEN: This grey, altered lava contains abundant mafic phenocrysts replaced by calcite in a fine-grained matrix showing red feldspar grains.

THIN SECTION DESCRIPTION:

This rock is a thoroughly carbonated and sericitized hornblende andesite which shows a weak foliation. Former mafic phenocrysts to 4mm long, with shapes suggestive of a hornblende precursor, are totally replaced by calcite. Some contained small inclusions of FeTi oxide. Vague ghosts of possible former plagioclase phenocrysts can be occasionally discerned, and may constitute up to 10 modal% of this rock. The groundmass of this sample was probably originally vitrophyric, but has been 90% replaced by spotty calcite rhombs which merge together to form patches of calcite throughout much of the groundmass. Streaks and veinlets of sericite are abundant and sericite defines the weak cleavage in this sample. Abundant leucoxenized FeTi oxide phenocrysts are present.

SAMPLE: 428031

LOCATION: Garden of Eden Drillhole 93m

SUMMARY: This rock is a weakly foliated, very sparsely plagioclase-phyric andesite.

HAND SPECIMEN: This is a well-preserved, dark grey massive aphyric andesite. or dacite.

DESCRIPTION:

This rock is a massive, uniform, very sparsely-plagioclase-phyric andesite with less than 1 modal% phenocrysts of albitized plagioclase to 1mm long, which have been almost completely replaced by sericite and albite. The groundmass is extremely fine-grained, with abundant pale green chlorite and FeTi oxide grains evenly distributed throughout the rock, and spotty calcite alteration. A weak cleavage is evident, defined by chlorite and sericite concentrations and localization of trains of small opaques, due to pressure solution during cleavage formation. Near the top of the slide is a 7mm wide band of heavily hematitized schistose variety of the same rock. This sample may be worth analyzing for our Mount Read Volcanics study; it is very similar to 428025.

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SAMPLE: 428032

LOCATION: Beulah barite drillhole BB4, 154m

SUMMARY: This rock is a totally carbonated volcanic of probably dacitic to andesitic composition.

HAND SPECIMEN: This is a light grey thoroughly carbonated aphyric lava.

DESCRIPTION:

This is a highly carbonated rock in which a few ghost relics of plagioclase phenocrysts may still be discerned. The groundmass texture has been totally obliterated by extensive calcite alteration which includes both discrete rhombs and large patches and veins; chlorite occurs together with calcite in some veinlets. It is not possible to determine the original lithology of this sample, although it was most likely a dacitic to andesitic lava or tuff.

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SAMPLE: 428033

LOCATION: Beulah barite drillcore BB5 75m

SUMMARY: This is a thoroughly carbonated and sericitized feldspar-phyric andesite or dacite

HAND SPECIMEN: This is a massive, uniform, light grey felsic volcanic with feldspar phenocrysts and brittle fractures filled by black chlorite.

THIN SECTION DESCRIPTION:

This is a thoroughly carbonated and sericitized andesite or dacite which contained around 10 modal% of phenocrysts to 2mm long of completely sericitized and carbonated albite (after more calcic plagioclase). The originally glassy groundmass of this sample is now replaced by a very fine-grained mosaic of quartz and albite, which itsekf has been almost totally replaced by calcite, sericite and minor green chlorite and dirty brown spongy epidote. The rock is transected by a number of veins of intergrown calcite, chlorite and ribbon quartz.

SAMPLE: 428035 GP

LOCATION: Lower Beulah 445022E 540925N

SUMMARY: This rock is an excellent plagioclase+augite+olivine-phyric basalt typical of the Western Volcanic Sequence basalts such as those at Hellyer and Lynchford.

HAND SPECIMEN: This is a very well-preserved highly plagioclase-phyric dark grey basalt or andesite with abundant visible mafic phenocrysts.

DESCRIPTION:

At last, a decent rock!!! This is a beautiful olivine+augite+plagioclase-phyric Hellyer-type basalt. Around 30 modal% of the rock consists of plagioclase phenocrysts to 5mm long which are euhedral, slightly elongate prisms that are albitized but retain igneous features, such as rows of chloritized melt inclusions defining crystal growth lines. The albitized plagioclase phenocrysts show only slight speckling by sericite, and occasionally contain bow-ties and fans of fawn-coloured prehnite. Augite occurs as about 5 modal% of discrete euhedral phenocrysts and as crystal clots. Many contain chloritized rounded melt inclusions from which ilmenite has exsolved in two crystallographic directions. Serpentine-chlorite pseudomorphs after euhedral olivine phenocrysts to 1mm long constitute around 1 modal% of this rock. Several wehrlite clots made up of subhedral augite, olivine are present. The vitrophyric groundmass is very dark coloured and heterogeneous in texture and grainsize. It contains abundant albitized plagioclase microlites in a very dark, FeTi oxide-rich irresolvable formerly glassy groundmass. Angular fractures and openings in the groundmass are filled by green chlorite in which is growing euhedral yellow epidote crystals. Minor pools of calcite occur in the groundmass. Several small-scale becciation zones showing granulated augite and plagioclase phenocrysts traverse the

SAMPLE: 428036 GP

LOCATION: Beulah Barite Spoil Pile 445070E 540869N

SUMMARY: This rock is a highly altered felsic or intermediate volcanic totally replaced by sericite and calcite, and strongly hematitized, and contains bands of hematite, quartz and barite..

HAND SPECIMEN: This is an extremely weathered and altered indeterminate brown rock cut by a vein of barite.

DESCRIPTION:

This is an exceptionally altered sample which is difficult to interpret in terms of original lithology. A few ghost relics of former feldspar phenocrysts are present in a very fine-grained groundmass which appears to have suffered several episodes of brittle brecciation. The rock has been extensively carbonated and sericitized, and hematite or goethite/limonite is abundantly distributed throughout the sample, appearing to replace calcite rhombs in places. Concentrically-zoned veins of hematite pass out into secondary quartz then into more coarsely-crystalline hematite and finally into blocky barite. The original rock was probably a felsic or intermediate lava.

SAMPLE: 428037

LOCATION: Lower Beulah 444992E 540911N

SUMMARY: This rock is a weakly foliated lithic tuff of probably dacitic to andesitic composition.

HAND SPECIMEN: This is a dirty brown, weathered and porous lithic tuff with volcanic rock fragments to 1cm in a foliated matrix.

DESCRIPTION:

This rock is a foliated intermediate lithic tuff . It is composed of approximately 10 modal% of slightly stretched albitized plagioclase phenocrysts usually less than 1mm long, with chlorite replacing trains of melt inclusions parallel to crystal faces. These phenocrysts have been patchily replaced by sericite. Some definite lithic fragments are defined by differences in the abundance and size of feldspar phenocrysts and the 'darkness' of the groundmass. Former FeTi oxide microphenocrysts have exsolved ilmenite along octahedral planes and the magnetite left has altered to leucoxene and chlorite. The groundmass probably contained much glass, which has altered to albite, quartz and relative abundant green chlorite. A weak cleavage is defined by wispy streaky sericite. The groundmass contains abundant orange-red patches mainly less than 1mm across composed largely of an orange layer silicate with very low, almost isotropic birefringence and little or no pleochroism; this is either Fe-stained sericite or perhaps an oxychlorite.

SAMPLE: 428038

LOCATION: Lower Beulah 445960E 540892N

SUMMARY: This rock is a meta-andesitic lava breccia or lithic tuff, with fragments derived from several different andesitic (dominant) and dacitic-rhyolitic flows.

HAND SPECIMEN: This is a massive dark grey-green fragmental andesitic volcanic with volcanic lithic clasts to 1.5 cm long.

DESCRIPTION:

This sample is a andesitic lava breccia with fragments to 1.5cm long. Most andesitic fragments are irregularly shaped to slightly rounded. Many smaller fragments are almost indistinguishable from the quartz-albite-chlorite groundmass, which presumably was originally a felsic glass. The groundmass and the small fragments contain small fractured prismatic plagioclase euhedra which have been albitized and flecked by sericite, and also almost rounded resorbed quartz phenocrysts and surprizingly large apatite prisms. Relatively large FeTi oxide phenocrysts (to 0,5mm) have exsolved ilmenite along octahedral planes and broken down to chlorite. The larger andesitic fragments contain phenocrysts of albitized plagioclase and augite in a formerly vitrophyric groundmass now altered to albite, quartz, sericite and leucoxene. One andesitic fragment has a distinctive groundmass composed of quenched spherulitic plagioclase (albitized), and a single gabbroic clast containing intimately intergrown plagioclase, augite (chloritized) and FeTi oxide are present.

SAMPLE: 428039 (samples in two bags.. both sectioned)

LOCATION: Top of Paradise Hill plantation 444300E 540957N

SUMMARY: This rock is a well-preserved plagioclase+augite+quartz-phyric meta-andesite.

HAND SPECIMEN: These are both well-preserved mafic andesites with visible phenocrysts of a mafic phase and plagioclase in a dark grey matrix.

DESCRIPTION:

This sample is a well-preserved plagioclase+augite+quartz-phyric andesite. It contains approximately 10% of euhedral blocky to elongate prismatic phenocrysts of albitized plagioclase, which are about 20% replaced by sericite, bright green pleochroic pumpellyite and non-pleochroic dull green chlorite. About 2 modal% of the rock is consists of smallish (<1mm) often fractured and reacted subhedra of fresh augite which often occurs intergrown with FeTi oxide microphenocrysts. A few gabbroic clots are present, dominated by augite and plagioclase crystals less than 0.7mm long . Plagioclase microlites riddle the formerly vitrophyric groundmass, which has devitrified to quartz-albite-chlorite intergrowths, and possibly minor K feldspar. The patchy distribution of chlorite in the groundmass gives an almost fragmental appearance to this rock in thin section. A few resorbed quartz phenocrysts are preseny. Tension gashes and fractures are filled with secondary albite and quartz with minor golden epidote.

In sample B (thin section 2), the rock is almost identical to the above except that several lithic fragments of quench-textured andesite occur; these may represent flow crusts incorporated into the magma during flow emplacement.

slide. 97 652098

SAMPLE: 428040

LOCATION: Forest Gowrie Park 436050E 540843N

SUMMARY: This rock is a relatively mafic crystal-lithic tuff with only a small lithic component.

HAND SPECIMEN: This is a dark grey andesitic fragmental volcanic with clasts of volcanic lithic fragments to 1cm long, although generally much smaller.

DESCRIPTION:

This sample is a relatively mafic crystal-lithic tuff. It is highly porphyritic, containing approximately 20-25 modal% of albitized plagioclase phenocrysts, around 3 modal% of augite phenocrysts, 1% FeTi oxide phenocrysts and <1% of altered olivine phenocrysts and resorbed quartz phenocrysts, plus a small number of lithic fragments. Plagioclase phenocrysts are subrounded euhedra which are partly to totally sericitized. Augite phenocrysts are euhedral chlorite with chlorite along fractures; some have altered completely to calcite, epidote, chlorite and minor leucoxene. Sparse small euhedral olivine phenocrysts are serpentinized and also partly replaced by secndary quartz. A small number of almost rounded, strongly resorbed quartz phenocrysts are present. Lithic fragments are mainly less than 2mm long and consist of devitrified felsic plagioclase-phyric lava or tuff.

The groundmass of this sample is unusual and consists of two different domains, which occur in irregular patches. The first type is light brown, irresolvable formerly glassy material, whereas the second type is darker, with colliform irregular edges and contains quartz-albite mosaics and FeTi oxide dust. These contrasting groundmass types may be due to different cooling rates, or different degrees and styles of devitrification.

SAMPLE: 428041

LOCATION: Gowrie Park 436550E 540875N

SUMMARY: This rock is a conglomerate derived mainly from a mixed mafic-felsic volcanic terrain, but includes a minor proportion of detritus derived from pelitic metamorphics.

HAND SPECIMEN: This is a dark green massive conglomerate with abundant lithic volcanic clasts set in a fairly dark chloritic matrix.

DESCRIPTION:

This sample is a conglomerate dominated by detritus derived from a mixed mafic and felsic volcanic terrain. About 10 modal% of the sample consists of rounded fragments of quartz+feldspar-phyric rhyolite with a very fine-grained devitrified glassy groundmass. However most of the rock consists of single grains of blocky, subhedral albitized plagioclase with slight sericite flecking and abundant alteration to epidote. Several modal% of fractured and partially chloritized augite phenocrysts and a few strongly pleochroic olive-brown hornblende phenocryst fragments are also present, and suggest an andesitic component in the source area. Several phenocryst fragments of partially resorbed quartz merge gradually with the groundmass at their margins. One lithic fragment is a plagioclase (albitized) cumulate with crystals about 0.3mm long.

Large patches of green chlorite enclose euhedral epidote crystals and tiny blebs of leucoxene. This sample also contains two quartz-muscovite schist fragments very clearly derived from Precambrian pelitic metamorphics. Minor amounts of pumpellyite and albite occur in the matrix, which is volumetrically subordinate to the well-packed clasts.

652100

SAMPLE: 428042

LOCATION: Gowrie Park 436840E 540880N

SUMMARY: This is a fractured siltstone derived from Precambrian metamorphic detritus.

HAND SPECIMEN: This is a dirty brown-green fine-grained sedimentary rock, strongly fractured, but with a weak fracture cleavage.

DESCRIPTION:

This rock is a siltstone fractured into centimeter-sized fragments, with goethite-limonite lining the fractures. Some fragments are Fe-stained and others are not. Detrital grains include monocrystalline and polycrystalline metamorphic quartz and detrital metamorphic muscovitein an indeterminate very fine-grained matrix probably quite sericite-rich.

SAMPLE: 428043

LOCATION: Gowrie Park 436520E 540877N

SUMMARY: This rock is a conglomerate derived mainly from a mixed mafic-felsic volcanic terrain, but including a minor proportion of detritus derived from pelitic metamorphics. It is presumably a correlate of the Jukes Breccia or basal Owen.

HAND SPECIMEN: This generally dark coloured massive conglomerate contains a few pebbles of reef quartz (not sectioned) and abundant lithic volcanic clasts to 2cm long.

DESCRIPTION:

This sample is a conglomerate containing lithic clasts to 1.5 cm diameter as well as abundant monomineralic grains and large clasts of vein quartz. The lithic clasts are dominantly volcanic, and include plagioclase+augite-phyric basalts and more felsic lavas. Clasts are pressed against eahch other and have clearly suffered pressure solution. Many smaller clasts are rounded; some contain totally sericitized feldspar phenocrysts and other have unsericitized albite phenocrysts. Several clasts of pelitic schist of clear Precambrian origin are present, composed of polycrystalline quartz and muscovite. The matrix of the conglomerate probably constitutes less than 10 modal% of the rock and is crystal-rich, dominated by volcanic quartz fragments and fragments and entire phenocrysts of albitized feldspar; the matrix contains both epidote and pumpellyite, and abundant chlorite, but not a great deal of sericite or calcite.

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SAMPLE: 428044

LOCATION: Tea-tree Road, Gowrie Park.

SUMMARY: This rock is a thoroughly sericitized quartz+plagioclase-phyric crystal tuff.

HAND SPECIMEN:

DESCRIPTION:

This sample is a rhyolitic crystal tuff dominated by 20-25 modal% of broken fragments of quartz phenocrysts to 2mm long. Sparse small, totally sericitized plagioclase phenocrysts are also present, set in a devitrified very fine-grained groundmass of quartz and albite. The groundmass shows fairly extensive replacement by sericite. Sericite wisps and streaks also define a weak fracture cleavage. FeTi oxide microphenocrysts and groundmass 'dust' are altered to hematite or goethite-limonite, which has stained the groundmass sericite red and yellow. Small amounts of green chlorite and dirty yellow-brown crusty epidote spot the groundmass.

BEULAH - GOWRIE PARK

SAMPLE: 428045

LOCATION: Gowrie Park 43625E 540886N

SUMMARY: This sample is a poorly-sorted volcanogenic greywacke derived from a mixed felsic and andesitic volcanic terrain.

HAND SPECIMEN: This is a fine-medium grained dark grey massive sandstone.

THIN SECTION DESCRIPTION:

This rock is a volcanogenic arenite in which the largest fragments are 1-2mm. Most fragments are angular, and both monomineralic and polymineralic clast populations are represented, as well as abundant lithic clasts. Monomineralic clasts include crystals and crystal fragments of augite, albitized plagioclase and quartz. Albitized plagioclase grains are blocky, slightly rounded euhedra making up about 30 modal% of the rock, and are partially sericitized, but they also contain small grains of strongly pleochroic pumpellyite and non-pleochroic green chlorite. Augite grains are generally fractured, and total around 20 modal % of the rock; they are quite fresh. Slightly resorbed to subhedral quartz phenocrysts are a minor component.

Lithic fragments are dominantly fine-grained andesite and occasionally contain plagioclase and augite phenocrysts; they are quite chlorite-rich and contain abundant leucoxene granules throughout the rock. The matrix constitutes less than 30 modal% of this greywacke, and is a chloritic silt in which dirty fine-grained epidote and patchy calcite have developed.

The rock was derived from a local intermediate and felsic volcanic-dominated source; there is no sign of detritus from the Precambrian metamorphics.

SAMPLE: 428046 GP

LOCATION: Garden of Eden Road, 445145E 540878N

SUMMARY: This is an extensively sericitized plagioclase-phyric felsic lava.

HAND SPECIMEN: This is a very weathered, pink felsic lava or tuff with feldspar pehnocrysts and a weak cleavage.

DESCRIPTION:

This sample is a very altered felsic plagioclase-phyric lava or welded tuff. Around 10 modal% of ghost relics of former blocky plagioclase phenocrysts are replaced by sericite. Occasional chlorite-sericite pseudomorphs probably represent former augite phenocrysts. The vitrophyric groundmass has devitrified to quartz-albite in a very fine-grained mosaic now almost entirely replaced by sericite. Any former FeTi oxide microphenocrysts and groundmass grains have dissolved, leading probably to the extensive red and yellow staining which permeates the sericiitic alteration in this rock.

SAMPLE: 428047

LOCATION: Garden of Eden Road 445145E 540878N

SUMMARY: This rock is a strongly sheared and altered felsic lithic tuff or polymict breccia that has been extensively sericitized and hematitized.

HAND SPECIMEN: This is a very highly weather and altered pink clayey, hematitized and sericitized, schistose fragmental volcanic.

DESCRIPTION:

This sample is a is a strongly sheared and altered felsic lithic tuff or polymict breccia that has been extensively sericitized and hematitized. Stretched clasts or fragments of feldspar-phyric felsic lava are streaked out into the cleavage; feldspar is totally sericitized. Some other flattened lithic fragments lack former phenocrysts and include varieties that resemble devitrified aphyric felsic pumice and possibly tuffaceous siltstone. Some discrete fragments of large albitized and sericitized plagioclase form augen-like bodies which the cleavage wraps around as dark hematite-stained sericitic layers.

SAMPLE: 428048

LOCATION: Dynans Bridge road, Beulah 445050E 540908N

SUMMARY: This rock is a plagioclase+augite+olivine-phyric meta-basalt probably correlatable with the Hellyer basalts.

HAND SPECIMEN: This sample is an almost black highly plagioclase+mafic phase-phyric basalt with some small areas of bright red alteration of groundmass

DESCRIPTION:

This sample is a well-preserved meta-basalt containing phenocrysts to 3mm long of augite, plagioclase and altered olivine. Plagioclase phenocrysts, now totally pseudomorphed by albite, constitue around 20 modal% of this rock, and are completely sericitized euhedral prisms in which ghost zoning is preserved. Augite phenocrysts are less abundant and smaller frequently twinned euhedra containing inclusions of plagioclase, FeTi oxides, altered olivine and chlorite after melt inclusions. Serpentine-chlorite pseudomorphs after euhedral olivine amount to <1 modal% of this lava. An interesting feature of this sample is the presence of several relatively fine-grained gabbroic nodules composed of plagioclase, augite and FeTi oxides. The groundmass is vitrophyric and even-textured, with pilotaxitic alignment of many plagioclase microlites. Occasional dark fragments to 2mm with the same mineral assemblage and features as the remainder of the rock except for being finer-grained, are probaly quenched crusts of the flow incorporated into the basalt during convective overturn.

This sample should be analyzed for major and trace elements, and is almost certainly equivalent to the Hellyer basalts.

SAMPLE NUMBER: 428081

SUMMARY:

This rock is a strongly sericitized formerly augite+ plagioclase + FeTi oxide-phyric andesite.

HAND SPECIMEN:

This is a grey green porphyritic andesite with phenocrysts of altered plagioclase and a mafic phase. It has a pronounced maroon weathering skin sharply defined from the 'fresh' rock.

THIN SECTION DESCRIPTION:

This is a strongly altered formerly augite+plagioclase- phyric andesitic lava. Augite phenocrysts to 3mm have been replaced by dull green chlorite that has oxidized extensively to brownish-olive ferrichlorite(?). They constituted around 10-15 modal% of this sample. Plagioclase phenocrysts are totally sericitized and often difficult to discern in the strongly sericitized groundmass. FeTi oxide phenocrysts are relatively common equidimensional crystals invariably replaced by leucoxenic aggregates.

The strongly sericitized and recrystallized groundmass of this sample was probably quite glassy. It devitrified to a quartz-albite-chlorite mosaic that subsequently was recrystallized by invasion of fluids which precipitated extensive sericite and minor secondary quartz.

SAMPLE NUMBER: 428083

LOCATION: 442162E 42508E Stonebridge prospect near Beulah

SUMMARY:

This is a weathered plagioclase+augite-phyric andesite similar to other porphyritic andesites described from the Beulah and Winterbrook areas.

HAND SPECIMEN:

This is a weathered grey highly feldspar-phyric andesite in which the feldspars have been altered to cream coloured clayey material.

THIN SECTION DESCRIPTION:

This sample is an andesitic lava that contains around 30-35 modal% of partially altered feldspar phenocrysts, and a few modal% of augite phenocrysts in a microcrystalline groundmass. Feldspar phenocrysts up to 4mm long are blocky to slightly elongate euhedra that have been albitized, then subsequently flecked by sericite (clay?) and pale green chlorite. Some crystals contain dull brownish radiating masses of prehnite with typical fan-like extinction, and others contain yellow epidote showing similar habit. Sites of former augite phenocrysts, probably totalling only 1 or 2 modal%, are now filled by green chlorite, secondary quartz, epidote, occasional prehnite and leucoxene. A similar assemblage fills tension gashes and voids in the rock.

The groundmas of this sample shows slightly variable texture from vitrophyric with well-defined flow textures shown by the elongate plagioclase laths, to formerly more glassy areas with more typical glass devitrification and recrystallization textures. The latter areas are composed dominant of chlorite and minor sericite in which are embedded small globule-like bodies of secondary quartz and minor albite. The metamorphic assemblage clearly indicates prehnite-pumpellyite grade metamorphic conditions.

SAMPLE NUMBER: 428091

LOCATION: 442210E 11000N

SUMMARY:

This rock is a highly feldspar-phyric dacitic lava with minor pyrite development in chloritic patches within the rock, and along fractures.

HAND SPECIMEN:

This sample on a freshly cut face is a dark brown-grey strongly feldspar-phyric felsic lava containing notable concentrations of accessory pyrite on fractures and scattered through the rock in minor quantities.

POLISHED THIN SECTION DESCRIPTION:

This dacitic lava contains at least 30 modal % of feldspar phenocrysts in a very fine-grained vitrophyric flow-textured groundmass. The feldspar phenocrysts are albitized plagioclase up to 3mm long. Most are slightly rounded blocky euhedra that are always flecked by both sericite and chlorite. Sparse former mafic phenocrysts, less than 0.5mm long, are now replaced by green chlorite with beautiful purple anomalous interference colours, and were probably augite. Perfect euhedral crystals of sphene and secondary quartz, and less crystalline masses of golden epidote are not uncommon growing in the chlorite.

The groundmass of this sample shows an excellent pilotaxitic flow texture with elongate tiny plagioclase microlites arranged so that they swirl around phenocrysts. These are embedded in an exceptionally fine-grained devirified glassy mesostasis which is quite dark due to abundant tiny equidimensional Fe oxide(?) dust-like grains.

In both the polished thin section and the polished block, the local concentrations of sulphide are seen to be pyrite, with no inclusions or intergrowths of any other sulphide. The pyrite is most commonly associated with chlorite patches, and occurs as fairly irregular scalloped and embayed grains. Secondary hematite euhedra also occasionally occur intergrown with chlorite and secondary quartz.

SAMPLE NUMBER: 428093

LOCATION: 442042E 11600N Stonebridge Prospect, W of Beulah

SUMMARY:

This is an intrusive dolerite with a composition guesstimated to be somewhere between a low MgO basalt and a basaltic andesite. It is almost certainly related to the Mount Read Volcanics.

HAND SPECIMEN:

This is a dark grey-green apparently holocrystalline poorly feldspar+augite(?)-phyric fine-grained dolerite.

THIN SECTION DESCRIPTION:

In thin section, the absence of groundmass and interlocking holocrystalline texture of this rock indicate that it is an intrusive dyke-or plug rock rather than a lava. Main constituent minerals were originally plagioclase, augite and FeTi oxide intergrown in a subophitic typically doleritic or 'diabasic' texture. Former augite crystals to around 1mm long are clear, non-pleochroic fractured subhedral to anhedral plates that partially or completely enclose occasional small plagioclase laths. They are invariably partially chloritized. Plagioclase crystals are mainly significantly larger than the augite plates, and have been albitized, and subsequently partly replaced by yellow to pale green pleochroic epidote that forms an almost granular interlocking mesh within many plagioclase grains. FeTi oxides were originally quite abundant in this sample, probably totalling around 3-5 modal%. They occur as equidimensional grains to 0.5mm across which are always broken down to smaller subgrains of an opaque oxide phase (magnetite?) intergrown with leucoxene and chlorite.

Matrix areas between the grains of plagioclase and augite are chlorite-dominated, but dirty yellow epidote patches and tiny globules of secondary quartz frequently occur growing in the pale green chlorite. Larger patches of polycrystalline secondary quartz are not uncommon. Minor phases include calcite and sericite, which replace plagioclase locally, and needles of primary apatite. The metamorphic assemblage albite-chlorite-quartz-epidote-leucoxene is typical prehnite-pumpellyite to lowermost greenschist facies.

There is little doubt that this sample is of a doleritic dyke or plug. The primary mineralogy is typical of the andesitic to evolved basaltic rocks of the Mount Read Volcanics, although a corrleation on any finer scale (ie, with Hellyer or Beulah basalts) is unwarranted at this stage.

SAMPLE NUMBER: 428094

SUMMARY:

This is a siltstone with a dominant quartz-muscovite detrital component, presumably derived from Precambrian metamorphics.

HAND SPECIMEN:

This is a fairly indurated pale olive green siltstone with weak bedding defined by colour banding, with subordinate dark grey bands up to 4mm wide in a more typical olive green 'host' rock.

THIN SECTION DESCRIPTION:

This is a uniform grainsize siltstone with a detrital component composed largely of angular quartz and small muscovite flakes. These are embedded in a much finer-grained shaley quartz-albite-sericite matrix. Grainsize variation across the slide is minimal, and the most pronounced mineralogical variation is the variably intense sericitization of the matrix across the section. Bedding is defined by variation in the amount of amorphous Fe hydroxides (after detrital FeTi oxide?) that has led to colour banding, with darker brown layers representing bands of higher oxide contents. A very weak parting parallel to bedding is defined by Fe-stained sericite.

The high abundance of detrital muscovite and quartz in this sample suggests a derivation largely from the Precambrian metamorphics to the (present) south.

SAMPLE NUMBER: 428099

LOCATION: 442420E 10880N

SUMMARY:

This is a quartz-hematite stockwork pervading a former biotite+hornblende+plagioclase-phyric microdiorite or granodiorite similar to 531409.

HAND SPECIMEN:

This is a yellowish red weathered, highly altered and fractured stockwork derived from a fairly fine-grained igneous rock. Quartz veins are lined with a dark oxide phase and several large pyrite cubes are visible on broken surfaces.

THIN SECTION DESCRIPTION:

This rock is intensely altered and veined, The original lithology can still be determined however, as former biotite, hornblende and plagioclase phenocrysts can still be discerned in less altered areas of the thin section. Former mafic phenocrysts are replaced by pleochroic green actinolite and chlorite, and tiny leucoxene granules line former cleavage traces in biotite crystals. Plagioclase phenocrysts have been thoroughly sericitized, and sericite is abundant throughout the rock. Much of the chlorite and actinolite, both replacing phenocrysts and scattered throughout the rock, is oxidized to reddish secondary micaceous phases. The primary texture of the rock is mainly totally obliterated by intense veining, fracture-filling and recrystallization. However, a shallow intrusive holocrystalline texture is suggested, and I think the protolith of this stockwork was a microdiorite similar to 513409.

Secondary quartz is abundant as intergrowths of polygonal crystals whose grainsize varies enormously over small distances. Vein quartz diffuses out to replace patchy areas of the rock in many places.

In reflected light, the abundant dark oxide phase lining the quartz veins is seen to be hematite being martitized. Grain shapes suggest that the hematite is not replacing pyrite. Despite a careful search, no sulphides were seen in this polished thin section.

SAMPLE NUMBER: 428100

LOCATION: 442134E 12200N Stonebridge Prospect, W of Beulah

SUMMARY:

This important rock is a fossiliferous micaceous siltstone derived from a pelitic metamorphic terrain.

HAND SPECIMEN:

This is a grey-brown fine-grained and poorly bedded siltstone or shale containing **TRILOBITE FRAGMENTS and AGNOSTID TRILOBITES.**

THIN SECTION DESCRIPTION:

In thin section, this rock is seen to be a poorly-bedded siltstone composed of abundant detrital muscovite and quartz set in a much finer-grained clayey murky matrix. Muscovite flakes are not aligned with bedding, which is defined instead by variations in the abundance of messy brown amorphous Fe hydroxides in the clayey matrix. Quartz grains are always much smaller than 0.1mm and are invariably angular. Occasional stylolitic planes are defined by concentrations of Fe hydroxides along scalloped fracture planes. A few small greenish tourmaline grains were also noted. This siltstone is probably entirely derived from eroding pelitic metamorphic rocks.

SAMPLE NUMBER: 513402

LOCATION: 442160E 10800N

SUMMARY:

This is an augite+plagioclase-phyric andesitic lava containing minor pyrite and chalcopyrite concentrations along fractures and scattered less abundantly through the rock.

HAND SPECIMEN:

This rock is a dark brown-grey porphyritic andesite lava with phenocrysts of augite and plagioclase, and some pyrite along at least one fracture plain.

POLISHED THIN SECTION DESCRIPTION:

This is a strongly porphyritic andesitic lava containing abundant phenocrysts of albitized feldspar and chloritized augite, and notably large microphenocrysts of apatite. Blocky to elongate albitized plagioclase phenocrysts are rarely larger than 1mm and are generally thoroughly sericitized.; these constitute around 15 modal% of the sample. Approximately equally abundant are partially and totally chloritized augite euhedra to 2mm long. Margins of some augite euhedra are rplaced by green-pleochroic actinolitic hornblende, that rarely shows the fibrous habit more typical of actinolite replacing augite. Unusualyy large and common apatite microphenocrysts are characteristic of this sample. These are euhedral hexagonal prisms to almost 1mm long. FeTi oxide phenocrysts are quite abundant and being replaced by leucoxene. Several almost perfectly rounded quartz xenocrysts with narrow reaction rims against the groundmass are present.

The groundmass of this sample is vitrophyric, with tiny plagioclase microlites and FeTi oxide 'dust' embedded in a very fine-grained quartz-albite intergrowth perhaps after interstitial glass.

In reflected light, it is seen that there are two styles of occurrence of sulphides. Pyrite occurs as uncommon irregular small grains mainly included in chlorite, and frequently surrounded by tiny blebs of chalcopyrite. It also occurs concentrated along a meandering fracture, where associated phases include hematite and more tiny blebs of chalcopyrite. Chalcopyrite also occurs as small primary(?) blebs in augite phenocrysts.

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SAMPLE NUMBER: 513403

LOCATION: 441560E 11200N

SUMMARY:

This is a highly altered (sericitized) former hornblende+plagioclase-phyric holocrystalline andesitic shallow intrusive rock similar to those better preserved intruding Central Volcanic Complex lavas at Crown Hill.

HAND SPECIMEN:

This is a massive, uniform, grey feldspar-phyric andesitic rock containing fairly abundant crystals of an altered mafic phase.

THIN SECTION DESCRIPTION:

Thin section examination shows this sample to be a highly sericitized formerly plagioclase+hornblende-phyric andesitic rock with a texture suggestive of a volcanic plug or shallow intrusive origin. Hornblende phenocrysts to 2mm long are quite abundant, perhaps making up around 25 modal% of the rock. They frequently show the characteristic hornblende cross-sections and cleavage traces, but are always altered to a slightly birefringent chlorite which still shows the pale brown to green pleochroic pattern of andesitic amphiboles. Most former hornblende phenocrysts have opacite rims. Former plagioclase phenocrysts are totally obliterated by intense sericitization, and only vague former oulines of areas richer in sericite than the adjacent areas of rock attest to their former presence. Small leucoxenized FeTi oxide microphenocrysts are relatively abundant scattered through the matrix of the rock.

The primary texture of the groundmass is extremely difficult to determine, due to the intensity of sericitization and alteration. There is no sign of the very fine-grained vitrophyric or devitrified glassy textures typical of most andesites from the Mount Read Volcanics. The matrix of this sample is composed dominantly of sericite, chlorite and secondary quartz, and what little textural evidence is still discernible suggests a former holocrystalline groundmass, significantly coarser grained than volcanic groundmasses.

This sample was probably a hornblende+plagioclase-phyric andesitic plug intruding the Mount Read lava sequence. Similar hornblende-phyric andesites are common in the Crown Hill area N of Queenstown, where they are clearly shallow intrusive rocks.

SAMPLE NUMBER: 513408

LOCATION: 441772E 11200N Stonebridge Prospect W of Beulah

SUMMARY:

This is a well-preserved mafic andesite bearing abundant phenocrysts of augite and albitized plagioclase.

HAND SPECIMEN:

This is a well-preserved dark grey pyroxene+plagioclase-phyric basaltic andesite.

THIN SECTION DESCRIPTION:

This rock is a highly porphyritic basaltic andesite lava with subequal modal abundances (~15 modal% each) of albitized plagioclase and augite phenocrysts in a very fine-grained dark matrix. Augite phenocrysts are up to 3mm long and vary from perfectly fresh to totally chloritized euhedra; these often occur clustered together in small cognate clinopyroxenite inclusions and glomerocIots. The augite phenocrysts are often replaced by pale green chlorite that contains small inclusions of globular secondary quartz and pale brown sphene or leucoxene. Albitized plagioclase phenocrysts are elongate prisms mainly less than 1mm long, that are almost totally replaced by sericite, giving the plagioclase phenocrysts a 'dirty' appearance in plane polarized light. An unusual feature of this rock is the virtual absence of any FeTi oxide phenocryst or microphenocryst phase or its leucoxene alteration products.

The groundmass of this sample is a very fine-grained vitrophyric intergrowth of stubby albitized plagioclase microlites and quartz-albite-chlorite-leucoxene after former andesitic glassy mesostasis.

This sample is a well preserved mafic andesite very similar to some of those previously described from Beulah (see earlier descriptions), most of which have been analyzed. This sample also will be put in for major and trace element wholerock analysis.

SAMPLE NUMBER: 513409

LOCATION: 442359E 10500N

SUMMARY:

This rock is an altered formerly hornblende+biotite+ plagioclase-phyric microdioritic holocrystalline intrusive rock.

HAND SPECIMEN:

This is a massive pink speckled holocrystalline rock with a microgranitic texture, containing altered phenocrysts of plagioclase and a former mafic phase.

POLISHED THIN SECTION DESCRIPTION:

This rock consists of phenocrysts to 2mm long of plagioclase and a former mafic phase set in a holocrystalline feldspar-rich groundmass with a grainsize notably greater than seen in any of the other andesitic lavas described above. Slightly sericitized blocky albite phenocrysts make up around 5 modal% of this rock, and often contin granular epidote inclusions. The other important phenocryst phase in this sample occurs as elongate rectangular grains typically 5 or 6 times longer in length than width, now composed of fibrous green to pale brown pleochroic actinolite and intergrown chlorite and pale green epidote. These were probably amphibole phenocrysts, although the shape of the crystals is rather unusual relative to other andesites in the Mount Read Volcanics. This is probably due to the fact that this sample is a subvolcanic granodiorite or hornblende diorite compositionally quite unlike the andesites typically sampled from this belt. Some of the former mafic phenocrysts, however, are strongly reminiscent of altered biotite phenocrysts, and it is likely that both hornblende and biotite phenocrysts were present in this sample. The groundmass is a feldspar-rich holocrystalline intergrowth containing abundant chlorite, sericite and secondary quartz. The metamorphic grade of this sample is low greenschist facies.

In reflected light, no sulphides were seen. The FeTi oxide phenocrysts are seen to be breaking down to a two-phase assemblage, probably hematite and magnetite.

SAMPLE NUMBER: 513412

SUMMARY:

This is a trachytic-textured formerly glassy feldspar-phyric andesitic lava.

HAND SPECIMEN:

This is an extremely weathered pinkish and cream coloured former lava or tuff with altered feldspar phenocrysts to about 1mm long.

THIN SECTION DESCRIPTION:

In thin section, this sample is seen to be an almost trachytic textured porphyritic lava with about 10-15 modal% of thoroughly sericitized feldspar crystals mostly showing subparallel orientation of their long axes. The phenocrysts are generally quite elongate, as is characteristic of basaltic to andesitic feldspars in the Mount Read Volcanics (compared with more blocky, large feldspar phenocrysts in felsic lava). The only other non-groundmass mineral phase in this rock is the abundant small equidimensional opaque grains scattered throughout; these lack the fuzzy outlines that characterize leucoxenized FeTi oxide grains, and thus they may be simply limonitized oxide grains; they do not show characteristic pyrite shapes.

The groundmass of this sample was almost certainly glassy to vitrophyric, and it is now composed of a very fine-grained quartz-albite mosaic flecked with ferruginized sericite or clay. The rock is cut by a weak fracture cleavage network that is emphasized by oxidation along the fracture planes.

The apparent lack of any mafic phenocrysts in this sample, coupled with the rather elongate plagioclase phenocrysts, suggest to me that this was originally an andesitic lava.

SAMPLE NUMBER: 513414

SUMMARY:

This is a strongly sericitized basaltic or andesitic lava breccia.

HAND SPECIMEN:

This is a highly weathered and altered andesitic polymict volcanic breccia with dark angular lava fragments up to at least 1.5cm long in a medium-grained matrix also composed of volcanic detritus or ash.

THIN SECTION DESCRIPTION:

This rock in thin section is seen to be a volcanic breccia composed of petrographically very similar fragments of highly altered andesitic or basaltic lava, uo to at least 1cm across, set in a similarly altered matrix that makes up about 10 modal% of the sample. The lava fragments are not jig-saw fit, but are almost certainly derived from the same flow/eruption. They are now composed of totally sericitized fairly elongate former plagioclase phenocrysts ususally less than 0.5mm long, and rare possible former mafic (augite?) phenocrysts that are now replaced by sericite and hematite, in a devitrified and recrystallized groundmass. The formerly glassy groundmass is now composed of a fine-grained quartz-albite-sericite intergrowth that is dotted by tiny equigranular opaques; probably 30modal% of the sericite is altered in turn to dirty brown, almost isotropic clayey material that has obliterated the primary texture over much of the rock.

This rock is a lava breccia probably derived from a single explosive eruption of a basaltic or andesitic lava. Fragments have probably been transported as a mass flow, as they lack the jigsaw fit characteristic of autobrecciated lavas produced by hydraulic fracturing within a gas-charged flow. The degree of silica and sericite-replacement in this sample is notably more than in regionally altered Mount Read Volcanics, and may be related to hydrothermal overprinting.

SAMPLE NUMBER: 513415

SUMMARY:

This rock is an extensively weathered and sericitized formerly plagioclase+augite+olivine-phyric basalt.

HAND SPECIMEN:

This is a light brown strongly weathered porphyritc lava with ferruginized and sericitized henocrysts to 2mm across.

THIN SECTION DESCRIPTION:

Despite the intense weathering that has strongly altered this sample, it is clear that it was a strongly porphyritic basalt with phenocrysts of olivine, plagioclase and augite. The most abundant phenocrysts are elongate euhedra of plagioclase that make up around 20 modal% of the rock, and are totally sericitized, and range up to 6mm long and only about 1mm wide. Former augite phenocrysts are also quite large (to 3mm across) but less abundant than plagioclase phenocrysts, probably constituting about 3 modal% of the sample. They have been totally pseudomorphed by pale green chlorite, that has in turn been replaced by dirty redbrown clayey or limonitic material. Former phenocrysts with characteristic olivine shapes are present, making up about 1 modal % of the rock. Besides their distinctive shapes, former olivine crystals have dark opacite rims that are not observed on the altered augite crystals.

The groundmass of this rock is replaced entirely by sericite and the same limonitic material that replaces augite phenocrysts. The latter is scattered in abundance through the groundmass as if it is replacing former FeTi oxide grains. Former plagioclase microlites are common, indicating that the groundmass was not entirely glassy. There is little doubt that this sample was originally an olivine+augite+plagioclase-phyric basaltic lava.

SAMPLE NUMBER: 513419

SUMMARY:

This is strongly weathered formerly plagioclase+olivine+ FeTi oxide-phyric basaltic lava.

HAND SPECIMEN:

This is a highly weathered and sericitized purple-pink oxidized andesitic or basaltic lava with rather 'stretched' and argillized plagioclase phenocrysts in a ferruginized groundmass.

THIN SECTION DESCRIPTION:

This is a slightly foliated formerly plagioclase+olivine-phyric basaltic lava. Plagioclase phenocrysts make up around 10-15 modal% of the sample and are toatlly altered to clay/sericite. Most are elongate euhedra to 5mm long and very narrow, and some are stretched out into the foliation. Sericite and clay is often Fe-stained to reddish and orange shades. Former olivine phenocrysts are mainly euhedra less than 0.7mm long, and have narrow opacite rims enclosing fine-grained colourless serpentine or chlorite cores. They originally contituted probably around 1 modal% of this sample. There is no evidence for the former existence of augite phenocrysts in this lava. Sparse large euhedral FeTi oxide phenocrysts have exsolved ilmenite and broken down to skeletal chlorite-magnetite-leucoxene intergrowths preserving octahedral exsolution planes.

The groundmass of this sample was probably pilotaxitic and vitrophyric, but is now strongly altered to a very fine-grained sericite/clay-Fe oxide dust mixture in which the relic outlines of aligned former elongate plagioclase microlites can be discerned within the sericite/clay. A weak foliation is developed in this rock, and is defined by streaky curved fractures along which sericite has developed in greater concentrations and to coarser grainsize than is found in unfoliated areas of groundmass.

This sample was certainly basaltic, judging by the amount of olivine in the rock.

SAMPLE NUMBER: 513428

SUMMARY:

This is a quartz-chlorite hydrothermal vein or fracture filling composed of intimately intergrown reef-type and green chlorite.

HAND SPECIMEN:

This is a massive quartz-chlorite rock composed of milky reef-type quartz intergrown on all scales with massive to streaky black chlorite; the latter forms irregular layers at least 1cm thick.

THIN SECTION DESCRIPTION:

Thin section examination shows this sample to be composed solely of massive quartz and pale green chlorite. The quartz and chlorite are interlayered in a very irregular fashion. Quartz forms long platy grains that show strain features and bending, and folded ribbon-like grains in some places. The chlorite occurs as particularly fine-grained dense matted intergrowths of tiny almost worm-like grains that show strong pale to deep green pleochroism and a prominent parting perpendicular to the long axis of these vermiform (!) grains. There is no evidence that the chlorite replaces any preexisting phase, so that this sample probably represents a quartz-chlorite hydrothermal vein or large fracture filling.

SAMPLE NUMBER: 513433

SUMMARY:

This sample is a foliated, strongly sericite+calcite-altered former augite+plagioclase-phyric andesite.

HAND SPECIMEN:

This is a blue-grey feldspar-porphyritic felsic volcanic with about 5-10 modal% of pale green altered feldspar phenocrysts in a dense, uniform dark greyblue groundmass. The sample has a redbrown weathering skin around 1cm thick, and shows an almost schistose foliation most notable on fracture surfaces..

THIN SECTION DESCRIPTION:

This sample was clearly originally an augite+plagioclase-phyric andesite. Former mafic phenocrysts with crystal shapes characteristic of augitic clinopyroxene make up around 10 modal% of the sample, and are now replaced by a polygonal mosaic of cacite. Former plagioclase phenocrysts are about equally as abundant as the augite phenocrysts, and are generally elongate prisms that have been thoroughly sericitized and streaked out into the foliation, that is also defined by sericite. Tiny altered FeTi oxide microphenocrysts spot the groundmass, which itself is highly altered, and composed essentially of abundant fine-grained calcite and sericite, with less common anhedral secondary quartz grains embedded in this matrix. Oressure fringes of calcite grow off many of the carbonated augite phenocrysts. In the more strongly weathered parts of the rock, a secondary Fe hydroxide or amorphous hematite has replaced the groundmass calcite, resulting in the red weathering skin.

SAMPLE NUMBER: 513434

SUMMARY:

This is a massive barite vein containing about 5 modal% of sulphides, represented by scattered intergrowths of galena and minor sphalerite that are frequently cored by anhedral small pyrite grains. The latter also occur throughout the sample unrelated to galena.

HAND SPECIMEN:

This is a coarse-grained, massive intergrowth composed of barite crystals to at least 15mm across, with around 5 modal% of galena and minor pyrite intergrown with the barite.

THIN SECTION DESCRIPTION:

This sample is dominated by coarse, strongly strained anhedral barite crystals that are intimately sutured against neighbouring crystals. Grain boundaries are frequently the site of extensive sub-grain recrystallization, with much finer-grained recrystallized barite showing better crystallized forms and more polygonal intergrowths. Cuspate blebs and trains of an opaque phase follow many grain boundaries in the coarse-grained barite.

The opaque mineralogy is relatively simple. The most notable opaque concentrations are large (to 5mm) highly irregular shaped, cuspate blebs and patches of galena that contain small (0 to <10 modal% of the galena grains) amounts of apparently equilibrium sphalerite. Many galena patches are core by one or more rather rounded and reacted-looking pyrite grains that appear to have been replaced by the galena. The small sphalerite patches in galena contain tiny grains of chalcopyrite.

SAMPLE NUMBER: 513436

SUMMARY:

This sample is a former vitric crystal tuff that has a well-developed foliation, and shows strong calcite-sericite alteration.

HAND SPECIMEN:

This is a foliated tuff with an unweathered blue-grey sparsely feldspar-phyric core surrounded by a more weathered maroon alteration zone sharply defined against the fresher rock.

THIN SECTION DESCRIPTION:

This sample is a stronly foliated, calcite+sericite-rich former vitric crystal tuff. Angular quartz crystal fragments make up about 1 modal% of the sample, and less well-defined phenocrysts of sericitized plagioclase are about equally as abundant, and always much less than 1mm across. Former vitric shards and curved glassy fragments are strongly sericitized, but are not as distinctive in this sample as the previous one (513464) because of the extensive sericite-calcite overprint on the matrix of this sample. The well-developed cleavage in this rock is defined by sericite, and quite often, calcite occurs as strings and streaks of tiny crystals drawn out in the cleavage direction. The calcite pervades the entire sample as tiny discrete rhombic crystals and crystal aggregates.

