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PASMINCO EXPLORATION

EL 9/92 DIAL RANGE
ANNUAL REPORT

JULY 1992 - JUNE 1993

- TRANSPARENCIES HELD
- LOCATED DATA TAPE HELD

AUTHOR:	FG FitzGerald
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SUBMITTED BY: Fergus FitzGerald

ACCEPTED BY:

Burnie
June 1993

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1 SUMMARY

Exploration Licence 9/92, covering 220km^2 in the Dial Range area of northwestern Tasmania, is being explored for polymetallic massive sulphide deposits and high grade copper precious metal deposits.

During the initial year of exploration the following program has been undertaken: compilation and assessment of previous exploration company and Geological Survey data; geological traverses to establish the regional setting and to identify favourable stratigraphic and structural sites for mineralisation, including a petrographic study; re-location and preliminary mapping and sampling of all the significant old prospects and mineral occurrences, including geochemical analyses; covering the entire tenement with a high resolution helicopter-borne magnetic and radiometric survey, with a preliminary interpretation of results, in conjunction with the extent gravity data, to aid in interpreting the sub-surface geology of the tenement. This program has cost a total of **$113 482** to the end of May 1993.

The results of this initial exploration program have been a little disappointing. No strong evidence for the occurrence of economically significant mineralisation has been discovered It appears that the area of EL /9/92 is largely underlain by a strongly magnetic phase of the Devonian Housetop Granite, at quite shallow depths (average 1km). Most of the widespread mineral occurrences can be spatially, if not temporally, related to structures associated with the mid-Devonian Tabberabberan Orogeny and granite emplacement. The Eo-Cambrian to early Ordovician sequence, which comprise the Dial Range Trough have been tectonically disrupted during an inferred arc-continent collision, which has resulted in allochthonous blocks being emplaced and confusion about stratigraphic relationships.

The most promising host formation, the Lobster Creek Volcanics, which are tentatively correlated with the Mt Read Volcanics, appears to be entirely intrusive diorite, intruded deep in the section during the late Cambrian to early Ordovician. The Volcanics appear to be associated with locally strong hydrothermal wall rock alteration and minor base metal mineralisation (eg. Penguin Mine) as well as possible plutonic copper-tin-arsenic mineralisation (eg. Dial Mine area). The ironstones at Blythe River-Cuprona and Penguin

Creek – Iron Cliffs appear to have formed from selective replacement of sedimentary units close to the Upper Proterozoic Burnie Formation – early Ordovician Duncan Conglomerate contact (a possible redox boundary). There is no evidence of major structural control in their formation, although the Housetop Granite, which is closely associated with them, may have obscured deeper crustal features. There is no encouraging base or precious metal geochemistry associated with these haematitic ironstones, apart from the limonitic Iron Cliffs occurrence, which could be a gossan after massive sulphides.

Despite the generally discouraging results from these initial investigations, several features have been identified which are quite similar to the geological setting of the highly productive Mt Read Volcanics in western Tasmania. It is recommended that further exploration is undertaken within EL 9/92 to evaluate these features in more detail, including: geological mapping; lithogeochemical sampling; full evaluation of aeromagnetic and gravity data, including possible additional gravity surveys; assessment of existing electrical geophysics in the Dial Mine area and diamond drill testing any targets generated by this work.

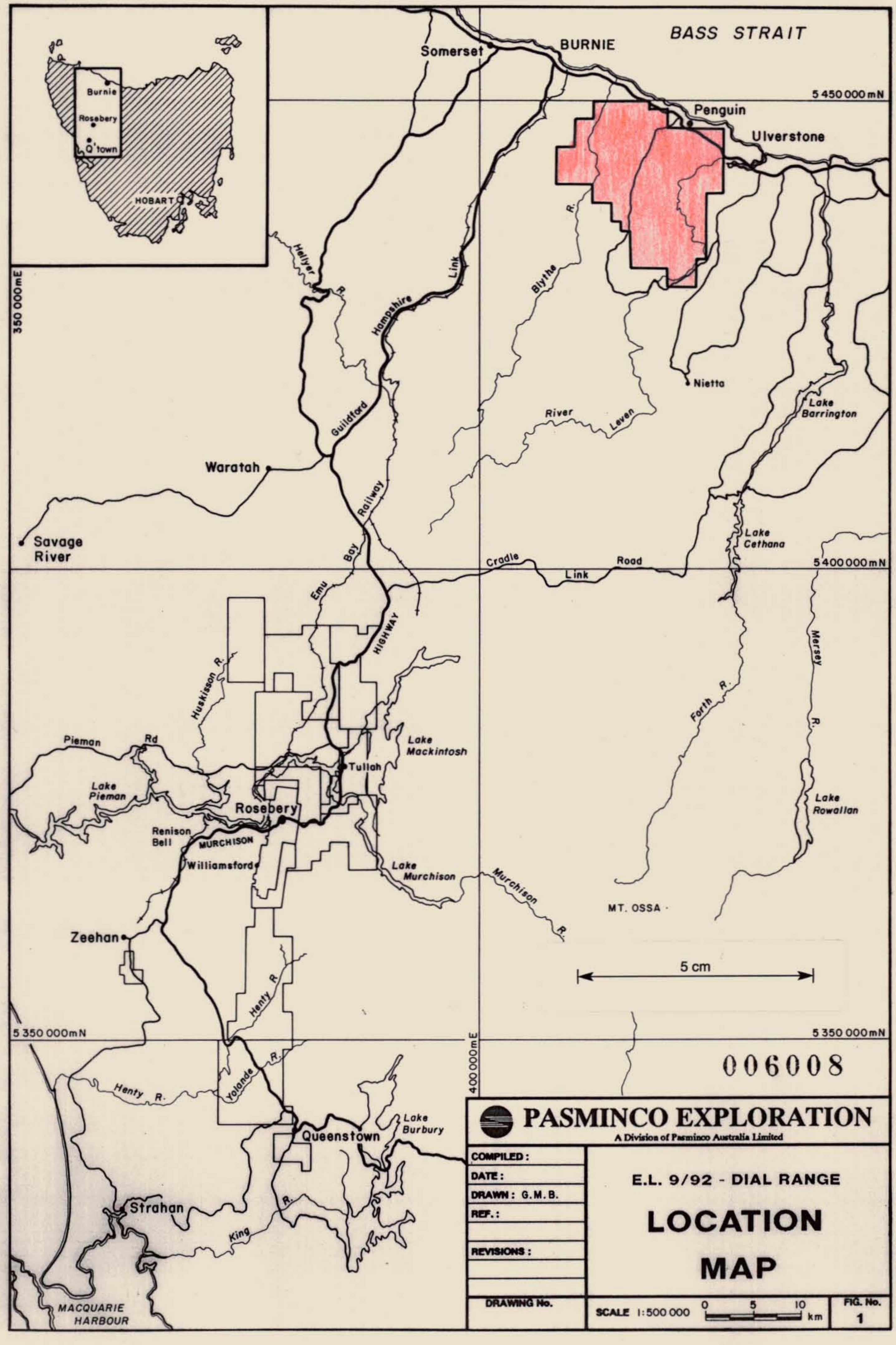
2 INTRODUCTION

This is the first Annual Report for Exploration Licence 9/92, in the Dial Range area of northwestern Tasmania. The report details work undertaken during the period July 1992 to June 1993. Most of the exploration has been of a reconnaissance nature, including geological mapping and sampling around old prospect areas, data evaluation and a helicopter-borne magnetic and radiometric survey.

The tenement, which covers an area of 220km^2, is located 10km SE of Burnie, stretching south from Sulphur Creek and Penguin on the NW Coast to South Riana – Gunns Plains (See Figure 1). The topography of the area is dominated by the north-trending Dial Range, a heavily timbered and rugged range of hills up to 681m in elevation, which occur through the central and eastern part of the licence. Away from the Dial Range a Tertiary basalt plateau has been deeply dissected by several major north-trending drainages, especially the Leven, Blythe and Emu River systems.

The area is well served with access from a network of secondary roads and country lanes south of the Bass Highway.

Most of the land is used for agriculture, outside the Dial Range and steeply incised valleys, with intensive cropping and grazing being the principal activity. Pasminco is sensitive to the commercial interests of the land holders and all exploration has been undertaken in close co-operation with them to minimise any disruption of their activities.


BASS STRAIT
BURNIE
Somerset
Penguin
Ulverstone
Burnie
Rosebery
Q'town
HOBART
5 450 000 mN
5 400 000 mN
5 350 000 mN
350 000 mE
400 000 mE
Hellyer R.
Hampshire Link
Guildford
Railway
Emu Bay
HIGHWAY
Blythe R.
R.
River Leven
Nietta
Lake Barrington
Lake Cethana
Waratah
Savage River
Cradle Link Road
Mersey R.
Forth R.
Huskisson R.
Lake Mackintosh
Pieman Rd
Lake Pieman
Tullah
Rosebery
Renison Bell
MURCHISON
Williamsford
Lake Murchison
Murchison R.
MT. OSSA
Lake Rowallan
Zeehan
5 cm
Henty R.
Yolande R.
Lake Burbury
Queenstown
Strahan
King R.
MACQUARIE HARBOUR
006008
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED :
DATE :
DRAWN : G.M.B.
REF. :
REVISIONS :
DRAWING No.
E.L. 9/92 - DIAL RANGE
LOCATION MAP
SCALE 1:500 000
0 5 10 km
FIG. No.
1

3 EXPLORATION PHILOSOPHY

Pasminco has established a strong tenement holding in western Tasmania, principally over the Cambrian Mt Read Volcanics between Hellyer and Queenstown, centred on the Rosebery Mine. The Mt Read Volcanics host several world class polymetallic massive sulphide deposits, including the current operations at Rosebery, Hellyer and Mt Lyell. This tenement holding has enabled Pasminco to assemble an extensive data base to aid in understanding the geological setting and controls of these world class deposits.

At the same time Pasminco has undertaken an evaluation of other areas within Tasmania, using this data base to assess their mineral potential. The Dial Range project was generated by these active studies when it was recognised that the area appeared to have strong similarities in structural setting and mineral style with the Mt Read Volcanics base metal province.

The principal objective of the exploration program on the Dial Range tenement is to identify economically viable polymetallic base metal deposits. It is also possible that copper-gold *mineralisation occurs in the area and this style of deposit is an important secondary target.* All signs of encouraging mineralisation will be vigorously explored to expedite possible mine development and treatment, either at a new plant, or through the Company's existing mill infrastructure at Rosebery, 75km to the south west.

4 TENURE

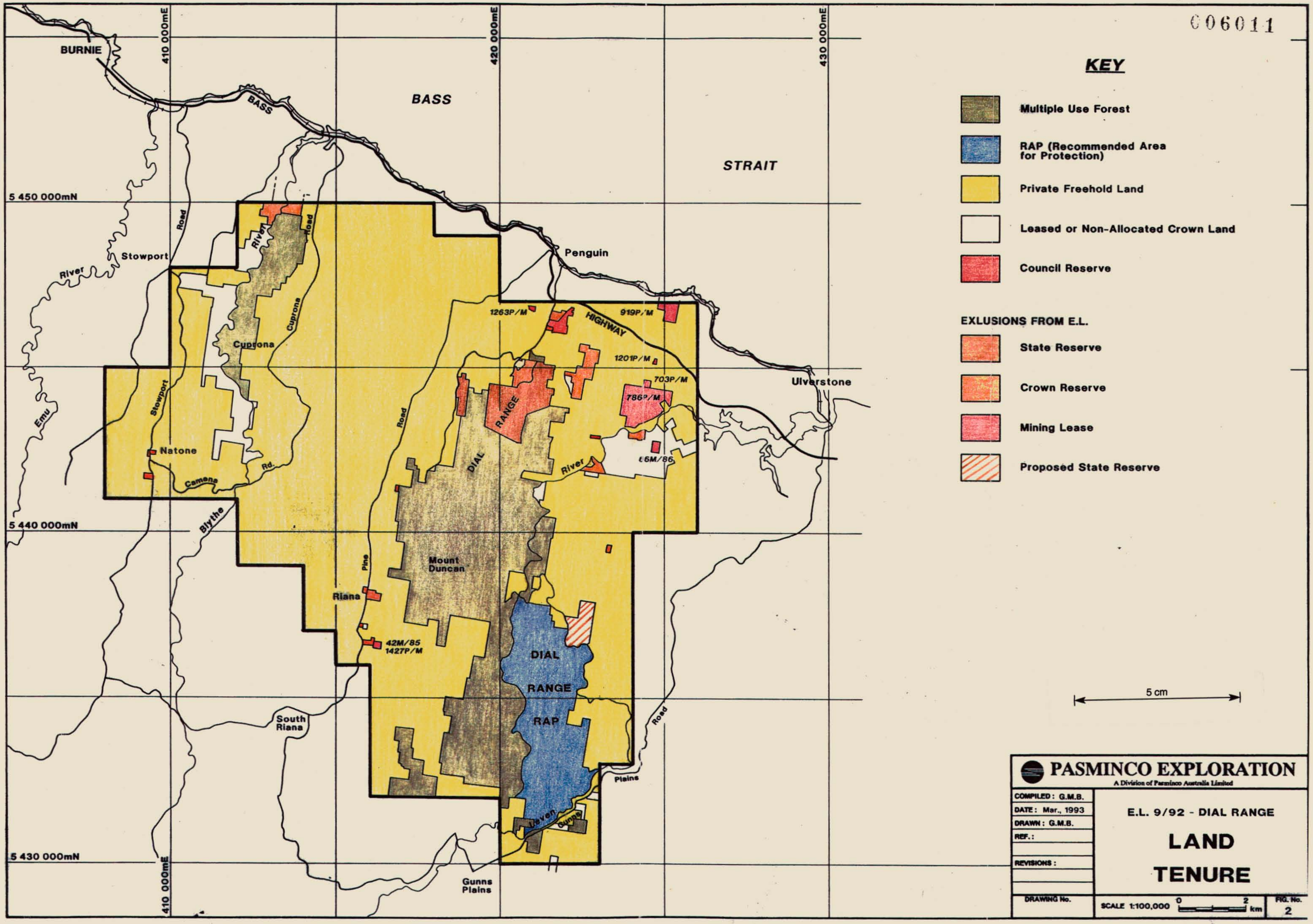
Exploration Licence 9/92 was issued to Pasminco Australia Limited on 25 July 1992, for a period of 12 months. The area of the tenement is 211km^2. The schedule of the licence area is given in AMG coordinates in Appendix A. Pasminco Exploration, a division of Pasminco Australia Limited manage all exploration undertaken on EL 9/92.

The licence area excludes the following Reserves and Leases (see Figure 2):

- i Mt Montgomery State Reserve - 229ha
- ii Ferndene State Reserve - 36ha
- iii Mining Leases - 200ha
- iv Crown Reserve - 3km^2
- v Proposed Sith Cala State Reserve - 0.8km^2

The land tenure of the area comprises predominantly Private Freehold Land and State Forest, as Multiple Use Forest and Recommended Area for Protection (the Dial Range RAP) (see Figure 2). Small areas of Leased or Non-allocated Crown Land are also included in the tenement.

Pasminco has lodged an application for the renewal of EL 9/92 for a further 12 month period.


006011
BURNIE
410 000mE
420 000mE
430 000mE
BASS
BASS
STRAIT
5 450 000mN
5 440 000mN
5 430 000mN
Road
River
Road
Stowport
River
Cuprona
Cuprona
Penguin
HIGHWAY
1263P/M
919P/M
1201P/M
703P/M
786P/M
RANGE
Ulverstone
Emu
Stowport
Natone
Camena
Rd.
Road
DIAL
River
66M/86
Blythe
Pine
Mount
Duncan
Riana
42M/85
1427P/M
DIAL
RANGE
RAP
South
Riana
Road
Plains
Leven
Gunns
Gunns
Plains
KEY
Multiple Use Forest
RAP (Recommended Area for Protection)
Private Freehold Land
Leased or Non-Allocated Crown Land
Council Reserve
EXLUSIONS FROM E.L.
State Reserve
Crown Reserve
Mining Lease
Proposed State Reserve
5 cm
PASMINCO EXPLORATION
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COMPILED : G.M.B.
DATE : Mar., 1993
DRAWN : G.M.B.
REF. :
REVISIONS :
DRAWING No.
E.L. 9/92 - DIAL RANGE
LAND
TENURE
SCALE 1:100,000
0
2
km
FIG. No.
2

5 REGIONAL GEOLOGY

The geology in the region of the Dial Range tenement spans a large part of the geological record, present in Tasmania (see Figure 3). The published geology sheets (Sheffield, Devonport & Burnie) date from mapping in the late 1950's and 1960's by the Geological Survey of Tasmania (Jenning's et al, 1959, Burns, 1963 and Gee, 1967). Whilst these map sheets, and accompanying explanatory notes, are dated and clearly require some revision, especially of the stratigraphy (see later discussion, Section 7.2), they still provide a very useful framework to understand the geology of the region.

The oldest rocks exposed in the area are Proterozoic metasediments. They have been assigned to a younger and an older sequence, largely on the basis of metamorphic grade and intensity of structural deformation (eg. Burns, 1964). The latter, the Ulverstone Metamorphic Complex, is comprised of poly-deformed greenschist facies meta quartzite, mica schist and stretched pebble conglomerate, structurally concordantly overlying the Forth Metamorphic Complex comprised of higher grade meta quartzite, garnet-albite-kyanite (?) schists and amphibolite. The inferred younger sequence, the Burnie Formation, is comprised of relatively unmetamorphosed poly-deformed turbiditic quartzwackes and mudstones, which structurally overlie the Ulverstone Metamorphic Complex. Turner (1989) has suggested that the two sequences may not necessarily be significantly different in age, since the shallow-dipping thrust which separates them may have juxtaposed rocks from different tectonic environments.

During the Eo-Cambrian to early Ordovician a series of sediments, volcanics and intrusives were deposited or emplaced in a tectonically active belt, called the Dial Range Trough (Burns, 1964). Burns described the Trough as a meridional belt, approximately 5km wide on the north ~~east~~ coast increasing in width to the south where it appears to be continuous with the Dundas and Fossey Mountain Troughs. The stratigraphic relationship between the different units is complicated by inferred structural repetition along multiple thrust faults. In fact the original architecture of the Dial Range Trough has been largely obscured by later deformations. Crawford (Appendix C) suggests that the trough developed following uplift and collapse of a passive continental margin to form a foredeep during a mid-Cambrian tectonic collision event.

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LEGEND

HOLOCENE — Alluvium, sand, gravel and talus.

PLEISTOCENE — Till, fluvioglacial, periglacial and associated deposits.

Errosional surface.

TERTIARY — Non-marine sequences (light); marine limestone (dark); basalt and related igneous rock types (orange).

Low angle unconformity.

TRIASSIC — Fluvio-lacustrine sequences of sandstone, siltstone, mudstone (light) with carbonaceous sequences indicated (dark). Fresh water sequence with some coal measures.

PERMIAN / **UPPER CARBONIFEROUS** — Upper glacio-marine sequence of pebbly mudstone, pebbly sandstone and limestone. Fresh water sequence with some coal measures. Lower glacio-marine sequence of pebbly mudstone, pebbly sandstone, minor limestone, Tasmanite oil shale and basal tillite.

UPPER – MIDDLE DEVONIAN — Terrestial cavern fillings.

Unconformity attributed to Tabberabberan Orogeny.

LOWER DEVONIAN – SILURIAN — Some quartzwacke sequences (dark) and siltstone-shale sequences (light) indicated; Devonian limestone-siltstone (horizontally lined over-print).

Limestone sequence.

ORDOVICIAN — Siliceous terrestrial conglomerate, marine quartzwacke and siltstone.

Unconformity in northern Tasmania and parts of western Tasmania attributed to Cambrian movements; apparent conformity in Adamsfield region and parts of western Tasmania.

CAMBRIAN — Middle-Upper Cambrian fossiliferous usually greywacke turbidite sequences (horizontally lined overprint); acid with intermediate volcanic and associated rocks dominant (dark), and horizon with fossiliferous Upper Cambrian shallow water deposits (vertically lined overprint); basic-intermediate volcanic and associated rocks dominant (diagonally lined overprint); probably Cambrian unfossiliferous usually greywacke turbidite sequences (light); probably Cambrian unfossiliferous orthoquartzite sequence (dotted).

Usually unconformity attributed to Penguin Orogeny but apparent conformity at Smithton and Pieman River.

PRECAMBRIAN — Comparatively unmetamorphosed sequences. Mudstone-sandstone sequences (u') – dominantly mudstone (light), dominantly orthoquartzite (dark), quartzwacke turbidite successions (small dot over-print), conglomerate (large dot over-print); dolomite (horizontally lined over-print); basalt lava (vertically lined over-print).

Metamorphic rocks. Pelitic sequences (dark); metaquartzite sequences (light) with some platy quartzite units indicated (vertically lined over-print); amphibolite (diagonally lined over-print). Garnet bearing rocks are indicated (g).

5 cm

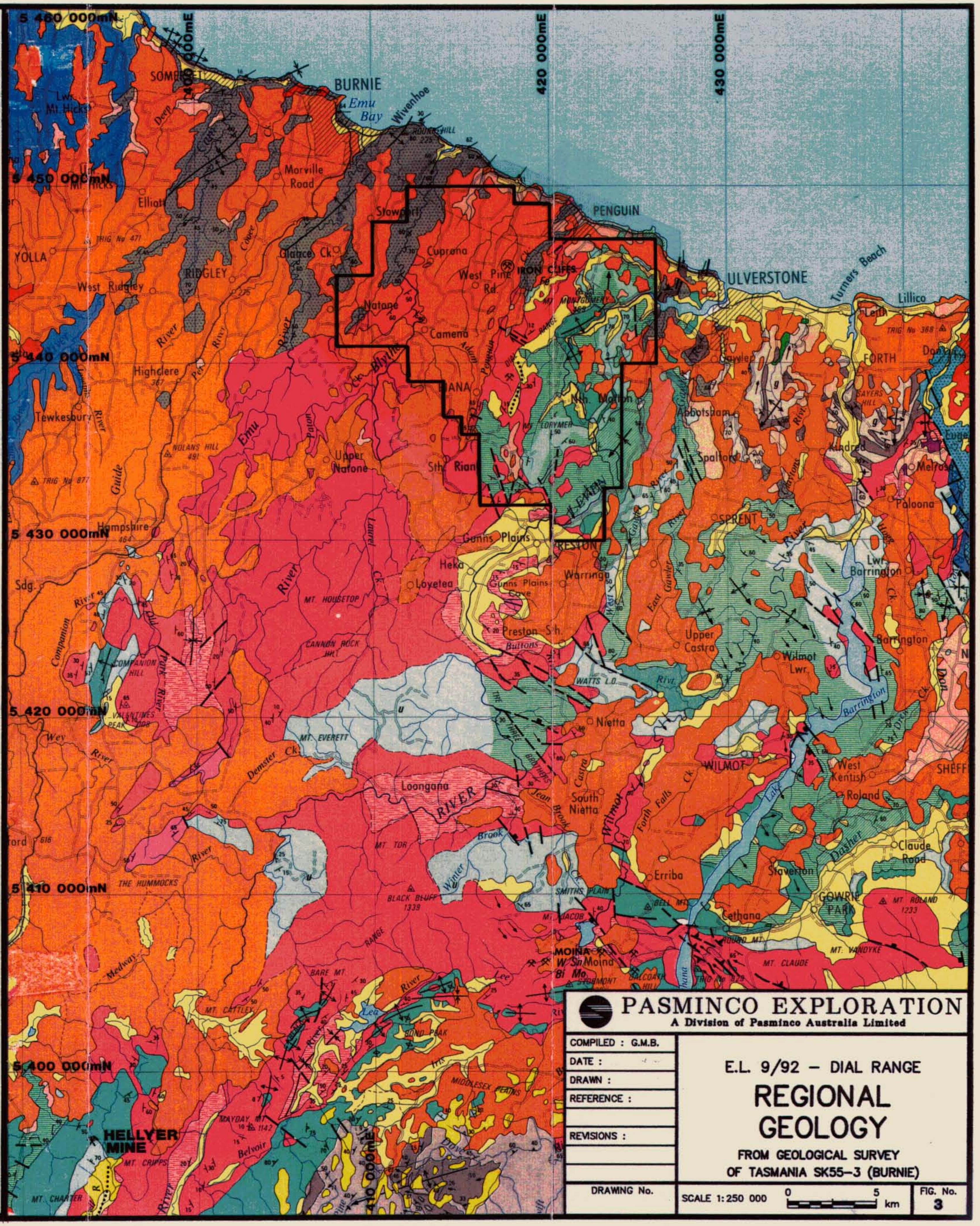
IGNEOUS ROCKS

TERTIARY — Basalt and related rock types.

JURASSIC — Dolerite and related rock types.

LOWER CARBONIFEROUS – UPPER DEVONIAN — Dominantly adamellite-granite.

CAMBRIAN — Serpentinite, peridotite and associated rocks. Acid with intermediate volcanic and associated rocks. Basic-intermediate volcanic and associated rocks.



PASMINCO EXPLORATION
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COMPILED : G.M.B.	E.L. 9/92 – DIAL RANGE
DATE :	**REGIONAL GEOLOGY**
DRAWN :	FROM GEOLOGICAL SURVEY OF TASMANIA SK55-3 (BURNIE)
REFERENCE :	
REVISIONS :	
DRAWING No.	SCALE 1:250 000 — 0 — 5 km — FIG. No. 3

The Dial Range Trough fill comprises mixed sequences of orthoquartzites, volcaniclastic sandstones and mudstones, cherts, mudstones and carbonates, serpentites, tholeiitic basalts, felsic to intermediate volcanics and intrusives (see Figure 3). Previous workers have subdivided these into a number of groups and formations including the Motton Spilite, Barrington Chert, Cateena Group, Radfords Creek Group and Lobster Creek Volcanics (see Burns, 1964). However, recent work (see Section 7.2) suggests that many of these subdivisions overlap.

These sequences have been correlated with, or inferred to be equivalent to, different parts of the Eo-Cambrian-Cambrian sedimentation and volcanism in western Tasmania, including the Success Creek Formation, Crimson Creek Formation, Dundas Group and Mt Read Volcanics. These relationships are summarised in Table 1.

These sequences are unconformably succeeded by a late Cambrian to early Ordovician sedimentary assemblage, correlated with the Denison Group. They include: basal mudstones, sandstones and minor chert conglomerate (Gnomon Mudstone); quartzite and vein quartz pebble to boulder conglomerate (Dundas Conglomerate) and marine quartzose sandstone, with minor conglomerate and shales (Moina Sandstone), at the top. Local angular unconformities occur throughout the Denison Group, indicative of continual uplift of the Precambrian basement, from which most of the detritus was derived.

During the ensuing marine transgression limestone, dolomite and mudstone (Gordon Group) was deposited during the Ordovician, succeeded by shallow marine quartz sandstone, mudstone and minor limestone of the Siluro-Devonian Eldon Group. This period of sedimentation ended with a major polyphase deformation (the Tabberabberan Orogeny) in the middle-late Devonian. Syn to post-kinematic granitiods were emplaced, intruding rocks from Precambrian to early Devonian in age. The partially eroded Housetop Granite forms the largest such body in the Dial Range area. Recent geophysical interpretations suggest that much of the underlying stratigraphy in the area of EL 9/92 has been stoped-out by the granite (see section 7).

The last part of the geological record preserved in the Dial Range region consists of terrestrial sands, gravels, silts and clays, which are locally indurated and deposited in deep leads during the Tertiary (Burns, 1964). These are overlain by Tertiary olivine basalt lava

TABLE 1.

STRATIGRAPHIC RELATIONSHIPS DIAL RANGE AREA & WESTERN TASMANIA

AGE	DIAL RANGE AREA	WESTERN TASMANIA	REFERENCE
Early Ordovician -Late Cambrian	Moina Sandstone Duncan Conglomerate Gnomon Mudstone	Owen Conglomerate	Banks, 1989
Late Cambrian	Lobster Creek Volcanics	Mt Read Volcanics	Crawford, Appendix C
Late middle–early late Cambrian	Radfords Creek Croup including: Kerrison, Wilsonia, Applebee Volcanics	Tyndall Group– Southwell Subgroup Upper Dundas Group	Crawford, Appendix C Brown, 1989
Late middle Cambrian	Cateena Group including Beecraft & Teatree Point Megabreccias	Lower Dundas Group	Brown, 1989
Eo–Cambrian	Motton Spilite	Crimson Creek Formation	Brown, 1989
Eo–Cambrian	Barrington Chert	Success Creek Croup	Jennings et al, 1959
Upper Proterozoic	Burnie Formation	Oonah Formation	Turner, 1989
Precambrian ?	Ulverstone Metamorphics Forth Metamorphics	?	

flows, which forms an extensive cover of the prospective Palaeozoic sequence in the area. The rich agricultural land is largely developed on soil derived from these basalts. Finally, widespread Quaternary talus and scree deposits, forming predominantly from the Denison Group siliciclastic rocks, and fluviatile alluvium complete the sequence.

6 PREVIOUS EXPLORATION

W Herrmann has given a comprehensive account of the previous exploration undertaken within the area of EL 9/92, including old prospecting and mining and more recent mineral exploration and Mines Department investigations (see Appendix B). The exploration history of the area is summarised in Table 2.

The earliest mineral prospecting began in middle Nineteenth Century, around the time of the first settlement of the district. James "Philosopher" Smith, of Mt Bischoff fame, is also credited with the first discovery of silver–lead in Tasmania at Penguin, around 1860, as well as the discovery of copper at Walloa Creek and iron at Penguin Creek. Further intense prospecting in the period 1880 to 1910 and intermittent work since then has located about 20 additional mineral occurrences (see Figure 4). Most prospects had no significant production, apart from 1331t of ore containing 16.7% Cu from the Copper King Mine at Cuprona (Gee, 1977) and approximately 40 000t of haematite from Penguin Creek (Hughes, 1953).

During the late 1950's – early 1960's "iron ore boom" the BMR and the State Mines Department investigated numerous iron occurrences throughout Tasmania, including the Blythe River and Iron Cliffs prospects within the area of EL 9/92. Preliminary drilling results were not encouraging, however.

Modern exploration in the area commenced in the late 1960's and has been undertaken within numerous exploration licence since then (see Table 2). This work has occurred in bursts of activity and has focussed on a range of commodities and geological targets including:

- i Cambrian volcanic and sedimentary hosted base and precious metal massive sulphides (Mt Read Volcanics–type).
- ii Tin – tungsten skarn mineralisation related to Devonian granitoids (Kara–type)
- iii Pyrrhotite – tin replacement massive sulphides (Renison–type)
- iv Iron ore, either as sedimentary replacement or skarn bodies
- v Gold–platinoids, associated with iron and copper mineralisation

Table 2.

MINERAL EXPLORATION HISTORY EL 9/92 DIAL RANGE AREA

General

1860–1910	Early prospecting, discovery of numerous of small base metal shows, mostly small scale to no production apart from 1331t of copper ore from the Copper King Mine and 40 000t of haematite from Penguin Creek.
1910–1960	Intermittent prospecting, results in further minor discoveries

Dial–Leven Area

1960	Mines Department investigated Iron Cliffs occurrence; including drilling 2 short holes, total 123m, no significant mineralisation
1972–73	EL 9/72, 104km^2, Tasminex undertook reconnaissance investigations of old mineral showings with generally disappointing results.
1973–1985	EL 24/73, 106km^2, Pennzoil–Geopeko JV, extensive exploration including mapping, rock and soil geochemistry, VLF–EM, IP, MIP, Turam EM, SP, aeromagnetic surveys and drilling 10 holes, total 1506m. Most effort focussed in Dial Mine area, where encouraging but sub–economic Cu and Sn mineralisation found, best intersection: 20m at 0.7% Cu.
1986–1988	EL 46/86, 93km^2, Derwent Minerals reassessed previous exploration results and limited sampling of old workings, but proposed further instigations not undertaken.

Natone – Cuprona Area

1958–1962	BMR covered area with aeromagnetic surveys and ground follow–up.
1960 – 1965	Mines Department investigated Blythe River – Cuprona iron occurrences, including drilling 4 holes, total 286m, intersecting sub–economic mineralisation.
1968–1972	EL's 13/68, 14/68 Minops investigated the iron occurrences at Natone and Blythe River including magnetics, IP, auger drilling and 4 diamond drill holes, total 506m. Intersected low grade skarn mineralisation with minor Cu.
1969–1974	EL 1/69, Tasminex – ANZECO JV. Early base metal exploration within current EL 9/92 focussed on Natone ironstone and Rutherfords copper prospect, including soil and rock geochemistry, mapping, magnetics, costeaning and shallow percussion drilling 5 holes, total 106m, intersected Cu mineralisation in quartz vein: best assay 4.5m at 0.5% Cu. costean 1.5m at 6.0% Cu.
1977–1985	EL 8/77, 316km^2 Comalco–Shell–CRA JV. Extensive exploration including: mapping; stream, rock, soil geochemistry; aeromagnetic and airborne INPUT EM surveys; SP, IP max–min EM, SIROTEM, gravity; drilling 2 diamond and 1 percussion holes intersecting a "barren" skarn at Natone and "basalt hill" at Cuprona respectively.
1986–1989	EL 30/86, 43km^2 CW Davis undertook stream geochemistry, mapping, rock chip sampling and drilling 28 holes total 252m with an airtrack rig. Identified potential resource of 1.2mt haematite at Blythe River ironstones.

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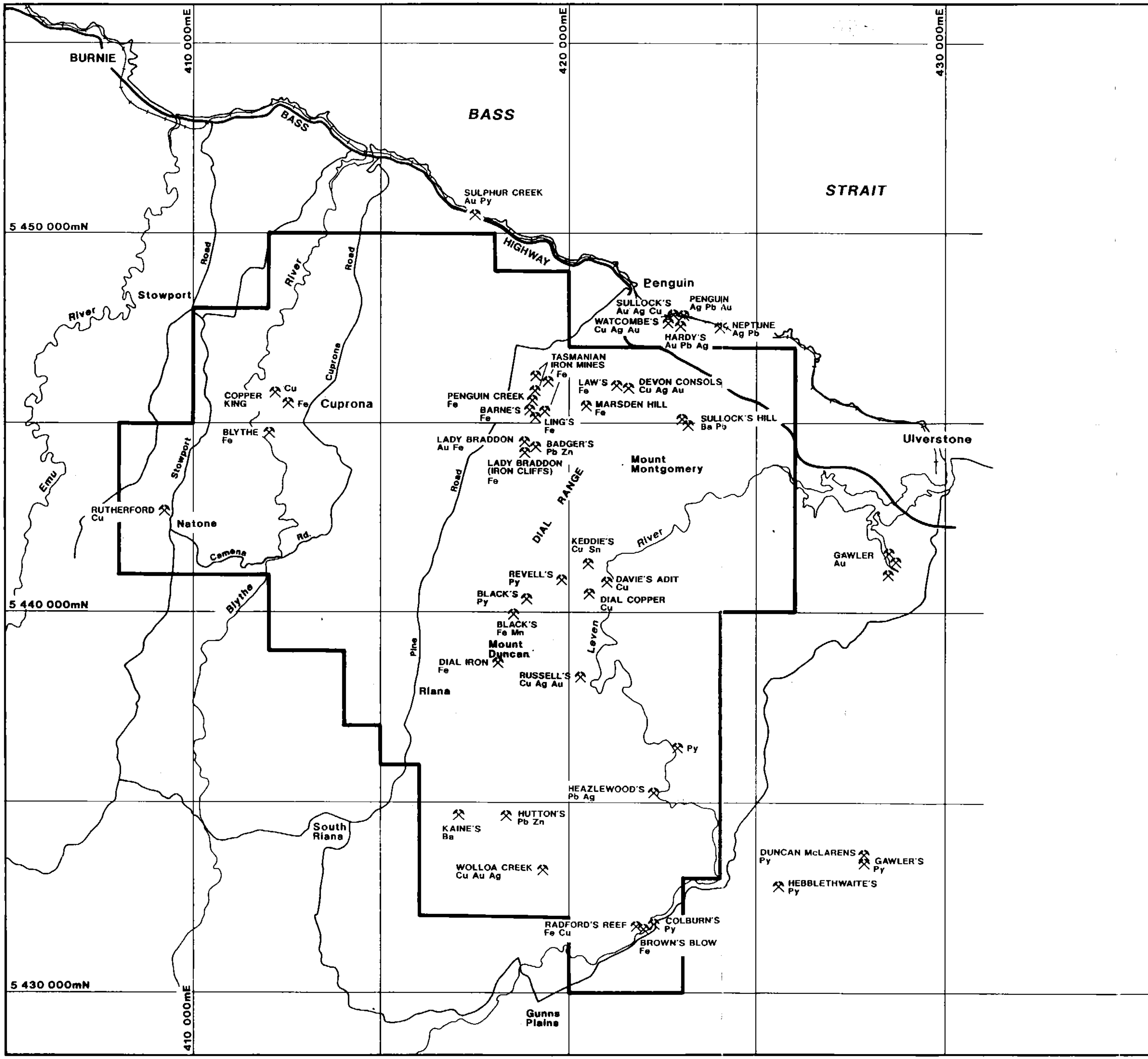

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DATE : Mar., 1993
DRAWN : G.M.B.
REF. :
REVISIONS :
DRAWING No.

E.L. 9/92 - DIAL RANGE

PROSPECT LOCATIONS

SCALE 1:100,000 0 2 km

FIG. No. 4

The results of this wide ranging exploration activity have been mixed. Geopeko-Pennzoil discovered sub-economic copper and tin mineralisation in the Dial Mine area, east of the Dial Range. The best drill intersection was 20m at 0.7% Cu in the last hole drilled. The pyrrhotite - magnetite skarns developed on the northern flanks of the Housetop Granite at Natone are essentially barren. The "ironstones" at Blythe River - Cuprona contain relatively small tonnages of variable grade Fe and are unlikely to ever be economic. The spatially associated copper mineralisation has been similarly interpreted. The search for gold and platinoids mineralisation has been singularly disappointing.

7 WORK UNDERTAKEN JULY 1992 - JUNE 1993

7.1 Introduction

The emphasis during the initial year's exploration of EL 9/92 has been to compile and evaluate all the previous prospecting and exploration data, to locate and undertake preliminary investigations of all the known mineral occurrences and to prepare a sound geological framework of the areas onto which subsequent, more detailed studies may be built.

To this end, Pasminco acquired available open file and Mines Department records. Contact geologist, Wally Herrmann, undertook a 3 month program of data review and field mapping and sampling. The main thrust of Herrmann's work was to locate old prospects, carry-out reconnaissance mapping to ascertain the geological setting and style of mineralisation and collect rock samples for comprehensive "path-finder suite" and lithogeochemical analyses (see Appendix D). All available Mines Department and Company exploration core was examined and selectively sampled. Several regional traverses were also completed, including the well-exposed coastal section from Penguin to Ulverstone, to help establish the stratigraphy and structure of the area. Herrmann's work is included as a thorough review report in Appendix B. A petrographic study of a suite of 35 rock and drill core samples taken by Herrmann was undertaken by Dr Tony Crawford, at the University of Tasmania (see Appendix C).

Existing aeromagnetic and gravimetric coverage of the tenement is patchy and includes various BMR and Mines Department surveys, as well as exploration company surveys undertaken with quite different specifications. Since a detailed analysis of the sub-surface, including sub-basalt geology is considered critical to effectively evaluate the mineral potential of the area, it was decided to cover the whole tenement with a high resolution helicopter-borne magnetic and radiometric survey. The survey was flown in conjunction with similar work on the Company's tenements in western Tasmania, thereby reducing mobilisation costs. The results of the aeromagnetic survey and extant gravity data have been evaluated in a preliminary interpretation by Dr David Leaman, of Leaman Geophysics (see Appendix E).

7.2 Geology

The discussion of the local geology of EL 9/92 is based largely on the work of Burns (1964), Gee (1977), Herrmann (Appendix B) and Crawford (Appendix C) to which the reader is referred. Salient features of this geology, including a discussion of the important unresolved aspects of the geology are given below. A geological interpretation map, based largely on mapping by the Geological Survey, is presented as Figure 5.

Table 1 summaries a proposed stratigraphy for the Dial Range area, which is significantly different to the published data of Jennings et al (1959) and Burns (1964) and, more recently, Woodward et al (1992). The basis for this revised interpretation of the stratigraphy is the observed structural relationships between many formations and the petrographic affinities of units and formations previously assigned to different groups. It is apparent that major tectonic disruptions of the pre-Devonian sequences has resulted in a pseudo-stratigraphy comprising numerous allochthonous blocks (see Brown, 1989 and Crawford, op cit).

The **Barrington Chert** is considered to form the base of the Cambrian, structurally over lying the poly-deformed Burnie Formation greywackes and slatey mudstones, as seen in the foreshore near Penguin (see Figure 6). The Chert sequence, which is up to 1 000m thick (Jennings, 1979), ranges in colour from grey to black, white or red and is typically finely laminated with common interbedded chert breccia units. The presence of intraformational slump folds and other soft sediment deformation features suggests that the chert was deposited in an unstable shallow marine basin. The Barrington Chert may be a correlate of the Black River Dolomite in the Smithton Basin and the Success Creek Group of western Tasmania.

The **Motton Spilite** apparently conformably overlies the Barrington Chert. The Spilite occurs as a sequence of pillowed and massive lavas with associated volcaniclastic mudstones, including locally abundant chert clasts, and is up to 500m thick (Burns, 1964). The lavas consist of altered dark green, fine to medium grained tholeiitic basalts. Limited chemical and petrological work suggests that the Spilite has affinities with ocean floor basalts (Brown, 1989) and is similar to basaltic lavas in the Cleveland – Waratah area. Crawford (op cit) and others suggest that they are a possible correlate of the Crimson

Creek Formation in western Tasmania, which formed during the Lake Proterozoic on a rifted passive margin. Crawford goes on to infer that the Motton Spilite and Barrington Chert have been tectonically emplaced along the base of an overthrust ophiolitic allochthon, during a mid-Cambrian tectonic collision.

The **Cateena Group**, as described by Burns (1964), consists of about 1000m of fossiliferous mudstone, lithic wacke conglomerate and minor volcanics. It is structurally overlain by the Barrington Chert but is composed of detritus derived from cherts, carbonaceous siltstones, tholeiitic basalt (Motton Spilite) and minor dolomites. These rocks appear to rest with angular unconformity on the Proterozoic rocks of the Forth region. The fossil assemblage suggests correlation with the Late middle Cambrian Lower Dundas Group of western Tasmania (Brown, 1989). Herrmann noted the marked similarly with the Beecraft and Teatree Point Megabreccia units, exposed on the Penguin foreshore, an observation strongly supported by Crawford's petrographic work. Crawford found no evidence for any Mt Read-type volcanic detritus in any of the samples that he studied. In fact Crawford (Appendix C) suggests that the Cateena Group, including the megabreccia units were derived from either a passive margin to the west of the "Dial Range Trough" or from a parautochthon of Motton Spilite - Barrington Chert prior to the formation of mid-late Cambrian volcanic activity in Tasmania.

The relationship of the Cateena Croup to the **Radford Creek Group** is unclear. Burns (1964) considered the latter group to comprise predominantly mudstones with lithic wacke, minor volcanics and spilite, chert-rich conglomerate overlying the Barrington Chert and unconformably overlain by the Dial Group (Early Ordovician conglomerate). However, Brown & Jago (1989) and Herrmann (Appendix B) have remarked on the similarity of the two groups and they have suggested that they possibly form part of a continuous sequence. Crawford (op cit) however, has interpreted that a mixed assemblage of sediments and volcaniclastics form a distinctive, and younger Cambrian sequence. Samples of the **Kerrison, Wilsonia** and **Applebee Volcanics**, as defined by Burns (1964), collected by Herrmann and described in thin section by Crawford appear to be very similar quartz-feldspar-vitric ash volcaniclastics derived from Mt Read Volcanics - type lithologies and been tentatively included in the Radfords Creek Group, which may be laterally equivalent to the Southwell Subgroup-Tyndall Group of western Tasmania.

The **Lobster Creek Volcanics** form a body roughly 8km x 3km in size on the western bank of the Leven River (see Figure 5). They consist of distinctly pink-red coloured plagioclase-hornblende-phyric diorite-microdiorite. Burns (1964) considered the Volcanics to be largely extrusive, however most evidence indicates that they are entirely intrusive (Corbett 1989, Herrmann, Appendix B). Rocks correlated with this formation are typically massive, and no intercalated sediments or pyroclastics have been mapped. Where contracts have been observed in the field and drill core, they are always intrusive eg. Penguin foreshore (see Figure 6) and in the Radfords Creek area. The Volcanics appear to have intruded the Barrington Chert, Motton Spilite, Cateena Group and the Megabreccias with associated locally extensive wall-rock alteration. Crawford has described this alteration as variably chlorite-haematite (magnetite); carbonate- sericite and silicification (see Appendix C). It appears to be most intense in rocks placed in the Cateena Group.

Burns (1964) suggested that the Lobster Creek Volcanics form the oldest Cambrian unit in the area. However the evidence, including an early Ordovician radiometric age (Rb-Sr: 490 ± 18 Ma) suggests that they are related to a late Cambrian sub-volcanic event, which is compositionally similar to the Mt Read Volcanics. Leaman (Appendix E) observed that the Lobster Creek Volcanics, if intrusive, were emplaced near the base of the Cambrian sequence and that they are spatially, closely associated with part of the Devonian Housetop Granite (see later discussion).

7.3 Mineral Prospects

One of the principal tasks assigned to Herrmann as part of his work in the Dial Range tenement was to relocate all the significant old mines and prospects, ascertain the current property ownership on which they occur and undertake preliminary mapping and sampling to help establish the geological setting and the potential of each occurrence to be associated with economically significant mineralisation. Herrmann successfully completed this work, which is comprehensively reported in Appendix B. Figure 4 shows the location of all prospects and the recorded commodity associated with each occurrence.

Herrmann recognised that the metallic mineral occurrences within EL 9/92 consist of four main styles of mineralisation, which are summarised in Table 3. Whilst these difference in

Table 3.

PROSPECTS & STYLES OF MINERALISATION – DIAL RANGE AREA

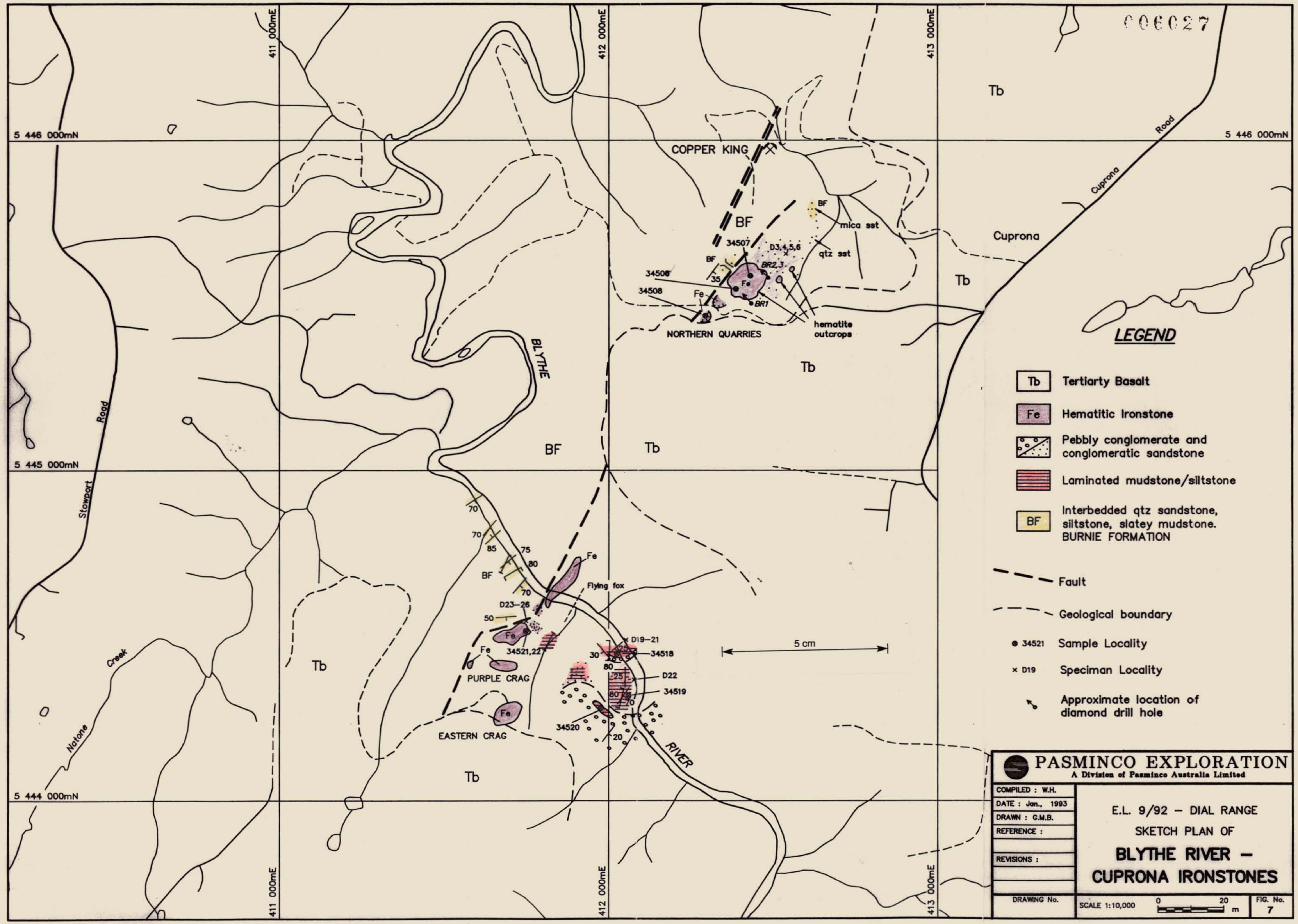
STYLE OF MINERALISATION	PROSPECT/MINE NAME	PRINCIPAL COMMODITY(S)
Cambrian hydrothermal system	Penguin	Ag Pb Cu (Au)
associated with intrusive	Neptune	Ag Pb
felsic magmatism	Dial Mine	Cu Ag (Au)
(Lobster Creek Volcanics)	Keddie's	Cu Ag (Au) (Sn)
	Davie's Adit	Cu
Haematite–silica replacement	Penguin Creek	Fe
uncertain age, structurally and/or	Iron Cliffs	Fe (py)–limonite
stratigraphically controlled	Dial	Fe
	Blythe River	Fe
	Cuprona	Fe
Devonian Vein	Copper King	Cu
small, fault fissure fill	Rutherford's	Cu
	Kaine's	Ba (Cu)
	Badger's	Pb Zn (Ag) (Cu)
	Hutton's	Pb Zn
	Wolloa Creek	Cu Ag
	Devon Consols	Cu Ag (Au)
	Russell's	Cu Ag (Au)
Devonian Skarn	Natone	Fe
Contact metasomatic mineralisation		
related to Housetop Granite		

style are noted, it is possible that they are all related to a single metallogenic epoch, a point discussed by many previous workers and raised again by the more the recent investigations (eg. Leaman, Appendix E). There is little doubt that the Devonian Housetop Granite, which underlies the entire tenement at depths mostly shallower than 1km below surface (Leaman op cit) is spatially, if not temporally associated with most of the mineral occurrences.

The inferred Cambrian hydrothermally related mineralisation, associated with dioritic intrusives of the Lobster Creek Volcanics suite, is a good case in point. Herrmann noted that the wall rocks adjacent to these intrusives on the Penguin foreshore are strongly altered to a mixed silica-sericite-carbonate-pyrite assemblage. Similarly, Cateena Group sediments, which host minor mineralisation at Devon Consols, and Russell's Adit have been strongly altered by hydrothermal chlorite - haematite (after magnetite?) - pyrite (see Appendix C). However, the type of mineralisation is rather similar to the widespread small veins and fault - related occurrences of Cu, Ag, Pb and Zn, which most geologists ascribe to the Devonian deformation and granitoid intrusion (eg Hughes, 1953). Leaman (op cit) also noted the close spatial association of many of the base metal occurrences with the thickest parts of the Lobster Creek Volcanics, but also observed that the shallow underlying Devonian granite surface often has an unusual step, suggesting a possible Devonian structural control on both of these features.

The mineralisation in the Dial Mine area, which was explored in some detail by Pennzoil-Geopeko is essentially pyritic breccia-fill, which is locally anomalous in copper, tin and arsenic. Geopeko considered this to be skarn mineralisation, related to the Housetop Granite (Herrmann, 1985). However, TC Lees (pers comm) has pointed out that the Fe-Cu-Sn- basemetal association is well known at a number of volcanic hosted massive sulphide deposits worldwide, including Kidd Creek and the Iberian Pyrite Belt.

The numerous ironstone deposits, which occur in the area, are usually associated with the contact zone between the Upper Proterozoic Burnie Formation and upper Cambrian - lower Ordovician Duncan Conglomerate. The deposits at Blythe River and Cuprona appear to be subvertical, parallel to the contact and with a faulted western margin (see Figure 7). All are composed of massive haematite and silica, apart from the Iron Cliffs occurrence, which is essentially limonite, thought to be after haematite. Textural evidence



006027
411 000mE
412 000mE
413 000mE
5 446 000mN
5 445 000mN
5 444 000mN
Tb
BF
COPPER KING
34507
D3,4,5,6
BR2,3
34506
34508
Fe
BR1
35
mica sst
qtz sst
hematite outcrops
NORTHERN QUARRIES
Cuprona
Cuprona Road
Stowport Road
Natone Creek
BLYTHE
RIVER
Flying fox
D23-26
34521,22
PURPLE CRAG
EASTERN CRAG
D19-21
34518
D22
34519
34520
5 cm
LEGEND
Tertiarty Basalt
Hematitic Ironstone
Pebbly conglomerate and conglomeratic sandstone
Laminated mudstone/siltstone
Interbedded qtz sandstone, siltstone, slatey mudstone. BURNIE FORMATION
Fault
Geological boundary
34521 Sample Locality
D19 Speciman Locality
Approximate location of diamond drill hole
PASMINCO EXPLORATION
A Division of Pasminco Australia Limited
COMPILED : W.H.
DATE : Jan., 1993
DRAWN : G.M.B.
REFERENCE :
REVISIONS :
DRAWING No.
E.L. 9/92 - DIAL RANGE
SKETCH PLAN OF
BLYTHE RIVER - CUPRONA IRONSTONES
SCALE 1:10,000
FIG. No. 7

favours a replacement of sedimentary strata model, which must be later than the early Ordorvician (host rocks to the Dial iron workings).

It is interesting to note the close spatial association of copper in quartz veins at Rutherford's and Copper King workings to the ironstones, suggesting that both are related to the same underlying structural control. However, Leaman (appendix E) noted that neither prospect is associated with a magnetic response, whereas the adjacent ironstones at Blythe–Cuprona and Natone have large magnetic effects. He concluded that there is no regional correlation between the ironstones and major structures and that the magnetic and gravimetric data infer a possible Devonian granite replacement origin for the deposits. Shell (Ruxton, 1983) have shown that the Natone pyrrhotite skarn deposit is unequivocally related to the contact metamorphic replacement of dolomites in the Burnie (Oonah) Formation by the Housetop Granite.

7.4 Geochemistry

During the course of Herrmann's mapping activities within EL 9/92, he collected a total of 104 rock samples and 16 drill core samples for geochemical analyses and/or petrographic descriptions. Sample locations and descriptions are listed in Appendix 1 of Herrmann's report (see Appendix B). Sample locations are also shown on Figure 8.

