

00 Phil Jones and Associates Pty. Ltd.

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Geotechnical Personnel

EXPLORATION LICENCE

NO. 10/88 - GOWRIE PARK

PROGRESS REPORT ON EXPLORATION ACTIVITY

22 AUGUST 1988 TO 22 JULY 1989

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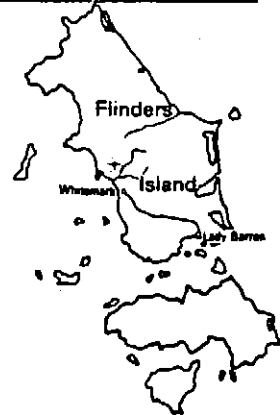
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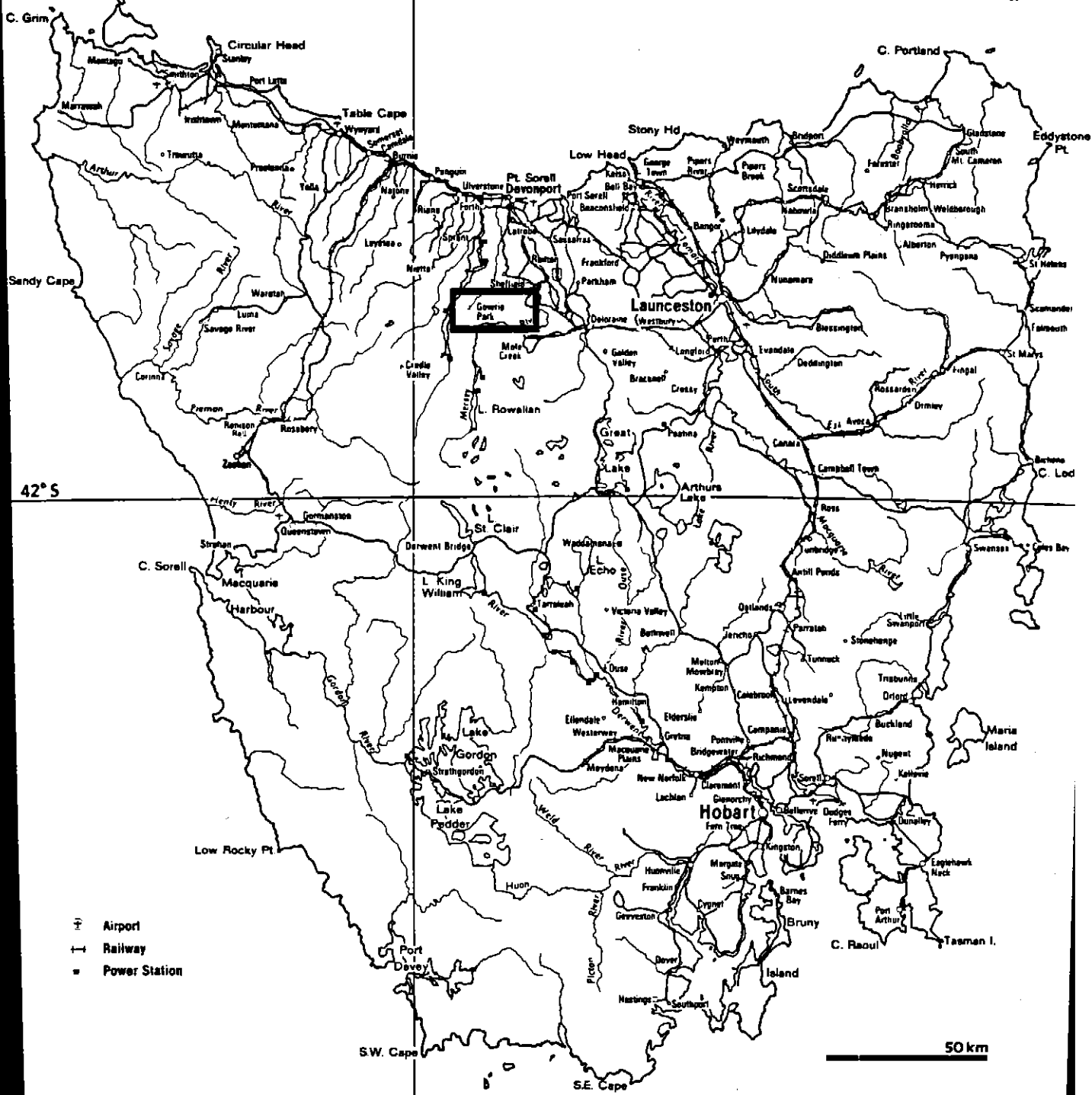
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146° E