SAMPLE NUMBER: 513437

SUMMARY:

This is a former feldspar-phyric felsic lava or shallow intrusive rock that has suffered intense sericite-calcite± minor chlorite alteration during development of a weak fracture cleavage.

HAND SPECIMEN:

This is a relatively well-preserved blue-grey fairly fine-grained weakly porphyritic felsic to andesitic lava or shallow intrusive with a weak foliation, with tiny (<0.5mm) dark chloritic spots in a lighter grey groundmass. The texture is very uniform, and is reminiscent of a shallow intrusive rock.

THIN SECTION DESCRIPTION:

This sample is a former feldspar-phyric felsic lava composed of about 20 modal% of thoroughly sericitized feldspar to around 1mm long set in a weakly foliated and very fine-grained calcite-sericite-quartz groundmass that contains minor pale green chlorite. A few almost subhedral masses of calcite may represent former larger feldspar phenocryst sites. Most of the dark spots that characterize the hand specimen of this sample are poorly defined in thin section, and where most clearly developed appear to be calcite-chlorite intergrowths replacing feldspar phenocrysts, or chlorite-Fe oxide spots replacing former FeTi oxide microphenocrysts. The weak foliation is poorly defined in thin section by sericite trains. Calcite is uniformly scattered through the groundmass as tiny rhombs embedded in the very fine-grained sericite-quartz matrix.

This sample is an excellent candidate for what I imagine the original protolith of the previous sample (515276) would have looked like before the intense surface alteration replaced the groundmass calcite with Fe oxide-hyroxide minerals. The groundmass is too sericitized to determine its original texture, but it shuld not be ruled out that this sample could have been a shallow intrusive rock rather than a lava. The hand specimen certainly resmbles a shallow intrusive texturally.

SAMPLE NUMBER: 513439

SUMMARY:

This is a strongly sericite-chlorite altered former hornblende+plagioclase-phyric andesitic rock that resembles shallow intrusive andesites from further S in the Mount Read Volcanics, around Crown Hill and Leach Hill.

HAND SPECIMEN:

This is a massive, uniform-textured speckled hornblende-phyric igneous rock with dark, altered hornblende phenocryst set in a pale grey uniform fine-grained groundmass.

THIN SECTION DESCRIPTION:

This sample is texturally well-preserved, and was clearly originally a hornblende+plagioclase-phyric andesitic rock, with possibly a shallow intrusive origin. Former hornblende phenocrysts make up around 10-15 modal% of the rock, and are generally euhedral to subhedral prisms less than 1mm long. They have been totally replaced by rather messy pale green chlorite that is oxidised around phenocryst margins to a yellowish chloritic mineral. Former plagioclase phenocrysts are fairly elongate prisms, also less than 1mm long, that show a pronounced parallel orientation, and are totally altered to a very fine-grained sericite aggregate, so much so that they are barely discernible in the strongly sericite-altered groundmass. They are probably slightly more modally abundant than the hornblende phenocrysts. Perhaps around 1 modal% of this sample is made up of microphenocrysts(?) of an opaque phase that is generally blocky euhedra with sharp outlines and no sign of leucoxene alteration that characterizes altered FeTi oxides. These grains may be hematitized pyrite, although without a polished thin section, it cannot be determined with any certainty. The groundmass is even-textured but highly sericitized, and it is not possible to determine whether the primary texture was glassy or holocrystalline. The texture of the sample in both hand specimen and thin section is reminiscent of shallow intrusive hornblende andesites such as those found around Crown Hill, north of Queenstown. A single narrow veinlet of hematite-limonite transects this section.

SAMPLE NUMBER: 513455

SUMMARY:

This is an strongly foliated, intensely sericitized and altered former feldspar-phyric probably dacitic lava or shallow intrusive, any evidence for the protolith of which has been totally destroyed by alteration, cleavage development and strong weathering. It is best classified as cohesive dirt.

HAND SPECIMEN:

This is an intensely weathered, crumbling light brown rock cut by a fairly strong foliation that is enhanced by dendritic manganiferous or Fe-hydroxide staining and encrustations.

THIN SECTION DESCRIPTION:

This sample is texturally and mineralogically obliterated. It is cut by a strong cleavage that is enhanced by oxidation and weathering of insoluble oxides concentrated along the cleavages. The rock is essentially a foliated very fine-grained sericite-quartz intergrowth. Several ghost outlines of stretched, sericitized former plagioclase phenocrysts are the only clues remaining that this sample had an igneous (or pyroclastic) precursor. The apparent paucity of feldspar phenocrysts and the absence of quartz phenocrysts (which would be preserved in a sample such as this despite the intense alteration), suggest that it may have been a dacitic lava, rather than a crystal tuff, which are usually highly crystal-rich. It cannot be ruled out on the basis of this pathetic specimen that this sample was originally a shallow intrusive porphyrite.

SAMPLE NUMBER: 513456

SUMMARY:

This sample was originally a plagioclase+hornblende-phyric andesitic lava or shallow intrusive rock. It has suffered intense sericitization, and surficial weathering has oxidized chlorite replacing former hornblende phenocrysts.

HAND SPECIMEN:

This sample is massive brown, highly altered fine-grained felsic igneous rock or tuff with narrow bands of bleaching and alteration parallel to the exposed face of the sample.

THIN SECTION DESCRIPTION:

This sample is highly altered, but a relict igneous texture is preserved. It is composed of approximately equal proportions (~10 modal% each) of former plagioclase and hornblende phenocrysts in a highly altered sericite-dominated groundmass. The plagioclase phenocrysts show a subparallel orientation, and many are somewhat smeared out in a weak fracture cleavage. They have been totally sericitized. Former hornblende phenocrysts are also totally altered, in this case to a messy olive and brown mixture of chlorite and an Fe oxide or hydroxide. These phenocrysts are set in a highly altered but even-textured microcrystalline groundmass containing sericitized plagioclase microlites that show a trachytic texture. Scattered unevenly through the groundmass are irregular patches and streaks of the same almost isotropic messy chlorite-Fe hydroxide material that replaces hornblende in this sample.

The texture of this sample is appropriate for either an hornblende andesite lava or shallow intrusive dyke or neck. The extent of alteration is probably greater than would be produced by surficial weathering, although the alteration of the chlorite replacing hornblende is probably a surficial weathering feature.

SAMPLE NUMBER: 513458

SUMMARY:

This sample is a foliated, sericitized and ferruginized former feldspar-phyric felsic lava or tuff that has been brecciated and intensely weathered.

HAND SPECIMEN:

This is a highly weathered, oxidized and ferruginized former felsic lava or tuff which shows, besides a well- developed foliation, pronounced brittle fracturing and brecciation suggesting it comes from a fault zone.

THIN SECTION DESCRIPTION:

In thin section, this rock is seen to be made up of stretched and flattened augen of variably altered feldspar-phyric felsic lava or tuff. Feldspar phenocrysts are sparse, but clearly preserved despite their being thoroughly sericitized, and are less than 0.5mm long. All the clasts or fragments in this sample are petrographically similar, attesting to the fact that this sample was formerly a felsic lava or tuff that has been brecciated and foliated due to proximity to a significant fault. It is not a lava breccia or former coarse epiclastic sediment. Calcite once pervaded the rock as tiny rhombic crystals, but surficial weathering altered calcite to a dirty Fe oxide-hydroxide, and has produced strong goethite alteration in veinlets and ferruginization of sericite defining variably intense cleavage domains. The major part of the rock is composed of intense sericite alteration overprinting a very fine-grained quartz (±albite?) intergrowth probably after devitrified glass. The best that can be said of the protolith of this sample is that it was originally a felsic lava or tuff.

SAMPLE NUMBER: 513459

SUMMARY:

This rock is a strongly foliated former lava breccia or coarse epiclastic sediment composed dominantly of sericite, very fine-grained secondary quartz and Fe-oxides or hydroxides. The latter have clearly replaced former fine-grained calcite.

HAND SPECIMEN:

This is a weathered, pale cream-light brown coloured strongly schistose rock composed of stretched and flattened clasts of aphyric felsic lava or very fine-grained pelitic sediment up to at least 5cm long in a highly altered silty foliated groundmass.

THIN SECTION DESCRIPTION:

This is an exceptionally altered rock in which the outlines of clasts or fragments, often more than 1cm long, are barely discernible in the foliated groundmass. Clasts appear to have included both fine-grained texturally homogeneous sedimentary rocks and more abundant sparsely porphyritic felsic lavas, although the textures of the latter have been all but obliterated by intense sericite-quartz-hematite alteration. With the exception of a single small euhedral quartz phenocryst in one fragment, only ghost outlines of former plagioclase phenocryst sites are occasionally preserved, marked by less abundant Fe oxide dust scattered through the sericite-quartz 'matrix'. Possible former FeTi oxide phenocryst sites are marked by more intense Fe oxide dust accumulations, but in shapes that are not idiomorphic. Clasts are all flattened to some extent, and a strong but irregular foliation is defined by Fe-stained sericite that wraps around former clasts and cuts through the matrix of the sample.

One of the most notable features of this rock in thin section is the abundance of tiny isotropic grains of dirty brown hematite or Fe hydroxide minerals scattered throughout the matrix and former clasts. High magnification shows that these have rhombic cross sections, and were almost certainly originally calcite. Small dilation fractures parallel to the cleavage are filled by fine-grained secondary quartz.

This sample was probably originally a coarse epiclastic sediment or felsic lava breccia that underwent strong calcite-sericite alteration during a cleavage-producing deformation event. Subsequent surficial weathering resulted in the fine-grained calcite being pseudomorphed by an Fe-oxide or hydroxide phase.

SAMPLE NUMBER: 513460

SUMMARY:

This is a highly weathered, strongly foliated plagioclse-phyric andesitic to dacitic lava breccia that is cut by a pervasive, strong hematite-limonite vein system parallel to the foliation.

HAND SPECIMEN:

This is a highly altered and ferruginized rock that is impossible to identify with any certainty in hand specimen. It has a fairly well-developed foliation that resembles brecciation on cut surfaces.

THIN SECTION DESCRIPTION:

This sample is exceptionally altered and veined, and only a few small areas between veins have retained any vestige of their original texture. In these areas, there is clear evidence of a volcanic breccia texture, with small (<2mm) fragments of plagioclase-phyric andesitic or dacitic lava set in a highly sericitized matrix. The few clearly-defined fragments are texturally and mineralogically identical, suggesting a lava breccia, rather than a coarse epiclastic sediment precursor. Plagioclase phenocrysts in these fragments are small (<0.2mm) and are also totally sericitized. There is no sign of the former presence of any mafic silicate, although traces of possible former FeTi oxide, in the form of subhedral opacite rims around secondary quartz cores are occasionally observed. The groundmass of the various lava fragments is strongly altered, and no trace of the primary texture is preserved, due to intense sericite-quartz alteration.

The dominant feature of this rock is the development of an intense subparallel meshwork of hematite-limonite veins that form more than 75% of the volume of the rock in places. The veinlets parallel the strong fracture cleavage evident in the hand specimen of this sample, but there is no evidence that the hematite-limonite is replacing a pre-existing alteration assemblage such as calcite or quartz.

SAMPLE NUMBER: 513462

SUMMARY:

This sample is a former hornblende+plagioclase-phyric andesitic (probably) shallow intrusive that has suffered intense sericitization, and chloritization of the former hornblende phenocrysts.

HAND SPECIMEN:

This is a massive bleached and highly altered, uniform textured former felsic to andesitic lava or shallow intrusive (?) containing abundant chlorite pseudomorphs after a mafic phenocryst phase, and dark chlorite-hematite spots and some large patches and veinlets of hematite or goethite alteration.

THIN SECTION DESCRIPTION:

Thin section examination of this sample shows that it was originally a hornblende+plagioclase-phyric andesitic lava or shallow intrusive rock. The primary texture has been strongly disturbed by intense sericitization and recrystallization of the groundmass. Distinctive shapes of former hornblende phenocrysts, to about 2mm long, have been preserved despite the alteration, but these crystals have been totally replaced by green pleochroic chlorite that is always slightly oxidized and brownish around the rims of crystals. Hornblende phenocrysts made up around 20 modal% of the rock. Former plagioclase phenocrysts have altered to sericite, and in most cases their former outlines are only vaguely discernible in the sericite-dominated groundmass. It is therefore impossible to derermine their former modal abundance, but I would estimate that they were approximately equally modally abundant as the hornblende phenocrysts. It is impossible also, to tell anything about the original texture of the groundmass of this sample (glassy or holocrystalline?), as it is so intensely altered. However, again I get a vague impression that this sample was not glassy, but had a groundmass texture more suggestive of a shallow intrusive rock.

The section is transected by meandering veins composed of a core of honey-coloured goethite that is rimmed by dirty isotropic Fe or Fe-Mn oxides and hydroxides.

SAMPLE NUMBER: 513464

SUMMARY:

This is a well-preserved quartz-phyric vitric crystal tuff, texturally transitional to an ignimbrite.

HAND SPECIMEN:

This is a light grey, platy felsic lava or crystal tuff with abundant small feldspar phenocrysts in a very fine-grained matrix. These have weathered out on the exposed surface of the rock, producing a pitted surface with a strong sercite- sourced lustrous sheen.

THIN SECTION DESCRIPTION:

This sample has a well-preserved texture indicative of a vitric crystal tuff. Quartz crystal fragments to almost 1mm across make up about 5-10 modal% of the rock, and are invariably angular and broken. They display uniform extinction and occasional chloritized melt inclusions, and are clearly of volcanic origin. Former feldspar phenocrysts are less abundant and less easily discerned, since they are thoroughly sericitized. The largest of the few unambiguous former feldspar phenocrysts are notably smaller than the largest quartz crystal fragments. A distinctive feature of the rock is the abundance of devitrified and sericitized former glassy shards and curved to angular glassy fragments that are slightly flattened. These are embedded in a microcrystalline, quartz-rich matrix that contains much less sericite, and that is consequently much darker in polarized light. It is difficult to tell for certain whether the matrix of this sample was welded or not. The texture is transitional to an ignimbrite.

SAMPLE NUMBER: 513465

SUMMARY:

This sample was probably a highly glassy vitric crystal tuff containing a few modal % of angular quartz crystal fragments. It has a weak fracture cleavage defined by crystalline sericite.

HAND SPECIMEN:

This is a fairly fresh, cream-coloured very fine-grained felsic lava or crystal tuff that is dotted by tiny white altered feldspar phenocrysts. Both the upper and lower surfaces of the sample are lustrous schistose sericite-dominated fracture planes.

THIN SECTION DESCRIPTION:

This sample is a fine-grained tuff oe epiclastic sediment composed of about 5 modal% of small quartz grains embedded in a very fine-grained weakly-foliated matrix. The quartz grains are slightly rounded or anhedral crystal fragments that show strong interaction with the groundmass (scalloped edges and intergrowths with groundmass). The remainder of the rock is a very fine-grained quartz-dominated intergrowth (with albite?) that is peppered by sericite. The latter mineral occasionally occurs in semi-prismatic concentrations that are suggestive of feldspar replacement. The weak foliation in this sample is defined by quite coarsely-crystalline (relative to groundmass flecks) sericite trains and streaks.

This rock is rather difficult to diagnose. I lean toward the opinion that it was originally a highly vitric tuff, containing a small amount of broken quartz crystal fragments. Devitrification of the uniform, glassy component to a very fine-grained quartz-albite-sericite mixture was accompanied by a weak deformation that saw sericite recrystallize along a fairly poorly-defined fracture cleavage.

SAMPLE NUMBER: 513470

SUMMARY:

This is a foliated, highly sericitized lava containing sparse altered feldspar phenocrysts. It contains a small but notable amount (~0.1%) of chalcopyrite and pyrite scattered through the rock, the former commonly intergrown in chlorite.

HAND SPECIMEN:

This is a light coloured, foliated, almost schistose fine-grained former felsic metavolcanic rock showing a few very thin, discontinuous veinlets of single crystals of pyrite and a less idiomorphic opaque. On the freshly cut surface, the sample shows a hetrogeneous texture that resembles local small-scale brecciation in places.

THIN SECTION DESCRIPTION:

This sample was originally a sparsely feldspar-phyric felsic lava that shows a fairly well-developed foliation defined by sericite and a few streaks of secondary quartz. Former phenocrysts are relatively rare and barely distinguishable due to their strong alteration to sericite and calcite. Most of this sample consists of a very fine-grained intergrowth of quartz, albite, sericite and chlorite that may have replaced former glass, although this is difficult to say with certainty due to the fairly intense recrystallization of this sample.

A single veinlet up to 1mm wide cuts the sample, and shows an interesting mineral assemblage, composed of almost colourless chlorite that shows anomalous blue pleochroism, well-crystallized sericite, quartz and barite. The latter mineral occurs as anhedral plates in the centre of the vein, whereas the chlorite lines the vein margins and generally grows inwards into the vein. A few veinlets of relatively coarsely-crystalline calcite cut almost perpendicularly across the foliation and the barite-chlorite vein, but also meander across the slide, and cannot be placed in paragenetic sequence relative to the barite-chlorite vein.

The opaque mineralogy is characterized by three discrete phases. Former FeTi oxide phenocrysts have exsolved ilmenite along octahedral planes, and the remaining magnetite has been replaced by mainly chlorite. Chalcopyrite occurs scattered through the sample, and commonly intergrown with chlorite, as irregular patches, commonly cored by reacted and rounded pyrite, and is rarely present as grains larger than 0.5mm; these tend to occur streaked along the foliation, although it is impossible to say whether the cpy is pre- or post-foliation. Pyrite grains are ~ equal in abundance to the chalcopyrite, but are generally less irregular shaped, and smaller than cpy.

652137

SAMPLE NUMBER: 515272

SUMMARY:

This sample is a foliated and very strongly hematite-limonite veined former felsic lava; the veining is likely to be hydrothermal

HAND SPECIMEN:

This is a weathered and strongly ferruginized, foliated dark brown rock with strong localized veining by hematite.

THIN SECTION DESCRIPTION:

More than any other sample examined in the present group of samples, the texture of this sample has been totally obliterated by intense veining and associated small-scale fracturing and brecciation. The only clue to its former identity is the textural similarity of the least-fractured parts of the rock to other less veined and brecciated samples in this collection, that are clearly former plagioclase-phyric dacitic or andesitic lavas. The intense vein meshwork is composed of dirty brown amorphous hematite-limonite areas and streaks that separate tiny boudins of unveined rock that consist essentially of very fine-grained quartz-sericite mixtures. This hematite-limonite stockwork is likely to be a hydrothermal feature based on observations made on similar samples in this collection, rather than a surficial weathering feature.

SAMPLE NUMBER: 515274

SUMMARY:

This is a former plagioclase-phyric felsic lava that has a strong foliation that is picked out by intense hematite-limonite veining that includes small euhedral barite crystals growing off the hematite. The barite occurrence indicates that the hematite is a hydrothermal feature not associated with recent surficial alteration.

HAND SPECIMEN:

This is a highly weathered fine-grained felsic metavolcanic or tuff that has a well-developed foliation and is cut by a fairly intense meshwork of hematite veins and patches up to at almost 1cm thick.

THIN SECTION DESCRIPTION:

The least altered areas of this sample have preserved an original feldspar-phyric volcanic texture, with strongly sericitized small former plagioclase phenocrysts, many of which are somewhat stretched and smeared out in the direction of the foliation. No traces of former mafic silicate phenocrysts are evident. although the degree of alteration of the sample, and the fairly intense hematite-limonite alteration pervading the rock would make it difficult to detect traces of totally altered former mafic phenocrysts. The groundmass of this sample in the least altered and veined areas is strongly sericitized, and peppered by tiny Fe oxide grains in the secondary quartz-sericite matrix.

The main feature of this sample is the strong development of an intense hematite-limonite meshwork subparallel to the foliation, and the Fe-staining of sericite that broadly defines the original foliation. An interesting feature of this vein system is the presence of small euhedral strongly zoned crystals growing off the hematite into cavities within the veinlets and patches of hematite. These crystals have high relief, low birefringence and two mutually perpendicular cleavages, and are probably barite, although the crystal shapes are rather unusual for orthorhombic crystals. If these crystals are barite, their occurrence in this rock (and this suite of rocks) is important, since they clearly have overgrown, and therefore post-date the hematite veining, which is thus clearly not a surficial oxidation feature resulting from percolation of Ferric iron-rich solutions along the foliation.

SAMPLE NUMBER: 515276

SUMMARY:

This is a strongly weathered former feldspar-phyric dacite or rhyodacite lava that suffered an intense sericite-calcite alteration during deformation that produced a weak fracture cleavage barely discernible in hand specimen. Calcite has been replaced by an Fe oxide or hydroxide phase during surficial alteration.

HAND SPECIMEN:

This is a pale brown, crumbly, fine-grained and uniform-textured siltstone or meta-felsic volcanic rock that is intensely weathered and altered.

THIN SECTION DESCRIPTION:

This rock is very strongly weathered, and the original texture is almost obliterated by a weak fracture cleavage that is accentuated by Fe-staining of sericite that defines the foliation planes. The former texture of the sample is weakly preserved in a few areas where fractures are more widely-spaced than usual in the rock. The rock was clearly a feldspar-phyric felsic lava, made up of probably 25 modal% or more of small (<1mm) mainly euhedral feldspar phenocrysts that are all totally replaced by sericite. The former very fine-grained or glassy matrix has altered to an unfoliated microcrystalline quartz-sericite intergrowth. This is transected by the Fe-stained meshwork fracture cleavage, and is riddled with tiny dirty brown Fe-oxide or hydroxides that, as for the previous sample (513459) show rhombic sections indicative of a calcite precursor. Former calcite grains make up close to 40 modal% of the matrix of this sample.

A narrow quartz vein (2-3mm wide) cuts the sample, and is composed of intimately intergrown grains that show some subgrain recrystallization.

SAMPLE NUMBER: 515277

SUMMARY:

This rock is a former quartz-rich sandstone that has been strongly deformed to produce an almost mylonitic fabric, suggesting it comes from the vicinity of a major fault.

HAND SPECIMEN:

This is a cream coloured highly fractured, recrystallized and silicified quartzite or quartz sandstone that contains occasional small (<0.5mm) altered pyrite cubes or holes from which these have been weathered.

THIN SECTION DESCRIPTION:

This sample is seen in thin section to be a highly deformed and recrystallized matrix-poor quartz sandstone or quartzite. The grainsize varies enormously across the slaide in no regular manner, from almost polygonal elongate grains up to almost 1mm long with fairly straight grain boundaries, that form poorly defined veinlets through the slide, down to almost microcrystalline aggregates of subgrain recrystallized quartz that form streaks and trains throughout the rock. In between the two extremes noted above, most grains are 0.1 - 0.4mm long and have remarkable convoluted and scalloped grain boundaries against adjacent crystals. Euhedral calcite crystals occasionally occur intergrown with the best-crystallized quartz in the poorly-defined veinlets.

The former matrix of the quartz-rich sandstone precursor to this quartzite constitutes less than 10 modal% of the sample and occurs as streaks of relatively well-crystallized sericite along grain boundaries between quartz grains. Small sometimes square holes in the slide are rimmed by rusty red sericite, and represent sites from which small pyrite euhedra have been weathered out.

The deformed quartz shows an almost mylonitic fabric, better seen in thin section than hand specimen, with a strong preferential grain growth fabric, although the highly variable texture suggests that the rock may have been subject to several periods of granulation and recrystallization. The strong fabric of this sample suggests that it comes from the vicinity of a major fault.

SAMPLE NUMBER: 515279

SUMMARY:

This sample is a foliated quartz-phyric vitric tuff with the foliation parallel to the layering defined by the flattened vitric fragments, that have been totally sericitized.

HAND SPECIMEN:

This is a an altered quartz+feldspar-phyric vitric tuff with abundant greenish fragments of devitrified glass defining an almost ignimbritic texture, although the rock appears to be fairly strongly foliated.

THIN SECTION DESCRIPTION:

Thin section examination of this sample shows that it was originally a quartz crystal-dominated vitric tuff. The sample is strongly foliated, and quartz phenocrysts (that were probably broken and angular originally) are deformed, rotated and internally subgrain recrystallized in many cases. Many were up to 3mm across. The quartz phenocrysts have been strung out in discontinuous layers separated by sericitized highly deformed and flattened vitric fragments. Rare totally sericitized and stretched former feldspar phenocrysts are difficult to discern from adjacent and enclosing vitric fragments. Several extremely drawn out and deformed zones composed of strongly birefringent sericite dotted with tiny opaque grains may represent former biotite crystals. The former vitric clasts are elongate, up to almost 1cm long, and wrap around quartz grains and trains of quartz grains.

An unusual feature of this sample, and many like it that I have seen from the Cethana and Gog Range areas, is that the foliation always seems to be parallel or subparallel to the original "ignimbritic" layering defined by the flattened fragments in these rocks. This is despite the fact that the foliation is undoubtedly tectonic, as shown by the strong granulation and recrystallization of the quartz crystal fragments in the tuffs. Why should the foliation always parallel the layering in the tuff, unless? One possibility is that the sericitized fragments I have identified as former pumice fragments may be strongly stretched and totally sericitized former feldspar crystals. I don't believe this, however, as generally, former feldspar crystals can be identified despite strong alteration and deformation.

SAMPLE NUMBER: 515347

SUMMARY:

This is a well-preserved plagioclase-phyric dacitic lava that also contains a small amount of FeTi oxide phenocrysts in a fine-grained but holocrystalline groundmass.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a blue-grey feldspar+mafic phyric andesite. It shows a strong weathering rind with a slightly greenish inner zone and a red outer weathering skin.

THIN SECTION DESCRIPTION:

This sample is a well-preserved and petrographically simple dacitic lava composed of abundant (perhaps 15-20 modal%) euhedral to subhedral phenocrysts of albitized plagioclase to 1mm across, and about 0.5-1 modal% of FeTi oxide phenocrysts set in a holocrystalline matrix dominated by tiny plagioclase microlites (albite), interstitial chlorite probably replacing original augite plates, and tiny altered FeTi oxide grains. The albitized plagioclase phenocrysts show slight flecking by sericite and pale green chlorite. The greenish inner weathering rind is due to slight yellowing of the green chlorite in the core of the sample, and the red outer rind is due to oxidation of the chlorite to an oxychlorite or goethite-type mineral.

SAMPLE NUMBER: 515348

SUMMARY:

This sample is a hornblende+plagioclase-phyric andesitic lava breccia, showing fairly abundant calcite alteration.

HAND SPECIMEN:

This is an andesitic lava breccia, with angular fragments of purplish-red highly altered porphyritic andesite to at least 10 cm across in a more dark grey green matrix of otherwise similar andesite.

THIN SECTION DESCRIPTION:

This sample is a texturally very well-preserved andesitic lava breccia. The largest breccia fragments were plagiolclase+hornblende -phyric andesitic lava fragments. Former calcic plagioclase phenocrysts are albitized euhedra from 0.1 to 2mm long, with twinning preserved and very minor flecking by sericite; they make up around 25 modal% of this sample. Former mafic phenocrysts have characteristic hornblende shapes and opacite rims. They are entirely altered to pale green chlorite and often contain up to 50% calcite. They made up around 20 modal% of these fragments. The groundmass in which the hornblende and plagioclase phenocrysts are set is an extremely fine-grained quartz-albite-chlorite intergrowth after devitrified glass. It is charged with tiny Fe or FeTi oxide grains that are responsible for the reddish-purple colour of these lava fragments.

The more greenish lava hosting the purple hornblende andesite fragments described above is slightly different texturally from the fragments it carries. The most notable differences are that hornblende phenocrysts are considerably less abundant in the host andesite than in the fragments (although not uncommon, and showing identical alteration to those in the fragments), and the host lava groundmass is not pervaded by the tiny Fe oxide grains responsible for the purple colour of the lava fragments. Calcite alteration of phenocrysts and patches of groundmass is common in the host lava. I suggest that the oxidized hornblende andesite lava fragments probably formed in a volcanic neck or cone that was pervaded by steam and percolating groundwater, and then were incorporated as fragments into a subsequent very slightly different lava flow erupting from the same cone.

SAMPLE NUMBER: 515349

SUMMARY:

This is former plagioclase+augite-phyric andesitic lava that contains localized epidosite development in well-defined patches in the groundmass.

HAND SPECIMEN:

This is a well-preserved light grey-green finely porphyritic andesitic lava.

THIN SECTION DESCRIPTION:

This sample is composed of abundant albitized plagioclase phenocrysts and less abundant former augite phenocrysts set in a fine-grained altered groundmass. Former plagioclase phenocrysts make up around 30-35 modal% of the sample, and are elongate to blocky euhedra, often with ghost zoning preserved. These crystals are generally abundantly flecked by sericite, and they contain common straight-line narrow seams of pale green chlorite, probably following cleavages. The former augite crystals make up around 5 modal% of the sample and are always altered to chlorite-granular epidote intergrowths that contain minor fluffy secondary quartz or chalcedonic silica grains. Former small (<0.5mm) FeTi oxide phenocrysts have been totally leucoxenized. A similar mineral assemblage fills dilation cracks and fractures in the groundmass of this sample. The groundmass was probably originally glassy, and jas been replaced by a murky epidote-rich mixture that includes chlorite, and patches and rounded grains of secondary quartz.

A strikingly unusual feature of this sample is the development of a very quartz-rich patch of groundmass at least 1 cm long and 1cm wide composed of a distinctive intergrowth of granular secondary quartz grains to about 0.2mm across embedded in a matrix of murky epidote, with minor chlorite and more granular, crystalline epidote. At first glance, this patch looks like an inclusion of a glassy dacitic lava that has devitrified. However, it contains occasional phenocrysts identical in appearance (but considerably reduced in amount relative to) to those in the rest of the rock, shows transitional contacts against the 'host' rock, and significantly, tapers out into quartz-dominated veinlets and apophyses that pass out into the host rock away from the 'inclusion'. I think that this strange feature represents a localized domain enriched in Si and Ca during burial metamorphic degradation of this sample, from which most former phenocrysts were displaced or resorbed. It is a small scal example of localized epidosite development.

SAMPLE NUMBER: 515350

SUMMARY:

This sample is a highly weathered former crystal-poor felsic lava or tuff that has been strongly sericite-clay altered, and that contains a hematite-quartz veinlet within a brittle fracture.

HAND SPECIMEN:

This is a strongly weathered fine-grained felsic lava or crystal-poor tuff, cut by a 5mm-wide hematite-quartz vein.

THIN SECTION DESCRIPTION:

This is an extremely difficult sample to diagnose, as strong weathering and intense sericite-clay alteration have almost obliterated its primary texture. Ghost outlines of former small (<0.5mm) feldspar phenocrysts are sparsely discernible due to slightly more or less intense sericite-clay development than in adjacent groundmass. Quartz or mafic phenocrysts were not present in this sample.

The groundmass of this sample consists of a very fine-grained sericite-clay-quartz intergrowth speckled with tiny equigranular opaque grains, but it is not possible to say from the extent of the alteration whether this was originally glassy or not. Diffusion bands of variably intense Fe-staining of the clay-sericite matrix are common in this sample. An unusual irregular vein composed of almost lamellar hematite fills a series of small-scale brittle fractures, and often has quartz in the cores of the hematite 'cells'. There are no sulphides in the vein, or in the matrix of the rock.

SAMPLE NUMBER: 515351

SUMMARY:

This is a weakly-foliated, strongly sericitized former plagioclase-phyric andesitic to dacitic lava that contains a small but significant amount of accessory pyrite.

HAND SPECIMEN:

This is a medium-grey coloured strongly altered and quite weathered feldspar-porphyritic felsic or andesitic lava with a weak foliation.

THIN SECTION DESCRIPTION:

This rock is seen in thin section to be a very highly altered formerly feldspar-phyric andesitic or dacitic lava. Former plagioclase phenocrysts make up about 25-30 modal% of the sample and are generally single, fairly prismatic euhedra up to 2mm long, although smaller crystals (0.5-1mm) are most abundant. These have been totally replaced by a very fine-grained sericite intergrowth throughout which are dispersed tiny crystalline, pleochroic olive-green chlorite flakes. Any sign of the former existence of mafic phenocrysts in this sample have been obliterated.

The groundmass of this sample is strongly recrystallized and quite heterogeneous in texture. It is composed of generally fine-grained intergrown sericite, olive chlorite and secondary quartz, but differs from the pseudomorphed feldspar crystals in that it contains much more abundant tiny Fe oxide dust clouds and masses, giving it a much darker overall colour under plane polarized light. Dispersed in irregular fashion through the groundmass are small patches of coarser-grained polygonal secondary quartz. In places, the masses of tiny Fe oxides in the groundmass are oxidized to limonite or goethite, and these areas are a dirty rusty red colour with little or no texture visible. Similarly, poorly-defined fracture networks that form an almost meshlike weak foliation through the rock are marked by concentrations of limonite-goethite material. Cubes of pyrite to about1mm across are relatively common in this sample, occurring dispersed unevenly through the matrix; these often have fuzzy edges, suggesting that they have been altered.

may be primary fluid streaming paths, or they may be metamorphic.
This sample should be analyzed for AJC's Mt Read data base if that's OK.

SAMPLE NUMBER: 515352

SUMMARY:

This sample is an andesite that has been totally replaced by an epidote-quartz intergrowth; it is an epidosite.

HAND SPECIMEN:

This is a pale brown-yellow intensely altered and epidote-rich fine-grained former porphyritic volcanic rock.

THIN SECTION DESCRIPTION:

Most parts of this sample are totally obliterated texturally by a fine-grained quartz-epidote intergrowth. However, in several places, vague outlines of former silicate phenocrysts are preserved although replaced by epidote. The shapes of these epidotized phenocrysts suggest both plagioclase and augite precursors. More easily recognizable are occasional former subhedral to euhedral FeTi oxide phenocrysts that exsolved ilmenite and then were leucoxenized. These make up about 1 modal% of the sample and are relatively large (mainly >0.2mm), typical of FeTi oxide phenocrysts in Mount Read Volcanics andesites.

Almost the entire sample is now composed of a fine- to medium-grained intergrowth of epidote and quartz. En echelon veinlets of quartz with large euhedral epidote crystals embedded in them transect the rock, but are not common; they contain a small amount of colourless chlorite. A single vein of well-crystallized epidote also cuts the sample.

On the basis of the former presence of augite and big FeTi oxides in this sample, I suggest that it was originally an andesite that has suffered intense epidotization in oxidizing, Ca-rich hydrothermal fluids.

SAMPLE NUMBER: 515353

SUMMARY:

This sample is an extremely fractured and altered felsic lithic tuff or lava breccia, that shows a hydrothermal assemblage dominated by chlorite-quartz-hematite and calcite.

HAND SPECIMEN:

This is a very strongly fractured and altered felsic lava breccia(?) or lithic tuff, that is transected by hematite veins up to 5mm thick.

THIN SECTION DESCRIPTION:

Thin section examination of this sample shows it to be exceptionally hydrothermally altered and reconstituted, so that only vague vestiges of the nature of the protolith are retained. Several small plagioclase-phyric lithic fragments are still identifiable in a thoroughly and variably recrystallized matrix that is extensively fractured and veined. The matrix is essentially a quartz-chlorite-hematite intergrowth of vary variable grainsize, that has been partially overprinted by granular calcite. The calcite is altered to messy brown limonitic material that makes up about 10 modal% of the sample.. The chlorite is fairly coarse-grained, and very bright green, typical of the hydrothermal chlorite and contrasting strongly with the regional metamorphic chlorite that is usually less abundant, finer grained and duller olive green. Hematite forms significant veins that cross cut quartz-chlorite veins, and in which the hematite is often rimmed by polygonal quartz; it shows excellent colloform and lamellar textures.

SAMPLE NUMBER: 515360

SUMMARY:

This sample is highly altered felsic (dacitic) lava breccia showing probable hydrothermal calcite-sericite alteration and minor galena-pyrite accessory mineralization.

HAND SPECIMEN:

This is a highly altered massive cream coloured felsic lava breccia, with angular grey lava fragments up to 1cm long set in a very fine-grained cream matrix spotted by sparse bright green fuchsite (?) and accessory galena.

THIN SECTION DESCRIPTION:

In thin section, this rock is seen to be very highly altered, with abundant calcite and sericite, as well as secondary quartz. Fragment boundaries are rarely discernible due to the extensive alteration, and where they can be seen, there is little petrographic difference between adjacent lava fragments. The rock is made of fragments of feldspar-phyric porphyritic dacite lava composed of generally 20-30 modal% feldspar phenocrysts to about 1mm long set in a devitrified and strongly altered formerly glassy groundmass. The feldspar phenocrysts are totally replaced by sericite-calcite intergrowths, and the same alteration assemblage pervades the groundmass, although very fine-grained mosaic intergrowths of secondary quartz in the groundmass serve to distinguish this from the phenocrysts. The rock is transected by a number of relatively widely-spaced subparallel shear zones up to 2mm wide in which schistose calcite-sericite alteration has totally obliterated the former texture. Several relatively large grains of pyrite are present in the section, and show well-developed pressure fringes of quartz. No sign of the one or two grains of bright green fuchsite noted in the hand specimen could be discerned in this section.

The extent of calcite-sericite alteration of this felsic lava breccia is far greater than is regionally developed, and implies local hydrothermal alteration.

SAMPLE NUMBER: 515361

SUMMARY:

This sample is very highly altered former lithic tuff with only a few identifiable diverse small felsic volcanic clasts set in a strongly carbonate- sericite altered groundmass.

HAND SPECIMEN:

This is a medium brown feldspar-phyric lithic tuff with diverse small fine-grained lithic fragments to about 8mm long in a fine-grained altered groundmass.

THIN SECTION DESCRIPTION:

This sample in thin section is seen to be highly carbonate-altered, to the extent that few vestiges of the primary texture are retained. Several small plagioclase-phyric lithic fragments are still discernible, and are texturally quite different, suggesting derivation from different lava flows and sources. In the remainder of the rock, only a few ghost outlines of totally sericitized feldspar phenocrysts are present in a very fine-grained quartz-albite-sericte groundmass that has been more than 60 modal% replaced by patchy and crystalline calcite. A weak foliation is defined by sericite concentrations. Weathered parts of the rock are characterized by fairly intense limonite replacement of the calcite euhedra and of the sericite along foliation planes.

SAMPLE NUMBER: 515363

SUMMARY:

This sample was probably a plagioclase+hornblende+ biotite-phyric crystal vitric tuff; it has been thoroughly sericitized, and contains minor calcite alteration.

HAND SPECIMEN:

This is a pale greenish slightly foliated feldspar-phyric felsic lava or crystal tuff with rare specking by bright green fuchsite (?).

THIN SECTION DESCRIPTION:

This is a very strongly recrystallized formerly feldspar+hornblende - phyric crystal vitric tuff. All feldspar phenocrysts have been replaced by sericite, and most are slightly stretched and streaked out with the foliation. Most were less than 1mm long, and they probably make up about 20 modal% of the sample. Former hornblende phenocrysts are much less abundant (around 5 modal%), and are also replaced by sericite, although it is coarser-grained and more highly birefringent than that replacing the feldspar. These may be bright green fuchsitic(?) spots visible though not common in the hand specimen. Several of the former mafic phenocrysts have shapes much more suggestive of a biotite precursor than hornblende, although the state of alteration renders this difficult to prove. Highly sericitized rather flattened grains quite abundant in this sample may be former pumiceous fragments, although they retain no sign of vesicularity.

The groundmass of this sample is a relatively coarse-grained holocrystalline secondary intergrowth dominated by polygonal quartz grains, albite and abundant sericite. It is probably repalcing a former glassy groundmass. About 2-3 modal % of the sample is made up of euhedral calcite grains that occur dispersed through the groundmass; many of these have been replaced in turn by quartz-goethite(limonite?). The sample is cut by diffuse, meandering veins of polygonal secondary quartz.

APPENDIX 4

Geochemical Analyses of Rock Chip Samples.

(In approximate order of sample number)

(Analyses performed by ANALABS)

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652158

ANALABS

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FAX: 004 31 8890
Telex AA92560

ANALYTICAL REPORT No. 23.3.08.05723

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

Aberfolye Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
4843	

DATE RECEIVED	RESULTS REQUIRED
14/09/88	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	11/10/88	1	2

REFER BELOW	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	428017/19/2	DC	Prep: 009,011,012,013,016						Cu,Pb,Zn,Ag/101		
	428017/19/2	DC							U/126,Th/401		

RESULTS TO

R. de Bomford
Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

CORE SAMPLES FOR ANALYSIS PRIOR TO Pb ISOTOPE

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

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ANALYTICAL REPORT No. 23.3.08.05161

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Aberfolye Resources Exp. Division
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Burnie
Tasmania 7320

ORDER No.	PROJECT
3017	

DATE RECEIVED	RESULTS REQUIRED
17/02/88	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	29/02/88	1	5

R W	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	271765/69	RC Prep: 009,011,012,013,016							Cu,Pb,Zn,Ag/101,As/114		
	271765/69	RC							Ba/401		
	271765/69	RC							Au/309		
	271765/69	RC							AuChk/309		
	271765/69	RC Prep: 009,011,012,013,016							Pb,Zn,Ag/104		

RESULTS TO

Aberfolye Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

R. de Bomford
Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

REMARKS

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
ole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
it core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
ting	CU	nitric acid	A3	other mixed acids	Mx	spectrophotometry	SPEC
k	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
ip	PU	HF mixture	A6	ignition	IG	titration	TTN
ater	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
ue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
eam sediment	SS					fluorescence	FLUOR
avy mineral	HM					inductively coupled plasma	ICP

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05161	29/02/88	3017	1 OF 2

JBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au	AuChk
1	271765	275	-	0.75	-	425	-	13	0.053	0.052
2	271766	930	-	2.17	-	650	-	42	0.057	-
3	271767	310	-	0.78	-	800	-	3	0.020	0.019
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	0.05	5	25	0.5	2	0.008	0.008
24	UNITS	PPM	PPM	%	PPM	PPM	PPM	PPM	PPM	PPM
25	METHOD	101	101	104	101	104	101	104	309	309

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05161	29/02/88	3017	2 OF 2

UBE No.	SAMPLE No.	Ba	As	Ti	Y	Zr				
1	271765	410	220							
2	271766	680	220							
3	271767	390	100							
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
18										
19										
20										
21										
22										
23	DETECTION	10	1	50	3	5				
24	UNITS	PPM	PPM	PPM	PPM	PPM				
25	METHOD	401	114	401	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

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652157

155

ANALABS

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ANALYTICAL REPORT No. 23.3.08.05131

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

Aberfolye Resources Exp. Division
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ORDER No.	PROJECT
2697	

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05/02/88	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	25/02/88	1	10

		PRE-TREATMENT							ANALYSIS		
P. W	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	271755/64	RD	Prep: 009,011,012,013,016						Cu,Pb,Zn,Ag,Ni/101,As/114		
	271755/64	RD							Ba,Cr,Zr,Ti/401		
	271755/64	RD							Au/309		
	271755/64	RD							Cr/101,BaO,TiO/406		
	271755/64	RD							Cr/143		

RESULTS TO

Aberfolye Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
olescore	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
rcore	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
ng	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
k	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
D	PU	HF mixture	A6	ignition	IG	titration	TTN
ter	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
ub	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
ore/sediment	SS					fluorescence	FLUOR
ry/mineral	HM					inductively coupled plasma	ICP

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BaO → Ba
÷ 1.117

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05131	25/02/88	2697	1 OF 2

JBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Ba	BaO	As	Cr
1										
2										
3										
4										
5										
6										
7										
8	271762	30	200	15	<0.5	<0.008	120	-	<1	-
9										
10	271764	30	175	10	<0.5	<0.008	1300	-	<1	-
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	10	0.1	1	5
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	%	PPM	PPM
25	METHOD	101	101	101	101	309	401	406	114	101

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05131	25/02/88	2697	2 OF 2

JBE No.	SAMPLE No.	Cr	Cr	Ni	Zr	Ti	TiO_2 TiO_2	Y		
1										
2										
3										
4										
5										
6										
7										
8	271762		8	25	<5	<50	-			
9										
10	271764	-	65	15	220	4100	-	30		
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	10	5	5	5	50	0.01	3		
24	UNITS	PPM	PPM	PPM	PPM	PPM	%	ppm		
25	METHOD	143	401	101	401	401	406	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

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6521-60

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05723	11/10/88	4843	1 OF 1

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Th	U			
1	428017	375	14.63	1.59	42	<10	<1			
2	428019	30	12.85	0.74	14	20	2			
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	0.05	0.05	2	10	1			
24	UNITS	PPM	%	%	PPM	PPM	PPM			
25	METHOD	101	104	104	104	201	126			

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

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159 652161

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ANALYTICAL REPORT No. 23.3.08.05712

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Tasmania 7320

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4832	

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No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	26/09/88	1	12

428020,428022/23,428025/33	SC	Prep: 009,011,012,013,016						Cu,Pb,Zn,Ag/101			
428020,428022/23,428025/33	SC							As/114,Ba,Cr,Zr,Ti,Y/401			
428026/28	SC							Au/309			

RESULTS TO

R. de Bomford
Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

REMARKS

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652162

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05712	26/09/88	4832	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Ba	As	Cr	Zr
1	428020	195	<5	210	<0.5	-	780	1900	85	110
2	428022	85	<5	240	<0.5	-	5050	170	60	85
3	428023	105	<5	155	<0.5	-	1100	62	80	110
4	428025	75	<5	140	<0.5	-	540	22	<5	160
5	428026	70	<5	100	<0.5	0.018	1800	40	8	150
6	428027	50	<5	175	<0.5	0.020	670	40	<5	160
	428028	45	<5	150	<0.5	<0.008	800	22	15	140
8	428029	60	<5	135	<0.5	-	900	26	<5	150
9	428030	160	<5	285	<0.5	-	460	22	45	170
10	428031	50	<5	160	<0.5	-	580	20	<5	160
11	428032	30	<5	260	<0.5	-	1300	15	75	100
12	428033	55	120	150	<0.5	-	600	21	55	100
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	10	1	5	5
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
25	METHOD	101	101	101	101	309	401	114	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

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652163

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
T1 Y	23.3.08.05712	26/09/88	4832	2 OF 2

1	428020	3900	25							
2	428022	3300	20							
3	428023	3950	25							
4	428025	4800	30							
5	428026	4800	40							
6	428027	5050	30							
7	428028	4400	30							
8	428029	4750	30							
9	428030	4350	35							
10	428031	4900	25							
11	428032	3850	20							
12	428033	3750	25							
13										
14										
15										
17										
18										
19										
20										
21										
22										
23	DETECTION	50	3							
24	UNITS	PPM	PPM							
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

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162

652164

ANALABS

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ANALYTICAL REPORT No. 23.3.08.05722

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

Aberfolye Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
4844	

DATE RECEIVED	RESULTS REQUIRED
14/09/88	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	25/10/88	1	10

STATE OF SAMPLES RE BELOW	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	Various	RC	Prep: 012,013,016						Cu,Pb,Zn,Ag/101,As/114		
	Various	RC							Ba,Cr,Zr,Ti,Y/401		

RESULTS TO

R. de Bomford
Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

BELLAH / GOWRIE PARK
Rock CHIPS.