A total of 81 samples were submitted to Analabs, Cooee for analysis of a suite of "path–finder" elements, which may be related to major base metal mineralisation. Elements determined and the analytical methods used are as follows:

Cu, Pb, Zn, Ag, and Mn – aqua regia, perchloric acid digestion, AAS finish

As – perchloric acid digestion, hydride generation, AAS finish

Ba, Sb, Sn – pressed powder XRF determination

Au – fire assay fusion 30g sample, AAS finish

Assay results are presented in Appendix D.

In general, very few significantly anomalous results were obtained. Noteworthy assays include the following:

i **Beecraft Megabreccia** near the old Penguin workings

Sample No. 34563 - vein and disseminated pyrite in fault zone within black chert, 0.63% Cu, 0.11% As, 0.06g/t Au

Sample No. 34570 - silicified rock with minor sulphides, 0.36% Cu, 1.05% Pb, 3.03% Zn, 23g/t Ag

ii **Iron Cliffs** from Mines Department drill core

Samples nos. 34578-86 mostly quartz veined limonite, maximum assays: 391ppm Pb, 341ppm Zn, 1200ppm As, 4400ppm Ba (apart from barite veins) and 3.2% Mn.

iii **Dial Iron prospect**

Sample No. 34504 - haematitic conglomerate, 385ppm Pb, 910ppm Zn

Sample No. 34525 - massive compact haematite, from near Penguin Sports Centre, 550ppm Pb, 300ppm As.

iv **Devon Consols**

Sample nos. 34544-48 weathered polymict mafic volcaniclastic sandstone (Cateena Group), range 550-1270ppm Cu

v **Sullocks Hill barite prospect**

samples nos. 34535-41 mostly weathered polymict conglomerate and mudstone, locally pyritic (Cateena Group), range 118-1210ppm Zn, 0.04-5.4% Ba

vi **Walloa Creek,** near old workings

Sample No. 34560 - brecciated green siltstone with quartz-chlorite-carbonate and minor disseminated haematite-pyrite; 0.11g/t Au, with 196ppm Cu.

vii **Keddies prospect**

Sample No. 34564 - silicified pyritic breccia conglomerate 0.14% Sn, 300ppm As viii **Kaine's prospect**

Sample Nos. 34528–34, mostly vein barite or volcaniclastic sandstones contain no anomalous values, apart from Ba

ix **Black's prospect**

Sample Nos. 345513–17, mostly limonitic and manganiferous ferricrete, range 3.5–3.8% Mn and 0.2100.84% Ba

Key conclusions to come from this initial geochemical work are that the haematitic ironstones do not appear to be associated with any significant base or precious metal mineralisation. However, the limonitic ironstones at the Iron Cliffs prospect do carry some Pb, Zn, As and Ba, as well as visible pyrite, keeping alive the concept that they represent a gossan after massive sulphides (eg. Hughes, 1953). If this is true, then the depth of oxidation here is unusual, in that neither the deepest workings, nor the two Mines Department drill holes penetrated the base of oxidation, at least 80m below the surface. Alternatively, the base metal mineralisation could be associated veinlets in a later mineralising event and the limonite is simply after haematite, of the Penguin Creek style (eg. Burns, 1961).

No whole rock or trace element geochemistry has been undertaken at the time of preparing this report, although both Herrmann and Crawford have recommended that specific samples should be analysed to aid in lithological correlations, especially with the Cambrian volcanics and intrusives in western Tasmania.

7.5 Aeromagnetic and Radiometric Survey

The area included in the current EL 9/92 has been covered in part by several aeromagnetic surveys. However, all have been flown in fixed-wing aircraft, and most, apart from the Shell Housetop survey are either not available in digital form or were flown in an unsuitable orientation to highlight important features of the geology, as follows:

1955 BMR Hampshire-Blythe River Survey, part of their Tasmanian iron ore program.

1980 Shell Housetop Survey, including radiometric survey, flown E-W.

1983 Geopeko Dial Range survey, original data tapes unavailable (lost)
1985 Mines Department Devonport Survey, flown N-S
1985 BMR Burnie Off-shore Survey, flown E-W

Pasminco acquired the data from the Shell, Mines Department and BMR (1985) survey, re-gridded the data in ER Mapper and merged the data sets to produce a regional aeromagnetic image over the Dial Range area (see Figure 9). The most striking feature of this image is the presence of a large, magnetic high, approximately 15 x 20 km in area, which dominates almost the entire area of EL 9/92. This magnetic feature is one of the strongest seen in the magnetic field of NW Tasmania. There has been considerable speculation about the source of this feature. Leaman (appendix E) concluded that it is due to a strongly magnetic phase of the Housetop Granite, with magnetic susceptibilities more than three orders of magnitude higher than the normal Tasmanian granitoids.

It was decided to cover the whole licence area with a high resolution helicopter-borne aeromagnetic and radiometric survey to enable a detailed analysis of the sub-surface geology, especially of the sub-basalt geology. The Tertiary basalts cover almost two thirds of the tenement (see Figure 5). The survey was flown in March 1993 by Geoterrex, as part of a larger program in western Tasmania for Pasminco. The survey was flown in an east-west orientation along 200m spaced lines at a nominal terrain clearance of 80m with orthogonal tie lines spaced every 2 000m. A total of 1 286 line kilometres was flown within EL 9/92. Differential GPS navigation, using a base station on the Black Bluff Range, enabled excellent flight path control to be achieved. Radar and barometric altimeters and good pilot and navigator operations resulted in similarly good terrain clearance controls, even over the rugged Dial Range. Flight paths and residual magnetic contour plans are presented at 1:25 000 scale as Figures 10-13. A logistics report for the survey, which details all the survey specifications, has been lodged with the Mines Department.

Dr David Leaman was commissioned to undertake a preliminary interpretation of the new aeromagnetic data, in conjunction with the extant gravity data. Specific issues to be addressed in this study included the following:

i The extent of the Housetop Granite beneath the area
ii Possible associations between the granite and known mineralisation

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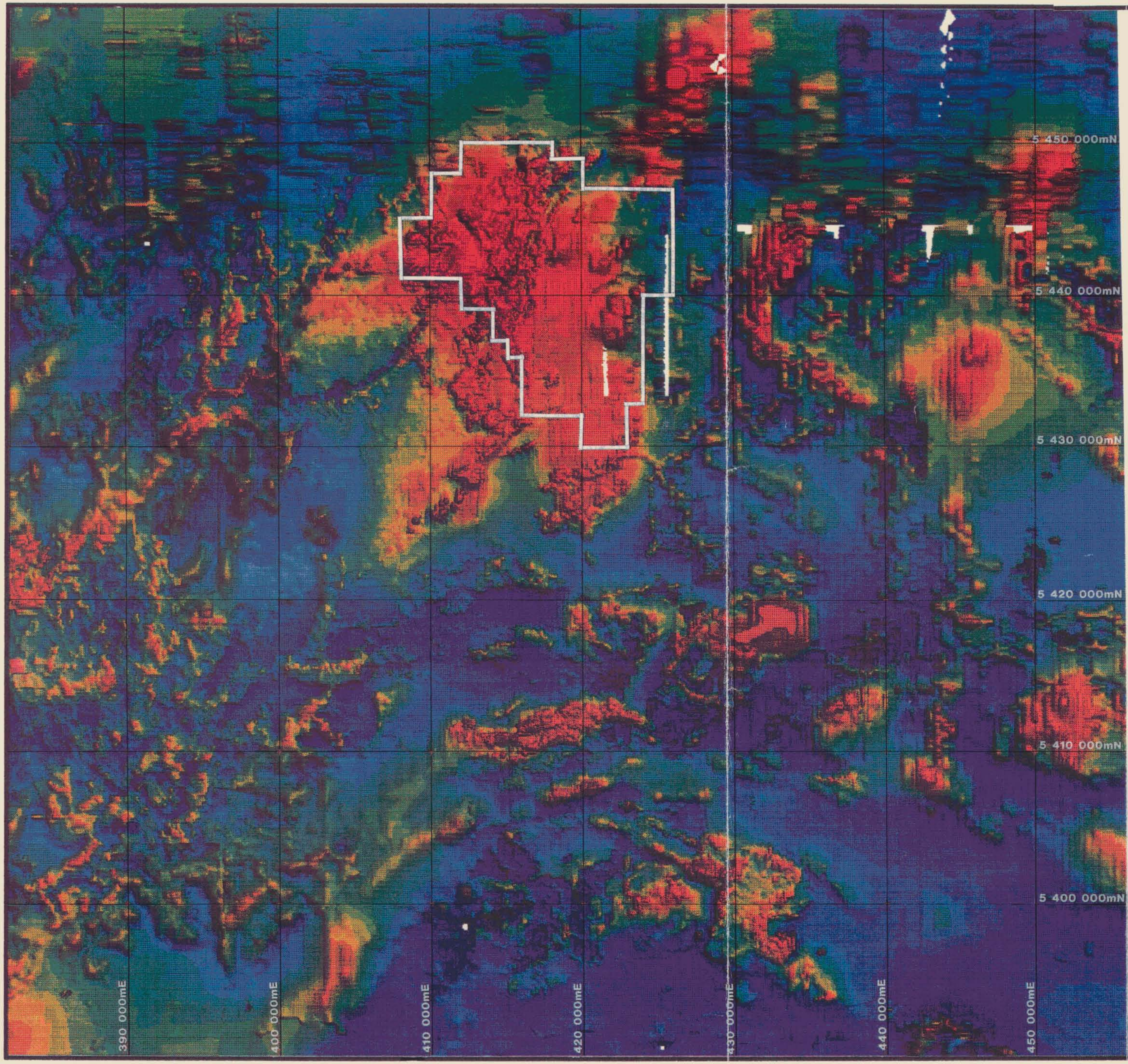

Merged aeromagnetics from

Shell Housetop survey, 1980.

Mines Dept. Devonport survey, 1985.

BMR Burnie offshore survey, 1985.

Colour drape with NE Sun angle 045° at 70°

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED :
DATE : May, 1992
DRAWN :
REFERENCE :
REVISIONS :
DRAWING No.

E.L. 2/90 – DIAL RANGE

REGIONAL AEROMAGNETIC IMAGE

SCALE 1:250,000 0 500 m

FIG. No. 9

iii The extent of the Cambrian sequences beneath cover, especially the Tertiary Basalt.

iv The thickness and form of the basalt distribution

v The setting and distribution of the Lobster Creek Volcanics

vi Any correlation of the ironstones at Penguin Creek–Iron Cliffs and Blythe River–Cuprona with major structures

vii The source of the dominant magnetic anomaly in the region

viii The structural architecture of the region

To assist in the analysis of the aeromagnetic survey, Herrmann routinely measured the magnetic susceptibility of all lithologies in outcrop during his mapping program. A summary of the results of this study are presented in Herrmann's report as Appendix II (see Appendix B). Leaman was provided with these results.

Leaman's report is presented as Appendix E. His conclusions are as follows:

i The Devonian Housetop Granite dominates the Dial Range region. It's roof occurs at relatively shallow depths (average 1km) and there are local spines present.

ii The large regional magnetic anomaly is due to a strongly magnetic phase of the Housetop Granite

iii Many of the mineral occurrences are spatially associated with the granite roof forms.

iv The Cambrian sequences are quite limited in extent, due to shallow angle structures and stoping by the granite

v The Lobster Creek Volcanics and the Motton Spilite are the only pre-Devonian formations that have any magnetic significance in the total field.

vi The Lobster Creek Volcanics always seem to occur deep in the section, closely associated with the underlying granite. No strong alteration signature is evident, however many mineralised sites are clustered about the thickest zone of the Volcanics

vii The ironstones appear to be truncated by the granite. There is no obvious structural control on their distribution, although the granite emplacement may have obscured (or utilised) pre-existing deep-seated structures, if the ironstones predate the Devonian,

viii The Tertiary basalts are the most magnetic unit in the area, however their distribution and thickness is quite variable, up to at least 200m. It is possible to remove the high intensity magnetic responses of the basalt to model the sub-basalt geology (see Figure 5, Appendix E).

ix Mineralisation within the Dial Range area appears to be linked to clearly defined regional magnetic and gravity trends, implying a strong association with the latest deformation, in the Devonian, although the possibility of remobilised early mineralisation is considered.

7.6 Environmental Disturbance and Rehabilitation

Field activities within EL 9/92 during the 1992-93 have been restricted to 4WD vehicles using existing access tracks and traverses on foot to specific prospect locations to collect a few fist-sized rock samples. Permission from the land owners was sought before entering any private land. No environmental disturbance was associated with any of these activities and no rehabilitation of previous disturbances was undertaken.

The helicopter magnetic survey was based from Mr Trevor Walker's property at Riana. Public notices in the local newspaper advising all land occupiers of the prosed survey were followed up with discussions and site visits to concerned residents, eg. the Carr's ostrich farm at South Riana. The contractors were made aware of property locations where disturbance of stock might be a problem. In the event, there were no such problems with the air-borne survey

8 EXPENDITURE

Total expenditure since the inception of EL 9/92 in June 1992 up to the end of May 1993 has been **$113 482.** A breakdown of this expenditure is given below.

Personnel: salary, wages & oncosts	11 163
Travel & Accommodation	897
Geological Contractors	10 096
Assays	2 244
Aeromagnetic & Radiometric Surveys	65 095
Photogrammetry	3 805
Other contractors	247
Stores & Supplies	1 056
Vehicles & Equipment	942
Computing	587
Tenement Costs	4 342
Office Running Costs	2 692
Administration Fee	10 316
TOTAL	**$113 482**

9 CONCLUSIONS

Preliminary exploration of EL 9/92 in the Dial Range area for potential polymetallic massive sulphides (Rosebery–Hellyer type), or the secondary target, high grade Cu–Au–Ag deposits (North Lyell type), has not been encouraging. The following important conclusions can be made:

- i The area is largely underlain by the Devonian Housetop Granite at relatively shallow depths (average 1km).
- ii Most known mineral occurrences appear to be related to Devonian structural features with an inferred primary magmatic (granitic) or tectonically remobilised association.
- iii The Lobster Creek Volcanics, initially regarded as potential Mt Read Volcanic host rocks for massive sulphide occurrences, appear to be entirely Late Cambrian – Early Ordovician dioritic intrusives.
- iv The Lobster Creek Volcanics are associated with locally intense hydrothermal alteration of wall rocks and accompanying minor base metal mineralisation. The principal mineralisation within these intrusives is a Cu–Sn–As assemblage, indicative of a plutonic rather than a volcanic–exhalative style of mineralisation.
- v The haematitic ironstones at Blythe River–Cuprona and the nearby copper occurrences do not appear to be controlled by major crustal structures and there is no precious metal association indicative of a North Lyell style of deposit. They appear to have formed from selective replacement of particular sedimentary units close to the Upper Proterozoic Burnie Formation–Early Ordovician Duncan Conglomerate boundary (a classic redox boundary).
- vi The origin of the limonitic ironstones at Iron Cliffs had not been resolved. The possibility that this represents the gossanous cap of a massive sulphide deposit remains, although the evidence favours a similar replacement model for the other ironstones, with the haematite subsequently oxidised to limonite.

vii It is unlikely that extensive areas of the Cambrian sequence, especially the magnetic Lobster Creek Volcanics and Motton Spilite, exist beneath the Tertiary Basalt cover, which is locally in excess of 200m thick.

Whilst the initial exploration results have been somewhat discouraging, there appears to be several potentially favourable geological features of the Dial Range region, based on analogies with the highly productive Mt Read Volcanics belt in western Tasmania. These include:

i The presence of potential source rocks such as the Barrington Chert–Motton Spilite, which appear comparable with the Success Creek Group–Crimson Creek Formation. Also noteworthy is the occurrence of serpentinite within the Forth Metamorphic Complex, east of Ulverstone.

ii Major tectonic disruptions, including several phases during the Eo–Cambrian to early Ordovician, related to an arc–continent collision during which allochthonous blocks have been emplaced and which could have resulted in major ore–bearing fluid movement.

iii The widespread occurrence of base metal and barite prospects throughout the limited exposure of the Cambrian sequences, even though they are individually quite small, is indicative of "fertile" fluid–flow.

10 RECOMMENDATIONS

It is suggested that further exploration is warranted to evaluate some of the concepts outlined in Section 9 in more detail. In particular, the following program is recommended:

i Carry out detailed geological mapping, accompanied by petrographic and lithogeochemical studies over key areas to resolve the major Cambrian stratigraphic problems and identify favourable zones of hydrothermal alteration.

ii Complete systematic geochemical sampling of key prospects, such as Keddies, Dial Mine, Badgers and the Penguin Mine, in conjunction with detailed mapping.

iii Undertake systematic geochemical sampling including petrography across the Iron Cliffs limonite occurrence and compare the results with established spidergrams to determine if this could be a base metal gossan. Note that the program will be limited by the Ferndene State Reserve, which covers much of the ironstone and is excluded from EL 9/92.

iv *Complete a detailed analysis of the aeromagnetic and gravity data*, especially over the northern part of the tenement. It is possible that some of the existing gravity needs to be re-surveyed, as well as in-filling the present coverage to assist in developing a refined sub-surface structural model for the area. The collection of additional magnetic susceptibility and specific gravity data would be an important component of this program.

v Undertake a thorough evaluation of the existing electrical geophysical results (especially IP) from surveys over the Dial Mine grid.

vi If any of the above is sufficiently encouraging, then initial diamond drilling to test specific targets should be undertaken.

11 KEYWORDS & LOCALITY

ACID VOLCANICS, BASIC VOLCANICS, GRANITE, BASALT, CHERT, IRONSTONE, SULPHIDES, BASE METALS, TIN, IRON, THRUST, RIFT, UPPER PROTEROZOIC, CAMBRIAN, ORDOVICIAN, DEVONIAN, TERTIARY, DATA REVIEW, GEOLOGY, GEOCHEMISTRY, GEOPHYS MAGNETICS, PETROGRAPHY, STRATIGRAPHY.

BURNIE SK5503, DIAL RANGE, DIAL RANGE TROUGH.

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APPENDICES

APPENDIX A

Schedule for EL 9/92 Dial Range

SCHEDULE

Commencing at a northwest corner at grid co-ordinates 412 000 metres E. 5 450 000 metres N. thence grid east to 418 000 metres E. grid south to 5 449 000 metres N. again grid east to 420 000 metres E. again grid south to 5 447 000 metres N. again grid east to 426 000 metres E. again grid south to 5 440 000 metres N. grid west to 424 000 metres E. again grid south to 5 433 000 metres N. again grid west to 423 000 metres E. again grid south to 5 430 000 metres N. again grid west to 420 000 metres E. aforesaid grid north to 5 432 000 metres N. again grid west to 416 000 metres E. again grid north to 5 436 000 metres N. again grid west to 415 000 metres E. again grid north to 5 437 000 metres N. again grid west to 414 000 metres E. again grid north to 5 439 000 metres N. again grid west to 412 000 metres E. aforesaid again grid north to 5 441 000 metres N. again grid west to 408 000 metres E. again grid north to 5 445 000 metres N. again grid east to 410 000 metres E. again grid north to 5 448 000 metres N. again grid east to 412 000 metres E. aforesaid thence again grid north to the point of commencement.

The area excludes:	299 ha Mount Montgomery State Reserve
	36 ha Ferdene State Reserve
	200 ha Mining Leases
	3 skm Crown Reserves
	.8 skm Proposed Sith Cala State Reserve

Land Tenure

The area comprises:	Private Property
	State Forest
	Crown Land
	Timber Reserve
	Crown Land (Dept. of E & P Approval)

The area contains the Dial Range RAP.
Note: This land tenure table is a guide only.

APPENDIX B

Notes on a Geological Reconnaissance of the Dial Range EL 9/92

- W Herrmann, January 1993

006046

NOTES ON A GEOLOGICAL RECONNAISSANCE OF THE DIAL RANGE - EL 9/92

For: PASMINCO EXPLORATION
PO Box 886 Burnie TAS 7320

By: W. Herrmann RSD 1066 Devonport TAS 7310

Date: January 1993

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1 SUMMARY

A geological reconnaissance including a review of previous mineral exploration in the Dial Range area has found that there are at least four types of mineralisation present:

a) Quartz-pyrite alteration zones with minor base metals, tin and arsenic occur in association with probably Cambrian felsic intrusive bodies.
b) Hematite-silica replacement deposits of uncertain age, but probably pre late-Tabberabberan deformation, occur along the western margin of the Dial Range Trough and are thought to be structurally controlled and associated with major faults defining the margin of the trough.
c) Widespread but minor vein and fault fissure Cu-Ag-(Pb-Ba-Au) mineralisation is thought to be associated with Devonian deformation and faulting.
d) Contact metamorphic/metasomatic skarn type mineralisation occur in carbonates adjacent to Devonian granite contacts.

Structural relationships at the base of the Cambrian sequence and between previously established lithostratigraphic subdivisions are equivocal or obscure but the following variations on the stratigraphy proposed by Burns (1964) are suspected:

* That the Lobster Creek Volcanics are Cambrian felsic intrusives.
* That there is substantial compositional similarity amongst polymictic conglomerates assigned to the Cateena Group, Radfords Creek Group and Megabreccias and that these units may be equivalents, younger than the Motton Spilite and Barrington Chert.

A suite of 35 rock samples has been selected for wholerock geochemical analysis and/or petrographic examination which it is anticipated will assist in sorting out the stratigraphic relationships within the Dial Range Trough and possible correlations with the Dundas Trough.

2 INTRODUCTION

Exploration Licence 9/92 covers an area of 220 sqkm in northwestern Tasmania extending from Penguin to Gunns Plains and from the Leven River westward across the Dial Range to Cuprona and Natone.

The licence was granted on 24 July 1992 to Pasminco Australia Limited which is undertaking an exploration programme for polymetallic base metal sulphide and copper-gold deposits.

This report presents some preliminary findings of a review and reconnaissance forming part of the first stage of exploration of EL 9/92 and encompassing:

* A review of previous prospecting and exploration.
* Rediscovery, reconnaissance mapping and sampling of many of the known mineral occurrences.
* Inspection and selective sampling of some existing diamond drill core.
* Cursory regional mapping and lithological sampling for petrographic and geochemical studies to elucidate volcano-stratigraphic relationships between the Dial Range Trough and the Mount Read Volcanics and Dundas Group of western Tasmania.

This work was carried out by W. Herrmann over about five weeks during December 1992 and January 1993 under a contract arrangement for Pasminco Exploration.

3 PREVIOUS EXPLORATION

The earliest metallic mineral prospecting in the area of EL 9/92 is attributed to James "Philosopher" Smith who is credited with the discovery of copper at Walloa Creek, iron at Penguin Creek and the first silver-lead in Tasmania at Penguin around 1860, (Burns, 1964).
Fairly intensive prospecting in the period 1880 to 1910 and intermittent work since then turned up about twenty additional mineral occurrences but in the majority of cases did not lead to significant production. The notable exceptions are production of about 40,000 tons of hematite from Penguin Creek (Hughes, 1953) and 1314 t of copper concentrates averaging 16.7% Cu from the Copper King Mine at Cuprona (Gee, 1977).

Surveys and reviews of the old prospects were carried out by Hughes (1953), Burns (1964) and Gee (1977) and they referred to numerous earlier reports by various Government geologists. These collectively form the basis of geological knowledge of most of the known mineral occurrences and will be referred to specifically in Section 5 dealing with my reconnaissance of them.

Modern exploration over the last quarter century has been carried out by several exploration groups including: Minops, Tasminex/ANZECO, Comalco, Shell/Billiton/CRAE, Pennzoil/Geopeko, C.W.Davis and Derwent Minerals.
The objectives, methods and results of their exploration programmes, under various previous Exploration Licences, are summarised below and are more specifically referred to in Section 5 where relevant to this reconnaissance.

3.1 Natone - Cuprona Area

Minops Pty Ltd - ELs 13/68 and 14/68

Minops' exploration programme was to evaluate the iron ore potential of the Natone and Blythe River areas, (Erdmanis, 1969)

At **Natone** they carried out grid based magnetics and IP and followed up with Gemco auger drilling (1159') and diamond drilling (DDHs 1,2,3; total 1284') to test magnetic anomalies.
DDH 1 intersected upto 10% vein and disseminated Py and Po with minor Cpy in silicified calcareous sediments.
DDH 2 of 600' intersected "magnetic hematite" (mainly hematite with a few percent magnetite) in the upper 265' of the hole with narrow zones of vein and disseminated Py, Po and Cpy mineralisation in a sequence of calc-silicate hornfels, limestone and quartzite in the lower part of the hole (Hughes, 1969). This mineralisation carried upto 0.3% Cu, a trace of Au but no Sn.
DDH 3 intersected minor secondary iron mineralisation but was abandoned before reaching target depth due to difficult drilling in deeply weathered ground.

Minops proposed a long list of further drill holes totalling 12650' (Byrne, 1969). Grace (1972a, p3) referred to drilling of eleven percussion holes with eight 5' intersections of around 0.07% Cu.

At **Blythe River**, Minops drilled one diamond hole (DDH 1, 386') which intersected 189' of low grade iron mineralisation. The location of this drill hole and whereabouts of the core is unknown.

Tasminex N.L. - EL 1/69

Tasminex carried out a programme of grid based B-horizon geochem, mapping, magnetics, costeaning and drilling of 5 shallow percussion holes at **Natone** to test the base metal potential of outcropping hematite bodies, the underlying metasomatic? sulphide mineralisation and the area of Rutherford's copper show, (Grace, 1972a)

Most of the costeaning and drilling was concentrated around Rutherford's Cu and outlined an inferred mineralised zone of 1300' strike length. The best drill intersection of 15' @ 0.52% Cu and costean channel sample of 5' @ 6.0% Cu were related to a 2' wide quartz vein carrying Py, Cpy, Bn and covellite. A chip sample from the same mineralised vein in an old adit assayed 7.2% Cu, 0.5% As and 4900g/t Ag!
This and other narrower veins appeared to be associated with a steeply west dipping NNE trending fault zone within an upto 45' thick black pyritic shale unit of the Burnie Formation.

Grace's (op cit) recommendations for drilling of two diamond holes were apparently not carried out.

Comalco, SHELL/Billiton and CRAE - EL 8/77, Riana

EL 8/77 covering 316 sqkm from Penguin around the northern side of the Dial Range, westwards to Natone and southwards to Riana, Loyetea and Nietta was granted to Comalco in 1977 with extensions in 1979. Comalco carried out regional stream geochemical surveys and reconnaissance at some known mineral occurrences including Penguin, Neptune, Tasmanian Iron Mines (Penguin Creek), Copper King, Blythe Iron and Natone Iron; (Banwell, 1981).

In 1980 SHELL joint ventured into the EL as operating partner with an exploration programme directed to tin, tungsten and base metal deposits and commissioned a Geometrics airborne magnetic/radiometric survey to locate Moina or Mt Bischoff type magnetic anomalies. The survey identified two aeromagnetic anomalies near, but not coincident with, the known hematite occurrences at Natone and Cuprona (Blythe River).

At **Natone** SHELL undertook a grid based programme (limited in scope due to "difficulties" with one of the landowners) of hand auger soil geochemical sampling (average sample depth: 1.5m), magnetics, VLF-EM and rock chip sampling. The soil geochem was only partly successful due to Tertiary basalt cover but did indicate a tungsten anomaly around the hematite ironstone outcrop. Semi quantitative ES analysis suggested high W in the ironstones but re-analysis with XRF indicated only 15-25 ppm W and 50-250 ppm Sb. Petrographic studies of the ironstones (including chert with qtz+tourmaline veins, hematitic chert, hematite-goethite and magnetite-limonite) suggested that they were of sedimentary oxide facies iron formation, not metasomatic, origin.

Follow up work reported by Ruxton (1983, 1984) included an airborne INPUT EM survey and grid based max-min EM, SP, IP, gravity and SIROTEM; re-logging and re-assay for Sn of the original three Minops' diamond drill holes and drilling of an additional two core holes (NT1 and NT3).
This led to recognition of a zoned (proximal-distal) contact metamorphic (minor metasomatic) calc-magnesian-iron silicate skarn deposit in a flattish dipping sequence of quartzite-chert clast conglomerate, sandstone, shale and dolomitic limestones adjacent to the steeply dipping contact of the Devonian Housetop Granite and underlying the hematitic ironstones. The skarn was estimated to have dimensions of about 1200x500m (elongated NE-SW) and thickness >210m. It contains massive bands and disseminations of magnetite and pyrrhotite which contribute to a strong magnetic and conductivity anomaly but it is essentially "barren" with maxima (ppm) of 80 Sn, 65 W, 1600 Cu, 90 Pb, 140 Zn, 210 Bi, 65 Sb, 7300 As and <0.05 Au.

Ruxton (1983) interpreted that the host sequence of dolomitic sediments and overlying hematitic ironstones/ferruginous silicified sediments were correlates of the PreCambrian/Cambrian? Oonah Formation. These were considered to rest unconformably on folded turbiditic sediments and intercalated dolerite-gabbro sills of the Burnie Formation although the possibility of a faulted contact was not discounted. He interpreted that Ordovician siliciclastic conglomerate and sandstone rested with slight angular disconformity on the ironstones at the top of the Oonah Fmn. The ironstones themselves were considered to be volcanogenic exhalatives and the spatially related quartz vein copper mineralisation in the underlying Burnie Formation (Rutherford's, Copper King) were regarded as feeder veins to the ironstone exhalatives.

At **Cuprona** SHELL carried out some grid based magnetics and soil geochem surveys (Banwell, 1981). Rock chip geochem on the hematitic ironstone outcrops indicated lower Sb, W values than at Natone (max: 80 and 15ppm respectively). Petrographic identification of a single grain of gold (in a quartz vein?) in brecciated hematitic chert led A.G. Whittle (in Banwell, op cit) to postulate a submarine felsic volcanic source for (very) low levels of Sb, Hg, W, Au in these "exhalative BIFs".
SHELL drilled a 200m vertical percussion hole into a Tertiary basalt covered hill to test the Cuprona magnetic anomaly (which had not given an INPUT EM response); (Banwell, 1981; Von Strokirch, 1985). This hole intersected 132m of basalt with magnetic susceptibility ranging from 0.0003 to 0.003 cgs units, then 14m of sub basalt Tertiary alluvium and passed into shales of the Burnie Formation; modelling indicated that "the most likely source of the aeromagnetic anomaly was a basalt hill".

CRAE joined the joint venture as operators in 1985; their main target was volcanic hosted lead-zinc deposits and the northern (Natone, Cuprona, Penguin) segment of the EL was relinquished in April, 1985; (Von Strokirch, 1985).

C.W. DAVIS - EL 30/86, Cuprona

EL 30/86 covered 43 sqkm in the Cuprona-Natone area and was explored for Au, Pt, Sn, W and Fe deposits, (Whitehead; 1988, 1989).
The exploration programme included:

* A regional stream sediment geochem survey carried out with bulk samples analysed by cyanide leach for Au and panned concentrates analysed for Au, Pt, W and Sn. The results were generally disappointing with maximum 0.86ppb Au in BCL and below detection Au and Pt in all PC samples.

* A re-appraisal of previous work on the Natone skarn with extensive re-sampling of drill core and analysis for Au and Pt but no significant values were detected.

* Re-assessment and surface geological mapping of the Copper King Mine area (Cuprona) with rock chip sampling and re-analysis for Cu, Au, Pt of core from four holes drilled by the Department of Mines in 1968-69. Pt was <0.005ppm in all samples and maximum Au was 0.045g/t in association with 3% Cu in an adit sample. Mapping indicated that copper mineralisation in quartz veins occurs in association with a well developed shear zone trending 030deg and dipping at 76deg to SE discordant with the bedding in a host sequence of Burnie Formation shales, siltstones and micaceous quartzites. The wall rocks in the mine area are contorted graphitic shales; to the south the shear zone is in micaceous quartzites and is apparently not mineralised.

* Geological assessment of the iron resource of the hematitic ironstones at Blythe River-Cuprona with particular attention to the Northern Quarries and Purple Crag deposits. This included a 28 hole (252m) airtrak drilling programme over Northern Quarries which defined a near surface mineable reserve of 75,000t @ average 79% Fe_2O_3 and potential reserves of 1.2million t. The ironstones were not, apparently, analysed for Au and Pt.

3.2 Dial - Leven Area

Tasminex N.L. EL 9/72

Modern exploration in the Dial Range area seems to have commenced with the reconnaissance work carried out by Tasminex NL for a variety of minerals including uranium, iron-manganese, scheelite and base metal deposits. (Grace, 1972b)

Tasminex carried out a three month programme of systematic sampling and investigation of the old workings in the area from Penguin to Kaines' and concluded that the area had good base metal potential, particularly in the area around Dial Mine where extensive pyrite mineralisation was found to be associated with the upper contact of the Lobster Creek Volcanics which were interpreted to represent a Cambrian submarine volcanic pile. Grace's (op cit) recommendations for improvement of access and some costeaning at Dial Mine were apparently not followed up.

Pennzoil / Geopeko - EL 24/73

I have made a fairly detailed (12pp) review of the eleven year history of EL 24/73 previously (Herrmann, 1985) and, rather than repeat it here, would refer the interested reader to that.

A very brief summary (lifted directly from Herrmann, op cit) is as follows:

"Mineral exploration of EL 24/73 has spanned approximately eleven years.
The initial few years work was undertaken by Pennzoil of Australia in search of stratabound volcanogenic massive sulphide deposits.
With the advent of a Pennzoil-Geopeko joint venture in 1978 the emphasis switched to exploration for pyrrhotite-cassiterite replacement deposits of the Renison Bell type.

Approximately four-fifths of the exploration effort and expenditure by Pennzoil and Geopeko has been directed at investigation of the old Dial Mine area in the central north of the licence area. Methods applied have included grid cutting, outcrop/float mapping, soil geochemistry, VLF-EM, IP, MIP, TURAM, SP and magnetic geophysics and the drilling of ten diamond drill holes into various geochemical/geophysical targets. Ferruginous (pyritic) sedimentary breccias, locally anomalous in copper, tin and arsenic, are widespread in the complex mixed sedimentary-volcanic-intrusive (?) Cambrian rock assemblage of the Dial Mine area.

Encouraging but sub-economic levels of tin and copper were intersected in several of the drill holes.

Regional appraisal of the greater part of the exploration licence has included stream sediment sampling and reconnaissance geological mapping, brief examination of some old mineral prospects and an aeromagnetic survey with ground follow up of eighteen selected anomalies."

Although the enthusiasm for tin exploration fizzled out after 1982, and the 1983 aeromagnetic survey and follow up a last resort to keep the project going after failing to attract a third partner, it seems Pennzoil/Geopeko never re-examined the regional base metal potential of the licence.

Derwent Minerals P/L - EL 46/86 (Dial Range)

Derwent Minerals acquired a 93sqkm EL over the Dial Range in 1987 with the objective of re-evaluating the results of previous explorers and "generating" base metal - precious metal targets, (Morrison & Davidson, 1988)

The first year's work included:

* A review of previous data by consultant P.Jones which identified at least 8 areas which had gold geochemical anomalies or other indications of gold potential. Recommendations were given for completion of stream geochemical survey over the EL, follow-up/reconnaissance rock chip sampling and mapping and (unspecified) gridding and detailed surveys over previously delineated anomalous areas.

* A review of regional magnetic, gravity and radiometric geophysical data over the Dial Range area by consultant D.E.Leaman.
  The reviewer found that the available data could be used for definition of alteration zones but that only the Lobster Creek Volcanics were sufficiently extensive and magnetic to allow such determination. It was suggested that much of the area is unprospective for Cambrian mineralisation and that initial detailed ground work should be restricted to the area around Keddies and east of the Dial Mine. It was also "shown" that Devonian granite had pervasively intruded the Cambrian sequence, that the top of the granite had sharp relief and came close to the surface and that with few exceptions, all the known mineral occurrences were marginal to these features.

Morrison and Davidson's overall conclusions were that the prospects were good for Cambrian submarine exhalative mineralisation.

A little work and sampling with inconclusive results was carried out in the following year but seems to have fizzled out after that.

4 REGIONAL GEOLOGY

The most comprehensive regional mapping of the EL 9/92 area was carried out by geologists of the Geological Survey of Tasmania during the late 1950s and the 1960s; this culminated in publication of the Devonport and Burnie 1 mile to 1 inch geological maps and explanatory reports in 1963/64 (Burns, 1964) and 1967/77 (Gee, 1977), respectively.

Their work, which had a strong structural bias, remains the basis for geological interpretation today. Although some of the Cambrian stratigraphic order may be due for revision the stratigraphic terminology of Burns (1964) and Gee (1977) is largely retained in the following discussion.

PreCambrian Basement:
The basement of the Dial Range area is probably constructed of PreCambrian sediments and metasediments which recent interpretations suggest were multiply deformed during the Late Proterozoic Penguin Orogeny; (Turner, in Burrett & Martin, 1989). An upper division of relatively unmetamorphosed turbiditic quartzwackes and mudstones, the Burnie Formation, structurally overlies greenschist facies meta quartzite, mica schist and stretched pebble conglomerate of the Ulverstone Metamorphic Complex.

The contact between them, exposed at Goat Island and south of Gawler, was regarded as a thrust (the Singleton Thrust) correlated with the later stage of the Penguin Orogeny by Burns (1964). Berry et al (1990) pointed out the problem of thrusting shallower level, less metamorphosed rocks over deeper level, more metamorphosed rocks if both were part of the same orogen and it seems that the structural relationships are not yet resolved. Most recently, Turner et al (1992) on the basis of a re-interpretation of complex radiometric age data, have suggested that peak metamorphism of the PreCambrian rocks occurred during an Early to Middle Cambrian tectonic collision which also introduced mafic volcanics and ultramafic rocks of oceanic affinity as a west travelling allocthon.

Dial Range Trough

The Dial Range Trough is 5km wide on the coast where it is flanked to west and east by PreCambrian sediments of the Burnie Formation and it widens out considerably southwards where it appears to be continuous with the Dundas and Fossey Mountain Troughs.

The Cambrian sequence, according to Burns (1964) was deposited in a tectonically active, narrow linear trough and had minimum thickness of about 1800m which he subdivided into five major litho-stratigraphic units. These were summarised by Jago and Brown (1989) as follows:

a. Lobster Creek Volcanics at the base;
b. the Cateena Group of late middle Cambrian age;
c. the Barrington Chert correlative and overlying Motton Spilite which Burns thought was separated from the Cateena Group by the Hardstaff Unconformity;
d. the Radfords Creek Group of late middle to early late Cambrian age; and
e. megabreccias and chaos structures which overlie the Motton Spilite on the north coast

Brown (1989) found that the mafic lavas of the Motton Spilite have similar chemistry to basaltic lavas of the Cleveland-Waratah area which have been interpreted to have affinities with ocean floor basalts. These would not be expected in a narrow rift setting and it has been suggested by Jago and Brown (op cit) that the Barrington Chert and Motton Spilite assemblage are older than the mid Cambrian and have been tectonically emplaced, perhaps as a result of a mid Cambrian tectonic collision. Burns (1964, p157) recognised the possibility of a thrust at the base of the Barrington Chert but considered an unconformity, with some differential movement on it, to be a simpler hypothesis.

Leaving aside the uncertainties of the stratigraphic place of Motton Spilite & Barrington Chert, there seems to be good palaeontological evidence for a correlation of the Cateena Group and Radfords Creek Group, which may form a continuous succession, with the lower parts of the Dundas Group (Jago and Brown, 1989). The most recent interpretation of stratigraphic relationships in the Mount Read Volcanics (Corbett, 1992) indicates that these were erupted over a short period of ~10m.y.? contemporaneous with Middle Cambrian sedimentation of the Lower Dundas Group.

However, the various volcanic units in the Dial Range Trough have not been studied in great detail and the possible litho-stratigraphic correlations with the Mount Read Volcanics, which are of importance to VHMS exploration, are not clear.

One of the objectives of this reconnaissance was to locate easily accessible exposures of the volcanic units mapped by Burns (1964) and obtain freshest possible samples for further petrographic and major/trace element geochemical studies which might lead to improved correlations with the Mount Read Volcanics by comparison with the extensive data base already available for those rocks.

Another lithostratigraphic problem, which has become apparent during this reconnaisance, is the lithological similarity between the Cateena Group, Radfords Creek Group and the

Megabreccias (and also, especially in weathered outcrops, the difficulty of distinguishing chert pebble conglomerates of possible Cateena Group or Radfords Creek Group from the lower members of the Dial Group).

If the Barrington Chert and Motton Spilite are exotic and allocthonous have they been the source for abundant chert and some mafic volcanic clasts in the Cateena Group which they now overlie?
Are mafic volcanic clasts in the Cateena Group similar to those of the Radfords Creek Group or are the palaeontological age differences supported by differing provenance?

The Radfords Creek Group (RCG) appears to unconformably overlie Barrington Chert in Walloa Creek and Motton Spilite in the Leven River and the palaeontological age of the RCG might be used as a constraint on the hypothetical Cambrian tectonic collision unless it be inferred that the RCG has ridden into place on the back of the allocthon.

Some of these uncertainties may be elucidated by petrological studies of the volcanic components of the Cambrian sequence. I am not enthusiastic about pre-empting the petrological work with any arm waving lithostratigraphic correlations but will record the comment that on lithological grounds alone, I see no need to differentiate between the Cateena Group, Radfords Creek Group and the Megabreccias.

The following notes are based on my impressions of the megsacopically identifiable composition and field relationships of "volcanic" rocks according to Burns' lithostratigraphic subdivisions and may be used as a basis for petrological and wholerock geochemical interpretation. It must be conceded, however, that in most instances the samples were collected on a "flying visit - grab sample of the freshest rock" rather than a systematic mapping approach and, in consideration of the apparent structural and sedimentological complexity, there is much scope for interpretation.

The discussion includes references to a fairly conservative number of the freshest available and representative rock samples which I think would make a good start for a petrological and whole rock geochemical study which could be extended by additional rocks from the collection of specimens if necessary.

The sample locations are plotted on the accompanying 1:25000 patched together topographic and geological maps; the latter copied directly by photocopier enlargement from Geological Survey of Tasmania 1" to 1mile and 1:50000 map sheets. Approximate geographical locations and AMG co-ordinates of samples are listed in Appendix I.

Lobster Creek Volcanics (LCV)

Burns (1964) considered this to be the lowest unit of the Cambrian sequence but did not see the base and noted that the overlying Cateena Group was missing in places. He discussed previous interpretatios of an intrusive origin and dismissed alteration in the adjacent wall rocks as a "hydrothermal effect post dating Devonian cleavages". Corbett (1989) refers to two more recent studies supporting an intrusive origin and indicating a minimum early Ordovician radiometric age.

In the exposures I have seen it certainly looks like a massive intrusive rock. The composition is typically of tabular phenocrysts of plagioclase with ragged to prismatic often partly altered grains of amphibole/pyroxene and small equant grains of magnetite in a pink to grey K-feldspar bearing fine grained base, probably also containing some quartz although this is not megascopically prominent. The mafic component is considerably variable from about 10 to 30% with the more mafic ones reasonably termed diorite; I haven't seen any quartz phyric examples.
Magnetic Susceptibilities are generally fairly high with the following ranges recorded: (SI/1000)

Ironcliffe Road	34511	7.5- 8.0	
Purtons Road	34555	12 -30	
Lobster Ck Road	34591	0.3- 13	
Dial Road	34592	1.3- 3	(some weathered)
Dial Creek	-	10 -15	

In places, as in Dial Creek adjacent to Keddies adit, the pink ground mass feldspar is altered to grey in patches or diffuse joint controlled zones; this alteration is magnetite destructive and there is a marked drop in Magnetic Susceptibilities associated with it. Just below the track crossing of Dial Creek at 420400E 5441330N the rock is strongly altered with minor disseminated pyrite and clumps of radiating tourmaline upto 15mm in diameter; this tourmalinised felsic intrusive? rock has Magnetic Susceptibility of <0.1. Similar partly vein associated tourmaline alteration occurs in Dial DDH 6 in a 15m wide zone at the contact of LCV with sediments.

There are several other occurrences of compositionally similar or related rocks which Burns (op cit) did either not map or not include with the LCV. The most extensive of these was mapped by Wilson (1982) in the Radfords Creek area; this is shown by Bamford and Green (1988) as a couple of large stocks of "dacitic feldspar porphyry" with NE trending dyke like extensions. My Sample No. 34594 is from this area; it is composed of about 10% tabular plagioclase, 5% chloritised mafics with sparse irregular shaped phenocrysts? of grey quartz in a pink feldspathic base with disseminated magnetite accessory. It looks like it could be a felsic phase or differentiate of the LCV; Magnetic Susceptibilities on somewhat weathered rocks are in the range

1.5 to 3.0 and upto 5.5 (SI/1000) on freshest faces.

On Gunns Plain Road at 424300E 5433000N in association with Motton Spilite metabasalts and gabbro? there is a small exposure in the road cutting of what appears to be a potassic diorite? dyke with chilled margin, intrusive into fine grained sandstone. The rock (Sample No. 34595) has an unusual texture with randomly oriented thin prisms of amphibole? (20%) and grey plagioclase (30%) with an interstitial base of pink feldspar; it is distinctly magnetic with Magnetic Susceptibility upto 15 (SI/1000).

On the shore platform at Penguin, within the Beecraft Megabreccia, Motton Spilite and Tea Tree Point Megabreccia, there are fairly extensive exposures of felsic to dioritic rocks with clearly intrusive relationships, mostly as narrow dykes but the largest body, exposed near the Penguin mine, is at least 150m wide and is associated with extensive peripheral wall rock alteration.
The freshest sample I have found is Sample No. 34596 from a fault dismembered westerly trending dyke which extends for at least 500m in metabasalts between the Tea Tree and Beecraft Megabreccias. It is a fairly mafic variety and closely resembles LCV Sample No. 34591 and likewise has high Magnetic Susceptibility in the range 4 to 20 (SI/1000) according to the degree of weathering.
Burns (1964) recognised the similarity of these dykes to "extrusive rocks interbedded with Cambrian sediments" and one of his major element analyses (No: 2, Table 8, op cit) is very similar to that of his LCV (No: 1, Table 4).

A couple of narrow NE trending flow layered dykes in the Teatree Point Megabreccia (Sample No. 34597) are of more felsic composition and might represent a co-magmatic differentiate of the above; Burns called it a trachyte (sample No: 1, Table 8 op cit).

The larger stock (Sample No. 34598) near the Penguin mine is strongly silicified and sericitised with minor disseminated pyrite mineralisation but I suspect that petrographic examination and possibly "immobile" trace elements will show a similarity to the dykes and rocks from the LCV in the Leven River area.

If the petrographic and gechemical studies bear out my suspicions then the clear evidence for intrusive relationships on the foreshore combined with the absence of any recognised LCV lavas or volcaniclastics elsewhere would suggest that they are everywhere intrusive and possibly younger than most of the Cambrian sequence. Although pink clasts are common in some of the "megabreccias" and other polymictic conglomerates in the area, these are generally fine grained glassy volcanics or cherty volcanicilastics and I have not seen any which are exactly like the LCV type feldspar and amphibole phyric

magnetite bearing felsic rocks.
It will be interesting to see if these LCV intrusives? have any similarities to Mount Read Volcanics.

Kerrison Volcanics

Burns (1964) considered the Kerrison volcanics were interbedded with Cateena Group sediments. From what I have observed they present a very mixed bag and I think many occurrences are probably intrusives related to the "Lobster Creek Volcanics" felsic intrusives.

I couldn't find Burns' type locality at Cateena Point but there is a good exposure (with a few fresh kernels) on the Preston Road at 427240E 5439200N. It has the appearance of a massive feldspar crystal rich volcaniclastic sandstone with 40% plag crystals, 20% ragged grains of chloritised mafic mineral and 30% pink grains of inclusion crowded K-spar or glassy felsic volcanic with accessory magnetite. It outcrops over an E-W width of about 150m and is notably finer grained toward the eastern side.
Magnetic Susceptibilities in fresh kernels are in the range 12 to 18 (SI/1000) falling to 3.5 in the coarsest rock at the western side.
The composition is thus possibly similar to that of mafic type LCV but given its volcaniclastic nature there is probably no point in a wholerock analysis unless the petrographer thinks otherwise. Sample No. 34551 selected for petrography is from the coarsest (western) side.

Four kilometres to the south on Isandula Road at 427600E 5435100N there are outcrops of mostly weathered pink felsic rocks also mapped by Burns (op cit) as Kerrison Volcanics. These, however, are plagioclase (amphibole) porphyritic with accessory magnetite in a pink felspar/minor quartz base and thus have textural and compositional similarity to the felsic types of LCV, probably most like 34594 from Radfords Creek area.
The sample selected for petrography and wholerock analysis, Sample No. 34556, is not particularly fresh but should be sufficient to check on the relationship or otherwise with LCVs.
Magnetic Susceptibilities: upto 4.5 (SI/1000) in freshest rock.

On the north bank of the Leven River at 422600E 5436680N there are large outcrops of massive, fresh plag+(mafic) phyric felsic intrusive looking rock with high Magnetic Susceptibilities (9 to 20, SI/1000) closely resembling LCV; Specimen Nos: D132, D133.
I interpret this to be a dyke or apophysis off the main LCV body which according to Burns' (1963) map outcrops 400m downstream to the west.
Burns (op cit) connects this up to an outcrop, on Allison Road at 423100E 5439180N, of thinly bedded medium grained

quartzo-feldspathic (lithic) sandstone and grey flinty vitric felsic volcaniclastic? cherty siltstone; Sample No. 34599. This has low Magnetic Susceptibilities: <0.10 (SI/1000) and is compositionally unlike the LCV type intrusives and volcanic sandstone (34551) described above; it is compositionally and texturally more like samples from the Wilsonia and Applebee Volcanics.

My impression is that Burns (op cit) has placed all igneous rocks which he found enclosed by Cateena Group sediments into the Kerrisons Volcanics "bag" and that they may not connect as stratiform looking units as shown on his 1963 map; certainly the occurrences to the west of the Leven River in Hardstaff Ck, near Blacks Mn prospect and those at Isandula Road mostly resemble felsic type LCV and are probably intrusives.

Wilsonia Volcanics

This formation has a fairly restricted distribution in the Lake Isandula to North Motton area; Burns (1964) placed it near the top of the Cateena Group.

I had a look at the type section below the Lake Isandula Dam and bagged a few specimens (D48 to D58).
The member well exposed immediately below the spillway seems to be about 100m thick consisting of two? westward fining felsic volcaniclastic units typically like Sample No: 34600 (427400E 5432950N). They consist of small crystals and grains of feldspar and minor quartz, wispy green glassy/pumiceous fragments and small black slaty siltstone clasts in a fine to medium grained glassy/feldspathic ground mass. The clasts and fragments are semi aligned with a crude compaction ? foliation in the matrix which seems to dip consistently at about 40-50 deg to the west.
These are underlain ? to east by an ~80m thick unit of massive blue grey flinty rock which could be an aphyric siliceous lava or non stratified fine cherty vitric siltstone. Sample No: 34601 is a fresh representative.

Both types have low Magnetic Susceptibilities in the range 0.08 to 0.12 (SI/1000).
Although at least one of these samples is volcaniclastic, they might still be worth analysing to see if there is anything distinctive about them.

Further east, the fine aphyric lava? is underlain? by a west dipping weathered mudstone/siltstone/sandstone assemblage included in the Cateena Group; the finer sediments often have distinctive flakes of detrital mica on the bedding surface and the sandier units are notably <u>not conglomeratic</u> but are feldspathic with small wispy green fragments of altered glassy volcanic material.

Cateena Group

Although the Cateena Group is dominated by fine grained mudstones and siltstones it is clear from this reconnaissance that some areas which Burns (1964) assigned to the group also contain significant coarse polymictic "breccia" conglomerates of rather variable, but commonly chert or mafic volcanic lithic, composition. Such rocks occur, for example, at Devon Consols, Sullocks Hill, Dial Mine area, Venture 7 magnetic anomaly at Paton Park, Russells Adit, Ironcliffe Road and Blacks Mn prospect. Regrettably they are often very weathered but I have picked out a few of the freshest samples for petrographic work to see if the volcanic clasts have distinguishing features for comparison with clast types in texturally similar rocks assigned to the Radfords Creek Group and the Megabreccias. A possible provenance for the mafic volcanic clasts, given the abundance of chert clasts, is the Motton Spilite and it will be interesting to see if this can be confirmed.

The samples are listed below:

34589 & 34590	Devon Consols area: Polymictic pebbly conglomerate, clasts dominantly green/grey chert and basalt?
34602	Venture 7; Dial DDH 11, 46m: Polymictic conglomerate, clasts of grey brown and reddish jaspery chert, also fine grained basalt and holocrystalline gabbros? The mafic clasts and the rock in general is strongly magnetic and appears to be the source of a discrete aeromagnetic bullseye anomaly. This is covered by river alluvium. It may be lithologically equivalent and in a similar stratigraphic position to the "spilite conglomerate" at the top of the Motton Spilite west of North Motton (Burns, 1964 p:46) and the chert + spilite conglomerate, called Sprent Conglomerate, in the Leven River near Bannon's (Clarke's) Bridge, (Jennings et al, 1959, 1979, p:20). Wilson (1982, p:8) tentatively included the latter in the basal? part of the Cateena Group. My Sample No. 34606 is from that unit exposed on Gunns Plain Road but I have placed it in with the Radfords Creek Group following Burns' (1963) map. A sample from hole Dial DDH 11 was previously described by N.W. Fander (in: Sumpton & Turley, 1984) who called the clasts "trachyte, melatrachyte/andesite, microtonalite, chert".

34603 Dial Mine Grid DDH 7, 77.5m. Polymictic conglomerate; looks rather altered and has minor disseminated pyrite but it would be interesting to see if there are any relic igneous clasts comparable to those of 34602.
A sample of core from 1.8m further up this hole was described by I.Pontifex (in: Large, 1981, Appendices) as a breccia of dolomitic, pyritic siltstones

34604 Russell's Adit; chert fragment conglomerate bed in lithic sandstone and dark siltstone with mafic looking and some feldspar grains in the matrix. This rock looks very similar to 34606 from Radfords Creek Group.

34605 Dial Mine Grid, DDH 5, 155.6m. Felsic lithic volcaniclastic; dominated by medium grained feldspar and quartz crystals with a few lithic fragments of pale feldspar phyric rhyolite? and dark angular/wispy cherty siltstone clasts. Could be compositionally akin to Wilsonia and Applebee Volcanics. Felsic volcaniclastics in this hole seem to be intimately interbedded with pyritised and altered polymictic conglomerates and lithic sandstones.

Radfords Creek Group

The same introductory comments as for Cateena Group (above) apply to Radfords Creek Group. The group contains some chert rich polymictic conglomerates very similar to those of the Cateena Group; some others from the Kaines Creek - French's Road area are texturally and sedimentologically? similar but appear to be composed dominantly of feldspar phyric andesitic/basaltic clasts and detritus. The interbedded Applebee Volcanics are felsic volcaniclastics which appear to be compositionally similar to the Wilsonia Volcanics and to quartzo-feldspathic lithic sandstones and cherty vitric? siltstones interbedded with Cateena Mudstones at Allison Road.

34531 Kaines Barite Prospect, 417200E 5434470N. Andesitic? volcaniclithic sandstone with clasts and lithic grains dominantly of altered feldspar phyric andesite/basalt; wall rock to 30cm barite vein. Not very fresh and not worth analysing but petrography may be able to distinguish the clast volcanics for comparison with other units. Outcrops on French's Road 800m to the north are more distinctly polymictic with quartzite, cherty siltstone and holocystalline felsic dolerite? as well as andesitic/basaltic clasts but are regrettably very weathered; they occur as thick unstratified units interbedded with lithic sandstone and turbiditic laminated siltstone.