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
w le core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
sp core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cu ng	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pu	PU	HF mixture	A6	ignition	IG	titration	TTN
w sr	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
ti e	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

AUTHORISED OFFICER

652165

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05722	25/10/88	4844	1 OF 2

JBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti	T/2
1	428034	155	145	215	<0.5	841	4	<10	93	6340	67
2	428035	60	80	135	<0.5	316	5	<10	78	4300	55
3	428036	95	20	140	0.5	13000	19	<10	83	3480	42
4	428038	20	45	1025	0.5	1480	<1	<10	189	4160	22
5	428039	15	55	170	<0.5	716	<1	<10	483	3600	7
6	428040	15	20	105	<0.5	954	<1	<10	206	4000	19
7	428045	15	15	125	<0.5	437	4	13	76	5790	76
8	428046	40	25	65	<0.5	515	<1	<10	201	6380	32
9	428047	30	45	95	<0.5	919	<1	16	174	7410	43
10	428048	85	25	105	<0.5	841	<1	<10	128	4030	31
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											
21											
22											
23	DETECTION	5	5	5	0.5	10	1	10	5	10	
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	
25	METHOD	101	101	101	101	401	114	401	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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.05722	25/10/88	4844	2 OF 2

No.	SAMPLE No.	Y
	428034	23
2	428035	26
	428036	14
4	428038	28
	428039	39
	428040	31
7	428045	21
	428046	34
9	428047	31
	428048	30
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23	DETECTION	3
24	UNITS	PPM
25	METHOD	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

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

Phone (09) 458 7999
52 Murray Road, Welshpool, W.A. 6106
FAX: 004 31 8890
Telex AA92560

ANALYTICAL REPORT No. 23.3.08.06132

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

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
6286	

DATE RECEIVED	RESULTS REQUIRED
17/04/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	12/05/89	1	5

		PRE-TREATMENT							ANALYSIS		
ES R W	SAMPLE NUMBERS	DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	513402,428091	RC	Prep: 016						Cu,Pb,Zn,Ag/101		
	513402,428091	RC							S/613,Zr,Ti,Y,Cr/401,MgO,Fe2O3/408		
	428099,513404,513407	RC	Prep: 016						Cu,Pb,Zn,Ag/101,As/114		
	428099,513404,513407	RC							Sn,W/401,Au/309		

RESULTS TO

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

STONEBRIDGE
Rock CHIPS.

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
ole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
t core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
ting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
k	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
p	PU	HF mixture	A6	ignition	IG	titration	TTN
ter	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
sue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
eam sediment	SS					fluorescence	FLUOR
vy mineral	HM					inductively coupled plasma	ICP

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A Division of Macconald Hamilton & Co. Pty. Ltd.

652168

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06132	12/05/89	6286	1 OF 1

BE o.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	As	Cr	Zr	Ti
	428091	15	5	70	<0.5	-	-	30	140	3800
	428099	760	10	95	<0.5	<0.008	4	-	-	-
	513402	15	15	65	<0.5	-	-	50	150	4800
	513404	5250	15	120	2.0	0.314	6	-	-	-
	513407	1500	2850	760	<0.5	0.512	1100	-	-	-
2										
3										
4										
5										
6										
8										
9										
0										
1										
2										
3	DETECTION	5	5	5	0.5	0.008	1	5	5	50
4	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
5	METHOD	101	101	101	101	309	114	401	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

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652169

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06132	12/05/89	6286	1 OF 1

JBE No.	SAMPLE No.	Y	Fe2O3	MgO	Sn	W	S			
1	428091	40	10.45	1.76	-	-	0.410			
2	428099	-	-	-	8	30	-			
3	513402	30	11.20	4.29	-	-	0.010			
4	513404	-	-	-	IS	IS	-			
5	513407	-	-	-	<3	<20	-			
6										
7										
9										
10										
11										
12										
13										
14										
15										
16										
18										
19										
20										
21										
22										
23	DETECTION	5	0.05	0.01	3	20	0.005			
24	UNITS	PPM	%	%	PPM	PPM	%			
25	METHOD	401	408	408	401	401	613			

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

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652170 Brevart

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Telex AA92560

ANALYTICAL REPORT No. 23.3.08.06172

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

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
7539	

DATE RECEIVED	RESULTS REQUIRED
03/05/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	25/05/89	1	2

	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	513408,513451	RC Prep: 009,012,013,016							Cu,Pb,Zn,Ag/101,As/114,MgO,CaO/104		
	513408,513451	RC							Ba,Cr,Zr,Ti,Y/401		

RESULTS TO

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

Stand Below

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
...ole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
...t core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
...ing	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
	PU	HF mixture	A6	ignition	IG	titration	TTN
...ter	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
...ue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
...am sediment	SS					fluorescence	FLUOR
...vy mineral	HM					inductively coupled plasma	ICP

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06172	26/05/89	7539	1 OF 2

BE o.	SAMPLE No.	Cu	Pb	Zn	Ag	Ba	As	Cr	Zr	Ti
	513408	40	<5	90	<0.5	550	2	95	110	7300
2										
3										
4										
5										
6										
8										
9										
0										
1										
2										
23	DETECTION	5	5	5	0.5	10	1	5	5	50
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
25	METHOD	101	101	101	101	401	114	401	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

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06172	26/05/89	7539	2 OF 2

BE o.	SAMPLE No.	Y	MgO	CaO						
	513408	25	3.44	3.12						
5										
6										
0										
1										
2										
3										
4										
5										
6										
8										
9										
0										
1										
2										
3	DETECTION	5	0.01	0.01						
4	UNITS	PPM	%	%						
5	METHOD	401	104	104						

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

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FAX: 004 31 8890

ANALYTICAL REPORT No. 23.3.08.06173

171

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

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
7540	

DATE RECEIVED	RESULTS REQUIRED
03/05/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	26/05/89	1	15

STATE OF SAMPLES:

REFER BELOW	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	Various	RC Prep: 009,012,013,016							Cu,Pb,Zn,Ag/101,As/114		
	Various	RC							Ba/401,Au/309		
	513454,513422,513430,513419	RC							Zr,Ti,Cr,Y/401		
	Various	RC							Ba/403		

RESULTS TO

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	*TI*	*fusion*	*A8*	*glass fusion (XRF)*	*GF*	*miscellaneous*	*MISC*
stream sediment	SS					fluorescence	FLUOR
heavy mineral	*HM*					*inductively coupled plasma*	*ICP*

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

652174

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06173	26/05/89	7540	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Ba	Ba	As	Cr
1	513410	10	30	145	<0.5	<0.008	45	-	2	-
2	513411	30	175	75	0.5	<0.008	960	-	24	-
3	513413	15	100	165	1.0	<0.008	-	1.65	4	-
4	513418	20	310	615	0.5	<0.008	130	-	17	-
5	513419	45	<5	30	<0.5	0.025	500	-	4	<5
6										
7										
8										
9	513428	60	405	90	<0.5	<0.008	100	-	1	-
10										
11										
12	513452	40	<5	110	<0.5	0.034	-	0.86	6	-
13										
14										
15	513463	10	10	70	0.5	0.034	85	-	10	-
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.006	10	0.01	1	5
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	%	PPM	PPM
25	METHOD	101	101	101	101	309	401	403	114	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

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

652175

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06173	26/05/89	7540	2 OF 2

TUBE No.	SAMPLE No.	Zr	Ti	Y						
1	513410	–	–	–						
2	513411	–	–	–						
3	513413	–	–	–						
4	513418	–	–	–						
5	513419	140	5550	15						
6										
7										
8										
9	513428	–	–	–						
10										
11										
12	513452	–	–	–						
13										
14										
15	513463	–	–	–						
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	50	5						
24	UNITS	PPM	PPM	PPM						
25	METHOD	401	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

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6521-76

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Phone (09) 458 7999 52 Murray Road, Welshpool, W.A. 6106 Telex AA92560
FAX: 004 31 8890

ANALYTICAL REPORT No. 23.3.08.06205

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

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
7588	

DATE RECEIVED	RESULTS REQUIRED
17/05/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
3	09/06/89	1	18

STATE OF SAMPLES (REFER BELOW)	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	Various	RC	Prep: 008,009,012,013,016						Cu,Pb,Zn,Ag/101,As/114		
	Various	RC							Ba/401		
	Various	RC							CaO/104		
	Various	RC							Cr,Zr,Ti,Y/401		
	Various	RC							Sn/401,Au/309		

RESULTS TO

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

STATE OF SAMPLES		ANALYSIS — PREPARATION				ANALYSIS — METHOD	
whole core	WC	perchloric acid	A1	cold acid	CA	atomic absorbtion	AAS
split core	SC	hydrochloric acid	A2	specific sulphide	SS	x-ray fluorescence	XRF
cutting	CU	nitric acid	A3	other mixed acids	Ma	spectrophotometry	SPEC
rock	Ro	aqua regia	A4	alkaline attack	AA	colorimetry	COL
soil	SO	nitric-perchloric	A5	volatilization	VO	chromatography	CHR
pulp	PU	HF mixture	A6	ignition	IG	titration	TTN
water	WA	HF under pressure	A7	pressed powder (XRF)	PP	other chemicals means	CHEM
tissue	TI	fusion	A8	glass fusion (XRF)	GF	miscellaneous	MISC
stream sediment	SS					fluorescence	FLUOR
heavy mineral	HM					inductively coupled plasma	ICP

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

652177

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06205	09/06/89	7588	1 OF 3

TUBE No.	SAMPLE No.	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au	Ba
1	513433	<5	10	-	110	-	<0.5	-	-	2250
2	513434	780	-	30500	-	300	-	94	<0.008	-
3	513435	290	-	25500	-	175	-	45	<0.008	-
4	513437	10	-	150	185	-	1.0	-	-	-
5	513438	115	115	-	255	-	0.5	-	<0.008	-
6	513439	5	35	-	550	-	0.5	-	-	1900
7	513455	5	25	-	155	-	<0.5	-	-	2050
8	513456	10	60	-	220	-	0.5	-	<0.008	-
9	513457	10	55	-	215	-	<0.5	-	-	-
10	513461	5	90	-	160	-	<0.5	-	<0.008	1300
11	513465	<5	40	-	85	-	<0.5	-	-	-
12	513466	20	-	2925	195	-	3.0	-	<0.008	-
13	513467	470	-	57000	-	275	-	96	<0.008	-
14	513468	190	245	-	220	-	2.5	-	<0.008	-
15	513469	575	5	-	-	100	-	12	<0.008	-
16	513470	455	20	-	125	-	<0.5	-	-	-
17	515272	20	40	-	300	-	<0.5	-	<0.008	-
18	515274	10	40	-	195	-	<0.5	-	-	-
19										
20										
21										
22										
23	DETECTION	5	5	25	5	25	0.5	2	0.008	10
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
25	METHOD	101	101	104	101	104	101	104	309	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

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

652178

ANALYTICAL DATA

SAMPLE PREFIX | REPORT NUMBER | REPORT DATE | CLIENT ORDER No. | PAGE

		23.3.08.06205		09/06/89	7588			2 OF 3	
TUBE No.	SAMPLE No.	Ba	Ba	As	Cr	Zr	Ti	Ti	Y	Sn
1	513433	-	-	<1	50	95	3200	-	25	-
2	513434	-	51.3	36	-	-	-	-	-	10
3	513435	-	47.6	18	-	-	-	-	-	<3
4	513437	0.48	-	1	25	110	3650	-	25	-
5	513438	0.41	-	4	-	-	-	-	-	<3
6	513439	-	-	<1	110	150	5450	-	30	-
7	513455	-	-	1	85	130	4800	-	30	-
8	513456	0.29	-	<1	-	-	-	-	-	3
9	513457	0.26	-	<1	85	160	4900	-	20	-
10	513461	-	-	1	-	-	-	-	-	4
11	513465	0.58	-	3	25	100	520	-	20	-
12	513466	-	14.9	2	-	-	-	-	-	<3
13	513467	-	44.5	18	-	-	-	-	-	15
14	513468	-	39.2	6	-	-	-	-	-	8
15	513469	-	55.6	22	-	-	-	-	-	15
16	513470	-	7.0	2	55	85	-	0.33	20	-
17	515272	1.28	-	<1	-	-	-	-	-	5
18	515274	0.45	-	1	85	100	3950	-	20	-
19										
20										
21										
22										
23	DETECTION	0.01	0.1	1	5	5	50	0.01	5	3
24	UNITS	%	%	PPM	PPM	PPM	PPM	%	PPM	PPM
25	METHOD	403	406	114	401	401	401	406	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

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652179

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A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06205	09/06/89	7588	3 OF 3

TUBE No.	SAMPLE No.	CaO								
1	513433	7.57								
2	513434	–								
3	513435	–								
4	513437	6.18								
5	513438	–								
6	513439	0.04								
7	513455	0.03								
8	513456	–								
9	513457	0.03								
10	513461	–								
11	513465	0.02								
12	513466	–								
13	513467	–								
14	513468	–								
15	513469	–								
16	513470	0.24								
[illegible]	515272	–								
18	515274	0.03								
19										
20										
21										
22										
23	DETECTION	0.01								
24	UNITS	%								
25	METHOD	104								

Results in ppm unless otherwise specified
[illegible] element present but concentration too low to measure
[illegible] element concentration is below detection limit
[illegible] element not determined

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652180

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FAX: 004 31 8890

ANALYTICAL REPORT No. 23 3 08 06279

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

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

ORDER No.	PROJECT
7853	

DATE RECEIVED	RESULTS REQUIRED
	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2		1	27

STATE OF SAMPLES (ENTER BELOW)	SAMPLE NUMBERS	PRE-TREATMENT: DRY	CRUSH	SPLIT	PULVERISE	SIEVE	OTHER SEE REMARKS	NONE	ANALYSIS: REFER TO ANALYSIS SECTION	PREPARATION	METHOD
	Various	RC Prep: 016							Cu,Pb,Zn,Co/101,Ca/104		
	Various	PU							Ag/101		
	Various	PU							As/114		
	Various	PU							Ti,Cr,Zr,Ba/401		
	Various	PU							Rb/401		

RESULTS TO

Aberfoyle Resources Exp. Division
P.O. Box 952
Burnie
Tasmania 7320

RESULTS TO

REMARKS

BERISSA/C.P.

STATE OF SAMPLES		ANALYSIS — PREPARATION		ANALYSIS — METHOD	
hole core	WC	perchloric acid	A1 cold acid	CA	atomic absorbtion AAS
lit core	SC	hydrochloric acid	A2 specific sulphide	SS	x-ray fluorescence XRF
tting	CU	nitric acid	A3 other mixed acids	Me	spectrophotometry SPEC
ock	Ro	aqua regia	A4 alkaline attack	AA	colorimetry COL
oil	SO	nitric-perchloric	A5 volatilization	VO	chromatography CHR
lp	PU	HF mixture	A6 ignition	IG	titration TTN
ter	WA	HF under pressure	A7 pressed powder (XRF)	PP	other chemicals means CHEM
sue	TI	fusion	A8 glass fusion (XRF)	GF	miscellaneous MISC
stream sediment	SS				fluorescence FLUOR
heavy mineral	HM				inductively coupled plasma ICP

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ANALABS

A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06279		7853	1 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Ba	As	Cr	Zr
1	515277	5	5	45	0.5	-	95	4	200	85
2	515278	10	100	715	<0.5	-	740	1	100	160
3	515279	5	10	75	<0.5	-	530	1	170	280
4										
5										
6										
7										
8										
9										
10										
11	515347	20	<5	70		-	1650	-	20	120
12	515348	5	5	470	-	-	860	-	120	110
13	515349	5	30	350	-	-	580	-	110	120
14	515350	10	80	170	-	-	470	-	160	160
15	515351	15	<5	145	-	-	450	-	30	120
16	515352	5	40	105	-	-	55	-	45	100
17	515353	560	5	215	0.5	0.075	330	5	110	65
18										
19										
20										
21										
22										
23										
24	515360	20	195	165	0.5	<0.008	450	16	80	95
25	515361	25	35	155	<0.5	0.009	570	1	120	90

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

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ANALABS

A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06279		7853	3 OF 4

TUBE No.	SAMPLE No.	Ti	Co	Ca	Rb	Ti/Zr				
1	515277	780	5	150	-	9				
2	515278	3700	20	150	-	23				
3	515279	4500	10	200	-	16				
4										
5										
6										
7										
8										
9										
10										
11	515347	4350	25	1825	-					
12	515348	3900	40	34000	-					
13	515349	5000	45	26900	80					
14	515350	5100	20	1550	-					
15	515351	3250	20	1375	-					
16	515352	4400	25	62800	-					
17	515353	2450	40	1775	20					
18										
19										
20										
21										
22										
23										
24	515360	3050	35	58500	-					
25	515361	3200	40	42300	-					

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

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ANALABS

A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06279		7853	1 OF 2

TUBE No.	SAMPLE No.	Sn	W							
1	515277	–	–							
2	515278	–	–							
3	515279	–	–							
4										
5										
6										
7										
8										
9										
10										
11	515347	–	–							
12	515348	–	–							
13	515349	–	–							
14	515350	–	–							
15	515351	–	–							
16	515352	–	–							
17	515353	4	<20							
18										
19										
20										
21										
22										
23										
24	515360	–	–							
25	515361	–	–							

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.

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ANALABS

A Division of Macdonald Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06279	07/07/89	7853	2 OF 2

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	Ba	As	Cr	Zr
1	515362	5	<5	30	-	-	1350	-	10	430
2	515363	25	<5	30	<0.5	-	890	4	30	190
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	0.008	10	1	5	5
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
25	METHOD	101	101	101	101	309	401	114	401	401

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

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06279	07/07/89	7853	4 OF 4

TUBE No.	SAMPLE No.	Ti	Co	Ca	Rb					
1	515362	2500	20	1375	–					
2	515363	3400	15	850	–					
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	50	5	25	5					
24	UNITS	PPM	PPM	PPM	PPM					
25	METHOD	401	101	104	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

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ANALABS

A Division of Macdonald Hamilton & Co. Pty Ltd

ANALYTICAL DATA

SAMPLE PREFIX	REPORT NUMBER	REPORT DATE	CLIENT ORDER No.	PAGE
	23.3.08.06279	07/07/89	7853	2 OF 2

TUBE No.	SAMPLE No.	Sn	W							
1	515362	-	-							
2	515363	-	-							
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	3	20							
24	UNITS	PPM	PPM							
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

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APPENDIX 5

List of Abbreviations used in Geological Mapping.

GEOLOGICAL MAPPING – LIST OF ABBREVIATIONS

Abundant	abn
Adularia	Adl
Agglomerate	agg
Albite	Ab
Alkali feldspar	Afd
Altered	alt
Amphibole	Amb
Amygdaloidal	amg
Andesite	A
Angular	ang
Aplite	Ap
Approximate	apx
Arcuate	ar
Arenaceous	arn
Argillaceous	arg
Argillite	Arg
Arkose	Ak
Arkosic	ak
Arsenopyrite	Ap
Ash volcaniclastic	av
Autobrecciated	aub
Average	ave
Banded	bnd
Barite	Ba
Basalt	B
Bedded	bd
Black	bk
Black shale	Bsh
Blue	bl
Boulder	bld
Breccia	b
Breccia volcaniclastic	bv
Bright	brt
Brown	br
Calcareous	cc
Calcite	Cc
Carbonaceous	g
Carbonate	Co
Cavernous	cav
Chalcopyrite	Cp
Chert	Ch
Chlorite	Cl
Chromite	Cr
Chromitiferous	cr
Clay	cy
Coarse	c
Coarse grained	cg
Colour	col
Common	com
Conglomerate	Cg
Conglomeratic	cg
Crystal	x
Crystal volcaniclastic	xv
Dacite	D
Dark	dk
Dense	dns
Devitrification	dv
Diorite	Di
Disseminated	dis
Dolerite	Dol
Dolomite	Dm
Dyke	dy
Elongated	el
Emphasised	emp
Epiclastic (adj.)	e
Epiclastic (noun)	E
Epidote	Ep
Euhedral	euh
Eutaxitic	eux
Fabric	fab
Fault	F
Fault zone	FZ
Feldspar	Fd
Feldspar phyric	fp
Felspathic	fel
Ferruginous	fer
Fibrous	fb
Fine	f
Fine grained	fg
Fissile	fis
Flowbanded	fbn
Fragments	fr
Fuchsite	Fu
Galena	Gn
Glass	Gl
Glassy	gl
Granular	glr
Graphite	Gt
Graphitic	gt
Green	gn
Grey	gy
Greywacke	Gw
Haematite	Hmt
Hornblende	Hb
Ignimbrite	Ig
Illite	Ill
Interbedded	ibd
Intercalated	icl
Intrusive	int
Jurassic	Ju
K-Feldspar	Kfd
Khaki	kh
Laminated	lm
Lapilli volcaniclastic	lv
Lava	l
Lava breccia	lb
Leached	lch
Limonitic	Lim
Light	lgt
Limestone	Lst
Lithic	lh
Magnetite	Mt
Massive	mas
Matrix	mtx
Matrix dominated	md
Medium	med
Medium grained	mg
Metamorphosed	meta
Mica	Mic
Micaceous	mic
Minor	mnr
Mixed	mxd
Mottled	mtl
Mudstone	Mst
Nodule	nd
Off white	ow
Olivine	Ol
Orange	or
Ordovician	O
Oxidised	ox
Patchy	pat
Peperitic	pep
Perlitic	prl
Pervasive	per
Phenocrysts	phn
Phyllite	phyl
Phyric	p
Picrite	Pic
Pillow lava	pl
Pink	pk
Polymict	Y
Porphyritic	por
Pumice	Pu
Pumiceous	pu
Purple	pp
Pyrite	Py
Pyritic	py
Pyroxene	Px
Quartz	Q
Quartzite	Qtz
Quellite	Qll
Questionable	?
Recrystallised	rx
Red	rd
Rehealed	rhd
Reworked	rw
Rhyodacite	RD
Rhyolite	R
Ripple marks	rmk
Round	rnd
Rubble	rbb
Sandstone	Ss
Schist	Sch
Schistose	sch
Sediment	sed
Selected fragments	sfr
Sericite	Se
Serpentine	Srp
Shale	Sh
Sheared	shd
Siderite	Sid
Silica	Si
Siliceous	sil
Siltstone	Slt
Slickenside	slk
Sphalerite	Sp
Spotted	spt
Spotty	spt
Stockwork	stw
Strong	str
Structure controlled	stc
Talc	Tc
Tertiary	T
Trace	tr
Trachyte	Tr
Tuff	Tf
Tuffaceous	tf
Variolitic	vr
Vein	vn
Vein concordant to bedd	cV
Vein discordant to bedd	dV
Very	v
Vesicular	ves
Vitric	vtr
Volcanic	vlc
Volcaniclastic	vlcl
Weak	wk
Weathered	wth
White	wh
Yellow	yw

APPENDIX 6

Drill Log and Survey Information for Diamond Drillhole BB6 (Beulah Barite Prospect).

652190

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MACKINTOSH / HATFIELD DATA BASE ENTRY FORM 1 of 2

DRILL HOLE NAME BB 6

LOCATION BELLATI BARITE

TOTAL DEPTH 400 m

NUMBER SURVEYS (Incl. collar P.U.) 15

NUMBER ASSAY INTERVALS

COLLAR NORTHING 5408647

COLLAR EASTING 450780

COLLAR R.L. 200

COLLAR DEPTH 0

SECTION (To nearest 50m)

STATUS OF DATA NEW

DATE STARTED 890516

DATE FINISHED 890615

LOGGED BY SWR.

FROM	TO	HOLE SIZE	CASING TYPE	CASING I.D.
0	156	HQ WL		
156	400	NQ WL		
0	400		PVC	36 mm

6 m 4" SEAL TOP OF HOLE.

COMMENTS (Casing lost etc.)

652191

189 MACKINTOSH / HATFIELD DATA BASE ENTRY FORM 2 of 2

DRILL HOLE NAME

DEPTH	DIP (- forD.H.)	AZIMUTH (Grid)
0	-70	231
25	-70	234
50	-69.6	244
75	-68.9	258
100	-68.8	266
125	-68.8	273
150	-68.5	275
175	-68.6	277
200	-68.8	278
225	-68.8	280
250	-68.9	280
275	-69	281
300	-69	282
325	-69	284
350	-69	286
375	-68.5	288
E.O.H 400.0 M	-68	289
425		
450		
475		
500		
525		
550		
575		
600		

N.B. Results for E.O.H. must be included

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PROJECT : Gownie Park

PROSPECT: Beulah Barite

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

652192

HOLE NO: BB6
PAGE: 1 of 10
LOGGED: SWR
DATE: 30-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
0			Weathered orange lapilli Volcaniclastic with angular lava fragments	medium to coarse grained rock composed of a mixture of red haematite altered grains and white sericite altered grains. Common small black flecks? grains? with brown cores. Occassional large sub-rounded to angular, purple - maroon coloured lava fragments (to 10cm)(generally around 2-3 cm).	Very strong weathering producing orange staining and leaching down to ≈ 10m. weak Sericite alt weak fuchsite spotty Strong haematite alteration of vesicular lava fragments no calcite.	Very minor orange stained quartz veins aligned in cleavage. Common brown limonite veins in weathered section		well developed cleavage at 10° to core axis			0-19m similar to BB4 34-35 and = 5fm 0-110m is very similar to BB4 142m-EOH.	
19.5m				Sharp contact								
20			fine-grained felsic lava Dacitic or andesitic.	Pale brown fine grained lava with occassional sub-rounded very fine grained lava fragments (to 4cm). Common weakly aligned round quartz filled vesicles?	moderately sericitic minor chlorite associated with some quartz veins and in 'wisps' in cleavage. not Haematitic. Calcite altd. rare fuchsite.	minor orange stained quartz veins	none visible	cleavage at ≈10° to core axis. defined by 'wisps' of chlorite.				
32.3m												
34			lapilli Volcaniclastic 35.4m	as for 0-19m but with increased number of stretched lava fragments.	fragments are haematite altered	minor quartz	none	moderate cleavage subparallel to core				
36			Dacitic or andesitic lava	Pale green-brown lava with occassional quartz filled vesicles and minor rounded fine grained lava fragments	weak chlorite moderate sericite no calcite	Very rare barite associated with Common orange quartz veins in cleavage	none	cleavage = 15° c.A.				
42												

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PROJECT : GOURIE PARK

PROSPECT: BEULAH BARITE

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

652193

HOLE NO: BB6
PAGE: 2 of 10
LOGGED: SVR
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
44			45.0m									
46			Dark medium grained andesite? lava with sub rounded fine grained lava fragments	Dark coloured fine-medium grained lava with common rounded fragments containing possible quartz vesicles. Fragments often have alteration rims.	weak haematite alteration gives purple-maroon coloured matrix. minor streaky chlorite alteration moderate sericite alteration no calcite.	common orange stained Quartz veins to 1cm generally aligned in cleavage with some fine grained chlorite edges	none	cleavage ≈10° to CA.			Probably lava with common fragments as opposed to volcaniclastic. Occassional vesicles suggest lavas.	
48												
50												
52												
54												
56												
58			58.0m lava 59.2m	Pale yellow fine grained lava with minor quartz vesicles	sericite (2) fuchsite spotting minor Cl assoc ± Q.	none						
60			lava with fragments	as for 45-58m (large frag. at 60.5m)	minor Haematite " Sericite	none						
62	61m		lava	light yellow brown dacite? lava.	moderate-Str. Sericite wk. Cl. assoc. ± Quartz rare fuchsite							
64			65.0m									
66			medium grained lava with abundant fragments	dark medium grained rock with red-purple matrix. Common sub rounded to angular fragments (lava) fragments to 5cm. Fragments have altered rims. Possible quartz filled vesicles weakly aligned.	mod sericite Haematite altered matrix and fragments weak chlorite with quartz veins weakly fuchsite spotted. no calcite.	common irregular orange stained Quartz veins occassionally with minor chlorite edges rare barite in Q/Cl veins.	trace barite in Quartz/chlorite veins	cleavage ≈10° to CA.				
68												
70												
72												
74												
76			76.0									
78			fine grained Dacite? lava.	fine grained yellow brown massive lava.	weak sericite-pyrite occassional fuchsite rare chlorite? in fractures? no calcite	minor Q ∨ rare Barite ± Q/Cl.	traces of disseminated Pyrite ≈ 1%	78.5 sheared 79.0 fault zone.			76m to 108m all similar yellow brown lava but with intense "crackle" at 82.0-88.5m and weak at 95-97m	
80												
82			82.0			81.0m Q vn ± trace Sphalerite-Galena Pyrite						
84			'Crackle'	lava as above with intense chlorite brecciation	weak sericite with traces of pyrite							

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PROJECT : Gowrie Park

PROSPECT: Beulah Baite

Aberfoyle Resources Limited
EXPLORATION DIVISION
DIAMOND DRILL LOG

652194

HOLE NO: BB6
PAGE: 3 of 10
LOGGED: S.WR
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
86			'crackle'	as above								
88			88.5	88.5								
90			Dacite? lava	massive very fine grained yellow brown aphyric lava	wk rare fuchsite rare sericite weakly siliceous? no calcite							
92						93.0-95.0m 1cm wide quartz vein down centre of core	weak rare disseminated pyrite	Vns parallel to core				
94			94.0 weak 'crackle'	weakly crackled lava as above								
96												
98			97.0		strong sericite weak fuchsite weak calcite	minor orange quartz veins	none	clasts stretched and flattened ≈30° to C.A.				
100			Dacite? lava	as for above but with common fragments								
102												
104											104.5 small patch of Pyrite crystals	
106												
108			108 lapilli volcaniclastic 109.5m	red-purple volcaniclastic with red+green altered lava fragments	strong haematite weak calcite	minor orange quartz veins						
110												
112			Dacite? lava with common fragments	as for 97-108.0 m	strong sericite weak fuchsite very weak calcite			111-112 m strongly sheared cleavage 10° C.A.				
114								114 as above				
116						black chlorite? vein	none					
118												
120												
122	1.22		CAVITY	SAND FILLED CAVITY								
	122.5											
124				Pale red-brown to pale yellow-green lava? with common small fragments of purple	moderate sericite weak chlorite 'wisps'	minor quartz	none	Flow boundaries? or alteration boundaries? or bedding?				
126												

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

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652195

PROJECT : Gowrie Park

PROSPECT: Beulah Barite

HOLE NO: BB6
PAGE: 4 of 10
LOGGED: S.W.R
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
128	128.5			lava (rounded) in fine grained lava matrix.	no calcite			at 32° to CA.			quite common fragments	
130	131		Dacite?	yellow fine grained lava rare frags	mod-str Calcite rare Fuchsite wk Hmt	Qz + Cl vns	none	Slightly sheared ~30° CA.			131–132.6 ksim. to 10–19.0m	
132	132.6		lava	Fine to medium grained lava & minor frags weakly vesicular	wk Hmt. & wk Se wk Fe.							
	133.5		lava	green lava as above	wk chlorite?							
134	135		lava	purple lava as above	wk Hmt.							
136			Massive lava	very fine grained felsic? lava. Pale yellow brown, common homogenous fragments to 5cm.	wk Se, wk Silica moderate fine grained Pyrite in small veinlets	Small quartz veins with meandering Pyrite veinlets	Pyrite << 1%	chlorite in Cleavage? ≈15-20° CA				
138												
140	139		Fragment rich Polymict Volcani-Clastic	Volcaniclastic, packed with polymict fragments from 5mm to 5cm. fragments both angular (and sheared) and also sub-rounded. matrix is weakly pyritic fine grained black ash?	v weak Se weak pyrite weak chlorite?	rare quartz veins	Pyrite ≈ 1% disseminated in matrix	moderately to strongly sheared ~25° to CA.			Similar in some ways to HVS.	
142												
144												
146												
148			Dacite lava and lava breccias	Pale yellow brown lava and lava breccia Dacitic? variable fragment content from packed with small rounded fragments to massive lava. 148–157 massive lava 157–161.5 lava breccia? 161.5–168 lava 168–171.5 lava breccia 171.5–181 lava	weak Sericite weak Silica Very weak Pyrite weak Fuchsite no calcite	164 weak 'crackle' with Pyrite 166.5	weak Pyrite veinlets				156m reduced to NQ.	
150												
152												
154												
156												
158												
160												
162												
164												
166												
168												

Aberfoyle Resources Limited
EXPLORATION DIVISION

PROJECT : Gourie Park

PROSPECT: Beulah Barite

194 **DIAMOND DRILL LOG**

652196

HOLE NO: BB6
PAGE: 5 of 10
LOGGED: S.M.R
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
170			lava breccia	as above								
	171-5											
172			massive lava	Pale yellow brown massive lava	mod-strong Si occassional pyrite reinlets to give weak crackle 176-179m	occassional large Quartz-Chlorite veins	small veinlets of pyrite	massive			-Similar to felsic units at M+ -Charter?	
174												
176												
178												
180												
	181											
182			Fault zone?	Sheared and fractured lava.								
	182-6											
184			Felsic lava	massive lava with common to abundant fine grained rounded lava fragments	weak silica Weak sericite weak fuchsite Very weak pyrite	none	trace pyrite	massive				
186												
188												
190												
192			transition zone? from felsic to intermediate lavas?	Pale yellow brown to 203m slightly red 203-204m Dark green 204-208m slightly red 208-211 Pale green below 211m rock is variably haematite altered lava with occasional small fragments of lava.	no sericite? weak silica minor variable haematite 203-204 208-211 rare fuchsite	minor quartz	none	massive				
194												
196												
198												
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Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

652197

PROJECT : Gowrie Park
PROSPECT: Beulah Barite

HOLE NO: B86
PAGE: 6 of 10
LOGGED: S.W.R
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
212			Andesitic to Basaltic lava.	massive fine grained green andesitic to basaltic? lava with variable weak haematite alteration and very rare fragments	minor haematite alteration occurs in patches throughout the matrix (ie not perrasive) no Sericite rare chlorite rare fuchsite moderately to strongly Calcite altered from 215m→256 Weak calcite alteration from to 287m	some large quartz/chlorite veins (late stage) some small irregular Hmt/Cc veins	minor haematite disseminated in matrix and in veins (lets) ± calcite.	massive to 229m 229-246m core quite broken 246-249 possible fault core very broken.				
214												
216												
218												
220												
222												
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228												
230												
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238												
240												
242												
244												
246												
248												
250												
252												

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Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

652198

PROJECT : Govie Park
PROSPECT: Beulah Barite

HOLE NO: BB6
PAGE: 7 of 10
LOGGED: SWR
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
254			Basalt lava	as above	weak Hmt weak Calcite	Hmt/Cc.	Hmt.					
256			257.6									
258			Dacite? lava	massive fine grained Dacite lava.	moderately siliceous rare fuchsite no Sericite no calcite no pyrite	Very rare Q. veins	none	massive				
260			261.0m									
262			Andesite to Basalt lava	massive green andesitic or basaltic lava. Slightly felsic? 261 to 276m.	moderately to strongly calcite altered weakly siliceous	minor haematite calcite veins. moderately common large white quartz	minor haematite in calcite veins	weak foliation? at 45°CA. weakly cleaved with small chlorite wisps				
264												
266												
268												
270												
272												
274												
276												
278												
280												
282						Hmt/Cc veining becomes quite common (2-5mm)							
284												
286												
288					Weak calcite no sericite							
290												
292				minor large Basalt lava fragments start to appear.								
294												

PROJECT : Gowrie Park

PROSPECT: Beulah Barite

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Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

652199

HOLE NO: BB6
PAGE: 8 of 10
LOGGED: SWR
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
296			Basalt lava	lava with common lava fragments. Fragment abundance increases down to 323.5m. Fragments range in size from ~1cm to 10 cm. large fragments have reaction rims or 'alteration zones'.	all fragment-rich rock is weakly to moderately haematite altered, with variable Calcite alteration. The more fragmental units are possibly weakly silica altered. Weak pyrite alteration.		traces of very fine grained disseminated pyrite.				Probable flow margin with common lava fragments.	
323.5			Basalt lava breccia?	Packed fragmental lava breccia, light creamy green.	Very weak calcite weak chlorite no sericite or pyrite	none		chlorite 'wisps' x 20° c.a.				
326.3			massive andesite lava	massive lava. Slightly lighter in colour than above lava.	weak calcite to 334m. Common pyrite in matrix. Weak hmt. 337.5-343. Mod to strong Calcite down to 350.5m.	Calcite/quartz veins with pyrite are quite common	fine grained disseminated pyrite.	massive				

PROJECT : Gowrie Park

PROSPECT: Beulah Barite

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Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

652200

HOLE NO: BB6
PAGE: 9 of 10
LOGGED: SNR
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
338–349			andesite lava		weak Hmt 338-343 moderate-strong Calcite	rare Hmt rich Calcite veins	very fine grained disseminated pyrite visible with fine grained Haematite?	massive				
349–350				creamy coloured lava as above	common pyrite moderate silica	traces of py veinlets.						
350.6–356.5			Basalt to andesite lava breccia.	light pale green massive lava breccia with common lava fragments	variable Hmt + Cal. alt^n Weak calcite minor disseminated pyrite	minor large Q/Cl vns very rare Calcite veining						
356.5–367			Andesite lava	as above but with no fragments.	Common pyrite weak silica Very weak calcite rare chlorite	minor pyrite associated with Quartz and Calcite	Common pyrite	massive.				
367–376			Basalt lava	massive fine grained green basalt lava.	moderate Calcite Variable Hmt Weak pyrite			massive				
376–378			lava breccia									

Aberfoyle Resources Limited
EXPLORATION DIVISION

DIAMOND DRILL LOG

PROJECT : Gourie Park

PROSPECT: Beulah Barite

199

652201

HOLE NO: BB 6
PAGE: 10 of 10
LOGGED: SWR
DATE: 31-5-89

DEPTH	DRILL RUNS	CORE LOSS	LITHOLOGY: ROCK NAME	LITHOLOGY: DESCRIPTION	ALTERATION	VEINING	MINERALISATION	STRUCTURE	WEATHERING	VISUAL LOG	REMARKS	DEPTH
380			Basalt lava breccia	Sheared chloritic lava with common variably chloritised angular lava fragments with many small rounded fragments	chlorite weak calcite weak pyrite	Q/cl. calcite ± trace pyrite	common fine grained disseminated pyrite.	sheared ≈10° to CA.				
382			382m Dacitic? to Andesitic? lava	light brown lava with homogeneous lava fragments in a lava matrix. Haematite altered lava with fragments.	weak Hmt Very weak calcite weak to moderate pyrite weak silica very trace fuchsite	Very rare orange qz/cl veins	disseminated pyrite.	massive				
400			E.O.H 400.0 m									

652202

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APPENDIX 7

Report on UTEM Survey for the Stonebridge Area

(J. Silic)

652203

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Survey Specifications

Discussion of Results

Conclusion

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Appendix II

Interpretation of TDEM Data Using First and Second Spatial Derivatives and Time Decay Analysis

652204

Introduction

Electromagnetic techniques have played important roles in the discoveries of the Que River and Hellyer deposits (Webster and Sky, 1979; Silic et al, 1985; Eadie et al, 1985). Since the Hellyer discovery Aberfoyle Resources has further refined the use of these techniques in the search for Hellyer and Que River type targets (Silic, 1989 and Appendix II).

The purpose of this report is to discuss the results of a UTEM (West et al, 1984) survey over the Stonebridge grid on the Gowrie Park EL's 43/85 and 11/88.

Previous Surveys

CRA Exploration has executed a number of UTEM surveys over these licences, in particular over the Beulah barite grid (see CRA reports up to 1987). However, Aberfoyle's review of this data has shown that a number of conductive features have been incorrectly identified as being caused by sulphide accumulations, as confirmed by CRA's drilling which failed to intersect any significant conductive sources. Using techniques from Silic, 1989, however it was concluded that CRA's UTEM "anomalies" were caused by resistivity variations across lithological suites. Proper interpretation and use of the UTEM system could still have led to successful identification of geologically desirable targets. As such Aberfoyle's programme was designed on these premises.

Survey Specifications

A three loop 18 km survey was executed over the Stonebridge grid (Plate 1).

The prospective geology on this grid is invariably covered by farm land, as such optimum loop layouts designed to couple with the most prospective horizons was not possible.

Therefore to a large extent any significant accumulations of sulphides would most likely show up as current gathering responses (eg Hellyer, Silic et al, 1985; Silic, 1989).

Vertical component data (Hz) was collected on 50 metre station spacings.

Discussion of Results

No features indicative of sulphide accumulations were detected by this survey. Some formational near surface conductors and fence effects as identified by the second derivative technique from Silic 1989, exist on some parts of the property.

Conclusions

No conductors which could be attributed to significant sulphide accumulations were detected by this survey. The effectiveness of this survey will be reviewed on the completion of the present research on current gathering effects in steeply plunging targets.

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APPENDIX I

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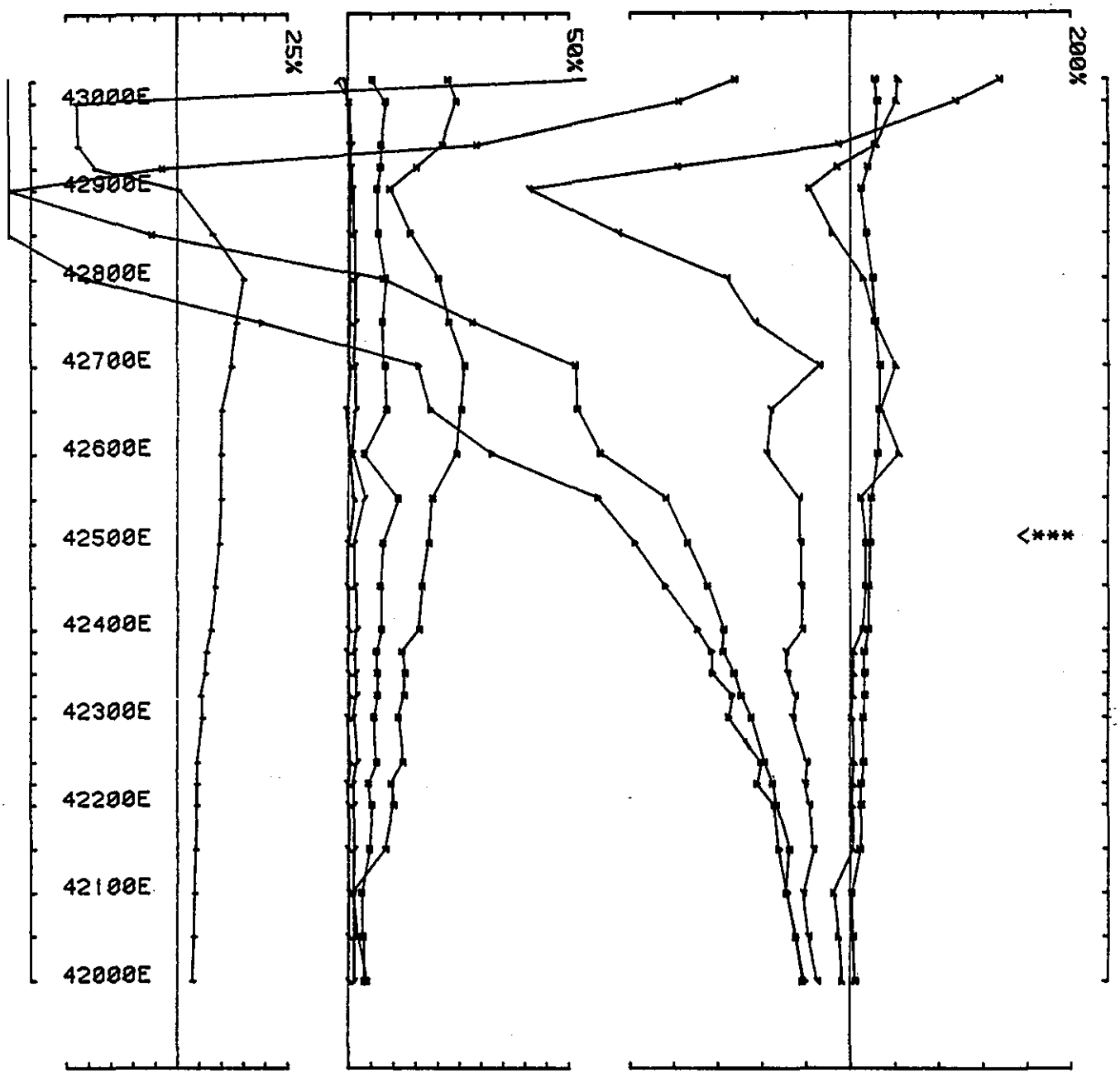

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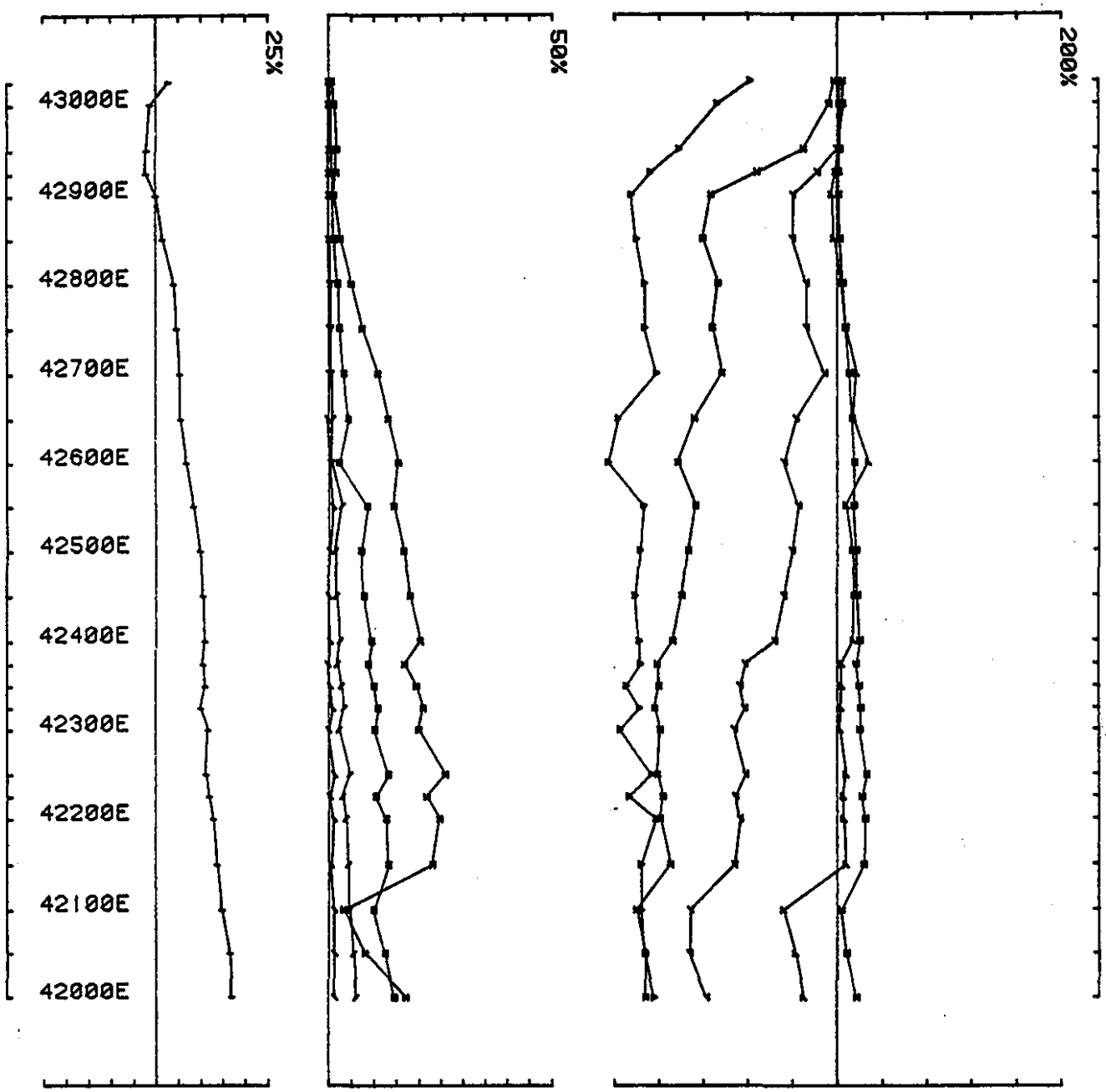

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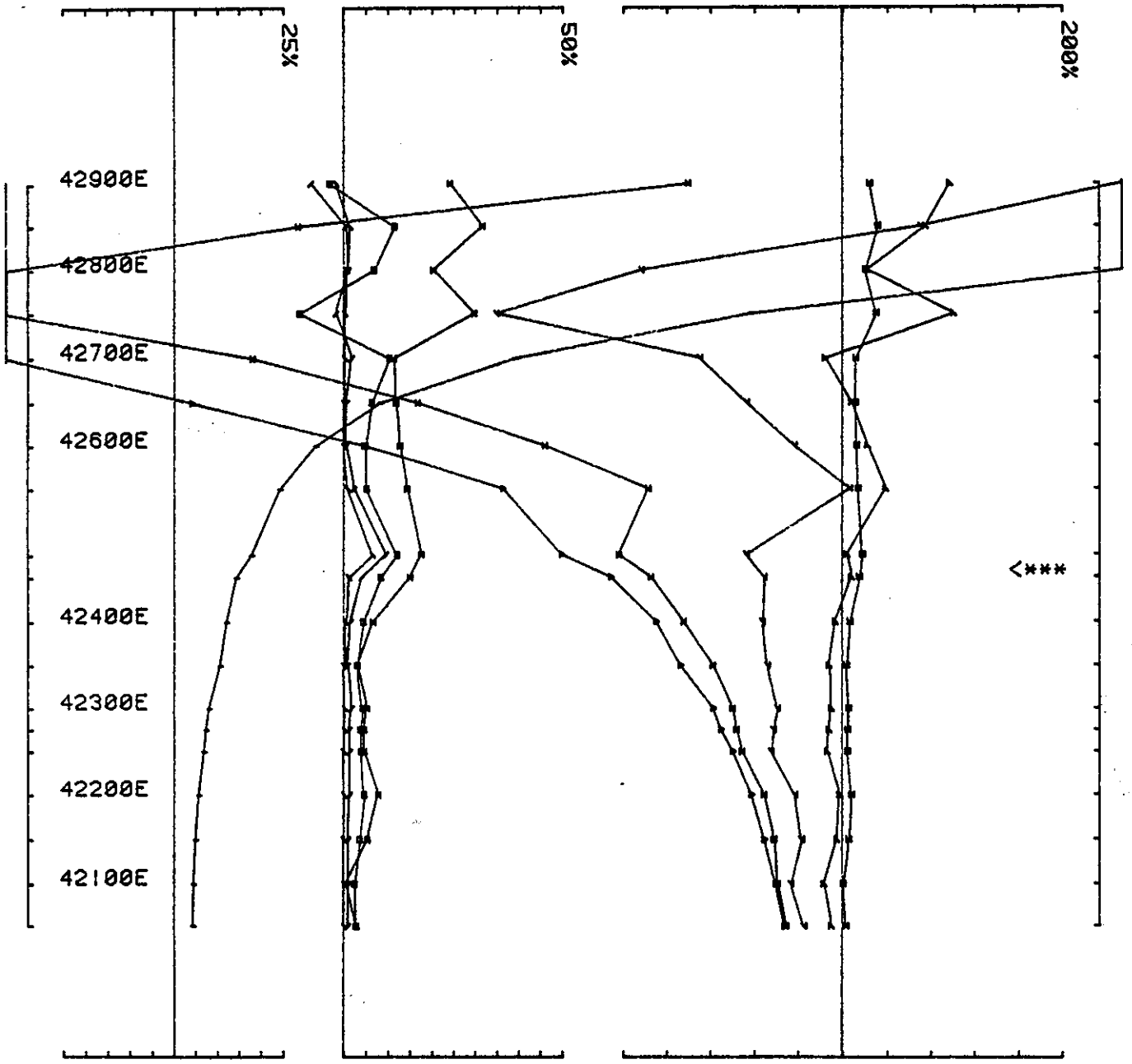

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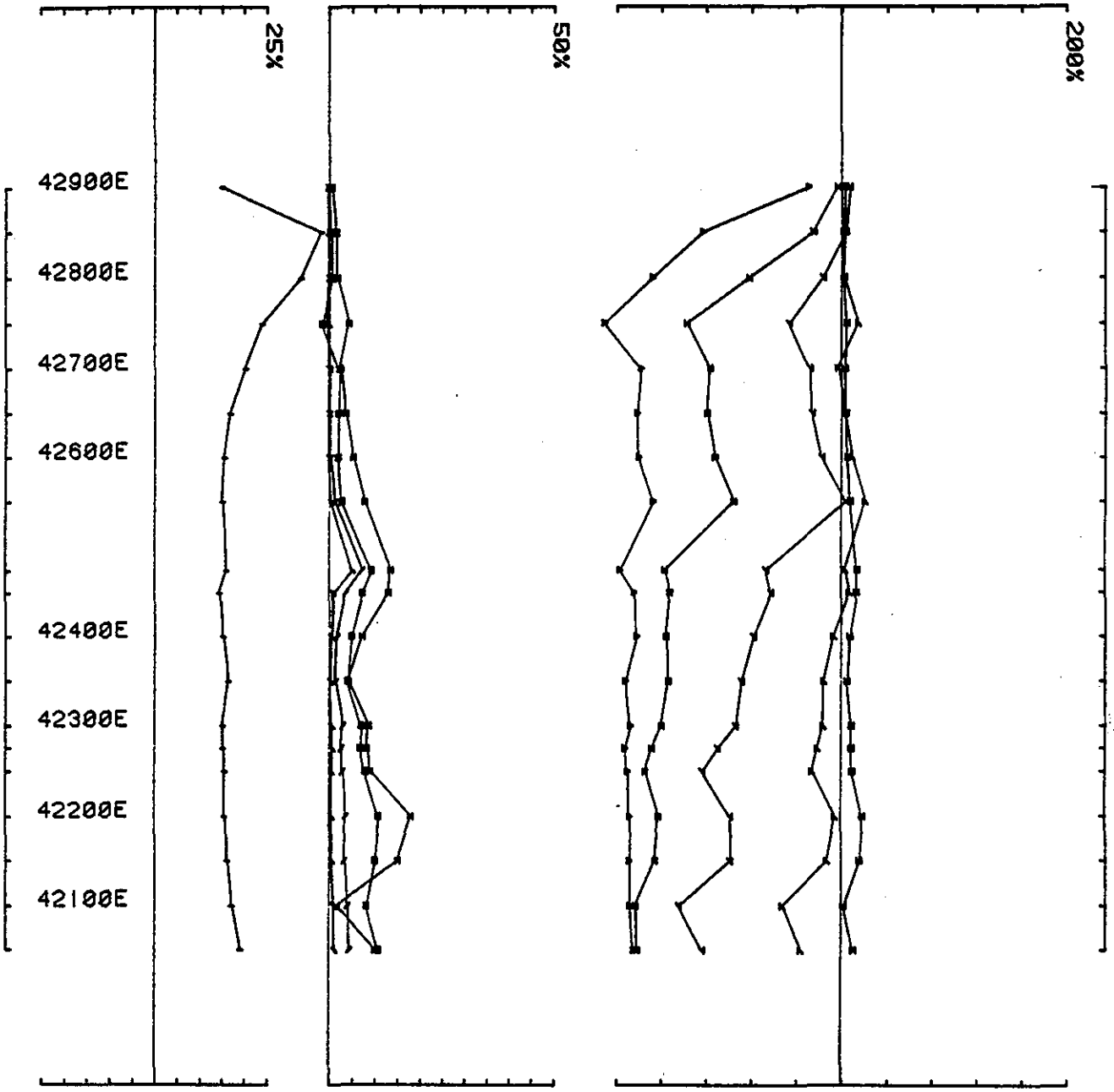

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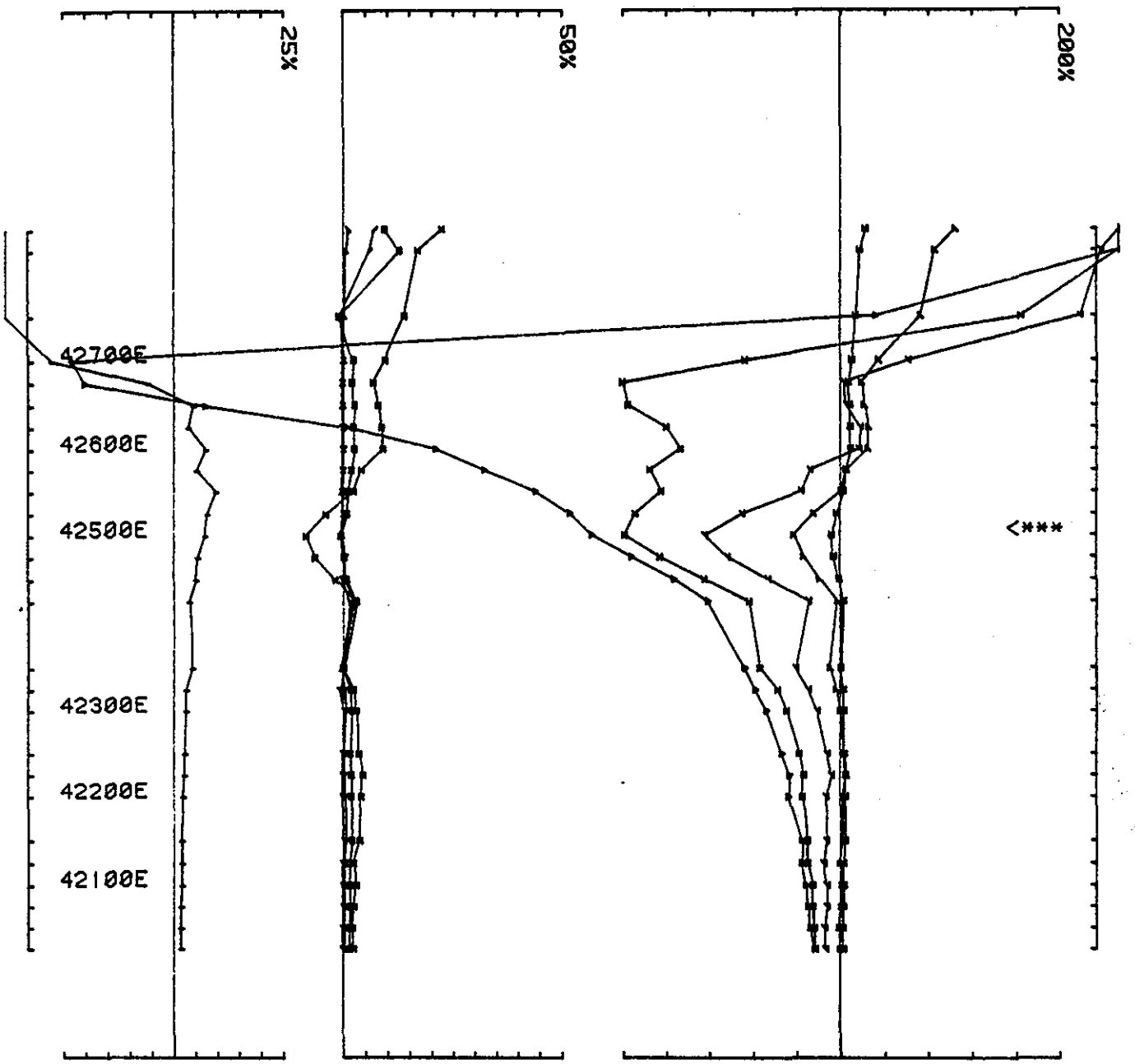

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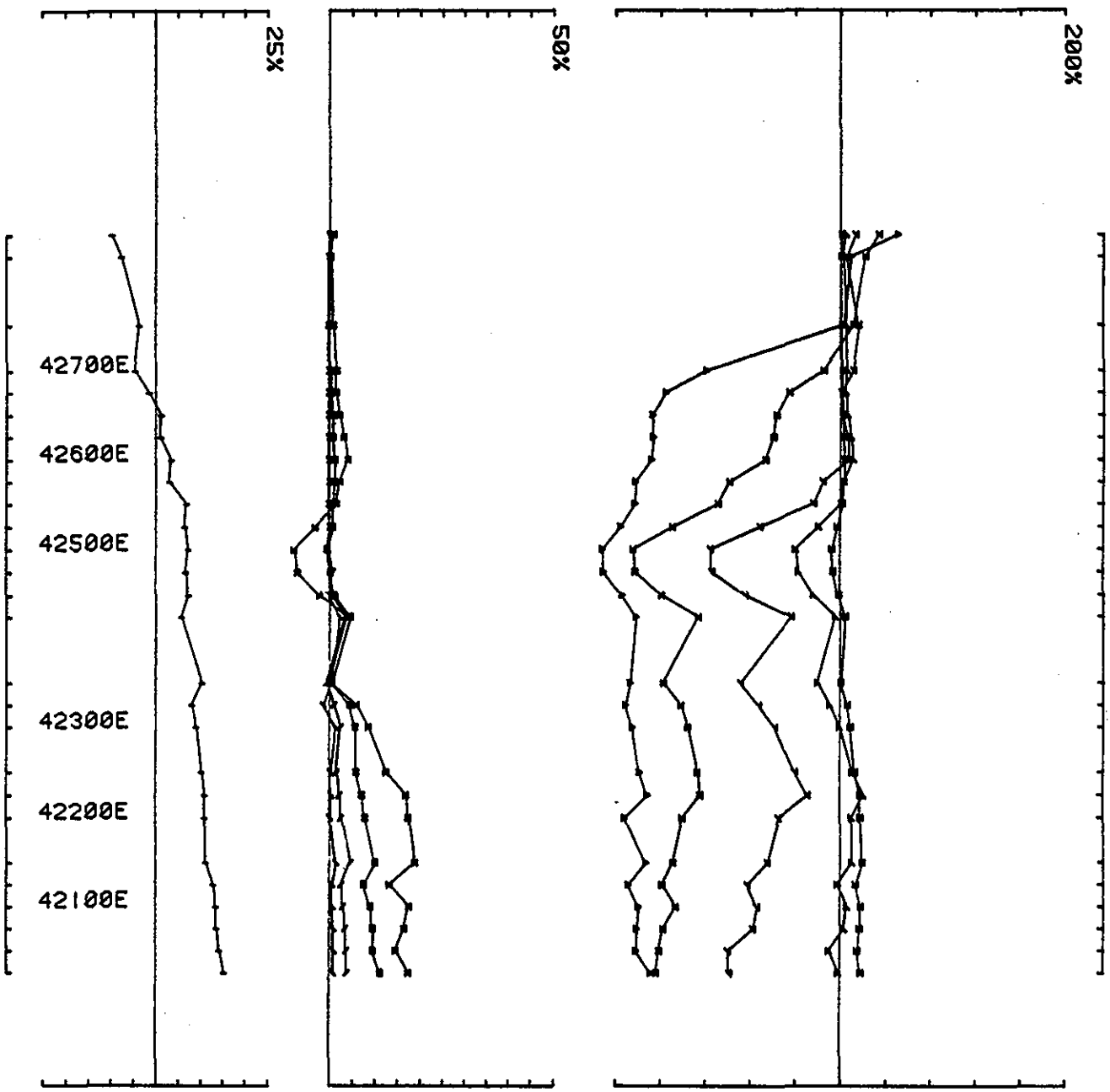

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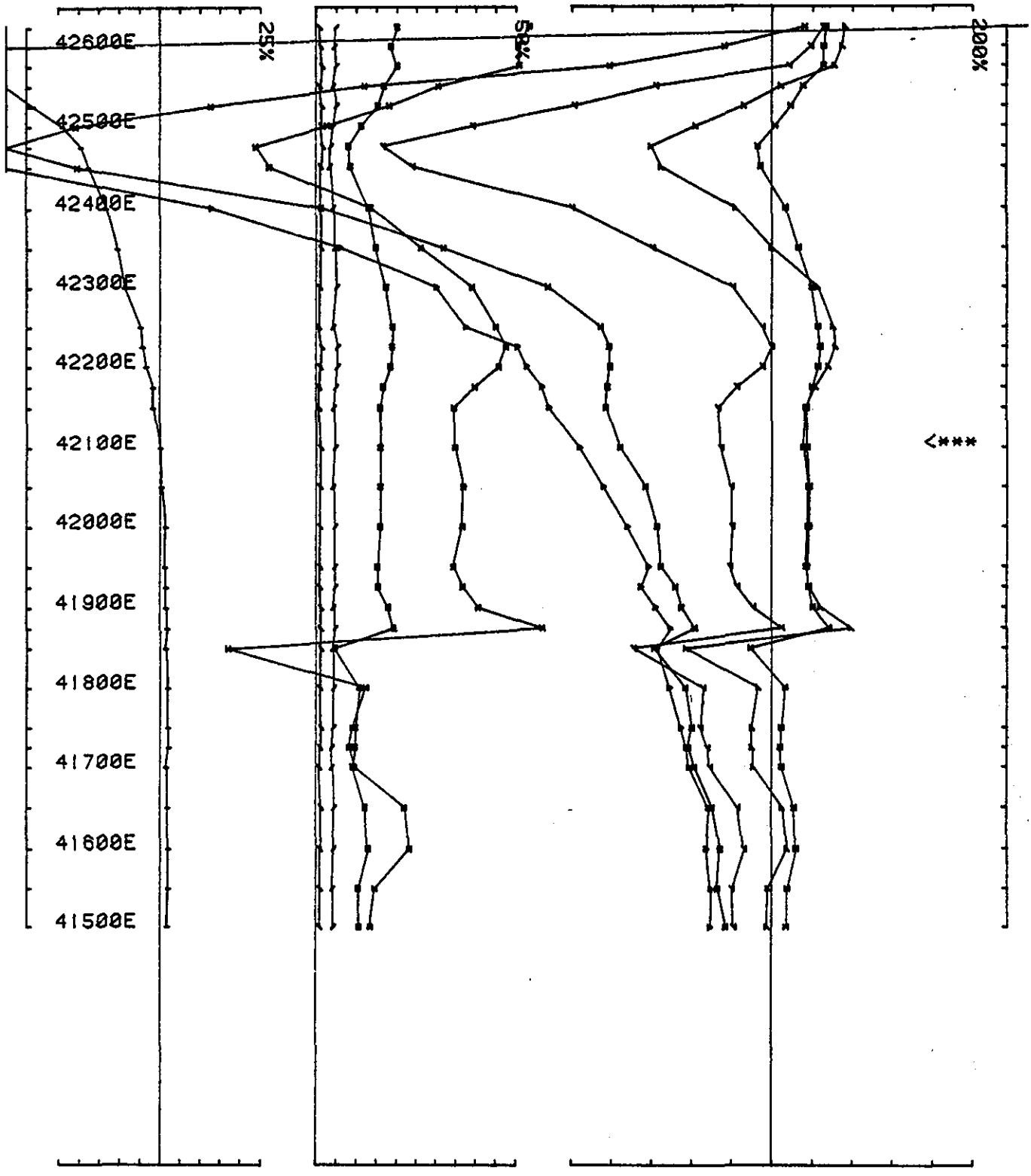

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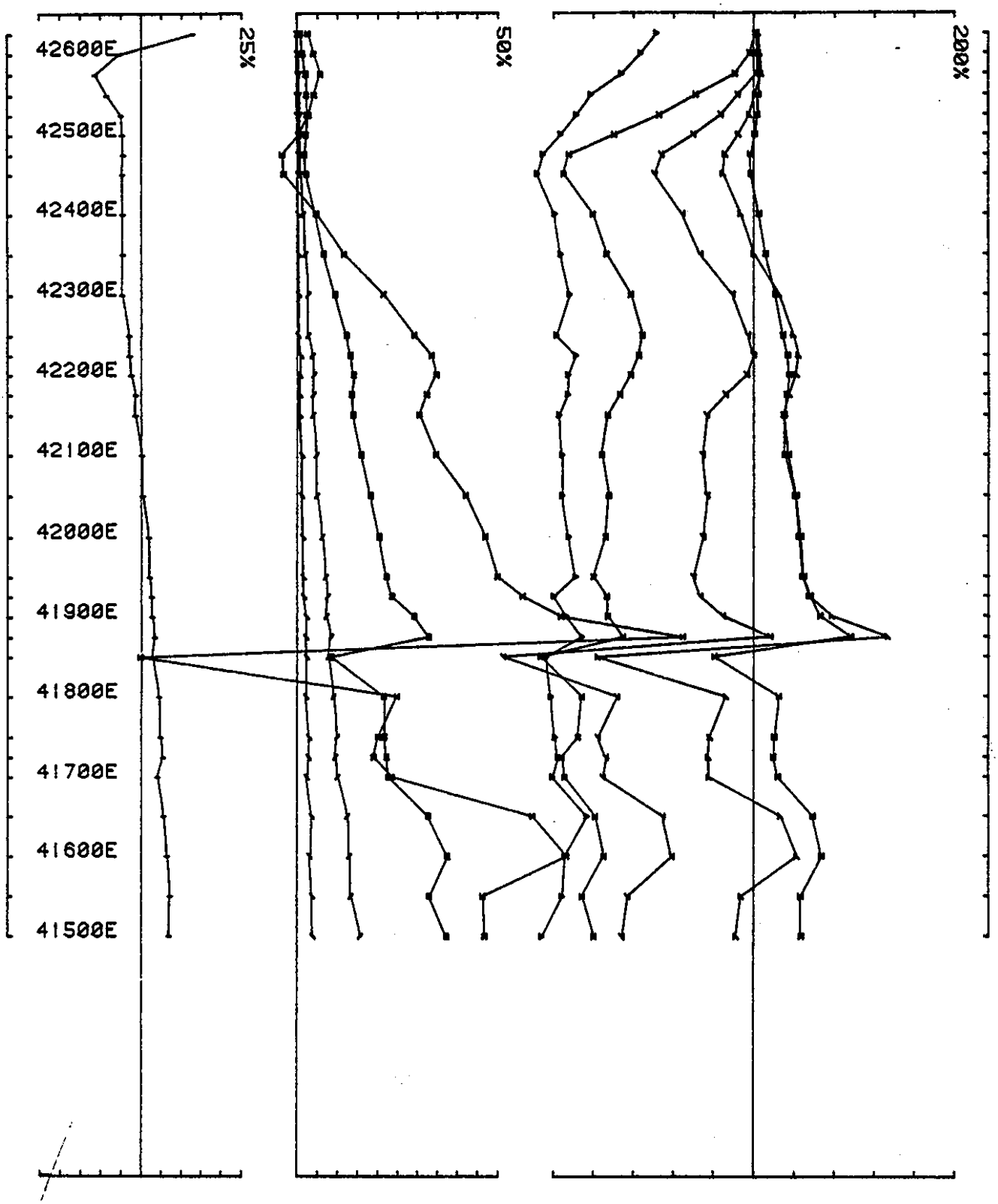

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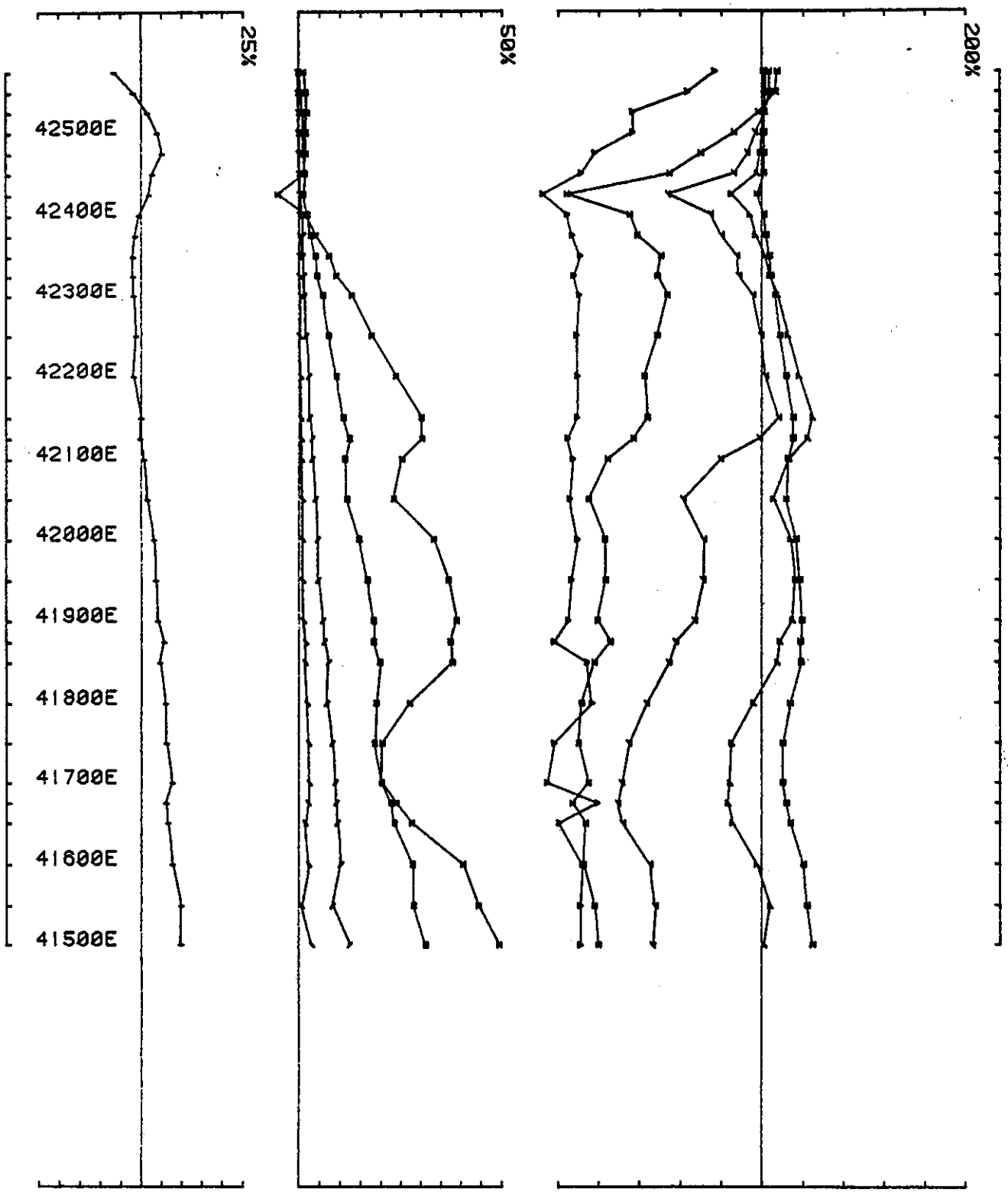

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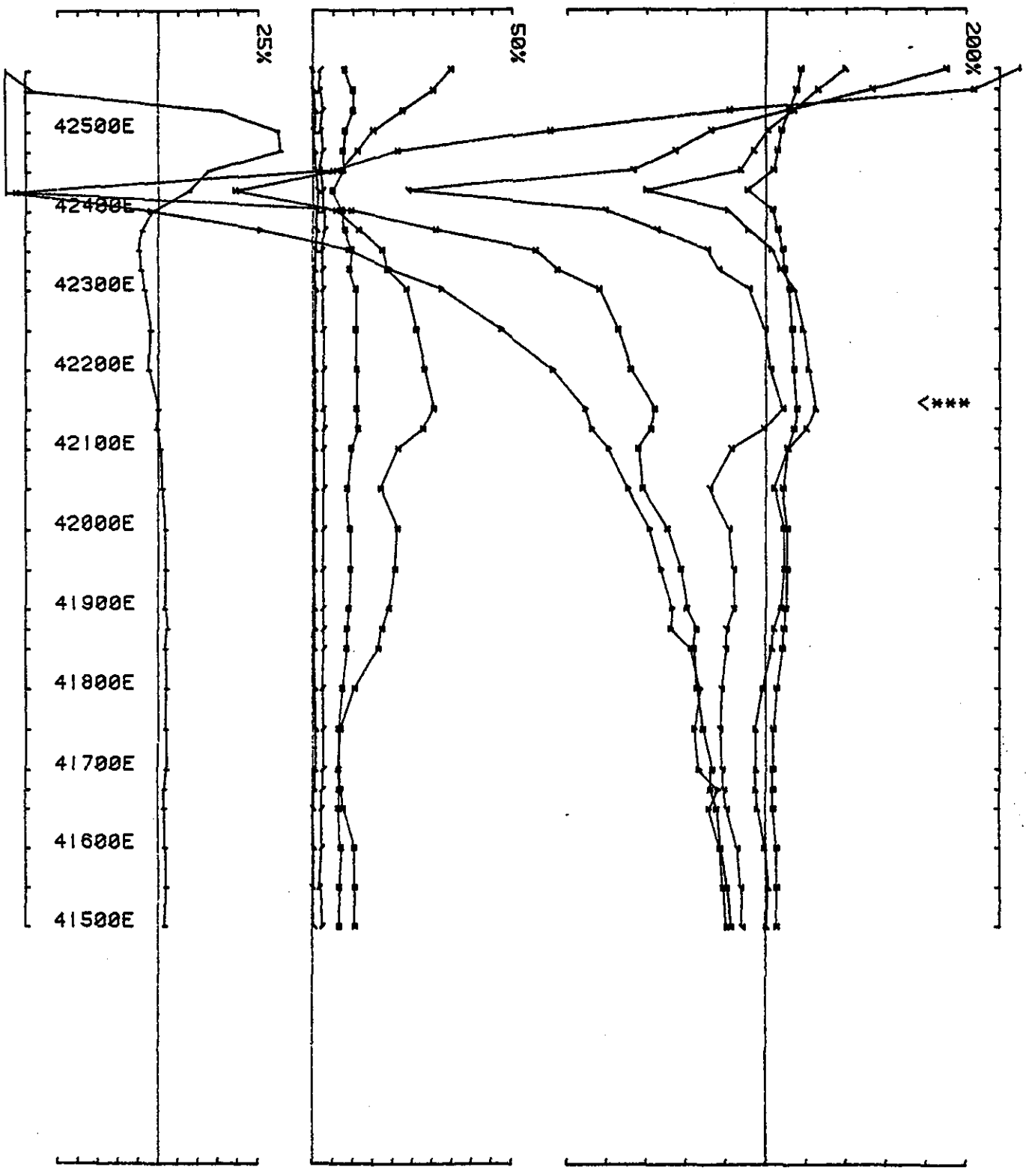

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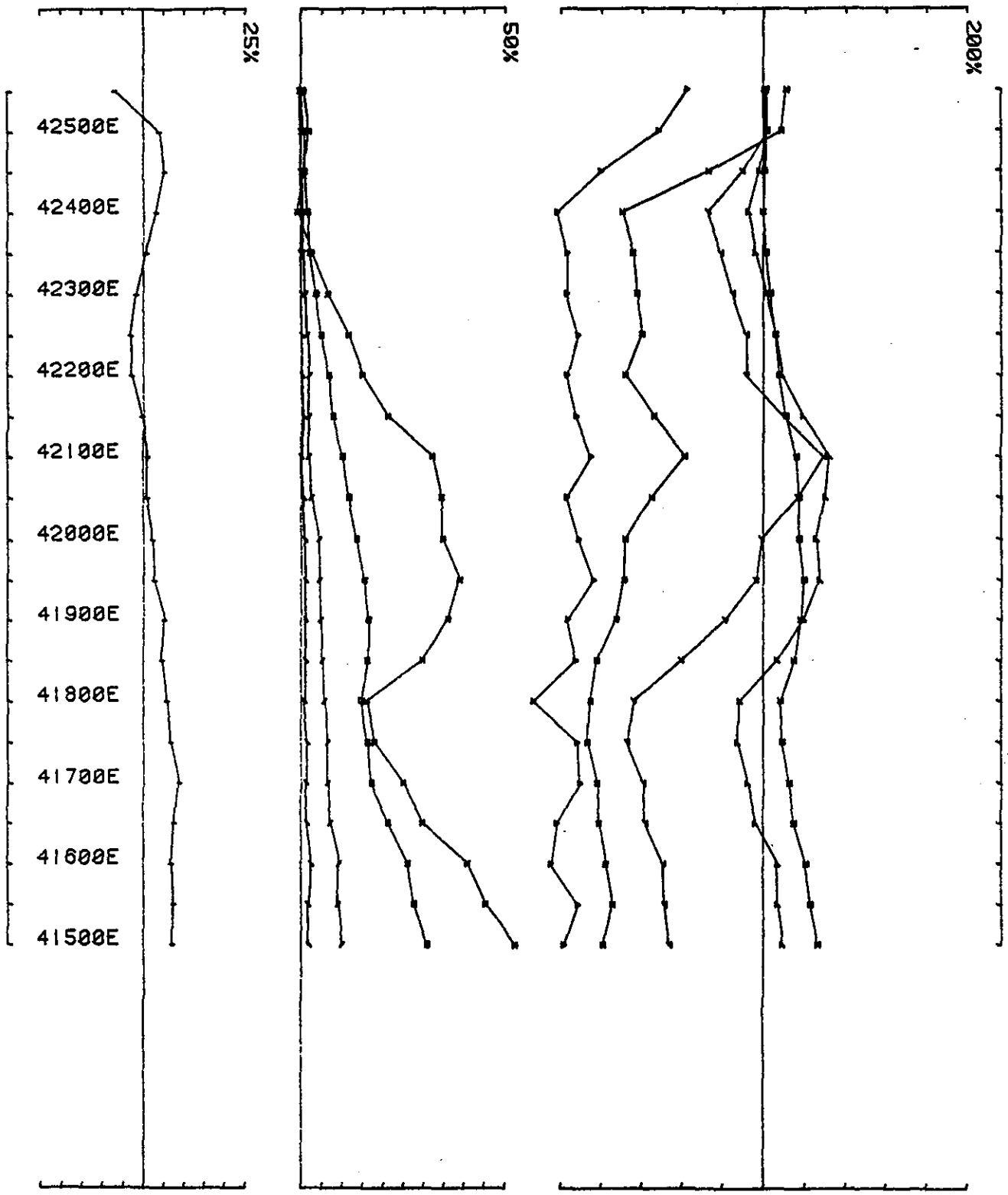

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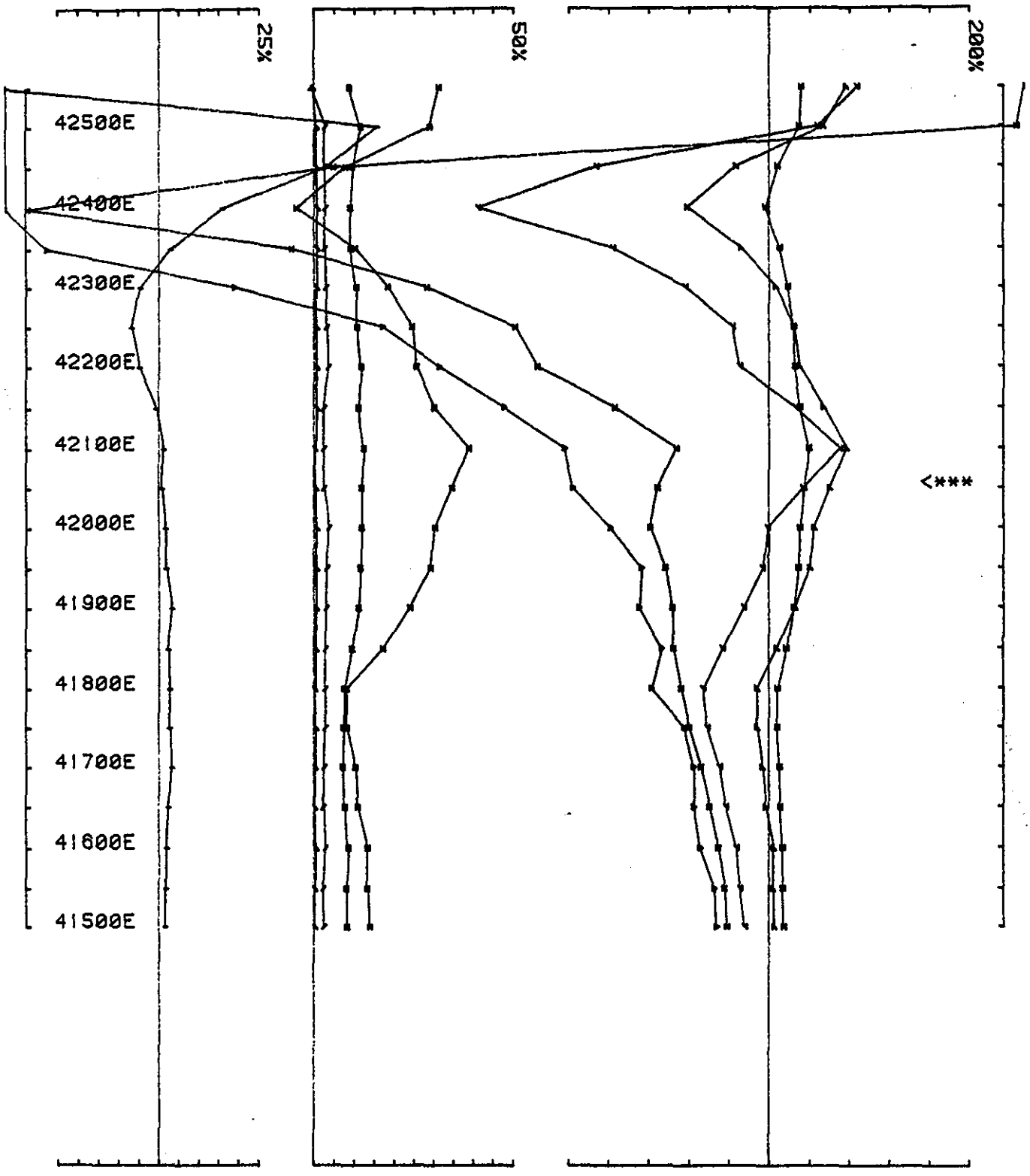

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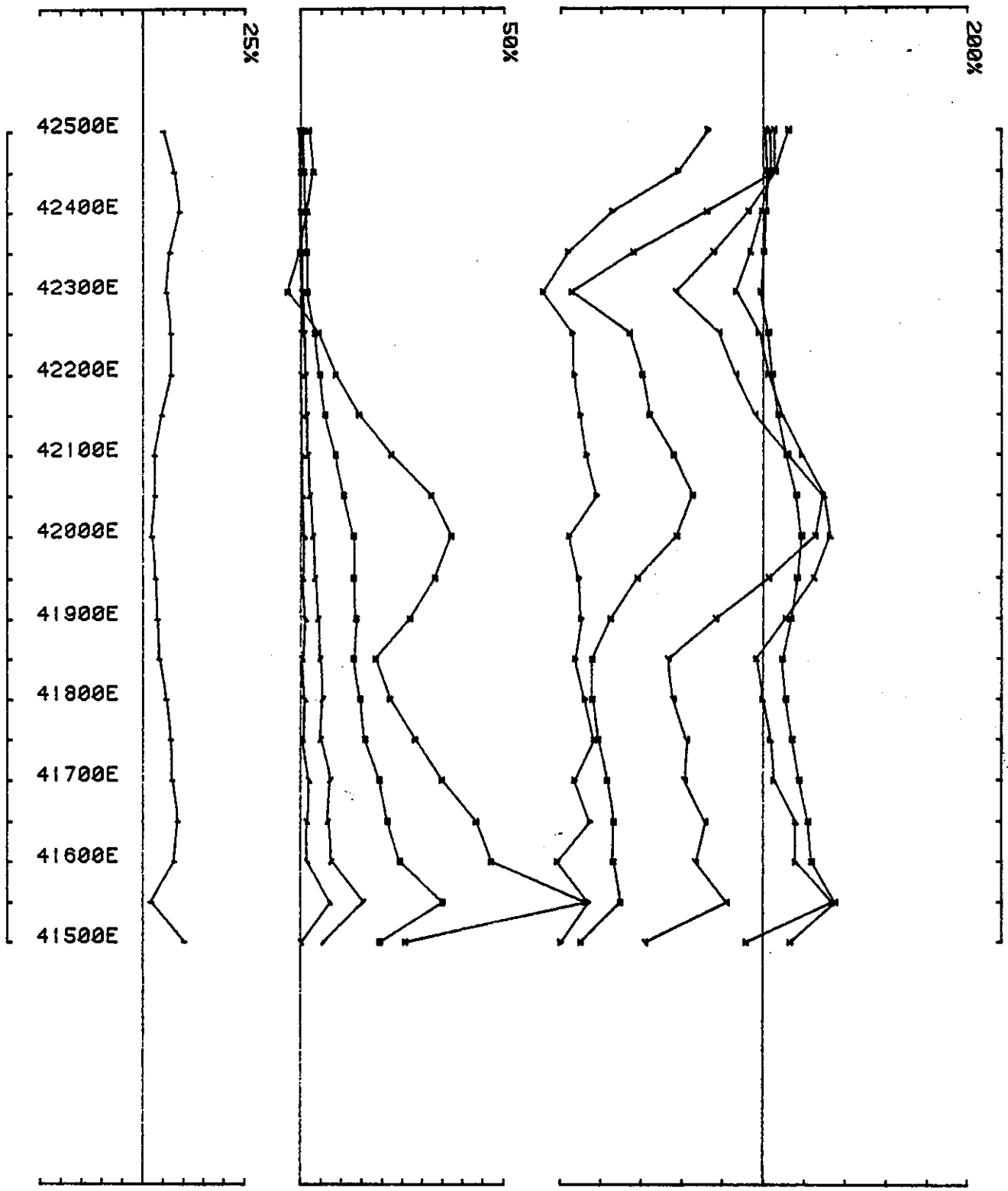

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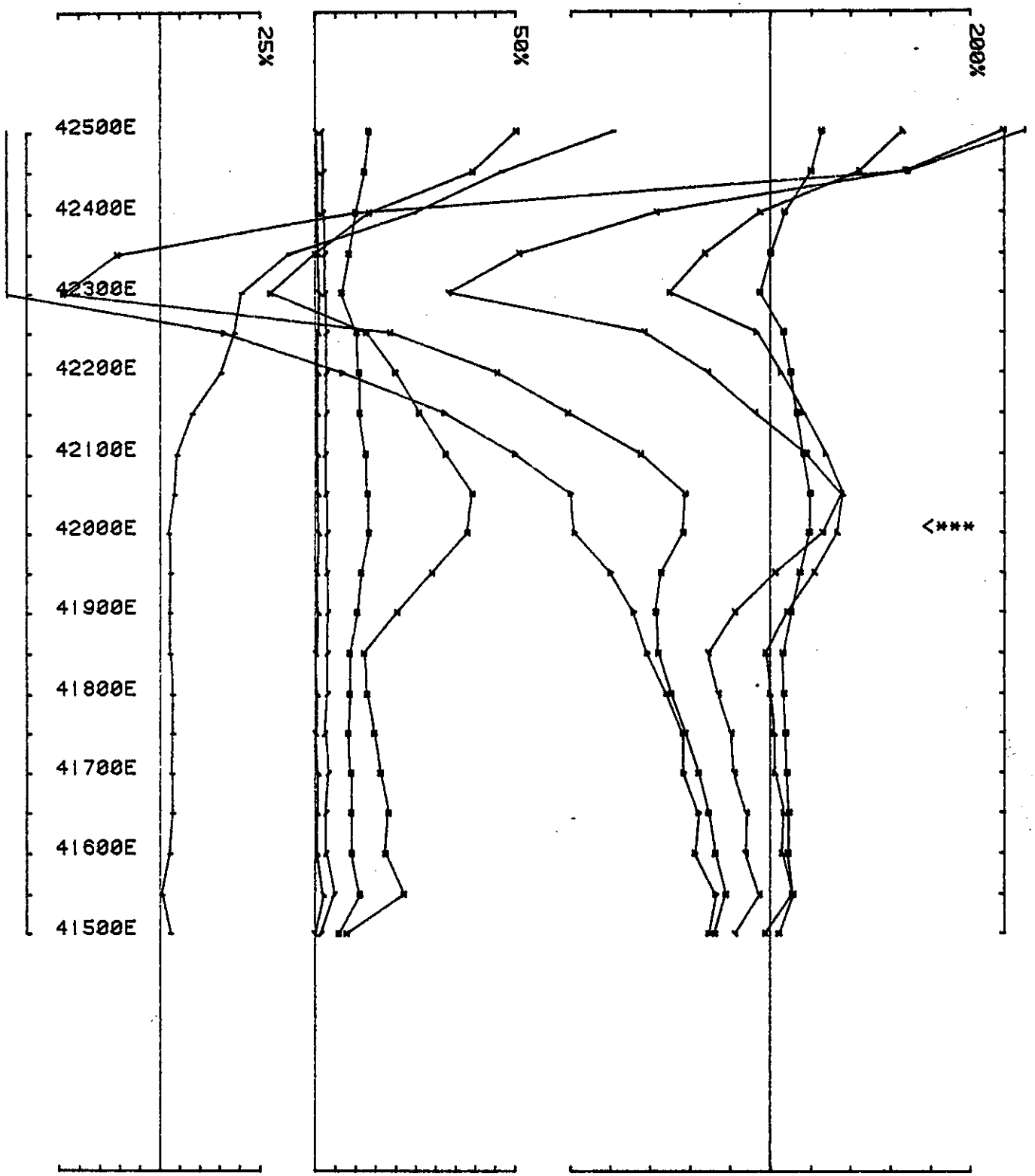