34533 Kaines Barite prospect. This sample is from a large clast in volcaniclithic sandstone, as above, on the hanging wall of the barite vein. It consists of altered feldspar phyric glassy intermediate? lava with preferred orientation of phenocrysts due to laminar flow or flattening and cleavage development; note contact with hematite stained lithic sandstone at one end of specimen. I think it is worth analysing this, despite alteration, for comparison of immobile trace elements with other mafic volcanics.

34606 Gunns Plain Road, 423500E 5432720N. Polymictic conglomerate with clasts dominantly of chert, pale fine grained mafic volcanic and a few large clasts of grey and dark grey limestone. It has close textural and compositional similarity to 34604 from Russells Adit. Occurs as isolated fresh kernels in road cutting of very weathered conglomerate and massive lithic sandstone. This was mapped as Sprent Conglomerate by Jennings et al (1959) and Burns (1963) seems to have regarded it as part of Radfords Creek Group. Wilson (1982) tentatively included apparently similar rocks in the Leven River near Bannon's (Clarke's) bridge with the lower part of the Cateena Group.

Applebee Volcanics

This unit also has a restricted distribution from Adit Creek south westwards to the NE corner of the St Valentines 1:50000 sheet (Burns, 1964).

Wilson (1982, p:11) mapped ~400m thick unit in Radfords Creek which he described as an orange brown massive porphyry with 2mm plagioclase phenocrysts and clots of chlorite after hornblende in a fine grained sericitised quartzo ferldpathic ground mass and correlated it with Applebee Volcanics. His boundaries (also depicted by Bamford and Green, 1988) are stock and dyke like and I think the rock was probably intrusive; my Sample No. 34594 is from this area and I have included it in the discussion on Lobster Creek Volcanics.

I have sampled a few rocks from Burns' (op cit) type area at Applebee Creek and Walloa Creek and as far as I've seen they are felsic volcaniclastics of more or less similar composition to those at Allison Road (34599), Dial DDH 5 (34605) and the Wilsonia Volcanics at Lake Isandula (34600).

In Walloa Creek they are interbedded and conformable with the enclosing sediments and appear to mark a change from underlying conglomerate/sandstone/siltstone of dominantly chert provenance to overlying green sandstone/siltstone of partly mafic? volcanic provenance. However, there is a thin unit of siliciclastic quartzite conglomerate, suspiciously like Dial Group conglomerate, at this contact which may indicate some fault complications and the sequence may not be continuous as implied by Burns (1964, p:46).

A couple of the freshest samples are:

34607 Walloa Creek. Medium grained quartzo-feldspathic felsic volcaniclastic sandstone with a few small lithic grains of black siltstone.
Magnetic Susceptibility: 0.05 - 0.25 (SI/1000)

34608 Applebee Creek (floater). Coarse grained quartzo-feldspathic felsic volcaniclastic sandstone with abundant small lithic grains of black siltstone. Some other floaters along the walking track down to crossing at Walloa Creek are of broadly similar composition but with coarser feldspar crystals/fragments and occaisional wispy, dark grey feldspar phyric lava clasts but I couldn't find any fresh specimens.
Magnetic Susceptibility: 0.1 - 0.3 (SI/1000) on freshest faces.

Beecraft and Teatree Point Megabreccias

Burns (1964) subdivided the Megabreccias exposed along the Penguin foreshore from the rest of the Cambrian sediments in the Dial Range Trough largely on the basis of the presence of large exotic "allocthonous" slabs, mainly of chert, within the lithic sandstone and conglomerate of the "autocthonous" beds. He interpreted that the megabreccias were formed by gravity down sliding of large masses of semi indurated material from the flanks of the trough and were the first products of the late Cambrian Jukesian Movement which went on to uplift a ridge of Barrington Chert along the axis of the trough leading to deposition of the Dial Group silicilastic conglomerates along the western basin of the former trough. He also recognised that the Megabreccias could be regarded as facies variants of the Radfords Creek Group (op cit, p: 158)

I have spent a couple of days looking at the Megabreccias and am impressed with the similarity of the autocthonous beds with the coarser lithologies in both the Cateena Group and Radfords Creek Group. Although the extent of outcrop is splendid, the degree of weathering is bad enough, the rocks are deceptive and lithological boundaries often difficult to pin down.

Many of the boundaries are faulted or complicated by faults which typically trend NNE to NE and have steep dips either way. Some of the lithological changes in the Beecraft Megabreccia appear to be sharp alteration boundaries, also often fault bounded, which seem to be spatially related to the felsic intrusive near the Penguin Mine. Bedding is not often apparent and it seems that the greater part were deposited as conglomeratic mass flows. Where observed, the bedding is sometimes discontinuous as at Teatree Point where Burns (op cit) mapped syn-sedimentary deformation and slumps. Except in the vicinity of some contacts the bedding dips tend to be shallow to moderate and Burns (op cit, p:52) guessed that the total thickness may not be greater than 150m.

His map (1964, Fig:7) has impressive detail; I have found it a valuable base plan for plotting sample localities and reproduce it here as a photocopy enlargement at 1:2500 scale.

Some examples of the megabreccia autocthonous sediments which I think would be suitable for petrographic study and comparison with lithic sandstones and conglomerates of the other Groups are:

34609 Teatree Point; Polymictic conglomerate, clasts are dominantly of black and grey chert with some of laminated cherty siltstone, mafic volcanic?, holocrystalline felsic gabbro? and rare clasts of grey carbonate. The conglomerate is interbedded with flat lying lithic sandstones. Magnetic Susceptibility: 0.1 - 0.15 (SI/1000) This lithological association is very similar to that of 34606 from Gunns Plain Road and occurs in a similar setting, adjacent to Motton Spilite.

34610 Beecraft Megabreccia, near eastern end;
34611 " " , central part.
These are both mafic looking volcaniclastic sandstones with a variety of clasts including jasper, chert, pink chert or glassy felsic volcanic?, dark mafic lava and holocrystalline gabbro. Are these comparable to or distinctive from clast types in samples from the Cateena Group and Radfords Creek Group?
Magnetic Susceptibility of these mafic volcaniclastic sandstones, which are predominant in the Beecraft Megabreccia, are generally in the range 0.3 to 1.0 (SI/1000) but in some small areas where fresh and mafic can be in range 5 to 30 with very abrubt changes; the susceptibility in these rocks seems very sensitive to weathering.

Motton Spilite

The work of Brown (1989) seems to have settled the tectonic setting of the basalts in the Motton Spilite formation but I have included a few mafic rocks from it in the suite for petrographic and wholerock geochemical study mainly for comparison with basic volcanic clasts in polymictic conglomerates from the other formations.

34552 Gunns Plain Road 424800E 5434700N Massive fine grained fresh basalt; Magnetic Susceptibility on fresh faces is 0.5 to 0.9 (SI/1000) and peculiarly higher on weathered outcrops at upto 1.5; clayey soil associated ranges upto 7.0!

34612 Gunns Plain Road 424320E 5433040N Massive fine grained fresh basalt, locally brecciated with greyish matrix alteration. Magnetic Susceptibility in range 0.5 to 0.8 (SI/1000).

34613 Gunns Plain Road 50m SE of 34612. Massive medium grained gabbro? outcropping in small falls in creek, relationship with basalts (34612) and felsic diorite? (34595) is uncertain. Magnetic Susceptibilities over most of the outcrop are low at ~0.6 but locally near the base of the falls the rock is distinctly magnetic in the range 5 to 11 (SI/1000).

34614 Lodder Point, 426280E 5446900N. Massive fine grained basalt in railway cutting; numerous small faults and a single 3m lense of reddish mudstone. Magnetic Susceptibility of the basalt is mostly in range 15 to 30 but locally highly variable in range 5 to 45 (SI/1000) over small distances of a few metres without obvious compositional changes. This variability of susceptibility is also present on the shore platform to the north where the basalt is mostly in pillowed form (pillows 0.2 - 2m dia.) sometimes with irregular interpillow disrupted bands of red mudstone and jaspery chert; these sediments have low Magnetic Susceptibilities: <0.5 (SI/1000).

34615 Lodder Point, 426420E 5447020N. Irregular zones of medium grained holocrystalline gabbro? amongst more or less massive basalt, not readily mappable as dykes. Magnetic Susceptibility is very variable on scale of a few metres in range of 1 to 85 (SI/1000).

34616 Dial Mine Grid DDH 7, 94.7m
Fine grained dark greenish grey andesite or basalt, faintly feldspar phyric? and strongly magnetic. The fine grained lava? is intruded by dykes, dykelets and veins from 2mm to 8m thick of similarly strongly magnetic medium grained holocrystalline gabbro? (or LCV type mafic diorite??). The intrusive contacts are associated with narrow bleached alteration selvedges (chlorite + carbonate?); both mafic rock types contain minor disseminated pyrite and chalcopyrite. There are occaisional narrow veins of Qtz + Chl + Hm + Py assemblage with pale chloritic? alteration selvedges which closely resembles the Walloa Creek Copper Prospect mineralisation.

These mafic rocks occur in a 35m thick intersection and are overlain by a sequence of pyritised sediment breccias (Large, 1981) and altered "dacites" which I suspect might be altered dykes of Lobster Creek Volcanics, the main mass of which outcrops within 50m to the NE. The mafic rocks are underlain by a +80m thick sequence of dolomitic siltstones, dolomites, limestones, chert, pyritic siltstone and green and purple lithic siltstone and fine sandstone, (Large, op cit).

I think it would be instructive to analyse the fine grained lava? and take a thin section of the other end of the segment with the intrusive dykelet for comparison to Motton Spilites.

5 PROSPECT GEOLOGY

This section presents details of the mapping and sampling, carried out during the course of this reconnaissance, which was aimed at investigating the style and tectono-stratigraphic setting of the various old prospects and mineral occurrences in EL 9/92.

Because of the variety of occurrences these notes follow no particular format but present a combination of descriptive information, discussion of previous data and interpretation of mineralisation style.

References are made to a collection of about 150 "type" rock specimens (numbered D1 to D149) which will be handed on to PASMINCO with this report.

Samples for geochemical analysis and/or petrographic work are numbered with PASMINCO sample numbers (34501 - 34616) and some off cuts of these are also included with the specimen collection.
Sample and specimen locations are listed in Appendix I.

5.1 Natone, Blythe River - Cuprona and Penguin Creek Area

My investigation has been confined to a couple of days reconnaissance around the hematite bodies at the Northern Quarries area (412400E 5445500N) and on the west bank of the Blythe River upstream from 544500N; a brief look at Department of Mines' core from holes BR 1,2,3 and a literature review.

Hematitic Ironstones

The ironstones and the Copper King workings lie mostly on Crown Land and a Timber Reserve; only the southern part of the Northern Quarries ironstone lies just within private land (2582) owned by Mr S. Casey.
The Penguin Creek ironstones (Tasmanian Iron Mines) lie on land on both sides of Ironcliffe Road owned by Mr Des Pearson of Abbotsham whom I was unable to contact despite numerous efforts and was therefore unable to obtain permission to reconnoitre those prospects.

The geological setting in the Blythe-Cuprona area as described by Blake, 1958; Gee, 1977; Banwell, 1981 and Whitehead, 1988; seems fairly straightforward with Burnie Formation shales and quartzites to the west, fairly tightly folded about NE trending axes and generally dipping steeply to the south east. These are reportedly unconformably overlain to the east by a 100m thick unit of hematitic and micaceous siliceous siltstone with shallower ~40deg dips to the south east. This unit is overlain immediately to the east by a slightly steeper (60deg?) SE dipping sequence of siliciclastic conglomerate and sandstone lithologically correlated with the late Cambrian - early Ordovician Denison Group and Dial Group.

The 100m thick siltstone unit hosts a number of outcropping hematite+quartz ironstone bodies and has been variously been interpreted as:

* the basal unit of the Late Cambrian-Ordovician (Owen Conglomerate) sequence with iron mineralisation related to Devonian granite, (Blake, 1958)
* of Cambrian? age with iron mineralisation of replacement origin localised in tectonic breccia zones exposed to a period of palaeo-weathering prior to deposition of the Ordovician siliciclastic conglomerate (Gee, 1977)
* a late PreCambrian-Cambrian correlate of the Oonah Formation composed of ferruginous sandstone/siltstone and dolomitic sediments; the latter hosting skarn mineralisation at Natone, (Ruxton, 1984; Whitehead, 1989)

Unfortunately, geological exposure around the ironstones is poor and at Northern Quarries I could not get an impression of the structural relationship or lithology of the host rock. It is, however, apparent that the trend of the ironstone here is NE and that it lies very close to the contact with Burnie Formation sediments which are exposed at the portal of a southeasterly driven adit only about 30m NW of the outcrop of hematite. The adit is caved 3m in but the mullock indicates that it intersected the hematite body.

In BR 2 (drilled with a -60deg inclination to NW at the northern end of the Northern Quarries outcrop; Noldart, 1966; Gee, 1977-Fig.20) the host rocks are thinly bedded siliceous/silicified? sandstone and siltstone with a 90' intersection of massive to veiny hematite as breccia infill and partial replacement of brecciated and strongly silicified host rock; there is no evidence of hematite layering or selective replacement of beds. Some of the siliceous breccia fragments have a faint "oolitic" structure (eg: at 87') of uncertain (sedimentary or silicification?) origin. The lower contact of the hematite zone is marked by a 15cm puggy fault zone at which the hematite <u>abrubtly</u> cuts out; below this is rather massive fine grained grey sandstone of Burnie Formation type criss-crossed with a stockwork of fine reddish iron-stained fractures.
Similar faulted contacts also occur at the down hole limits of hematite mineralisation in both BR 1 and 3 from the same area.

Specimens D3, 4, 5 & 6 show the typical veiny, blotchy/mottled and compact massive textures in hematite and fine granular/saccharoidal quartz from the Northern Quarries area; the textures suggest part fracture controlled, part pervasive hematite-quartz replacement. Some specimens, eg: D4, D6, show wavy and folded hematite-quartz banding and traces of relict cleavage, often best observed on weathered etched surfaces, which may be interpreted as post deformational, partly preferential replacement of sedimentary layers.

On the west bank of the Blythe River, below Purple Crag, the exposure is likewise insufficient to exactly determine the contact relationships. On the track about 100m west of the HEC flying fox there outcrops a large 10m wide lode of hard hematite-quartz rising about 20m above the track; this must be the lode lying about 100m north of Purple Crag (Gee, 1977-Fig.20). The walls of the lode are somewhat irregular but trend NE and are apparently sub-vertical. Weathered and sheared Burnie Formation type sandstone outcrops immediately under the northern face of the hematite body which appears to pinch out here against a fault zone trending 070deg.

The composition and textures of the ironstone are similar to those at Northern Quarries (cf: D23, 24, 25, 26)

There is no useful outcrop for 300m upstream in the river bank and then the first encountered consists of an interbedded sequence of laminated mudstone/sandy lithicwacke (D19, 20) and chert pebble conglomeratic sandstone (D21) in a broad shallow S plunging antiform with strong north trending subvertical axial plane? cleavage. These pass upwards, in the cliffs above to the south, to coarser cobbly sandy conglomerate with flattish, 10 to 40deg southeasterly, dips. Clasts in the conglomerate are dominated by well rounded grey and black chert with some micaceous metaquartzite, occaisional small clasts of green fuchsite? or serpentinite? and wispy/angular/deformed clasts of flinty mudstone; the latter presumably rip up clasts from the interbedded mudstone. This sedimentary assemblage is lithologically identical to rocks outcropping in the Dial Range at Black's Mn prospect and on Ironcliffe Road at 417900E 5441400N and it is a moot point whether they represent the lower members of the Dial Group (Gnomon Mudstone, Duncan Conglomerate) or the upper units of the Cambrian sequence (Cateena Group, Radfords Creek Group). Unfortunately, the river was flowing too deep and the cliffs on the south bank too precipitous to allow me to trace this sequence further upstream to see if there are any remarkable lithological changes. Blake (1958, p31) reported that the "breccia conglomerates" (chert pebble conglomerates) here "pass upwards into normal conglomerate and quartzite of the Owen Conglomerate formation ... succeeded by Gordon Limestone which is exposed in the acute bend of Blythe River ... northeast of the Camena bridge".

Thomas & Henderson (1943) recognised the mineralogical similarity and linear relationship between iron and silica content (pointing to a replacement origin) of the "hematite-limonite replacement lodes" at Natone, Blythe River and Penguin Creek. Also that they "are characterised by their development along zones of faulting, with massive isolated bodies of ore of varying grade, usually associated with brecciated iron ore, pointing to later earth movements of the lines of weakness along which the iron-silica solutions were introduced". Another similarity is that Longman (1966) reported that the western limit of the Penguin hematite deposits was a fault along Penguin Creek which is consistent with my observations of faulted western contacts at Blythe and Cuprona.

It is now apparent that all of these occurrences are spatially related to the contact zone between the Burnie Formation and the westernmost limit of chert pebble conglomerates assigned to the base of the Dial Group although there is some confusion as to whether they are in the Burnie Formation or the overlying rocks. The Natone and Blythe hematite deposits are thought to lie in Cambrian or EoCambrian sediments (Gee, 1977; Ruxton, 1984) close to the Burnie Formation contact whilst the Penguin Creek deposits appear to lie within the Burnie Formation (Longman, 1962; Burns, 1961 and 1963) although Thomas & Henderson (1943, p215) reported that the latter were in interbedded slates, breccias and breccia conglomerates. Burns (1961, p119) thought that the Blythe deposits were in the PreCambrian (Burnie Formation) and because of the poor exposure there I am not convinced that he was wrong. The key to this problem might be found at Natone where Ruxton (1983) interpreted the ironstones to be in the upper part of a flattish dipping sequence of conglomerate and dolomitic sediments which he correlated with the Oonah Formation.

The megascopically observable hematite textures suggest a replacement origin and the distribution indicates strong structural control. This could be connected with structures defining the western margin of the Dial Range Trough westward of which only the upper unit of the Dial Group (= Moina Sst) has extended.

There has been some consensus amongst previous authors that the hematite mineralisation must have predated deposition of the Dial Group because of the presence of hematite clasts in the conglomerates. However, the hematisation process evidently continued beyond the deposition of the Dial Group and good examples of fracture controlled, blotchy, and roll type pervasive hematite alteration of both clasts and matrix can be observed in boulders of (chert pebble siliciclastic) Duncan Conglomerate at Surf Club Point on the Penguin foreshore. Similar but much weaker fracture and bedding controlled hematite alteration occurs in some units of the otherwise pyritic conglomerate (= Moina Sst) at Sulphur Creek Point. Presumably similar post-Duncan Conglomerate hematite mineralisation was recognised by Burns (1961 p125) at Mt Dial and Myrtle Creek.

The sketch map in Figure 3 shows the general geology and location of specimens and rock chip samples.
Of the previous investigators, only Banwell (1981) appears to

have carried out multi element and base metal analyses of the hematitic ironstones and her semi quantitative results were not encouraging.
There are 7 grab samples (Nos. 34571-77) of representative hematite mineralisation from drill holes BR 1, 2, 3; for analysis.

Magnetic susceptibilities in Blythe River area:

Hematitic ironstone:	0.6 to 1.2	
Burnie Formation:	0.02 to 0.12	
Conglomerate and mudstone 300m upstream of ironstones		
Dial Group? :	0.05 to 0.41 increasing with degree of limonite saturation and veining.	

Copper King and Rutherfords Cu Prospects

I did not visit these prospects but their spatial association with hematitic ironstones at Blythe River and Natone (respectively) is of interest.

The Copper King mineralisation reportedly consists of Py + Cpy in vertical E trending quartz veins in massive quartzite and in patches and veins of quartz + siderite in slate within a NE trending zone 9m wide within the Burnie Formation; (Gee, 1977). Whitehead (1988) identified this zone as a steeply SE dipping shear discordant to the bedding. The prospect lies 400m N of the Northern Quarries hematite body and the southward projection of the shear zone would pass about 100m west of the ironstone. Samples by Whitehead (op cit) ranged upto 4.7% Cu with traces of Au, no Pt and other base and precious metals not analysed. Gee, (1977) reported production of 1314t of concentrate averaging 16.7% Cu in the period 1904 to 1909.

Rutherfords Copper prospect lies about 600m N of the Natone hematitic ironstone outcrop. Mineralisation consists of Py, Cpy (+ minor bornite, covellite) in isolated steeply dipping quartz veins within a 100m wide NE trending zone, (Gee, 1977). Exploration by Tasminex (Grace, 1972) indicated that the mineralised veins occurred over 1300' of strike within a steeply west dipping NNE trending fault zone in a pyritic black shale unit of the Burnie Formation. Analyses of percussion drill and rock chip samples indicated anomalous Cu and Ag (upto 7.2% Cu and 4900g/t Ag) but insignificant Pb, Zn.

In both areas the mineralisation is Cu (Ag) rich, occurs in quartz veins in Burnie Formation sediments, particularly black slates, within a steeply dipping shear/fault zone parallel to and about 100m west of a line of hematite ironstones which appear to be structurally controlled at the eastern contact of the Burnie Formation.

A cogenetic relationship between Cu and Fe mineralisation may be speculative but a structural association with the eastern contact of the Burnie Formation is strongly inferred.

5.2 Iron and Manganese occurrences in the Dial Range

Black's Manganese Prospect

This prospect was described by Rowe (1963); it lies in State Forest 1km north of Mt Duncan. There are two groups of old workings: the eastern adit and trench are situated in a small creek at 419080E 5440150N, 30m downstream of the Dial Creek Road. The western group of trenches and shafts are 150m west of the above on the spur immediately west of the sharp bend in Dial Creek Road. The adit is not caved but is flooded to within 70cm of the back and was not inspected; the western workings are densely overgrown with tall bracken and there is little surface exposure.

Outcrops in the creek near the adit and at trench No.5 (Rowe, 1963) are of dark grey (buff to brown weathering) laminated slaty micaceous mudstone and silty to sandy lithicwacke with moderate to steep WNW dips and subvertical N trending cleavage; (Specimens: D12, 15, 16). Lithic grains in the sandy beds are dominated by black and grey chert. Immediately west of the southern end of the trench and on the road above, are outcrops of steeply W dipping interbedded mudstone, lithic sandstone and conglomerate in which the lithic components are also dominantly chert, (eg: specimens D14, 17). There is local patchy strong limonite staining, partial limonite replacement of clasts and botryoidal limonite infilling of rounded cavities presumably after leached out clasts.
The chert clasts vary from well rounded to splintery and angular; these coarser rocks were called breccia conglomerates and assigned along with the mudstones to the Cambrian sequence by Rowe (op cit). There is no doubt that the mudstones, sandstones and conglomerates here are interbedded and, as at Blythe River (cf: section 5.1), there is some doubt about whether they represent part of the Cateena/Radfords Creek Group or the lower member of the Dial Group.

The only signs of mineralisation at the eastern workings are a few bits of mullock at Trench 5 consisting of weathered mudstone with surficial looking encrustation and fracture filling brownish black earthy Fe-Mn oxides (Sample No. 34513)

At the western workings consisting of 4 trenches and 3 shallow shafts there is no useful outcrop but a fair bit of limonotic ferricrete lies scattered about the surface. The western wall of Trench 3 exposes a subhorizontal layered sequence which, from the surface down, consists of:

0.6m	brown clayey soil
0.4m	soft earthy/cavernous, sooty black Mn/Fe stained soil or wad (Sample No. 34516)
0.3m	hard brown limonitic ferricrete (Sample No. 34517)
0.4m	brown clayey soil to bottom of trench

Rowe (op cit) interpreted the layers of colluvial soil as weathered breccia and the limonitic band as a folded bed of mineralised breccia but I have little doubt that this is a ferricrete related to surficial weathering processes.

There is nothing at Black's prospect resembling a gossan and although some of the ferruginous samples might contain minor scavenged base metals I don't think that the occurence is related to sulphide mineralisation. Somewhat similar exhumed ferricretes occur on the Penguin foreshore (Surf Club Point and eastern end of Watcombes Beach).

Magnetic susceptibilities:

mudstone/sandstone/conglomerate	:	0.15 to 0.32
conglomerate	:	upto 5.0 where strongly limonite saturated
Ferricretes	:	0.5 to 2.5
Felsic porphyry (D 11)	:	4 to 8

Dial Iron Prospect

The Dial Iron occurrence as described by Twelvetrees and Reid (1919) consists of a north trending string of outcrops of hematitic conglomerate over about 1km of strike centred on 417700E 5439150N in State Forest (700m west of the Ironcliffe Road - Dial Creek Road junction).

The host rocks are pebbly conglomerates and minor pebbly sandstone of the Duncan Conglomerate (Burns, 1964).

The area is one of thick scrub and I found it difficult to get around in and determine the exact distribution of ironstone but my impression is that hematitic conglomerate, carrying 5-10% and occaisionally upto 20-30%, is quite widely scattered, mainly as float and the narrow lode formations depicted by Twelvetrees and Reid (op cit) were not apparent to me.
I did not persist south of the stream flowing NW at 417700E 5439100N but managed to locate the hill at 417700E 5439350N which Twelvetrees and Reid (op cit) reported as being "crowned with a knob of hard iron ore". Hematite mineralisation here is patchily developed over about 80% of the outcrop and consists of fine specular hematite as replacement of the sparse sandy matrix, in fine anastomosing veinlets and as partial jasperisation around the rims of and along cracks within chert

clasts. The rock here contains an average of around 20% hematite. Twelvetrees and Reid (op cit) quoted an analysis from here which yielded 42.5% Fe and 30.9% SiO_2.
Sample No. 34504 is from this knob; 34502 and 34503 are respectively from float 80m amd 200m to the south.

In cliffs above Ironcliffe Road, 400m to the NE of the above knob, there is an outcrop of chert pebble conglomerate dipping at 60deg to SW and containing small irregular patches of hematite in the sandy matrix and in fractures within partially hematised/jasperised chert clasts. This is essentially the same style of mineralisation but sparsely developed and constituting only about 2% of rock volume. (Sample No. 34501; Specimens D1, D2).
In some cases chert clasts appear to be nearly totally replaced by fine hematite but I did not see any that resembled pebbles of reworked massive hematite.T

The textural indications are that the hematite is of replacement origin, not detrital, with deposition partly controlled by matrix permeability and partly by fracture permeability. It seems a similar style to the fracture and bedding controlled hematisation/jasperisation observable in similar chert pebble conglomerate boulders at Surf Club Point, Penguin, and may be related to the Penguin Creek and Blythe River hematite mineralisation though generally of considerably lesser intensity.

Ironcliffs

The Ironcliffs limonite deposit lies within the Ferndene State Reserve at Ironcliffe Road 5km Sw of Penguin. Because of its location in the reserve, which is excluded from EL 9/92, I have not made a field inspection during this reconnaissance.
However, the deposit has been described in some detail by Burns (1961), some drill core survives from two diamond holes at the southern end and I have made a one day reconnaissance of the prospect previously (Large and Herrmann, 1980)

So, I was interested to have a look at the drill core but ultimately disappointed to find it in very poor condition; the greater part of both holes (DD1 and DD2) was drilled with small diameter core (20mm) and the recovery was evidently low. Of DD1, which went to 252', there is only about 75' remaining in the trays and for DD2, only 30' from a hole 155' deep and so the geological information to be gleaned is skeletal indeed.
Some specimens of the core are included in the collection.

The following observations can be made:

* The limonitic ironstone is hosted by Burnie Formation sediments as shown by Burns' drillhole sections. Occaisional

core segments in the interval 0-100' in DD1 are of sheared, kinked and rather silicified fine grained siltstone of similar lithology to the footwall rocks. The footwall in both holes is of fine grained pale grey siliceous siltstone locally rather sheared or brecciated with a stockwork of fine carbonate-barite? veinlets and disseminated blebs of pyrite <0.5%.

* The limonite is variably compact massive, vuggy botryoidal or less commonly spongy gossanous looking; it is at least partly after hematite and relict sheaf structure is locally present eg: DD1 95'. Siliceous patches and fragments are common within the limonite zone, they are generally of amorphous looking grey or ironstained quartz with small gossany blebs. In DD2 (eg; 69') there are rare relict patches of grey totally silicified rock (of indeterminate precursor) with patchy 5% fine disseminated Py overprinted by brown oxide ironstaining pervading outwards from spaced fractures. The limonite thus appears to be partly derived from hematite and partly from pyrite.
* Barite veins occur on the footwall side of the limonite zone in DD1 and high in the hole well away from the limonite zone in DD2 and appear to be a later fissure fill type mineralisation (with slickensides on some core faces) possibly related to the ESE to SE trending late faults associated with sulphide mineralisation as described by Burns (op cit).
* The upper part of DD2 is in sheared grey-black pyritic siltstone with wispy deformed fragments of feldspar phyric felsic volcanics, quartz and quartz +/- carbonate-barite? with disseminated pyrite some of which are oxidised limonitic and resemble the limonite lode. Burns called this a pebbly greywacke but it looks like a cataclasite with entrained, flattened fragments of volcanics and lode material; eg; Specimen at 13' in DD2. Shear planes are sub parallel to core axis indicating a steep dip.

Burns regarded the contact between the Burnie Formation and sediments of the "Dundas Group", as exposed in the end of Ellis' (Thorsby's) tunnel (where it is vertical and strikes 015deg) and intersected at 43' in DD2, as an unconformity flattening off to the east. In view of the strong shearing on the east side a subvertical NNE trending fault would have to be a strong possibility.
Burns noted that two minor limonite bodies in Ellis' tunnel and others at surface were formed at the intersection of variably dipping, mostly N to NE trending reverse faults related to formation of a NE trending upright antiform immediately west of the iron lode which he suggested might occupy a large fault zone of this generation.
He concluded that the iron mineralisation postdated the (first) folding and faulting deformation and was strongly fault controlled. The presence of limonite pebbles in the Dial Conglomerate (later called Duncan Conglomerate) was taken as evidence that the deformation and iron mineralisation predated

the Ordovician although he recognised that there was also some, subordinate, post Ordovician iron mineralisation.
The presence of fragments of mineralised silicified rock in the "cataclasite" in upper DD2 suggests that there has been some reactivation of the fault zone after mineralisation.

Burns' (op cit) structural interpretation included a post iron mineralisation stage of minor cross folding confined to the E limb of the anticline and ESE trending/steep faulting with dextral displacement offsetting the iron lode. Minor sulphide mineralisation, including Pb Ag (Cu Zn) at the nearby Badgers prospect and traces of Pb and Cu in fault zones in DD1 and DD2, was found to be associated with these late faults and led to Burns' conclusion that the Ironcliffs lode was not a gossan associated with Badgers type mineralisation.

It does, however, appear to be fault controlled, with evidence of reverse faulting associated with the eastern boundary of the Burnie Formation in a possibly similar structural setting to the hematite lodes at Cuprona-Blythe etc. and the Penguin Creek deposits only a few hundred metres to the north. Although these deposits have so far shown little in the way of a base and precious metal association the presence of at least some early? disseminated pyrite and silicification (in DD2) suggests that the mineralising system did not only deposit iron oxides.

Nine samples (Nos: 34578-86; listed in Appendix I) of small segments of core representative of the Ironcliffs limonite mineralisation have been obtained from DD1 and DD2, for analysis.

Twelvetrees (1903, p15) was "told" that the limonite in the Lady Braddon Tunnel returned an assay of 16grs/ton gold (~1g/t) but his own samples could not duplicate it and it seems that no one has found any significant gold at Ironcliffs since then. Burns (1961) found a "trace" of gold in two samples from the western margin of the limonite lode in DD1; both were associated with Barite.

5.3 Barite Prospects

Sullock's Hill

Bamford and Green (1988) indicate two Ba, Pb occurrences near Sullocks Hill 3km SSE of Penguin.

The southern occurrence 027 is probably that adit referred to by Burns (1963) as being driven at 317deg into black and white banded chert. I have not attempted to locate it as there is no record of base metal mineralisation there.

The northern occurrence 026 was mentioned by Hughes (1953; p18, "other prospects") who was given anecdotal information by Mr Revell that an adit there had cut a lode of black material carrying galena with a 6' wide lode of barite on the footwall.

This prospect lies on the property of C & F McKay (0032) at 423080E 5445040N and the several workings were kindly pointed out to me by Mr McKay. The workings consist of at least 3 shallow pits, a water filled shaft and 4 trenches (one of which might be a fallen adit) spread over about 50m along the south bank of the creek and a trench and short adit on the north bank. The area is covered in thick scrub, there is no outcrop in the creek, there is very little float on the slopes and the trenches are partly filled and do not expose the bedrock.

The only outcrop is close to the floor of the short NE adit on the north bank; it consists of very weathered pale grey clayey structureless conglomeratic mudstone with abundant matrix supported small grains and well rounded pebbles mainly of siltstone with some pebbles and boulders of coarse holocrystalline diorite or felsic gabbro; (Specimen 34535). Pinkish to greenish brown weathered mudstone, often with a little limonite staining, occurs as float on the south slope of the creek whilst colluvium on the north bank contains only pale chert. The mudstones and conglomerate are assigned to the Cateena Group and the chert occupying the hill to the north and west to Barrington Chert, (Burns, 1963).

Sparse mullock at the collar of the shaft is of two types:

* pebbly conglomeratic mudstone with pervasive limonite staining an limonite rimming and partly replacing some of the leached and sintery looking clasts; this could be a superficial weathering effect; (Sample No. 34537).
* dark grey laminated siliceous sintery siltstone with fine disseminated Py along bedding laminae and in small slugs and veinlets; (Sample No. 34538). A fine resilicified breccia fabric, similar to that sometimes observable in Barrington Chert, is visible on sawn faces. This might be the black material referred to by Hughes.

At the easternmost trench there is a bit of limonitic gossanous brecciated siliceous siltstone (34539) and small nodular lumps of limonite saturated conglomeratic mudstone with rare specks of relict pyrite and and crystalline barite (34540).
The only other barite I observed around the place was in a single 20cm floater from the creek 15m downstream of the last trench; it consists of brecciated siliceous siltstone with relict traces of disseminated pyrite, coarse crystalline barite and vuggy botryoidal encrustations of limonite occur as open space fracture fillings, (Sample No. 34541).

I had expected a bit more barite, than this, from a 6' wide lode and like Hughes (op cit) could find no sign of galena.
The form of the occurrence can only be guessed at but it seems

from the distribution of workings that the prospectors were chasing something with an ESE strike, parallel to the creek. This would also parallel the sulphide mineralised, late faults described by Burns (1961) at the Ironcliffs and Badgers prospects and a metallogenic relationship with those seems a reasonable speculation.

Kaines' Prospect

Kaines' barite prospect is located on the east bank of Kaines Creek at 417200E 5434470N on the property of Mr Radford of Fabers Road, Riana. The immediate area of the workings, consisting of a trench and a water filled shaft, is thickly overgrown with blackberries and I don't think I would have found them without Mr Radford's directions. The workings were also described by Blake (1928).

The trench is about 9m long trending slightly east of north, upto 2m wide and 1.5m deep with a cross trench westward for drainage at the southern end. The main trench appears to have been cut along the barite lode which is exposed in the corner at the southern end as a 30cm thick vein of fine crystalline compact colourless barite with a clean hanging wall trending 010deg/ dip 70E and a sheared footwall with stringers of creamy carbonate and traces of chlorite on the shear surfaces. Rare specks of fresh chalcopyrite (<0.2%) occur within massive parts of the barite. Immediately on its western side is a 30cm thick dyke? of fresh, unsheared, magnetic, fine grained olivine basalt with a chilled margin against the barite. This dyke is presumably related to Tertiary basalts; it has a northerly trend and slightly shallower dip to the east so that it appears to pinch out the barite vein downwards.

The rocks in both footwall and hanging wall consist of rather sheared and weathered purplish medium grained mafic volcaniclithic sandstone. The sandstone is reasonably well sorted but not well stratified with grains mainly in range 0.2-1mm composed mainly of mafic volcanic material. There are common small angular clasts and a few larger ones to 20cm mainly composed of greenish, purplish brown or pinkish grey altered feldspar phyric basalt or andesite and occaisional quartzite and hematitic quartzite. There is a weak cleavage and some of the larger clasts along the hanging wall seem to be flattened parallel to the steep north trending cleavage.
Close to the barite lode the wall rocks are more or less sheared with shear planes parallelling the trend of the lode but there is no apparent wall rock alteration.

It appears to be an extensional vein filling with some movement persisting after deposition of barite; faint striae on slip surfaces within and on the walls of the lode suggest a dip slip movement.

Sample Nos. from Kaine's Prospect:

34528-30	:	Barite vein
34531-33	:	wallrocks
34534	:	basalt dyke

Magnetic susceptibilities:

Barite lode:	0.06-0.09
basalt dyke:	7.5-12.0
wall rocks :	0.2 -0.4

The volcaniclithic sandstone wall rocks are lithologically similar to more weathered outcrops on French's Road 750m to NNE where they appear to be thick mass flow type deposits interbedded with minor, moderatly WNW dipping laminated flinty siltstone and fine lithic sandstone. (Specimen Nos: 22A-25A) The coarser lithic sandstone/conglomerates at French's Rd are more distincly polymictic with significant well rounded to angular pebbles of hematitic quartzite, cherty siltstone and holocrystalline diorite? as well as andesitic-basaltic clasts (D25A).

Thirty metres east of the mass flow/interbedded siltstone outcrops at French's Rd is a narrow outcrop of weathered, sheared conglomeratic looking rock composed of aligned fractured pebbles of pink quartzite, grey chert and altered feldspar phyric andesite-basalt in a sparse, sheared quartz sandy matrix; it most resembles the siliciclastic conglomerates of the Dial Group but could be a cataclasite. The shear planes trend 020deg/ dip 60E. The eastern contact of this conglomerate/cataclasite is not well exposed but there is an 0.5m wide puggy zone, probably a fault, which separates it from moderate westerly dipping laminated grey siltstone and quartz/cherty lithic (not volcaniclastic) sandstone immediately to the east.

Burns (1963) indicated another couple of more or less northerly trending major faults in this area; the Duncan Fault, to the east, was interpreted as a thrust related to the first phase of Tabberabberan folding and the Kaines Ck fault to the west as a dextral wrench related to a later phase of folding. Burns (1964, p:183) noted that at the barite prospect "there is a complex succession of intersecting faults with thrust faults common" and also that "in the quarry at Riana there is a succession of mineralised brecciated thrust zones followed by unmineralised strike slip faults".

It seems likely that the barite mineralisation occupies an extensional fracture related to Devonian deformation.

5.4 Base metal prospects - Dial Range

Badger's Prospect

This prospect is located on a small west flowing tributary of McBride's Creek 200m east of the Ironcliffs lode and included about five adits and a shaft. The workings were described by Twelvetrees (1903), Burns (1961) and mentioned in Large and Herrmann (1980).

Twelvetrees (op cit) reported the occurrence of some "bright galena" and I was hoping to get a bit of this stuff for Pb-isotope analysis but was ultimately unsuccessful.
However, I did manage to find another adit, possibly not plotted on Burns' (op cit) plan, with the portal about 40m up the bank southeast of the portal of Burns' Tunnel 6.

I think this upper adit is the main tunnel referred to by Twelvetrees; it was driven at 130deg, has a winze dipping ~80deg SW just inside the entrance and appears to be caved about 8m in. Material on the substantial mullock dump is of silicified/sericitised but unmineralised feldspar phyric rhyolite (D31A) and pale buff-grey flinty vitric looking siltstone (D32). But there's nothing in the way of sulphide mineralisation and the best I could do there was a lump or two of altered rhyolite with 1cm bands of limonitic specks after pyrite ?; sampled as 34543.
The lower adit, which Twelvetrees reported as having been driven 400' without cutting the lode, is now virtually below creek level and filled to within about 20cm of the back with orange sludge. The mullock appears to have dammed the creek and the bed built up by sludge. Some of the mullock in the creek is of greenish grey, medium grained feldspathic, rather volcaniclithic looking sandstone; somewhat silicified and with traces of disseminated pyrite (D33).
About 100m upstream there are outcrops of grey flinty mudstone and pebbly mudstone dipping 55deg E (D29A 30A) but otherwise there is little exposure.

Twelvetrees (op cit) implied that the galena vein in the upper adit was upto 2" wide, followed the SE direction of the adit, dipped to the SW and contained also some sphalerite, chalcopyrite and pyrite.
Burns (1961, p127-129) appears to have had access to this (or the lower?) adit and described a fault striking 120deg/dipping 62 S with a narrow zone of chloritic gouge and sulphide mineralisation which he related to a late generation of dextral faults carrying minor Pb, Ag and Cu mineralisation in drillholes at the Ironcliffs.

Sample Nos: 34542, 34543
Specimen Nos: D 28A-31A, D 32, D33

Hutton's Prospect

This prospect was described by Twelvetrees (1903) and Hughes (1953) and is plotted by Bamford and Green (1988) at 418300E 5434500N at the head of Walloa Creek. If so, it is on a property owned by Messrs Richard and Tony Gee of Somerset. I contacted Mr R Gee to obtain access and was advised that he preferred not to grant permission at this time because they had a mob of fairly flighty cows and calves there but possible access at a later date, in a few months, was not ruled out. So, I have not tried to find the prospect on the ground and suspect it might not be simple as the locations given by Twelvetrees and Hughes are fairly vague.

Twelvetrees reported a 3" vein of quartz with a little galena conformable to layering in blue banded slate trending 010deg. Hughes found a 30' adit on the west bank of the creek in rather cherty, slightly pyritic, black slates but could find no sign of a lode or other mineralisation. Both of these geologists concluded that there was nothing of economic interest there.

Walloa Creek

This prospect, also referred to as Copper Creek Mine, is located in State Forest on the south side of Walloa Creek 200m downstream from the confluence of Adit Creek.

The workings which include three adits and a couple of surface cuts, have been described by Twelvetrees (1909), Hughes (1953) and Wilson (1982) who mapped and sampled the lower two adits. (Wilson's "upper" adit probably corresponds to that referred to as McDonald's adit by Twelvetrees; its length and layout does not tally with the upper adit described by Twelvetrees and Hughes.) All three adits appear to be in good condition with only a little water on the floor.

The local country rocks at the prospect are thinly interbedded dark greenish grey, mafic volcaniclastic looking, slaty siltstones and fine sandstones (D79, 80) which generally strike NNE to ENE with steep dips to the SE. 100m upstream there is an ~80m thick unit of fine to medium grained felsic volcaniclastic sandstone (34607) and siltstones interbedded on the eastern side with flinty grey siltstones. Another 100m west, above the confluence of Adit Creek, is a ~100m thick sequence of steep dipping, east facing and fining black flinty siltstones, lithic sandstones and fine pebbly conglomerates derived almost entirely from black and grey chert; (D74-77). Upstream of these, with a contact not well exposed but possibly unconformable, are massive and brecciated/recemented grey cherts (D73).

Outcrops in the bank near the lower portal carry minor stringer veinlets of fresh specular hematite with a little quartz and

pyrite.
There is plentiful mineralised rock on a small dump near the portal of the upper adit; it consists of dark greenish grey flinty siltstone and fine sandstone, somewhat brecciated and silicified with rather irregular thick veins and patches of coarse specular hematite, lesser pyrite and chalcopyrite with subordinate gangue of quartz, chlorite and possibly a little carbonate. Both hematite and sulphides are quite fresh and the coarse euhedral nature of sulphide grains often enclosed by massive foliated hematite suggests textural equilibrium. The quartz is mostly associated with sulphides and may be a late stage of veining, sometimes occurring as small terminated crystals lining open cavities.

Twelvetrees (1909) described a 5' wide lode in the upper adit which he thought was probably the same as a 9' wide lode formation intersected in the south west crosscut in the lower adit. Interestingly, Hughes (1953) called this a fault (and gave its orientation as strike: 160deg, dip: 60 E) but noticed little mineralisation; Wilson (1982) did not record it at all. Hughes also had trouble finding mineralisation in the upper adit whilst Twelvetrees recorded the lode there as being well mineralised with pyrite, chalcopyrite, covellite and specular hematite and got 2.9% Cu and 2dwts. 8oz./ton (?) Ag out of it. (This might be a typographic error; it is probably meant to be 2oz 8dwt/ton which would be about 73g/t Ag)
He also obtained values of around 1g/t Au and Ag from the gossan at surface.

Given the 340deg strike and the 60 E dip, this fault/lode should cross Walloa Creek at about 100m upstream of the lower aduit. This position coincides with outcrop of a siliciclastic conglomerate composed of pebbles of white vein quartz and metaquartzite in a medium grained quartz sandy matrix. The rock is locally brecciated and silicified with bunches of specular hematite and disseminated pyrite associated with white quartz in veins and fractures oriented 340deg/60E exactly parallel to the fault/lode formation at the mine. This rock most resembles siliciclastic Dial Group conglomerate and might be an infaulted slice; the eastern contact against laminated dark greenish grey siltstones is sharp and trends 015deg/70W with minor chlorite alteration in the matrix of the conglomerate close to the contact.

The prospect is close to, if not on, the Walloa Creek Fault of Burns (1964, p183) which he interpreted to be vertical with a dextral/west side down oblique slip displacement associated with late reactivation of the Duncan reverse fault with which it appears to link up or to offset. Hughes noted that minor mineralisation occurred all along the bed of Walloa Creek which more or less follows the fault.

Given Burns' structural set-up and the descriptions of Twelvetrees and Hughes, it seems that the Hem-Py (Cu-Ag-Au) mineralisation at Walloa Creek has a strong structural control, localised in fault(s) associated with the later stages of Devonian deformation.

Specimen Nos: D73 - D80, D91
Sample Nos: 34559, 34560, 34587, 34588

<u>Magnetic Susceptibilities:</u> (SI/1000)

Mineralised rocks (Hm Py Cpy Qtz Chl)	0.4 - 0.65
Unmineralised green grey slst/sst	0.2 - 0.45
Felsic volcaniclastic sandstone	0.05- 0.25
Cherty lithic slst/sst/cgl	0.1 - 0.2

Devon Consols Mine

This old mining prospect is located 200m south of the Penguin Speedway at about 421570E 5445800N near the eastern boundary of land owned by Penguin Municipality (0086) which is managed by a local society as an organic gardening centre. The local contact person is Mr Ray Mason of Pine Road, West Pine.

There is an adit driven at 320deg just below the level of the road at a point about 100m east of the edge of the cleared land at the organic gardening centre. Across the creek, 40m south east of the adit, is a filled shaft now only about 2m deep.

There is no informative mullock at the shaft and upslope to the south are scattered large floaters of pebbly siliciclastic conglomerate composed of well rounded framework supported clasts of pale chert, minor jasper and occaisional slabby clasts of compact hematite (D34); typical of the Dial Group conglomerates. On the flat area south of the speedway, 200m north of the mine, are scattered low outcrops of chert pebble conglomerate and silicic lithic sandstone dipping at about 20deg to west. These contain patchy strong hematite alteration varying from fracture controlled selective replacement of chert clasts to massive pervasive hematisation, especially of the coarser pebbly lithologies. This was sampled as Sample No. 34527. Similar rocks and hematite mineralisation occur 200m further north adjacent to the Penguin Sports Centre (Sample Nos: 34524-26) These conglomerates, on the higher ground, appear to represent the base of the Dial Group (=Duncan Conglomerate).

The Devon Consols adit appears to have intersected very different rocks. At the portal the rock is very weathered; the SW wall is of clayey limonite stained fairly indeterminate (but clearly not siliciclastic) non stratified, conglomerate (D36, 34544) with a crude preferred orientation of flattish pebbles suggesting a dip of about 15deg to the SW. On the NE wall is orangey brown limonite stained fine grained massive rock with a faint relict fabric suggesting a feldspar porphyritic felsic precursor (34545). The contact between the two is observable at the portal as a sharp line running down the back of the adit at 320deg with a steep dip of about 80deg to the NE. Although possibly masked by strong weathering, it does not look like a major fault and the 2 to 3' of pug mentioned by Hughes (1953) is not visible at the portal.

Fresher rocks on the fairly extensive mullock dumps are polymictic pebbly mafic volcaniclithic sandstones which I consider to be the unweathered equivalents of the rocks on the SW wall at the portal. The clasts are generally in the range 5-30mm and well rounded; consist largely of pale grey, pinkish grey or greenish grey chert and cherty siltstone and some of dark green fine grained mafic basalt?, glassy felsic lava? and holocrystalline medium grained mafic gabbro?. They are sometimes closely packed but generally supported in a medium to fine grained sandy, green and more or less chloritic feldspathic/lithic matrix. Some of the cherty clasts have dark rims of chlorite alteration.
(Specimen Nos: D36 - D43)
(Petrographic sample Nos: 34589, 34590)

Minor mineralisation occurs as occaisional bunches and sprays of specular hematite and intimately associated slugs of chalcopyrite, not clearly associated with penetrative veins and sometimes within clasts, especially in fractured chert pebbles. The hematite mineralisation is in some specimens associated with small scale, pervasive reddish staining of the rock. Minor disseminated small euhedral grains of pyrite and lesser chalcopyrite are common, often occurring within clasts, but generally do not exceed 0.5%.
(Sample Nos: 34546, 34547, 34548)

Burns (1964) referred to an 1896 report by Montgomery in which he recorded his doubts about anecdotal information indicating grades of 32% Cu, 6oz/ton Au and 7% Ag whilst his own samples only yielded a trace of Cu and Au and about 1oz/ton of Ag.

The descriptions of Hughes (1953) and Burns (1964) indicate that the mineralisation occurs in a well defined fault zone; the orientation of this fault is fairly close to Burns' (op cit) SE trending dextral late faults which contain minor sulphide mineralisation at Ironcliffs and Badgers prospect and might be of the same style and generation.
The Hm-Py-Cpy assemblage, fault control and composition of the wall rocks (chloritic - mafic? volcaniclastic though coarser grained here) is similar to the mineralisation and setting at Walloa Creek. I speculate that they are of similar generation and that the mafic country rocks have had an influence, as a source or host or both, on the mineral assemblage deposited in these fault zones.
There is possibly also a structural connection with the patchy but locally strong hematite mineralisation in the siliciclastic conglomerates overlying this occurrence.

Some of the earlier geologists thought that Devon Consols also was in Dial Group siliciclastic conglomerates (eg: Hughes, 1953) but Burns (1964, p256) suggested it was in the Cambrian even though his map (1963) placed it in the Gnomon Mudstone which he interpreted as the lowest member of the Dial Group. This highlights the difficulty of assigning the conglomeratic rocks to formations on a lithological basis alone for there is clearly a considerable compositional overlap between the Cambrian and the succeeding rocks.

Specimen Nos:	D34 to D43	
Sample Nos:	34544-34548;	
	34589 = D39	(for petrography)
	34590 = D42	"

Magnetic Susceptibilities: (SI/1000)

Polymictic pebbly mafic volcaniclithic sst: (freshest flat faces)	0.5 - 0.7
Weathered clayey feldspar phyric felsic rock?	0.4 - 0.9

Russel's Prospect

This prospect is located just west of the confluence of Hardstaff creek with the Leven River on private land (owned by B & C Robertson of Lonah, West Ulverstone) adjoining State Forest. It has previously been referred to as Hardstaff & Rogers', McKenna's, and Russell's (Hughes, 1953).

There is an adit, at the NE end of the grassy flat at about 420440E 5438240N, which was driven only a couple of metres above creek level at 325deg into dark grey to greenish grey siltstones, lithic sandstones and fine cherty/mafic volcanic lithic breccia conglomerates (D44, D45) which, by the look of the stuff on the fairly substantial mullock dumps, were essentially unmineralised.

By the descriptions of Twelvetrees (1903) and Hughes (1953) this must be Russell's "old" adit which Hughes stated went in for nearly 300' without intersecting any (mineralised) formation. Accordingly the main workings, consisting of some surface cuts and an adit driven NW about 20' above creek level (No:1 adit) to expose a NNE trending/ 50degWNW dipping lode, must lie on the NW side of Hardstaff Creek some distance upstream of Russel's old adit. I spent an afternoon searching along there in thick scub and ferns but found nothing. Without some more precise indications of the location it will take a concerted effort and some luck to re find this prospect.

The nature of this lode seems rather different from most of the other lode type prospects visited in this reconnaissance in that the previous reports describe it as occurring:

* in a felsic intrusive rock,
* as fissure lode 0.5m wide dipping at 50deg NW which is flatter than others,
* as a quartz reef banded with siderite, arsenopyrite, chalcopyrite and pyrite

Some 1949 EZ Co. sampling (quoted by Hughes, 1953) averaged 1.24% Cu, 72g/t Ag and 0.6g/t Au. Twelvetrees (1903) also noticed a bit of galena in it.

The presence of arsenopyrite in this lode suggests a possible relationship to the felsic intrusive (perhaps Devonian granite?) related style of Py-Cu-Sn-As mineralisation which occurs at the Dial Mine area 2.5km to the north.

Dial Mine Area

The Dial Mine area has been the subject of detailed exploration by Pennzoil and Geopeko which culminated in the drilling of ten diamond drill holes; the first six holes tested targets under a VHMS mineralisation model and the last four holes tested targets for tin-copper mineralisation, (Herrmann, 1985).

I have had a quick look at some of the drill holes, (now stored at Department of Mines in Hobart) mainly to obtain fresh samples of volcanic and intrusive lithologies for petrological examination, but I have not made a detailed review of the previous Dial Mine exploration.

However, my impressions are that the extensive quartz + pyrite with minor copper, arsenic and tin mineralisation occurring in the "sedimentary breccias" is probably related to the intrusion of the Lobster Creek Volcanics along the lines of the model proposed by Large (in: Large and Herrmann, 1980) but not necessarily involving extrusion of the felsic magma which I interpret to be intrusive.

Outcrops in Dial Creek upstream from Keddies Adit and intersections in DHH 6 suggest the presence of a marginal phase or shell of alteration with tourmaline and minor pyrite mineralisation over at least 300m along the western contact of the Lobster Creek Volcanic. Altered LCV with disseminated pyrite was also intersected in DDH 8 indicating that the altered margin could be continuous for another 600m around the contact to the south east. Hughes and Everard (1952) found that pyritic replacement bodies occurred in the sedimentary breccias adjacent to the LCV contact over a length of 20 chains (400m) in the Keddies area.

Although Large (1981) modified his mineralisation model to suggest that the tin in pyritised breccias and in quartz - pyrite veins within the LCV were probably related to an (unidentified) Devonian granite intrusive, I consider that the tourmalinisation and mineralisation could be associated with the intrusion of the LCV. It seems unnecessarily complex to introduce a granite into the model if the LCV is itself a felsic intrusive and has an altered marginal phase with close spatial association to alteration and mineralisation in the country rocks. The LCV would not seem to be a good reactive target for tourmalinisation by a Devonian hydrothermal system.

Furthermore the broadly similar quartz + pyrite alteration associated with a felsic intrusive on the Penguin foreshore suggests the possibility of more extensive Cambrian? intrusive related hydrothermal activity. Several other pyrite occurrences of disseminated or unkown style are charted by Bamford and Green (1988) along the Leven River (Brown's, Colburn's, Radford's, unnamed 067) and near Black's Mn prospect; in each case LCV or somewhat more felsic rocks which I interpret to be intrusive relatives of LCV, occur close nearby.

Penguin Mine Area

According to Hughes (1953) the Penguin Mine workings were long since filled in and little could be seen there even then; I had a bit of a surreptitious poke about the vicinity (now overgrown with creepers) and found nothing to contradict Hughes' story.

However, there is an extensive zone of quartz-sericite alteration and disseminated pyrite mineralisation within and around the felsic intrusive stock outcropping on the adjacent shore platform. Within this altered zone and particularly to landward in the vicinity of Penguin Mine and about 50m to the east, are numerous gossanous veins upto 5cm wide and scattered slugs and small pods of massive pyrite. The veins often have bleached alteration selvedges upto 20cm wide and are commonly steeply dipping with NNE trends associated with minor faults or in en echelon E-W arrays.
This vein style mineralisation fits the earlier descriptions discussed by Hughes (op cit); apparently the sulphides contained Ag, Pb, Cu, Au, Ni?, and Co in association with carbonate.