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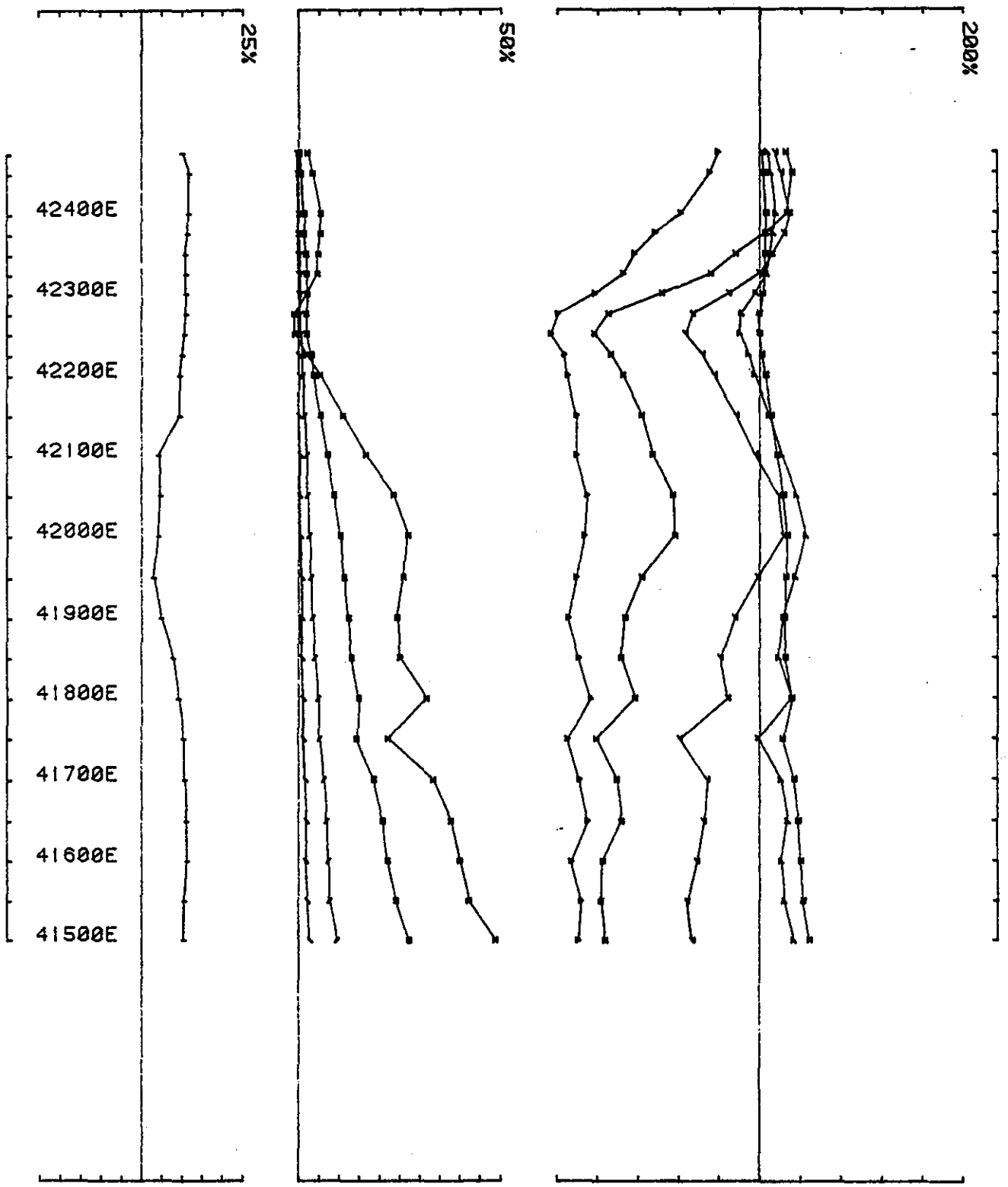

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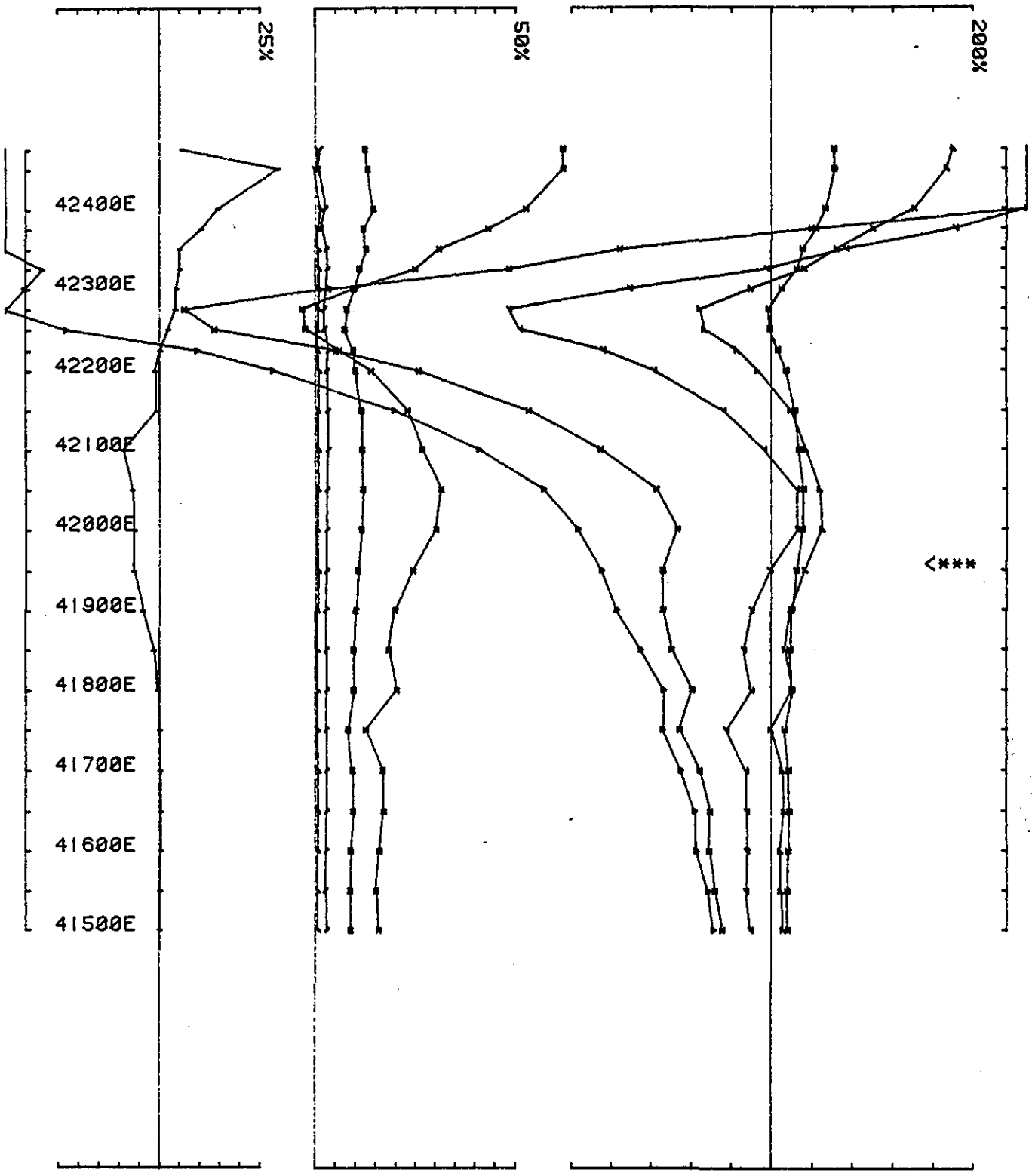

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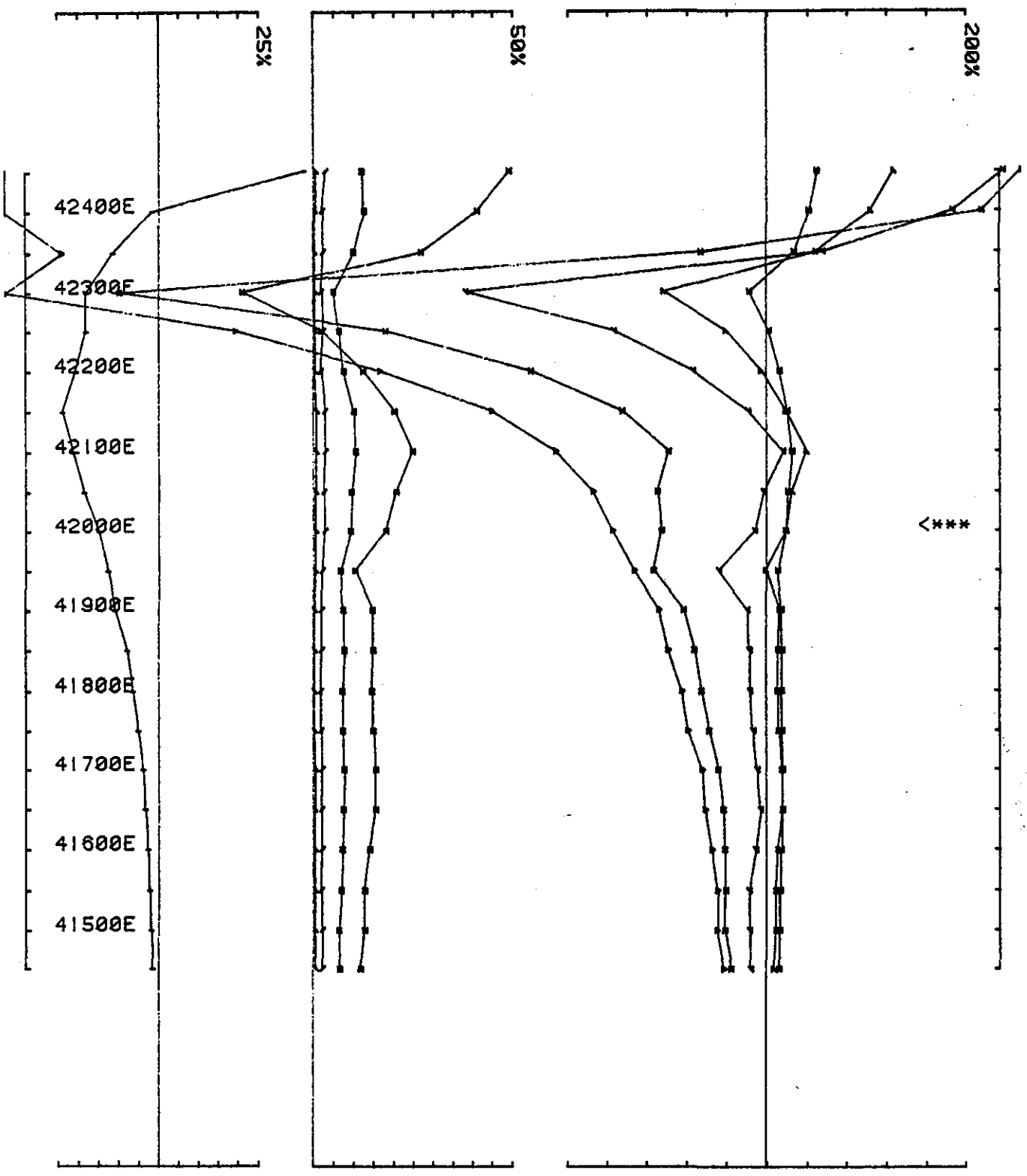

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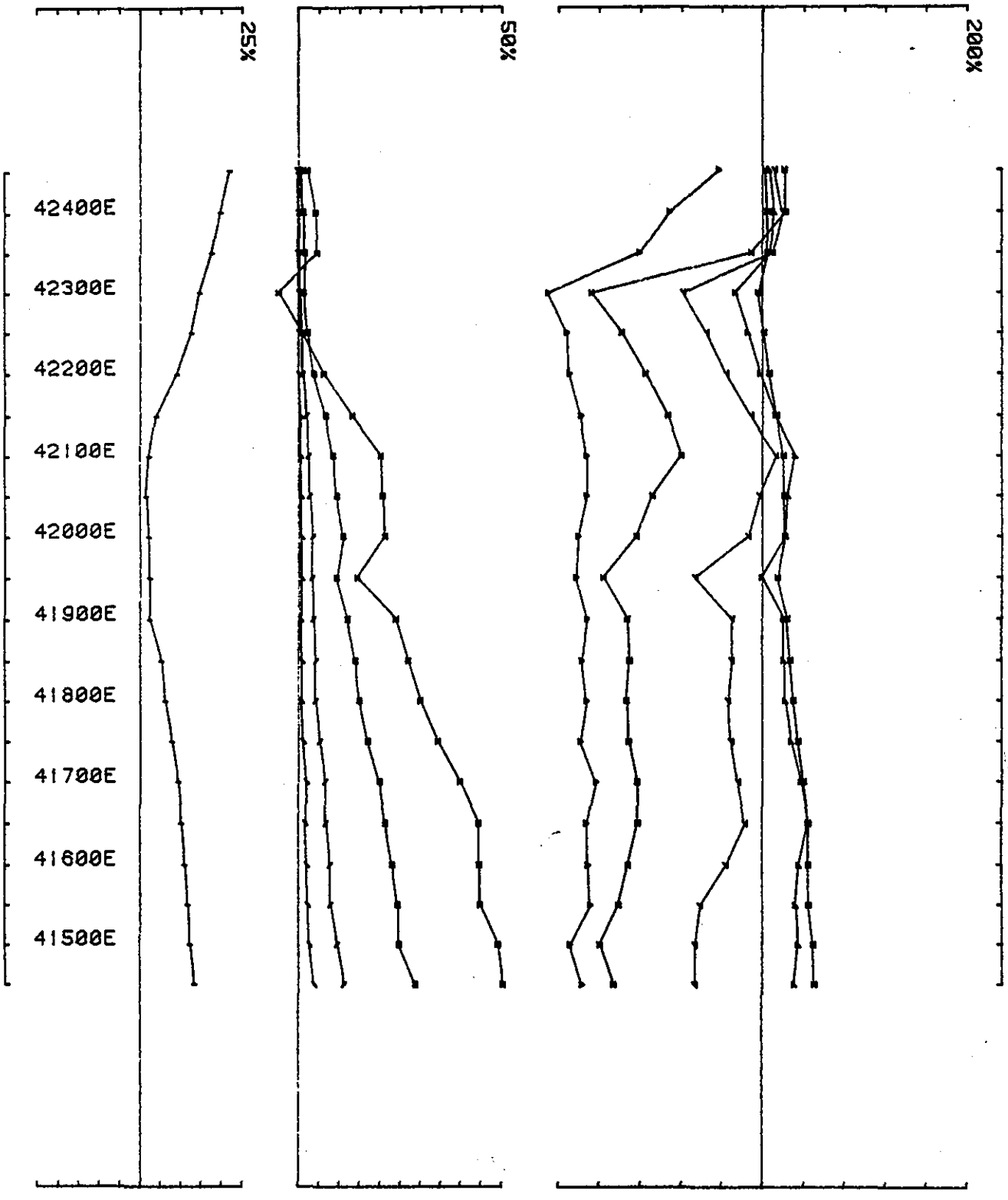

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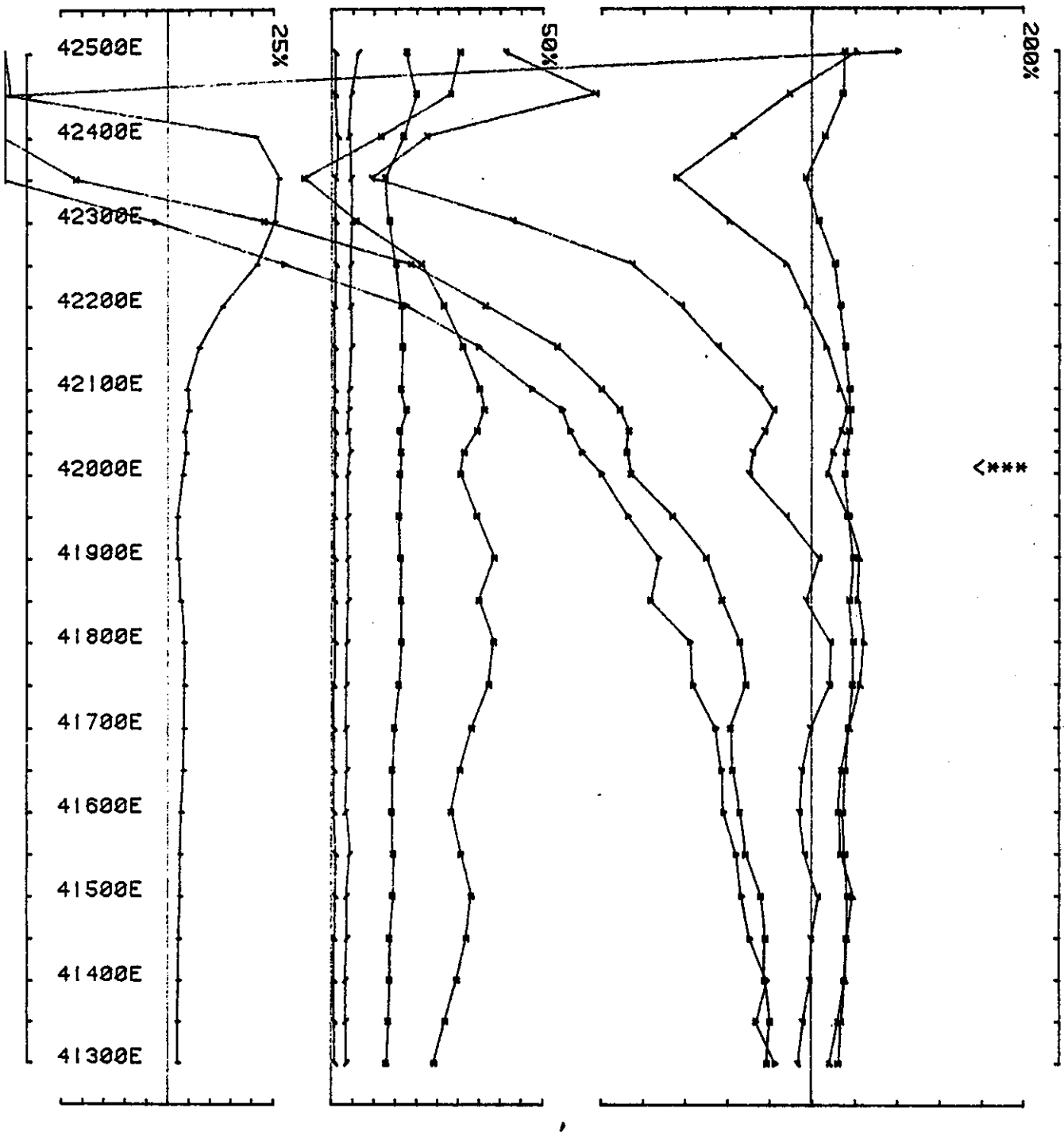

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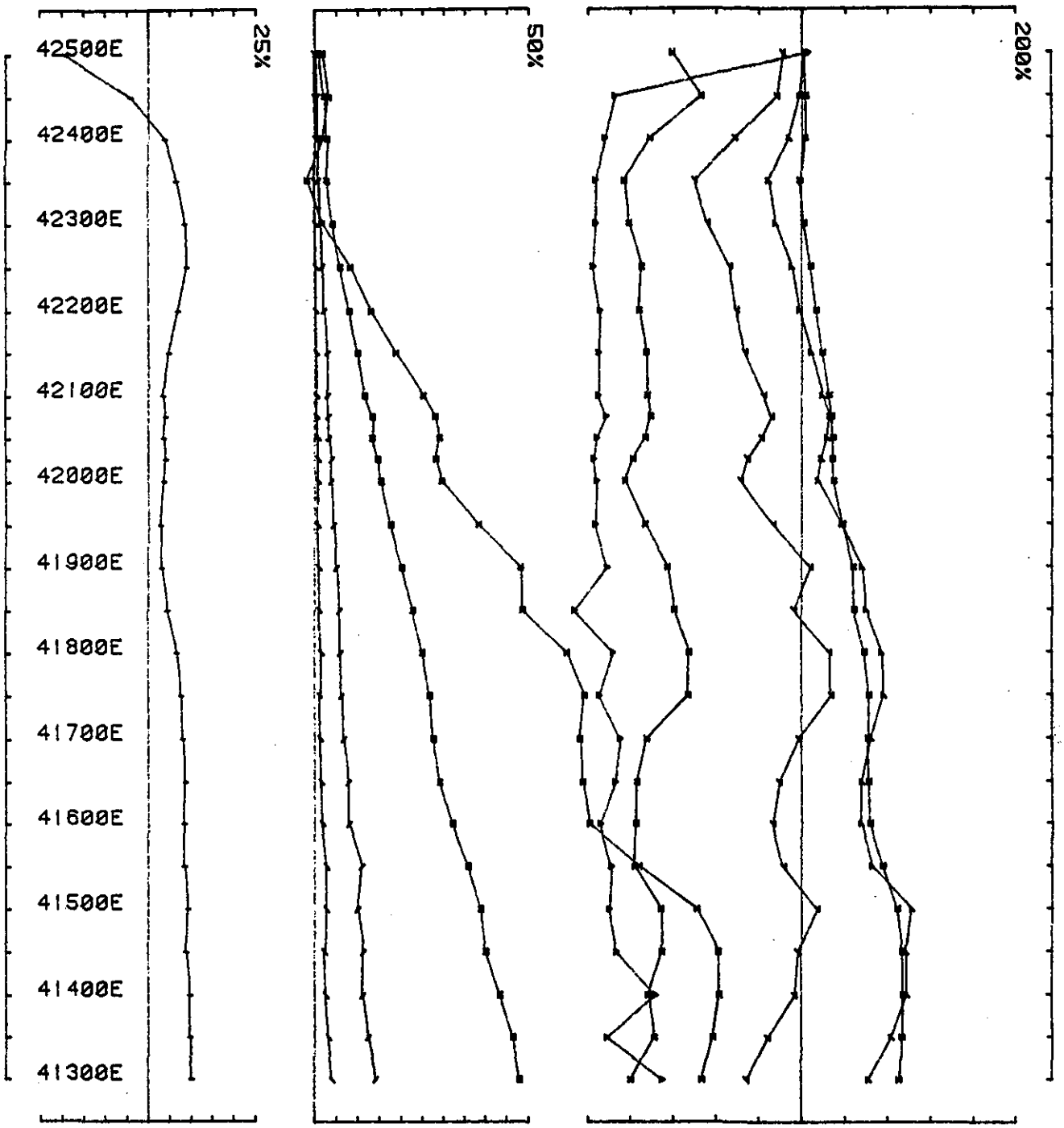

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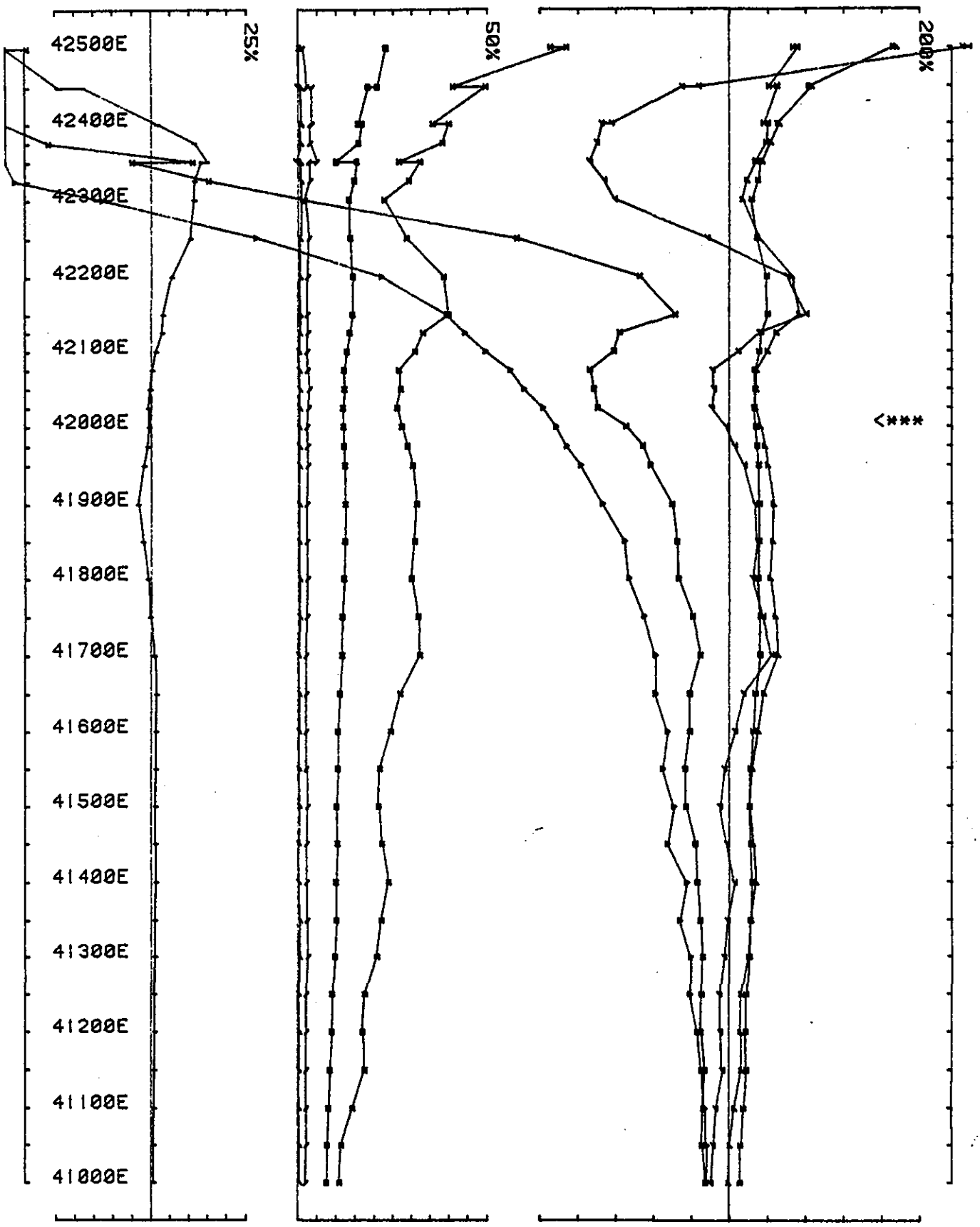

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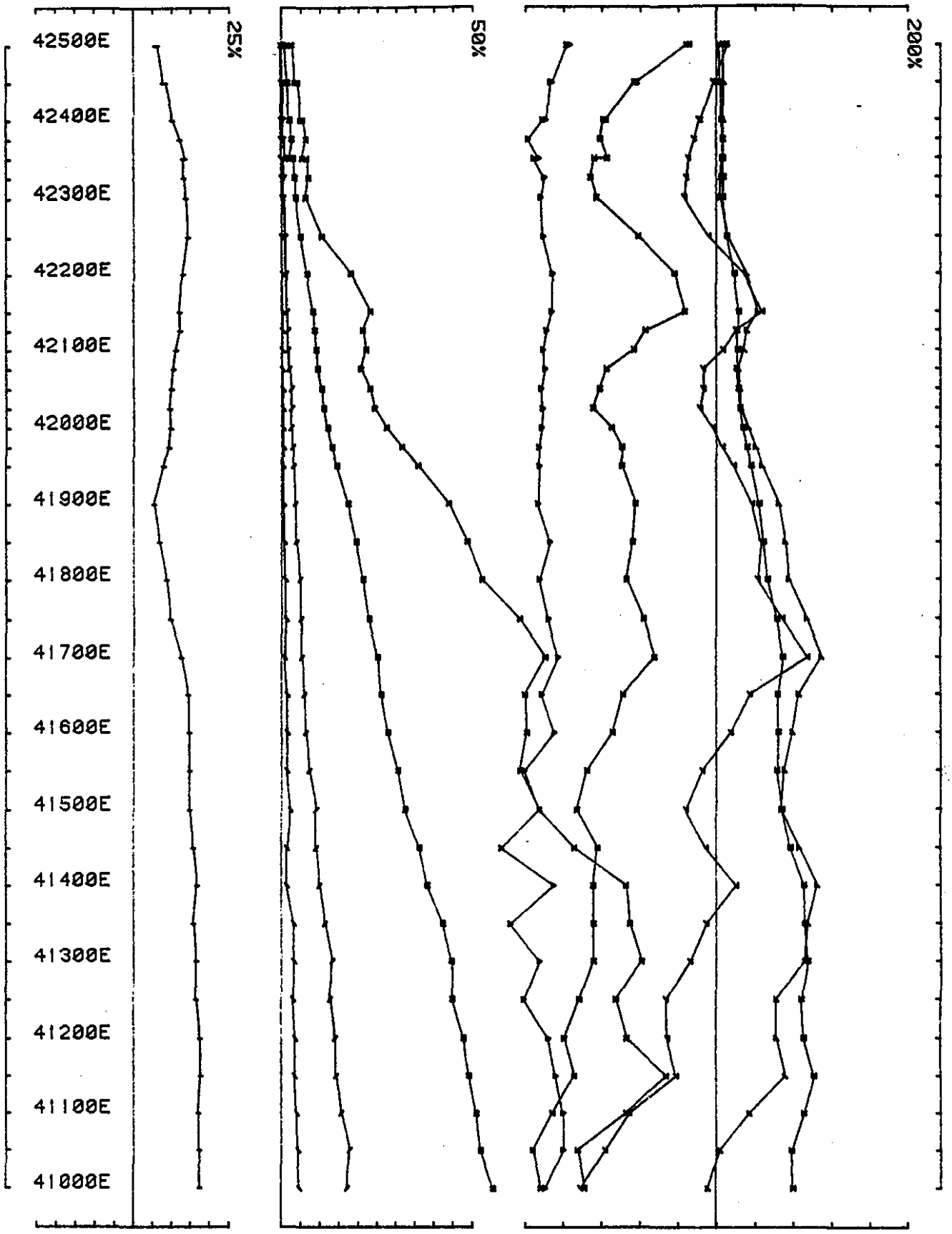

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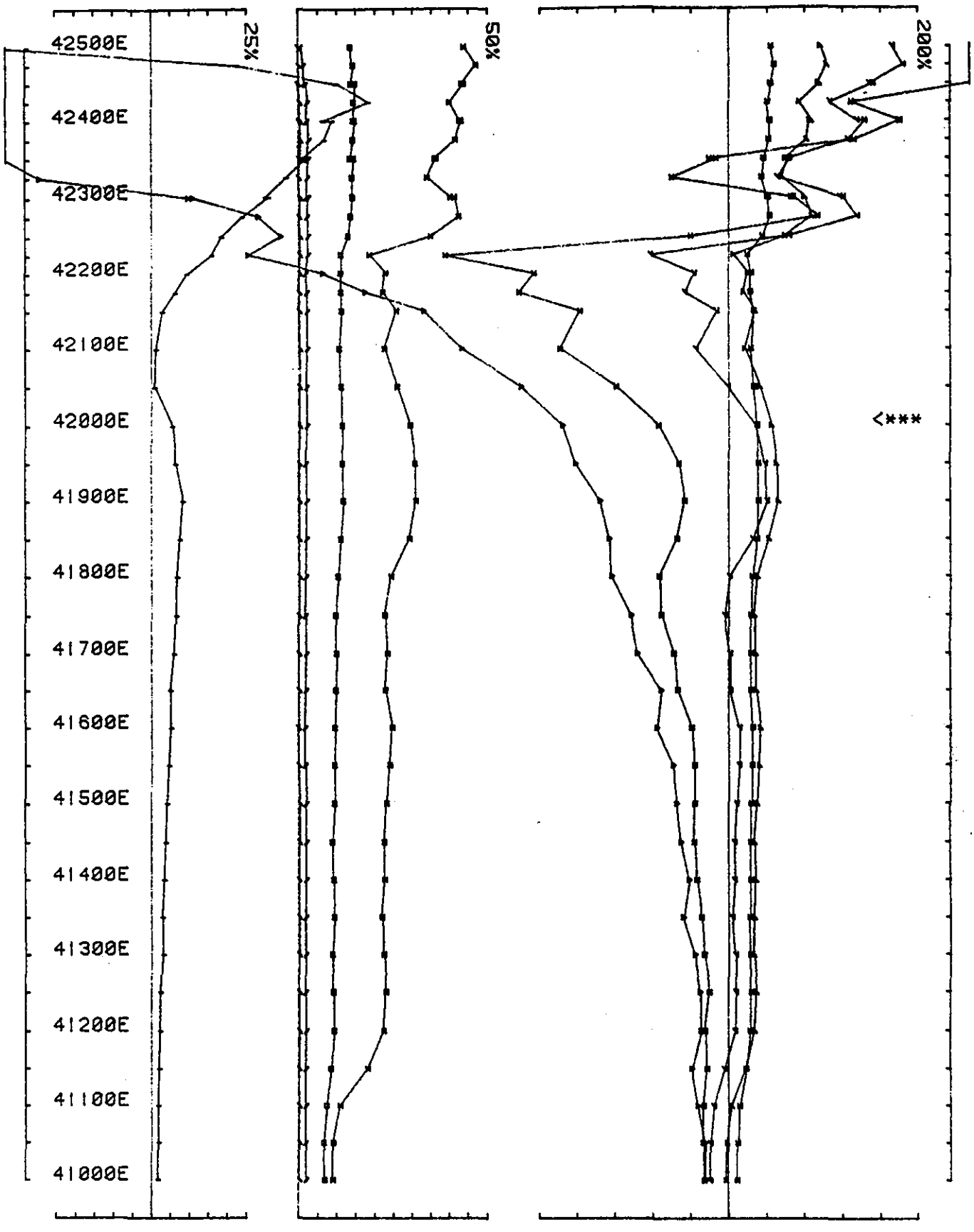

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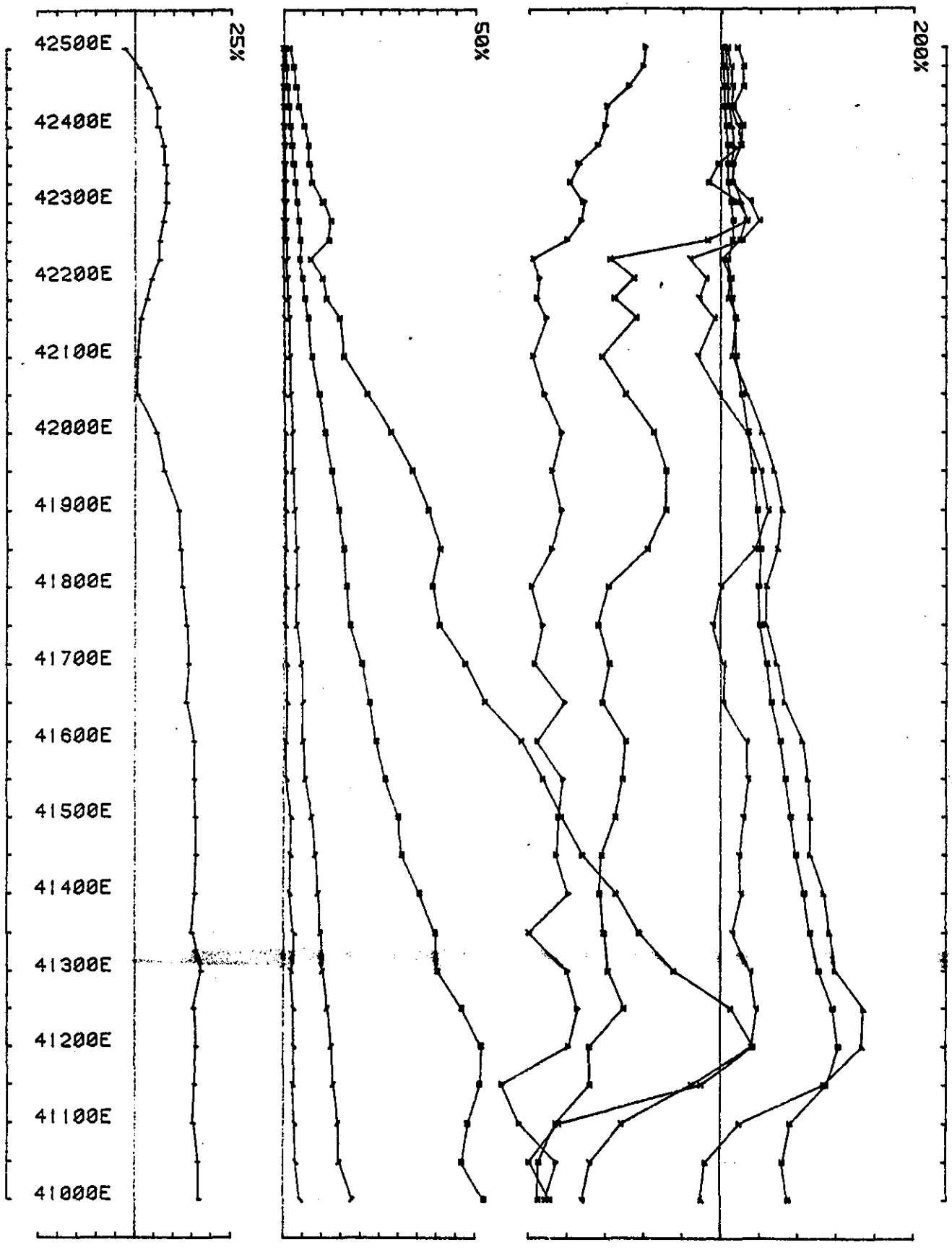

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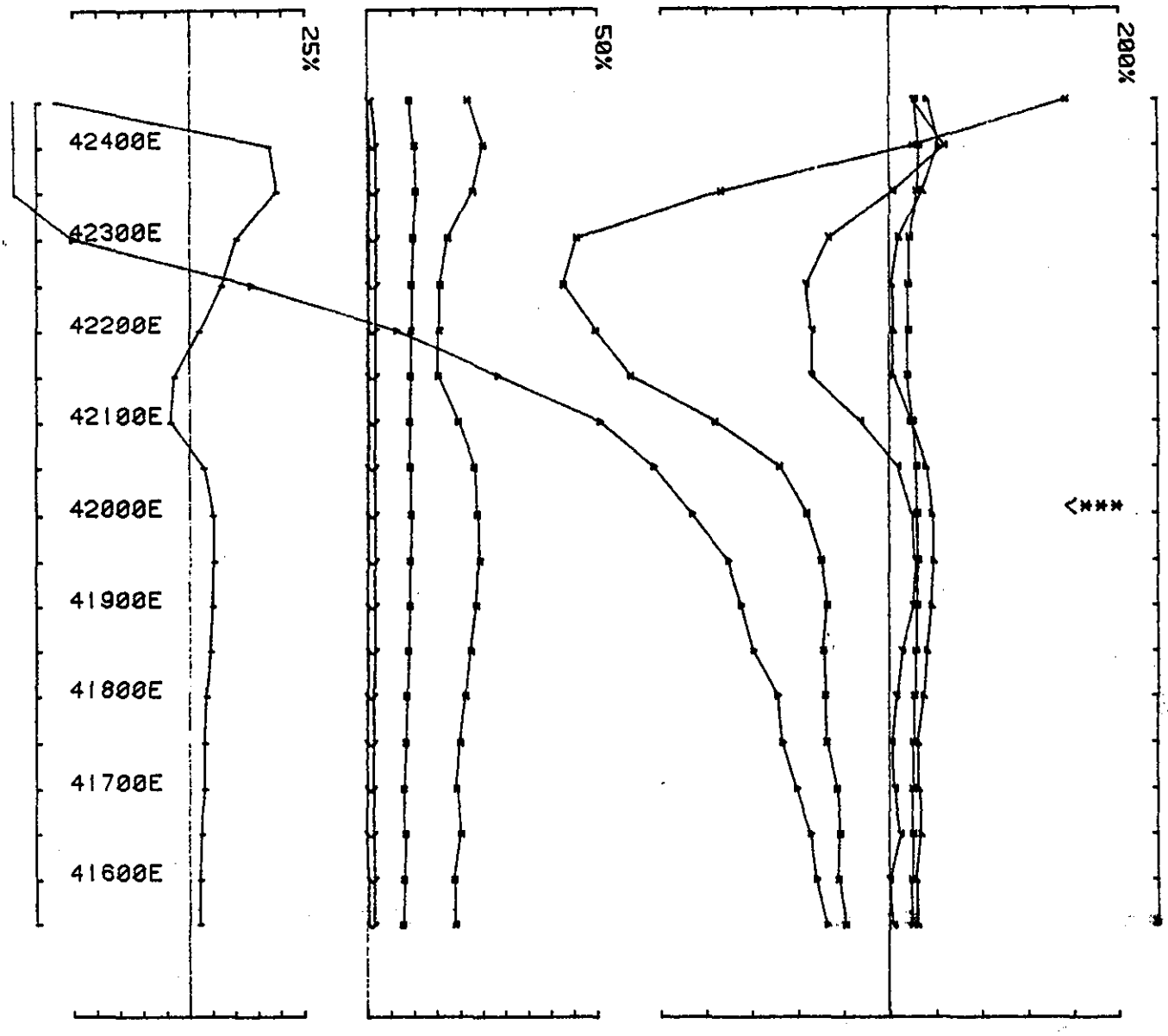

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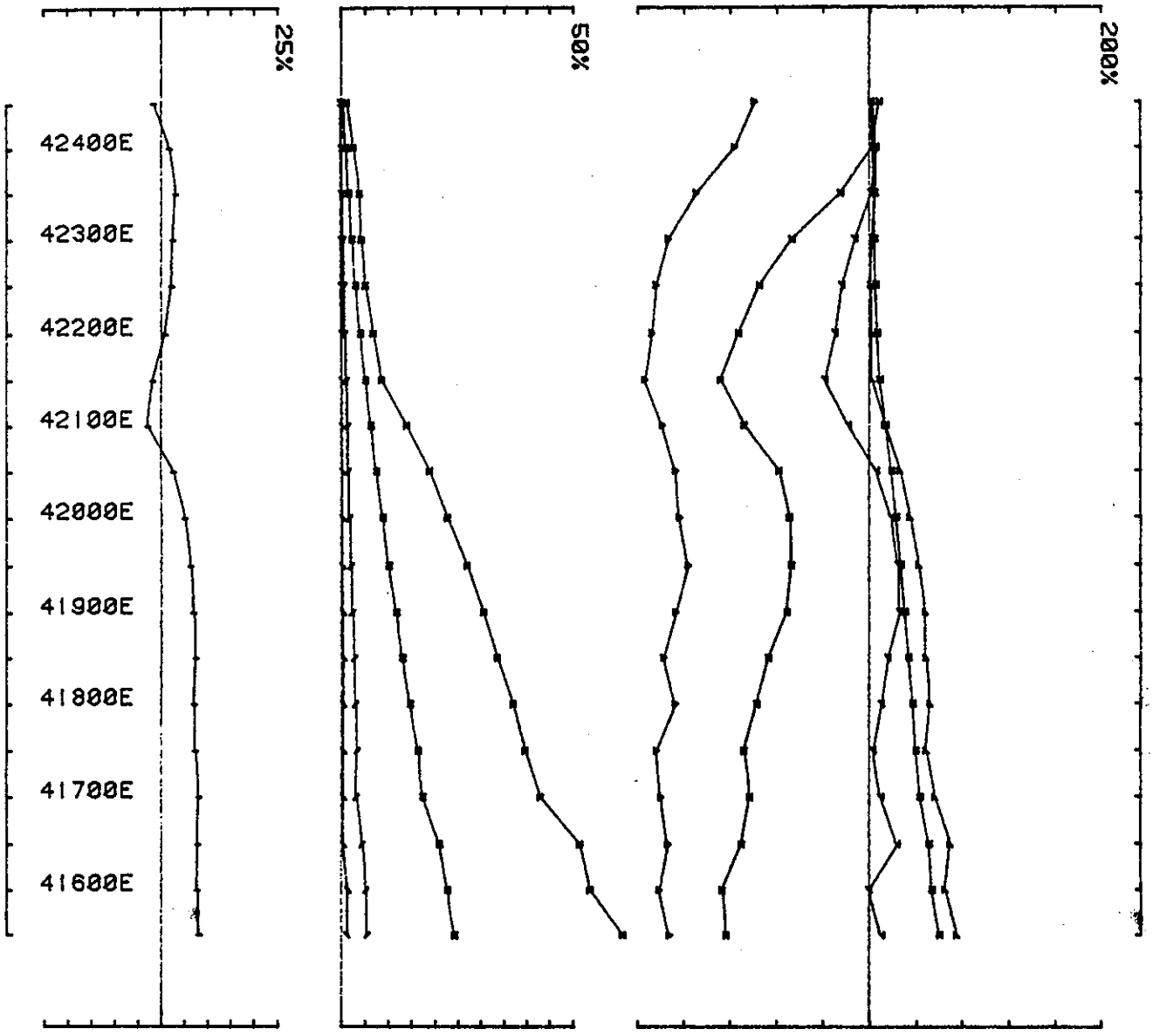

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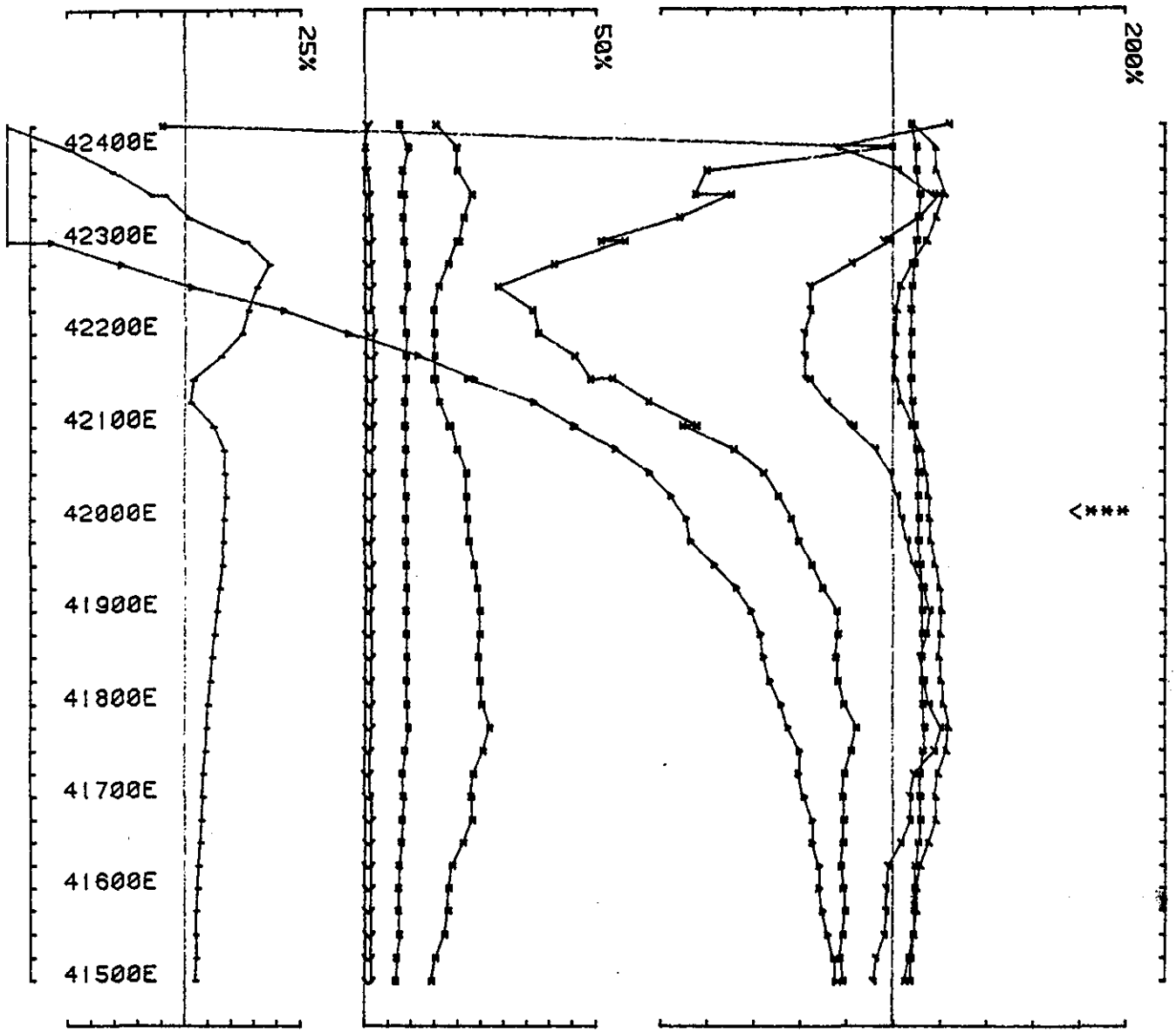

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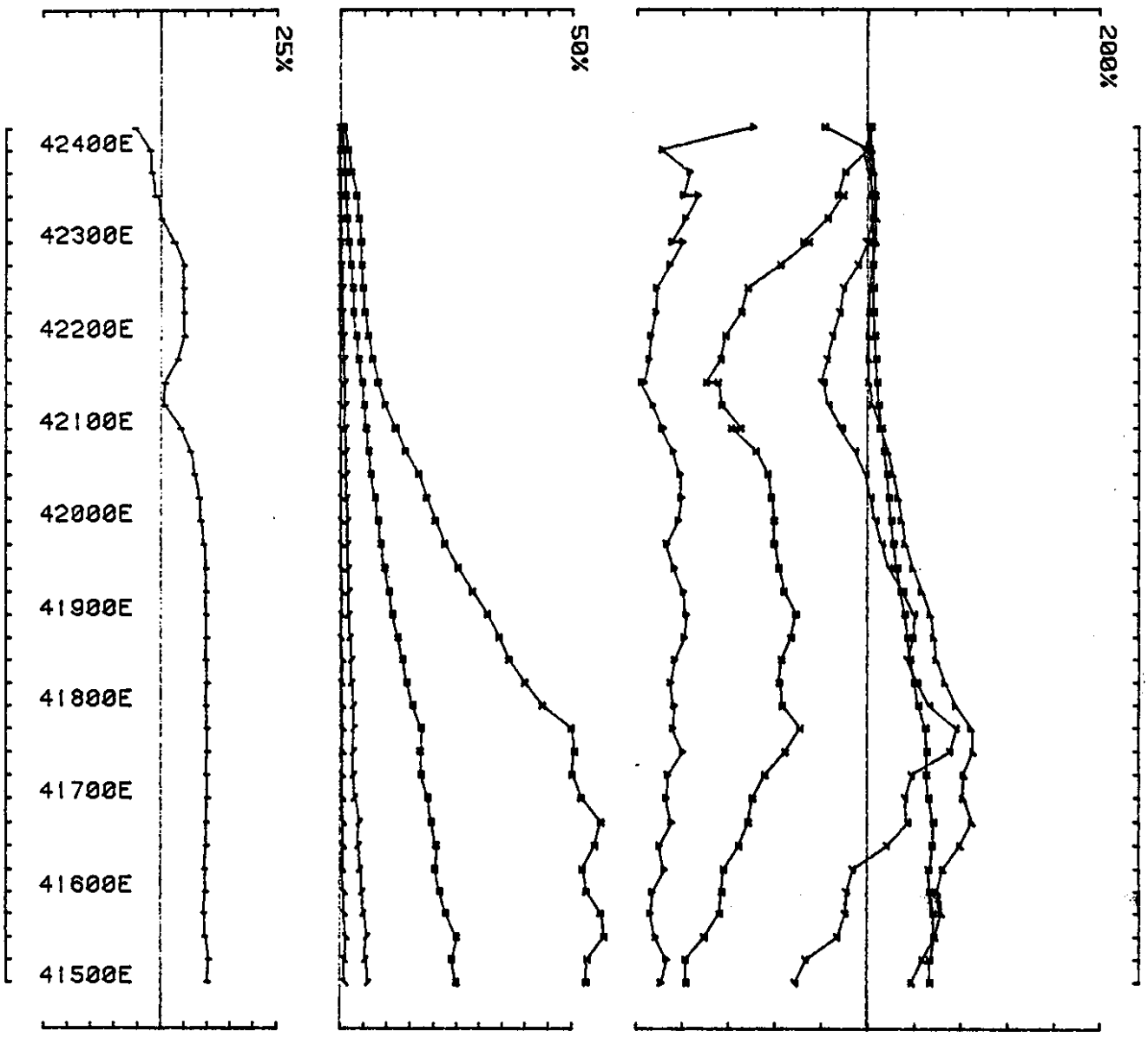

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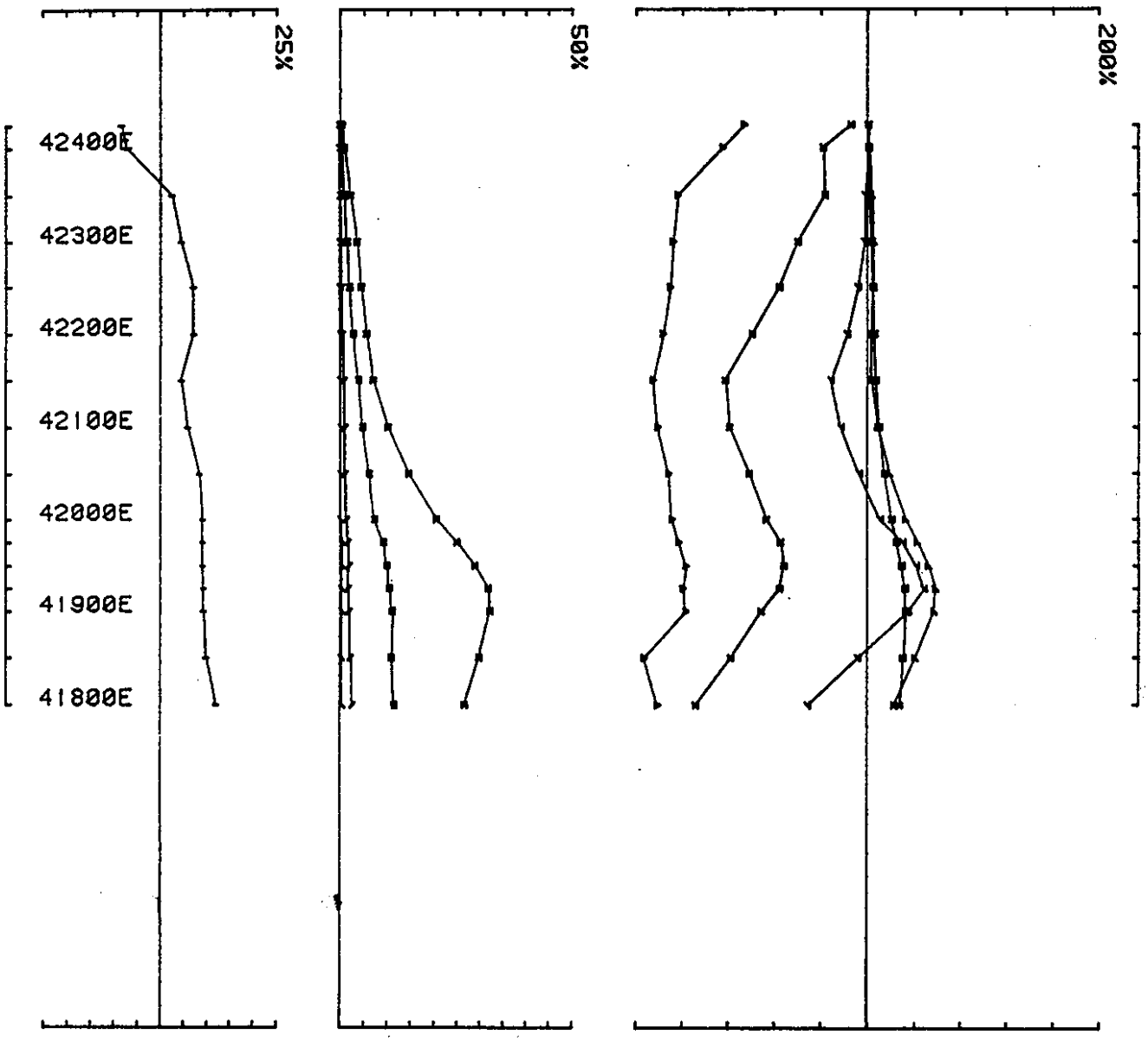

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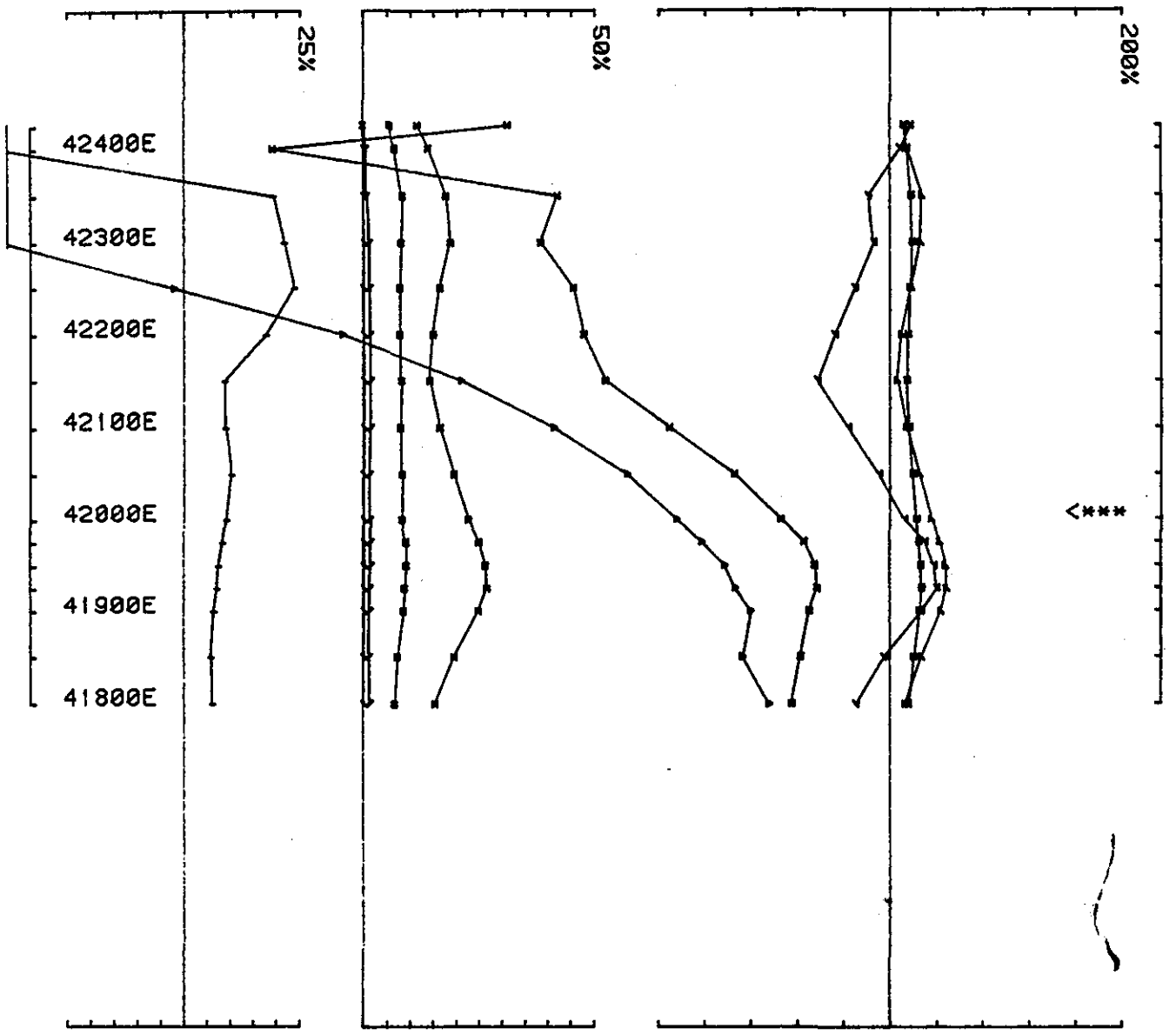

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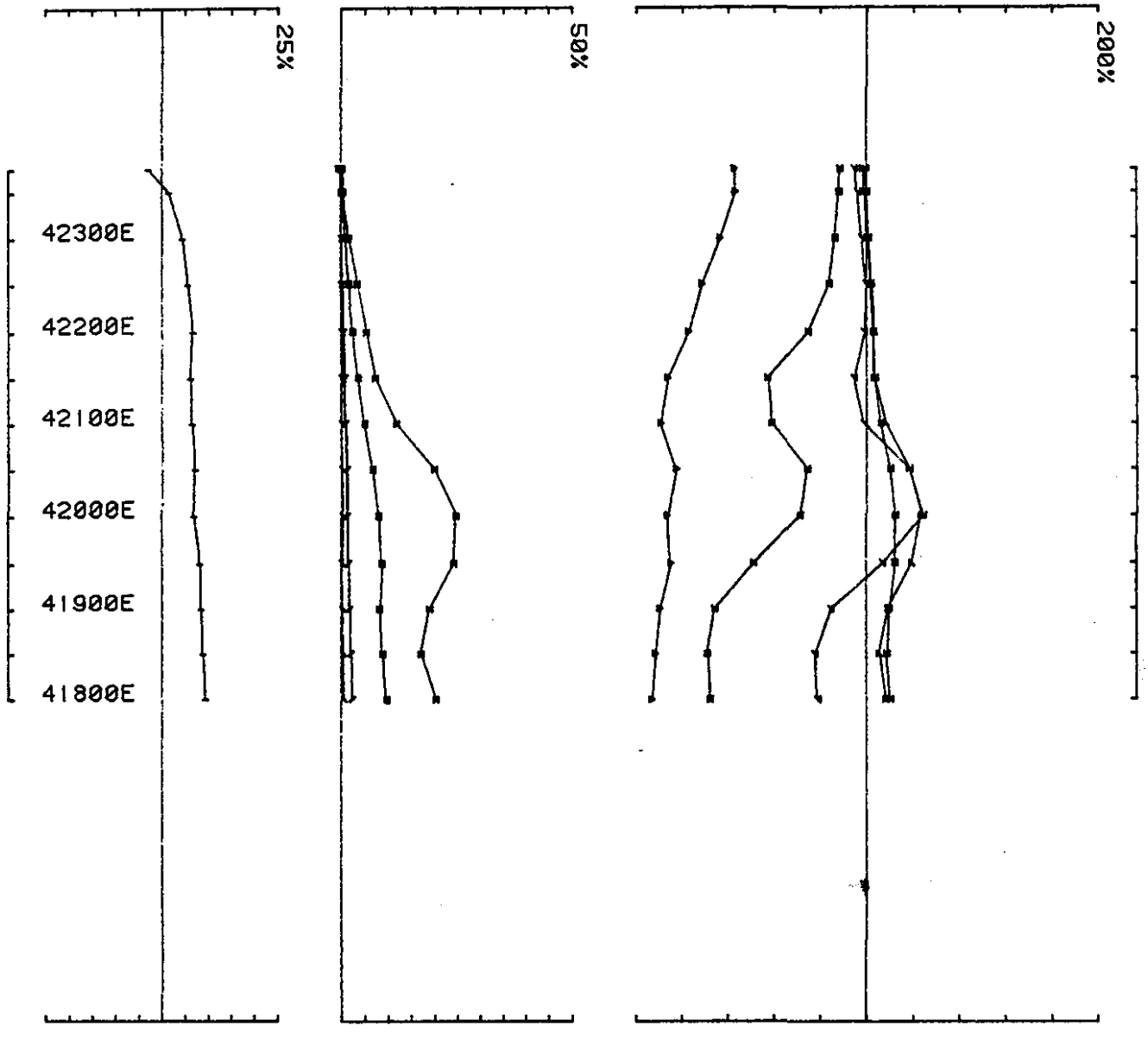

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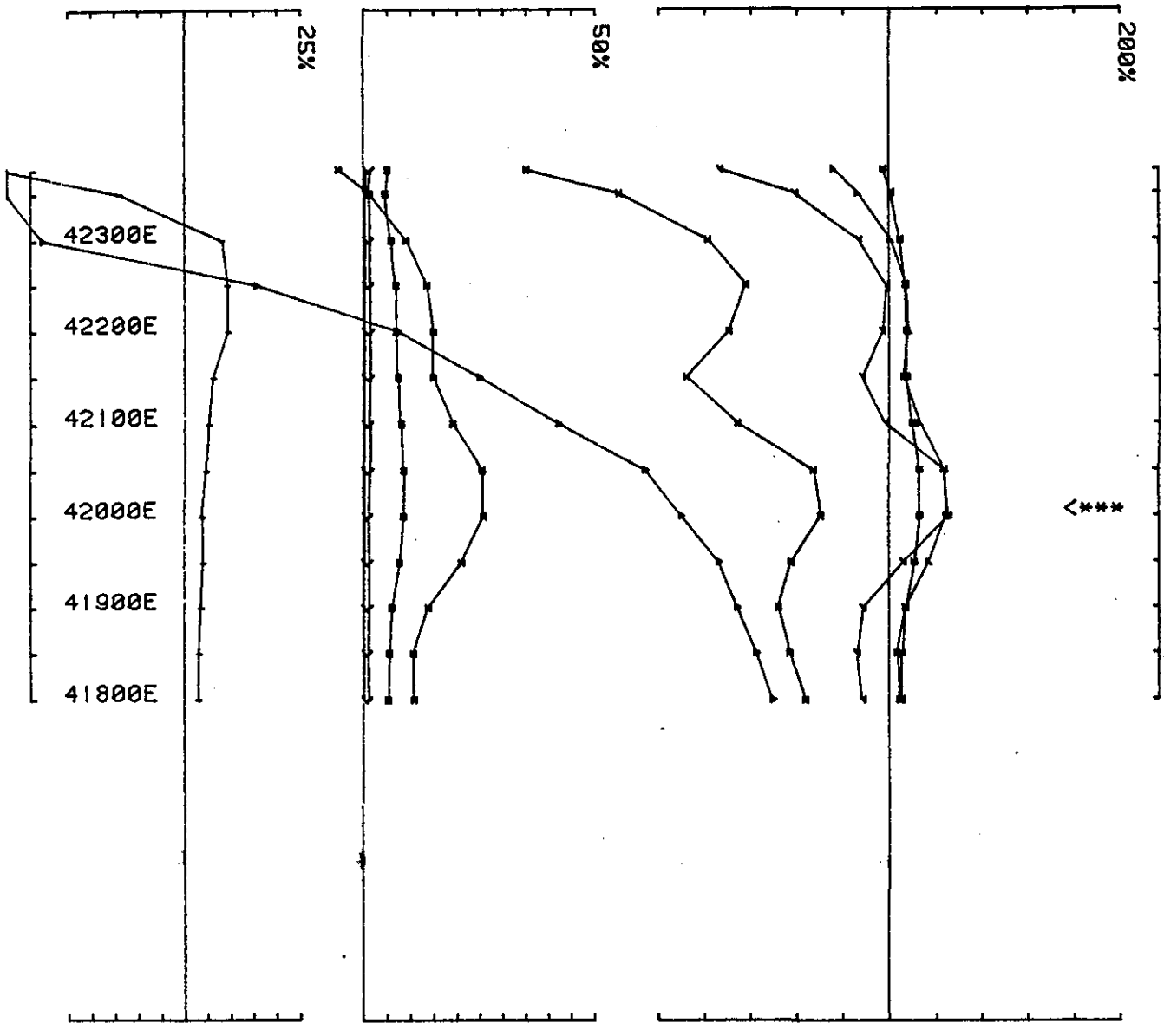

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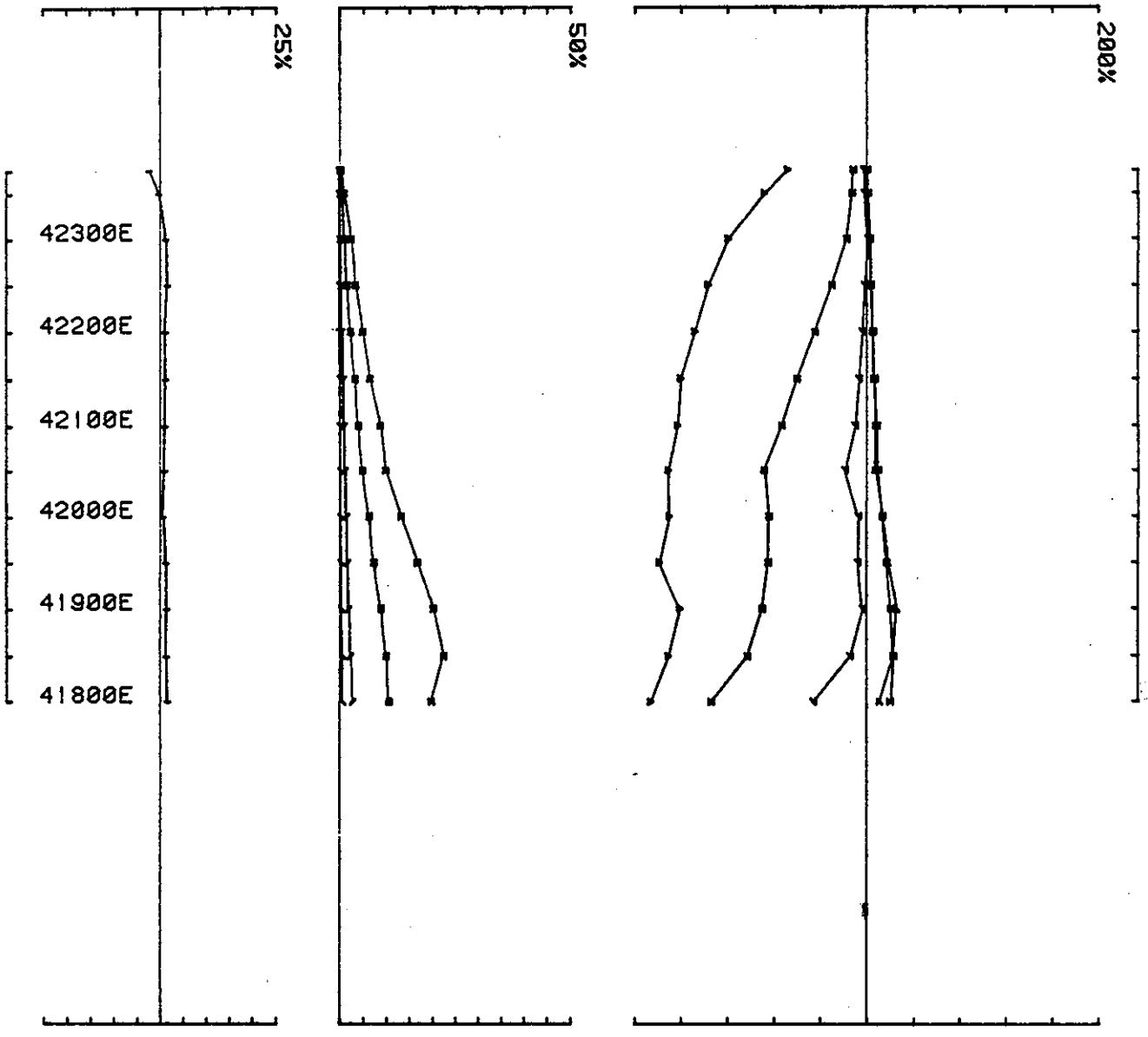

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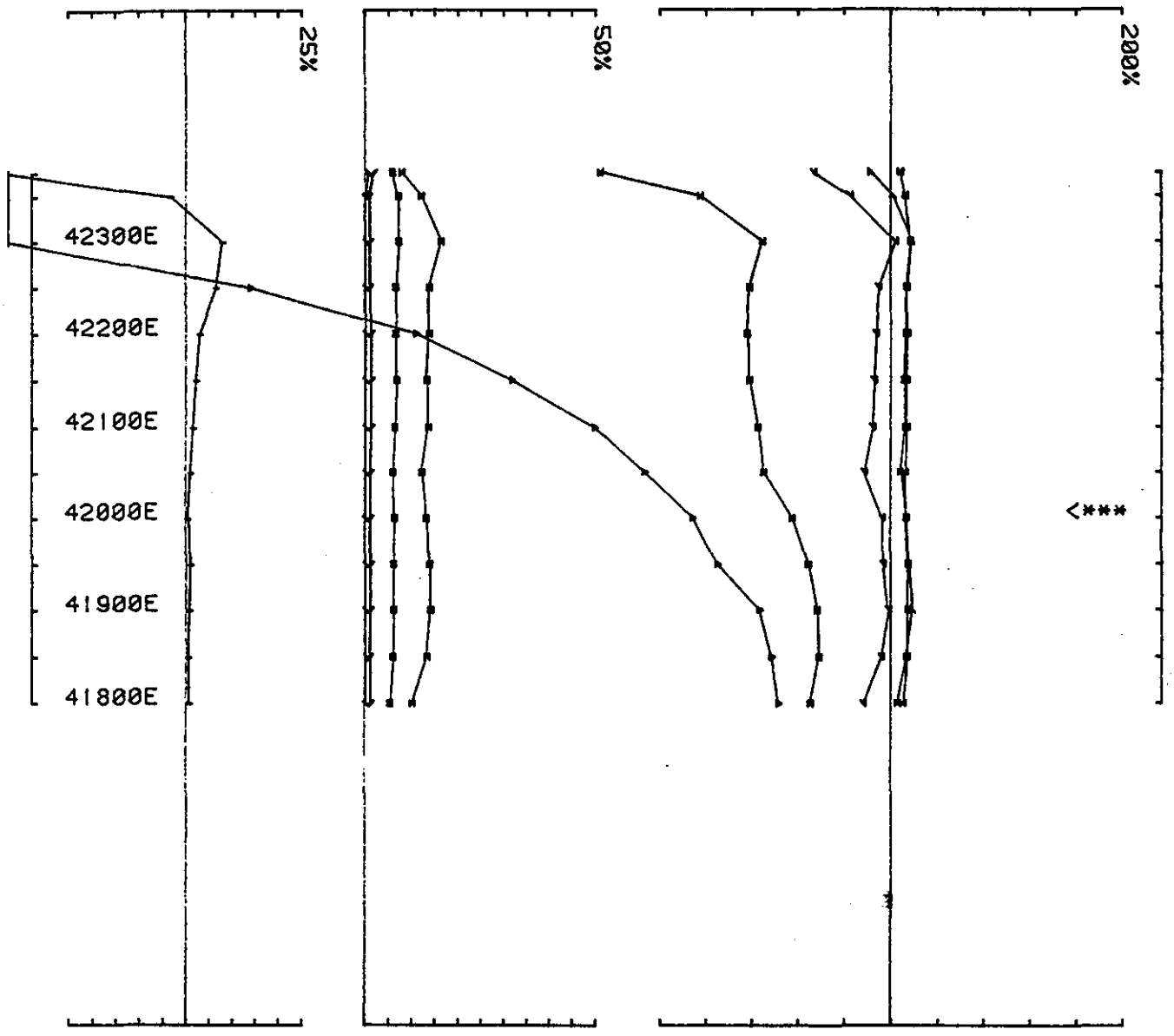

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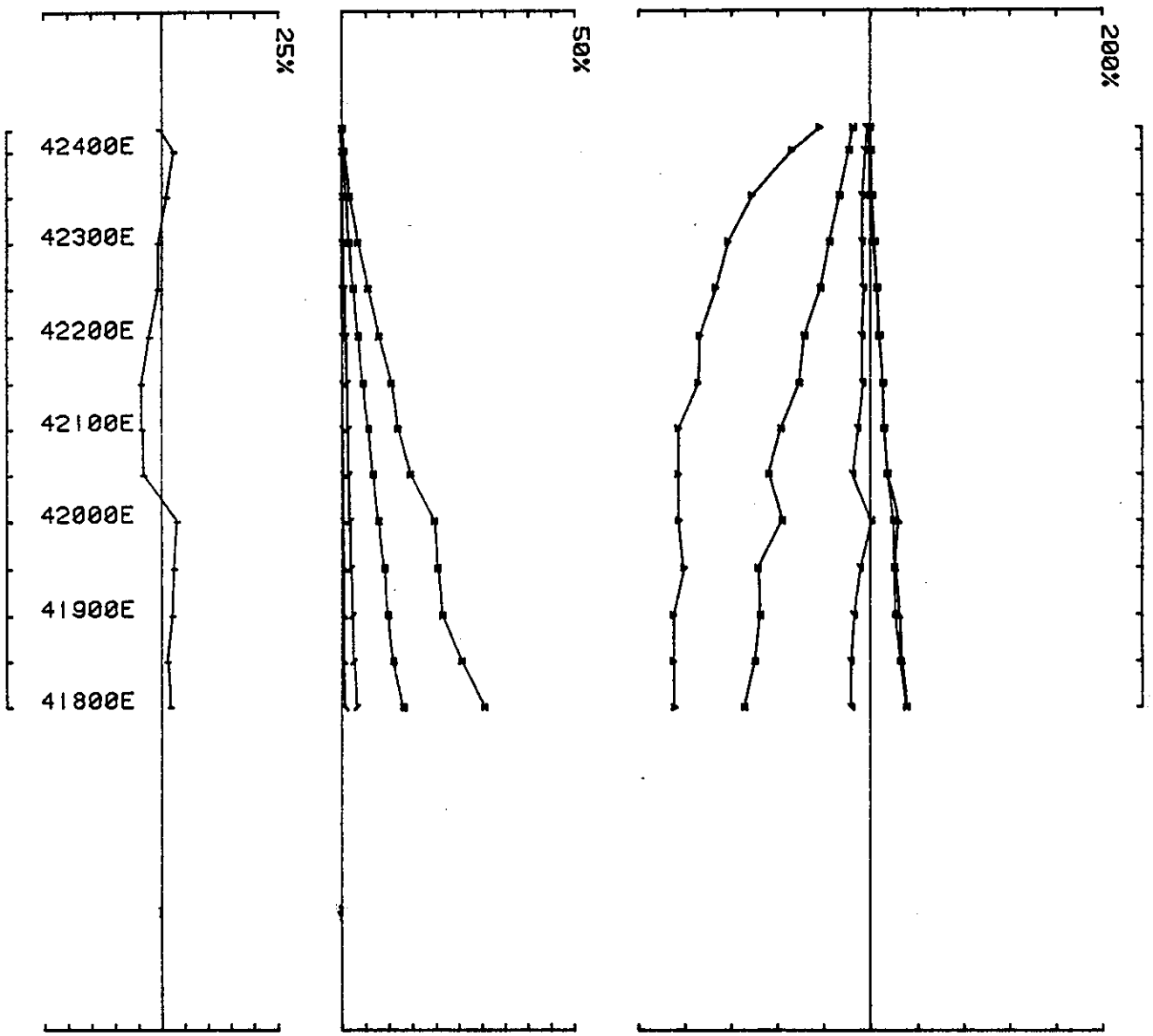

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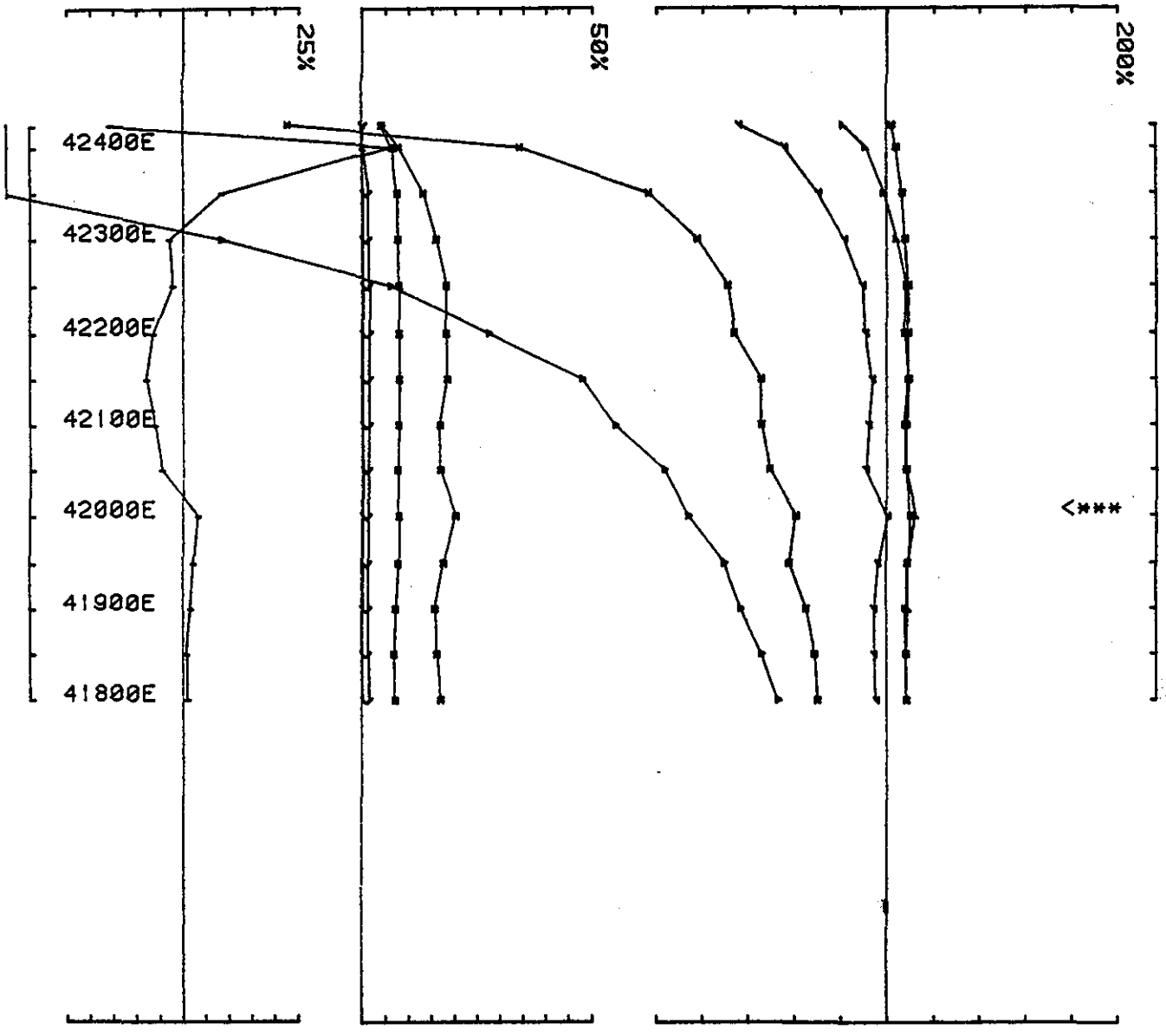

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APPENDIX II

652246

7th ASEG Conference Paper No

Interpretation of TDEM Data Using First and Second Spatial Derivatives and Time Decay Analysis

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Keywords

Time Domain electromagnetics, spatial derivatives, decay analysis, current gathering, deposits, formational conductors

Short title

Spatial Derivatives in TDEM

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ABSTRACT

Current gathering in fixed loop electromagnetic data often dominates responses from large high-grade ore bodies as well as responses from less desirable features such as fault zones, weathering troughs and regional conductors. Through decay curve analysis, current gathering can now be unambiguously recognised. Many widely used EM interpretation techniques are not applicable to current gathering (channelling) responses. An effective method of deriving the location and shape of the causative source is to study the second spatial derivative, as is shown in several examples.

INTRODUCTION

The discovery of the Hellyer orebody in Tasmania by Aberfoyle Resources (Silic et al, 1985), has shown that important economic discoveries need not be characterised by long time constant, time domain electromagnetic (TDEM) responses. At the time of the discovery it was recognized that the Hellyer response was largely dominated by current gathering effects, and that other non-economic features such as lithologies or weathering troughs which have a resistivity contrast with their surroundings, may produce responses lasting to similar times. Some authors have reported on some of these problems from case histories as difficulties or limitations of TDEM (Spies and Parker, 1984; Irvine and Staltari 1984).

The purpose of this paper is to show that these problems can be

overcome; to discuss decay analysis techniques for recognising responses which are largely dominated by the "static" interaction between the half spaces electric field and the target, commonly known as current gathering (West and Edwards, 1985), and to illustrate the use of the spatial derivative of fixed loop TDEM data in recognizing the geometry of the conductive targets. Only the 2-D solution for the geometry of the targets will be presented; however, the concept can be extended to 3-D bodies.

APPLICATION OF THE INTEGRAL EQUATION METHOD

Numerous authors have discussed the generalized frequency domain integral equation for the total vector electric field that is composed of a primary field $\underline{E}^p$ within a half space perturbed by a secondary field $\underline{E}^s$ from a local conductivity variation within the earth (Hohmann, 1975; Raiche, 1974; Weidelt, 1975). Similar formulations apply to the solutions for the magnetic field (eg. West and Edwards, 1985). San Filipo and Hohmann (1985), and Oristaglio and Hohmann (1984) have successfully obtained solutions for the time domain.

The purpose of this section however is not to discuss the solutions for the "scattering" or "anomalous" current $\underline{J}^s(\underline{r}',t)$ within the inhomogeneity, but rather to determine the effect of a conductive half space on the problem of determining the secondary magnetic field from the scattering current. The equation relevant to the problem expresses the secondary magnetic field as

$$\underline{H}^s(\underline{r},t) = \int_{vo}^{t}\int \underline{Gh}(\underline{r},\underline{r}',t-\bar{t})\ \underline{J}^s(\underline{r}',\bar{t})\ d\bar{t}d\underline{r}' \quad -(1)$$

and only the convolution integral

$$\int_{o}^{t} \underline{Gh}(\underline{r},\underline{r}',t-\bar{t})\ \underline{J}^s(\underline{r}',\bar{t})d\bar{t} \quad -(1a)$$

needs to be considered. To study this effect the Green's tensor solutions for a line source in a half space were evaluated (Silic, 1989). By assuming that current density with an arbitrary time dependence can be synthesised as a discreet or continuous sum of exponential decay functions $I_n e^{-t/\tau_n}$ it was concluded by evaluating equation 1a for a number of time constants τ_n, that for $\frac{t}{\sigma\mu r^2} \geq 1.0$ (r being the distance to the source, σ the halfspace conductivity) and measuring times up to about $4\tau_n$, free space approximations may be used to relate the magnetic field components to the current source, although in some instances a time delay which is largely a function of $\sigma\mu r^2$ may have to be incorporated into the calculation (Silic, 1989). Identical results are obtained for a current dipole which is relevant to the 3-D problem. As an example, for a 200 Ωm half space, and a distance r of 200 m, $\frac{t}{\sigma\mu r^2} = 1.0$ gives a time of 252 microseconds, a very early time for most TDEM responses. However the preceding conclusions are not suggesting that the half space is not affecting the current distribution within the inhomogeneity at these "late" times since the two effects can scale differently in time. It is only suggested that free space approximations may be used to relate the magnetic field to a current source. This concept is vital to the following sections.

RECOGNITION OF CURRENT GATHERING RESPONSES:

West and Edwards (1985) have shown by studying the response of a disk inhomogeneity in a conductive half space that to calculate the scattering current, direct interaction between the scattering current and the eddy currents they induce in the host medium may

be neglected to a first order approximation. These static or DC solutions suggest that in the case where the body is reasonably compact, and the primary electric field has the same general direction throughout, then as long as the target's "skin effect" does not dominate, current gathering "anomalous" current density $\underline{Jg}^s(r',t)$ may be written from magneto metric response solutions (eg. Edwards, 1974) as,

$$\underline{Jg}^s(\underline{r}',t) = C\,\underline{E}^p(\underline{r}',t) \quad -(2)$$

where C is a conductivity contrast/geometrical (body shape) function.

The current gathering "anomalous" current density will then essentially have the time dependence of the primary electric field in the vicinity of the body. Therefore, as long as the "late" time free space approximation from the previous section is valid, the magnetic field will have the same time dependence. To study this time dependence, electric field in a half space solutions from Lewis and Lee (1978) and Silic (1987) are used. It is shown that for step TDEM systems (eg. UTEM, West et al, 1984) at "late" times when $(a^2 + r^2 + z^2)\frac{\sigma\mu}{4t} << 1$, where a is the loop radius, Υ is the distance from the loop centre and z is the depth,

$$\underline{E}^p(r,z,t) = \frac{a^2 r}{40\sigma\sqrt{\pi}}\left(\frac{\sigma\mu}{t}\right)^{5/2} + \frac{5a^2 rz\Gamma(5/2)}{48\sigma\sqrt{\pi}}\sqrt{\frac{\sigma\mu}{4t}}\left(\frac{\sigma\mu}{t}\right)^{5/2} \quad -(3)$$

while for the impulse systems (Buselli and O'Neill, 1977; McNeill, 1982)

$$\underline{E}^p(r,z,t) = \frac{a^2 r}{16\sigma^2\sqrt{\pi}}\left(\frac{\sigma\mu}{t}\right)^{7/2} + \frac{a^2 rz\Gamma(5/2)}{32\sigma^2\sqrt{\pi}}\left(\frac{\sigma\mu}{t}\right)^{4} \quad -(4)$$

Essentially at "late" times the step system electrical field is characterized by a $t^{-5/2}$ power-law decay, while the impulse

system's electric fields will have a $t^{-7/2}$ time dependence. To determine whether current gathering effects are dominating the response, a power law decay is fitted with care to the latest anomalous times. If this power law then dominates the response for most of the anomalous time, and its exponent depending on the system is close to -5/2 or -7/2, then current gathering effects may be inferred.

It is also recognized from Kaufman and Keller (1985), that the "very late" time inductive effect, when the vortex currents in the conductive target are following the decay of the half space magnetic field, will also have a $t^{-5/2}$ or $t^{-7/2}$ power law decay. However, this effect may only be important for thick or relatively flat lying targets since the direction of the half space primary magnetic field is relatively vertical at the "late" times. However, unlike the current gathering effect, it begins as a "very late" time phenomena. As such it is not expected to dominate the response for most of the anomalous time.

INTERPRETING SPATIAL DERIVATIVES OF FIXED LOOP TDEM DATA

Different interpretation methods must be used for current gathering anomalies than for eddy current induction responses. The strength of a current gathering effect is a function of conductivity contrast between the anomalous body and the host medium, the body's geometry and the conductivity of the half space, whereas the time dependence of the response is largely a function of the host medium's primary electric field. The latest time at which the anomalous response will be detected, will

therefore be largely a function of the maximum amplitude of the magnetic field at early time, this also being a function of depth or distance to the conductor. Therefore, discriminating techniques which rely on conductivity-thickness estimates from decay analysis, or the latest time affected by a conductor, are not valid for current gathering responses.

This section looks at the problem of attempting to obtain the shape of the conductive source from spatial derivative data, and its implementation as a discriminating technique. It is reasoned that if the shape of the target can be estimated from the profile data, then we may discriminate between the conductive bodies on the basis of their interpreted geometry.

Theoretical Considerations

By using the approximation discussed in the previous section that at "late" times free space Green's tensors may be used in equation 1, considerable simplication results in evaluating the potential field problem which links the magnetic field components to a current distribution. In this section, only results for 2-D bodies will be discussed. Formal solutions have been obtained for arbitrary current distributions within dipping sheets and blocks; however only some of the formal solutions for a dipping current sheet will be presented, as they have a similar, but simpler form to block conductor formulations (Silic, 1989). More complex shapes can be modelled by a superposition of a number of blocks and sheets. By assuming that a current density distribution can be expressed as a polynomial, then analytical solutions for the vertical (Hz) and horizontal (Hx) field components are obtained using Gradshteyn and Ryzhik (1980). Furthermore by manipulating the integral equation which links the

magnetic field components to a current density it is shown (Silic, 1989) that the first and second horizontal spatial derivatives of the magnetic field components are related through a set of geometric functions to the current density and its first spatial derivative at the edges of the conductor. As a result a number of simple relationships between the first and second derivatives of the magnetic field components and the edges of the conductive units are obtained. For example, for relatively uniform current flow in a current sheet

$$\left(\frac{\partial Hz}{\partial x}\right)^2 + \left(\frac{\partial Hx}{\partial x}\right)^2 = \frac{J(o)^2}{(x^2+h^2)} + \frac{J(L)^2}{(x_L^2+h_L^2)} \qquad -(5)$$

where J(O) and J(L) are the current densities at the respective edges of the sheet, while x, h and x_L, h_L, are the horizontal and vertical distances to the edges. This function is completely independent of dip, and is a sum of two bell shaped functions which peak over the edges of the sheet with halfwidths 2h and $2h_L$.

Similarly it is shown that over a current sheet that is flat lying and has uniform current (eg. current gathering weathering trough), the second horizontal derivative of the vertical magnetic field peaks over the edges of a sheet with halfwidths equal to the depth to top of the sheet. The peak to peak distance in the vertical magnetic field however, is always greater than or equal to the width of the sheet. In cases where the width of the sheet is large in comparison to its depth to top, the peaks in the second derivative and the vertical magnetic field are in close proximity to each other. Similar conclusions apply for non-uniform current flow (Silic, 1989).

Figure 1 illustrates these important points. Some responses are

superficially similar. For example the magnetic field over a vertical sheet at depth may approximate the vertical magnetic field over a wide sheet. However, the second derivative method will highlight the short halfwidths in the derivative over the "shallow" edges of a flat lying sheet and allow the discrimination between the two responses as will the "proximity' of the second derivative maxima with respect to the peaks in the vertical magnetic field. Over vertical conductors the peaks in the second derivative for Hz are at least a half depth unit closer to the cross-over point than the peaks in the magnetic field (Silic, 1989). By considering block conductors, similar conclusions apply; second derivatives peak over the edges of relatively steeply dipping blocks, with halfwidths equal to twice the depth to top. Also, in comparison with sheets, the inflection points of the vertical magnetic field are further out from the edges. Discrimination between block conductors, simulating broad lithological units, and relatively steeply dipping sheets then depends on the identification of block edges through the second derivative technique.

ANALYSIS OF FIELD DATA

All three techniques, the forward modelling of the magnetic field components and first and second derivatives have the capacity to recognise the shape and location of conductive bodies. The spatial derivatives however, are preferred as they have a set of simple relationships with the edges of an arbitrary shaped conductor as discussed previously.

Four field examples, all of which have a dominant current gathering $t^{-5/2}$ "late" time decay and a scale model data set will be used to illustrate interpretation techniques which are based on the insights from previous sections. Of the four field examples, two are over world class orebodies, one is over a lithological conductor which shows superficial similarities with responses over the two orebodies and a fourth is a complex response which may contain a worthwhile exploration target. No second derivatives are actually calculated for reasons discussd in the following section. However to follow the logic of the arguments it is sufficient to know that the locations of the peaks in the second derivative can be estimated as points corresponding to the maximum change in the slope of the raw data, and that zeroes occur where the slope of the raw data does not change over some profile length. The examples are used not so much to give a recipe for the interpretation technique but rather to demonstrate the general principles on which an interpretation can be based so that a plausible explanation for the EM processes for the shape of conductive bodies can be obtained. Both the qualitative technique and the present limitations to the quantitative approach will be discussed.

(a) <u>Qualitative Approach</u>

By visually estimating the variation in the slope of the Hz profiles, we can determine the location of the second derivative maxima and its wavelength. We can use this information in conjunction with Hz data, to estimate the shape of the source and its depth to top. In particular any sudden changes in the slope are to be understood as indicating a shallow edge to a conductive unit, or an abrupt variation within a wider conductor.

UTEM scale model data in Figure 2 adapted from Macnae et al (1983), shows that every edge within a conductor, (in this case representing variations within the overburden), corresponds to one of the maximum changes in the slope of the profile. Away from these second derivative peaks the slopes are relatively constant, indicating a "narrow" second derivative and therefore that the source is shallow. This is supported by the fact that the peaks in the second derivative are also close to the minima and/or maxima of the anomaly due to the variations in the overburden as discussed in the previous section. Other maximum changes in the slope are due to normal thin layer, early to late time moveouts. This simple analysis could have led Spies and Parker (1984) and Irvine and Staltari (1984) to recognise their responses as being due to variations in overburden and not from a conductor at depth.