The felsic stock outcrops over a width of about 100m with a number of narrow ENE trending dykes extending to the east; the western margin is also extremely irregular with short dyke like projections and angular fault displaced wedges. The main stock is mostly weathered but where fresh (eg:34598) has a medium grained hypidiomorphic granular looking fabric and appears to be composed of grey feldspar, some quartz and pale greenish grey altered ferromagnesian and minor (~0.5%) but ubiquitous fine disseminated pyrite and a trace of chalcopyrite.

Burns (1963) gave a description and major element analysis from this stock (No:4. Table 8 p59) indicating that the plagioclase is heavily sericitised and the mafic mineral is tremolite which is probably reflected in the surprisingly high 5% MgO.

Strong quartz-sericite? alteration is present in the adjacent rocks for at least 200m to the west and around 100m to the east; the alteration intensity appears to diminish seaward into weaker patchy quartz-epidote alteration with very minor disseminated pyrite <0.5% and traces of chalcopyrite.
The strong qtz-ser alteration tends to be quite pervasive but in unoxidised samples clastic/sedimentary textures are well preserved indicating that the precursors were mainly unstratified pebbly conglomerates and lithic sandstones with some well bedded fine grained sandstones and siltstones towards the western margin of the zone, (eg: D130, D138, D147, D148). This alteration type is associated with disseminated pyrite generally around 1 to 2% but locally upto 5% and traces of pyrrhotite (D138), galena (34566) and chalcopyrite. Representative samples for geochemical analysis are 34565, 34566, 34568, 34570.

The alteration boundaries are quite sharp, particularly on the western fringe where there are several separate more or less NNE trending zones separated by apparently unaltered and unmineralised polymictic pebbly green mafic? volcaniclastic sandstones; the boundaries are sometimes but not always faults. I am fairly sure that some of the "allocthonous" slabs mapped by Burns (op cit) are alteration zones.

Sample No: 34569 is representative of the weaker peripheral alteration.

The spatial association between the stock and alteration zone suggests a porphyry style magmatic type of mineralisation; the relationship between the disseminated and vein type mineralisation is not clear but a degree of fault control on the margins of both stock and alteration suggest that they are not post tectonic. The associated dykes bear a considerable megascopic resemblance to the Lobster Creek Volcanics, as discussed above.

Such felsic intrusive rocks appear to be widespread in the Cambrian sediments of the Dial Range trough but have not been observed in the Barrington Chert or siliciclastics of the Dial Group. Burns (1964) noted the presence of keratophyre boulders in Duncan Conglomerate at Myrtle Creek which implies a pre Late Cambrian time of intrusion. He also considered that the Lobster Creek Volcanics had been emplaced early during Cambrian sedimentation before the deposition of the Barrington Chert (op cit p31).

6 Styles of Mineralisation

This reconnaissance and review has found indications that there are at least four styles of mineralisation in the area of EL 9/92.

a) Probably the oldest recognised type of mineralisation is the extensive quartz + pyrite alteration within and adjacent to Cambrian? felsic intrusive bodies as observed at Keddies/Dial Mine, Penguin Mine and reported in several other localities in the Dial Range area. An intrusion related hydrothermal origin is suspected with mineralising solutions possibly derived in part from the felsic magma (tourmalinisation) and in part from connate fluids in the country rocks. The mineralisation is known to be associated with minor copper, tin and arsenic at the Dial Mine area and traces of galena have been observed at Penguin foreshore. Also at Penguin Mine is a spatially associated vein system with pyritic Cu-Ag-Pb mineralisation of uncertain genesis, possibly related to the intrusive system or later deformation.

b) A number of hematite deposits occur along the western margin of the Dial Range Trough particularly associated with the contact zone between the PreCambrian Burnie Formation and the westernmost extent of the lower conglomerates of the Dial Group. The deposits appear to be subvertical, parallel to the contact, have faulted western margins and are esentially composed of hematite and quartz with textures suggesting replacement of sedimentary rocks of uncertain affiliation. A strong structuaral control is implied and may have been associated with major faults defining the western margin of the Dial Range Trough during deposition of the Dial Group and possibly earlier during the Cambrian. The timing of this mineralisation is uncertain; previous geologists have taken the presence of rounded pebbles of massive hematite in conglomerates of the Dial Group to indicate reworking of older (ie: at least Cambrian) mineralisation but the presence of similar though generally less intense hematite replacement in the conglomerates (eg: Dial Iron) indicates that the process was active in post Cambrian time.
The Ironcliffs deposit, which is limonitic, is interpreted to have been derived by oxidation of a hematite deposit although there is evidence that there was some pyrite in it. Other than this occurrence the hematite bodies cannot be regarded as gossans and previous, perhaps not very exhaustive, sampling has not turned up any significant base or precious metals in them.

c) Widely scattered in the Dial Range area are small vein and fault fissure type deposits of somewhat variable reported metal assemblages principally including Cu-Ag-(Au), Ba-(Pb), Ba-(Cu) and Pb-Ag. They occur in various Cambrian lithological units and in most cases appear to be related to faults which Burns (1964) attributed to Devonian deformation. The vein style mineral occurrences may therefore be from syn-deformational hydrothermal processes or related to post tectonic granite intrusion as suggested by Leaman (in: Morrison and Davidson, 1988). The quartz vein-Cu deposits at Rutherfords and Copper King probably fall into this category, although they are in PreCambrian sediments, and likewise have a strong fault zone control which parallels the hematite lodes and suggests a structural if not temporal link.

d) The pyrrhotite skarn deposit at Natone seems to be unequivocally related to contact metamorphic/metasomatic effects of the Devonian intrusion of Housetop Granite. Leaman (op cit) interprets that the granite is extensive in the subsurface in the Dial Range area and concurs with Large (1981) in attributing the tin at Dial Mine to Devonian mineralisation.

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APPENDIX I

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LIST OF SAMPLES DIAL RANGE EL 9/92

Sample No	Location	Description	AMG co-ordinates E	AMG co-ordinates N	GEOCHEMICAL ANALYSIS	MAJOR / TRACE WHOLEROCK ANALYSIS	PETROGRAPHY
34501	Dial Iron prospect	Hematitic conglomerate	418000	5439600	*		
34502	"	"	417700	5439270	*		
34503	"	"	417700	5439150	*		
34504	"	"	417700	5439350	*		
34505	Natone Junction	oxidised limonitic ironstone	409400	5442200	*		
34506	Cuprona, Nth Quarries	Hematitic ironstone	412400	5445550	*		
34507	"	"	412450	5445600	*		
34508	"	"	412300	5445450	*		
34509	Sulphur Ck Point	Hematite stained conglomerate	418300	5450340	*		
34510	"	Pyritic pebbly sandstone	"	"	*		
34511	Ironcliffe road	Feldspar porphyry	418050	5441350		*	*
34512	"	Hematite on joints in Duncan Congl	418000	5441350	*		
34513	Black's Mn prospect	Trench No 5, Mn oxides	419050	5440200	*		
34514	"	Shaft No 1, limonitic ferricrete	418940	5440190	*		
34515	"	"	"	5440185	*		
34516	"	Trench No 3; Mn oxides	418940	5440160	*		
34517	"	Trench No 3; limonitic ferricrete	"	"	*		
34518	Blythe River	10mm limonite veins in congl.	412050	5444430	*		
34519	"	Limonite stained shd. slst/mudst.	412070	5444300	*		
34520	"	Limonite stained lenses in mudstone	411970	5444280	*		
34521	Blythe River Ironstone	Massive compact hematite, 90% Hem	411750	5444500	*		
34522	"	Siliceous blebby hematite, 50% Hem	"	"	*		
34523	White Hills Rd Quarry	Pyritic chert; 2% Py	422800	5445450	*		
34524	Penguin Sports Centre	Siliceous breccia; 5% hematite	421600	5446180	*		
34525	"	Massive compact hematite; 90% Hem	"	"	*		
24526	"	Weathered pebbly conglomerate with hematite in mat	421500	5446240	*		
34527	Penguin Speedway	Massive compact hematite; ~80% Hem	421440	5445920	*		
34528	Kaines' Barite prospect	Vein; 95% barite, 5% carb+chl	417200	5434470	*		
34529	"	Vein; 90% barite, 10% carb+chl	"	"	*		
34530	"	Sheared vein/wallrock; ~10% barite, 5% carb.	"	"	*		
34531	"	Andesitic volcaniclithic sandstone	"	"			*
34532	"	"	"	"	*		
34533	"	Andesitic/basaltic clast, fs phyric, flattened?	"	"		*	*
34534	"	0.3m basalt dyke	"	"			

LIST OF SAMPLES   DIAL RANGE EL 9/92

Sample No	Location	Description	AMG co-ordinates E	N	GEOCHEM ANALYSIS	MAJOR/TRACE WHOLE ROCK	PETROGRAPHY
34535	Sullocks Hill Ba prospect	Weathered polymict cgl/mudstone	423080	5445040	*		
34536	"	Weathered limonite stained mudstone	"	"	*		
34537	"	Limonitised congl/mudst	"	"	*		
34538	"	Pyritic siliceous siltstone; <5% Py	"	"	*		
34539	"	Gossanous lim. sil. slst; 1% relict Py	"	"	*		
34540	"	Limonitic congl/mudst; trace Py, barite	"	"	*		
34541	"	Bx. slst; Ba veins and limonite encrustation	"	"	*		
34542	Badger's prospect	Limonite stained clay	419150	5444090	*		
34543	"	Silicfd. fs phyric Rhyolite <5% Py bxwk	"	"	*		
34544	Devon Consols	Weathd. polymictic conglomerate	421570	5445800	*		
34545	"	Weathd. felsic fs porphyry?	"	"	*		
34546	"	Polymict mafic volc. sst; 1% Cpy, 1% Hem	"	"	*		
34547	"	Polymict mafic volc sst; <1% Hem, <0.1% Py	"	"	*		
34548	"	Polymict mafic volc sst; 1% Py, 1% Cpy	"	"	*		
34549	Preston Road	Kerrison Volcs; mafic volc. sandstone	427350	5439040			
34550	"	"	427280	5439100			
34551	"	"	427240	5439200			*
34552	Gunns Plain Road	Motton Spilite	424800	5434700		*	*
34553	Hardstaff Creek	Silicfd felsic volcaniclastic breccia, 0.5% Py	420250	5437960	*		
34554	"	Pink fs-(hbl) felsic porphyry; floater	420260	"			
34555	Purtons Road	Feldspar phyric micro diorite?	421800	5438500		*	*
34556	Isandula Road	Fs (hbl) porphyritic felsic intrusive?	427600	5435100			*
34557	"	" with carb-epid alt.	"	"			
34558	Gunns Plain Road	Weathd chert; trace Py, Cpy	423650	5432740	*		
34559	Walloa Ck Cu mine	Silicfd congl. 20% Hem, 5% Py dissem/vns	419400	5432970	*		
34560	"	Bx grn slst, qtz/chl/carb, minor diss Hem, Py,Cpy	419440	5432880	*		
34561	Lodders Point	Pyritic blk siltstone; 2% Py	426500	5446880	*		
34562	Lobster Ck Rd.	Earthy limonite in cataclasite?	425240	5443850	*		
34563	Beecraft Megabreccia	Vn/dissem Py ~10% in blk chert, on faults	423530	5447740	*		
34564	Keddies	Silicfd/pyritic brecc/congl; 50% Py	420560	5441150	*		

APPENDIX I

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LIST OF SAMPLES　　　　DIAL RANGE EL 9/92

Sample No	Location	Description	AMG co-ordinates E	AMG co-ordinates N	GEOCHEMICAL ANALYSIS	MAJOR/TRACE WHOLEROCK	PETROGRAPHY
34565	Beecraft Megabreccia	Silicfd polymict congl, dissem 1%Py, <0.5%Gn	422900	5447900	*		
34566	"	" dissem Py,Gn,Cpy	422900	5447850	*		
34567	Leven River	Silicfd pyritic breccia, 5%Py	422300	5436580	*		
34568	Beecraft Megabreccia	Slicfd polymict congl; 2% Py, tr Cpy	423000	5447800	*		
34569	"	Wkly silicfd polymict congl; 1%Py, tr Cpy	423040	5447880	*		
34570	"	Silicfd rock? 2% Gn, 1% Py, tr Cpy	423205	5447815	*		
34571	Cuprona: hematite	BR1 150-180'	412430	5445500	*		
34572	"	BR1 180-219'	"	"	*		
34573	"	BR2 80-110'	412480	5445580	*		
34574	"	BR2 110-140'	"	"	*		
34575	"	BR2 140-169'	"	"	*		
34576	"	BR3 110-130'	"	"	*		
34577	"	BR3 130-155'	"	"	*		
34578	Ironcliffs	DD1 12' Qtz, 50% limonite ex Hem?	418900	5444020	*		
34579	"	DD1 63'6" Fract vn qtz; 60% gossany? limonit	"	"	*		
34580	"	DD1 95' 90% compact limonite ex Hem?	"	"	*		
34581	"	DD1 109' 90% compact limonite ex Hem? vuggy	"	"	*		
34582	"	DD1 110-120' Qtz + 60% lim mainly ex Hem?	"	"	*		
34583	"	DD1 130-132' fragment of barite veins 100%	"	"	*		
34584	"	DD1 210' BF fg sst, 5% carb veinlets	"	"	*		
34585	"	DD2 8'9"-9'6" 90% barite	418850	5443930	*		
34586	"	DD2 74'-81' massive compact lim, minor qtz	"	"	*		
34587	Walloa Ck, upper adit	Bx grn slst; 10% qtz, 60% Hem, 10% Py, 5% Cpy	419430	5432860	*		
34588	"	Bx grn slst; 20% qtz, 20% Hem, 10% Py, <5% Cpy	"	"	*		
34589	Devon Consols	D39 polymictic pebbly congl/sst	421570	5445800			*
34590	"	D42 "	"	"			*
34591	Lobster Ck Road	D103 LCV diorite? intrusive?	423200	5442900		*	*
34592	Dial Road	D120 "	420780	5442100			*
34593	Dial DDH 6, 116m	"	420450	5441610		*	*
34594	Radfords Ck area	D85 Feldspar porphyry	422000	5432950		*	*
34595	Gunns Plain Road	D61 Diorite	424300	5433000		*	*
34596	Beecraft Megabreccia	D110 "	423750	5447670		*	*
34597	Teatree Point	D97 Trachyte? dyke	424180	5447590		*	*
34598	Penguin Mine	D143 Altered diorite?	423080	5447820		*	*
34599	Allison Road	D131 Qtz-feldspathic felsic volcaniclastic	423100	5439180			*

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LIST OF SAMPLES DIAL RANGE EL 9/92

Sample No	Location	Description	AMG co-ordinates E	AMG co-ordinates N	GEOCHEM ANALYSES	WHOLEROCK MAJOR/TRACE ANALYSES	PETROGRAPHY.
34600	Isandula Dam	D53 Felsic volcaniclastic	427400	5432950		*	*
34601	"	D51 Felsic aphyric lava or vitric slst	427500	5432950		*	*
34602	Dial DDH 11, 46m	Polymictic conglomerate	423600	5442860			*
34603	Dial DDH 7, 77.5m	"	420320	5441240			*
34604	Russell's Adit	D44 Chert fragment conglomerate	420440	5438220			*
34605	Dial DDH 5, 155.6m	Felsic lithic volcaniclastic	420120	5440480			*
34606	Gunns Plain Road	D71 Chert dominated polymictic congl.	423500	5432720			*
34607	Walloa Ck	D78 Qtz-fs felsic volcaniclastic sst.	419380	5433060			*
34608	Applebee Ck	D83 "	419620	5433260			*
34609	Teatree Point	D98 Chert dominated polymictic congl.	424180	5447580			*
34610	Beecraft Megabreccia	D115 Polymictic congl./ mafic volc sst	423380	5447760			*
34611	"	D139 "	422940	5447860			*
34612	Gunns Plain Road	D 59 Motton Spilite	424320	5433040		*	*
34613	"	D68 Gabbro	424370	5433000		*	*
34614	Lodders point	D92 Motton Spilite	426280	5446900		*	*
34615	"	D93 Gabbro	426420	5447020		*	*
34616	Dial DDH 7, 94.7m	F.g. magnetic basalt with gabbro? dykelet	420320	5441240		*	*
34617	Penguin Ck Iron Mines	Massive compact hematite; 90% Hem	419100	5445600	*		
34618	"	Massive compact hematite, patches specular; 90% He	"	"	*		
34619	"	Limonitic colluvium,Hem pebbles, 20% Hem, 20% Lim	"	"	*		
34620	"	Compact/botryoidal limonite, resembles Ironcliffes	"	"	*		
120					80	18	35

LIST OF SPECIMENS DIAL RANGE EL 9/92

Spec No		Location	Description	AMG co-ordinates E	N
D	1	Dial Iron	Hem conglomerate	418000	5439600
D	2			"	"
D	3	Cuprona Nth Quarries	Hematite-qtz ironstones	412550	5445650
D	4	"	"	"	"
D	5	"	"	"	"
D	6	"	"	"	"
D	7	Ironcliffe Rd	Wd feldspathic mudst/sst/cgl	418100	5441200
D	8	"	"	"	"
D	9	Blacks Mn prospect	Mudst/sandy wacke	418700	5439750
D	10	"	"	"	"
D	11	"	siltstone	419080	5440190
D	12	"	"	"	"
D	13	"		"	"
D	14	"	conglomerate, chert clasts	"	"
D	15	"	Mudst/conglomerate	"	"
D	16	"	mudstone	"	"
D	17	"	conglomerate	"	"
D	18	"	conglomerate	419000	5440050
D	19	Blythe River	mudst/congl; Dial Group?	412060	5444400
D	20	"	"	"	"
D	21	"	"	"	"
D	22	"	slst/mudst	"	"
D	23	"	Hem-qtz ironstone	411700	5444600
D	24	"	"	"	"
D	25	"	"	"	"
D	26	"	"	"	"
D	22A	French's Rd	Intbdd lithic slst/sst/mass flow polymict congl	417350	5435200
D	23A	"	"	"	"
D	24A	"	"	"	"
D	25A	"	"	"	"
D	26A	"	Shd qtzite congl	417420	5435220
	27A	"	"	"	"
D	27B	"	slst/sst	"	"
D	28	Kaines Ba prospect	floaters: andesitic lithic sandstones	417300	5435500
D	29	"	"	"	"
D	30	"	"	"	"
D	31	"	"	"	"
	28A	Badger's prospect	fs phyric rhyolite?	419140	5443940
	29A	"	flinty siltstone	419260	5444200
	30A	"	pebbly mudstone	"	"
	31A	"	fs phyric rhyolite?	419160	5444120
D	32	"	flinty flinty siltstone; vitric?	"	"
D	33	"	felsic volcaniclastic sandstone	"	"
D	34	Devon Consols	polymict conglomeratic mafic volc sandstones	421560	5445800
D	35	"	"	"	"
D	36	"	"	"	"
D	37	"	"	"	"
D	38	"	"	"	"
D	40	"	"	"	"
D	41	"	"	"	"

LIST OF SPECIMENS DIAL RANGE EL 9/92

Spec No		Location	Description	AMG co-ordinates E	N
D	45	Russells Adit	flinty siltstone/lithic sandstone	420400	5438220
D	46	Isandula Rd	pebbly lithic sandstone/ Cateena Gp	427500	5436800
D	47	"	micaceous siltstone/ "	"	"
D	48	Isandula Dam	Feldspathic lithic sandstone	427850	5433200
D	49	"	"	"	"
D	50	"	fg aphyric rhyolite or vitric tuff/slst?	427600	5433040
D	52	"	Pumiceous felsic volcaniclastic (sst)	427450	5432950
D	54	"	"	"	"
D	55	"	"	"	"
D	56	"	"	"	"
D	57	"	"	"	"
D	58	"	"	"	"
D	60	Gunns Plain Rd	Metabasalt; (Motton Spilite)	424340	5433000
D	62	"	Diorite?	"	"
D	63	"	contact metamorphosed slst?	"	"
D	64	"	Chert?	"	"
D	65	"	contact metamorphosed slst?	"	"
D	66	"	"	"	"
D	67	"	Gabbro	"	"
D	69	"	"	"	"
D	70	"	Metabasalt; (Motton Spilite)	424230	5432860
D	72	Adit Creek	Barrington Chert	419680	5433520
D	73	Walloa Creek	"	419200	5433080
D	74	"	Chert lithic congl/breccia	"	"
D	75	"	"	419240	"
D	76	"	Lithic sandstone	"	"
D	77	"	Lithic siltstone	"	"
D	79	"	Grn lithic sst	419420	5432920
D	80	"	Grn lithic sst with hemqtz veins	"	"
D	81	Adit Creek	Felsic volcaniclastic sandstone	419440	5433100
D	82	"	"	419570	5433180
D	84	Applebee creek	feldspar phyric felsic intrusive?	420360	5433200
D	86	Westbank Chaos	Gabbro dyke	427800	5445400
D	87	"	"	"	"
D	88	"	Silicified calcareous polymict congl	"	"
D	89	"	Microgabbro	"	"
D	90	"	"		
D	94	Lodder Point	Intbdd slast/lithic sst	426540	5446340
D	95	"	Felsic volcaniclastic lithic sandstone	"	"
D	96	Teatree Point	Metabasalt (Motton Spilite)	424360	5447540
D	99	"	"	424000	5447600
D	100	Lobster Ck Rd	Red flinty mudstone	425300	4543850
D	101	"	"	424940	5443640
D	102	"	Chert	424840	5443520
D	104	"	fs/amph phyric "Lobster Creek Volcanic"	423140	5442880
D	105	"	Intbdd mudstone/sandstone; Burnie Formation?	425200	5443840
D	106	Teatree Point	Fragmental, hyaloclastite? metabasalt	424130	5447590
D	107	"	Mudstone conglomerate	424060	5447560
D	108	"	fs/amph phyric "Lobster Creek Volcanic" dyke	424040	5447600
D	109	"	banded chert, lenses in Motton Spilite	423980	"

LIST OF SPECIMENS DIAL RANGE EL 9/92

Spec No	Location	Description	AMG co-ordinates E	AMG co-ordinates N	
D 111	Beecraft Megabreccia	Altered/weathered metabasalt?	423750	5447680	
D 112	"	"	"	"	
D 113	"	"	"	"	
D 114	"	Slicifd polymictic brecc/congl	423720	5447700	
D 116	"	Polymict congl. mafic volc. sst; patchy Si-Ep alt	423680	5447760	
D 117	"	"	"	"	
D 118	"	fs phyric felsic dyke	423500	5447760	
D 119	"	Altered diorite with dissem Py	423450	"	
D 120	Dial Road	felsic "Lobster Creek Volcanic" intrusive?	420790	5442110	
D 121	Keddies	Wd sed breccia/congl	420560	5441140	
D 122	"	Altd felsic Lobster Creek Volcanics	420600	5441190	
D 123	Dial Creek	"	420560	5441220	
D 124	"	Pink unaltered Lobster Creek Volcanics	"	"	
D 125	"	Altd Lobster Creek Volcanics/ tourmaline	420430	5441330	
D 127	Watcombes Beach	Fe/Mn oxide	422500	5447780	
D 128	Beecraft Megabreccia	Polymict conglomeratic/ mafic volcaniclastic sst	422650	"	
D 130	"	Pyritic silicified sst			
D 132	Leven River	fs(amp) phyric felsic intrusive	422600	5436650	
D 133	"	"	"	"	
D 134	"	pink qtz sandstone	422340	5436690	
D 135	"	pyritic silicifd limy sed brecc/congl	422230	5436690	
D 136	"	pink qtz sandstone	422340	5436675	
D 137	Beecraft Megabreccia	Penguin Mine alteration zone	422920	5447860	vicinity
D 138	"	"	"	"	
D 139	"	"	"	"	"
D 140	"	"	"	"	"
D 141	"	"	"	"	"
D 142	"	"	"	"	"
D 143	"	"	"	"	"
D 144	"	"	"	"	"
D 145	"	"	"	"	"
D 146	"	"	"	"	"
D 147	"	"	"	"	"
D 148	"	"	"	"	"
D 149	"	"	"	"	"
D 150	Cateena Point	Pumiceous feldspar phyric felsic volcaniclastic	428240	5442660	

APPENDIX II
Dial Range EL 9/92
Observed Magnetic Susceptibilities

Units: SI/1000

Lithostratigraphic Unit	Location	Approx AMG: E	N	Lithology	fr/wd	Magnetic Susc. Min.	Max.
Ulverstone Metamorphics	Goat Island			Qtzite congl	fr	0.00	0.02
"	"			Mica schist	"	0.05	0.20
Burnie Formation	Goat Island			Qtzite/sst	fr	0.00	0.02
				Mudstones	"	0.05	0.20
	Westbank Chaos	428200	5445400	Qtzite/sst	fr		0.05
	"			Mudstones	fr	0.05	0.10
	Beecraft M/bx	422600	5447800	Qtzites	fr		0.02
	Blytne River			"	fr	0.02	0.12
Barrington Chert	Adit Creek	419680	5433520	Chert	fr	0.01	0.10
	Walloa Ck	419200	5433080	"	fr	0.20	0.30
	Lobster Ck Road	424840	5443520	"	fr	0.05	0.10
	White Hills road	422800	5445450	"	fr	0.02	0.15
Motton Spilite	Gunns Plain Rd	424800	5434700	Metabasalt	fr	0.50	0.90
"	"	"	"	"	wd	0.50	1.50
	"	424300	5433000	Metabasalt	fr	0.50	0.80
	"	"	"	Gabbro	fr	0.60	11.00
	Lodders Point	426280	5446900	Metabasalt	fr	5.00	45.00
	Lodders Point	300m traverse eastwards from 426300E/5447000N with readings every 5-10m or so; on fresh, pillowed metabasalts: 33.1, 12.4, 10.9, 12.9, 5.3, 21.7, 20.6, 15.4, 14.7, 0.61, 10.4, 3.49, 0.57, 0.48, 14.9, 10.8, 0.58, 0.72, 2.47, 0.45, 0.48, 2.62, 8.06, 9.55, 31.0, 0.66, 8.02, 70.1, 0.94, 31.3, 0.61, 8.03 4.16, 0.75, 40.9, 30.4, 16.5, 0.51					
	Teatree Point	424360	5447540	Pillowed metabasalt	fr	5.00	25.00
	Lodders Point	426300	5447000	Chert	fr	0.01	0.02
		"	"	Red interpillow mudstone	fr	0.13	0.66
Lobster Creek Volcanics	Gunns Plain Rd	424300	5433000	Diorite dyke?	fr	6.00	15.00
	Lobster Ck Road	423200	5442800	fs-amph phyric diorite	fr	0.30	13.00
	Dial Road	420750	5442100	fs-amph phyric diorite	"wd	1.30	3.00
	Dial Ck /Keddies	420560	5441220	pink LCV diorite	fr	10.00	15.00
	Leven River	422600	5436650	"	fr	9.00	20.00
	Dial Ck /Keddies	420600	5441190	altd LCV diorite	altd	0.10	0.20
	"	420560	5441220	"	altd	1.30	4.00
	"	420430	5441330	altd/tourmalinised diorite	altd		0.10

APPENDIX II
Dial Range EL 9/92
Observed Magnetic Susceptibilities

Units: SI/1000

Lithostratigraphic Unit	Location	Approx AMG: E	N	Lithology	fr/wd	Magnetic Susc. Min.	Max.
Kerrison Volcanics	Preston Rd	427280	5439100	mafic v/clastic sandstone	fr	3.30	18.00
	Isandula Rd	427600	5435100	Fs porphyry intrusive?	fr	0.40	4.50
	Allison Road	423100	5439180	felsic v/clastic slst/sst	fr		0.10
Wilsonia Volcanics	Isandula Dam	427600	5433020	Aphyric silic Rhyolite?	fr	0.08	0.12
	"	427450	5432950	Pumic felsic v/clastic	fr	0.08	0.12
Applebee Vocanics	Walloa Creek	419380	5433060	Felsic v/clastic sst	fr	0.05	0.25
Cateena Group	Devon Consols	421570	5445800	Congl-mafic v/clastics	fr	0.50	0.70
	Preston Rd	427100	5439100	Mudst/feldspathic sst	fr	0.04	0.08
	Isandula Rd	427500	5436800	Mudst/feldspatic sst	wd	0.70	1.25
	Isandula Dam	427850	5433200	Feldspathic lithic sst	wd	0.25	0.45
	Westbank Chaos	427800	5445400	grn & blk mudstone	fr	0.15	0.45
	"			Polymict limy congl.	fr	0.30	1.00
	Lodder Point	426540	5446340	Intbdd slst/feldspathic sst	fr	0.10	0.40
	Keddies	420560	5441150	Silicfd/Py sed breccia	fr	0.02	0.10
	Leven River	422230	5436690	"	fr	0.07	0.21
Radfords Ck Group	Frenchs Rd	417350	5435200	Andesitic v/clastics	wd	0.30	1.90
"	Kaines Ba prospect	417200	5434470	Barite vein	fr	0.06	0.09
				Andesitic v/clastics	fr	0.20	0.40
	Walloa Creek	419240	5433080	Chert brecc/cgl/lith sst/slst	fr	0.10	0.20
	"	419420	5432920	Mafic lithic sst/slt	fr	0.20	0.45
B/craft & T Tree Megabreccia	Teatree Point	424200	5447600	Cht pebble congl/mudstone	fr		0.50
	"	424180	5447580	Cht pebble congl/lithic sst	fr	0.10	0.15
	Beecraft	423680	5447760	congl-mafic v/clastic sst	fr	5.00	30.00
	"	"	"	"	altd	<1	1.00
	"	422650	5447780	"	fr	0.25	0.60
	Penguin Mine area	422920	5447860	Silicfd/Py v/clastic seds	altd	0.20	1.30
Dial Group	Frenchs Rd	417420	5435220	Shd qtzite congl.	wd	0.05	0.08
	Penguin Beach			Chert pebble congl	fr	0.25	0.35
	"			" with jasper clasts	fr	0.02	0.03
	"			Chert pebble congl	fr	0.03	0.05
				Congl / strong Hem alt	altd	0.35	0.45
	Leven River	422340	5436680	pink qtz sandstone	fr	0.10	0.15
Hematitic Ironstones	Blythe River	411750	5445500	massive compact hematite, qtz	fr	0.60	1.20
Tertiary basalt	Kaines Ba prospect	417200	5434470	0.3m dyke	fr	7.50	12.00
	Lodders Point	426530	5446300	Basalt flow	fr	2.00	4.00

APPENDIX C

Petrographic Report Dial Range EL 9/92 - AJ Crawford, March 1993

SUMMARY AND IMPLICATIONS OF PETROGRAPHIC WORK ON PASMINCO DIAL RANGE EL 9/92

Tony Crawford, 26/3/93

The samples examined were collected by Wally Herrmann during a reconnaissance mapping-sampling program for Pasminco in late 1992. I am impressed by the detail of Wally's observations, and most of my petrographic work supports his assignments and conclusions. There are clearly big problems with Burns' stratigraphy, and I offer the following thoughts towards reconciling some of these with Wally's observations and my petrographic assignments.

1: LOBSTER CREEK VOLCANICS

Despite being put at the bottom of the stratigraphic pile by Burns, this unit is clearly a correlate of the Mount Read Volcanics sensu stricto. None of the samples I have looked at are volcanic. Al are holocrystalline intrusive plagioclase-phyric hornblende diorites, very similar to rocks I described from the Preston E/L of Geopeko in the Leven Gorge area. I have some detailed geochemical data for the latter, and am sure that the samples collected by Wally represent part of the same late stage intrusive episode.

If these were intruded through or into the recently emplaced allochthon (which in this region probably included parautochthonous slivers of basement including rift tholeiites and dolomites), I would imagine that the possibility of porphyry Cu-Au mineralization might be more tantalizing than previously considered for the Mount Read Volcanics.

2: MOTTON SPILITE

These rocks are all tholeiitic metabasalts, typical of the Latest Proterozoic rifted passive margin. I am certain that compositionally, they will overlap the fields for the Crimson Creek Fmn and Smithton tholeiites, and that the Barrington Chert is a correlate of the chery, hematitic siltstones and associated rocks of the Success Creek Group and units below the basalts in the Smithton Trough. In the Smithton Trough, such basalts and associated rocks are in situ, but in the Dundas and Dial Rge Troughs, they may be allochthonous, having been dragged westward along the base of the overthrusting ophiolitic allochthon.

3: MEGABRECCIA UNITS

These very distinctive rocks are all remarkably similar, and are composed of varying proportions of cherts, carbonaceous siltstones, tholeiitic basalts (often quenched) and subordinate dolomites. They are clearly derived from either the passive margin to the west (exact petrographic correlates are present throughout the Smithton Trough, for example), or from the advancing parautochthon of Motton Spilite-Barrington chert. Interestingly, however, there is apparently no ophiolitic detritus in the samples I looked at, which tends to support a westerly derivation, from an area in which the ophiolite had yet to be emplaced. Uplift and collapse of a passive margin to form a foredeep is one of the standard stages in emplacement of big ophiolite sheets. I think that the Dundas - Dial Rge Trough formed as this foredeep, and did not exist before ophiolite emplacement as a distinct volcano-sedimentary trough.

4: CATEENA GROUP pre MRV?

This suite of rocks is almost identical petrographically to the samples from the megabreccia, and demand a similar age and provenance. I have not read Burns (1964) carefully enough recently to remember the details of his stratigraphic assignments, but we can be absloutely sure that the Cateena Group samples that I have looked at are from the same stratigraphic unti as the Megabreccias, presumably minus the intense and complex deformation. One sample however, 34605, recorded by Wally as being from the Cateena Group, is petrographically absolutely unlike the other samples, and is composed of detritus from felsic volcanics. It is better correlated with the Kerrison-Wilsonia-Applebee 'Volcanics', with which it matches petrographically. I have not gone through the maps to see what sort of a problem this throws up for map interpretation, but there is no doubt about the petrographic assignment. I would argue that the Cateena Group and the Megabreccias were deposited ever before there were any Mt Read Volcanics or their correlates, so that 34605 and its correlates (Kerrison-Wilsonia-Applebee) must significantly post-date the Cateena-Megabreccia units.

5: RADFORDS CREEK GROUP

Wally was inclined to draw a strong link between the Radford's Creek Group and the Cateena Group, based on field and hand specimen evidence. However, sample 34531 is a volcaniclastic sandstone derived from plagioclase+quartz-phyric felsic volcanics and is akin to the Kerrison-Wilsonia-Applebee Volcanics. It is nothing like the Cateena Group - Megabreccia volcaniclastics. Supporting this interpretation, 34533 is a typical Beulah Formation andesitic clast in a volcaniclastic conglomerate from the Radford's Creek Group, which clearly indicates that this formation either post-dates or is synchronous with the Mount Read Volcanics.

The third sample of Radford's Creek Group that I examined, 34606, is quite clearly a petrographic correlate of the Megabreccia - Cateena Group volcaniclastics, having lots of chert clasts and tholeiitic basalt detritus. This suggests, especially when coupled with Wally's observation that the Radford's Creek Group is commonly composed of chert-basalt conglomerates, that there is a mapping problem, and that the main part of this stratigraphic unit is, in fact, a direct correlate of the Cateena Group (as suggested by Wally). However, in the area of Kaine's prospect, at least, the Radford's Creek Group appears to have strong petrographic similarities to the Kerrison-Wilsonia-Applebee 'Volcanics'. This problem can probably be sorted out by a careful look at the maps (and illustrates the value of petrographic work to regional mapping!).

6: KERRISON-WILSONIA-APPLEBEE VOLCANICS

I am not too sure of the stratigraphic levels at which these formations occur (eg Applebee are apparently interbedded in the Radford's Creek Group, but the latter formation at this locality may be mis-identified). The major point arising from this petrographic work is that there can be no doubt that all the rocks I have looked at from these units are very similar quartz-feldspar-vitric ash volcaniclastics derived from Mount Read Volcanics-type lithologies. They contrast markedly with the Cateena Group - Megabreccia volcaniclastics, and are probably better corelated in a regional sense with the Southwell Subgroup - Tyndall Group.

7: DYKES IN THE MEGABRECCIA

Supporting the claim that the Megabreccia volcaniclastics pre-date the Mount Read Volcanics-type magmatism in this region, is the occurrence of two dykes of dacite and andesite through the Megabreccia.

SUMMARY OF PETROGRAPHIC ASSIGNMENTS

PASMINCO DIAL RANGE EL 9/92

Tony Crawford, 26/3/93

LOBSTER CK VOLCANICS AND CORRELATES

SAMPLE NUMBER: 34511
LOCATION: Ironcliffe Rd., Lobster Ck Volcanics
SUMMARY: This is a plagioclase+sparsely hornblende-phyric microdioritic shallow intrusive similar petrographically to 34593.

SAMPLE NUMBER: 34555
LOCATION: Purtons Road, Lobster Creek Volcanics
SUMMARY: This is a very well-preserved sparsely plagioclase-phyric hornblende microdiorite.

SAMPLE NUMBER: 34556
LOCATION: Isandula Rd, Lobster Ck Volcanics
SUMMARY: This was a plagioclase+sparsely hornblende-phyric microdioritic shallow intrusive similar to 34592 and 34593, and the Leven Gorge diorites.

SAMPLE NUMBER: 34591
LOCATION: Lobster Creek Volcanics from Lobster Creek Road.
SUMMARY: This is a well-preserved sparsely plagioclase-phyric hornblende microdiorite, similar to 34593, 34555 and 34598, and those from the Leven Gorge area.

SAMPLE NUMBER: 34592
LOCATION: Dial Road, Lobster Creek Volcanics
SUMMARY: This was a plagioclase+sparse hornblende-phyric microdiorite similar to 34555, 34598 and 34593.

SAMPLE NUMBER: 34593
LOCATION: Dial DDH 6, 116m, Lobster Ck Volcanics
SUMMARY: This is a hydrothermally altered plagioclase+sparsely hornblende-phyric dioritic intrusive rock, again similar to those from the Leven Gorge area.

SAMPLE NUMBER: 34594
LOCATION: Radford's Ck Area, Lobster Ck Volcanics
SUMMARY: This is a plagioclase-phyric fairly evolved microdioritic intrusive rock from a small stock or plug. It is petrographically very similar to the dioritic intrusives from the Leven River Gorge area.

SAMPLE NUMBER: 34595
LOCATION: Gunns Plain Rd. Lobster Ck Volcanics. A small intrusive microdiorite body in fine sandstones.
SUMMARY: This is a quenched, aphyric, dacitic chilled margin of a small intrusion, which contains long, hollow bladed plagioclase crystals in a spherulitic, formerly glassy groundmass.

SAMPLE NUMBER: 34598
LOCATION: Penguin Mine, Lobster Ck Volcanics
SUMMARY: This is a low greenschist facies holocrystalline dioritic intrusive rock with pronounced similarities to those from the Leven Gorge area.

WILSONIA AND KERRISON VOLCANICS

SAMPLE NUMBER: 34601
LOCATION: Isandula Dam Wilsonia Volcanics
SUMMARY: This is probably a devitrified volcaniclastic siltstone originally dominated by comminuted felsic ash.

SAMPLE NUMBER: 34600
LOCATION: Isandula Dam, Wilsonia Volcanics.
SUMMARY: This is a volcaniclastic sandstone derived entirely from quartz+plagioclase-phyric glassy felsic lavas.

SAMPLE NUMBER: 34599
LOCATION: Allison Rd; Kerrison Volcanics
SUMMARY: This is a bedded specimen composed of volcaniclastic sandstone and siltstone derived largely from explosive quartz+albite-phyric felsic volcanics; the finer beds also seem to carry a minor component derived from pelitic metamorphics.

SAMPLE NUMBER: 34551
LOCATION: Preston Rd., Kerrison Volcanics
SUMMARY: This is a volcaniclastic sandstone derived from plagioclase+augite-phyric andesitic to dacitic volcanics, presumably correlated with the Mount Read Volcanics (eg Beulah Formation).

SAMPLE NUMBER: 34599
LOCATION: Allison Rd; Kerrison Volcanics
SUMMARY: This is a bedded specimen composed of volcaniclastic sandstone and siltstone derived largely from explosive quartz+albite-phyric felsic volcanics; the finer beds also seem to carry a minor component derived from pelitic metamorphics.

APPLEBEE VOLCANICS

SAMPLE NUMBER: 34608
LOCATION: Applebee Creek, Applebee Volcanics.
SUMMARY: This is a volcaniclastic (tuffaceous) sandstone dominated by quartz and feldspar detritus and recrystallized vitric ash from explosive felsic volcanism of 'Mount Read Volcanics' type.

SAMPLE NUMBER: 34607
LOCATION: Walloa Creek, Applebee Volcanics
SUMMARY: This is a volcaniclastic (tuffaceous) sandstone composed of quartz and plagioclase crystal detritus in a reworked vitric ash matrix. It is similar to some Southwell Subgroup volcanogenic sediments. Is is similar also to sample 34605.

MEGABRECCIA UNITS

SAMPLE NUMBER: 34609
LOCATION: Tea Tree Point (Megabreccia)
SUMMARY: This is a coarse sandstone dominated by clasts of carbonaceous shale and siltstone, with a minor volcanic component from Motton Spilite metabasalts. It is strikingly similar to 34604, and is almost certainly from the same unit.

SAMPLE NUMBER: 34611
LOCATION: Central section of the Beecraft Megabreccia.
SUMMARY: This is a coarse, mainly volcaniclastic sandstone derived from a terrain dominated by tholeiitic basalts and shallow intrusive dolerites and leucogabbros correlated with the Motton Spilite. It has a greenschist facies burial metamorphic assemblage.

SAMPLE NUMBER: 34610
LOCATION: Beecraft Megabreccia coastal outcrop at the eastern end of the Megabreccia.
SUMMARY: This is a greenschist facies volcaniclastic sandstone derived dominantly from Motton Spilite-correlated tholeiitic metabasalts and dolerites, but with a minor detrital metapelite component. It is similar to samples 34602 and 34604.

MOTTON SPILITE AND CORRELATES

SAMPLE NUMBER: 34615
LOCATION: Lodders Point, Motton Spilite
SUMMARY: This is a tholeiitic dolerite dyke or very thick lava flow, correlated with the Motton Spilite, that contains micro- pegmatoidal patches of similar material. It has a prehnite-pumpellyite facies alteration assemblage.

SAMPLE NUMBER: 34613
LOCATION: Gunns Plain Rd., Motton Spilite
SUMMARY: This is a coarse augite-phyric tholeiitic meatbasalt correlated with the Motton Spilite.

SAMPLE NUMBER: 34616
LOCATION: Dial Mine Grid DDH 7 94.7m, Motton Spilite
SUMMARY: This is a Motton Spilite-correlated, quenched plagioclase + augite + FeTi oxide-phyric, evolved metabasaltic lava with a low grade burial metamorphic alteration assemblage.

SAMPLE NUMBER: 34612
LOCATION: Gunns Plain Road, Motton Spilite
SUMMARY: This is an augite-phyric evolved tholeiitic metabasalt with a low-grade prehnite-pumpellyite facies burial metamorphic overprint. It is correlated with the Motton Spilite.

SAMPLE NUMBER: 34552
LOCATION: Gunns Plain Rd., Motton Spilite
SUMMARY: This is an evolved tholeiitic metabasalt, composed of glomeroclots of augite in a highly altered, formerly glass-rich groundmass. It is correlated with the Motton Spilite.

CATEENA GROUP

SAMPLE NUMBER: 34604
LOCATION: Russell's Adit, Cateena Group
SUMMARY: This is a coarse mixed provenance sandstone in which predominant clasts are from Motton Spilite-correlated metabasic lavas and dolerites, but clasts of carbonaceous, pyritic shale, siltstone, and minor chert are also present.

SAMPLE NUMBER: 34605
LOCATION: Dial Mine Grid DDH 5, 155.6m, Cateena Group
SUMMARY: This is a volcaniclastic sandstone composed of quartz and albite phenocryst detritus from porphyritic felsic lavas presumably correlated with the Mount Read or Lobster Creek Volcanics. It has suffered moderate hydrothermal alteration (silicification).

SAMPLE NUMBER: 34603
LOCATION: Cateena Group, Dial Mine Grid DDH7, 77.5m, intruded by Lobster Ck Volcanics
SUMMARY: This is a quite strongly hydrothermally altered (carbonate-sericite-pyrite±chlorite) coarse sandstone composed of clasts derived from siltstone, dolomite, chert and basic volcanics of the passive margin sequence (pre-Mount Read Volcanics).

SAMPLE NUMBER: 34590
LOCATION: Devon Consols area, Cateena Group
SUMMARY: This is a coarse sandstone derived dominantly from a chert-siltstone source area. It has been quite strongly chloritized during moderate to strong hydrothermal alteration.

SAMPLE NUMBER: 34589
LOCATION: Devon Consols, Cateena Group
SUMMARY: This is a coarse sandstone or fine conglomerate composed of clasts of siltstone and chert; the rock has suffered strong hydrothermal chlorite±hematite alteration.

SAMPLE NUMBER: 34602
LOCATION: Venture 7, DIAL 11 drillhole, 46m, Cateena Group, intruded by Lobster Ck Volcanics
SUMMARY: This is polymict conglomerate derived from Motton Spilite-correlated tholeiitic pillow basalts and hyaloclastites, and a subordinate component from a metapelitic source. It is very similar in source and implcations to sample 34604.

RADFORDS CK GROUP

SAMPLE NUMBER: 34531
LOCATION: Kaine's Barite Prospect. Radford's Ck Group
SUMMARY: This is a weakly hydrothermally altered volcaniclastic sandstone derived entirely from glassy, plagioclase+quartz-phyric felsic volcanics of 'Mount Read Volcanics'-type.

SAMPLE NUMBER: 34533
LOCATION: Kaine's Barite Prospect. Radford's Ck Group. This is from a large a clast in a volcaniclastic sandstone.
SUMMARY: This is a weakly foliated plagioclase+sparsely augite-phyric andesite with a strong calcite-sericite-hematite hydrothermal overprint.

SAMPLE NUMBER: 34606
LOCATION: Gunns Plain Rd, Radfords Ck Group
SUMMARY: This is a conglomerate derived from the passive margin sequence, and includes clasts of rift tholeiites, limestone or dolomite, carbonaceous shales and siltstones, and cherty material. It is identical to 34604 and 34609, and derived from the same stratigraphic unit as these samples.

DYKES IN MEGABRECCIA

SAMPLE NUMBER: 34597
LOCATION: Dyke at Teatree Point in the Megabreccia
SUMMARY: This is a sparsely plagioclase-phyric dacitic to rhyodacitic fine-grained dyke rock that is petrographically very like many of the Que-Hellyer felsic lavas and narrow dykes.

SAMPLE NUMBER: 34596
LOCATION: Dyke In Beecraft Megabreccia
SUMMARY: This is a plagioclase+augite-phyric andesitic fine-grained dyke rock that is petrographically identical to the Beulah Formation - Que Footwall Andesites.

SAMPLE NUMBER: 34556

LOCATION: PASMINCO Dial Range EL9/92. Lobster Ck Volcanics

SUMMARY:

This was a plagioclase+sparsely hornblende-phyric microdioritic shallow intrusive similar to 34592 and 34593, and the Leven Gorge diorites.

HAND SPECIMEN:

This is a rather coarsely plagioclase+mafic-phyric pink microdioritic intrusive rock with phenocrysts to about 4mm across in a much finer-grained matrix.

THIN SECTION:

This sample is another plagioclase+mafic-phyric microdioritic holocrystalline intrusive, composed of around 10 modal% albitized plagioclase phenocrysts and a few modal of chloritized mafic phenocrysts in a fairly fine-grained but holocrystalline groundmass. The plagioclase phenocrysts are quite euhedral and are up to at least 4mm long, and are lightly speckled with sericite. They often occur in clusters of several crystals, and occasionally intergrown with chloritized mafics in cognate gabbroic clots. The former mafic phenocrysts are much smaller and more ragged than the plagioclase phenocrysts and are always thoroughly replaced by chlorite. By inference from comparison with better preserved samples, these were probably hornblende. Granular FeTi oxide phenocrysts are not uncommon, and sometimes show skeletal exsolution of ilmenite, which has subsequently been replaced by chlorite and leucoxene, leaving lattices of magnetite.

The groundmass of this sample is a fine-grained assemblage composed of small laths of albite mainly around 0.05-0,1mm long, set in a background of anhedral quartz and Kspar, with common interstitial chlorite and small sphene grains.

This is another microdiorite very similar petrographically to some of the less mafic microdiorites described elsewhere in this set. The metamorphic grade is very low, and characteristic of burial metamorphism rather than hydrothermal alteration.

SAMPLE NUMBER: 34610

LOCATION: PASMINCO Dial Range EL9/92; Beecraft Megabreccia coastal outcrop at the eastern end of the Megabreccia.

SUMMARY:

This is a greenschist facies volcaniclastic sandstone derived dominantly from Motton Spilite-correlated tholeiitic metabasalts and dolerites, but with a minor detrital metapelite component. It is similar to samples 34602 and 34604.

HAND SPECIMEN:

This is a dark green volcaniclastic sandstone with clasts up to 3mm long, dominated by metabasic volcanic detritus.

THIN SECTION:

This sample is a poorly-sorted, framework-supported volcanogenic sandstone composed of about 95 modal% of subrounded to subangular clasts of metabasic lithologies, and a small amount of metapelitic clasts. The metabasic clasts show a remarkable range of textures, varying from rather coarse-grained microgabbros, through coarse, intersertal-textured basalts, to spherulitic-textured basaltic glasses. Most are aphyric or sparsely augite-phyric, and all show greenschist facies metamorphic assemblages characterized by albite and actinolite, with subordinate leucoxene after the FeTi oxides; all show minor calcite overprinting. Several clasts are composed of blocky prisms of actinolite after pyroxenes, and were probably clinopyroxenite originally.

The metapelitic clasts are rounded to subrounded, mainly 1-2mm across, and are mainly siliceous recrystallized mudstone and possibly chert. The matrix of this sample has been eliminated by pressure solution, and most clasts intrude into adjacent clasts. Interstitial areas are filled by secondary quartz that is often riddled by actinolite needles, and calcite is quite abundant overprinting both clasts and interstitial quartz.

This is another volcanogenic sandstone derived dominantly from Motton Spilite-correlated metabasic lavas and intrusive rocks. The greenschist facies metamorphism is notable in this rock. In many respects, the detrital grain population in this rock is very similar to the detrital assemblages in coarse volcaniclastics such as 34602 and 34604, and a correlation with these rocks can probably be made with some confidence.

SAMPLE NUMBER: 34552

LOCATION: PASMINCO Dial Range EL9/92. Gunns Plain Rd

SUMMARY:

This is an evolved tholeiitic metabasalt, composed of glomeroclots of augite in a highly altered, formerly glass-rich groundmass. It is correlated with the Motton Spilite.

HAND SPECIMEN:

This is a massive, aphyric dark green-grey metabasaltic lava.

THIN SECTION:

This is a texturally well-preserved metabasaltic lava with a rather distinctive texture, dominated by glomeroclots of small anhedral, fresh augite microphenocrysts set in a near-isotropic messy aggregate of altered small plagioclase laths and altered interstitial glass. The small augite microphenocrysts that form the crystal aggregates are rarely larger than 0.2mm long, but the glomeroclots of these crystals are often 1-1.5mm across and composed of ten or twenty crystals. Small altered plagioclase laths are ophitically included in many of these clots. The matrix or groundmass in which these crystal aggregates are set is a rather heterogeneous and messy aggregate of small anhedral augite plates and totally altered plagioclase laths with abundant interstitial altered glass. Plagioclase laths are always replaced by an almost isotropic aggregate of very fine-grained green pumpellyite and chlorite. Altered glass is composed of green chlorite with small globular leucoxene blebs after FeTi oxides, brown devitrified glass, and clear interstitial quartz.

This is clearly a Motton Spilite correlated metabasalt, of tholeiitic affinities. It's cocrystallizing augite and plagioclase, and absence of olivine pseudomorphs, indicate that it is a quite evolved composition (probably around 6% MgO). The relative abundance of former glass suggests that this was probably from a mid- to core region of a pillow. The metamorphic grade is within the prehnite-pumpellyite facies of burial metamorphism.

SAMPLE NUMBER: 34604

LOCATION: PASMINCO Dial Range EL9/92: Cateena Group, Russell's Adit.

SUMMARY:

This is a coarse mixed provenance sandstone in which predominant clasts are from Motton Spilite-correlated metabasic lavas and dolerites, but clasts of carbonaceous, pyritic shale, siltstone, and minor chert are also present.

HAND SPECIMEN:

Thank heavens for geologists that send me useful-sized pieces to look at. This is a bedded volcaniclastic(?) sandstone or grit with abundant quite angular clasts of black chert(?), and less abundant clasts of metabasalt(?) up to several cm long, as well as several large flat rip-up clasts of dark shale or chert.

THIN SECTION:

This is a poorly-sorted, framework-supported coarse sandstone composed in the thin section of angular to subrounded polymict clasts around 5mm maximum and 2-3mm average size. The very dark clasts so distinctive in the hand specimen are seen to make up only about 10-15modal% of this rock, and they are very fine-grained carbonaceous shale in which lamellar bedding is evident and small idiomorphic pyrite euhedra are not uncommon. Other common clast types are either sedimentary, or igneous. Among the latter group, most abundant are aphyric metabasaltic lavas composed of subophitic to intersertal-textured intergrowths of albitized plagioclase and augite, with interstitial chlorite. More quench-textured intergrowths of the same minerals are from pillow margins, and several clasts with coarser-grained doleritic to microgabbroic textures are also present. Many of the metabasic clasts show strong calcite overprints. The range of lithologies represented among the metabasic clasts is absolutely diagnostic of the typical Crimson Creek Formation metabasalts and correlates (e.g Motton Spilite), and a positive correlation of these clasts with the passive margin rift tholeiites can be made with confidence. There is no input from any ophiolitic source, nor from Mount Read Volcanics-type lava sequences.

The abundant sedimentary clasts in this unit are very fine-grained siltstones and mudstones with overprinting calcite, and possibly a few cherty clasts. I can make no diagnostic correlation of these rocks, although many may be Rocky Cape Group metapelites. Matrix has been eliminated from this sample by winnowing and pressure solution. Alteration is predominantly a calcite overprint in clasts and interstitial areas.

SAMPLE NUMBER: 34613

LOCATION: PASMINCO Dial Range EL9/92: Gunns Plain Rd

SUMMARY:

This is a coarse augite-phyric tholeiitic metabasalt correlated with the Motton Spilite.

HAND SPECIMEN:

This is a massive, dark grey-green rather coarse-grained augite-phyric metabasalt or fine dolerite.

THIN SECTION:

This is another texturally well-preserved metabasalt with quite large, fresh augite phenocrysts ophitically including plagioclase laths set in a near-holocrystalline groundmass. The augite phenocrysts are subhedral, generally fairly equidimensional prisms up to 3mm across and show weak normal zoning. Many have unusual brown rims, possibly resulting from abundant Fe oxide dust in the late-crystallizing crystal margins. The common plagioclase laths ophitically included in augite are albitized.

The groundmass of this sample is quite coarse-grained and composed of an intersertal-textured intergrowth of well-formed albitized plagioclase laths intergrown with more anhedral platy to granular augite. Many albite laths have abundant inclusions of chlorite and pumpellyite, and minor sericite. Other components of the groundmass are quite large leucoxene-altered FeTi oxide grains, often intergrown with plagioclase, and triangular interstices between plagioclase laths filled by green chlorite.