The response over the Hellyer deposit in Tasmania shown in Figure 3 is dominated by a "late" time $t^{-2.7}$ power law decay and hence current gathering effects may be inferred. The reason that current gathering dominates is that in this cross section ~~of~~ the dimension of the deposit is small in comparison to its depth. Therefore, at the surface, inductive flow effect is small compared to the magnetic field from unidirectional current gathering flow. This is not to say that the body is a poor conductor. The time constant obtained from down hole EM measurements is about 3-4 milliseconds (Eadie, 1987). In spite of the fact that current gathering was known to dominate this response, the

conductor became a primary target because the visual estimate of the second derivative of the profile shows a smooth continuous variation not indicative of any obvious edge effects which may be related to a broad shallow formational conductor.

The response over the very large Red Dog deposit (Van Blaricon and O'Connor, 1986), is dominated by a current gathering effect, due to its bulk resistivity of 125 Ω m (Figure 4). Any attempt to explain these results in terms of a free space model fails. However the maximum changes in the profile slope uniquely correspond with the edges of the mineralization, with the smoother slope variation corresponding to deeper terminations. The response between edges 2 and 3 is not diagnostic of any particular source and interpreting it by conventional techniques would result in identification of a shallow conductor. However connecting edges 2 and 3, with the deeper edges at 1 and 4, results in a unique interpretation of a substantial, mostly buried flat-lying target. As a comparison, the response marked by edge 5 is interpreted to be a very broad and outcropping source, and surface inspection downgraded it as a prospect.

Superficially, the current gathering response in Figure 5 is similar to the Hellyer anomaly. However, analysis of the very sudden changes in the slope of the profile identifies very shallow edges (less than 10 m from surface) from a broad conductive unit. In this area, this was not considered to be an orebody target.

A more complex profile (Figure 6) can be evaluated as a superposition of a number of responses, some of which show obvious near surface edge effects as sharp changes in the slope of the curve. Their locations have been confirmed by a conventional resistivity survey. These anomalous responses all have an approximate $t^{-5/2}$ "late" time power law decay lasting until about 4 ms, and have no separation in time. However, since the objective on this property is to find a deeply buried deposit, the smooth continuous variation in the profile's slope, indicating a "broad" second derivative gave evidence of a primary target. In this case the smooth part of the profile is outlining only a part of a normal cross-over type anomaly making quantitative interpretation difficult.

(b) Quantitative Approach

The problem posed in the quantitative approach is to remove or identify responses from sources which are not considered to be of economic importance, and to quantitatively interpret the second derivative.

As an example the profile data from Figure 6 is splined and the subsequently splined second derivatives is produced (Figure 7). This highlights the "broad" non-zero second derivative and the near surface edge effects. Since, as discussed earlier, the halfwidth of the second derivative data due to broad conductors is approximately equal to its depth to top, a problem is encountered. Fifty metre sampling of the data, as was done in this case, seriously undersamples the field data for very shallow sources. The splined second derivative data in this case has minimum

halfwidths of about 50 metres. As a result, any attempt to quantitatively remove the shallow "edge" effects is inaccurate. More closely spaced profile data is needed to accomplish this.

The quantitative approach to this type of interpretation is still being developed. A simple filter has been formulated to remove shallow edge effects from data, and a full inversion technique is the next step.

CONCLUSION

We in the exploration industry who have worked on interpretation problems have been frustrated over the difficulty of 3D-EM generalized modelling techniques to provide answers and inversion algorithms that are usable over a complex set of conductivity structures. As a result the historical tendency has been to discriminate between responses on the basis of their time constants or latest anomalous times. Our experience has however shown that this can be a very dangerous practice, if current gathering effects dominate, as the examples over the Hellyer and Red Dog deposits illustrate. As a result a new discrimination technique had to be found. Current gathering effects can now be recognised through decay analysis, and information about the shape and location of the source can be derived through analysis of the spatial derivatives. Although only some aspects of the spatial derivative and these new modelling techniques have been discussed in this paper and examples have been restricted to understanding current gathering responses, the technique can be applied to a completely general current flow.

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LIST OF FIGURES

Figure 1 Normalized vertical (Hz) magnetic fields (bottom) and second horizontal derivatives (top) over a current sheet with a constant current. The profiles are normalized by their peak values, with the magnetic field showing cross-over type responses over the sheet, and the second derivative peaking over the edges of the sheet. The halfwidth of the second derivative over the edges is equal to depth to top. Peak to peak distances in the vertical magnetic field are greater than or equal to the width of the sheet. Second derivative maxima are close to the minima and the maxima in the vertical magnetic field.

Figure 2 UTEM (Hz) scale models over disruptions in a thin layer adapted from MacNae et al. (1983). Every disruption within the layer corresponds to one of the maximum changes in the slope of the profile. Additional maximum changes in the slope are due to normal thin layer moveout.

Figure 3 UTEM (Hz) data from Hellyer ore body. The variation in the slope of the profile is continuous and smooth indicating a broad second derivative. No obvious edge effects are evident. The decay between the two arrows is dominated by a $t^{-2.7}$ power law decay, and so a current gathering effect is inferred.

Figure 4 UTEM (Hz) data from Red Dog deposit, Alaska. Maximum changes in the slope of the profile correspond to the edges of the orebody. Smoother changes correspond to the deeper terminations. Edge 5 outlines a nonprospective outcropping conductor. The decay analysis for the data between the two arrows, shows that a $t^{-2.33}$ "late" time asymptote dominates.

Figure 5 Current gathering response from a prospect near Marysville, B C, Canada shows superficial similarities to the Hellyer response in Figure 3. Sudden changes in slope identify this response to be from a broad near-surface source.

Figure 6 UTEM (Hz) data showing superposition of a number of responses, some of which show obvious edge effects from near surface broad conductors. All responses asymptote to a $t^{-5/2}$ power law. No separation between responses in time is evident. The response marked with the shaded line has a broad second derivative as indicated by a continuous variation in the profile slope, and could represent a buried target at a depth of 200-250 metres. The shaded line represents only a part of a normal Hz cross-over anomaly.

Figure 7 Cubic splined second derivative of the 2 ms UTEM data from Figure 6, highlighting the broadness of one of the responses. The data is not good enough for a quantitative analysis, without the removal of the near surface effects.

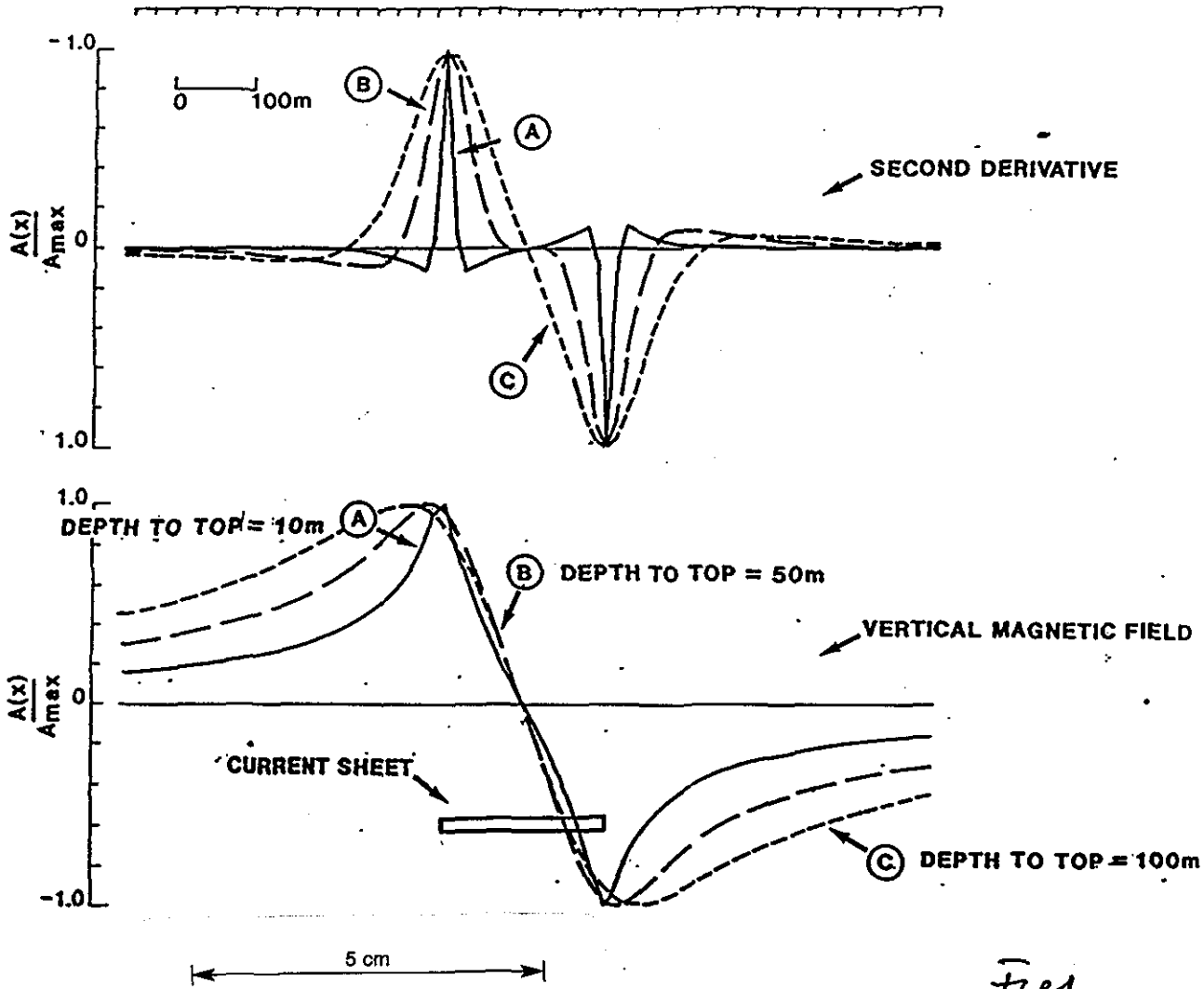
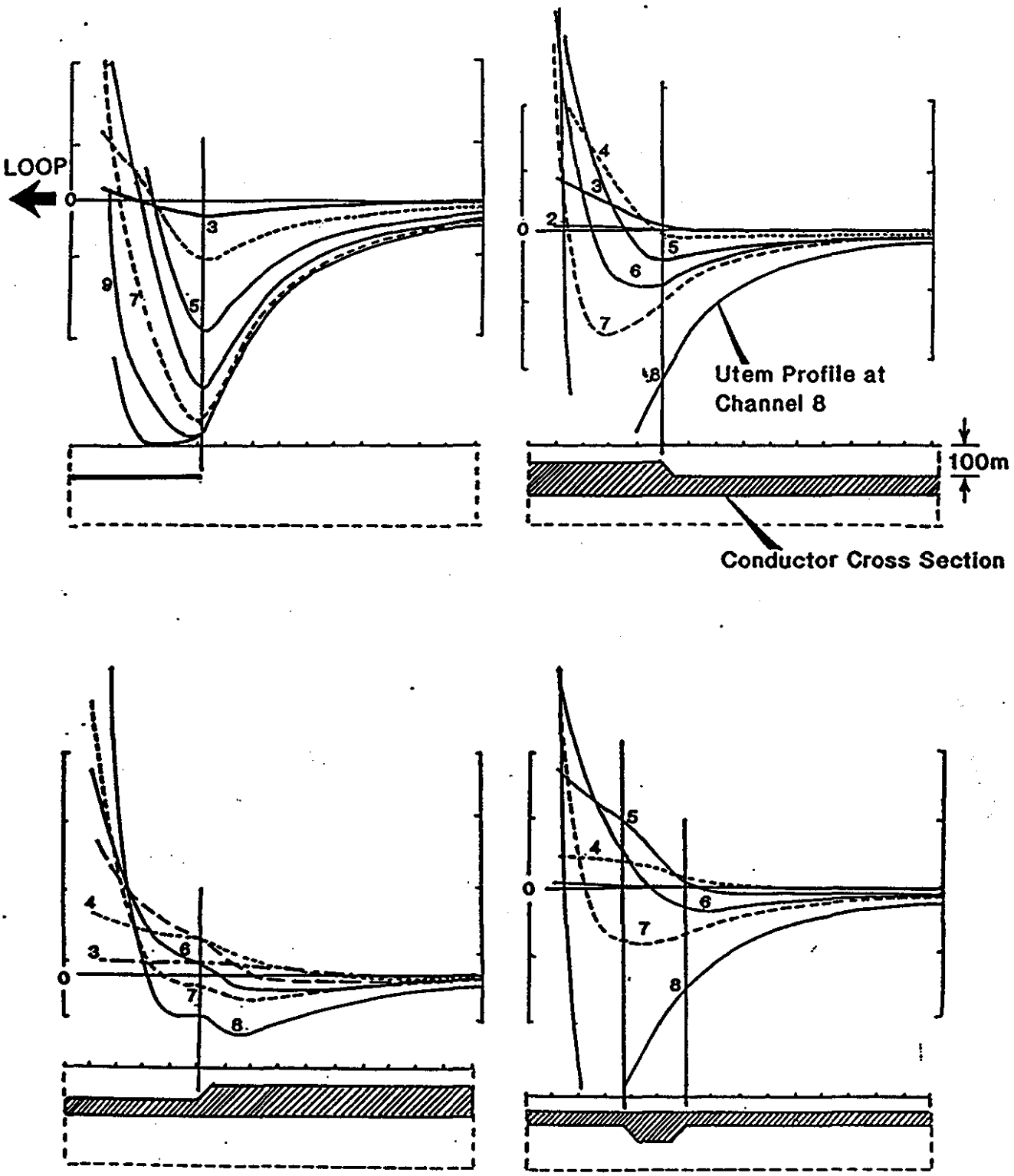
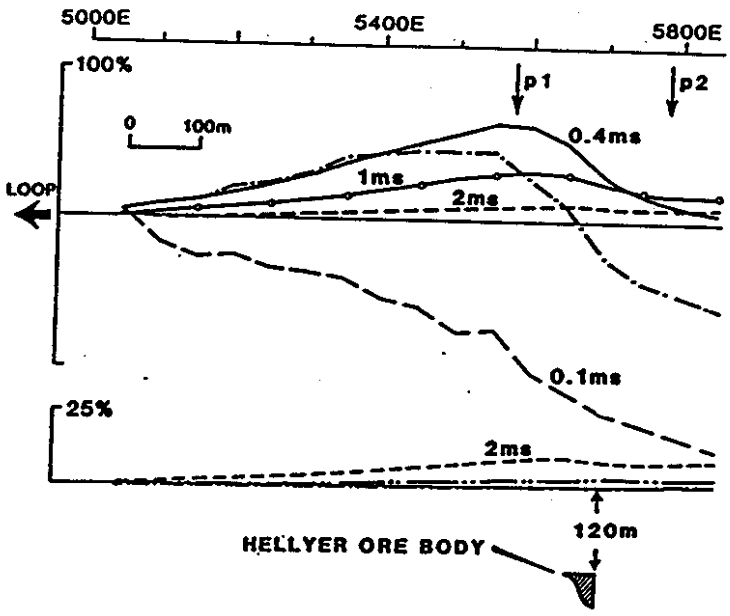
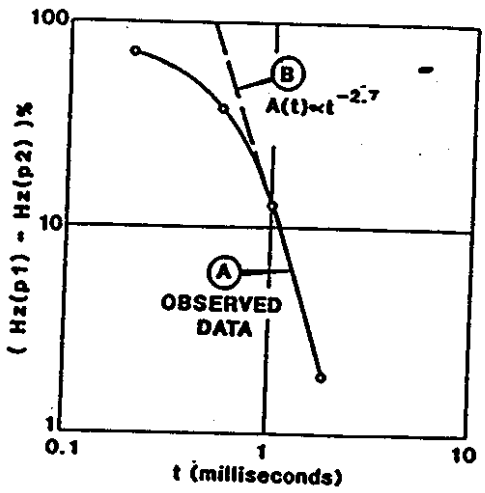

-1.0
0
100m
B
A
SECOND DERIVATIVE
A(x)/Amax
0
1.0
C
1.0
DEPTH TO TOP = 10m
A
B
DEPTH TO TOP = 50m
VERTICAL MAGNETIC FIELD
A(x)/Amax
0
CURRENT SHEET
C
DEPTH TO TOP = 100m
-1.0
5 cm

Fig 1




LOOP
0
3
9
5
0
4
3
2
5
6
7
8
Utem Profile at
Channel 8
100m
Conductor Cross Section
4
3
6
0
7
8
5
4
0
6
7
8
5 cm


5000E
5400E
5800E
100%
p1
p2
0
100m
0.4ms
1ms
2ms
LOOP
0.1ms
25%
2ms
120m
HELLYER ORE BODY


100
10
1
(Hz(p1) - Hz(p2))%
B
A(t)∝t^-2.7
A
OBSERVED
DATA
0.1
1
10
t (milliseconds)

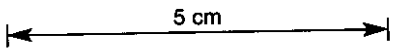
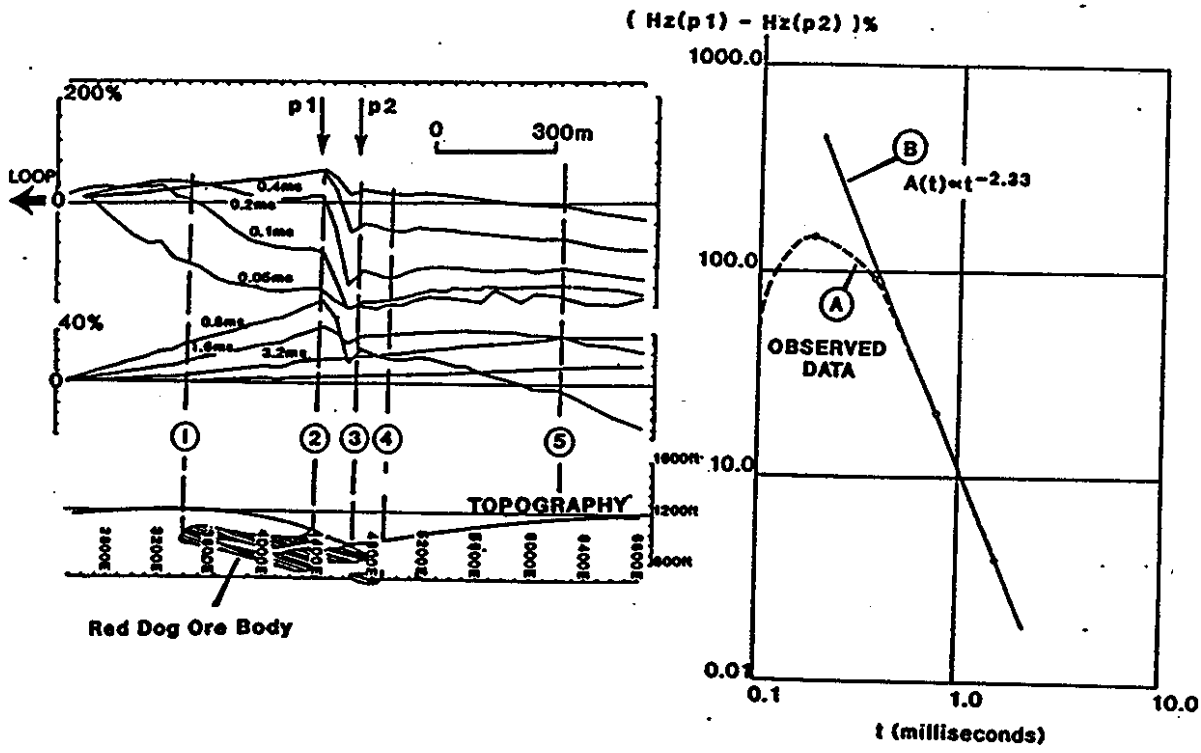
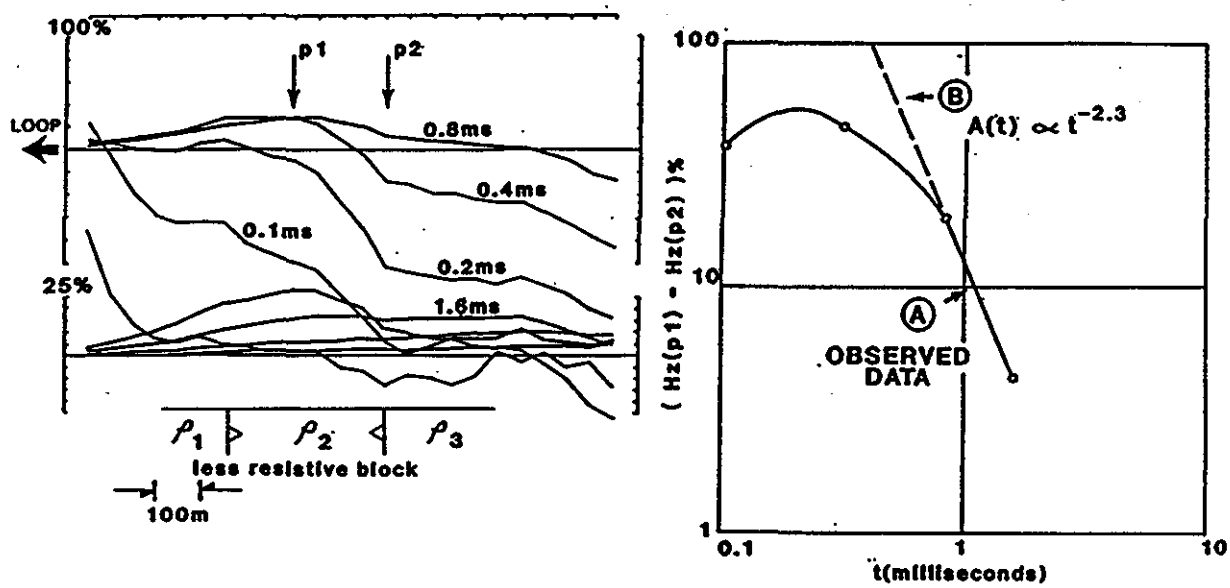

5 cm

Fig 3


200%
p1
p2
0
300m
LOOP
0.4ms
0.2ms
0.1ms
0.05ms
40%
0.8ms
1.6ms
3.2ms
0
1
2
3
4
5
TOPOGRAPHY
1600ft
1200ft
800ft
Red Dog Ore Body
(Hz(p1) - Hz(p2))%
1000.0
100.0
10.0
0.01
0.1
1.0
10.0
B
A(t)∝t^-2.33
A
OBSERVED DATA
t (milliseconds)

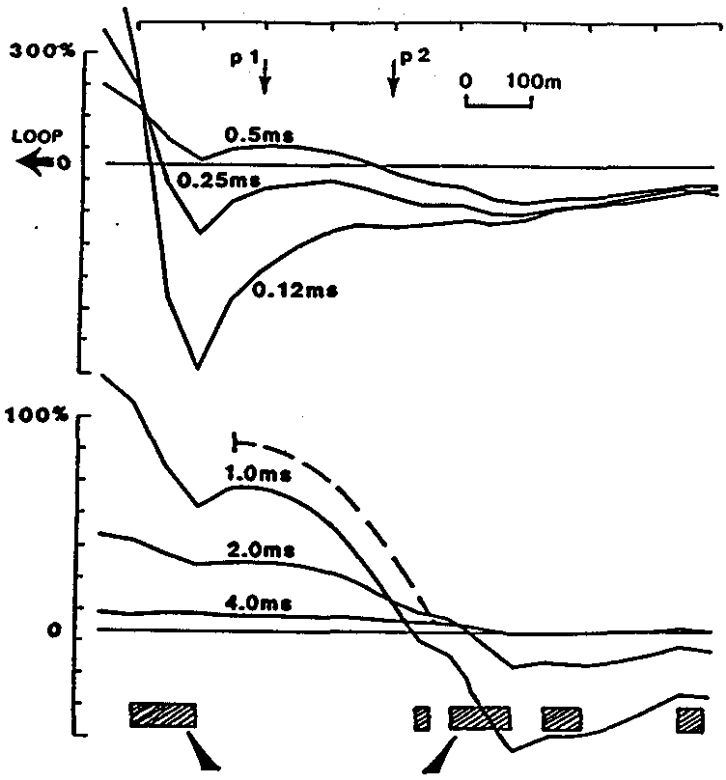
5 cm

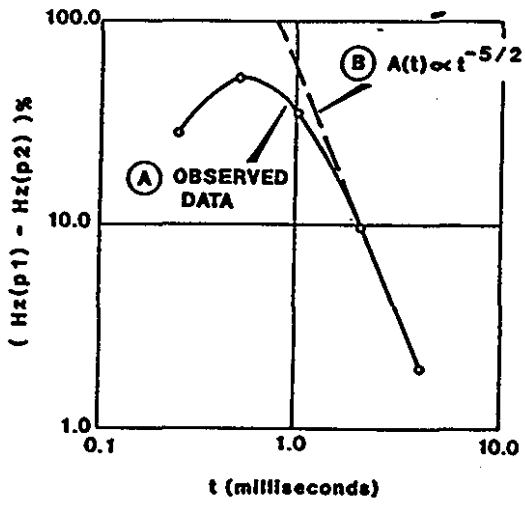
Fig 4


100%
p1
p2
LOOP
0.8ms
0.4ms
0.1ms
0.2ms
25%
1.6ms
ρ1
ρ2
ρ3
less resistive block
100m
100
10
1
(Hz(p1) - Hz(p2))%
B
A(t) ∝ t^-2.3
A
OBSERVED DATA
0.1
1
10
t(milliseconds)

5 cm

Fig 5


300%
p1
p2
0 100m
LOOP
0
0.5ms
0.25ms
0.12ms
100%
1.0ms
2.0ms
4.0ms
0
LATERAL EXTENT OF WEATHERING CONDUCTORS


100.0
10.0
1.0
0.1
1.0
10.0
(Hz(p1) - Hz(p2))%
A OBSERVED DATA
B A(t)∝t^-5/2
t (milliseconds)

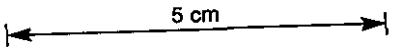

5 cm

Fig 6

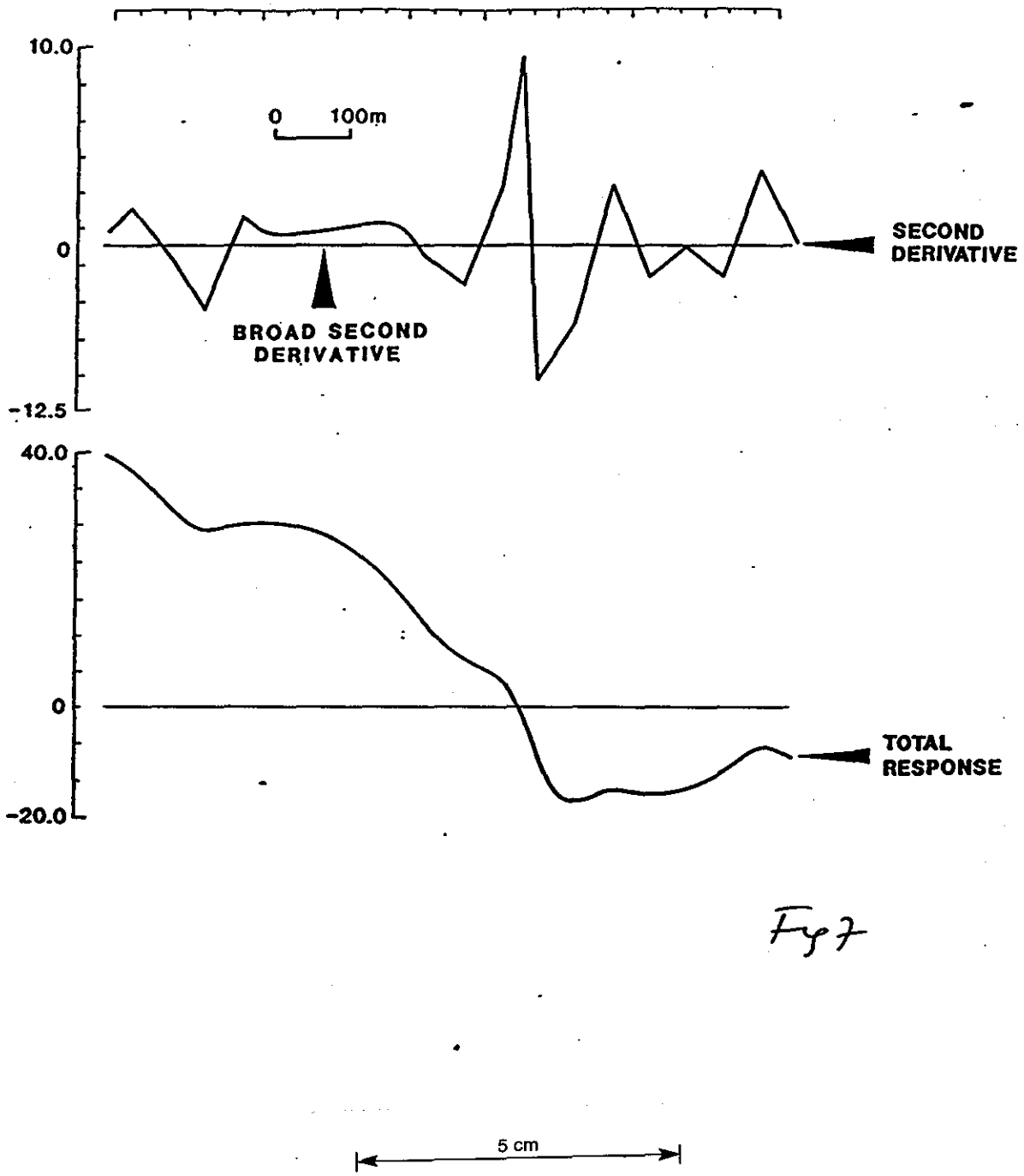

10.0
0
-12.5
0 100m
BROAD SECOND DERIVATIVE
SECOND DERIVATIVE
40.0
0
-20.0
TOTAL RESPONSE

Fig 7

5 cm

652272

APPENDIX 8

Report on Cambrian Fossils from near Paradise.

(J. B. Jago)

REPORT ON CAMBRIAN FOSSILS FROM NEAR PARADISE

The fossils were collected by Dr. K.D. Corbett after the initial discovery by Dr. A. Crawford while looking at petrological specimens provided by Aberfoyle Resources Ltd. Dr. Corbett states (pers common) that they occur within thin (? up to the 10m thick) lenses of north-south striking tuffaceous siltstone from within a sequence of volcanics - mainly felsic lavas and porphyries.

All fossils occur as internal and external moulds and in general show considerable distortion. Many of them are fragmentary.

Most fossils occur in thin (1-2mm) horizons of slightly coarser, ?tuffaceous, micaceous, pale grey to brown siltstone within the generally laminated grey siltstone which forms the bulk of the rock. These horizons probably represent material washed in from higher on the sea floor by turbidity currents. The fossiliferrous horizons are generally quite rich. Because of the limited amount of available material no attempt has been made to distinguish between the faunas in the thin slightly coarser horizons from that in the bulk of the rock.

Agnostoid trilobites include Diplagnostus, Valenagnostus, Goniagnostus, ?Lejopyge, ?Hypagnostus, Peronopsis plus other small agnostoids. Almost all the agnostoids occur as separate cephala and pygidia rather than as complete specimens.

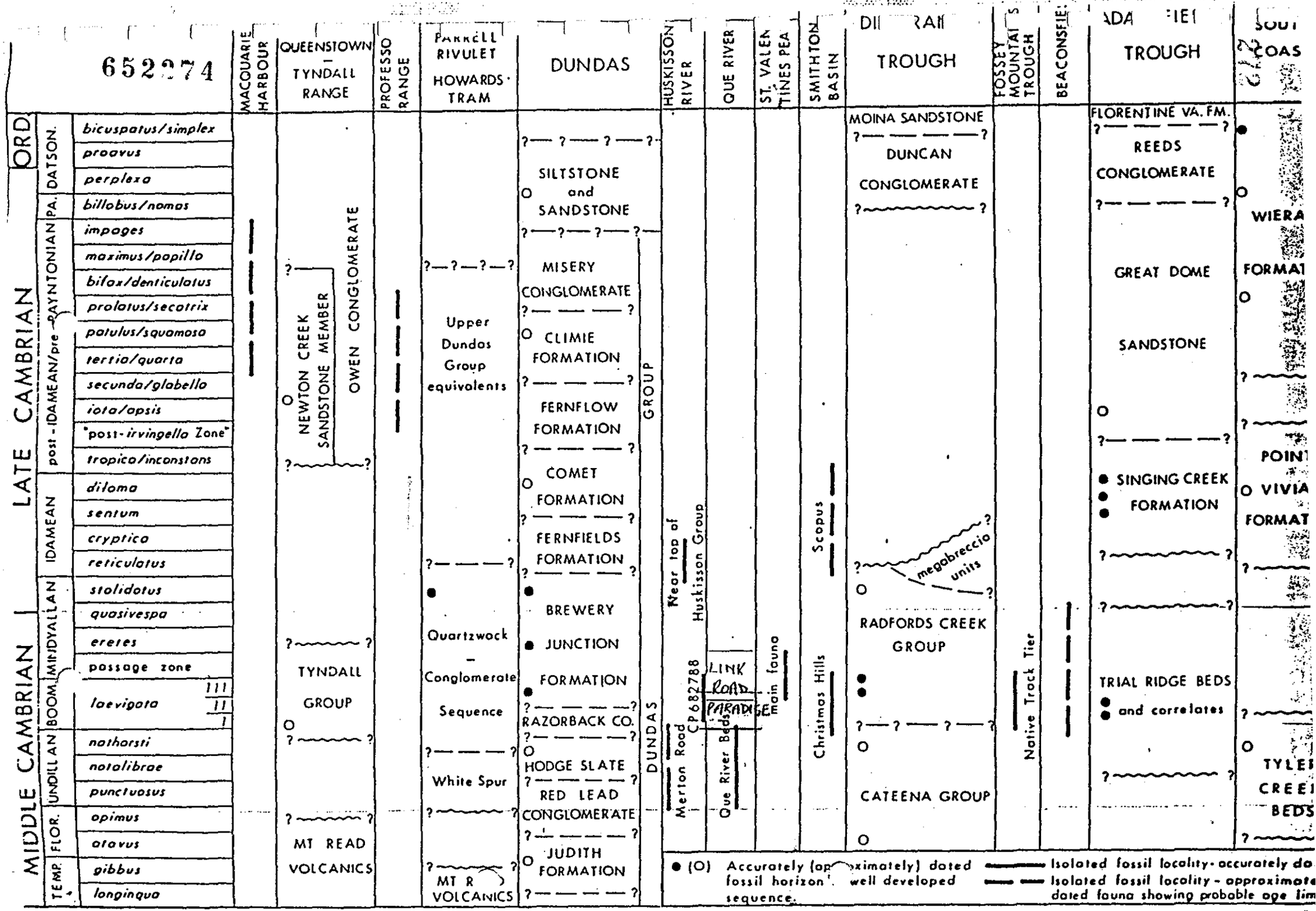
The polymeroid trilobites include Nepea, Amphoton, a possible papyriaspid and at least one other species. The polymeroids are much less abundant than the agnostoids.

Age of Fauna

The fossils noted above are of late Middle Cambrian age. They probably fall within the range of the Lejopyge laevigata I, L. laevigata II or L. laevigata III Zones, although the preservation of the fossils prevents identification to species level and hence the determination of an exact age.

The fragmentary nature of the fossils particularly the polymeroids, suggests that further collection will reveal a more diverse fauna than currently available, and hence a more precise age.

J.B. Jago,
Department of Applied Geology,
South Australian Institute of Technology,
The Levels,
South Australia 5095


652274
MACQUARIE HARBOUR
QUEENSTOWN - TYNDALL RANGE
PROFESSO RANGE
PARRELL RIVULET HOWARDS TRAM
DUNDAS
HUSKISSON RIVER
QUE RIVER
ST. VALEN TINES PEA
SMITHTON BASIN
DI RAN TROUGH
FOSSEY MOUNTAI S TROUGH
BEACONSFIE
ADA IEI TROUGH
SOUT COAS
ORD
MIDDLE CAMBRIAN | LATE CAMBRIAN
DATSON.
PA.
PAYNTONIAN
post-IDAMEAN/pre
IDAMEAN
MINDYALLAN
BOOM
UNDILLAN
FLOR.
TEMP.
bicuspatus/simplex
proavus
perplexa
billobus/nomas
impages
maximus/papillo
bifax/denticulatus
prolatus/secatrix
patulus/squamosa
tertio/quarta
secunda/glabello
iota/apsis
"post-irvingello Zone"
tropico/inconstans
diloma
sentum
cryptica
reticulatus
stolidotus
quasivespa
eretes
passage zone
laevigata
III
II
I
nathorsti
notalibrae
punctuosus
opimus
otavus
gibbus
longinqua
NEWTON CREEK SANDSTONE MEMBER
OWEN CONGLOMERATE
TYNDALL GROUP
MT READ VOLCANICS
Upper Dundas Group equivalents
Quartzwock – Conglomerate Sequence
White Spur
MT R VOLCANICS
SILTSTONE and SANDSTONE
MISERY CONGLOMERATE
CLIMIE FORMATION
FERNFLOW FORMATION
COMET FORMATION
FERNFIELDS FORMATION
BREWERY
JUNCTION FORMATION
RAZORBACK CO.
HODGE SLATE
RED LEAD CONGLOMERATE
JUDITH FORMATION
DUNDAS GROUP
Near top of Huskisson Group
Merton Road
CP682788
LINK ROAD
PARADISE
Que River Beds
main fauna
Scopus
Christmas Hills
MOINA SANDSTONE
DUNCAN CONGLOMERATE
megabreccio units
RADFORDS CREEK GROUP
CATEENA GROUP
Native Track Tier
FLORENTINE VA. FM.
REEDS CONGLOMERATE
GREAT DOME SANDSTONE
SINGING CREEK FORMATION
TRIAL RIDGE BEDS and correlates
WIERA
FORMAT
POINT
VIVIA
FORMAT
TYLER
CREEK
BEDS
● (O) Accurately (approximately) dated fossil horizon: well developed sequence.
Isolated fossil locality - accurately da
Isolated fossil locality - approximate
dated fauna showing probable age lim

OPEN FILE

652275
89-3004

MINES
File Ref. EL 11/88
10 AUG 1989
Doc. Ref.
Action Officer | Initials, Date
Letter refers 9-8-89
Resubmit to | Date

EXPLORATION LICENCE 11/88

GOWRIE PARK

TASMANIA

PROGRESS REPORT FOR THE YEAR ENDED JULY 1, 1989

VOLUME 2

PLATES

MICROFILMED

COMPILED AND WRITTEN BY:

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GEOLOGIST.

D. J. NOONAN
GEOLOGIST.

ISSUED BY:

D. B. WALLACE
REGIONAL MANAGER.

AUGUST 19

Distribution:

Department of Mines
Aberfoyle - Burnie
Aberfoyle - Hawthorn

89-3004 Vol 2/2



5 cm

89-3004

Aberfoyle Resources Limited
EXPLORATION DIVISION

652276

REVISIONS				
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Location Code :

NORTH WEST TASMANIA

BEULAH - GOWRIE PARK AREA
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Date : December, 1988

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Traced :
Checked :
Plate No : GP 6a

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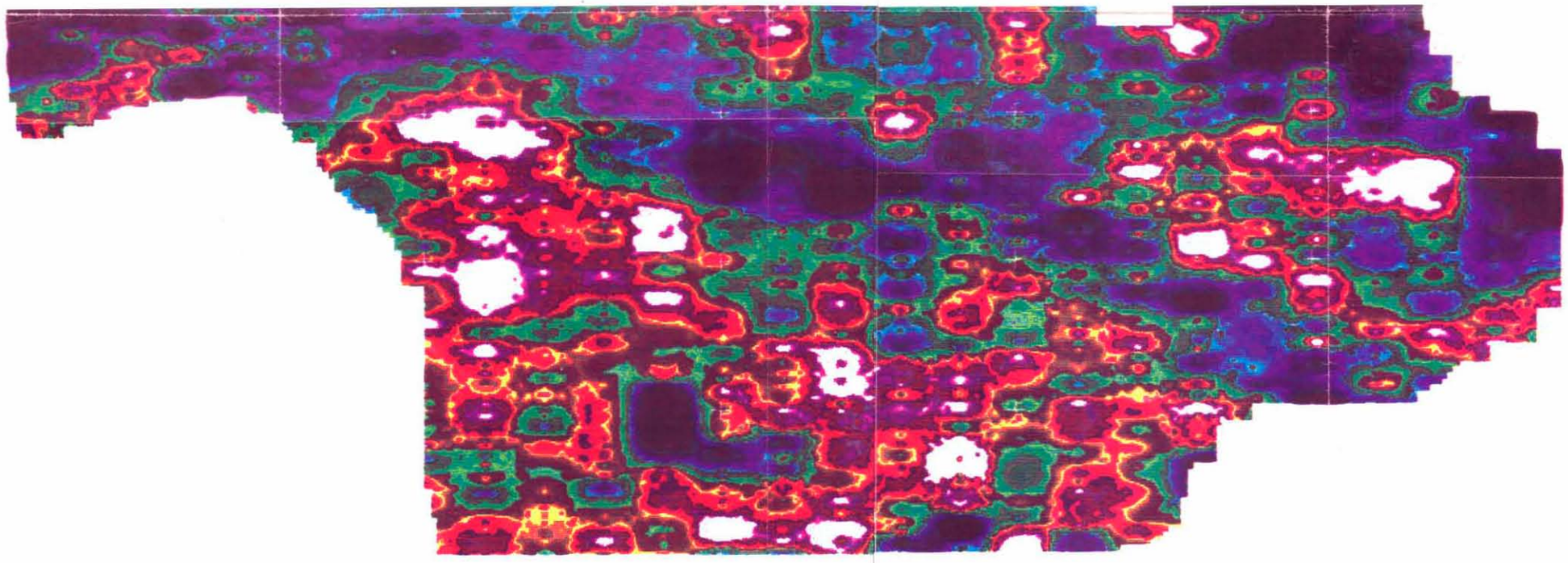

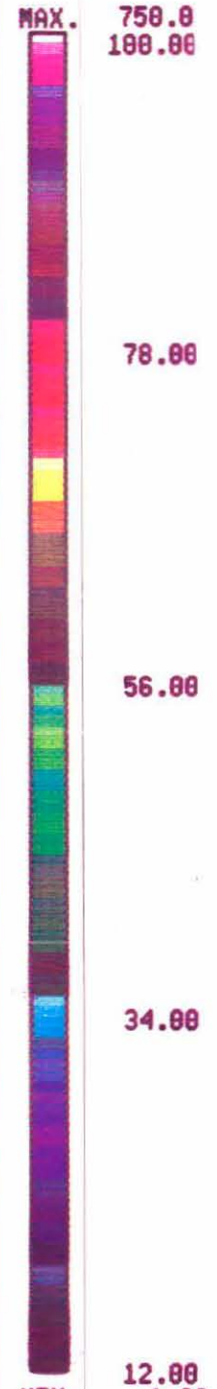

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89-3004

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Scale: 1-10000

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date
Location Code :			

NORTH WEST TASMANIA
GOWRIE PARK E.L.11/88
GEOCHEMISTRY (Cu)

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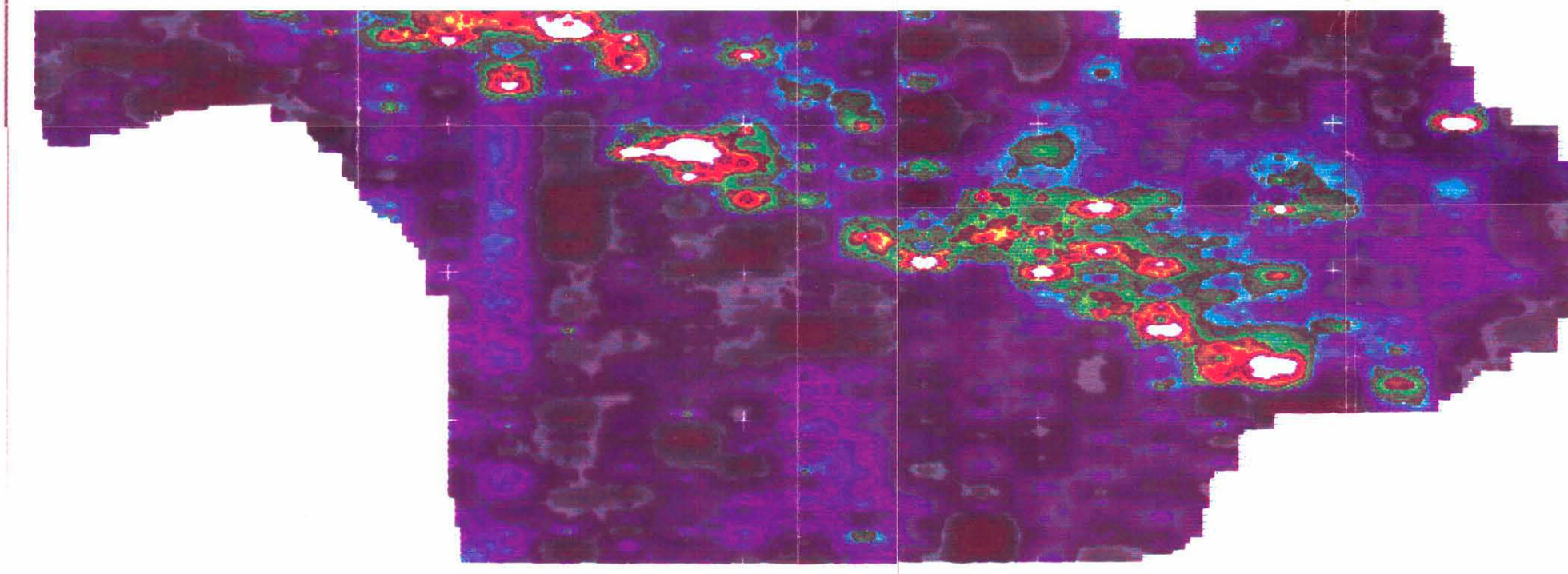

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200.00
150.00
100.00
50.00
0.00
MIN. 0.65
units = PPM