Several narrow, irregular brittle fracture microshear zones transect the rock, and are characterized by granulation of both augite and plagioclase, which are set in abundant chlorite. Veins composed of epidote, prehnite and calcite transect the sample, and spots and blotches of greenish to clear pleochroic pumpellyite are common throughout the rock.

This is a tholeiitic metabasalt, from the interior of a thick flow, easily correlated with the Motton Spilite. The lack of olivine and cocrystallization of augite and plagioclase show that this basalt was quite evolved.

SAMPLE NUMBER: 34602

LOCATION: PASMINCO Dial Range EL9/92: Venture 7, DIAL 11 drillhole, 46m; Cateena Group

SUMMARY:

This is polymict conglomerate derived from Motton Spilite-correlated tholeiitic pillow basalts and hyaloclastites, and a subordinate component from a metapelitic source. It is very similar in source and implications to sample 34604.

HAND SPECIMEN:

This is a dark brown polymict conglomerate with fragments to at least 1cm across of dominantly metabasic volcanics.

THIN SECTION:

This sample is a poorly-sorted, framework-supported polymict fine conglomerate very similar in many respects to sample 34604. The dominant lithic clasts are subrounded aphyric metabasaltic lavas showing a great variety of textures. Perhaps most abundant are quenched basaltic glasses that are totally devitrified and often show spherulitic textures developed in crystallites of former plagioclase and augite. Devitrification of these spherulitic clasts has produced abundant very fine-grained hematite or magnetite. In the typical ophitic to intersertal textured basaltic clasts, and also in the not uncommon doleritic to microgabbroic clasts, augite is always altered to pale green actinolite, and plagioclase laths are albitized.

The other dominant clast type in this rock reflects a pelitic metamorphic source, and clasts range from mudstone and siltstone to cherty material, the former often showing small calcite rhombs overprinting the rock. Many of these metapelites were quite siliceous, and have been further silicified before erosion, transport and incorporation into this conglomerate, as indicated by extensive networks of hairline silica veinlets.

This is a conglomerate derived largely from Motton Spilites, including abundant glassy pillows and hyaloclastites, but with a significant component from a metapelitic sedimentary source. In many respects, this rock is very similar to sample 34604, except that the distinctive, locally-derived carbonaceous clasts in the latter sample are not evident in this rock. It is notable that this sample shows a greenschist facies metamorphic assemblage, indicating higher ambient temperatures of alteration than most of the other rocks described in this set.

SAMPLE NUMBER: 34615

LOCATION: PASMINCO Dial Range EL9/92: Lodders Point, Motton Spilite

SUMMARY:

This is a tholeiitic dolerite dyke or very thick lava flow, correlated with the Motton Spilite, that contains micro-pegmatoidal patches of similar material. It has a prehnite-pumpellyite facies alteration assemblage.

HAND SPECIMEN:

This is an unusual textured sample that is essentially a metabasaltic lava or fine-grained metadolerite with irregular patches of coarser-grained metadolerite or microgabbro.up to a few cm long.

THIN SECTION:

This is a tholeiitic metabasaltic lava or microdolerite, typical of the Motton Spilite, that includes some fragments of coarser-grained metadolerite or microgabbro. The finer-grained variant is holocrystalline, and if I hadn't seen this hand specimen I would say this was the chilled margin of a dyke. It consists of an equigranular intergrowth of albite and fresh augite, with abundant chlorite and occasional quite large FeTi oxides. The contact with the coarser-grained microgabbro is irregular, and not sharp, but occurs over a very short distance, less than 1mm. The metadolerite or microgabbro is quite variable across the slide, varying from augite-poor leucogabbro to more typically augite-rich gabbro. Pyroxenes are typically quite brownish, and occur in a coarse ophitic intergrowth with blocky albite prisms, big leucoxene-altered FeTi oxides and minor interstitial chlorite.

The rock is transected by veins composed of bladed pale green pumpellyite intergrown with colourless prehnite, pale yellow epidote and some hematite, the lot overprinted by common calcite. The metamorphic grade is clearly prehnite pumpellyite facies.

This rock is rather difficult to interpret. Probably, the coarser-textured areas are simply pegmatoidal patches in the dolerite or basalt, grown in areas in which hydrous fluids were concentrating during differentiation. This is a common feature of thick tholeiitic basalt flows and sills (eg. Colombia River Basalts in W USA).

SAMPLE NUMBER: 34605

LOCATION: PASMINCO Dial Range EL9/92: Cateena Group, Dial Mine Grid DDH 5, 155.6m.

SUMMARY:

This is a volcaniclastic sandstone composed of quartz and albite phenocryst detritus from porphyritic felsic lavas presumably correlated with the Mount Read or Lobster Creek Volcanics. It has suffered moderate hydrothermal alteration (silicification).

HAND SPECIMEN:

This is a strongly altered volcanogenic fine conglomerate with occasional cm-sized black shale clasts, but it is dominated by clasts of altered feldspar and quartz.

THIN SECTION:

This is matrix-supported volcaniclastic sandstone derived almost entirely from quartz and albite phenocryst detritus from felsic volcanics. The only clasts not from this source are the distinctive dark clasts obvious in the hand specimen, that are composed of a dense intergrowth of very fine-grained actinolite and albite or quartz. The protolith of these recrystallized clasts is not obvious, but they were possibly mafic vitric tuffs. The remainder of the rock consists of subequal proportions of quartz and albite phenocryst fragments. Many are 1-2mm across, rather angular to subrounded, and together they make up about 60 modal% of the rock. Albite phenocrysts are blocky and slightly speckled by sericite. Quartz phenocrysts are more angular, and show internal strain features, occasional chloritized melt inclusions.

The matrix of this rock is very siliceous, being composed of a variably fine-grained and recrystallized quartzo-feldspathic intergrowth that has intergrown with quartz phenocryst margins. Concentrations of chlorite and calcite are not uncommon in interstitial areas through the matrix.

This is a weakly silicified volcaniclastic sandstone derived from quartz+albite-phyric felsic volcanics. It clearly derives from the Mount Read Volcanics (or Lobster Creek Volcanics, that I believe are MRV correlates), and contrasts strongly with many other volcaniclastic sandstones in this set, which lack completely any Mount Read Volcanic input.

SAMPLE NUMBER: 34590

LOCATION: PASMINCO Dial Range EL9/92: Cateena Group, Devon Consols area.

SUMMARY:

This is a coarse sandstone derived dominantly from a chert-siltstone source area. It has been quite strongly chloritized during moderate to strong hydrothermal alteration.

HAND SPECIMEN:

This is a dark green rather mafic volcaniclastic sandstone with clasts on average about 5mm across, but varying up to 1.5cm across, of mainly mafic volcanics.

THIN SECTION:

Despite the apparent volcaniclastic nature of this sample, there are, in fact, very few volcanic clasts in the rock. Rather, it is seen to be composed of two main types of metasedimentary clasts, and to have been strongly chloritized. The sandstone is matrix-supported, but only just, and consists of very angular to subrounded clasts set in a strongly altered matrix. The dominant clast type is a chloritic siltstone, and only slightly less abundant are angular clasts of exceptionally fine-grained cherty material, sometimes traversed by hairline silica veinlets. There are only a few volcanic clasts, and they are so altered as to be of uncertain affinities, although I think they are tholeiitic metabasalt; their augite is chloritized and plagioclase laths are albitized,and they contain abundant interstitial secondary quartz.

The matrix of this sample originally probably constituted around 30 modal% of the rock, and consisted of smaller angular fragments of the same lithotypes that constitute the larger clasts, plus some angular detrital metamorphic quartz. However, the matrix has been very thoroughly chloritized, and green actinolite is also common in the chlorite.

The provenance of this rock was a chert-siltstone terrain,and quite unlike the other sandstones and conglomerates in this set. One possible source may be the Barrington Chert, although this is purely hypothetical. The rock has been intensely chloritized during strong hydrothermal alteration, and a small amount of disseminated pyrite is scattered through the rock.

SAMPLE NUMBER: 34616

LOCATION: PASMINCO Dial Range EL9/92. Dial Mine Grid DDH 7 94.7m; Motton Spilite

SUMMARY:

This is a Motton Spilite-correlated, quenched plagioclase + augite + FeTi oxide-phyric, evolved metabasaltic lava with a low grade burial metamorphic alteration assemblage.

HAND SPECIMEN:

This is a fine-grained, weakly plagioclase-phyric metabasalt with a narrow veinlet of albite or calcite.

THIN SECTION:

This sample is a plagioclase+augite-phyric metabasalt with an unusual texture. Basically, the sample varies across the section from a very fine-grained quenched basaltic lava with small plagioclase phenocrysts set in devitrified and altered glass, to more slowly-cooled, fined-grained but almost holocrystalline basalt, again with the plagioclase phenocrysts. In all textural variants, plagioclase phenocrysts are narrow, tabular laths to about 1mm long, composed of albite which is often replaced by very fine-grained sericite, calcite and minor yellowish chlorite. It averages around 5-8 modal% of the rock. Less abundant, and more difficult to discern due to total alteration, are smaller euhedra of augite. These are replaced by messy chlorite and calcite. Also common are small, equigranular FeTi oxide microphenocrysts with minor marginal alteration to leucoxenitic material.

The groundmass of this sample varies texturally from devitrified glass charged with sericite-altered spherulitic to acicular albite microlites in most rapidly cooled areas, to a coarser intergranular texture with granular small augite and FeTi oxide between slightly larger plagioclase laths.

The more glassy, rapidly-cooled part of this rock is traversed by abundant sharp, discontinuous cracks marked by chlorite and some calcite, and a large, continuous crack has been invaded by a late-stage residual melt that has cooled slowly, and consequently is much coarser-grained than the remainder of the rock, consisting of blocky to anhedral albite, chloritized augite, possibly containing minor actinolite needles. This may be due to enhanced volatile contents in the late-stage melts, as shown by the small areas of brownish-green hornblende. The late stage melts form by squeezing out of residual liquids during cooling and cracking of solidifying flows and pillows, and migration of these into newly-formed cracks and fractures. The burial metamorphic assemblage (chlorite-albite-calcite±actinolite) is typical of the lowest greenschist or uppermost prehnite-pumpellyite facies.

This is a Motton Spilite correlated metabasaltic flow margin.

SAMPLE NUMBER: 34614

LOCATION: PASMINCO Dial Range EL9/92: Lodders Point, Motton Spilite

SUMMARY:

This is a massive, augite-glomerophyric evolved tholeiitic metabasalt, correlated with the Motton Spilite and almost identical petrographically to sample 34552.

HAND SPECIMEN:

This is a massive, aphyric, medium-grained metabasaltic lava.

THIN SECTION:

This is a Motton Spilite-correlated massive tholeiitic metabasaltic lava. It is contains abundant glomeroclots of small, anhedral augite plates making up aggregates up to about 1mm across. These probably make up around 25 modal% of the rock. Also present are about 3-5 modal% of relatively large (to 0.5mm) sometimes almost skeletal FeTi oxide phenocrysts with marginal leucoxenitic alteration. The remainder is made up of blunt tabular laths of albitized plagioclase, and some interstitial anhedral albite, and messy altered mesostasis composed of sericite, chlorite and minor quartz. Occasional large, irregular patches of pale green chlorite are not uncommon, but are fracture fillings rather than pseudomorphs after olivine or augite. A few meandering fractures show pressure solution-related concentrations of very fine-grained altered opaques, and some calcite. The grade of burial metamorphism is prehnite-pumpellyite facies.

This sample is almost identical texturally and mineralogically to sample 34552,

SAMPLE NUMBER: 34611

LOCATION: PASMINCO Dial Range EL9/92. Central section of the Beecraft Megabreccia.

SUMMARY:

This is a coarse, mainly volcaniclastic sandstone derived from a terrain dominated by tholeiitic basalts and shallow intrusive dolerites and leucogabbros correlated with the Motton Spilite. It has a greenschist facies burial metamorphic assemblage.

HAND SPECIMEN:

This is a rather altered, dark green volcanogenic graded sandstone with clasts up to 1cm across in the coarsest-grained part of the rock.

THIN SECTION:

This is a volcaniclastic coarse sandstone derived almost completely from tholeiitic basalts, dolerites and microgabbros, except for a few grains of chert-like rocks. It was probably close to framework-supported, and is fairly poorly-sorted, but extensive hydrothermal alteration has almost obliterated many grains boundaries by chlorite development and limited interstitial silicification

. The meta-igneous clasts show an enormous range of textures, although all were originally either basaltic (plagioclase-augite-FeTi oxides) or trending to more fractionated leucogabbroic compositions (dominant plagioclase). Quenched basaltic fragments with acicular altered augite and plagioclase microlites in devitrified glass are not uncommon, and much coarser-grained coarse basalt or doleritic lithic clasts are common. Also quite abundant are largely altered single discrete crystals of augite or blocky plagioclase. The former are always totally replaced by chlorite and pale green actinolite, and plagioclase grains are albitized, and speckled with sericite. A small number of rather angular clasts composed of very fine-grained anhedral silica, and are either chert, or possibly silicified basaltic glass.

This rock is essentially derived entirely from tholeiitic basalts and shallow intrusive rocks of the Motton Spilite. Given the abundance of apparently coarser-grained intrusives, this sandstone was either shed from a fault scarp along which deeper crustal levels were exposed, or else the detritus constituting this sandstone was derived from an uplifted and eroded older land surface dominated by tholeiitic lavas and intrusives correlated with the Motton Spilite. The metamorphic grade is clearly low greenschist facies, but the rock probably hydrothermally altered rather than burial metamorphosed.

SAMPLE NUMBER: 34601

LOCATION: PASMINCO Dial Range EL9/92. Isandula Dam 'Wilsonia Volcanics'.

SUMMARY:

This is probably a devitrified volcaniclastic siltstone originally dominated by comminuted felsic ash.

HAND SPECIMEN:

This is a dark, flinty massive aphyric felsic lava or silicified tuff(?).

THIN SECTION:

This is a very fine-grained aphyric rock, that is very difficult to diagnose. A careful search of this thin section, which is essentially composed of fine-grained to irresolvable quartzo-feldspathic material, suggested the presence of a few obvious, curved glassy shards now replaced by silica. However, in many places there are ghost-like relic textures that are suggestive but not indicative of the former presence of vitric ash. Much of the very fine-grained groundmass has quartzo-feldspathic textures identical to devitrification textures in felsic ash. The only obvious detrital component are a few sericitized laths of albite to about 0.2mm long, and a few tiny detrital quartz grains. The rock is overprinted by numerous subhedral, rather dirty brown calcite rhombs to about 0.5mm across.

While the rock is very difficult to diagnose with confidence, I believe that this rock was a volcaniclastic siltstone composed very largely of comminuted felsic volcanic ash. It is presumably related to Mount Read Volcanics - Lobster Creek Volcanics magmatic activity, and is certainly not related to the Motton Spilite.

SAMPLE NUMBER: 34609

LOCATION: PASMINCO Dial Range EL9/92. Tea Tree Point (Megabreccia)

SUMMARY:

This is a coarse sandstone dominated by clasts of carbonaceous shale and siltstone, with a minor volcanic component from Motton Spilite metabasalts. It is strikingly similar to 34604, and is almost certainly from the same unit.

HAND SPECIMEN:

This is a coarse-grained, dark green-black sandstone composed of angular clasts to at least 5mm across dominated by dark cherty material.

THIN SECTION:

This is a poorly-sorted, framework-supported coarse sandstone dominated by angular lithic clasts of siltstone and cherty material with a maximum size around 8-10mm. Particularly notable among the rather diverse clast population, making up probably >70 modal% of the rock, are rather brownish shaley clasts with carbonaceous films and layers; these are very distinctive petrographically, and absolutely identical to those in 34604, indicating a similar source, and probably a correlation between this sample and 34604. Other clasts include:

1: occasional quenched tholeiitic basalts of Motton Spilite-type, made up dominantly of elongate albitized plagioclase laths and granular chloritized augite. These constitute about 5-8 modal% of the rock.

2: cherty material composed of very fine-grained to irresolvable silica intergrowths.

3: sparse clasts of dolomitic siltstone to fine sandstone with rhombs of brown dolomite(?) in a silty matrix.

The matrix of this rock was fine sand to silt, but has almost totally been winnowed out, and coarse detrital grains are now mutually intrusive against adjacent grains, indicating extensive pressure solution. The grade of metamorphism of this sample is probably prehnite-pumpellyite facies, as no actinolite is present in the altered volcanic clasts.

SAMPLE NUMBER: 34612

LOCATION: PASMINCO Dial Range EL9/92. Gunns Plain Road, Motton Spilite

SUMMARY:

This is an augite-phyric evolved tholeiitic metabasalt with a low-grade prehnite-pumpellyite facies burial metamorphic overprint. It is correlated with the Motton Spilite.

HAND SPECIMEN:

This is a massive finely augite-phyric metabasaltic lava.

THIN SECTION:

This is another Motton Spilite metabasalt, composed of abundant small phenocrysts and glomeroclots of augite a fairly altered plagioclase-rich groundmass. The augite microphenocrysts are fresh, anhedral and equidimensional, and up to about 0.4mm long, but more commonly occur as clots of 4 or 5 crystals. They make up around 25 modal% of the rock, and occasionally show subophitic inclusions of altered plagioclase. There is no sign of the former presence of either plagioclase or olivine phenocrysts, and FeTi oxide grains are all much too small to be termed microphenocrysts.

The groundmass of this sample is quite altered but was originally an intergrowth of tabular plagioclase laths and more bladed anhedral augite, with quite abundant interstitial glassy mesostasis. The plagioclase was albitized, before being replaced by sericite(?) and very fine-grained silica. Mesostasis, as well as common irregular fractures, are replaced and picked out by concentrations of green chlorite. Groundmass FeTi oxide granules are entirely replaced by messy leucoxenitic material, and small spherical blebs of sphene have grown in chlorite patches throughout the rock.

This is a prehnite-pumpellyite facies, burial metamorphosed augite-phyric evolved tholeiitic metabasalt, correlated with the Motton Spilite.

SAMPLE NUMBER: 34603

LOCATION: PASMINCO Dial Range EL9/92. Dial Mine DDH7 77.5m
Cateena Group, intruded by Lobster Ck Volcanics

SUMMARY:

This is a quite strongly hydrothermally altered (carbonate-sericite-pyrite±chlorite) coarse sandstone composed of clasts derived from siltstone, dolomite, chert and basic volcanics of the passive margin sequence (pre-Mount Read Volcanics).

HAND SPECIMEN:

This is a grey-brown, altered coarse sandstone to conglomerate with slightly rounded clasts to about 1cm of chert and basic volcanics.

THIN SECTION:

This is a very altered, poorly-sorted and matrix-supported coarse sandstone to fine-grained conglomerate, with clasts up to about 8mm across in this section. Strong calcite-pyrite alteration overprints the rock, and has obliterated the primary texture, as well as the textures and original mineral compositions of many of the clasts. Most clasts appear to have been rather rounded grains of very fine-grained siltstone in which angular detrital quartz grains are common, but set in a much finer-grained matrix. Other clasts include occasional carbonated metabasaltic lavas with distinctive quench textures, and also quite common clasts that are probably dolomitic. The latter are composed of very fine-grained, dirty dolomite or calcite, and it is difficult to determine whether they are original dolomitic siltstone clasts that have been carbonated during alteration, or whether they were originally dolomitic at the time of deposition of this coarse sandstone. Another clast type is composed of clear intergrowths of very fine-grained silica, and may be chert, and several clasts composed of rather coarse-grained intergrowths of polycrystalline quartz are quartzitic.

The matrix of this rock was probably a silt or dolomitic silt, but is now strongly overprinted by messy brown dolomite charged with tiny sericite crystallites, in which are set not uncommon small angular clasts of quartz, and common patches of secondary chlorite. Idiomorphic grains of pyrite up to almost 1mm across are not uncommon disseminated throughout the rock, although most are much smaller.

This sample is a coarse sandstone derived from siltstones, dolomitic sediments and some basic volcanics and cherts. This assemblage is common in 'passive margin' sequence of western Tasmania, especially in the Success Creek Group and Crimson Creek Basalts, and their correlated formations in the Smithton and Dial Range Troughs. There is no sign of detritus from the Mount Read Volcanics. The alteration of this sample is probably local hydrothermal in origin (carbonate-sericite-pyrite±chlorite), and is quite strong compared to most rocks examined in this set.

SAMPLE NUMBER: 34589

LOCATION: PASMINCO Dial Range EL9/92. Devon Consols, Cateena Group

SUMMARY:

This is a coarse sandstone or fine conglomerate composed of clasts of siltstone and chert; the rock has suffered strong hydrothermal chlorite±hematite alteration

HAND SPECIMEN:

This is a dark green-black coarse sandstone to fine-grained conglomerate composed of angular to subrounded clasts of pale siltstone (?), dark green metabasic volcanics, and black chert to about 1cm maximum size.

THIN SECTION:

This sample is a fine-grained conglomerate composed almost entirely of clasts of siltstone and chert in a strongly chloritized matrix. The rock is poorly sorted, and matrix-supported. The cherty clasts are quite abundant and occurs up to almost 1cm across; they are composed of an extremely fine-grained to irresolvable intergrowth of silica, sometimes peppered with fine chlorite. Most abundant are clasts of siltstone, dominated by very fine-grained, messy, almost isotropic material containing tiny angular detrital quartz crystals in some clasts. Many of these have been partially to totally overprinted by remarkable prehnite intergrowths, that occur as bowties and crosses of clear, pale brown material. This is concentrated on grain boundaries in some clasts, but in others it permeates the entire clast, producing a texture that is strikingly similar to altered, quenched metabasalts from the Crimson Creek Formation - Motton Spilite -type basalt piles. There is, however, no convincing evidence for the presence of metabasaltic clasts in this rock.

Many of the siltstone-chert clasts have been totally replaced by bright green chlorite, with consequent destruction of primary textures. The sandy matrix of this rock was composed of essentially the same material as the coarser clasts described above, but also contains some angular detrital quartz. However, like may of the clasts, it has been strongly chloritized, and small anhedral patches and blebs of secondary silica are common in the chlorite. Also very common throughout the chlorite are small, ragged aggregates of hematite or magnetite. The source area for this rock was composed essentially of siltstones and cherts, and may have been a Success Creek Group correlate of the passive margin sequence of western Tasmania. The rock has clearly suffered strong hydrothermal alteration that produced a chlorite-hematite (or chlorite-magnetite) assemblage. The common prehnite alteration probably developed pre-hydrothermal alteration.

SAMPLE NUMBER: 34596

LOCATION: PASMINCO Dial Range EL9/92. Dyke In Beecraft Megabreccia

SUMMARY:

This is a plagioclase+augite-phyric andesitic fine-grained dyke rock that is petrographically identical to the Beulah Formation - Que Footwall Andesites.

HAND SPECIMEN:

This is a brown plagioclase+augite-phyric, non-vesicular andesitic lava.

THIN SECTION:

This sample is a texturally well-preserved, quite strongly porphyritic andesitic fine-grained dyke rock, with around 15-20 modal% of albitized plagioclase phenocrysts, around 5-8 modal% of altered former augite phenocrysts, and perhaps 3-4 modal% of quite large FeTi oxide phenocrysts, all set in an altered vitrophyric groundmass. The plagioclase phenocrysts are mainly stubby tabular euhedral laths to around 1.5mm long, very often occurring in aggregates of 5 or 10 crystals, and often intergrown with a few former augite phenocrysts in microgabbroic clots up to a few mm across. Plagioclase phenocrysts are weakly sericitized, but sometimes host concentrations of very fine-grained messy epidote, and in clots of crystals are mainly altered to calcite and quartz rather than sericite. Altered augite phenocrysts are mainly equidimensional euhedral prisms that are entirely altered to green chlorite and calcite. Former FeTi oxide phenocrysts are up to 1mm across, although most are <<0.5mm across, and grade through microphenocrysts to groundmass-sized crystals. They appear to have marginal to near-complete alteration to leucoxenitic material. A few small apatite phenocrysts are also present.

The groundmass of this rock was composed of an intergrowth of randomly oriented albite prisms and laths, and considerably less chloritized augite blades and tiny altered FeTi oxides. Subordinate amounts of interstitial glassy material have devitrified and partially crystallized to exceptionally fine-grained quartz-feldspar-Fe oxide intergrowths. Irregular patches and fracture-fillings in the groundmass are mainly composed of polycrystalline silica and green chlorite. The metamorphic grade is probably transitional between the greenschist and prehnite-pumpellyite facies or regional burial degradation.

This sample, a dyke cutting the Beecraft Megabreccia, is in every way petrographically similar to the Beulah Formation basaltic andesites and andesites, which I correlate with the Tullah CVC and Que Footwall Andesites. An analysis would be interesting.

SAMPLE NUMBER: 34594

LOCATION: PASMINCO Dial Range EL9/92. Radford's Ck Area, Lobster Ck Volcanics

SUMMARY:

This is a plagioclase-phyric dacitic intrusive rock from a small stock or plug. It is petrographically very similar to many of the feldspar porphyrites from along the western margin of the Mount Read Volcanic belt, as well as the intrusives from the Leven River Gorge area.

HAND SPECIMEN:

This is a reddish, plagioclase-phyric dacitic to rhyolitic lava

THIN SECTION:

This sample is a texturally well-preserved felsic , fine-grained intrusive rock composed of around 8-10 modal% of albitized plagioclase phenocrysts and much less than 1 modal% each of small totally altered mafic phenocrysts, and Fe Ti oxides, set in a holocrystalline quartzo-feldspathic groundmass. Plagioclase phenocrysts are well-formed and up to 4mm long in exceptional cases, although most are around 0.5-1mm long. They are always albitized, and quite heavily but evenly overprinted by sericite, although former twinning is still visible. They often occur in multi-crystal clots. Former mafic phenocrysts are rarely larger than 1mm long, and are rather elongate narrow prisms replaced by quite birefringent chlorite and probably minor fibrous, colourless actinolite. Although it is not absolutely certain, the habit and alteration of these crystals suggest they were augite rather than hornblende. Small altered FeTi oxide phenocrysts are not uncommon, and many are replaced by crystalline sphene.

The groundmass of this sample is holocrystalline, and composed of a rather even-textured intergrowth of small, stumpy, dusty albite and Kspar laths set in clear quartz, with tiny altered Fe oxide grains also common throughout the groundmass. Patches and fractures are filled by polycrystalline quartz

This is clearly an intrusive dacitic rock from a reasonable sized intrusive body, judging by the almost microgranitoid texture of the groundmass. In compares favourably with some of the finer variants of the intrusive dioritic-granodioritic suite from the Leven River Gorge area.

SAMPLE NUMBER: 34597

LOCATION: PASMINCO Dial Range EL9/92. Dyke at Teatree Point in the Megabreccia

SUMMARY:
This is a sparsely plagioclase-phyric dacitic to rhyodacitic fine-grained dyke rock that is petrographically very like many of the Que-Hellyer felsic lavas and narrow dykes.

HAND SPECIMEN:
This is a mid-grey, quite fine-grained, moderately plagioclase-phyric dacitic dyke rock.

THIN SECTION:
This sample is a texturally well-preserved dacitic fine-grained dyke rock composed of around 2-4 modal% of small albite phenocrysts and <<1 modal% of altered former mafic phenocrysts in a quartzo-feldspathic groundmass. The plagioclase phenocrysts are blocky to rather elongate prisms of albite, rarely larger than 1mm long, and with only a very weak overprint of sericite. Former mafic phenocrysts are quite sparse, and are mainly narrow prisms of fibrous actinolite, or more equidimensional messy aggregates of silica, magnetite and common tiny zircons. The former may have augite, and the latter small biotite phenocrysts. Small altered FeTi oxide phenocrysts are not uncommon.

The groundmass of this sample is a rather mottled, ragged intergrowth of quartz and feldspar (including both albite and Kspar), riddled with tiny albite microlites, with common overprinting sericite and possible very fine-grained chlorite. I would never have picked this texture as anything but volcanic, and would guess that the groundmass originally contained a significant glassy component. The grade of metamorphism is lowest greenschist facies. The relative abundance of zircon in this section (at least it seems more common than in most rhyodacites and rhyolites) is notable, and I wonder whether it will be reflected in the whole rock analysis. High Zr felsic rocks are recorded from the Mount Read Volcanics in the Sheffield - Quamby Brook area. This is clearly a 'Mount Read Volcanics'-type dacitic to rhyolitic dyke rock.

SAMPLE NUMBER: 34533

LOCATION: PASMINCO Dial Range EL9/92. Kaine's Barite Prospect Radford Ck Group; This is from a large a clast in volcaniclastic sandstone.

SUMMARY:

This is a weakly foliated plagioclase+sparsely augite-phyric andesite with a strong calcite-sericite-hematite hydrothermal overprint.

HAND SPECIMEN:

This is a grey-green, weakly-foliated plagioclase-phyric andesite with common small chloritic clots and some irregular bladed hematite veins and replacement patches.

THIN SECTION:

This sample is a weakly foliated plagioclase+augite(?)-phyric andesitic lava with a very fine-grained, probably formerly glassy groundmass. Plagioclase phenocrysts made up around 15-20 modal% of this rock, and were mainly less than 2mm long, although many crystals are stretched into the cleavage and much longer than they were originally. They have been totally albitized, and most are overprinted to a greater or lesser degree by sericite and calcite, although plenty of what appear to have been albite phenocrysts are also apparently replaced by pale green chlorite. A number of more equidimensional and less stretched phenocrysts, now entirely replaced by calcite and minor hematite, may originally have been augite, although compared to the plagioclase phenocrysts, these are volumetrically insignificant. Small FeTi oxide microphenocrysts are totally altered to messy leucoxenitic material.

The groundmass of this rock is a very even-textured mosaic intergrowth of quartzo-feldspathic material after devitrified glass. It is transected by a penetrative fracture cleavage with two sets of cleavage planes picked out by abundant sericite. These sets intersect at around 30o. Although the hematite-rich band was not intersected in this thin section, hematite becomes more abundant at one end of the section rimming phenocrysts and replacing sericite along cleavages.

The alteration of this sample (calcite-sericite-hematite) is identical to that of the andesites in the Beulah Formation at the Beulah Barite Formation, and is clearly hydrothermal in origin. The rock is very similar to the more mafic crystal-poor andesites of the Beulah Formation.

SAMPLE NUMBER: 34606

LOCATION: PASMINCO Dial Range EL9/92. Gunns Plain Rd., Radfords Ck Group

SUMMARY:

This is a conglomerate derived from the passive margin sequence, and includes clasts of rift tholeiites, limestone or dolomite, carbonaceous shales and siltstones, and cherty material. It is identical to 34604 and 34609, and derived from the same stratigraphic unit as these samples.

HAND SPECIMEN:

This is a dark grey conglomerate with rather rounded black and grey chert pebbles up to several cm long, and smaller dark green clasts of mafic volcanics.

THIN SECTION:

This sample is a distinctive framework-supported, almost matrix-free conglomerate dominated by clasts of cherty material, carbonaceous siltstone and mainly quench-textured tholeiitic basalts. The finely laminated carbonaceous shales and siltstones are identical to those in 34604 and 34609. Basaltic clasts include mainly quench-textured lavas composed of sheaves and spherulitic bunches of quench pyroxenes and plagioclase, and these grade through intersertal-textured basalts to intergranular basalts with small granular augites set in among abundant plagioclase laths. Several clasts have subophitic textures, with albite laths included within fresh large augite phenocrysts. The latter also occur as discrete detrital grains. Another distinctive but not common clast type in this rock is fine-grained limestone or dolomite. The abundant cherty rocks in this sample seem to show an exceptionally fine detrital texture rather than being chemical precipitates. The only other significant detrital component is occasional grains of polycrystalline metamorphic quartz.

This sample is petrographically almost identical to 34604 and 34609, and must certainly be from the same stratigraphic unit. Provenance was likely to be the Rocky Cape passive margin sequence in which dolomites and siltstones occur interbedded with, and above and below the rift tholeiites of Crimson Creek Formation - Motton Spilite - Smithton Trough type.

SAMPLE NUMBER: 34595

LOCATION: PASMINCO Dial Range EL9/92. Gunns Plain Rd. A small Lobster Ck Volcanics intrusive microdiorite body in fine sandstones.

SUMMARY:

This is a quenched, aphyric, dacitic chilled margin of a small intrusion, which contains long, hollow bladed plagioclase crystals in a spherulitic, formerly glassy groundmass.

HAND SPECIMEN:

This is a brown fine- to medium-grained intrusive andesitic or dioritic rock with elongate narrow plagioclase crystals up to 1cm long.

THIN SECTION:

This sample is a most unusual-textured andesitic to dacitic very shallow intrusive rock, with long bladed albite crystals up to 12mm long, sometimes radiating from a common centre, set in a quenched dominantly quartzo-feldspathic groundmass. The long plagioclase crystals are slightly sericitized and often have hollow cores that are filled by sericite and or chlorite. These plagioclase crystals make up around 40 modal% of the rock, and are set in a quenched groundmass composed of domains approaching spherulitic textures of tiny acicular albite microlites set in cells of quartzo-feldspathic material after glass. Also set in this matrix are occasional small totally chloritized augite phenocrysts, and 1 or 2 modal% of totally leucoxene-altered Fe Ti oxide microphenocrysts.

Taking into account Wally Herrmann's description of this sample being intrusive into sandstones, this unusual rock is a quenched dacitic dyke which was effectively aphyric at the time of quenching. The long bladed hollow plagioclases are quench crystals nucleated near the chilled margin of the body which grew rapidly in spherulitic glass. The metamorphic assemblage is prehnite-pumpellyite facies, and the dacite is probably compositionally equivalent to typical Mount Read Volcanics dacites, although an analysis is certainly worthwhile to test this.

SAMPLE NUMBER: 34598

LOCATION: PASMINCO Dial Range EL9/92. Penguin Mine, Lobster Ck Volcanics

SUMMARY:

This is a low greenschist facies holocrystalline dioritic intrusive rock with pronounced similarities to those from the Leven Gorge area.

HAND SPECIMEN:

This is a quite altered and possibly silicified rather coarse-grained dioritic intrusive rock.

THIN SECTION:

This sample is less altered in thin section than it appears in the hand specimen. It is a relative coarse-grained rock with quite common (~20 modal%) large plagioclase phenocrysts, mainly 1-2mm long, set in a holocrystalline groundmass of feldspar quartz, altered mafics and sphene. The plagioclase phenocrysts are euhedral mainly equidimensional prisms, largely overprinted by sericite alteration, although ghost zoning and twinning can still be seen. Former mafic crystals are totally replaced by very pale green actinolite, and occur as anhedral to subhedral crystals up to about 1.5mm long, sometimes ophitically including small albite laths. They were almost certainly hornblende, although it would not be unexpected if some were originally augite.

Hornblende and plagioclase crystals were set in a holocrystalline groundmass composed of an intergrowth of quartz and feldspar (including both Kspar and albite), with scattered subhedral small augite (now actinolite) and subhedral high-relief crystals of sphene up to 0.3mm long. Some of the groundmass feldspar is replaced by calcite, although the rock is not very altered; it is hard to judge whether the abundant groundmass quartz is primary or secondary, although the texture is apparently primary. Small aggregates of pyrite or magnetite(?) are present in a number of the altered plagioclase phenocrysts. The low greenschist facies alteration assemblage is more characteristic of regional burial metamorphism than local hydrothermal alteration.

This is a rather mafic dioritic intrusive rock which bears strong similarities to the Leven Gorge (former Geopeko Preston E/L) diorites, supporting the suggestion made by Wally Herrmann in his report on the Dial Range E/L.

SAMPLE NUMBER: 34593

LOCATION: PASMINCO Dial Range EL9/92. Dial DDH 6, 116m
Lobster Ck Volcanics

SUMMARY:

This is a hydrothermally altered plagioclase+sparsely hornblende-phyric dioritic intrusive rock, again similar to those from the Leven Gorge area.

HAND SPECIMEN:

This is a dark pinkish-red holocrystalline felsic intrusive, with common clots and fracture fillings of black chlorite.

THIN SECTION:

This sample is a fairly fine-grained but holocrystalline rock composed of plagioclase and altered hornblende phenocrysts set in a quartzo-feldspathic groundmass. The plagioclase phenocrysts are rather ragged-edged euhedra, and make up around 8-10 modal% of the rock, and are mainly less than 1mm long, although a few are up to 2mm long. They are totally albitized, and often overprinted to varying extents by sericite and calcite. Former mafic phenocrysts are far less abundant, and are mainly subhedral prisms rarely more than 1mm long, with very ragged and reacted shapes; they are entirely replaced by chlorite, or chlorite+calcite, and occasionally contain tiny actinolite needles. Based on the evidence offered by better preserved sample 34555, these crystals were probably originally hornblende. Small FeTi oxide phenocrysts are present, but not common, and are replaced by leucoxene with chloritic rims.

The groundmass is holocrystalline, and composed of an even-textured, granular intergrowth of small albite laths set in an anhedral quartz and Kspar matrix with minor chlorite and FeTi oxides

This is another intrusive microdiorite very similar to the Leven Gorge diorites, although it carries less mafics than microdiorite 34598 from the Penguin Mine. Its alteration assemblage is at the lowest part of the greenschist facies, although the abundance of Kspar in the groundmass and the rather ragged, recrystallized nature of the sample suggest that alteration may have been local hydrothermal rather than regional..

SAMPLE NUMBER: 34555

LOCATION: PASMINCO Dial Range EL9/92. Purtons Road, Lobster Creek Volcanics

SUMMARY:

This is a very well-preserved sparsely plagioclase-phyric hornblende microdiorite.

HAND SPECIMEN:

This is a massive, grey even-textured and probably holocrystalline finely plagioclase-phyric dioritic intrusive.

THIN SECTION:

This sample is a rather mafic microdiorite composed of around 2-4 modal% of 1mm-sized plagioclase phenocrysts in a rather coarse-grained holocrystalline quartz-feldspar-hornblende-FeTi oxide groundmass. The plagioclase phenocrysts are blocky and albitized, and most are overprinted by strong sericitic alteration. The remainder of the rock is a coarse intergrowth of more anhedral plagioclase, with quite common subhedral to anhedral primary hornblende, abundant quartz, and subordinate but common Kspar. The hornblende is pleochroic from pale green to more olive green, and is mainly replaced by pale green chlorite, although minor actinolite also replaces hornblende together with pale yellow epidote.

Groundmass feldspars are dusted by weak sericite overprinting, and occur intergrown with quite anhedral quartz and about 1-2 modal% of equidimensional Fe Ti oxides with marginal leucoxene alteration. The alteration is low greenschist facies and of regional burial metamorphic origin.

This is another intrusive microdiorite of the Leven Gorge-type, and is, in fact, one of the best preserved that I have seen, with fresh hornblende being preserved.

SAMPLE NUMBER: 34591

LOCATION: PASMINCO Dial Range EL9/92. Lobster Creek Volcanics from Lobster Creek Road.

SUMMARY:

This is a well-preserved sparsely plagioclase-phyric hornblende microdiorite, similar to 34593, 34555 and 34598, and those from the Leven Gorge area.

HAND SPECIMEN:

This is a dark brown-red, rather mafic-looking dioritic intrusive rock with altered plagioclase and mafic phenocrysts in a finer red groundmass.

THIN SECTION:

This sample is a holocrystalline plagioclase-phyric hornblende microdiorite, almost identical petrographically to 34555. Phenocrysts of albitized plagioclase to almost 2mm long make up around 3-5 modal% of the rock and are totally replaced by sericite, although ghost twinning and zoning can still be seen. Rare reacted phenocrysts to about 1mm long of hornblende are present, but both this hornblende, and that occurring quite abundantly in the groundmass, are partially to completely altered to green chlorite. There is apparently no actinolite replacing hornblende in this rock.

The groundmass is medium-grained and holocrystalline, and consists of a ragged intergrowth of anhedral quartz and dusty Kspar, laths of albite, and anhedral to subhedral crystals of hornblende (mainly replaced by chlorite). Also not uncommon are microphenocryst-sized grains of altered FeTi oxides that sometimes have skeletal shapes, due to exsolution of ilmenite during the slow cooling experienced by this sample.

This is a prehnite-pumpellyite facies burial metamorphosed hornblende microdiorite intrusive, very similar petrographically to those from the Leven Gorge, and samples 34555, 34593 and 34598.

SAMPLE NUMBER: 34607

LOCATION: PASMINCO Dial Range EL9/92. Walloa Creek, Applebee Volcanics

SUMMARY:

This is a volcaniclastic (tuffaceous) sandstone composed of quartz and plagioclase crystal detritus in a reworked vitric ash matrix. It is similar to some Southwell Subgroup volcanogenic sediments. Is is similar also to sample 34605.

HAND SPECIMEN:

This is a fairly fine-grained, unbedded grey sandstone.

THIN SECTION:

This sample is a volcaniclastic sandstone composed dominantly of quartz and plagioclase crystal detritus derived from felsic volcanics. It is matrix-supported, and composed of dominantly two grainsizes, >0.2mm to 1mm, and recrystallized ash. Crystal detritus makes up about 30-35 modal% of the rock, and quartz crystal fragments dominate, making up around 25 modal% of the sample. These are clearly volcanic, yet never preserve crystal faces. They are probably crystals blown, with ash, into the air during explosive eruptions, to be subsequently dumped into water. Plagioclase crystal fragments are not so abundant, but contain both totally anhedral crystal fragments, and crystals that retain crystal shapes. They are weakly sericitized. Small euhedral zircon crystals are also notable but not common.

The matrix of this sample is distinctive in that it appears to be a typical slightly sericitized quartzo-feldspathic, fine-grained intergrowth after felsic glass. In fact, careful searching showed up quite a number of curved shapes in the recrystallized matrix that were almost certainly glass shards. The matrix is therefore interpreted as vitric ash that has devitrified and recrystallized during burial metamorphic degradation. The matrix is cut by a weak fracture cleavage in which cleavage planes are picked out by sericite and subordinate green chlorite.

This is clearly a 'Mount Read Volcanics'-type lithology, being a volcaniclastic sandstone derived from explosive eruptions of quartz+ plagioclase-phyric felsic magmas. It is similar to many volcanogenic sediments in the Tyndall Group-Southwell Subgroup, and is a less altered version of sample 34605.

SAMPLE NUMBER: 34608

LOCATION: PASMINCO Dial Range EL9/92. Applebee Creek, Applebee Volcanics.

SUMMARY:

This is a volcaniclastic (tuffaceous) sandstone dominated by quartz and feldspar detritus and recrystallized vitric ash from explosive felsic volcanism of 'Mount Read Volcanics' type.

HAND SPECIMEN:

This is a grey, poorly-sorted volcaniclastic sandstone with grainsize to about 2mm across.

THIN SECTION:

This sample is a very poorly-sorted, matrix-supported volcaniclastic sandstone dominated by detrital quartz and albite grains in a groundmass that probably originally was made of vitric ash. The detrital quartz and albite grains are about equally modally abundant (each ~20 modal%), and brownish-yellow, very fine-grained lithic fragments of siltstone or chert. As for sample 34607, also from the Applebee Volcanics, the detrital quartz is quite angular and fragmental, whereas the plagioclase occurs both as fairly well-preserved crystal shapes and quite angular crystal fragments. The albite is weakly sericitized. Leucoxene-altered FeTi oxide detrital grains are also quite common.

Unlike in similar sample 34607, the matrix of this sample is quite heterogeneous and variably recrystallized. It is composed of texturally variable, and grainsize-variable ragged quartzo-feldspathic intergrowths with limited interstitial chlorite and sericite. No sign of shard textures are preserved, but I have little doubt that the matrix here was originally like in 34607, composed of vitric ash.

This sample, probably from the same unit as 34607, is a volcaniclastic sandstone derived from quartz+feldspar-phyric explosive felsic magmas of 'Mount Read Volcanics' type.

SAMPLE NUMBER: 34599

LOCATION: PASMINCO Dial Range EL9/92. Allison Rd; Kerrison Volcanics

SUMMARY:

This is a bedded specimen composed of volcaniclastic sandstone and siltstone derived largely from explosive quartz+albite-phyric felsic volcanics; the finer beds also seem to carry a minor component derived from pelitic metamorphics.

HAND SPECIMEN:

This is a bedded sandstone-shale rock with 2cm beds of black shale in a volcaniclastic sandstone

THIN SECTION:

This sample consists of interbedded volcaniclastic sandstone and darker siltstone, the latter also largely of volcaniclastic origin. Bedding planes are rather diffuse, although grading is not obvious. The coarser sandstone beds were probably originally matrix-supported, and are now composed of quite angular detrital albite and quartz grains averaging around 0.2mm across that are often in contact, and show convoluted grain boundaries indicative of extensive pressure solution. Both the quartz and albite are of felsic volcanic origin. A few very fine-grained cherty lithic clasts are also present. The matrix of the sandstone beds is thoroughly recrystallized vitric ash now composed of a fine-grained, heterogeneous quartzo-feldspathic intergrowth, Fe-stained in some places.

The dark grey fine-grained beds are detrital volcaniclastic siltstones, very poorly-sorted, with dispersed angular quartz and albite grains set in a messy matrix which may have had a vitric ash component, but the presence of altered detrital muscovite and several grains of zoned tourmaline reflect some input from pelitic metamorphics. An interesting feature of the fine-grained beds in this rock is the presence of quite common pseudomorphed calcite rhombs, now composed of hematite and silica(?). Abundant quartz veins cut the sample, and meandering hematite seams mark pressure solution-derived stylolites, and these may both parallel, and cut at high angles, the bedding..

This is a finer-grained version of sample 34607 and 34608, all of which are tuffaceous sandstones derived from explosive felsic volcanics, with the difference that the finer beds in this rock seem to have a minor detrital component derived from non-volcanic (ie passive margin or Tyennan) rocks.

SAMPLE NUMBER: 34531

LOCATION: PASMINCO Dial Range EL9/92. Kaine's Barite Prospect. Radford's Ck Group

SUMMARY:

This is a weakly hydrothermally altered volcaniclastic sandstone derived entirely from glassy, plagioclase+quartz-phyric felsic volcanics of 'Mount Read Volcanics'-type.

HAND SPECIMEN:

This is a rather altered volcaniclastic sandstone with an average grainsize around 1mm or less, but with occasional clasts up to 7 - 8mm across.

THIN SECTION:

This sample is a poorly-sorted, framework-supported volcaniclastic sandstone with an average grainsize around 0.5-1mm across. Most clasts are rather equidimensional, subrounded felsic volcanic lithic clasts, and a large percentage of these were originally glassy. The most abundant lithic clasts are sparsely plagioclase-phyric formerly glassy dacitic to rhyolitic lavas in which glass has totally devitrified, then recrystallized to mosaic intergrowths of quartz and albite. In some of these, abundant very fine-grained hematite dust pervades the quartz-feldspar mosaics. Other detrital components include around 3-5 modal% each of albite and quartz phenocryst fragments, and quite common leucoxene-altered FeTi oxide phenocrysts.

Matrix is very difficult to differentiate from the clasts, and has probably been largely eliminated by both syn-depositional winnowing, and post-depositional pressure solution. Where some matrix is still present, it is clearly now recrystallized to quartzo-feldspathic intergrowths very similar petrographically to the altered formerly glassy clasts. This suggests that the matrix was almost certainly vitric ash.

This is a volcaniclastic sandstone derived entirely from plagioclase and quartz-phyric glassy felsic lavas of Mount Read Volcanics-type. Calcite is quite abundant throughout the rock, and the extent of recrystallization is more typical of hydrothermal alteration than regional burial metamorphic alteration.

SAMPLE NUMBER: 34592

LOCATION: PASMINCO Dial Range EL9/92. Dial Road, Lobster Creek Volcanics

SUMMARY:

This was a plagioclase+sparse hornblende-phyric microdiorite similar to 34555, 34598 and 34593.

HAND SPECIMEN:

This is a massive pink holocrystalline microdioritic intrusive rock with small altered feldspar and mafic phenocrysts

THIN SECTION:

This sample is a holocrystalline plagioclase+sparsely hornblende-phyric dioritic intrusive very similar to others described in this set. It consists of around 10-15modal% of blocky tabular plagioclase phenocrysts to about 2mm maximum size. These are albitized, and show weak sericite speckling. Hornblende phenocrysts make up much less than 1 modal% of the rock, and occur as narrow, elongate prisms with ragged edges. Most are totally replaced by chlorite and minor actinolite, but a few cores of olive green to pale green pleochroic hornblende are still preserved. Many small crystals of apatite occur within the hornblende phenocrysts. Small FeTi oxide phenocrysts are common, and altered to leucoxene.

The groundmass of this sample is a holocrystalline, rather coarse sugary-textured intergrowth of quartz and feldspar, with both albite and Kspar present. Both groundmass feldspar are rather dusty and weakly sericite altered. Small equidimensional FeTi oxides and anhedral chloritized hornblende grains are also present in the groundmass. The alteration of this sample is lowest greenschist facies, and it shows no sign of hydrothermal alteration. It is virtually identical to samples 34555, 598 and 593.

SAMPLE NUMBER: 34551

LOCATION: PASMINCO Dial Range EL9/92. Kerrison Volcanics

SUMMARY:

This is a volcaniclastic sandstone derived from plagioclase+augite-phyric andesitic to dacitic volcanics, presumably correlated with the Mount Read Volcanics (eg Beulah Formation).

HAND SPECIMEN:

This is a medium-grained volcaniclastic sandstone with an average grainsize from 0.5-1mm, and abundant detrital feldspar and mafic crystals.

THIN SECTION:

This sample is a poorly-sorted, framework-supported volcaniclastic sandstone dominated by detrital phenocrysts of albitized plagioclase and fresh augite and hornblende with some lithic clasts of formerly glassy felsic lavas. Well over 50 modal% of the sample is made up of blocky, slightly sericite-altered albite phenocrysts mainly 0.5-1mm long. Detrital augite phenocrysts are quite common, probably around 3-5 modal%. They show no sign of alteration, and are occasionally set in devitrified glass in andesitic to dacitic lithic clasts. Pale brown to pale green pleochroic hornblende phenocrysts and phenocryst fragments are present but not common, and detrital FeTi oxide phenocrysts are quite common and strongly altered to leucoxene. Lithic clasts make up about 5 modal% of the rock, and are mainly devitrified glassy felsic lavas with occasional albite and augite phenocrysts. Some of these have been totally chloritized before incorporation into the rock.

Most of the matrix of this sample was either winnowed out before burial, or has been dissolved out by pressure solution. What matrix there is has been largely replaced by chlorite. This sample has clearly been derived from a mixed andesite-dacite terrain, such as the Beulah Formation or the Que Footwall andesites. It contains no detritus from Precambrian passive margin rocks or from the Tyennan pelitic metamorphics. It has suffered weak alteration, in the prehnite-pumpellyite facies of regional burial metamorphism.

SAMPLE NUMBER: 34511

LOCATION: PASMINCO Dial Range EL9/92. Ironcliffe Rd., Lobster Ck Volcanics

SUMMARY:

This is a plagioclase+sparsely hornblende-phyric microdioritic shallow intrusive similar petrographically to 34593.

HAND SPECIMEN:

This is a massive pale mauve feldspar+sparsely mafic-phyric felsic lava or shallow intrusive.

THIN SECTION:

This sample is a texturally well-preserved microdioritic intrusive with rather sparse phenocrysts of albitized plagioclase, altered mafics and occasional altered FeTi oxides in a fairly fine-grained holocrystalline groundmass. The plagioclase phenocrysts are mainly 0.5-1mm long and make up around 5-8 modal% of the rock. They are speckled with sericite, and often occur in clots of several intergrown crystals. The former mafic phenocrysts are much less abundant than feldspar phenocrysts, probably making up around 2 modal% of the rock. They vary from quite euhedral to rather ragged, anhedral grains, and all are now composed of chlorite. Some have inclusions of small albite laths and less common apatite crystals. The former mafic phenocrysts were almost certainly hornblende, although one or two crystal shapes are quite reminiscent of augite. Former FeTi oxide phenocrysts are not common, rarely bigger than 0.3mm across, and quite altered to leucoxene and chloritic material.

The groundmass of this sample is fine-grained, but clearly holocrystalline, and is composed of stubby laths of albite intergrown with anhedral quartz-Kspar mosaics, with tiny dispersed Fe oxides and occasional small chloritized mafic prisms, as well as interstitial chlorite.

This sample is a very low-grade burial metamorphosed microdioritic intrusive from a dyke or small plug. It is akin petrographically to 34593, and a bit finer-grained but obviously related to 34555, 34598 and 34592, as well as the diorites from the Leven Gorge area.

SAMPLE NUMBER: 34600

LOCATION: PASMINCO Dial Range EL9/92. Isandula Dam, Wilsonia Volcanics.

SUMMARY:
This is a volcaniclastic sandstone derived entirely from quartz+plagioclase-phyric glassy felsic lavas.

HAND SPECIMEN:
This is a poorly-sorted volcaniclastic sandstone with rare clasts of black cherty material and detrital quartz and feldspar crystals mainly around 1mm or less across.

THIN SECTION:
This sample is a very poorly sorted, matrix-supported volcaniclastic sandstone containing common detrital grains of volcanic quartz and albite, and not uncommon lithic clasts of formerly glassy felsic lavas. The detrital quartz grains are clearly phenocryst from felsic volcanics, and one or two are still set in altered glassy lithic clasts of rhyolite. Many quartz grains still have crystal faces, and contrast with the highly angular quartz in otherwise similar sandstones such as 34607 and 34608. Likewise, albite phenocrysts are often almost entire, up to 2mm across, and only slightly speckled with sericite. The outer margins of many lithic clasts are very difficult to discern from the very similar-textured matrix, and their modal abundance is impossible to estimate. Most of the lithic clasts were apparently glassy felsic lavas, but at least 4 or 5 have rather ignimbritic, or banded pumice textures.

The matrix of this sample is texturally very heterogeneous, both in terms of texture and grainsize, but is everywhere a ragged intergrowth of quartz and feldspar, peppered with very fine-grained sericite and subordinate chlorite. The matrix was undoubtedly composed almost entirely of vitric ash and comminuted glass, and the rock is clearly another volcaniclastic sandstone derived entirely from quartz+feldspar-phyric felsic glassy lavas of 'Mount Read Volcanics' type. The alteration assemblage (chlorite-albite-quartz-sericite) reflects very low-grade burial metamorphism.

APPENDIX D

Assay Results; Rock Geochemistry

- Analabs, February 1993

006154

DAL RANGE : WALLY HERRMANN SAMPLING

RECEIVED 25 [redacted]

ANALABS

A Division of Inchcape Inspection and Testing Services Australia Pty. Ltd.
A.C.N. 004 591 664

Phone (004) 316837 | 14 Thirkell St. COOEE TAS 7320 | Fax (004) 318890

ANALYTICAL REPORT No. 111310.60.09282

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

INVOICE TO:
Pasminco Exploration
P.O. Box 886
BURNIE TAS 7320

ORDER No.	PROJECT
1401	3014

DATE RECEIVED	RESULTS REQUIRED
05/02/93	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
8	24/02/93	1	81

SAMPLE NUMBERS	SAMPLE DESCRIPTION	ELEMENT/METHOD
34501/10,34512/30,34532,34534 34535/48,34553,34558/88,34617/20	RO Prep : GP033,GP034,P1	Cu,Pb,Zn,Ag,Mn/GA140 As/GA114 Au,Au(R),Au(S)/GG309 Ba,Sb,Sn/GX401 Cu/GA104

RESULTS TO:
Mr F Fitzgerald
Pasminco Exploration
P.O. Box 886
BURNIE TAS 7320

RESULTS TO:

RESULTS TO:

REMARKS

Note : Due to complex sample matrix some XF results are subject to larger than normal errors.

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	1 OF 8

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Mn	Mn
1	34501	8	-	20	-	82	-	<1	241	-
2	34502	8	-	23	-	74	-	<1	91	-
3	34503	3	-	6	-	41	-	<1	125	-
4	34504	25	-	385	-	910	-	1	148	-
5	34505	46	-	<3	-	140	-	<1	>5000	1.36
6	34506	5	-	<3	-	20	-	<1	85	-
7	34507	3	-	<3	-	11	-	<1	41	-
8	34508	3	-	<3	-	18	-	<1	54	-
9	34509	7	-	5	-	17	-	<1	38	-
10	34510	18	-	13	-	17	-	<1	34	-
11	34512	7	-	23	-	15	-	<1	51	-
12	34513	69	-	38	-	59	-	<1	>5000	3.53
13	34514	5	-	13	-	90	-	<1	>5000	8.49
14	34515	6	-	8	-	82	-	<1	>5000	4.80
15	34516	25	-	152	-	48	-	2	>5000	38.30
16	34517	12	-	169	-	117	-	1	>5000	1.41
17	34518	66	-	<3	-	60	-	<1	>5000	1.32
18	34519	215	-	<3	-	33	-	<1	>5000	0.82
19	34520	36	-	<3	-	56	-	<1	2230	-
20	34521	7	-	19	-	51	-	<1	1610	-
21	34522	3	-	<3	-	10	-	<1	118	-
22	34523	30	-	35	-	29	-	1	67	-
23	34524	71	-	146	-	43	-	1	48	-
[illegible]	34525	92	-	550	-	46	-	3	40	-
25	34526	21	-	62	-	24	-	<1	119	

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 No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	2 OF 8

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Mn	Mn
1	34527	81	-	360	-	24	-	4	55	-
2	34528	143	-	<3	-	11	-	1	380	-
3	34529	82	-	<3	-	12	-	<1	470	-
4	34530	34	-	10	-	45	-	<1	3050	-
5	34532	6	-	6	-	41	-	<1	1620	-
6	34534	49	-	<3	-	114	-	<1	1480	-
7	34535	86	-	67	-	206	-	<1	112	-
8	34536	87	-	136	-	520	-	1	393	-
9	34537	47	-	32	-	390	-	<1	2240	-
10	34538	16	-	166	-	118	-	2	>5000	0.96
[illegible]	34539	24	-	96	-	1210	-	<1	925	-
12	34540	37	-	41	-	404	-	1	>5000	2.90
13	34541	109	-	131	-	419	-	1	201	-
14	34542	27	-	280	-	550	-	<1	1150	-
15	34543	132	-	230	-	66	-	2	58	-
16	34544	595	-	14	-	30	-	1	39	-
17	34545	1270	-	50	-	59	-	<1	30	-
18	34546	550	-	8	-	146	-	<1	333	-
19	34547	52	-	4	-	196	-	<1	375	-
20	34548	875	-	19	-	101	-	1	194	-
21	34553	56	-	8	-	62	-	<1	214	-
22	34558	71	-	4	-	45	-	<1	124	-
23	34559	20	-	<3	-	9	-	<1	86	-
[illegible]	34560	196	-	<3	-	22	-	<1	4910	-
25	34561	57	-	32	-	23	-	1	3050	-

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	3 OF 8

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Mn	Mn
1	34562	51	–	15	–	277	–	<1	>5000	1.74
2	34563	>5000	0.63	6	–	15	–	1	140	–
3	34564	42	–	65	–	4	–	2	47	–
4	34565	170	–	1080	–	4850	–	2	1650	–
5	34566	292	–	482	–	660	–	1	178	–
6	34567	115	–	<3	–	34	–	<1	282	–
7	34568	198	–	122	–	422	–	1	620	–
8	34569	88	–	28	–	89	–	<1	355	–
9	34570	3640	–	>5000	1.05	>5000	3.03	23	175	–
10	34571	15	–	214	–	55	–	<1	59	–
[illegible]	34572	30	–	10	–	35	–	<1	86	–
12	34573	12	–	<3	–	13	–	<1	59	–
13	34574	27	–	173	–	45	–	1	3100	–
14	34575	56	–	<3	–	60	–	<1	>5000	0.93
15	34576	7	–	<3	–	17	–	<1	77	–
16	34577	9	–	<3	–	13	–	<1	100	–
17	34578	179	–	391	–	47	–	2	57	–
18	34579	97	–	63	–	341	–	<1	780	–
19	34580	13	–	<3	–	106	–	<1	1120	–
20	34581	53	–	171	–	91	–	<1	965	–
21	34582	55	–	25	–	60	–	2	730	–
22	34583	21	–	15	–	15	–	<1	74	–
23	34584	13	–	<3	–	31	–	<1	3650	–
24	34585	21	–	17	–	58	–	<1	>5000	3.21
25	34586	74	–	27	–	107	–	<1	925	–

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	4 OF 8

TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Mn	Mn
1	34587	35	-	<3	-	21	-	<1	217	-
2	34588	36	-	<3	-	26	-	<1	309	-
3	34617	9	-	19	-	57	-	<1	>5000	1.37
4	34618	3	-	<3	-	13	-	<1	170	-
5	34619	12	-	7	-	58	-	<1	1220	-
6	34620	239	-	<3	-	73	-	<1	1270	-
7										
8										
9										
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12										
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14										
15										
16										
17										
18										
19										
20										
21										
22	IS = INSUFFICIENT SAMPLE									
23	DETECTION	2	0.01	3	0.01	2	0.01	1	3	0.01
24	UNITS	ppm	%	ppm	%	ppm	%	ppm	ppm	%
25	METHOD	GA140	GA104	GA140	GA104	GA140	GA104	GA140	GA140	GA104

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
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ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	5 OF 8

TUBE No.	SAMPLE No.	As	As	Au	Au(R)	Au(S)	Sn	Sb	Ba	Ba
1	34501	>100	150	<0.008	-	-	16	30	256	-
2	34502	21	-	<0.008	-	-	4	4	297	-
3	34503	>100	100	<0.008	-	-	7	8	49	-
4	34504	13	-	<0.008	-	-	4	<3	388	-
5	34505	>100	150	0.010	-	-	<3	21	649	-
6	34506	21	-	<0.008	-	-	4	62	275	-
7	34507	28	-	<0.008	-	-	15	57	199	-
8	34508	14	-	<0.008	-	-	10	30	23	-
9	34509	4	-	<0.008	-	-	4	<3	84	-
10	34510	8	-	<0.008	-	-	4	<3	142	-
	34512	14	-	<0.008	-	-	8	32	226	-
12	34513	28	-	<0.008	<0.008	<0.008	6	8	441	-
13	34514	28	-	<0.008	-	-	7	6	5346	-
14	34515	41	-	<0.008	-	-	14	3	2107	-
15	34516	<1	-	<0.008	-	-	<3	<3	8354	-
16	34517	86	-	<0.008	-	-	5	<3	854	-
17	34518	19	-	<0.008	-	-	12	<3	1889	-
18	34519	35	-	<0.008	-	-	24	48	1137	-
19	34520	34	-	<0.008	-	-	6	<3	425	-
20	34521	37	-	<0.008	-	-	24	76	634	-
21	34522	10	-	<0.008	-	-	7	26	43	-
22	34523	17	-	<0.008	<0.008	-	<3	3	123	-
23	34524	>100	100	<0.008	-	-	10	28	127	-
24	34525	>100	300	0.047	-	-	9	223	474	-
25	34526	78	-	<0.008	-	-	10	20	543	

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 No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	6 OF 8

TUBE No.	SAMPLE No.	As	As	Au	Au(R)	Au(S)	Sn	Sb	Ba	Ba
1	34527	>100	400	<0.008	-	-	6	98	1143	-
2	34528	9	-	<0.008	-	-	<3	3	-	44.4
3	34529	3	-	<0.008	-	-	<3	5	-	45.2
4	34530	4	-	<0.008	-	-	<3	4	-	18.2
5	34532	3	-	<0.008	-	-	5	<3	5423	-
6	34534	2	-	<0.008	-	-	3	<3	-	1.7
7	34535	15	-	<0.008	-	-	4	<3	434	-
8	34536	>100	100	<0.008	-	-	7	3	631	-
9	34537	32	-	<0.008	-	-	3	<3	-	1.0
10	34538	47	-	<0.008	-	-	5	4	2204	-
	34539	50	-	<0.008	-	-	8	4	1238	-
12	34540	27	-	<0.008	<0.008	-	8	<3	1705	-
13	34541	85	-	<0.008	-	-	<3	9	-	5.4
14	34542	95	-	<0.008	-	-	4	11	225	-
15	34543	82	-	0.011	-	<0.008	8	30	246	-
16	34544	15	-	0.009	-	-	11	7	97	-
17	34545	10	-	<0.008	-	-	3	5	130	-
18	34546	9	-	<0.008	-	-	7	7	178	-
19	34547	12	-	<0.008	-	-	6	11	191	-
20	34548	15	-	<0.008	-	-	5	6	361	-
21	34553	12	-	<0.008	-	-	7	6	537	-
22	34558	5	-	<0.008	<0.008	-	6	<3	49	-
23	34559	2	-	0.016	-	-	9	4	767	-
24	34560	<1	-	0.105	-	-	7	<3	187	-
25	34561	21	-	<0.008	-	-	7	<3	136	

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

AUTHORISED OFFICER

ANALABS

A Division of Inchcape Testing Services (Australia) Pty. Ltd.
A.C.N. 004 591 664

ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	7 OF 8

TUBE No.	SAMPLE No.	As	As	Au	Au(R)	Au(S)	Sn	Sb	Ba	Ba
1	34562	51	-	<0.008	-	-	4	<3	4990	-
2	34563	>100	1050	0.061	-	0.058	8	<3	151	-
3	34564	>100	300	<0.008	-	-	1385	4	61	-
4	34565	44	-	<0.008	-	-	13	<3	462	-
5	34566	33	-	0.008	-	-	5	3	668	-
6	34567	19	-	<0.008	-	-	11	<3	113	-
7	34568	17	-	<0.008	-	-	7	3	170	-
8	34569	5	-	<0.008	-	-	10	3	187	-
9	34570	49	-	<0.008	-	-	6	10	317	-
10	34571	15	-	<0.008	-	-	19	20	32	-
	34572	32	-	<0.008	-	-	18	38	33	-
12	34573	39	-	<0.008	<0.008	-	11	66	292	-
13	34574	31	-	<0.008	-	-	6	4	359	-
14	34575	60	-	0.094	-	-	17	38	1720	-
15	34576	16	-	<0.008	-	-	19	24	20	-
16	34577	53	-	<0.008	-	-	10	59	151	-
17	34578	>100	1200	<0.008	-	-	7	55	58	-
18	34579	>100	100	<0.008	-	-	31	<3	293	-
19	34580	IS	-	<0.008	-	-	6	13	4405	-
20	34581	IS	-	<0.008	-	-	IS	-	-	-
21	34582	42	-	0.012	-	-	<3	30	-	12.0
22	34583	8	-	0.017	-	-	IS	-	-	-
23	34584	7	-	<0.008	-	-	5	<3	3757	-
24	34585	16	-	<0.008	-	-	8	10	525	-
25	34586	IS	-	<0.008	-	-	4	36	701	-

Results in ppm unless otherwise specified
T = element present; but concentration too low to measure
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– = element not determined

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ANALYTICAL DATA

SAMPLE PREFIX	REPORT No.	REPORT DATE	CLIENT ORDER No.	PAGE
	111310.60.09282	24/02/93	1401	8 OF 8

TUBE No.	SAMPLE No.	As	As	Au	Au(R)	Au(S)	Sn	Sb	Ba	Ba
1	34587	13	-	0.008	-	-	16	<3	107	-
2	34588	11	-	<0.008	-	-	4	<3	50	-
3	34617	5	-	<0.008	-	-	5	12	2000	-
4	34618	6	-	<0.008	-	-	10	15	42	-
5	34619	50	-	<0.008	-	-	4	5	86	-
6	34620	85	-	<0.008	-	<0.008	10	15	116	-
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22	IS = INSUFFICIENT SAMPLE									
23	DETECTION	1	100	0.008	0.008	0.008	3	3	10	0.1
24	UNITS	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
25	METHOD	GA114	GA101	GG309	GG309	GG309	GX401	GX401	GX401	GX404

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

AUTHORISED OFFICER

APPENDIX E

Preliminary Interpretation Aeromagnetic Survey

Dial Range EL 9/92 - DE Leaman, June 1993

LEAMAN GEOPHYSICS
Survey Review, Specification, Reduction, Interpretation
Gravity, Magnetic and Seismic Methods
Structure and Prospect Evaluation

Registered office:
3 MALUKA STREET, BELLERIVE, TAS. 7018
All correspondence to:
GPO BOX 320 D, HOBART, TAS. 7001
Telephone: (002) 44 1233
Fax: (002) 44 6674

006164

PRELIMINARY INTERPRETATION
AEROMAGNETIC SURVEY
DIAL RANGE EL 9/92

for
PASMINCO EXPLORATION

by
D.E. LEAMAN

June 1993

DIAL.DOC

006165

CONTENTS

FIGURES

INTRODUCTION

EL 9/92, Dial Range, is located south of Penguin on the NW coast of Tasmania (Figure 1).

The area contains numerous mineralised prospects and workings (Figure 3) with a wide range of ore and metal types.

This report considers the implications of a new and detailed aeromagnetic survey of the area by Pasminco Exploration and the existing coverage by gravity data. Previous assessments and surveys were summarised by Leaman (1987) who recommended an improved magnetic coverage and infill gravity surveys. The latter have yet to be undertaken.

This preliminary study was commissioned in order to focus second year exploration effort. Some particular issues were specified for attention.

1. What is the extent of the Housetop Granite beneath the area?
2. Are there any possible associations between granite and known mineralisation?
3. What is the extent of Cambrian sequences beneath Tertiary cover and can the thickness of the basalt be resolved?
4. What is the setting and distribution of the Lobster Creek Volcanics? Are these rocks altered?
5. Do the ironstones at Penguin Creek or Blythe River have any correlation with major structures?
6. What is the source of the dominant magnetic anomaly in the region?
7. What is the possible structural architecture of the area?

GEOLOGY

The most recent geological compilation of the Dial Range region is shown in Figure 2. This simplified version was based on an original by Pasminco Exploration including reviews by W. Herrmann, F. Fitzgerald and T. Lees. The basic stratigraphic outline of Burns (1964) has been questioned and some radical tectonic variants have been proposed by A.J. Crawford. Complete discussion of these topics is beyond the scope of the present report.

The analysis provided below considers some relationships in a pragmatic (on an as-they-are) basis which may assist resolution of some of the controversies.

Various views have been expressed about the structural evolution of the Dial Range area. These include the basin analysis by Burns (1964) and compressive or thrust regimes (Berry & Crawford 1988; Leaman, 1986; Woodward et al, 1993). Woodward et al (1993), in particular, imply some overturning of previously accepted stratigraphy - namely that the Barrington Chert overlies the Motton Spilite. There appears to be no justification for this on the basis of the observations of Burns (1964), existing mapping relationships or geophysical data (below).

The basic stratigraphic sequence includes Precambrian quartzose Burnie Formation and the more deformed Ulverstone Metamorphics.

Older, imperfectly understood, Cambrian units include conglomerates (Gog Range), basalts (Motton Spilite) and cherts (Barrington). These units are now believed to be overlain by the sedimentary Cateena Group (compare Burns (1964)) - a belief I find unsustainable, and the volcaniclastic Radfords Creek Group which includes felsic volcanics. There are many confusing structural and unconformable relationships which is to be expected in a developing and complex sub basin.
The Lobster Creek Volcanics have been considered basal to the entire sequence (Burns, 1964) or intrusive (Pasminco Exploration).
Ironstones occur near/at the unconformity with basal Cambrian cover on the Precambrian rocks.

Ordovician rocks overlie this entire complex sequence and the whole package has been folded, overthrust, and intruded by Devonian granites (Housetop). The granite has very limited outcrop within the licence area.

Most of the confusion within the region is related to the Ordovician cover, and the irregular uplifts and erosion which preceded it, and subsequent Tertiary cover (sediments and basalt). A large proportion of the licence (estimated at 50%) is covered by Cainozoic materials.

The following interpretation has been restrained by my judgment of realistic relationships using extant mapping and general knowledge in those areas where folding, free of possible fault or intrusion boundaries, allows conclusions to be drawn. It may be observed that many such judgments presume reliable formation identifications and both Herrmann and Crawford (reports to Pasminco Exploration) indicate potential for some argument. The constraints listed below have been tested.

1. Cateena Group rocks may onlap or be intruded by Lobster Creek Volcanics.
2. Radfords Creek Formations overlie Barrington Chert (unconformably?)
3. Motton Spilite overlies the Barrington Chert (conformably?)
4. Barrington Chert overlies Cateena Group (unconformably).
5. Radfords Creek Formation overlies Motton Spilite (unconformably?).

These observations suggest a basic sequence of
Cateena Gp - Barrington Chert - Motton Spilite - Radfords Ck Gp
,with no established site for the Lobster Creek Volcanics, which is a normal basin evolution sequence and not dissimilar to Burns (1964). No presumptions have been made about the various breccia complexes.

Mineralisation within the area is variable (Figure 3). The most anomalous site is Keddies with tin recorded. This may imply that the granite extends at least this far northeast and may underlie the entire area as suggested by Leaman & Richardson (1989a).

Demonstration that the granite actually does so extend would have profound consequences for both type and origin of mineralisation, its distribution and its exploration potential.

None of the structural proposal for the region (e.g. Woodward et al, 1993) have considered the impact that the granite might have on the fold, thrust and fault evolution inferred as well as the volume of roof retained.

PREVIOUS GEOPHYSICS

Previous geophysical work has been summarised by Leaman (1987) and includes surveys by Geopeko.
The 1987 summary concluded that the Housetop Granite was pervasive and had probably remobilised Cambrian mineralisation although no granite shape analysis was undertaken. Few magnetic alteration responses were defined and the most marked of these were east of Dial Copper and near Keddies. No significant alteration was inferred within the Lobster Creek Volcanics.

Previous work was limited by deficiencies in data quality (magnetics) or coverage (gravity). Problems have included wide line spacing, inappropriate line orientation and erratic terrain clearance factors. The 1985 Mines Department survey (Figure 4), in itself a survey of reasonable quality, is of reduced value due to its N-S line bias and 150 m clearance. This was the best data set in existence in 1987.

Gravity coverage was virtually non-existent east of 420 000 mE in 1987 and was patchy elsewhere.

CURRENT GEOPHYSICAL DATA

Data used for this assessment include preliminary compilations of a new aeromagnetic survey by Pasminco Exploration (1993) and the current gravity data base (various surveys 1963-1988).

The Pasminco 1993 magnetic survey was specified in order to provide an E-W traverse line spacing of 200 m and a N-S tie line spacing of 2000 m at a nominal terrain clearance of 80 m. The magnetometer sensitivity was 0.05 nT with a recording interval of 0.1 secs.
The preliminary contoured version of the residual magnetic field, after removal of IGRF, is shown in Figure 5. Plotted values are based on a field datum of 61900 nT (at 411 000 E, 5460 000 N (claimed)) with a shift of 2000 nT added.

The contrast between the new survey (Figure 5) and the best previous survey (Figure 4) is striking and suggests the great improvement in detail and resolution which has been achieved.

Gravity data remain much less satisfactory. Coverage is excellent west of 420 000 mE but is poor elsewhere with nominal station spacings of 1 and 2 - 2.5 km respectively west and east of this grid position. Unfortunately some problems exist in the data sets due to their varied origins and some key features are not well defined. Two regions were identified as suspect during this analysis and the original field observations have been inspected. Some revisions have now been made to the TASGRAV database (after plotting of Figure 6) but there is a need for some repeat surveying in some small areas and expansion of cover elsewhere. The zone of Cambrian rocks within the licence area is not well covered.

The data used here, presented as Figure 6, have been derived from the Mines Department TASGRAV data base and processed using the MANTLE91 equivalent source algorithm (see Leaman & Richardson, 1989b) to generate residuals which sharpen the anomaly texture and allow interpretation focus within the upper half of the crust.

ROCK PROPERTIES

The properties of many of the materials within the region are well known and new observations by W. Herrmann (for Pasminco Exploration) have improved understanding of others.

The table summarises current knowledge.
All values are bulked averages and may be considered conservative estimates. Susceptibilities are considered bulk maxima. Inferences are bracketed.

Unit	Density t/cu m	Susceptibility cgs
<u>Precambrian</u>		
Ulverstone Metamorphics	>2.7	<0.00001
Burnie Formation	>2.6	<0.00001
<u>Cambrian</u>		
Lobster Creek Volcanics	(2.74)	~0.001
Cateena Group	(2.72)	=<0.00003
Haematitic ironstones	(2.74)	~0.0001
Barrington Chert	(2.70)	~0.00001
Motton Spilite	(2.85)	~0.001
Radfords Creek Group	(2.74)	0.00002
Kerrison Volcanics		0.00005
Wilsonia Volcanics		0.00001
Applebee Volcanics		0.00001
Megabreccias	(2.75)	0.00002
<u>Ordovician</u>		
Dial Group	~2.60	0.00001
Gordon Limestone	~2.76	0.000001
<u>Devonian</u>		
Housetop Granite	>=2.66-2.68	>0.0003 (0.001+)
<u>Tertiary</u>		
Sediments	2.00	0.000001
Basalt	~2.85 var	>=0.001 (0.005)

Note SI susceptibilities are about 13 times larger.

These observations and inferences indicate that major density contrasts are relatively rare; Dial Gp to all Cambrian and most Precambrian units, granite to all, Tertiary sediments to all, Motton

Spilite to all. Finer resolution may become possible with additional measurements and more detailed gravity survey coverage.

There are, however, only four significant magnetised (magnetisable) materials - Lobster Creek Volcanics, Motton Spilite, Housetop Granite and Tertiary basalts.
The Housetop Granite has been studied in some detail (Collins et al, 1981) and although the magnetisation is variable the entire body is magnetised at levels in excess of 0.0002-0.0003 and significant portions are more strongly magnetised. A large number of dispersed samples have yielded contrasts up to five times this lower background. The basic contrasts are at least an order of magnitude greater than most other units in the region and more than three orders of magnitude higher than normal west Tasmanian granitoids. This is an exceptional body.
There is also much experience relevant to the Tertiary basalts. The effective contrast of the basalts (including the effect of remanence) may exceed 0.015 cgs locally. The effective density may be variable depending on thickness of flows, weathering, intercalated sediments and other variables.
The contrasts assigned to the Motton Spilite and Lobster Creek Volcanics are based on susceptibility determinations and the values are supported by response calculations. Bulk contrasts much in excess of 0.001 cgs are not supportable.

The effects of the Housetop Granite and the Tertiary basalts should dominate the form of the magnetic field on the basis of these observations.

INTERPRETATION

QUALITATIVE COMMENTS

Regionál assemblies of magnetic data show that the magnetic field in the Dial Range region is elevated and that there is no obvious correlation with any surface effect or exposed unit (Figure 7).
Detailed high frequency texture is superimposed upon this large anomaly - which must have either a deep or large volume source - and the origin of the spiky texture is evident in Figure 8 where the direct correlation between intense anomaly patterns and the exposure of Tertiary basalts is evident.
The Precambrian rocks in the west of the area are magnetically quiet and anomalous effects within them are most likely related to local oxidation effects along major fractures or faults. The ironstones are not particularly noticeable in this context.
Ordovician rocks present a similar response pattern but do transmit the ghosts of suppressed or concealed sources. The anomalies noted do not imply great depths to source and this is consistent with the relatively thin Ordovician cover which is noted in the area.
Rocks of the Cateena and Radfords Creek Groups display similar behaviour although there are some marked and isolated responses and several features consistent with modest burial. The isolated responses are discussed in more detail later in this report but many may be due to local and perhaps fresher exposures of some members of each group, or the local alteration about a fracture or fracture intersection. These explanations are always more likely than some mineralisation response but each must be reviewed independently for the most likely cause.
The Lobster Creek Volcanics are very different from all the above suites and generate noisy and variable responses. The Barrington Chert is essentially non magnetic while the Motton Spilite is associated with modest responses. These associations suggest that the measured properties for the Lobster Creek Volcanics are typical and appropriate while those of the Motton Spilite (after bulking) may be excessive by a factor of at least two.

The magnetic field reflects what could reasonably be expected given the table of observed properties.

The Housetop Granite is barely covered by the 1993 survey but the field is disturbed in those small areas where it is involved.

Many isolated, and more intense, effects may be noted in the eastern part of the survey area and these may be related to unmapped remnants of the Tertiary (basalt) cover. It should be noted that the chocolate soils with minimal bedrock and many basalt fragments may generate sizeable effects.

The gravity data set (Figure 9) offers fewer direct correlations. This is partly due to the small density contrasts present, variations in survey coverage and the widespread interference of source effects.

The residual Bouguer anomalies calculated using a reduction density of 2.67 t/cu m yield generally negative values across the Housetop Granite. Values are of the order of -3 mgal.
The generally negative pattern extends north and west of the Dial Range and the region north of Mt Duncan presents a neutral field.
South of Mt Duncan the anomalies are generally positive, at about +4 mgal. This is an area in which the Barrington Chert, Motton Spilite and Radfords Creek Group are exposed. Some of the strongest positive gradient in the region occur north of the Housetop Granite south of Stowport and in the Leven valley east of 430 000 mE.

Some false effects have now been identified in the gravity data set and the extreme and localised negative anomalies noted at 417 000, 5441 000 and 420 000 E, 5436 000 N are the result of loop parts with elevation and other errors. A possible revision for the southern error has been found and the modelled profiles which involve this feature include the corrections. It should be noted, however, that the reliability of the corrections, while improving the survey compilation, is not known and the loops involved should be repeated.

Trends identified in the magnetic and gravity data sets have been plotted in Figure 10. The lighter line weight indicates magnetic features and the heavy line weight gravity features. This diagram has been overlain on both geological and prospect maps in order to suggest the location of critical breaks in mapped units or associations with mineralised sites(Figures 11, 12).

The correlation between many magnetically mapped trends and gradients and the mineralised sites is extremely good. This suggests that these sites may be related to relatively recent structuring and fracturing possibly related to granite intrusion. This concept has been further tested by quantitative study of granite distribution (below).

STRUCTURE MODELLING

Eight profiles have been examined in detail (Figure 13). Each was selected to provide guidance on structural and stratigraphic relationships and the origin of marked changes in the potential fields.
Six of these profiles have considered both the gravity and magnetic effects and the remaining profiles have used gravity data in isolation. All the magnetic profiles use the 1993 Pasminco data set where available but augment this, where necessary, with the 1985 Mines Department survey. This coupling allows more regional review of the structure and the setting of the entire licence area without significant loss in quality since the regional data set is adequate away from the vicinity of the Dial Range.
This coupling of data sets did reveal some inconsistencies in the correction of the new survey. A shift of -1000 nT was required to match -2070 nT for the old survey when the contractor's legend implied that the shift should have been -2000, -2070 nT. This is not a serious problem but does suggest a labelling error or perhaps a total base shift.

Symbols shown on all diagrams and sections are consistent with those given in Figure 2. Physical contrasts employed are based on those tabled unless geometric and response character forces some bulk variation. Such variations may be important and may indicate local replacement, skarns or alteration.

LINE 433 (Figure 14)

The models indicate the dominance of the Housetop Granite in an area apparently far removed from the principal exposures. The gravity profile stresses the difference in geology east and west of 417 E as marked by both the outcrop limit of the granite and the gravity gradient. The gravity model requires a balance between Motton Spilite and granite east of the main exposures. This is demanded by the observed gravity spike and gradient. The magnetic model, however, is dominated by the spike effects related to Tertiary basalt cover and the broad long wavelength anomaly rise. On this basis the spilite is not necessary and could be replaced by the granite (magnetically). The smooth response and small deviation away from outcrop can be interpreted in these two ways. The gravity profile is much more demanding.
These models employ Motton Spilite in order to provide both the magnetic balance and the required excess mass but it should be noted that the magnetic contrast used is very high for this unit; much higher than determined in all other sections - or actually observed in property measurements. This may mean that the main accumulation of the spilite is in this region and that it is massive and unaltered.
The various possibilities cannot be unambiguously resolved along this profile. The suggestion that the Cambrian and local exposed Precambrian packages, as relatively dense assemblages, are quite thin is far more certainly determined. The siliceous, Tyennan-style, basement of northern Tasmania is little more than 2 km deep.
Three mineralised sites occur near the main pitch point in the magnetic gradient indicating the limit of the granite margin. This view is supported by the gravity model which includes a fine balance of rock types.

LINE 436 (Figure 14)

The existence of a broad magnetic response is evident along this profile. Most spikes can be linked to Tertiary basalt.
The gravity balance, however, depends on the presence of more than 2 km of Cambrian rocks near 417 E. These must be quite dense and at least partly Lobster Creek Volcanics (possibly all). Compare these requirements which can be linked to Lobster Creek Volcanics and the forced link with Motton Spilite implied on Line 433 (above) which required some unbelievable property relationships. In the models presented the magnetic and mass balance is made up of a combination of Lobster Creek Volcanics and Radfords Creek Group even though the former unit - plus a little Motton Spilite, perhaps - would satisfy the magnetic needs which here form the critical aspect. If this is the case then the greatest accumulation of Lobster Creek Volcanics lies west of its principal outcrop. A cluster of mineralised sites about this zone may be related to its presence.

The departure of the calculated magnetic profile near 418E is related to the forced geometry shown between Lobster Creek Volcanics and Radfords Creek Group. Were the relief on these units to be reduced and the effect of the exposed part of the Radfords Creek Group ignored then the result would be comparable to a simple continuation of a shallow granite surface (not allowed gravimetrically). This would produce the smoothly arching observed field. The discussion for Line 632 (Figure 20) explains how this is possible and presents both options in order to show how the two fields can be satisfied. In this case the best solution would be a slab Lobster Creek Volcanics extending along the roof of the granite to 416 E.

The curve fits for this and other profiles may seem crude and inadequate.
In the gravity case no precise fits are warranted due to the 0.3 to 0.5 mgal noise almost certainly present in this data set and the possibility that some stations contain larger errors. The median fits offered and their style is far more critical than perfection of fit which can be manufactured by subtle adjustments of surface cover. There are also some inevitable 3D effects due to limited volumes or curvature in the geometry of some bodies (especially the granite). These effects do not greatly affect the general conclusions offered in the models but do mean that some depth or property estimates should not be taken literally, but rather as guide estimates with an envelope of confidence up to 15%.
In the magnetics case the blend of 3D effects and interference patterns may modify the simple model patterns. The models strive to illustrate the nature of probable geometries and likely contrasts only.
The critical test for each data set is, can key elements of its interpretation be supported by the other data set? This requirement is particularly crucial near the roof of the granite and at interfaces between Cambrian and Precambrian rocks.

These conditions are satisfied for this line and confirm the relative thinness of the Cambrian sequence and the overthrust nature of the eastern Precambrian blocks. This aspect of regional structure does not seem to be in doubt.
The data sets also define two distinct granitic suites within the Housetop Granite; one which is strongly magnetised and another which possesses a contrast typical of most property determinations. Some samples have been found with the much higher contrast and there is reason to believe that the model estimates are valid. The density values fall within observed ranges. The raised magnetic field corresponds with the zone of more magnetic granite, which is also slightly less dense.
The only mineralisation observed near this profile occurs near the eastern margin of the granite which is also its shallowest point in this part of the region.

LINE 440 (Figure 16)

3D effects bias both models at this northing. The north plunging

margin of the granite affects the profile. This effect increases the apparent contrasts slightly but the broadly sweeping magnetic form is retained. *Curve fitting is more difficult, however.*
The extreme spikiness near 414E is partly due to thick basalt cover (~200 m). The cover is also very variable in thickness. A more detailėd analysis of actual flight observations would be required to improve on the current model estimates but this could be done using a combination of spectral and model methods if required. Cover effects alone, however, cannot account for the amplitudes noted and the effect of the granite roof, and perhaps some skarns or aureole, may be preserved beneath them. Some very extreme and isolated anomalies occur in this zone.
No rigorous gravity fit is justified since fine tuning depends on assumptions about the sedimentary content in the Cainozoic cover.
The pattern of thin Cambrian section and overthrust Precambrian units in the east is consistent with other profiles.
The Lobster Creek Volcanics do not make a major mark on this profile other than to introduce some noise. Their "stratigraphic" position seems to be maintained either near the granite roof or basal to the Cambrian sequence - as preserved.
The effects of the Housetop Granite dominate the section.
Mineralised sites appear to be located near the shallow roof section of the granite west of its eastern wall and near the Lobster Creek Volcanics. It may be observed that the Keddies site, with tin, lies 1 km north of Dial Copper and directly above the marginal spike in the granite roof. This relationship and the general linkage between the two potential fields suggests that the solution offered is credible.

LINE 444 (Figure 17)

The broad magnetic rise is readily observed at this northing even though some large spikes are superimposed. The spikiness reflects the variable basalt cover across much of the section but three broader, medium wavelength, features can be associated with ironstones. The responses from each of the latter indicates that these rocks possess bulk properties far in excess of the determinations summarised in the property table. It should also be noted that there is a large "bulls eye" anomaly near this line (covered by Line 845) which may be due to skarns or abnormaly iron enrichment.
The profiles are remarkable in that there is no trace of any response which might be assigned to either the Motton Spilite or the Lobster Creek Volcanics even though both occur at this northing. This suggests that the mass of Lobster Creek Volcanics has no significant thickness at this northing and is not simply a northward plunging body - as the mapping could be used to imply. The Motton Spilite, likewise, is of no consequence near the Leven River. These conclusions differ markedly from the appearance and requirements of sections further south and west.
The gravity profile shows the overall W-E form of the granite north of its primary outcrop area but cannot reveal the true nature of the NW face due to line aspect (see Line 409, Figure 18). The models do suggest that much of the known mineralisation is related to the eastern marginal form and the roof. The mineralisation at Bullock's Hill may be fracture or thrust-related. The ironstones are either

truncated units or replacement effects related to the granite and its margin.

The coupling of methods is definitive. The gravity low mirrors the form of the granite and any subtleties (if real) are probably related to the sediment content in the cover. The magnetic data stresses the broad impact of the unusually magnetic granite mass which underlies the Dial Range region. The two methods leave no doubt that the granite is the source of both primary effects in the field; magnetic high, gravity low.

LINE 409 (Figure 18)

This profile provides a link within the gravity models in order to test the 3D form of the granite and the contrast assumptions. It also verifies the origin of the northern gravity gradients. The model confirms the general assumptions of all other profiles.

This model also implies, as do some others, that the roof of the granite lies near the contact between dense Oonah/Burnie type and more siliceous Tyennan type Precambrian.

LINE 419 (Figure 18)

This profile confirms the relief on the granite surface near mid section for profiles 433, 436, 440 and 444 and shows that the distribution in those solutions represents <u>maximum</u> depth. The granite surface may be shallower as the magnetic data implies (so does Keddies prospect). The roof profile along this line does not suggest the likely controls on mineralised sites other than that granite (if it is part of the genesis) is near. Review of all other profiles shows that the granite roof plunges steeply eastward less than 2 km from this profile and it is this change - plus wall margin fracturing and fluid control - which has probably controlled the siting and deposition at many sites.

The two profiles shown in Figure 18 (409, 419) provide some assurance that the gravity models and granite concepts are well founded.

LINE 845 (Figure 19)

This profile provides a link for each data set and all other profiles across the entire licence. Its position was selected so as to include the most extreme magnetic effects.

The magnetic model places the ironstones in perspective (at 3 and 9.5 km) to show that their effect is much less than the main magnetic anomaly at 5 km. This can be explained if the ironstones are folded and their greatest thickness is concealed by the Tertiary cover. It would also be possible to account for the effect with an extraordinary skarn. The folded ironstone, possibly enriched near the granite roof, is the preferred solution.

The Motton Spilite is included in this section but its effect is shown to be inconsequential in terms of both data sets. Indeed the results suggest that the properties to be employed should be only about 20% of those tabulated. This finding adds to the view expressed in discussion of other profiles that this unit is not generally

significant. No unit comparable to the Lobster Creek Volcanics, or any extension of them, is likely along this section.
The variations within the Housetop Granite seem extreme magnetically and this may reflect three dimensional problems or a failure to provide for severe variations near the roof (including a spread of skarns or ironstone). The gravity profile is more clear cut and provides sufficient restraint when coupled with other profiles.
The gravity data suggest that the granite extends SE of the present section and this may well account for mineralised sites such as Hebblethwaites. Other sites seem more directly related to shallow roof or spine positions.

LINE 632 (Figure 20)

This line orientation was selected in order to assess the effect of the Radfords Creek Group and the principal exposure of the Lobster Creek Volcanics. The effect of the volcanics is most marked in the magnetic field. This appears to be an exceptional response for these rocks until some previous sections are reviewed (436, 440 and 433 implied). This section samples the major part of the unit where it is also exposed.
The effect of the Lobster Creek Volcanics may be compared with that of the Motton Spilite which is minor. The correlated response of the spilite implies a much reduced property assumption and confirms the Lobster Creek Volcanic unit as the most important Cambrian (?) unit in magnetic terms. As noted in other sections the volcanics are located deep in section or along the granite roof.
The broad magnetic effect due to the Housetop Granite is apparent and all other spikes due to Tertiary basalt, Motton Spilite or Lobster Creek Volcanics are superimposed.

The figure presents two different models for the granite roof near 5.5 km. Variations on the themes shown have been incorporated into all previous models.
The magnetic version suggests a smooth granite roof and a resulting smooth sweep of anomaly.
The gravity data do not allows this form due to the presence of a positive effect in this position. This implies that a denser or locally thicker Cambrian or Precambrian cover is present. The gravity model attempts to achieve the effect using normal contrasts. It fails to do so. This suggests that a much higher density unit is involved - presuming the observed data are valid.
The magnetic data show that the dense body must also be magnetic and possess a contrast equivalent to the granite. Unless this coupling of properties is made the magnetic response cannot yield a smooth convex sweep such as achieved by the granite roof model and the effect is disruptive such as seen in other models (lines 436 and 440 at 418E) but more extreme.
Assuming the data are valid what could this source be? The Motton Spilite may possess an appropriate density but its established magnetic properties fall short. The Lobster Creek Volcanics could account for the magnetic effect easily but seem unlikely to be dense enough. Resolution of the material present must await density determination of both source options and a check of gravity data.

It is now relevant to consider the structural concept for the Dial Range area proposed by Woodward et al (1993). The offered solution is reproduced as Figure 21. It implies facing reverse and thrust faults, opposed inversions and overthrust Precambrian blocks.
The bimodal thrust pattern and the thrust involvements are consistent with previous work and deductions (e.g. Leaman, 1986, 1992). The stratigraphy shown cannot be so easily sustained and the inversion of the Motton Spilite is a problem.
The interpretation of the profiles described above supports only the east facing thrust elements of the concept in so far as these involve the Precambrian blocks.
The Motton Spilite distribution is not supportable and the involvement of the Lobster Creek Volcanics is critical. It is excluded from the published concept.
The entire proposal also ignores the effect of granite emplacement and the rejuvenation or rearrangement of many structures.
The concept as presented is not geophysically sustainable.

ANOMALY CORRELATIONS

Particular anomalous responses and known mineralised sites have been reviewed in order to check if there are any patterns. Given the variation in mineral types observed further subdivisions may be warranted.

It is clear, however, from inspection of Figure 12 that mineralisation within the Dial Range area may be linked with clearly defined regional trend patterns. The preservation of these within a detailed, high resolution magnetic data set indicates that most, if not all, trends are relatively recent in structural and chemical terms - probably Devonian in age. This does not exclude the possibility that many features are reactivations of older discontinuities but the dominant and shallow presence of a large granitoid mass must colour these judgments.
Such a conclusion would imply that the mineralisation observed in the area is either Devonian in age or was remobilised during the Devonian.

Available gravity data are suited to provision of an indication of structural setting rather than provide measure of targets or sites. Even so the data need careful review in order to separate possible surface effects which may contaminate judgments about couplet or alteration responses. Such a couplet might be inferred near Keddies, for example, but so might alluvial distortions.

Three main classes of anomalies may be considered at this stage; gradients, zonal highs, or shelves.

Prospects such as Kaines, Huttons, Wolloa Ck, Bullocks Hill, Marsden Hill, Davies Adit, Dial copper and Revell's all fall on distinct gradients which are not regionally persistent. This implies that a major structure or lithological change has controlled the site.

Prospects such as Radfords Reef, Colburn's, Brown's Blow, Devon Consols, Laws, Neptune and Keddies lie on limited localised highs in the gravity field. These features may be significant in terms of anomalous mass and mineralisation but may also be fortuitous pockets within a dense local lithology. There are insufficient data to decide this in most cases.

Sites such as Lady Braddon, Badgers, Lings, Barnes and Tasmanian Iron fall within a shelf anomaly pattern. This could imply that these sites have some unit control on mineral deposition or replacement since the lack of gradient or field disturbance indicates limited structural or lithological variation. The effect could also be caused by dominance of the underlying granite or lack of detailed coverage.

In these terms the local high in the gravity field near 418 000 e, 5433 000 mN should be checked.
The most interesting and anomalous sites appear to be Laws, Devon Consols and Keddies given the extant gravity data.

Magnetic responses are more variable but similar classifications are possible.
Sites such as Copper King and Rutherford have no associated magnetic responses and Lady Braddon and Badgers have a negligible response.

The iron deposits present variable responses. Blythe and Cuprona are associated with large effects while Laws, Marsden Hill and Tasmanian Iron are moderate or locally significant only.

Other sites such as Blacks, Dial Iron, Revells, Dial copper, Wolloa Creek, Radfords Reef, Davies Adit and Bullock's Hill are related to local gradients implying local structural control.

Bulls-eye responses are associated with Russells, Heazlewoods, Kaine's and Colburn's and may be linked to Keddie's and Devon Consols. Such responses may reflect the mineralisation outright, local alteration or local outcropping of a magnetic lithology. The first two alternatives are the most likely but the shallow exposure or cultural source option must be excluded in every case of such responses.

It is not possible to predict further mineralised sites on the basis of local gradient or shelf type anomalies since so many possible source arrangements are possible and the mineralisation does not directly contribute to any response. Trend review within the gross structural framework is the only way in which such sites might be predicted. This approach certainly appears to explain all known sites.
Bulls-eye type sites, however, may reflect mineralisation directly and must be reviewed. Figure 22 suggests a number of such sites and responses for which no mineralisation is yet known.

CONCLUSIONS

This preliminary study has been sufficient to resolve many issues and answer most of the particular questions raised in Introduction.

1. The Housetop Granite dominates the Dial Range region. Its roof occurs at relatively shallow depths (av 1 km) and there are local spines. At least two lithologies are present and both are anomalous in terms of west Tasmanian granitoids. Both are much denser than is normal for rocks not considered granodiorites and both are very magnetic. The marginal and eastern phase is the second most magnetic lithology in the region (after Tertiary basalt). The combination of properties allows reliable definition of intrusion form.

2. The large regional magnetic anomaly noted in other surveys is related to the more magnetic granite phase. The scale of the anomaly reflects the enormous volume of moderate contrast.

3. The Cambrian sequence is strictly limited by low angle structuring, perhaps primary deposition, and stoping by the granite. The Precambrian rocks exposed in the east of the area have been locally overthrust as previously suggested by Leaman (1986) and Woodward et al (1993).

4. Few Cambrian rocks have any magnetic significance and only the Motton Spilite and Lobster Creek Volcanics make any marked contribution to the magnetic field. The Volcanics are the more important and always seem to occur deep in the section. There may be an intimate relationship with the underlying granite. If the volcanics are considered in a stratigraphic setting then they are basal; if intrusive then the emplacement has occurred near the base of section. Both the Motton Spilite and Lobster Creek Volcanics appear to be pods of material - possibly the result of erosion or original deposition.

5. Many mineralised sites are clustered about the zone in which the Lobster Creek Volcanics are thickest and retained in the section after granite intrusion. These associations can not definitively separate such issues as - are these volcanics Devonian and related to the granite?, are they the source of mineralisation?, are they Cambrian intrusives? etc.

6. The structural concepts proposed by Woodward et al (1993) cannot be sustained since these ignore stratigraphic relationships, the impact of the granite and cannot be supported fragmentally by the distribution of such units as the Motton Spilite using magnetic data.

7. Much mineralisation is associated with unambiguous granite roof forms. Virtually every known site can be correlated with abrupt magnetic trend changes which can be mapped regionally. This suggests that the prospects are likely to be small and the result of Devonian remobilisation in, at least, most cases.

8. The linkage of fracture patterns to mineralisation is not encouraging in terms of large scale deposition unless it is possible to trace a primary source at depth, perhaps associated with the Lobster Creek Volcanics (assuming these are in fact Cambrian in age).

9. Ironstones appear to be units truncated by the granite. The largest effects occur where these parallel the granite roof. The pattern of responses indicates a possibility of replacement and fluid alteration. There is no correlation between ironstones and any major structural control although the latter may now not be recognised due to emplacement of the granite.

10. The Tertiary cover is very variable and has not been the subject of detailed examination. Total thicknesses may exceed 200 m and the mix of basalt and sediment is certainly variable within the region. Basalts may make up the entire thickness in some zones.

RECOMMENDATIONS

1. Several issues cannot be refined without some additional gravity coverage. There is a need to check certain portions of the data base (usually anomalously negative at present) and to infill coverage of the eastern half of the region. This data will be essential if the distribution of the Lobster Creek Volcanics is to be defined. A reasonable infill would achieve a nominal station spacing of 1 km but a more satisfactory spacing would be 500 m. The latter might be concentrated in the mineralised areas.

2. Some further analysis is justified in the northern part of the licence area but was beyond the time frame for this review. The existing data sets could be used for profiles at 415 or 416 000 mE, 5448 000 mN and parallel to the coast. These would provide a fuller view of the granite and the structural localisation near Penguin.

3. Detailed review of the Tertiary cover is possible using the new, high resolution magnetic data set. This would entail a combination of modelling and spectral methods to extract the basalt component but the analysis is only justified where more general evidence indicates targets. Only one is obvious at present due to the unroofing of the granite beneath a large part of the basalt-covered area; the isolated example may be a skarn or ironstone near 413 000 E, 5442 000 N. This area should be reviewed.

4. Given the apparent relationships between Lobster Creek Volcanics, exposed or inferred, and mineralisation in the central part of the region it is recommended that this unit be adequately sampled for density and magnetic properties and the models of its distribution reviewed.

5. Some further classification of known mineralisation and anomaly patterns may be justified in order to recognise which minerals or alteration may be important. Magnetic anomalies have been defined which may have an association with mineralisation and these sites should be checked for a cultural origin for the response. If this is unlikely then the site should be inspected. It may be necessary to undertake a limited surface magnetic survey in order to identify the exact location.

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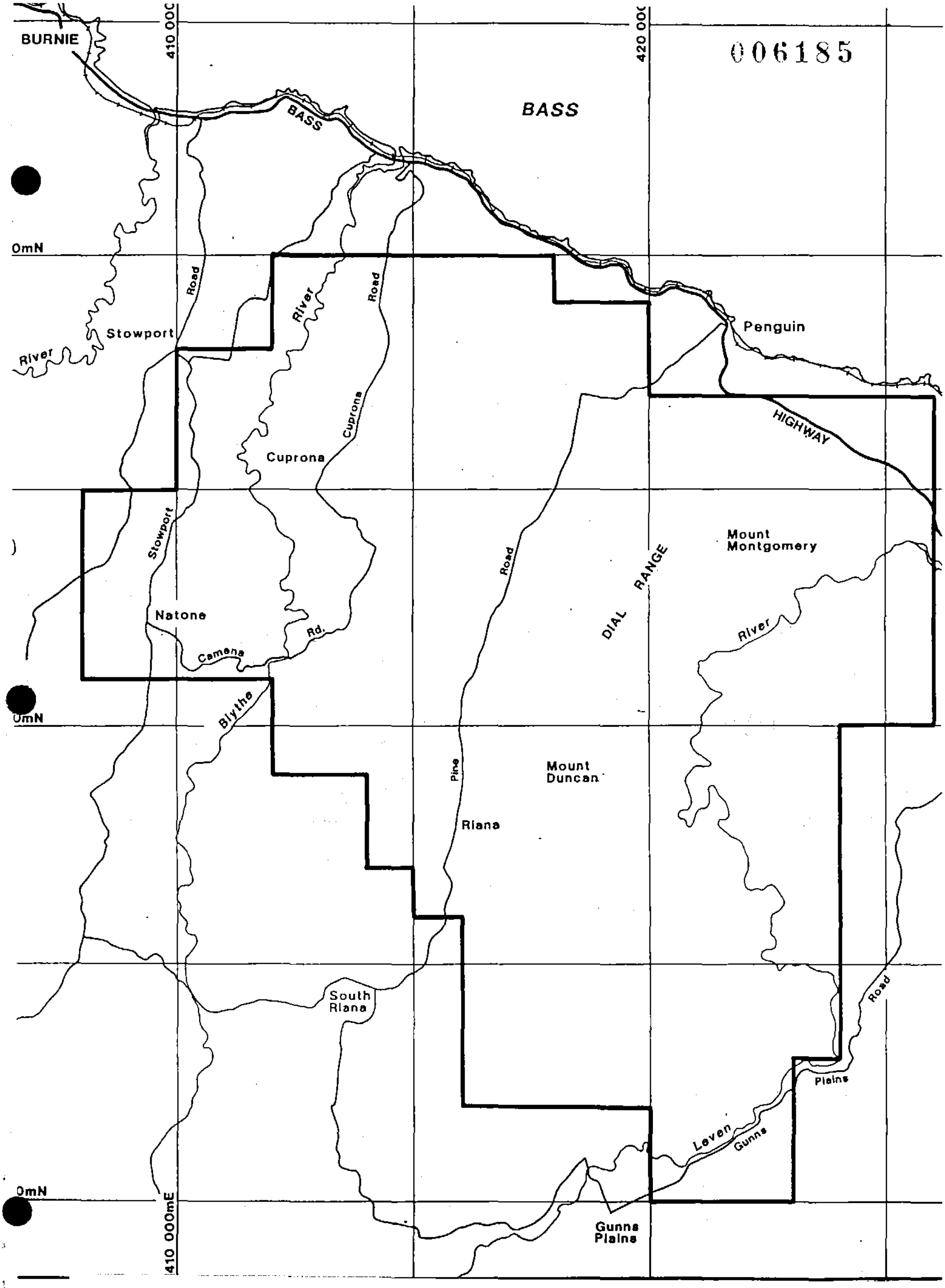
006184

Report submitted on behalf of
Leaman Geophysics
by

D. Leaman

Dr. D.E. Leaman, B.Sc., Ph.D
F.Aus.I.M.M., M.M.I.C.A

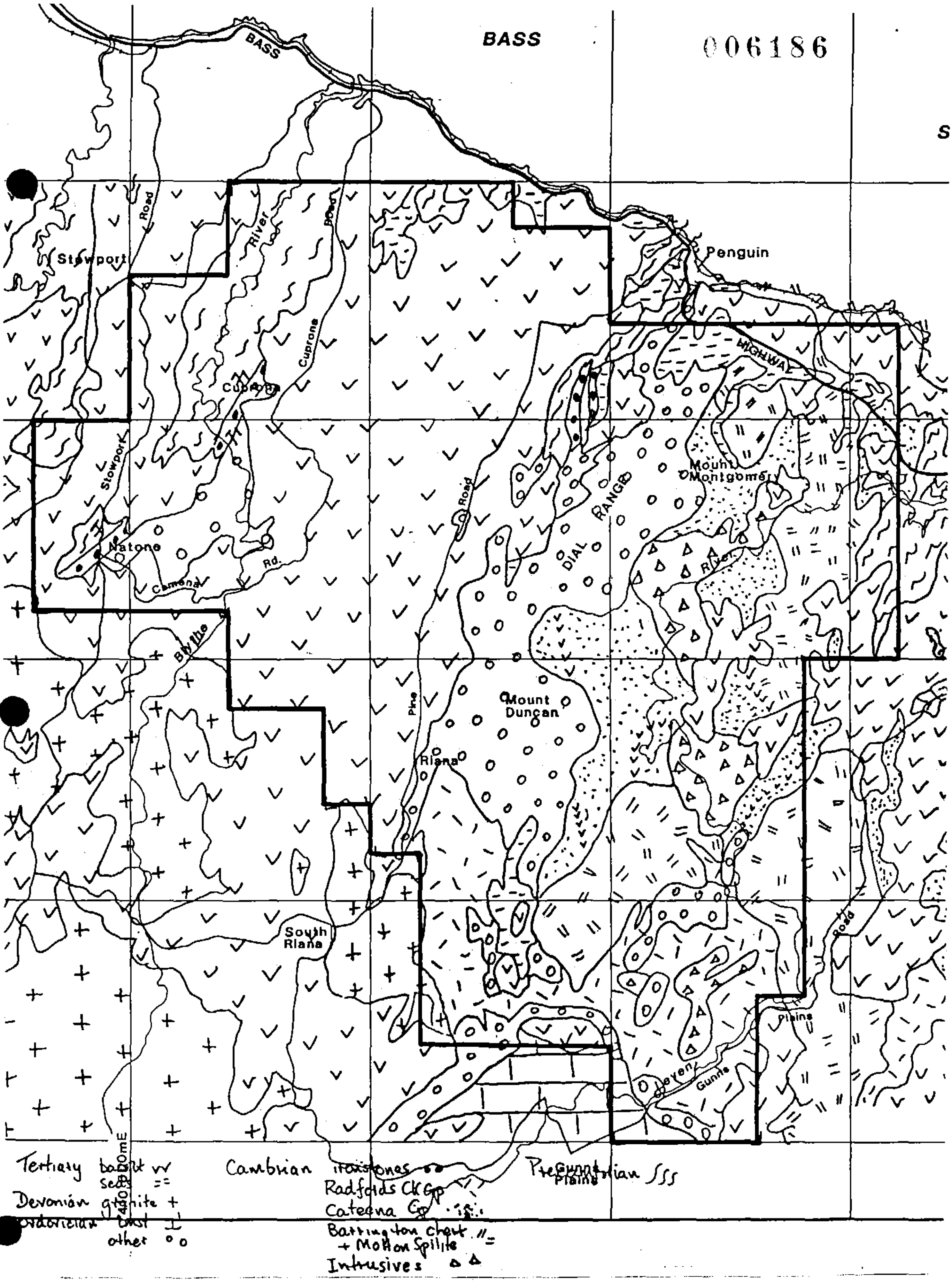
006185



LOCATION OF LICENCE EL 9/92 DIAL RANGE

FIGURE 1

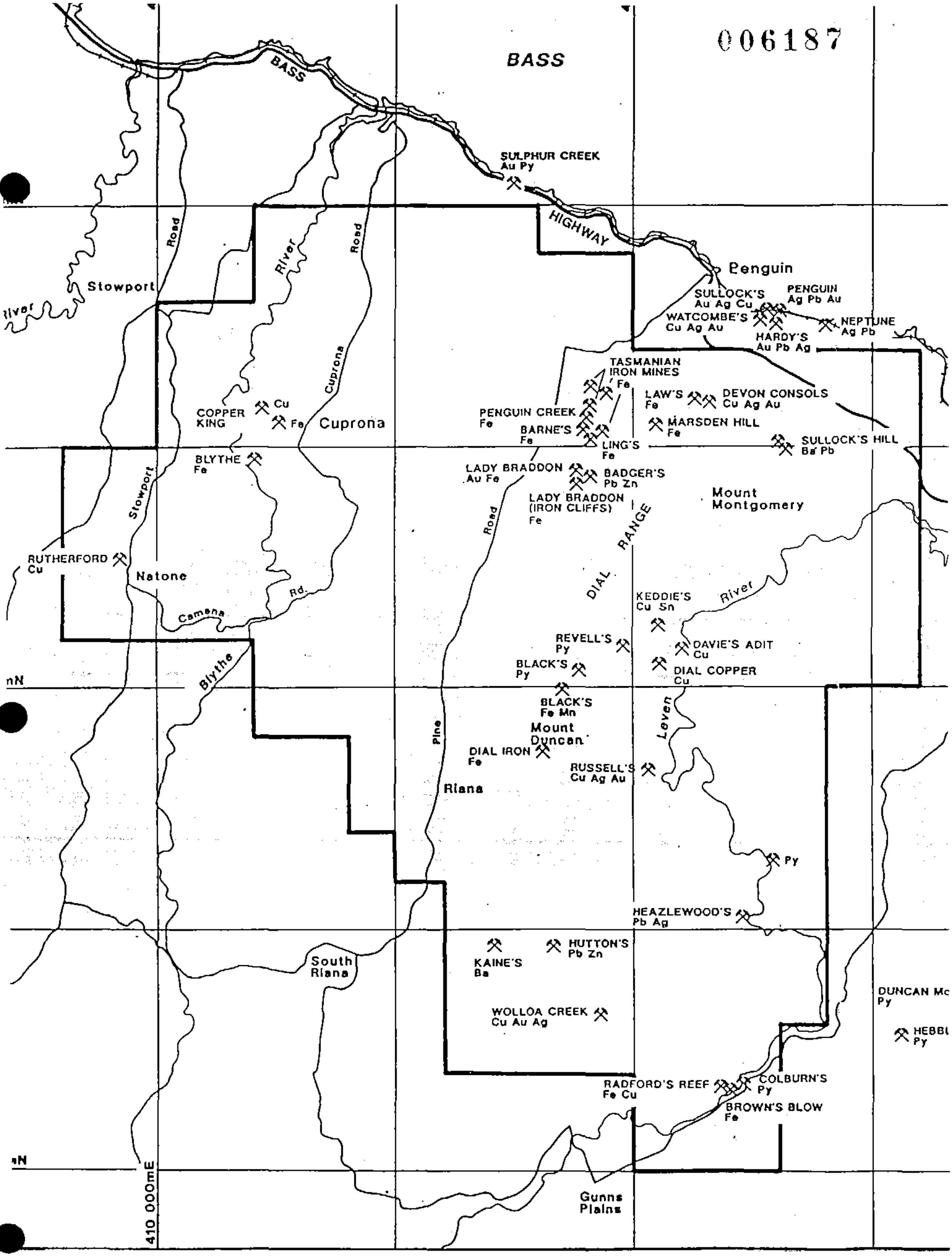
006186



SIMPLIFIED COMPILATION OF GEOLOGY OF DIAL RANGE AREA
(after Pasminco Exploration)