5 cm

89-3004

Gowrie Park (Pb)
Date: 22-1-89 Drawn: RGP
Scale: 1-10000

Aberfoyle Resources Limited
EXPLORATION DIVISION
652[illegible]S

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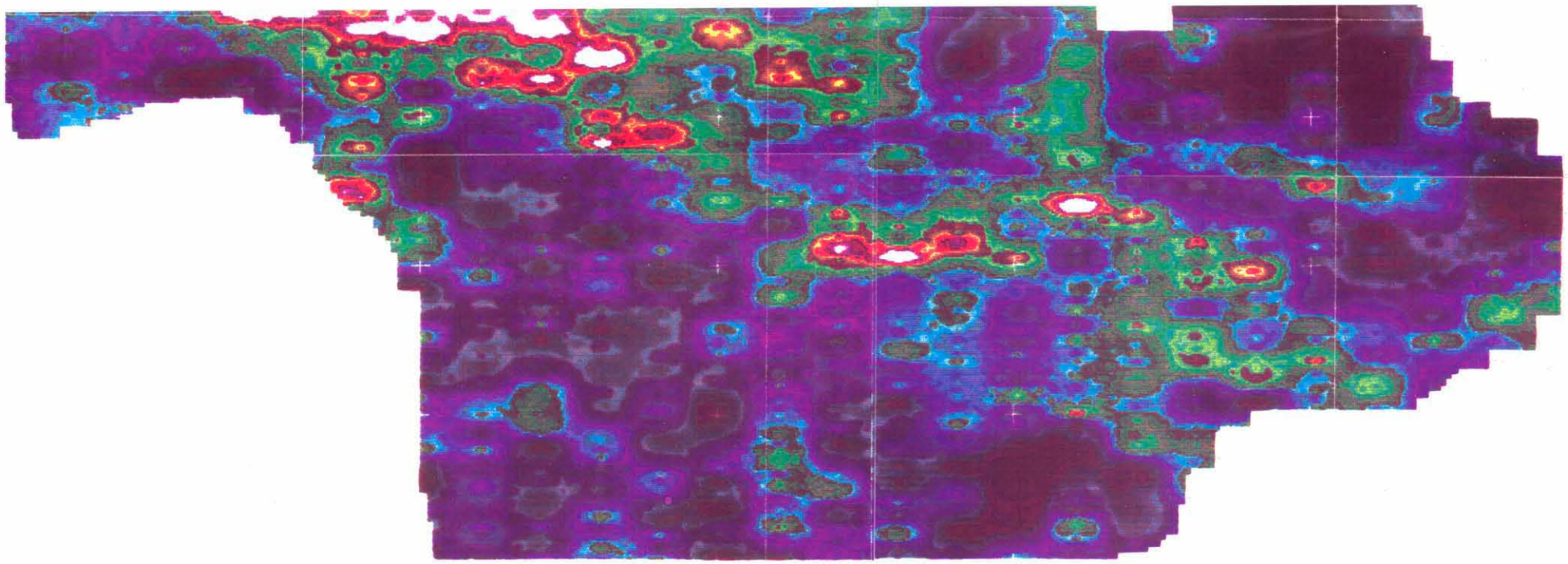

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35.00
MIN. 2.09
units = PPM

5 cm

489000E
494000E
500000E
510000E
520000E

89-3004

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Date: 22-1-89 Drawn: RGP
Scale: 1-10000

Aberfoyle Resources Limited
EXPLORATION DIVISION
652279

REVISIONS			
Init	Date	Init	Date
Location Code :			

NORTH WEST TASMANIA
GOWRIE PARK E.L.11/88
GEOCHEMISTRY (Zn)

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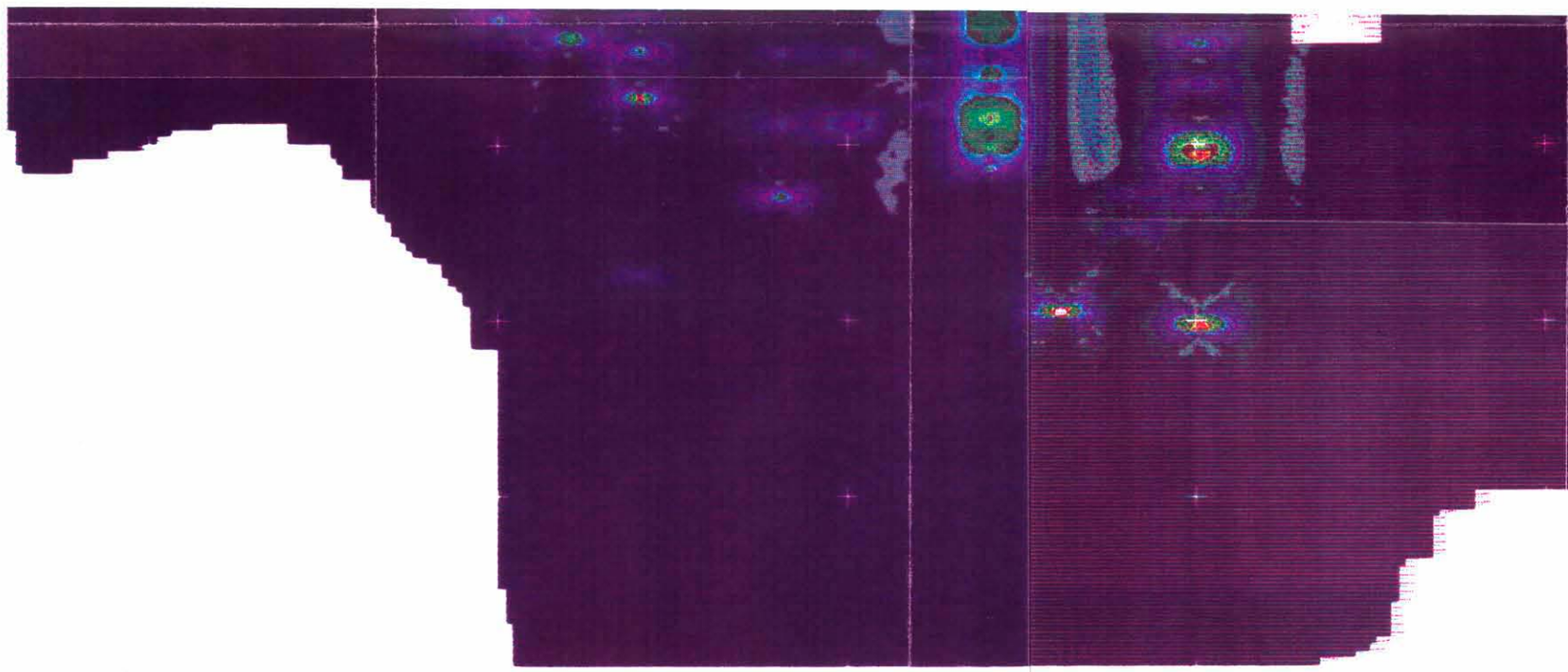

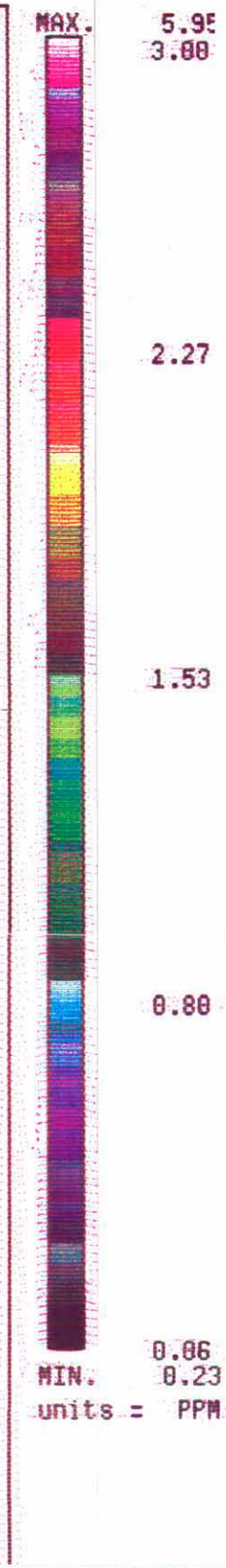

89-3004

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Scale: 1-10000

Aberfoyle Resources Limited
EXPLORATION DIVISION
652280

REVISIONS			
Init	Date	Init	Date

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GOWRIE PARK E.L.11/88
GEOCHEMISTRY (Ag)

Location Code :
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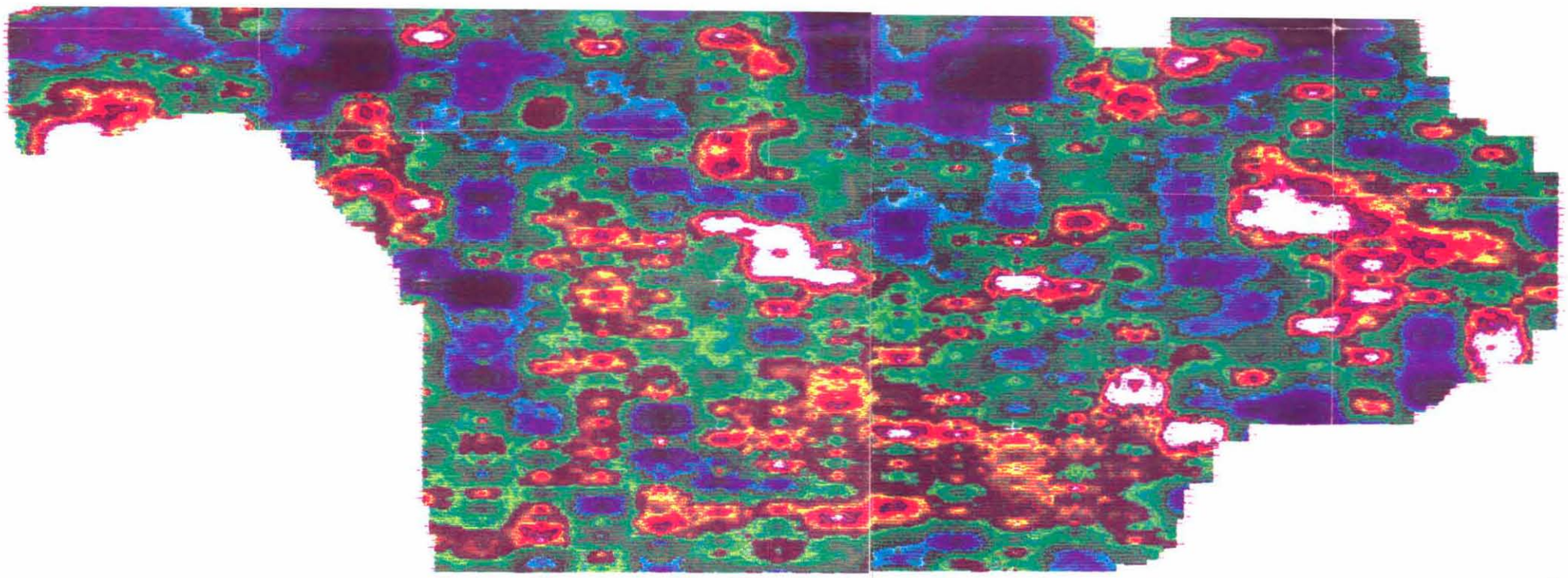

MAX. 144.58
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9.95
5.63
1.30
MIN. 0.22
units = PPM

5 cm

89-3004

Gowrie Park (As)
Date: 22-1-89 Drawn: RGP
Scale: 1-10000

Aberfoyle Resources Limited
EXPLORATION DIVISION 652281

REVISIONS				NORTH WEST TASMANIA	
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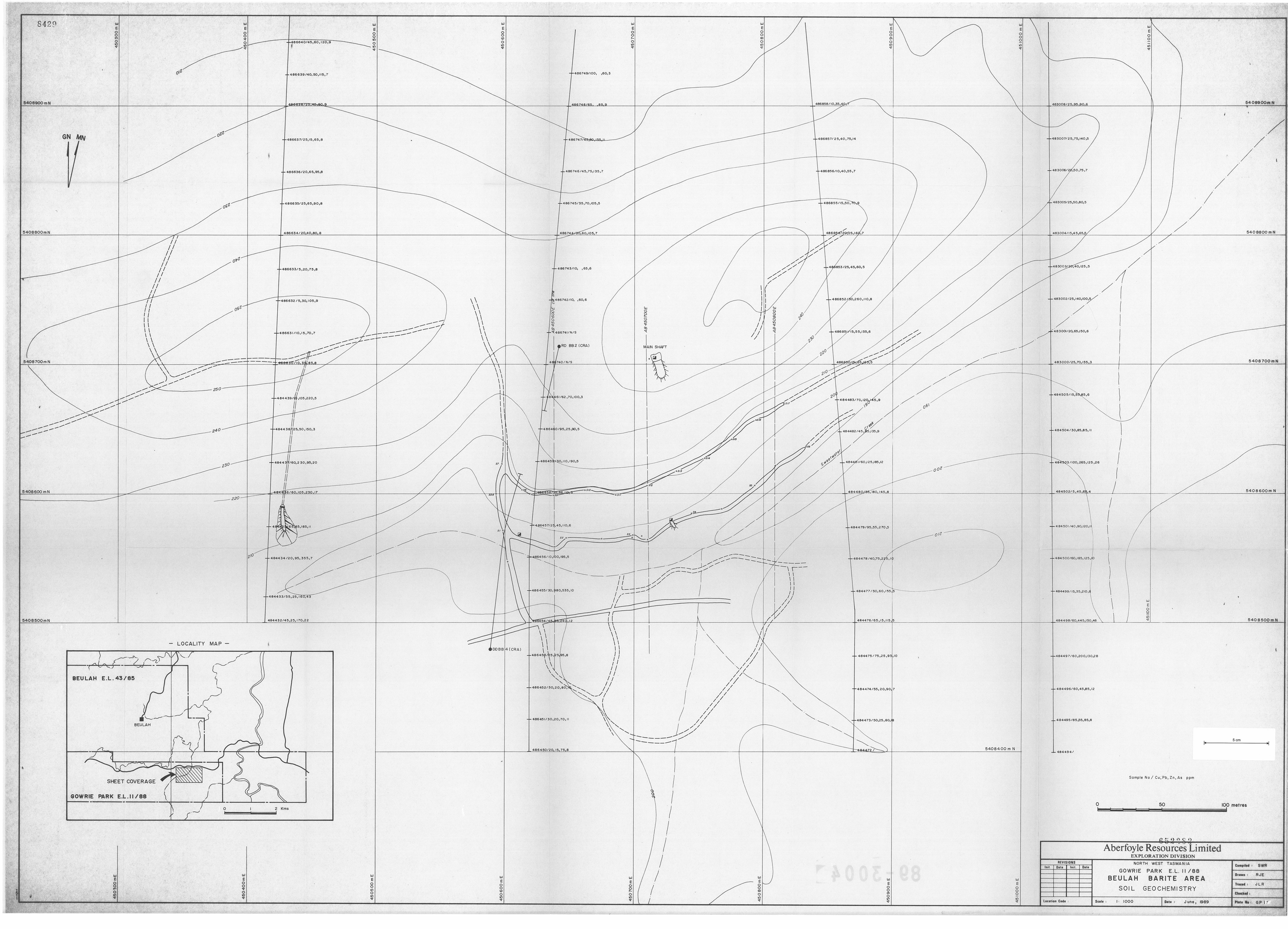
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MAIN SHAFT
RD BB2 (CRA)
DDBB4 (CRA)
Sweetwater Creek
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5408400 mN
450300 mE
450400 mE
450500 mE
450600 mE
450700 mE
450800 mE
450900 mE
451000 mE
451100 mE
- LOCALITY MAP -
BEULAH E.L. 43/85
BEULAH
SHEET COVERAGE
GOWRIE PARK E.L. 11/88
0 1 2 Kms
5 cm
Sample No / Cu, Pb, Zn, As ppm
0 50 100 metres
Aberfoyle Resources Limited
EXPLORATION DIVISION
NORTH WEST TASMANIA
GOWRIE PARK E.L. 11/88
BEULAH BARITE AREA
SOIL GEOCHEMISTRY
REVISIONS
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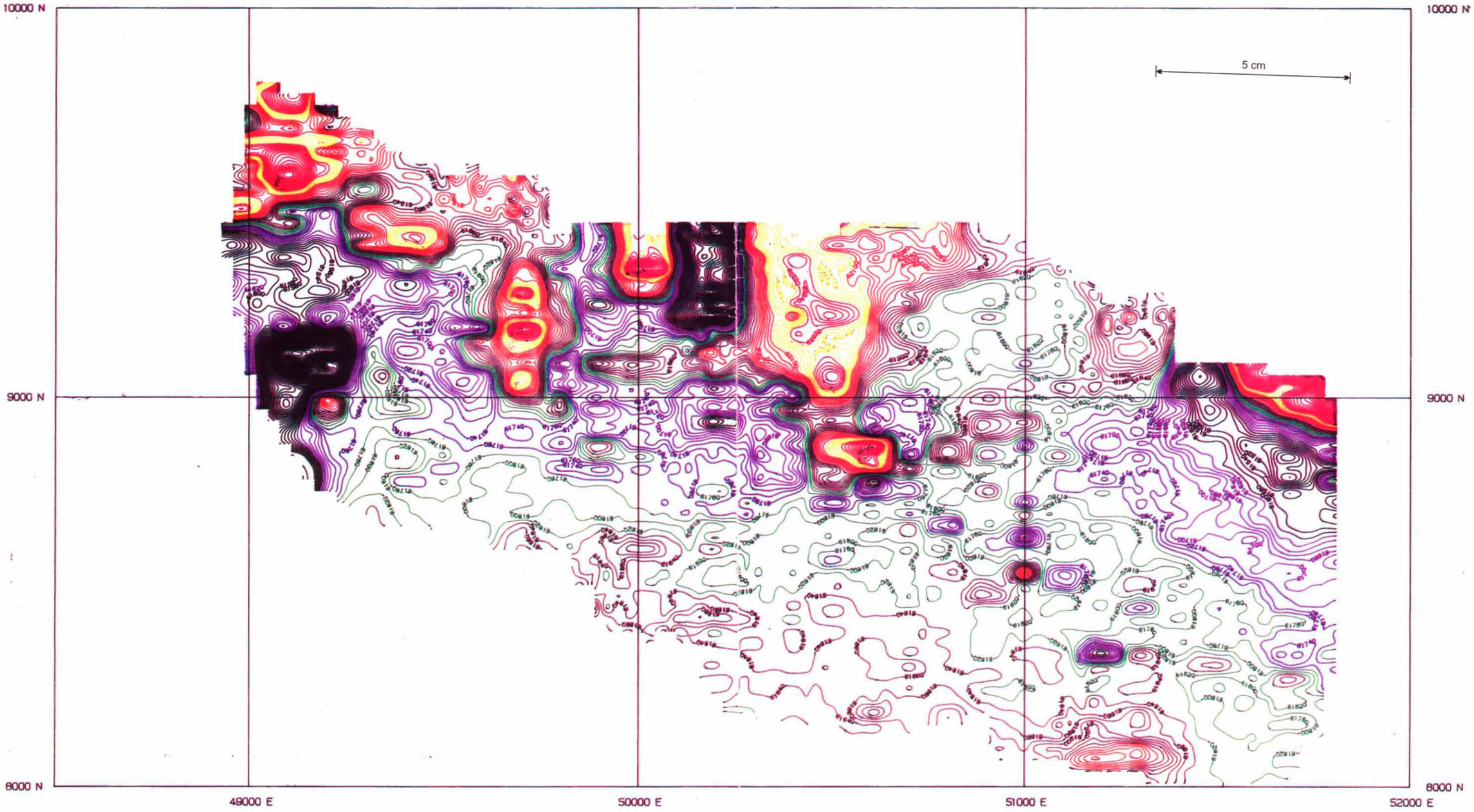


COLOUR RANGES
60000-61600 Black
61600-61700 Purple
61700-61770 Blue
61770-61820 Green
61820-61970 Brown
61970-62100 Orange
62100-62200 Yellow
62200-63000 Red

200 0 200 400 600 metres

AUSTRALIAN MAP GRID

89-3004

Aberfoyle Resources Limited

EXPLORATION DIVISION

652283

REVISIONS			
Init.	Date	Init.	Date
Location Code :			

NORTH WEST TASMANIA

GOWRIE PARK E.L. 11 / 88

BEULAH - BARITE GRID

GROUND MAGNETIC CONTOURS

Scale : 1:10000 | Date : May, 1989

Compiled : JJR
Drawn : Apollo
Traced :
Checked : JJR
Plate No. : GP 13

8424

5410 000mN

5410000 m N

449000mE

450000mE

E.L. 43/85

E.L. 11/88

Dowkins Road

RIVER

MINNOW

Gregorys Road

Bridge Road

Lower Dynans

"LOWER BEULAH"

200

mg. rded. fp packed E ?

v str. Hmt alt. vlc.

or-br. wth. fg. B.I. ℰ occ. Px or Hb phn. and wk. Hmt alt. mtx. or fg vlcl ?

y-br. Q rich vlc. ℰ mnr. Q vn. (similar to 515352)

Fe st. Hmt ? rich Gossanous rock ℰ alt. B ? D ? lava frags ?

515353 P.G. Highly Cl/Si alt. gossanous glassy felsic lava ℰ common Hmt. vn.

bd. Sh

513463 G spec. Hmt + Q rock

spec. hoem. magnetite rock

rd + bk. Mn rich B

4280345 rd. wh. + br. wth. B

515351 P.G. mas. br. wth. wk. fp. wk. Hmt ? alt. A - D.I. ℰ mnr. Py

rd + bk. Mn rich B

dom. B.I. float soc. D?I. float

D?I.

mas. rd-br. mod. str. Hmt ? Mn stn. wk. ves. alt. B.I. ℰ or. wth. ves. + float as for

428035 P.G. dk. gy. unalt. str. fp. A or B.I. ℰ abn. mafic phn.

dom. B.I. float ℰ occ. D?I. float.

float comprises mixture unalt. B.I. & fg. y-br. lava ℰ com. Q/Ep 515352 P.G. Epidosite (similar to 515350 ?)

mas. unalt. B. I.

shd. Hmt fp. B ?

mas. fp. shd. B ℰ mnr. lge Q vn.

428037 P br. wth. Y lh. A. D. ℰ fg. mtx. wk. foln.

515349 P.G. mas. mg. fd + Cl. alt. Px phn. A. B.I. ℰ local epidosite development.

515348 P.G. float v. fg. dk. gn. or A. lb. ℰ mnr. dk. frags. mod. Cc. alt. frags. show. wk. int. nature)

rd. mg. Sst/Gw

ST 28 49000E

ST 29 49200E

ST 12 D

ST 11

ST 10

ST 12 A

ST 13

ST 12

ST 12 E

ST 12 F

ST AR

ST 1

ST 2

48200 E

48400E

48600E

48800E

49400E

49600E

49800E

50000E

50200E

50400E

5409000 m N

700/060°m or bd. Gw.

float mix of fg or sed & fr-mg. gn. v. wk. ves. 515347 P.G. br-gy fpD!

mas. rd. soil ℰ com. rded qz frags. Gw

y. or. soil ℰ abn. rnded pebbles Gw.

mas. rd. soil other B ?

bd. bn. gn. rd. Sh. Slt. Ss

85/273°m

lt. bn. Slt/ Gw

lt. bn. Slt. Gw

78/147°m

90/125°m

fawn bd. Slt

60/125°m prom. bd. Sh.

428038 P.G. mas. dk. gy-gn. A. lb. E mnr. D-RD vic. lh. frags. wk. Cc.

mas. wmd. B?I.

mas. pale. y-br. v. wk. Hmt. alt. ? lava

mas. pale y-br. v. wk. Hmt. alt. D. xtl. or lava ℰ mnr. Fu. spt. mnr. Fe. rich (Hmt ?) vns.

513418G spec. Hmt. vnt.

wh. alt. lava ℰ occ. Hmt. stn.

gr - lt. gn. lava / Fp 4 hoem. 4

wh. rd. fp. volc.

gn. Bx/ v. l.

wth. rd fp lava / hoem

wth. small fp. lava

SM2 (CRA)

SM1 (CRA)

bd. Hmt. alt. Gw

gy. Sh. / lava mx.

Shd. mudstone vi

Gwt. mudstone

bd. mudstone

br. Gw

or. pk. leached Gw

mudstone

Gw

Gw q. vn.

bd. Sh. D!

Gw ? vlc ?

D / mudstone ?

q. vn.

Gw ?

Bsh

Gw ? sh

Gw / mx. hoem.

/ hoem 5

br. Sh / Gw

Gw / hoem 3

br. Gw + mudstone

mas. rd. soil

mas. fp. shd. B ℰ mnr. lge Q vn.

gr - lt. gn. lava / Fp 4 hoem. 4

wh. alt. lava ℰ occ. Hmt. stn.

gr. wth. / hoem. 3

/ hoem

wh. Si ?, Se ?, spec. hoem.

/ hoem. 5

wth. / hoem. (lava ?)

D ? / spec. hoem.

D ? / hoem

brn. D ? / spec. hoem. vn

gy D. patchy wh 5

rd. fp. lava / hoem

/ hoem. 4 Spec. hoem. 5

fp. B / hoem. 4

wth. rd. gr. Y. lv. / Si., spec. hoem / hoem. 5

rd. bk. + wh. wth. lava

/ hoem 5

schists / highly Se (S)

Gw ?

gy. sh.

Gw + sh.

Gw / mx. hoem.

gy. sh.

Gw + sh.

Gw

bd. sh. Gw

shd. Hmt. fp. B ?

mas. fp. shd. B ℰ mnr. lge Q vn.

wh. lava, q. vns.

fp. lava

fp. Y. gv.

aphyric gn B.

lava / hoem. spec. hoem

wth. B

fp / hoem

shd. prom. fp. lv., porty. Y

wth. rd. or yw. blr. lava

/ Si., hoem. vns.

maroon. unalt. gr. fm. por. B (Beulah B.)

rd. gn. Y. lv. / Si., spec. hoem / hoem. 5

rd. bk. + wh. wth. lava

/ hoem 5

513412 P. yl. gr. str. wth. trachytic. Afp. A. l. ℰ mnr. Fu. spt.

wh. spsilne Si., Mn spec. hoem. q

/ Si., Se ? 513411

wth. lt. gn. shd. q. Se rich lava

gn. lava / hoem. spec. hoem. patches.

Gw.

gr. wh. bd. Gw

gn. tan bd. sh.

rad. / hoem. 5

pk. gn. sh.

Gw ? / hoem

513443 G Hmt + Si. dr. lch. rock

515360 P.G. 515361 P.G.

bd. sh. Gw

For Details in this area see BEULAH BARITE PROSPECT 1:1000 Plate GP 15

513414 P mor. gy. str. Se + Si. alt. A. B. lb.

shd. lava / hoem. spec. hoem.

shd / Se

Gw / hoem, spec. hoem.

lava ? / hoem.

513428 P.G. Blody Q + mas. strky. bk. Cl. vn. or frac. filling.

513405 Bloody Q + spec. Hmt.

428045 P.G. gy-bk. fd + Px. phn. B.I. ℰ mnr. Hmt.

wh. lava / Mn

Index to sheets

A	B
A	B
C	D

Beaulah 16

Gowrie Park 25

5 cm

652284

Aberfoyle Resources Limited

EXPLORATION DIVISION

NORTHERN TASMANIA

GOWRIE PARK E.L. 11/88 - BEULAH E.L. 43/85

GARDEN OF EDEN GRID

OUTCROP GEOLOGY & SAMPLE LOCATIONS

REVISIONS			
Init.	Date	Init.	Date
DeM-re	1/8/89		

Location Code :

Scale : 1 : 2500

Date : June , 1989

Compiled : SWR

Drawn : RJE

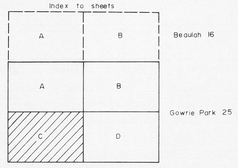
Traced : RJE

Checked : SWR

Plate No : GP 25 A


8425
5410000 mN
451000 mE
452000 mE
453000 mE
E.L.43/85 BEULAH
E.L.11/88 GOWRIE PARK
Index to sheets
A
B
Beulah 16
A
B
Gowrie Park 25
C
D
5409000 mN
For details in this area see
BEULAH BARITE PROSPECT
1:1000 Plate GP15
BB3 (CRA)
BB2 (CRA)
BB6 (ABERFOYLE)
BB5 (CRA)
BB4 (CRA)
GE1 (CRA)
Dynans Bridge Road
5 cm
652285
Aberfoyle Resources Limited
EXPLORATION DIVISION
NORTHERN TASMANIA
GOWRIE PARK E.L.11/88 - BEULAH E.L.43/85
GARDEN OF EDEN GRID
OUTCROP GEOLOGY & SAMPLE LOCATIONS
REVISIONS
Init. Date Init. Date
Location Code :
Scale : 1 : 2500
Date : June , 1989
Compiled : DJJ, SWR
Drawn : RJE
Traced : RJE
Checked : SWR
Plate No : GP25 B





652286

89-3004

5 cm

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTHERN TASMANIA
GOWRIE PARK E.L.11/88
GARDEN OF EDEN GRID
OUTCROP GEOLOGY & SAMPLE LOCATIONS

Location Code :
Scale : 1: 2500
Date : July, 1989

Compiled : DJJ SWR
Drawn : SWR
Traced : RJE
Checked : SWR
Plate No : GP 25 C



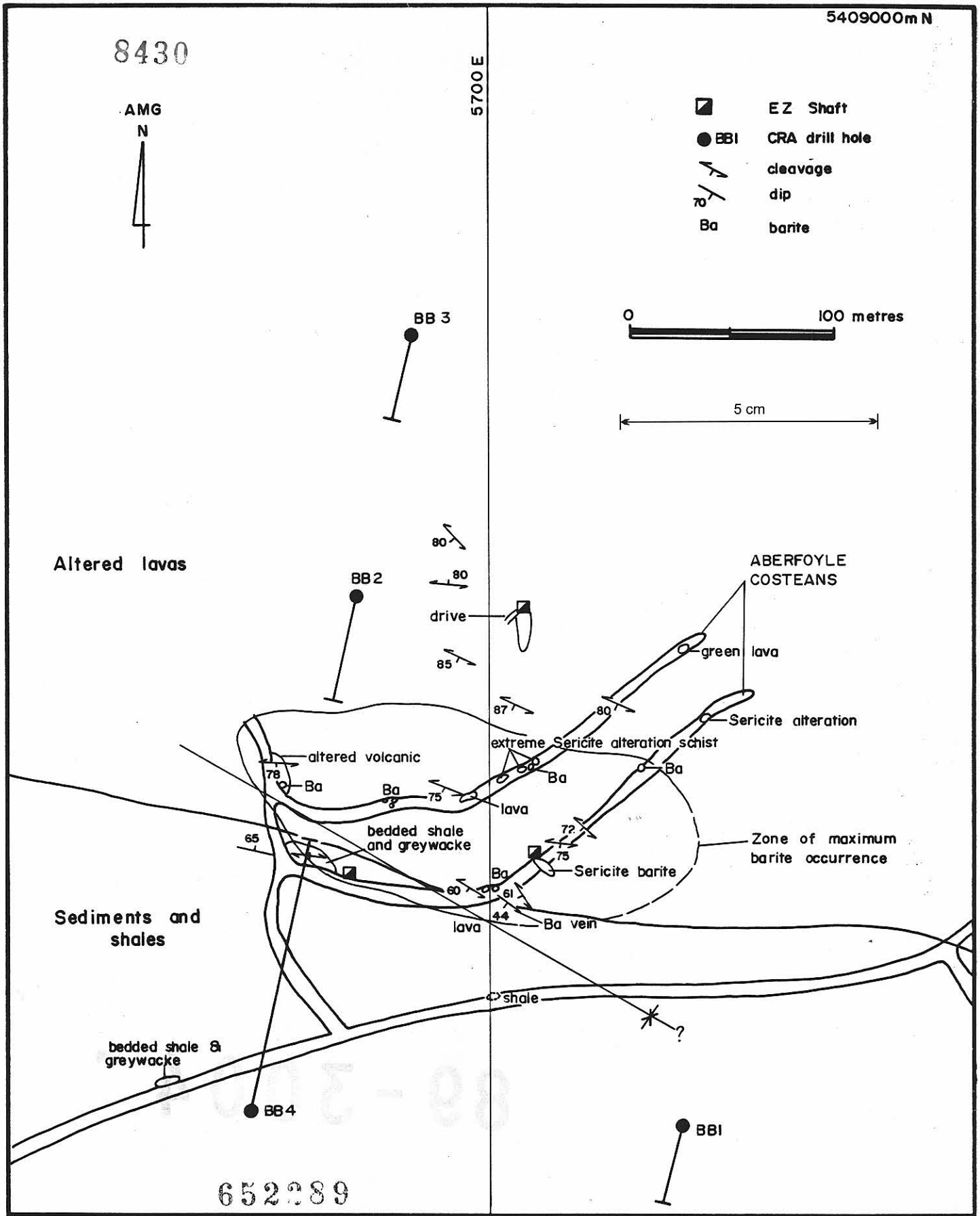
652287

89-3004

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS					
Init.	Date	Init.	Date	NORTHERN TASMANIA	Compiled : DJJ SWR
				GOWRIE PARK E.L.11/88	Drawn : SWR
				GARDEN OF EDEN GRID	Traced : RJE
				OUTCROP GEOLOGY & SAMPLE LOCATIONS	Checked : SWR
Location Code :				Scale : 1:2500 Date : July, 1989	Plate No : GP 25D


8428
GN MN
MAIN SHAFT
RD BB2 (CRA)
DDH BB6 (Aberfoyle)
DD84 BB3 (CRA)
DD84 BB5 (CRA)
DDBB4 (CRA)
PD83 BB1 (CRA)
Sweetwater Creek
5408900 m N
5408800 m N
5408700 m N
5408600 m N
5408500 m N
5408400 m N
450300 m E
450400 m E
450500 m E
450600 m E
450700 m E
450800 m E
450900 m E
451000 m E
451100 m E
- LOCALITY MAP -
BEULAH E.L. 43/85
BEULAH
SHEET COVERAGE
GOWRIE PARK E.L. 11/88
0 1 2 Kms
5 cm
89-3004
0 50 100 metres
652288
Aberfoyle Resources Limited
EXPLORATION DIVISION
NORTH WEST TASMANIA
GOWRIE PARK E.L. 11/88
BEULAH BARITE AREA
OUTCROP GEOLOGY
REVISIONS
Init. Date Init. Date
Location Code :
Scale : 1 : 1000
Date : June, 1989
Compiled : SWR
Drawn : RJE
Traced : JLR
Checked :
Plate No : GP 15



Aberfoyle Resources Limited

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTHERN TASMANIA

BEULAH BARITE

CALCITE-BARITE HANGINGWALL ALTERATION AREA

Compiled :	DJJ
Drawn :	DJJ
Traced :	RJE
Checked :	
Location Code :	
Scale :	1:2500
Date :	May, 1989
Plate No. :	GP 19

1511

8431

450600mE 450700mE 450800mE 450900mE

5408700mN 5408600mN 5408500mN

(CRA) RD BB2 450642·84 E 5408714·74 N 225·83 RL

GN MN

ZONES OF INTENSE BARITE VEINING

SERICITIZED ZONES

PROPOSED ABERFOYLE DDH BB6

wk. bnd. Fe + Ba av. vn. 515272
shaft
mass. wh/ Se. Fu 5
vlc. blk. min. 515274
Fe? vn.
or. bd.? vlcl. 515276
Adit
Ba vns
spoil
Ba vn.

513460 P { bk. rd. or. yw. vlc. haem. kernels
gn. fp. lava 513439 PG 513462 P
q. vn. 513461 G
or. l. lt. gn. l
alt. shd. gn + or. lava
513459 P
l. Se 5
shd. lt. gn vlc
gn. l
mnr. Ba vn.
513437 PG bd. gy. hbl. fp. av.
/Se5. Sch - vlc.
bd.?
Ba vn.
q. mosshaem. 513438 G
513455 PG yw. or. shd. vlc. eux. vlc. leisagang rings
513456 P
l/Se. Fu. Mn
Ba vn.
l. / Se5
l. / shd. alt. 513458 P
513436 P haematitic sch. / Se core
shd. haem. Sch. in lava
mass. gy. lens in lava 513433 PG
Schd. Se rd. or. pk. lava
513470 G Se. Ba. Sch.
mass. gy Ba pod. 513468 G 513469 G
513465 /Se5 tr. Py
or. rd. q. por. Gn
bd. Sh.
Gw / CoSe4
sed / Co34
Ba vn. c. Se gy. Sh. mnr. Ba vn. sed
513466 Ba goss.
lava / or. bk. + gn.
Ba vn. Gn. goss. 513434 GP. 513467 G 513435 G
Sweetwater Creek
LAVA GREYWACKE & BLACK SHALE
MOSTLY BLACK SHALE
Gw? / Si5
Sh
tight fold bd.? Gw / volc.
100 ppm Pb
200 ppm Pb
MOST ABUNDANT BASE METALS WITH BARITE
AB 450800
AB 450600 cut line
AB 450700

DD BB4 (CRA) 450589·64 E 5408478·08 N 196·31 RL

5 cm

0 50 metres

652290

FIG. 2

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

Location Code :

NORTHERN TASMANIA

GOWRIE PARK E.L.11/88

BEULAH BARITE PLAN

GEOLOGICAL INTERPRETATION - PROPOSED HOLE

Scale : 1 : 1000 Date : May, 1989

Compiled : DJJ SWR
Drawn : DJJ
Traced : RJE
Checked :
Plate No. : GP 20

151

8432

A

B

450700 E

450800 E

DDH BB6
450780E
5408647N, 200RL

RL.200 m

100 m

00 m

-100 m

Se Fu altered with occassional strong heamatite alteration

mixed zone of andesitic/dacitic lavas & common lava fragments, & minor volcaniclastic units.

50

sericite - fuchsite - pyrite altered tr. dissem. Py

100

sericite - fuchsite occ. weak heamatite alteration

F

polymict volcaniclastic

weakly sericite - pyrite altered

150

mixed yellow - brown dacitic ? lavas and lava breccias.

common small pyrite veinlets

very weakly fuchsite - sericite altered with minor silica and occ. pyrite alteration.

F

transition zone from dacite to andesitic/ basaltic lavas with minor lava fragments.

200

weak heamatite alteration

massive green basalt lava with rare lava fragments, minor heamatite / Cc veining

variable fuchsite - calcite alteration

f.g. yellow - brown dacite lava

250

Weakly silica - fuchsite altered

green basalt lava with rare fragments

weak calcite alteration

300

basalt lava with fragment abundance increasing to 323.5m

Flow margin ?

packed basalt lava breccia

weak - moderate heamatite / calcite alteration occassionally with silica / pyrite alteration

mixture of massive green andesite / basalt lavas and lava breccias.

moderate - strong calcite alteration and variable heamatite / pyrite alteration.

common pyrite

350

weak calcite alteration with weak heamatite and/or pyrite alteration.

E.O.H. 400 m
R.L. - 173.26m

5 cm

0 50 100 metres

652291

FIG. 3

Aberfoyle Resources Limited

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

Location Code :

NORTH WEST TASMANIA
GOWRIE PARK E.L. 11/88
BEULAH BARITE PROSPECT
SUMMARY SECTION DDH BB 6

Scale : As shown

Date : June, 1989

Compiled : SWR
Drawn : SWR
Traced : RJE
Checked :
Plate No. : GP 23

1511

BB4 450590E
5408478N
196·3RL

BB6 450780E
5408647N
200RL

BB2 (CRA)
450643E
5408715N
226 RL

5408500 N

5408600 N

200 RL

100

0

-100

(+11m)

(-180m)

Sweet Water Creek

Costeans

Ba vn.

Ba vn.

MAROON LAVAS & LAVA BRECCIAS

8433

50(+8)

f.g. bk. Sh.

100(+5)

mxd. zone of bk. Sh. ic & lavas

Ba vn in Sh.

150(+2)

Se. Fu. Ca alt in lava

pred. f.g. lavas & mnr. lava b.

gn. lava 'crackle'

200(-5)

Hmt. alt.

highly shd. Fu. Se. alt

E.O.H 218·8m (-8)

50(-166)

Se. Fu. occ Hmt.

E.O.H. 99m

mxd. A/D. lavas & com. lava fr. & mnr. vic. units

Se. Fu. Py. alt.

?

100(-149)

F

Ylv. wk. Se Py

150 (-131)

D.I. & D.Ib

wk. Fu. Se. Si. Py

F

200(-112)

transition zone D.I./Ib – A/B.I.

wk. Hmt.

mas. gn. B.I.

var. Fu Co

250(-95)

D.I.

wk. Si. Fu

wk. Co

mas. gn. B.I. & com. fr. increasing to 327m

300(-77)

wk. mod. Hmt./Co & mnr. Si Py

packed B.Ib.

350(-60)

com Py

mix of mas. gn. A/B.I Ib.

wk. Co. Hmt. ± Py

E.O.H. 400m (-42)

GOG RANGE SEDIMENTS

MIXED SEDIMENT/LAVAS

MIXED LAVAS

POSSIBLE TARGET

PREDOMINANTLY BASALTIC/ ANDESITIC LAVAS & LAVA BRECCIAS

5 cm

652992

Aberfoyle Resources Limited

EXPLORATION DIVISION

NORTH WEST TASMANIA

GOWRIE PARK E.L. 11/88

BEULAH BARITE-GARDEN OF EDEN PROSPECT

CROSS SECTION 450600mE

Location Code :

REVISIONS

Init.	Date	Init.	Date

Scale : 1:1000

Date : July, 1989

Compiled : SWR

Drawn :

Traced : JLR

Checked :

Plate No. : GP 24

Quaternary

Qcl	Quaternary colluvial scree or talus of Roland conglomerate and Moina sandstone.

Tertiary

Tb	Tertiary basalt.

Cambrian

€p	Hornblende, biotite and plagioclase phyric. Phyolitic to Granodioritic porphyry.
€I	Massive buff brown Rhyolitic to Dacitic Intrusive.
€sh	A grey fossiliferous dolomitic shale
€Al	Massive feldspar phyric Andesitic-Basaltic lavas.
€Alv	Feldspar phyric Andesitic lapilli-volcaniclastic with minor bedded volcaniclastic.

8435

441000 m E

442000 m E

443000 m E

5414000 m N

5413000 m N

RIVER

DASHER

Paradise Road

200

13600 N

13400 N

13200 N

12800 N

12600 N
42592 E

TB

'CLYDEBANKS'

Q 'granite - like' por.

Ep

Tb

soil por. ?

E.L. 43/85 Beulah

E.L. 11/88 Gowrie Park

5 cm

652294

Aberfoyle Resources Limited
EXPLORATION DIVISION

NORTHERN TASMANIA

GOWRIE PARK E.L.11/88 - BEULAH E.L.43/85

STONEBRIDGE GRID

INTERPRETIVE GEOLOGY

REVISIONS			
Init	Date	Init	Date

Location Code :

Scale : 1:2500 | Date : February, 1989

Compiled : DJJ
Drawn : RJE
Traced : RJE
Checked : DJJ
Plate No : GP14 B

8436

441000 m E

442000 m E

443000 m E

'Paradise'

12400 N
42565 E

12200 N
42535 E

12000 N
42507 E

11800 N
42514 E

11600 N
42556 E

11400 N
42550 E

11200 N
42508 E

11000 N
42479 E

10800 N
42460 E

5412000 m N

5411000 m N

Dawsons Road

E.L. 11/88
E.L. 43/85

gn granite like por
wtn rd por
mnr. bd. sh
d pit
mass B
q. por R (Minnow Keratophyre)
f.g. por. granite like
pit
sh. dol
T.B
gy. brc. sh. 428100 P
dol. bed
goss
515363 P,S
BARN
gy. bd. Sh
wtn. rds-or. por.
wtn. fp. rich. por.
or + wh. bd. sh
uniform or wh. R q. fp
granite like mica. por
grn goss
pit
wtn. rd. gn. bk. R (int.)
por.
271764 G, P
271762 G
mass. lt. gn. br. sparsely fp. A-D
rd-gn B-D partly fp.
gn. rd. B
pk. fp. gn. mtx. por.
Owen Cg
granite - like por
wtn.
buff R (rt)
wtn. mass. br. R-D
xtal. crowded por
Owen Cg
Owen Cg
rd. wtn. q. fp. por
R (int)
mica
428093 P
xtal. rich gn. por. bio
fresh rd + gn. q. fp + fm por. R (int.) granite
shd
R (int)
q. ves ? R
D ? meta. sed ?
428094 P
fr. rd. + bk. fm por. R (int.)
wtn. rd. fp + bk. fm. A
xtal. rich gn. por.
fp. rich. A
T.B.
mass. B
gn. granite like por
wtn. rd. por.
wtn. rd. por.
d pit
T.B.
Owen Cg
Owen Cg + Moina Ss scree
Owen Cg
Owen Cg scree
Roland Cg + Moina Ss scree
Qcl
Qcl
Qcl
Tb
Tb
Tb
Tb
Ep
Ep
Ep



5 cm

89-3004

652296

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS				NORTHERN TASMANIA	Compiled	DJJ
Init	Date	Init	Date	GOWRIE PARK E.L. 11/88 - BEULAH EL. 43/85	Drawn	RJE
				STONEBRIDGE GRID	Traced	RJE
				INTERPRETIVE GEOLOGY	Checked	DJJ
Location Code				Scale 1:2500 Date February, 1989	Plate No	GP 14c

8438

N

DASHER

442000mE

13600N

13400N

13200N

Clydebanks

5413000mN

13000N

BEULAH E.L.43/85

12800N

12600N
42592E

GOWRIE PARK
E.L. 11/88

12400N
42565E

12200N
42535E

258° Mag

5412000mN

12000N
42507E

11800N

80 in R.

11600N
42556E

11400N
42550E

11200N

5411000mN

11000N

10800N
42466E

10600N
42436E

10400N
42417E

gossan

10200N
42460E

5410000mN

PARADISE

Herland

Rise

Road

Paradise

Road

Dawsons

10 9 8

Aberfoyle grid 1988

Corner of UTEM Loop 9

5 cm

Aberfoyle Resources Limited

EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date

NORTH WEST TASMANIA

GOWRIE PARK E.L. 11/88 - BEULAH E.L.43/85

STONEBRIDGE GRID

UTEM LOOP LOCATIONS

Location Code :

Scale : 1: 10 000

Date : August, 1989

Compiled : DJJ JS

Drawn : RJE

Traced : RJE

Checked : SWR

Plate No : GP 30

8440

5412850 m N

443000 m E

446500 m E

54 10000 m N

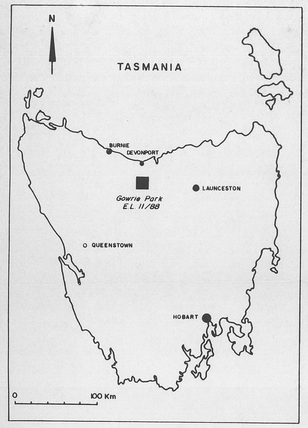
5409400 m N

5409000 m N

5407000 m N

442000 m E

450000 m E



Index to Sheets

A	B	C

0 500 1000 metres

5 cm

89-3004

€gg	Gog Range Greywacke : dominantly greywacke sequence ± mudstone
€bf	Beulah Formation : basic to intermediate lavas, pyroclastics & breccia
€by	Polymict volcaniclastic
€bd	Dacite lava
F	Fault interpreted from magnetometer survey

Aberfoyle Resources Limited
EXPLORATION DIVISION

REVISIONS			
Init.	Date	Init.	Date
DJJ/JP	24589		

NORTHERN TASMANIA

GOWRIE PARK E.L.11/88

SUMMARY GEOLOGY

Location Code :	K55/3
Scale :	1 : 10,000
Date :	July, 1988
Compiled :	SWR DJJ
Drawn :	RJE
Traced :	RJE JLR
Checked :	SWR
Plate No :	GP5 B

8439



89-3004

652299

Aberfoyle Resources Limited
EXPLORATION DIVISION

NORTHERN TASMANIA
GOWRIE PARK E.L. 11/88
OUTCROP GEOLOGY

REVISIONS			
Init.	Date	Init.	Date

Location Code : K55/3 | Scale : 1 : 10,000 | Date : July, 1988

Compiled : DJJ
Drawn : RJE SWR
Traced : RJE
Checked : SWR
Plate No : GP5 A