FIGURE 2

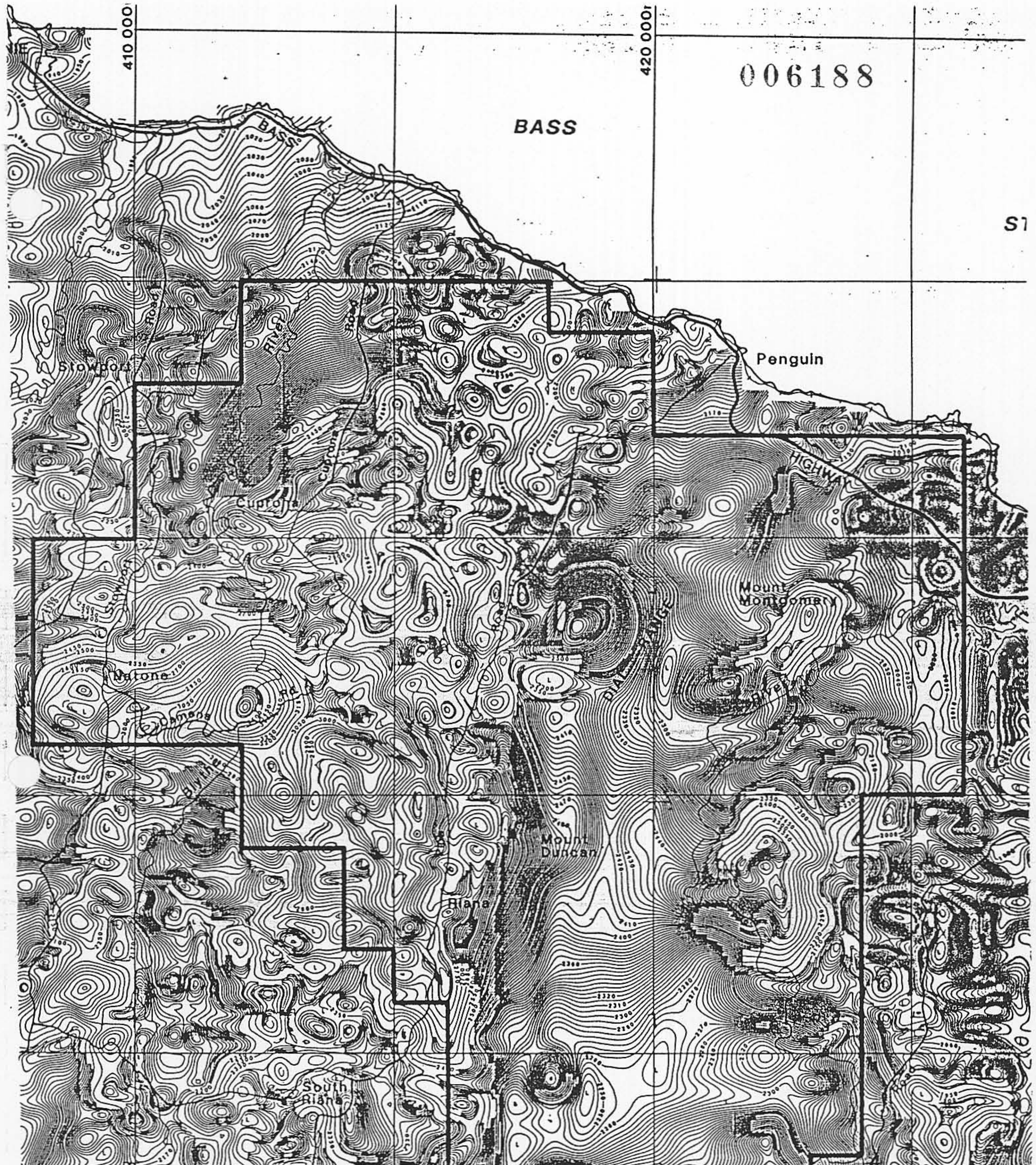
006187



MINERALISED SITES WITHIN THE DIAL RANGE AREA (after Pasminco Exploration)

FIGURE 3

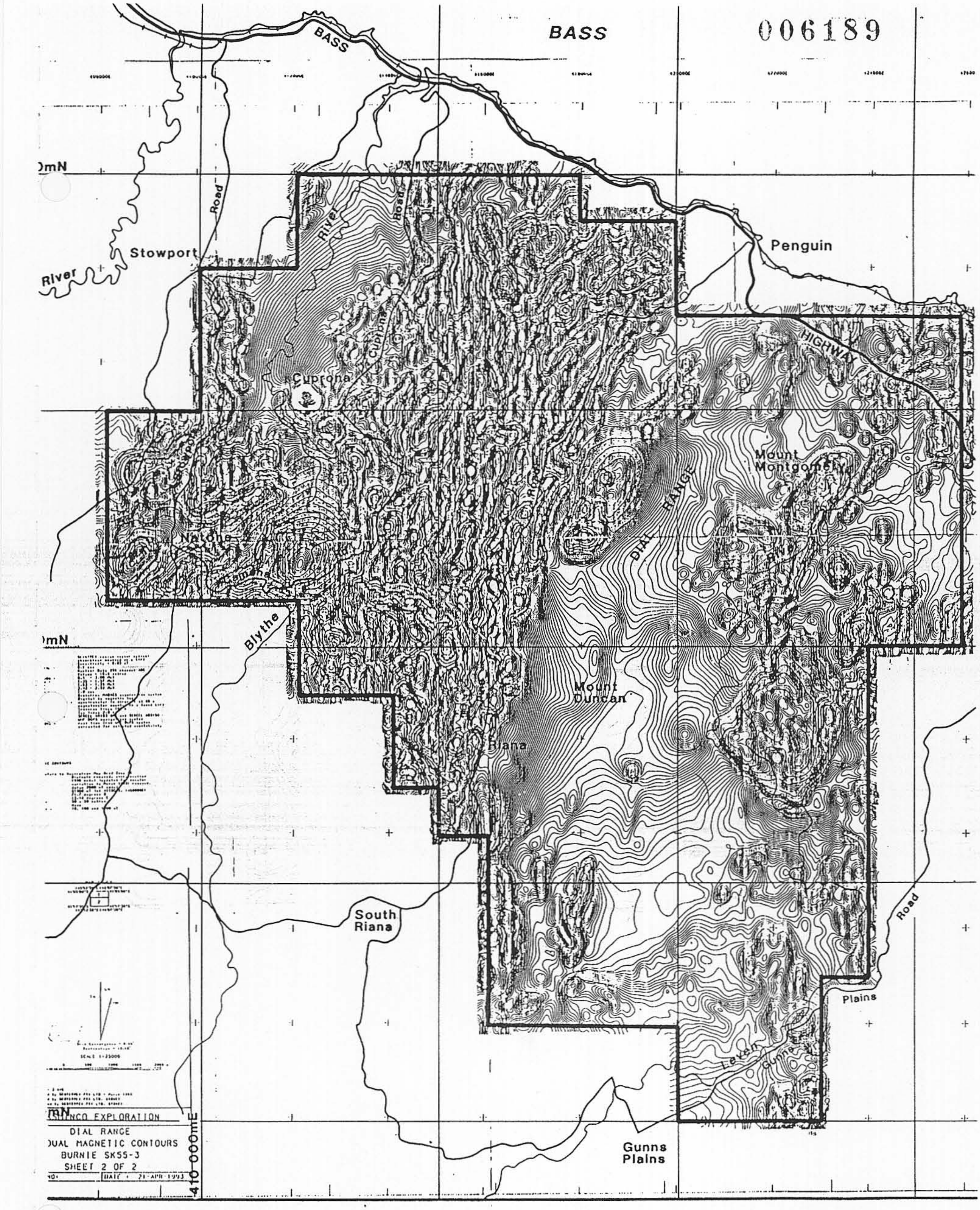
006188



MAGNETIC FIELD INTENSITY DIAL RANGE AREA
MINES DEPARTMENT 1985 SURVEY

FIGURE 4

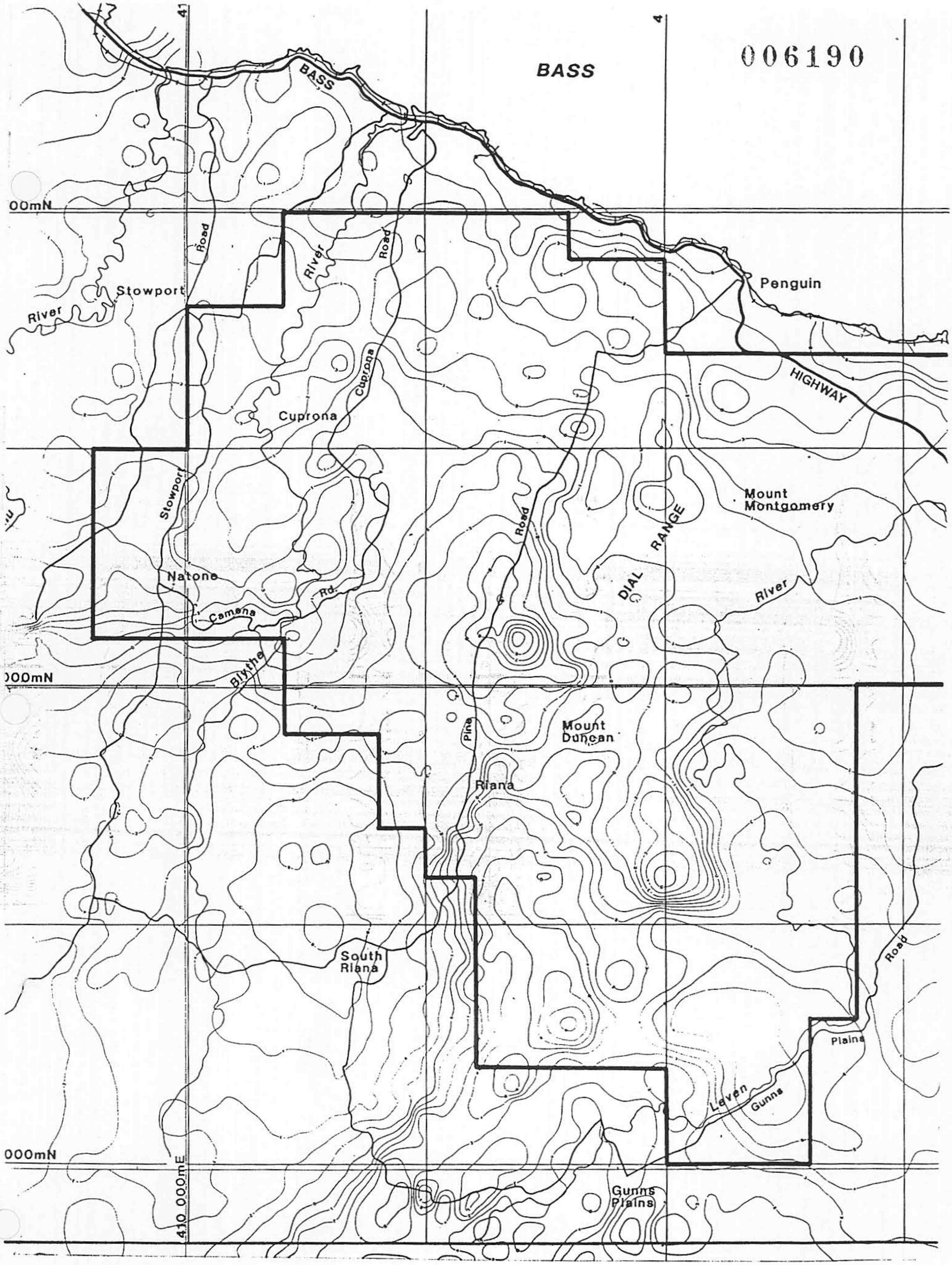
006189



MAGNETIC FIELD INTENSITY DIAL RANGE AREA
PASMINCO EXPLORATION 1993 SURVEY

FIGURE 5

006190



RESIDUAL BOUGUER ANOMALIES DIAL RANGE AREA
TASGRAV DATA BASE PROCESSED USING MANTLE91 MODEL

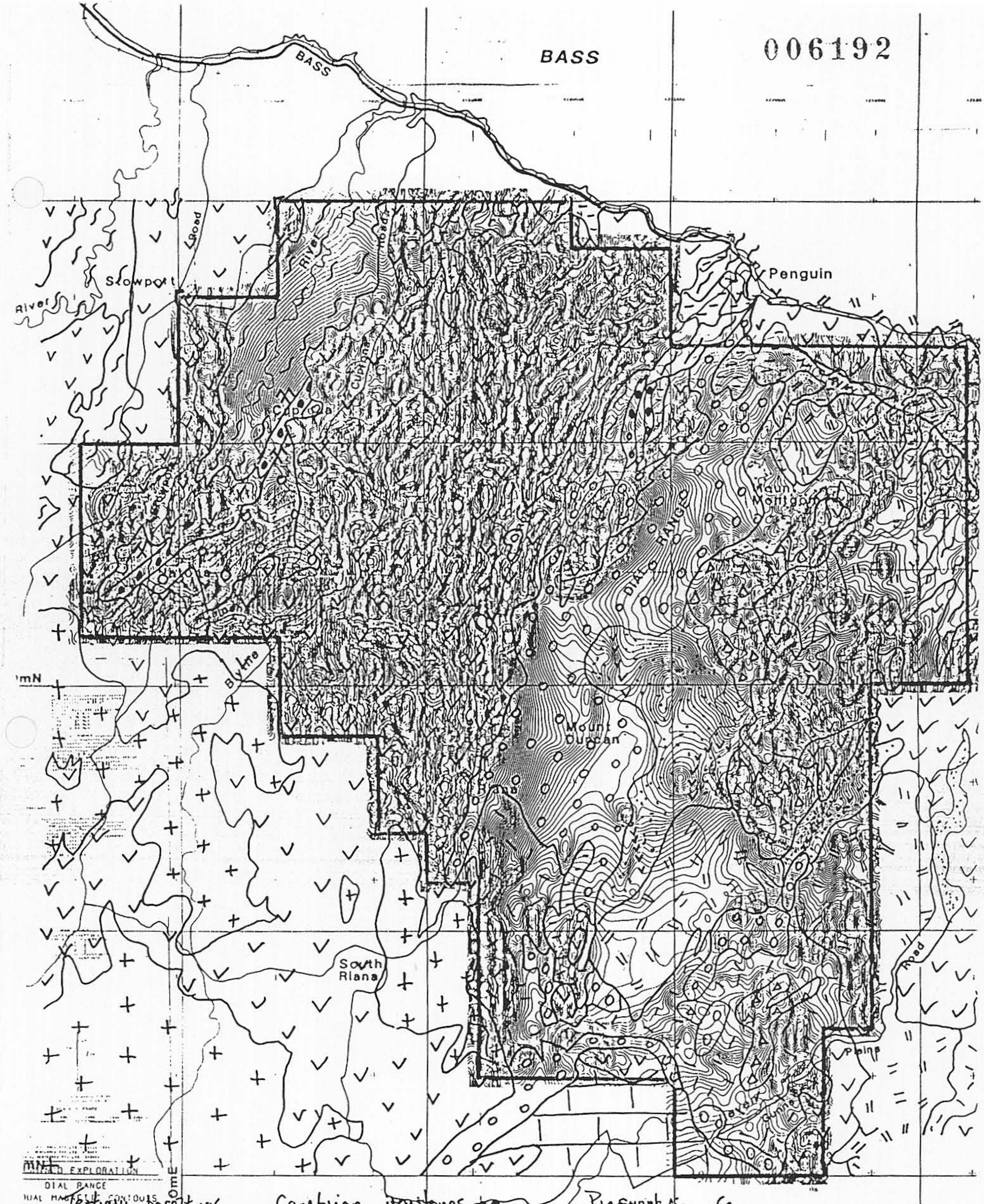
FIGURE 6

006191

REGIONAL MAGNETIC ANOMALY DISTRIBUTION
(from colour image prepared by Pasminco Exploration)

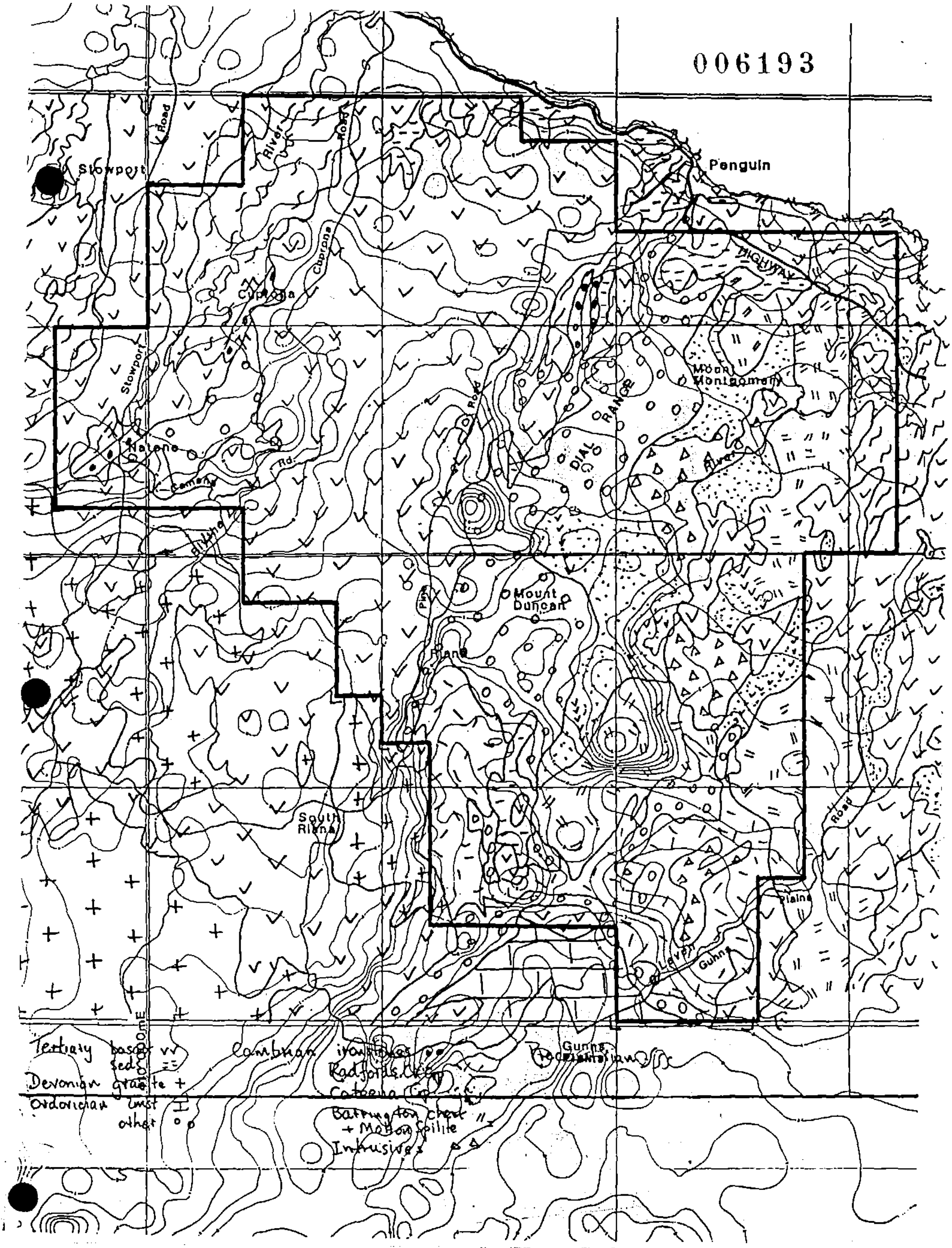
FIGURE 7

006192



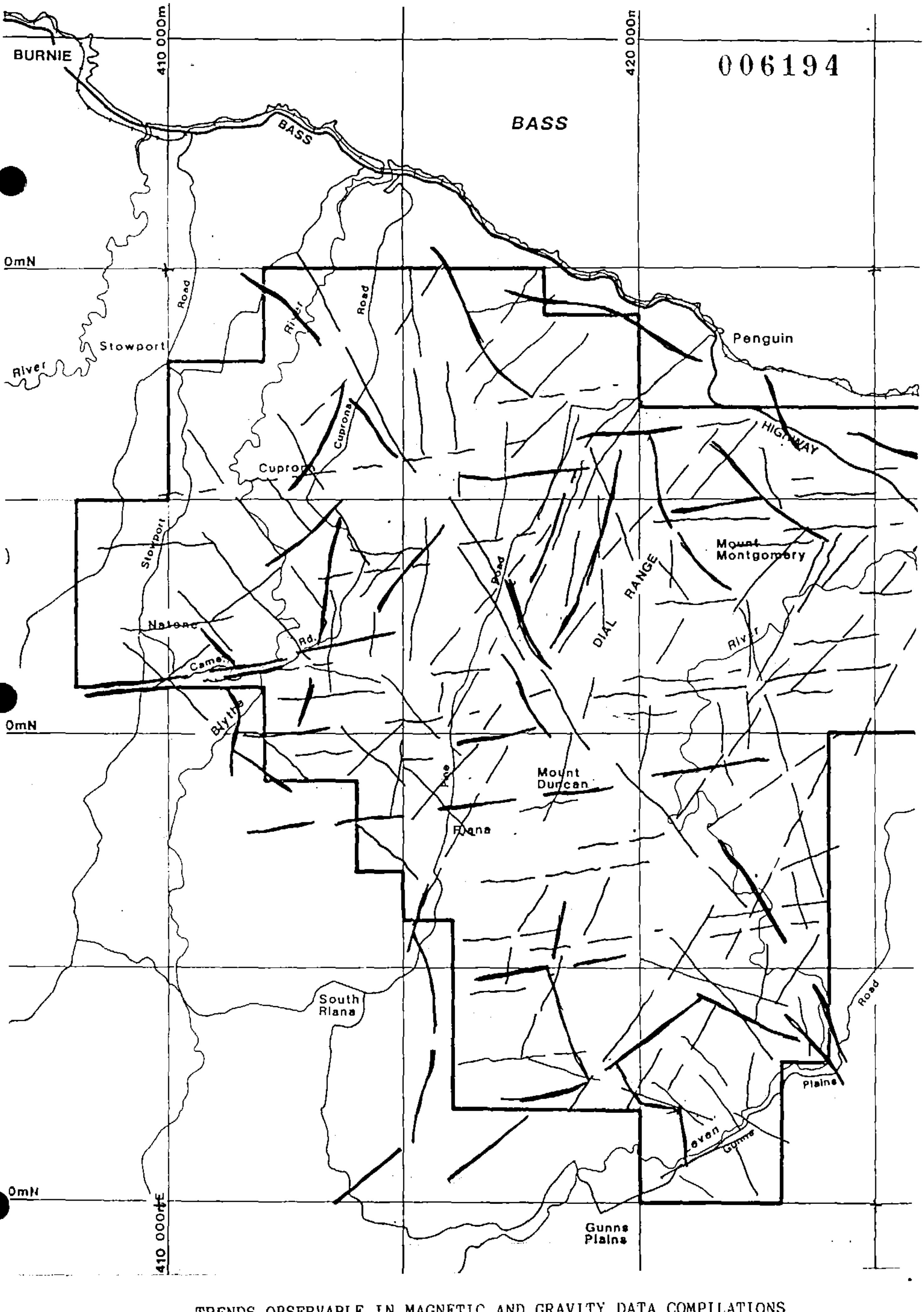
OVERLAY: 1993 MAGNETIC SURVEY AND GEOLOGY

FIGURE 8



OVERLAY: CURRENT COMPILATION RESIDUAL BOUGUER ANOMALIES AND GEOLOGY
FIGURE 9

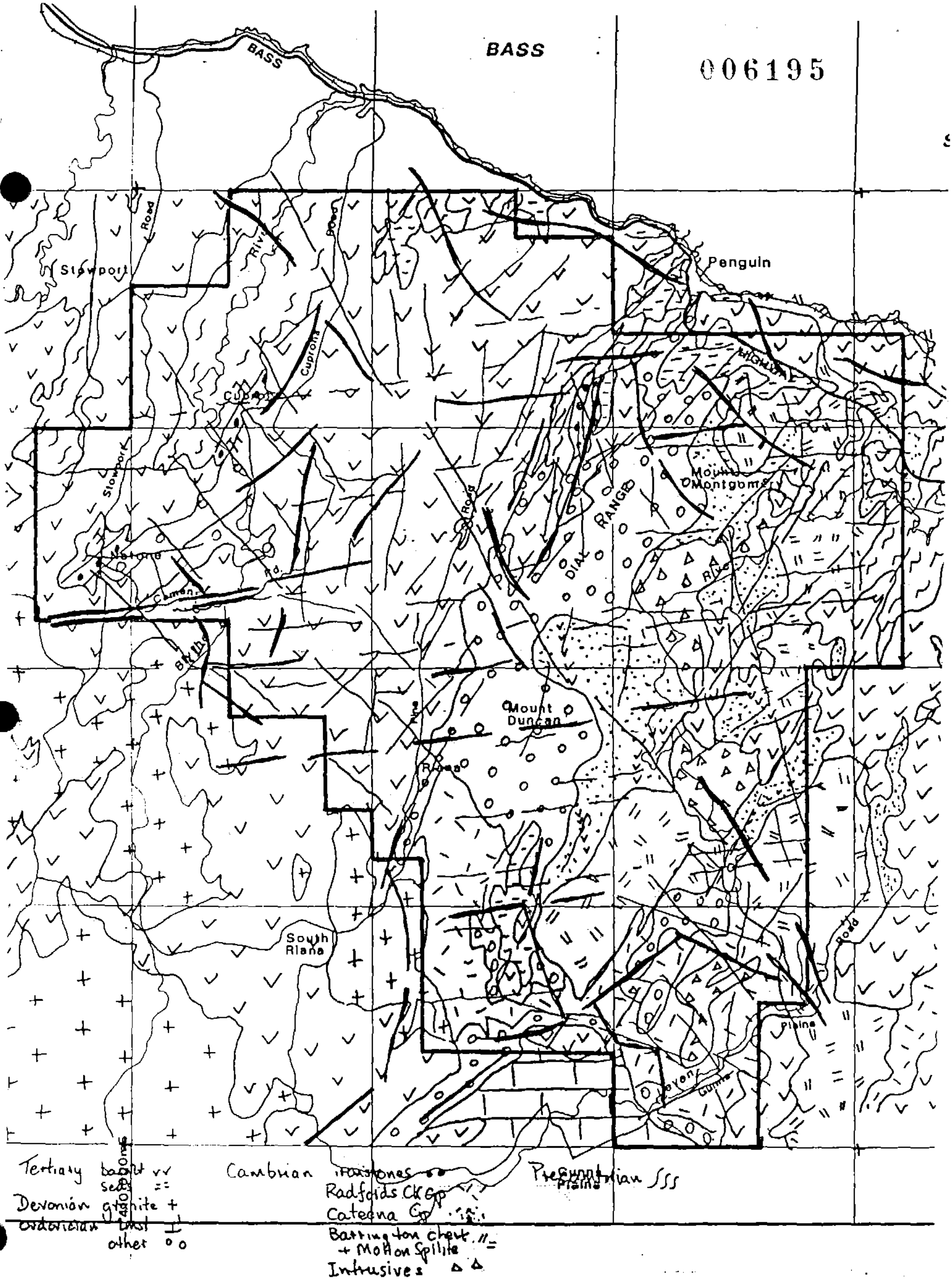
006194



TRENDS OBSERVABLE IN MAGNETIC AND GRAVITY DATA COMPILATIONS

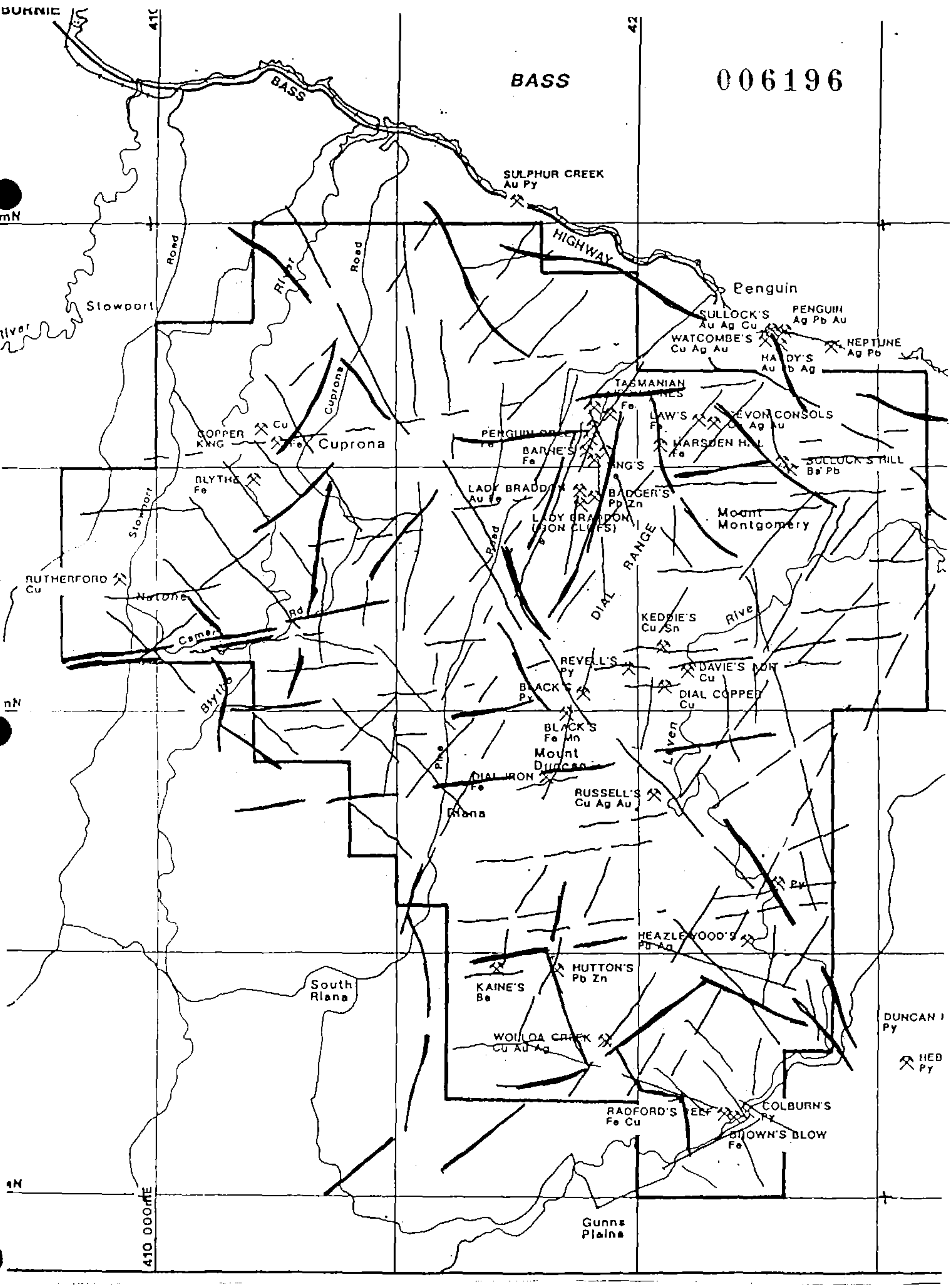
FIGURE 10

006195



OVERLAY: TRENDS AND GEOLOGY BASE MAP

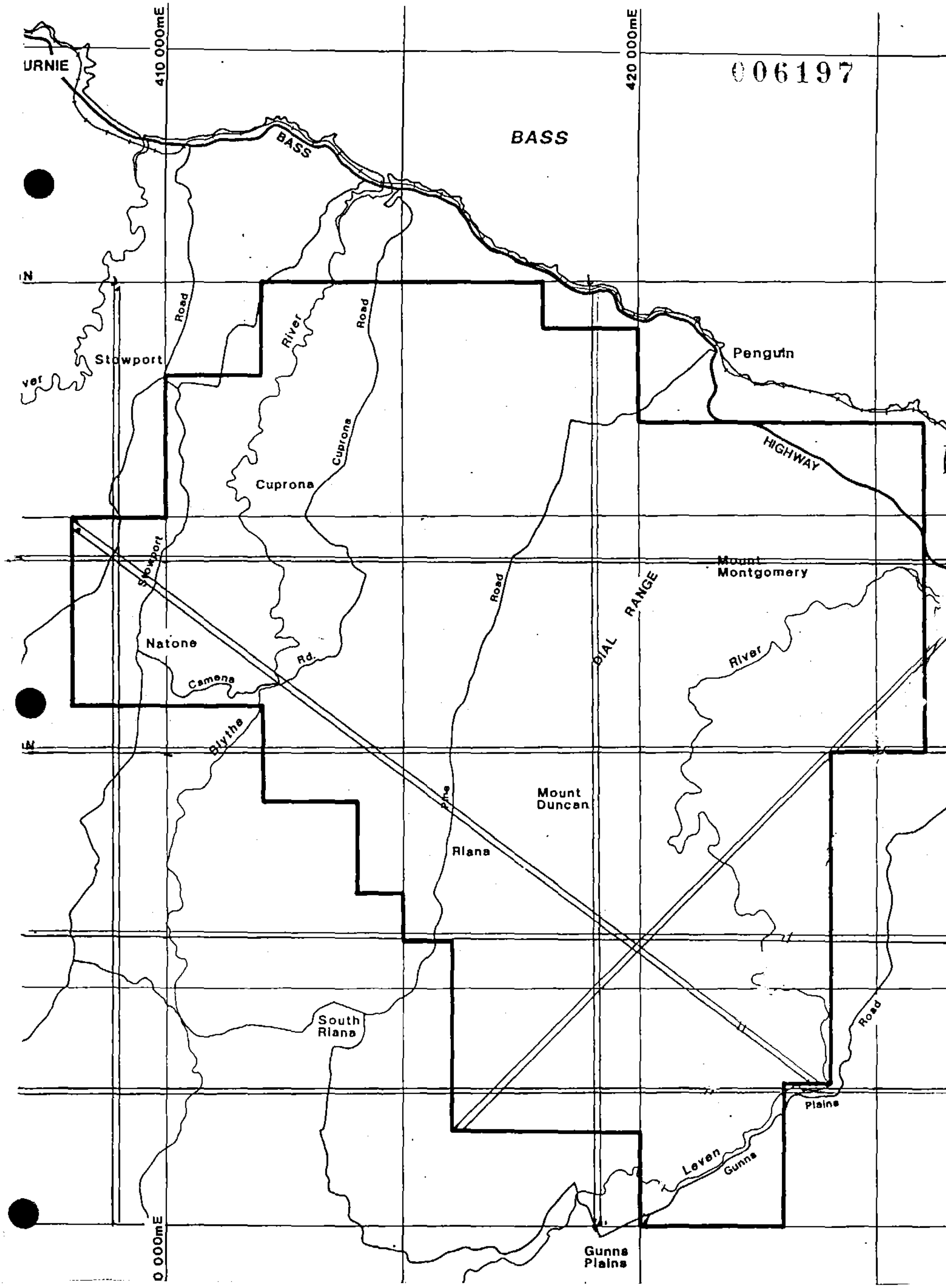
FIGURE 11



OVERLAY: TRENDS AND PROSPECT LOCALITY MAP

FIGURE 12

006197



DIAL RANGE MODELLING STUDY: LOCATION OF PROFILES FIGURE 13

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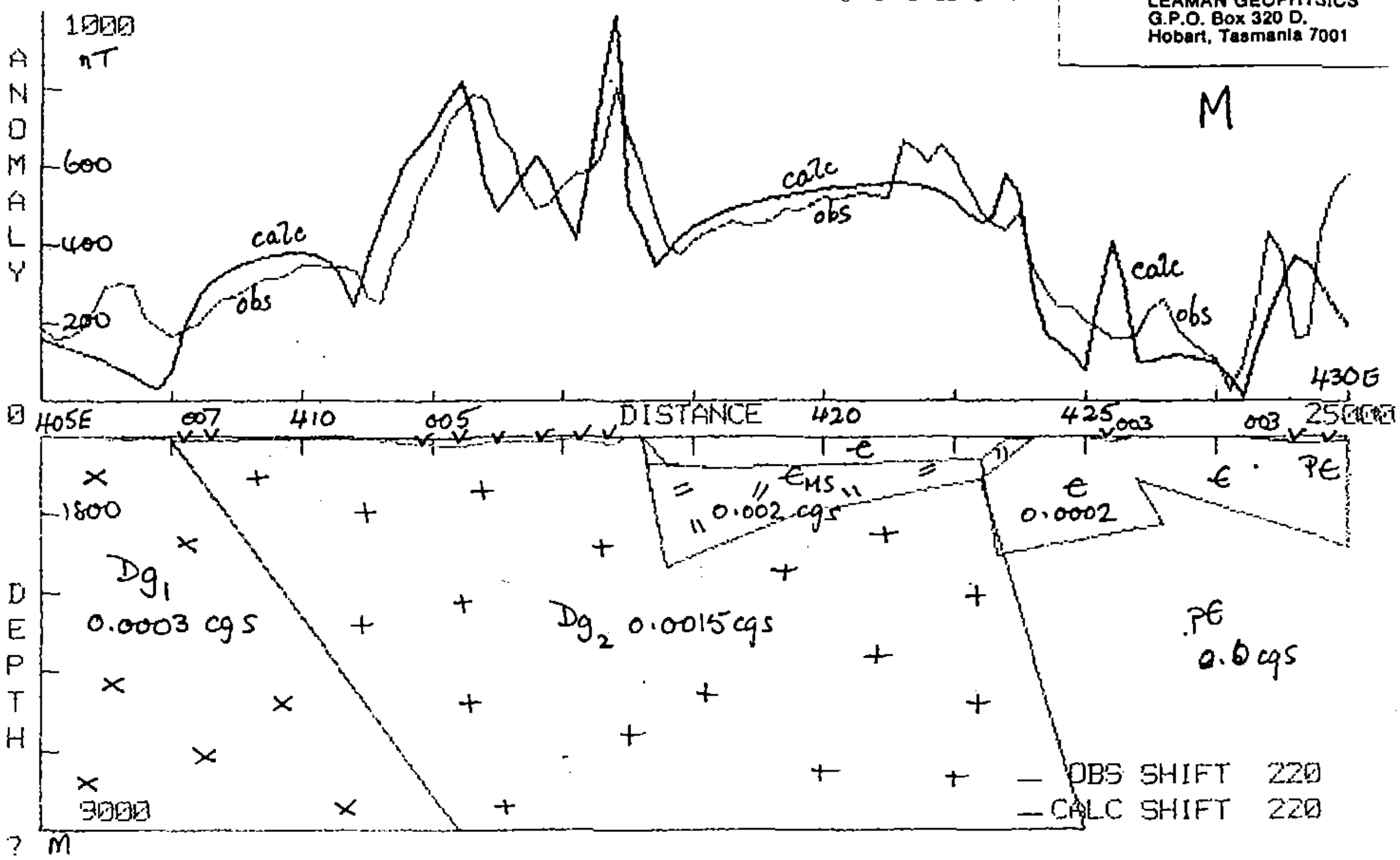
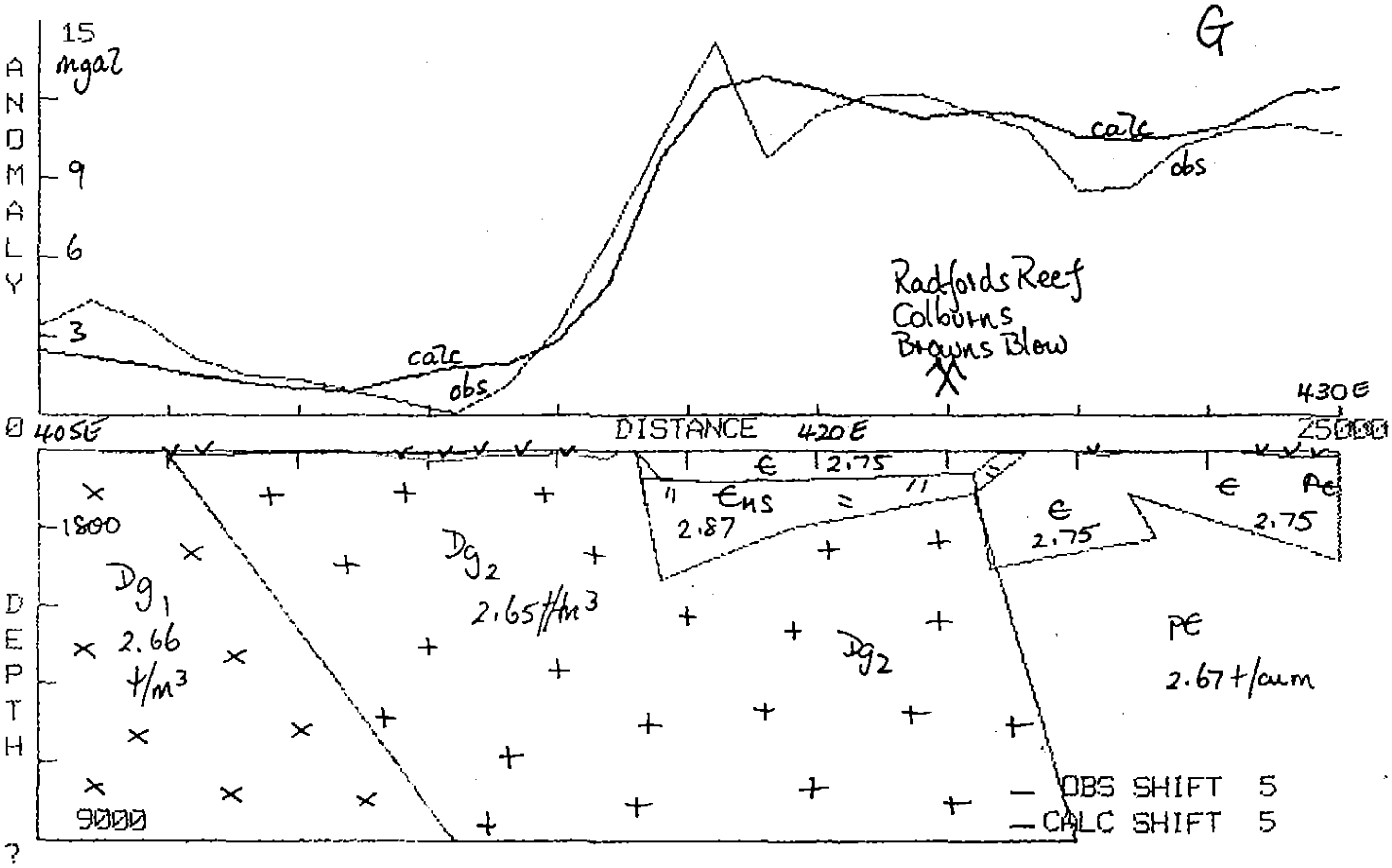
Hobart, Tasmania 7001





2D GRAVITY AND MAGNETIC MODELS 5433 000 MN (LINE 433) FIGURE 14

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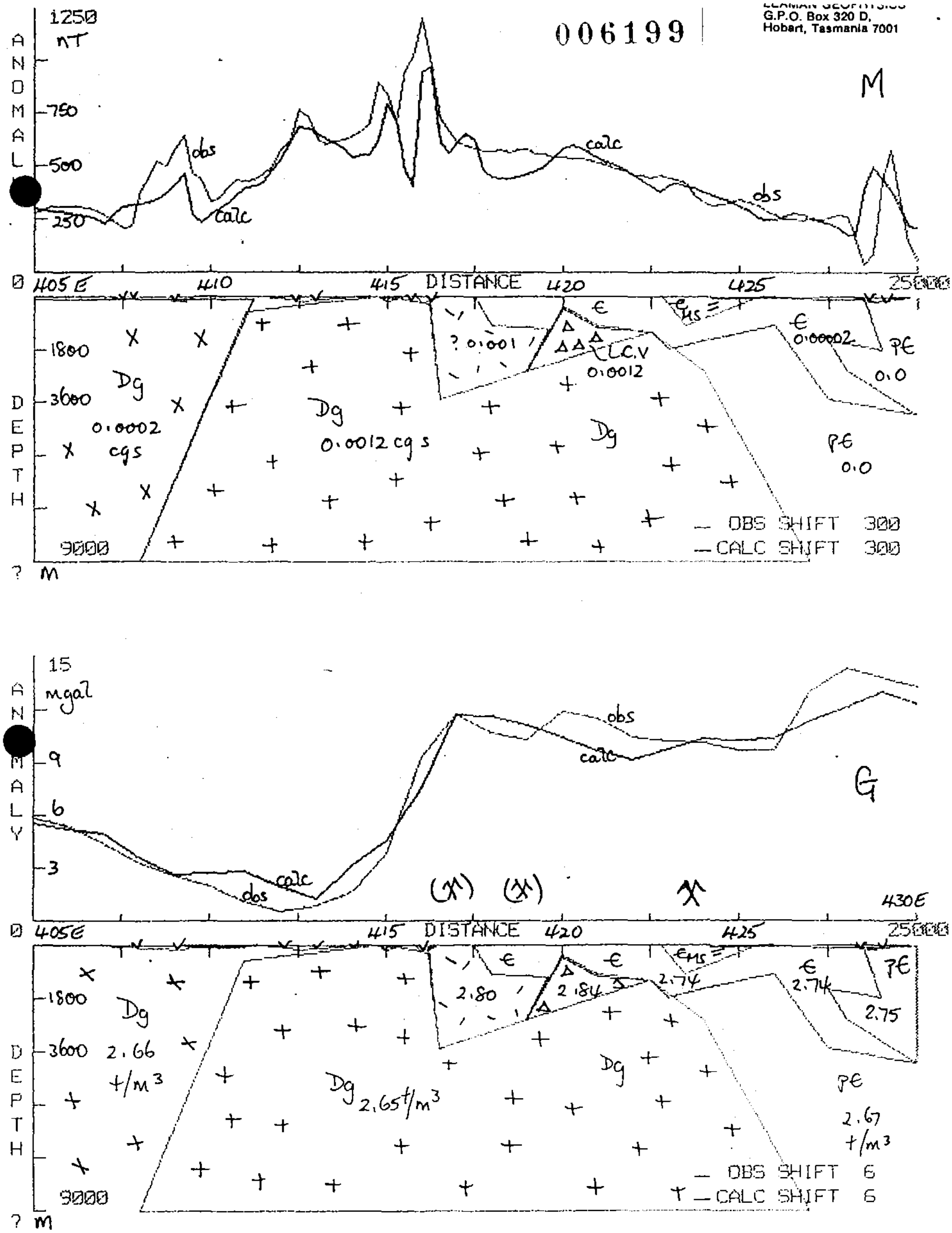
006199



2D GRAVITY AND MAGNETIC MODELS 5436 000 MN (LINE 436) FIGURE 15

006200

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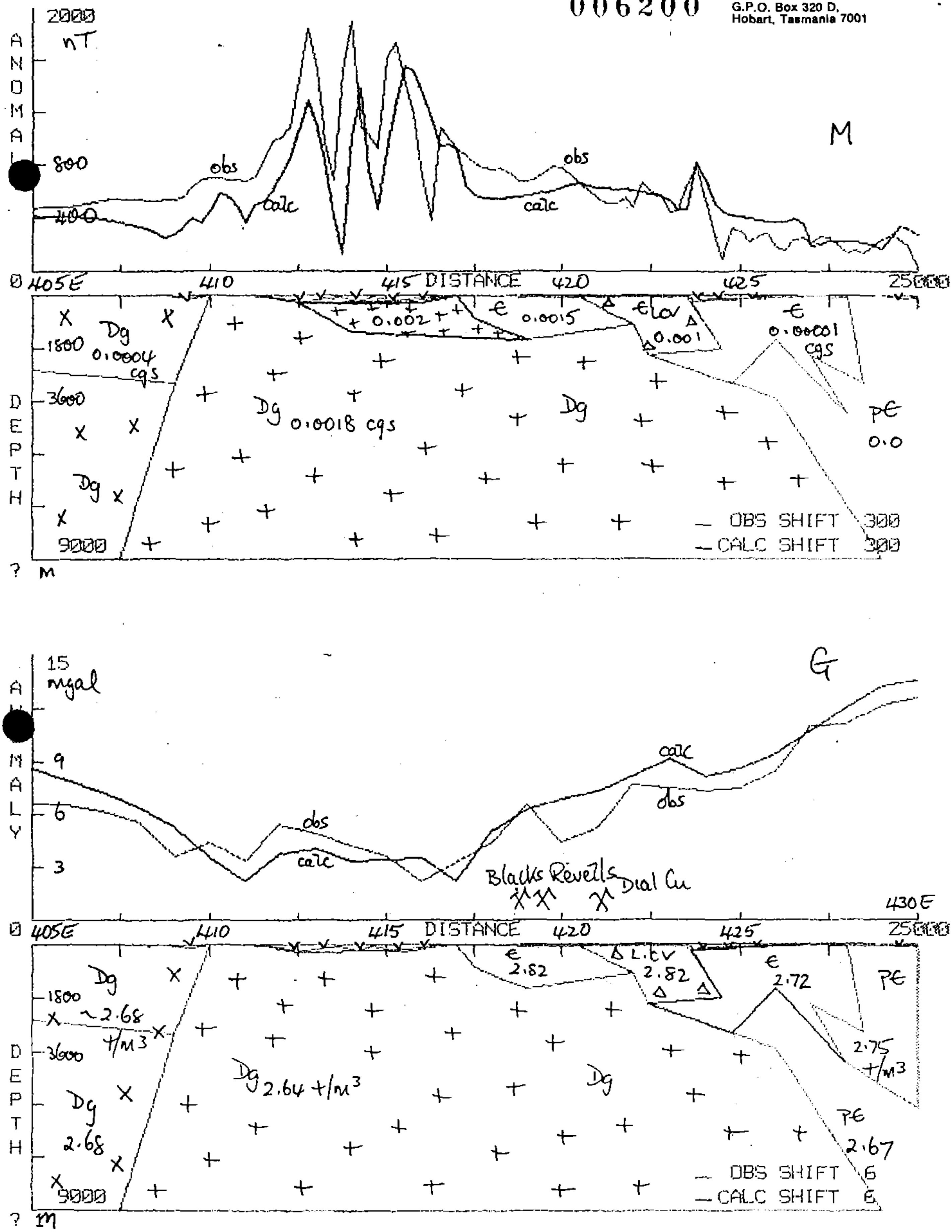

2D GRAVITY AND MAGNETIC MODELS 5440 000 MN (LINE 440) FIGURE 16

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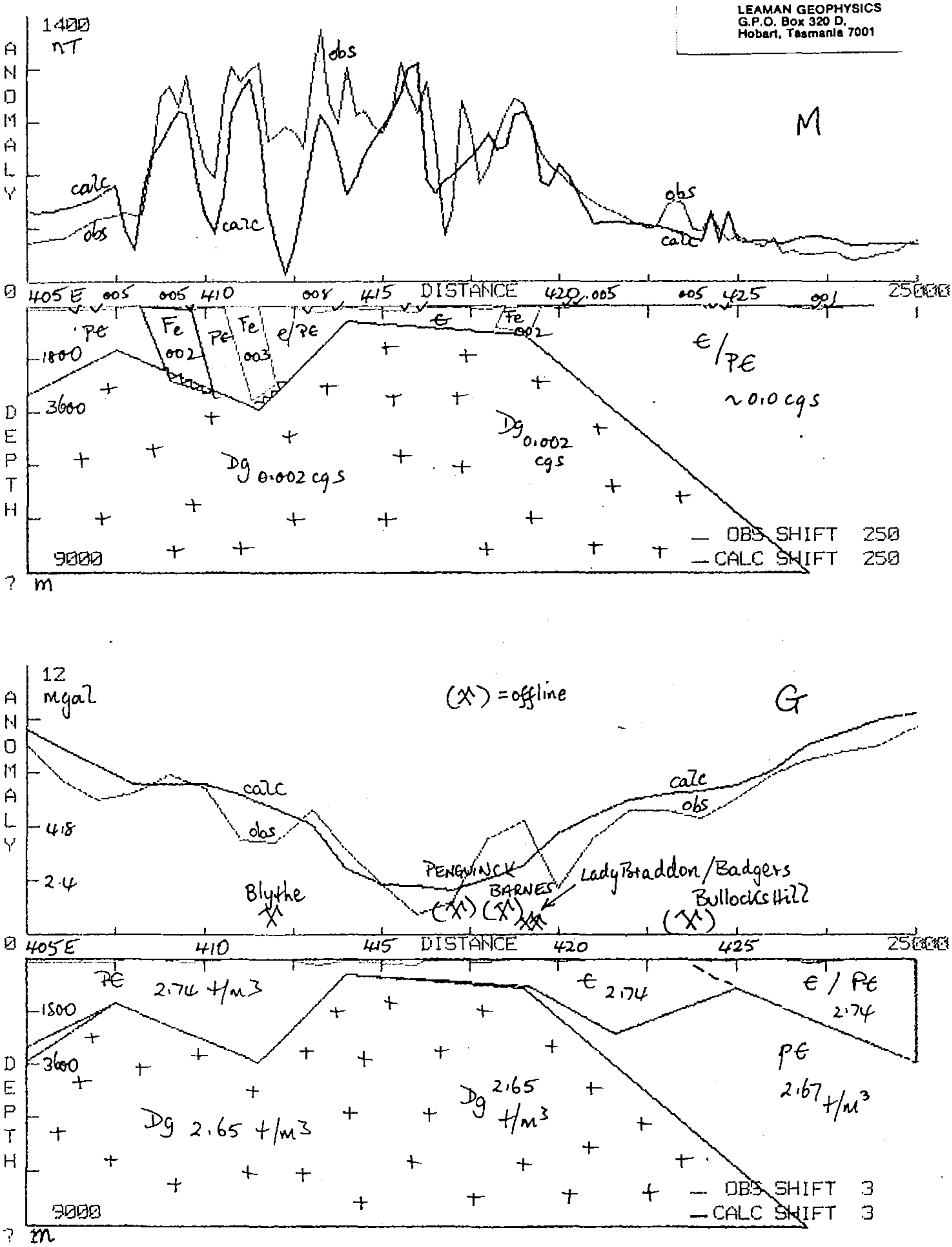
Hobart, Tasmania 7001



2D GRAVITY AND MAGNETIC MODELS 5444 000 MN (LINE 444) FIGURE 17

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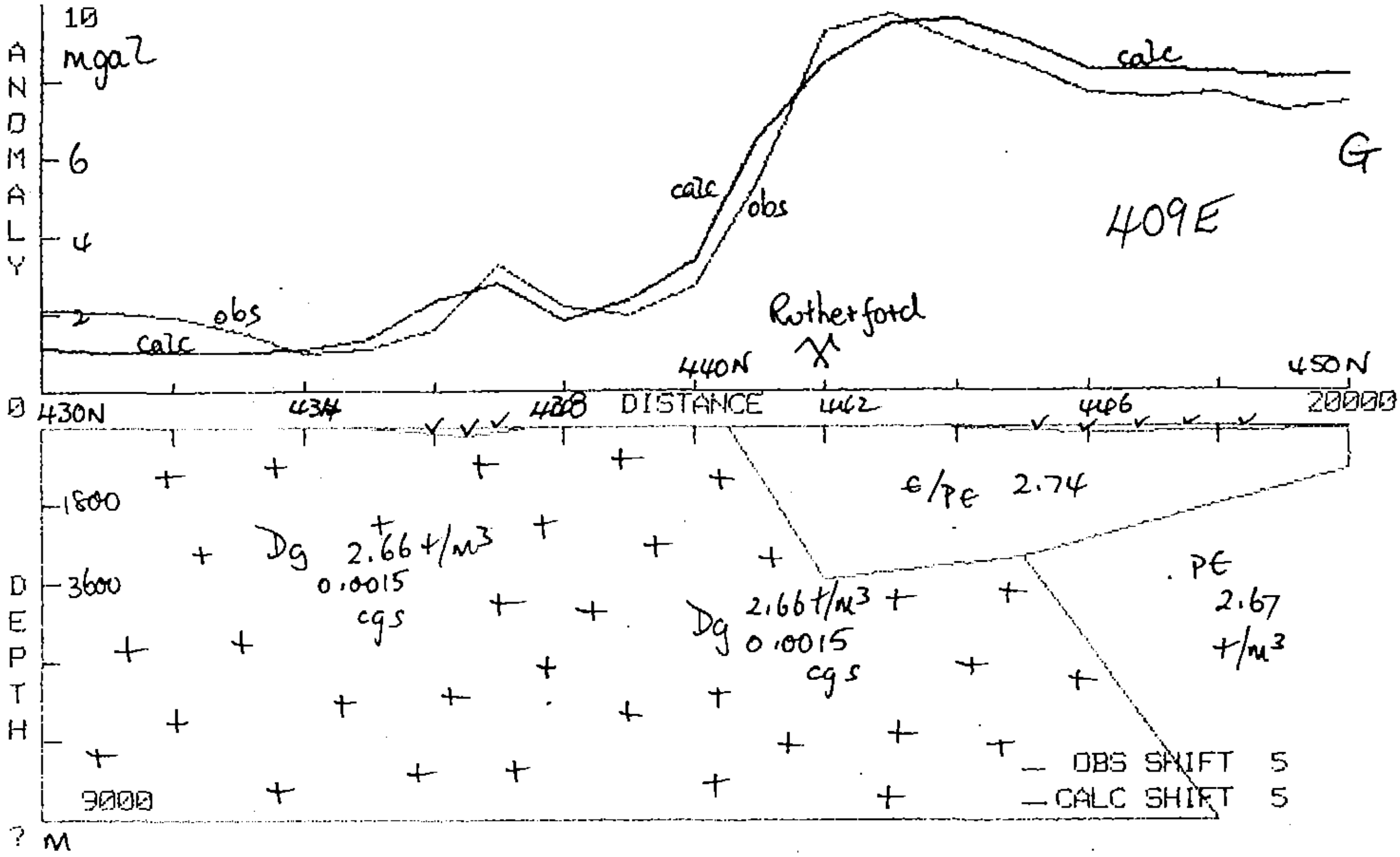

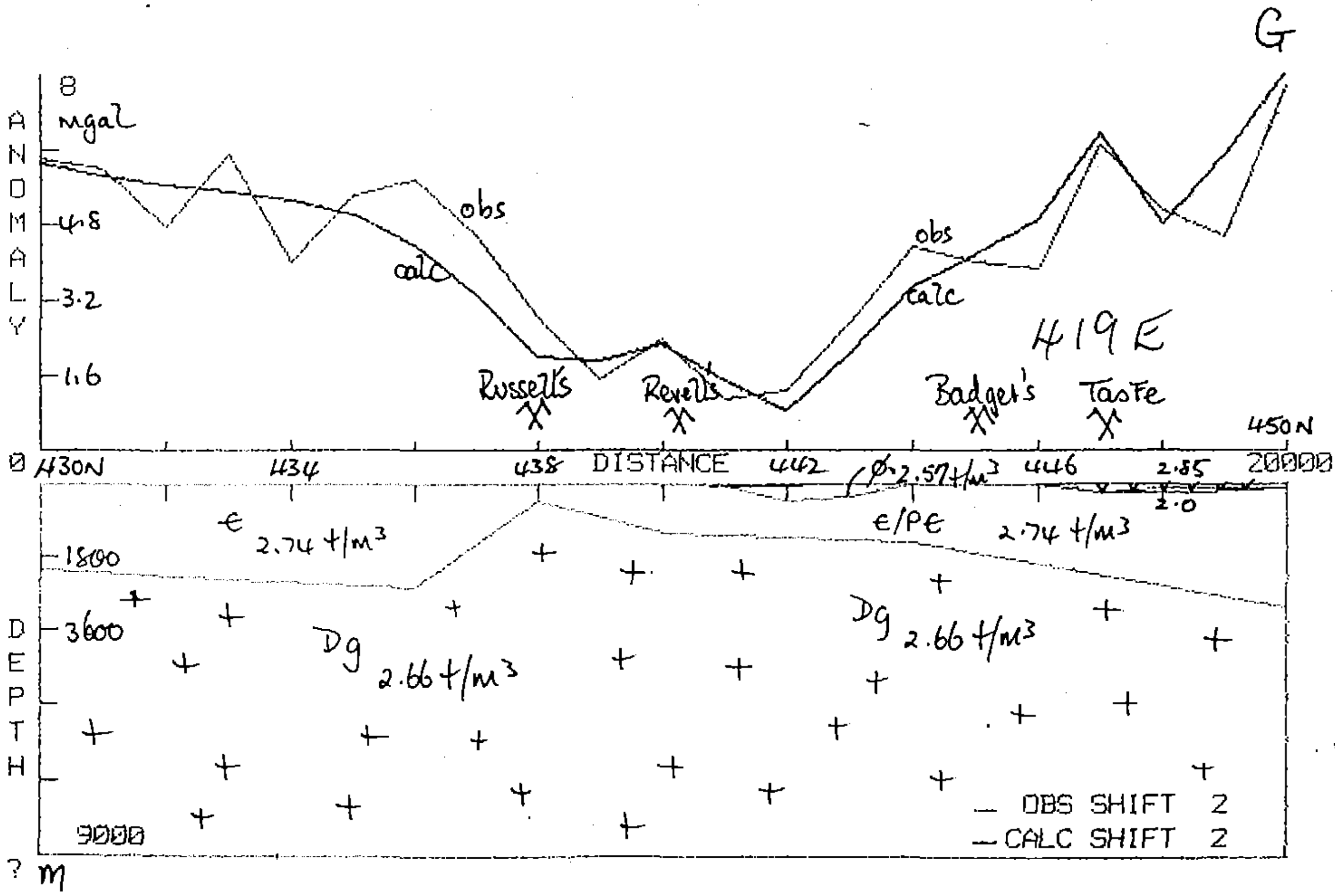

2D GRAVITY MODELS 409 000 ME (LINE 409)
419 000 ME (LINE 419)

FIGURE 18

006203

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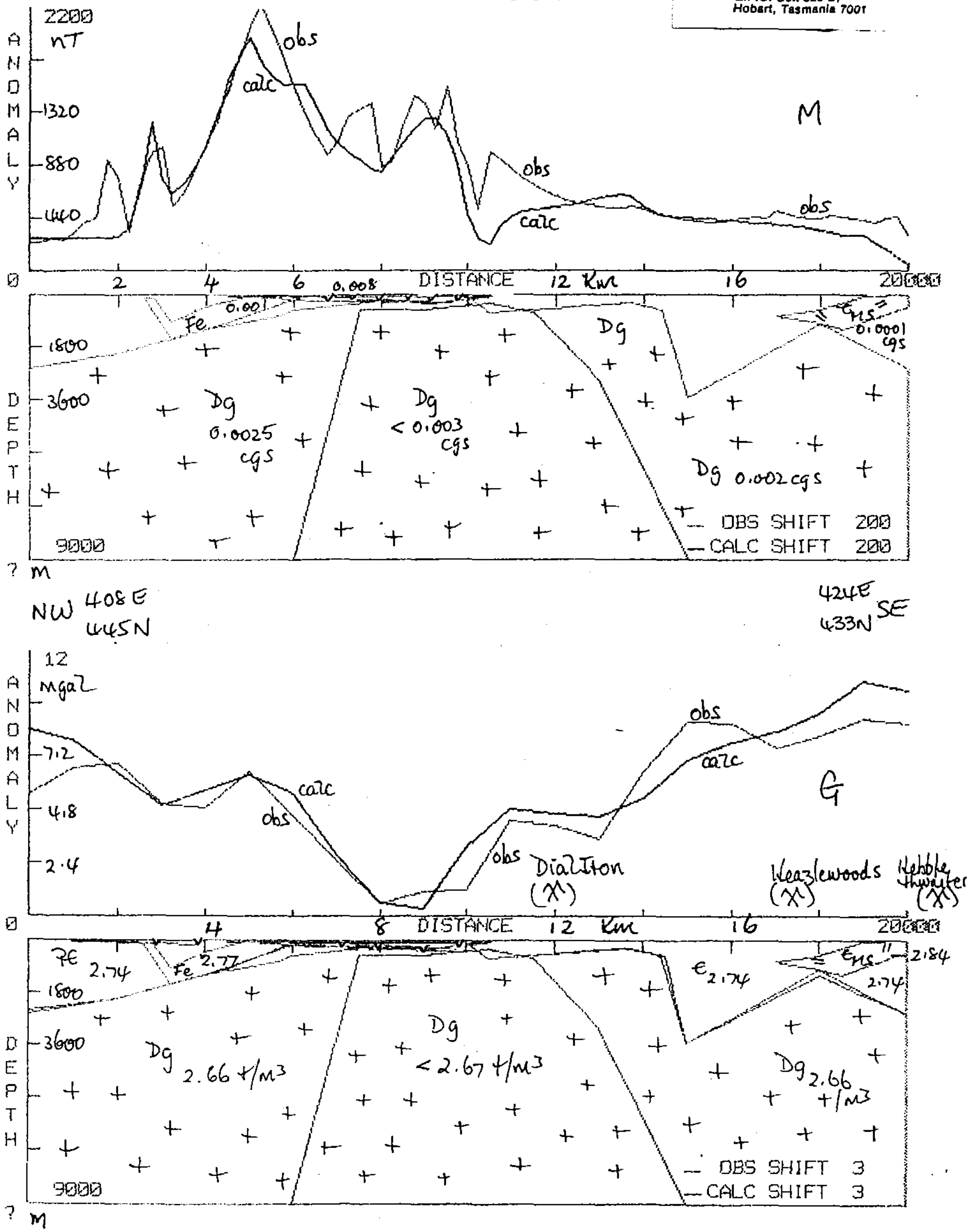

2D GRAVITY AND MAGNETIC PROFILES LINE 845 FIGURE 19
end of line coordinates marked

006204

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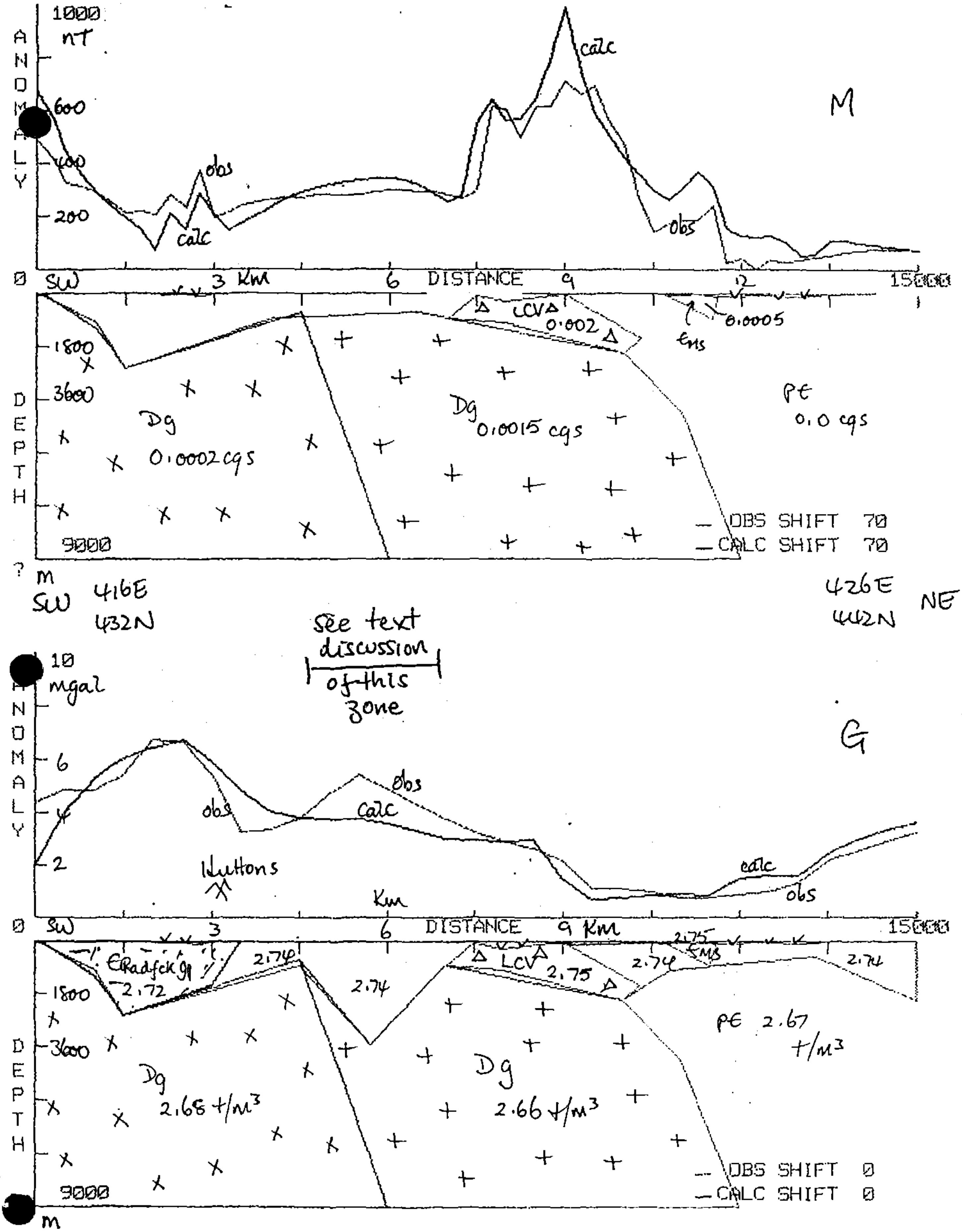


2D GRAVITY AND MAGNETIC PROFILES LINE 632 FIGURE 20
end of line coordinates marked

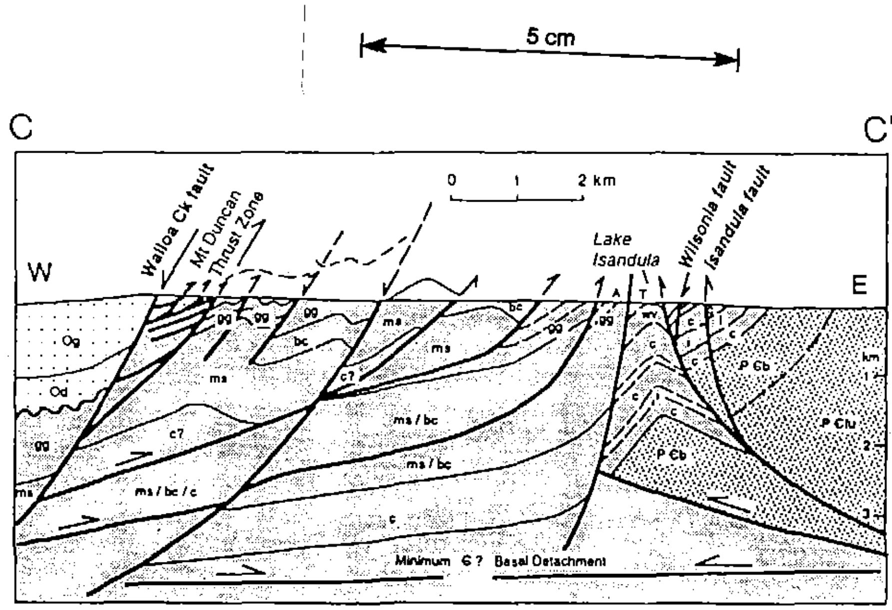
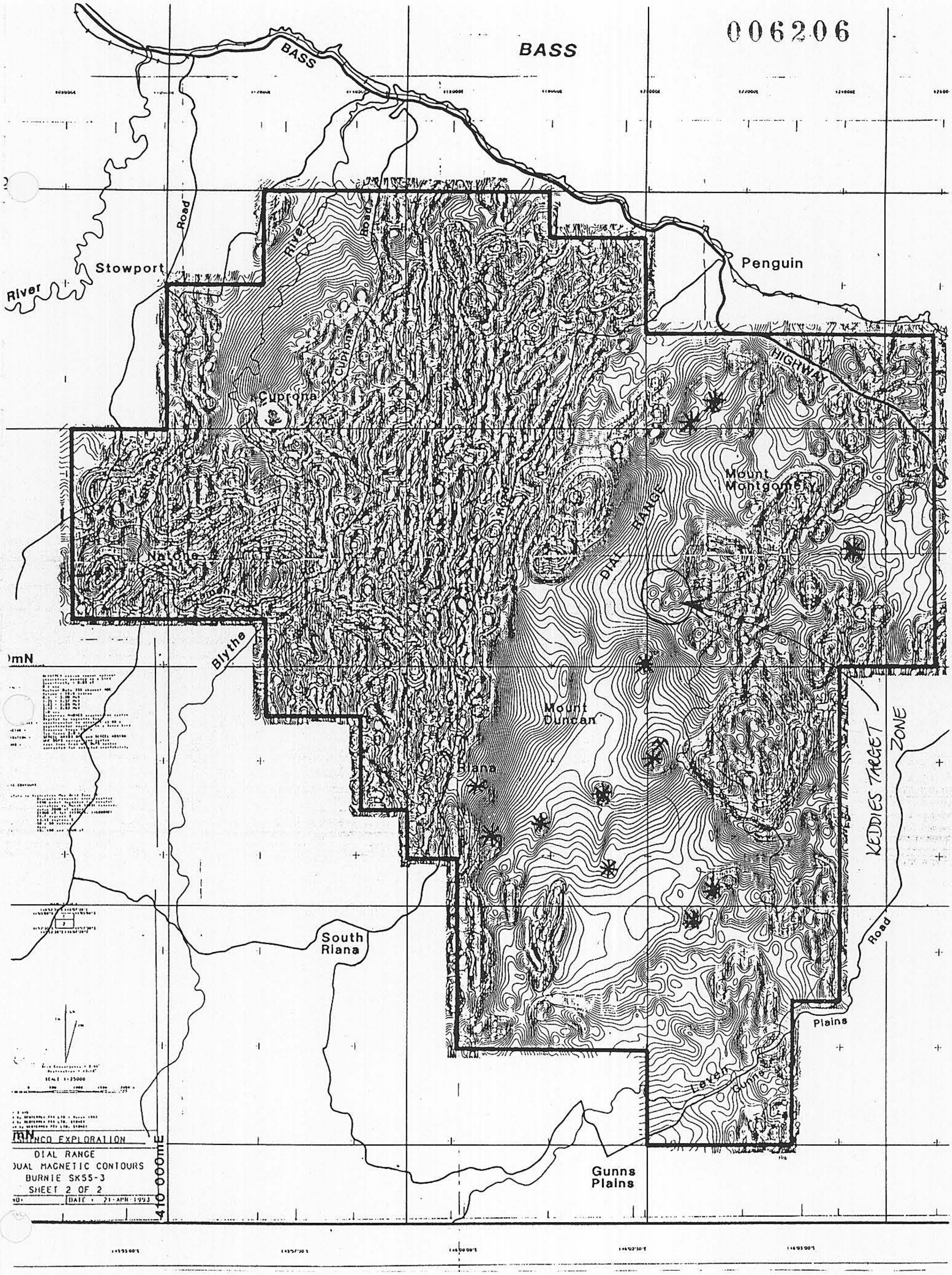


Fig. 6 West–east cross-section (C–C', Fig. 2) across the southern Dial Range along Leven Gorge (based on Burns 1963; Jennings 1979; and new mapping). Key structural elements are the extensional Walloa Creek Fault and the change in structural vergence across the anticline at Lake Isandula. The stratigraphic thickness of the units suggests that the surficial fault blocks extend to a depth of at least 2–3 km. Below that depth a repeated Cambrian stratigraphy is expected in the footwall of the Forth Massif basal thrust, and in the footwall of the Mt Duncan thrust. The structure at Lake Isandula is interpreted to be a triangle zone between converging thrust blocks. Stratigraphic units: ms = Motton Spilite; bc = Barrington Chert; c = Cateena Mudstone; gg = Gog Greywacke; Od = Denison Group; Og = Gordon Group; PCb = Burnie Formation; PCfu = Forth/Ulverstone Massif; i = Isandula Conglomerate; wv = Wilsonia Volcanics. Combined units, for example ms/bc/c, indicate that several units of similar stratigraphic position probably occur.

STRUCTURAL MODEL OF DIAL RANGE AREA - WOODWARD ET AL (1993)

FIGURE 21

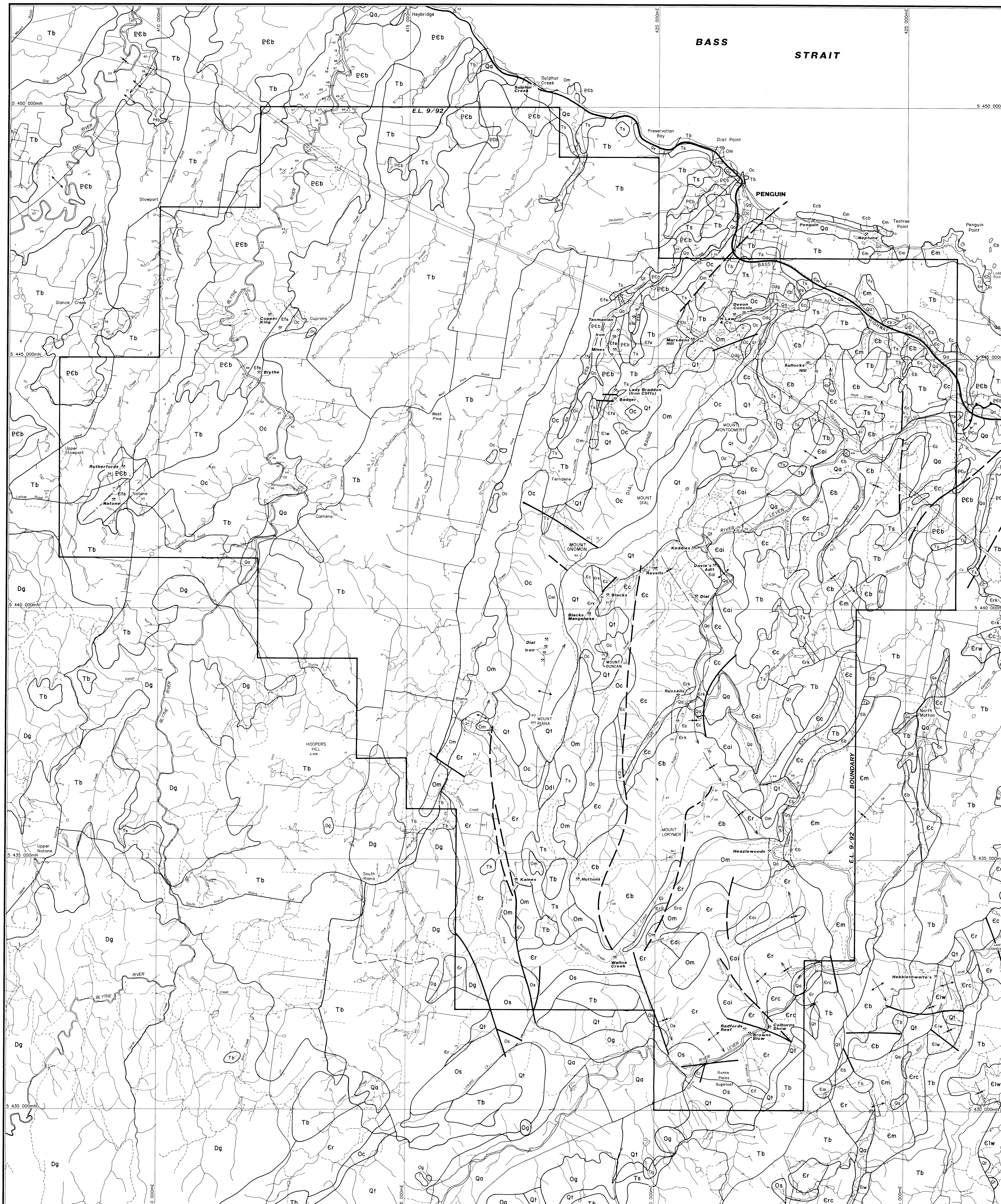
006206



UNEXPLAINED MAGNETIC RESPONSES

FIGURE 22

FIGURES



LEGEND

QUATERNARY

- **Qa** Alluvium
- **Qt** Talus and scree deposits

TERTIARY

- **Tb** Basalt lava and pyroclastic rocks
- **Ts** Terrestrial sand, gravel, silt and clay with rarer indurated equivalents

ORDOVICIAN

- **Og** Limestone, dolomite, and mudstone (Gordon Group Correlate)

EARLY ORDOVICIAN - LATE CAMBRIAN

- **Om** Marine quartzose sandstone, shale, minor conglomerate (Moina Sandstone)
- **Oc** Dominantly quartzite and vein quartz pebble to boulder conglomerate (Duncan Conglomerate)
- **Odg** Purple mudstone, sandstone, minor chert conglomerate (Gnomon Mudstone)
- **Os** Undifferentiated sandstone–conglomerate (above)

CAMBRIAN

- **Єfe** Ferruginous deposits, heamatite and goethite
- **Єf** Felsic volcanic rocks (including Minnow Keratophyre)

Radfords Creek Group

- **Єr** Volcaniclastic sandstone and mudstone with horizons of lithicwacke and quartzose conglomerate
- **Єra** Plagioclase – phyric dacite and volcaniclastics (Applebee Volcanics)
- **Єrw** Feldspar–phyric felsic lava and volcaniclastics (Wilsonia Volcanics)
- **Єrk** Feldspar–phyric intermediate lava and volcaniclastics (Kerrison Volcanics)
- **Єrc** Conglomerate with clasts of chert and less common spilite in a lithicwacke matrix (Sprent Formation)

Cateena Group

- **Єc** Dominantly mudstone, sandstone, conglomerate, with minor chert
- **Єcb** Megabreccia with blocks of chert, siltstone, dolomite in a lithicwacke–conglomerate matrix (Beecraft Megabreccia, Teatree Point Megabreccia)
- **Єci** Conglomerate with mudstone clasts in feldspathic sandstone matrix (Isandula Conglomerate)

CAMBRIAN - Other

- **Єlw** Lithicwacke, mudstone, minor conglomerate (Gog Range Greywacke)
- **Єb** Chert, minor mudstone (Barrington Chert)
- **Єm** Tholeiitic basalt, locally pillowed (Motton Spilite)

PRE-CAMBRIAN

- **PЄb** Quartzose turbidite sandstone and mudstone (Burnie Formation)
- **PЄu** Strongly deformed pebble conglomerate and schist (Ulverstone Metamorphics)

INTRUSIVE IGNEOUS ROCKS

DEVONIAN

- **Dg** Biotite adamellite (Housetop Granite)
- **Ddl** Tholeiitic dolerite

CAMBRIAN

- **Єai** Feldspar – horneblende–phyric diorite (Lobster Creek Volcanics)
- **Єdi** Dacitic feldspar porphyry

SYMBOLS

- Geological boundary – position approximate
- ? Geological boundary – position inferred
- Thrust or reverse fault
- Fault showing relative movement
- Fault unspecified inferred
- 40 Strike and dip of bedding
- 69 Overturned bedding
- 40 Strike and dip of slatey clevage
- Syncline
- Anticline
- Mine or prospect

006208

5 cm

Geology modified after :

I. B. Jennings et al (1959), K. L. Burns (1963), R. D. Gee et al (1967), P. W. Baillie et al (1986) A. L. Bomford and G. R. Green (1988)

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : F.G.F.	E.L. 9/94 - DIAL RANGE
DATE : May, 1993	
DRAWN : G.M.B.	
REFERENCE :	GEOLOGY
	93-3447.
REVISIONS :	
DRAWING No.	SCALE 1:25,000 0 500 1000 METRES

FIG. No. 5

LEGEND

CAMBRIAN

- €ai — Felsic intrusives, including albite microsyenite, albite trachyte
- €cb — Megabreccia, including greywacke conglomerate, tuffaceous (spilitic) conglomerate sandstone, mudstone, interbedded spilite tuff and chert conglomerate breccias and siltstones
- €cb (patterned) — Dolomite and bedded limestone
- €b — Chert, including chert breccias and interbedded siltstones
- €m — Spilite, including tuffs, microgabbros

PRECAMBRIAN

- P€b — Quatrzite and metasiltstone, slate

Fish trap

ALTERATION (overprint)

- Weak silica–epidote, minor disseminated pyrite, trace chalcopyrite
- Strong silicification and disseminated pyrite mineralization
- Contact hornfels (?)

SAMPLE LOCALITY

- ⊗ 34568 — Sample for assay and/or petrography
- × D143 — Hand speciman for reference

SYMBOLS

- Geological boundary
- Thrust or reverse fault
- Fault unspecified inferred
- Strike and dip of bedding
- Anticline
- Prospect

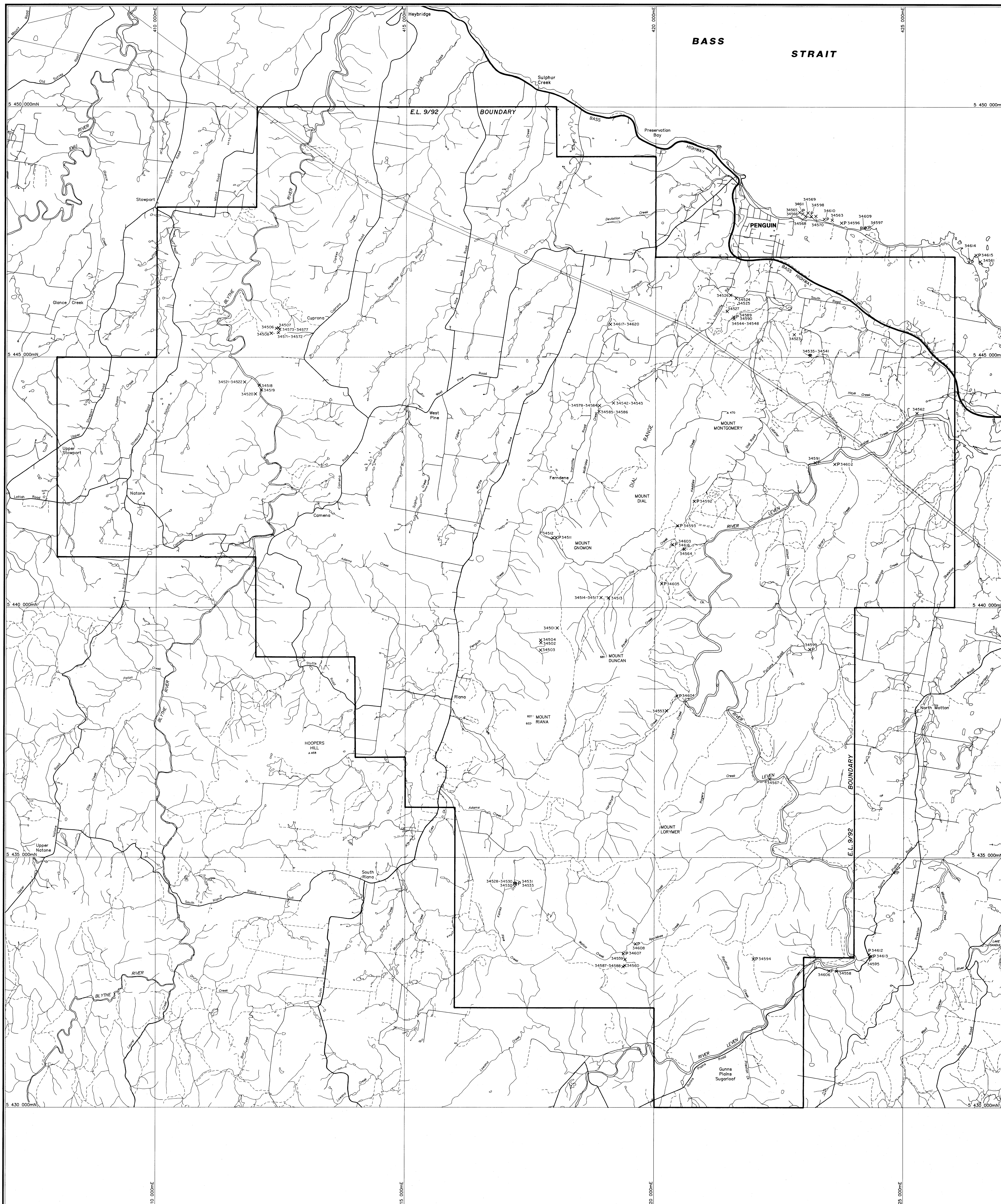
006209

5 cm

93-3447.

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED : W.H.	E.L. 9/92 – DIAL RANGE
DATE : Jan., 1993	THE BEECROFT MEGABRECCIA MAP AND SAMPLE LOCATIONS
DRAWN : G.M.B.	(Geology modified from Burns, 1962)
REFERENCE :	
REVISIONS :	
DRAWING No.	SCALE 1:2500 Approx. — FIG. No. 6



LEGEND

XP- 34570 - PETROGRAPHY SAMPLE LOCATION.

X - 34504 - GEOCHEMICAL ANALYSIS SAMPLE LOCATION.

006210

5 cm

93-3447.

PASMINCO EXPLORATION
A Division of Pasminco Australia Limited

COMPILED :	E.L. 9/92 - DIAL RANGE
DATE : 8-6-93	
DRAWN : N.W.D.S.	**SAMPLE LOCATIONS**
REFERENCE :	
REVISIONS :	
DRAWING No.	SCALE 1:25,000 — 0 500 1000 METRES — FIG. No. 8

AIRBORNE SURVEY SPECIFICATIONS

AIRCRAFT :	Squirrel Helicopter
MAGNETOMETER :	SCINTREX cesium vapour optical absorption mounted on a bird Sensitivity : 0.05 nT
RECORDING INTERVAL :	0.1 sec
NOMINAL TERRAIN CLEARANCE :	Sensor in towed bird at 80 m
SPECTROMETER :	Nuclear Data 256 channel ADC Volume : 16.8 litres
TOTAL COUNT WINDOW :	0.4 - 3.00 MeV
POTASSIUM WINDOW :	1.35 - 1.57 MeV
URANIUM WINDOW :	1.63 - 1.89 MeV
THORIUM WINDOW :	2.42 - 2.82 MeV
RECORDING INTERVAL :	1.0 sec
DATA RECORDING :	Geoterrex MADACS acquisition system Digital to magnetic tape
NOMINAL TERRAIN CLEARANCE :	Detectors in aircraft at 110 m
NOMINAL LINE SPACING :	Traverse lines 200 m Tie lines 2.0 km
FLIGHT PATH NAVIGATION :	SERCEL NR103 GPS and SERCEL NDS100 UHF DGPS navigation system
FLIGHT PATH RECORD :	real time from UHF DGPS system corrected for selected availability

RESIDUAL MAGNETIC CONTOURS

Grid notation refers to Australian Map Grid Zone 55

Magnetics :	Diurnals removed
IGRF :	1990 model (updated for secular variation to March 1993) removed, datum 2000 nT added
Total Field :	61900 nT (at 411000S, 1460000E)
Inclination :	71.7 degrees S
Declination :	13.18 degrees E
Grid mesh size :	50 x 50 metres
Grid filter :	None
Contour interval :	10, 100 and 1000 nT

MAP INDEX

145°52'30"E 146°07'30"E
41°05'00"S 1 41°05'00"S
2
41°17'30"S 41°17'30"S
145°52'30"E 146°07'30"E

006211

5 cm

TN GN MN

Grid Convergence = 0.66°
Declination = 13.18°

SCALE 1:25000

500 0 500 1000 1500 2000 m

93-3447.

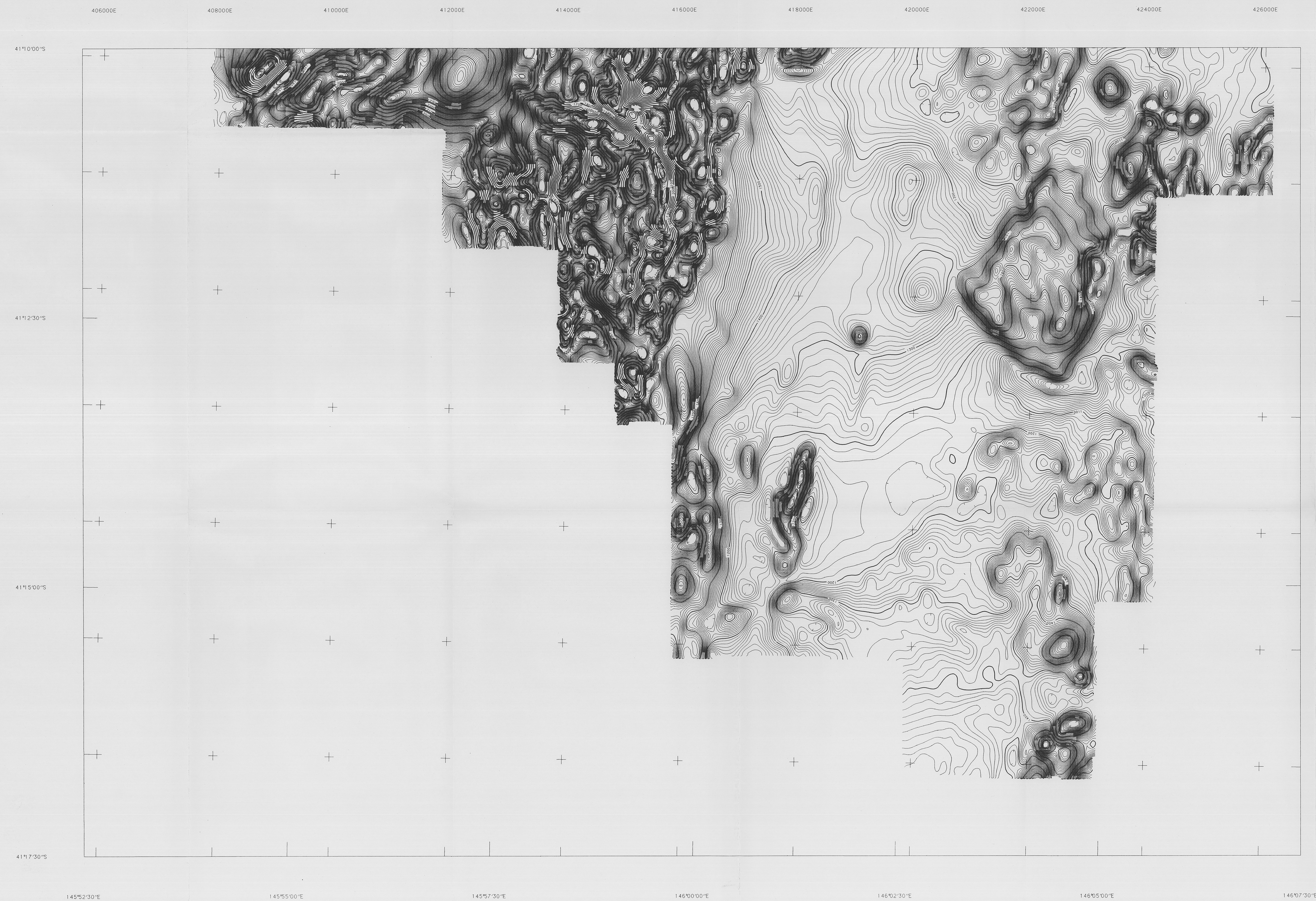
JOB NO : 3-446
Surveyed by GEOTERREX PTY LTD : March 1993
Compiled by GEOTERREX PTY LTD, SYDNEY
Processed by GEOTERREX PTY LTD, SYDNEY

PASMINCO EXPLORATION

DIAL RANGE EL 9/92
RESIDUAL MAGNETIC CONTOURS
BURNIE SK55-3
SHEET 1 OF 2

Figure 10

DRAWING NO: DATE : 26-MAY-1993



AIRBORNE SURVEY SPECIFICATIONS

AIRCRAFT :	Squirrel Helicopter
MAGNETOMETER :	SCINTREX cesium vapour optical absorption mounted on a bird Sensitivity : 0.05 nT
RECORDING INTERVAL :	0.1 sec
NOMINAL TERRAIN CLEARANCE :	Sensor in towed bird at 80 m
SPECTROMETER :	Nuclear Data 256 channel ADC Volume : 16.8 litres
TOTAL COUNT WINDOW :	0.4 - 3.00 MeV
POTASSIUM WINDOW :	1.35 - 1.57 MeV
URANIUM WINDOW :	1.63 - 1.89 MeV
THORIUM WINDOW :	2.42 - 2.82 MeV
RECORDING INTERVAL :	1.0 sec
DATA RECORDING :	Geoterrex MADACS acquisition system Digital to magnetic tape
NOMINAL TERRAIN CLEARANCE :	Detectors in aircraft at 110 m
NOMINAL LINE SPACING :	Traverse lines 200 m Tie lines 2.0 km
FLIGHT PATH NAVIGATION :	SERCEL NR103 GPS and SERCEL NDS100 UHF DGPS navigation system
FLIGHT PATH RECORD :	real time from UHF DGPS system corrected for selected availability

RESIDUAL MAGNETIC CONTOURS

Grid notation refers to Australian Map Grid Zone 55

Magnetics :	Diurnals removed
IGRF :	1990 model (updated for secular variation to March 1993) removed, datum 2000 nT added
Total Field :	61900 nT (at 411000S, 1460000E)
Inclination :	71.7 degrees S
Declination :	13.18 degrees E
Grid mesh size :	50 x 50 metres
Grid filter :	None
Contour interval :	10, 100 and 1000 nT

MAP INDEX

145°52'30"E 146°07'30"E
41°05'00"S 1 41°05'00"S
2
41°17'30"S 41°17'30"S
145°52'30"E 146°07'30"E

006212

5 cm

GN
TN
MN

Grid Convergence = 0.66°
Declination = 13.18°

SCALE 1:25000

500 0 500 1000 1500 2000 m

93-3447.

JOB NO : 3-446
Surveyed by GEOTERREX PTY LTD : March 1993
Compiled by GEOTERREX PTY LTD, SYDNEY
Processed by GEOTERREX PTY LTD, SYDNEY

PASMINCO EXPLORATION

DIAL RANGE EL 9/92
RESIDUAL MAGNETIC CONTOURS
BURNIE SK55-3
SHEET 2 OF 2

Figure 11

DRAWING NO:
DATE : 13-MAY-1993

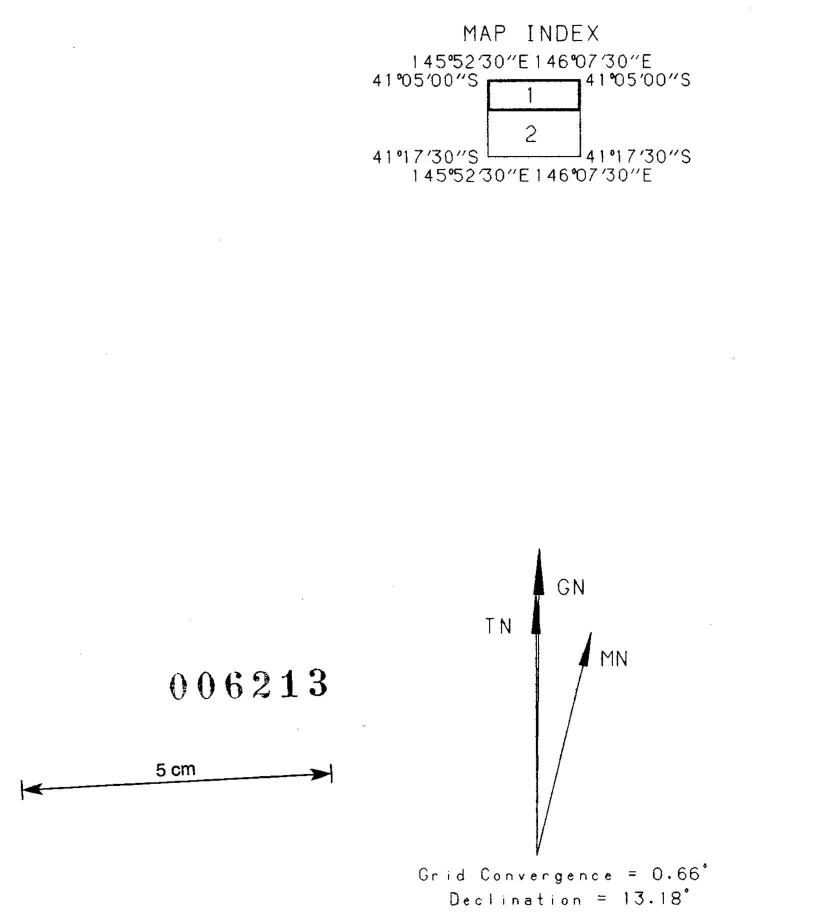
AIRBORNE SURVEY SPECIFICATIONS

AIRCRAFT :	Squirrel Helicopter
MAGNETOMETER :	SCINTREX cesium vapour optical absorption mounted on a bird Sensitivity : 0.05 nT
RECORDING INTERVAL :	0.1 sec
NOMINAL TERRAIN CLEARANCE :	Sensor in towed bird at 80 m
SPECTROMETER :	Nuclear Data 256 channel ADC Volume : 16.8 litres
TOTAL COUNT WINDOW :	0.4 - 3.00 MeV
POTASSIUM WINDOW :	1.35 - 1.57 MeV
URANIUM WINDOW :	1.63 - 1.89 MeV
THORIUM WINDOW :	2.42 - 2.82 MeV
RECORDING INTERVAL :	1.0 sec
DATA RECORDING :	Geoterrex MADACS acquisition system Digital to magnetic tape
NOMINAL TERRAIN CLEARANCE :	Detectors in aircraft at 110 m
NOMINAL LINE SPACING :	Traverse lines 200 m Tie lines 2.0 km
FLIGHT PATH NAVIGATION :	SERCEL NR103 GPS and SERCEL NDS100 UHF DGPS navigation system
FLIGHT PATH RECORD :	real time from UHF DGPS system corrected for selected availability

FLIGHT PATH

Grid notation refers to Australian Map Grid Zone 55

Navigation fix · 32768



SCALE 1:25000

500 0 500 1000 1500 2000 m

93-3447

JOB NO 93-446

Surveyed by GEOTERREX PTY LTD : March 1993

Compiled by GEOTERREX PTY LTD, SYDNEY

Processed by GEOTERREX PTY LTD, SYDNEY

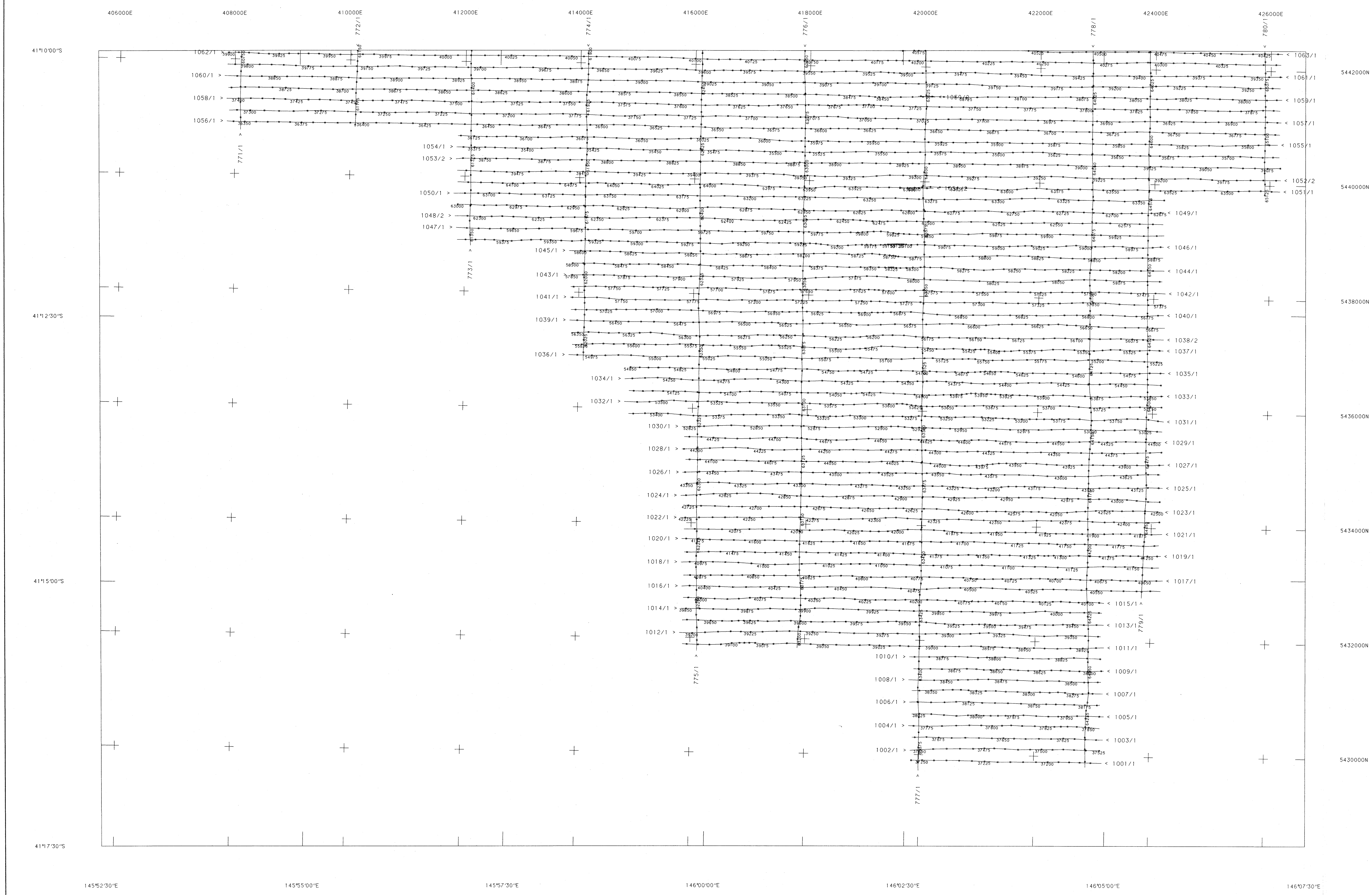
PASMINCO EXPLORATION

DIAL RANGE EL 9/92
FLIGHT PATH
BURNIE SK55-3
SHEET 1 OF 2

Figure 12

DRAWING NO:

DATE : 13-MAY-1993



AIRBORNE SURVEY SPECIFICATIONS

AIRCRAFT :	Squirrel Helicopter
MAGNETOMETER :	SCINTREX cesium vapour optical absorption mounted on a bird Sensitivity : 0.05 nT
RECORDING INTERVAL :	0.1 sec
NOMINAL TERRAIN CLEARANCE :	Sensor in towed bird at 80 m
SPECTROMETER :	Nuclear Data 256 channel ADC Volume : 16.8 litres
TOTAL COUNT WINDOW :	0.4 - 3.00 MeV
POTASSIUM WINDOW :	1.35 - 1.57 MeV
URANIUM WINDOW :	1.63 - 1.89 MeV
THORIUM WINDOW :	2.42 - 2.82 MeV
RECORDING INTERVAL :	1.0 sec
DATA RECORDING :	Geoterrex MADACS acquisition system Digital to magnetic tape
NOMINAL TERRAIN CLEARANCE :	Detectors in aircraft at 110 m
NOMINAL LINE SPACING :	Traverse lines 200 m Tie lines 2.0 km
FLIGHT PATH NAVIGATION :	SERCEL NR103 GPS and SERCEL NDS100 UHF DGPS navigation system
FLIGHT PATH RECORD :	real time from UHF DGPS system corrected for selected availability

FLIGHT PATH

Grid notation refers to Australian Map Grid Zone 55

Navigation fix · 32768

MAP INDEX

145°52'30"E 146°07'30"E
41°05'00"S 1 41°05'00"S
2
41°17'30"S 41°17'30"S
145°52'30"E 146°07'30"E

006214

5 cm

TN GN MN

Grid Convergence = 0.66°
Declination = 13.18°

SCALE 1:25000

500 0 500 1000 1500 2000 m

93-3447.

JOB NO : 3-446
Surveyed by GEOTERREX PTY LTD : March 1993
Compiled by GEOTERREX PTY LTD, SYDNEY
Processed by GEOTERREX PTY LTD, SYDNEY

PASMINCO EXPLORATION

DIAL RANGE EL 9/92
FLIGHT PATH
BURNIE SK55-3
SHEET 2 OF 2

Figure 13

DRAWING NO: | DATE : 13-MAY-1993