TASMANIA



BASS STRAIT



- Airport
- Railway
- Power Station

50 km

597005

5 cm

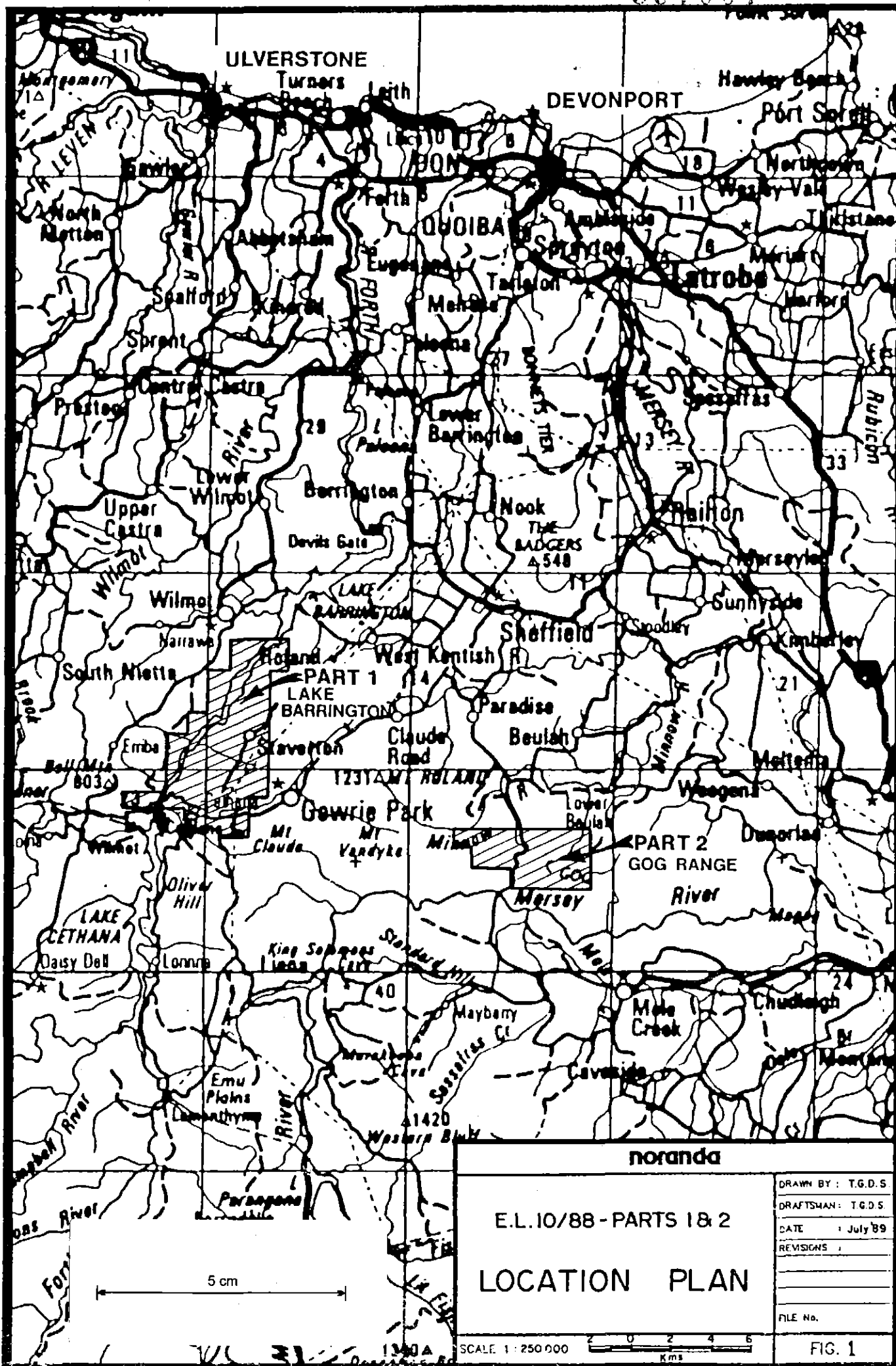
Project Location

SUMMARY AND CONCLUSIONS

The primary exploration target for EL 10/88 is a polymetallic volcanogenic massive sulphide deposit of the Rosebery or Hellyer style. The secondary target is for a volcanic hosted gold deposit for which no type deposits are reported from the Mount Read Volcanics.

The licence, totalling approximately 53 square kilometres, was granted to Noranda Pty Ltd for a period of 12 months from 22 August 1989. A renewal application is currently with the Department. The tenement comprises two separate areas: Part 1 - Lake Barrington and Part 2 - Gog Range. Both portions of the licence are well situated to power, water, transport and labour facilities. Access is good within the prospective area with numerous gravel and 4 x 4 wheel drive tracks being utilised.

Minor prospecting was undertaken late last century to early this century with no serious exploration being completed until Asarco was granted a licence in March 1973. Their original 743



square kilometre application was reduced to 199 square kilometres in 1976 when CRAE entered into a joint venture with Asarco. By 1983 CRAE held sole title to the EL and continued to explore the licence until early in 1988 when it was finally relinquished. During this period extensive ground surveys were completed assessing many of Asarco's original stream sediment anomalies. Many areas were gridded, mapped, soil and rock chip sampled, surveyed with geophysics/gradient array IP, dipole dipole IP, Magnetics, SP, VLF-EM) and later more detailed surveys completed prior to drilling (both diamond and percussion). Significant but low grade basemetal mineralisation was encountered both at Cethana and Staverton. Significant copper silver \pm gold mineralisation was also intersected at the Lake Barrington prospect.

Best results from the CRAE drilling were as follows:

Cethana:	77CC1	78.6 - 79.0 =	0.4m @ 8.3% Zn, 0.2% Pb
	77CC5	37.8 - 38.8 =	1.0m @ 3.9% Zn, 0.8% Pb, 1.2% Cu, 185 g/t Ag
Staverton:	PD 83 SP1	20 - 44 =	24.0m @ 0.5% Zn, 0.9% Pb, 10 g/t Ag
Lake Barrington:	DD 82 LB3	156.5 - 172.45 =	15.85m @ 1.2% Cu, 12 g/t Ag
	DD 82 LB4	225.8 - 226.3 =	0.50m @ 4.8% Cu, 36 g/t Ag, 3.2 g/t Au

The geology of the area is poorly understood, however, the basement sequence includes the Fossey Mountain Trough portion of the MRVs. The volcanics include rhyolitic to dacitic extrusive, intrusive and pyroclastic sequences with minor intercalated units of felsic vitric tuffs and volcanoclastic/tuffaceous siltstones. An anomalous belt of mixed andesite/rhyolite and epiclastics lying in the vicinity of the Lake Barrington Road may be an equivalent to the Que-Hellyer central volcanic sequence. Overlying these volcanics unconformably and also thrust faulted is the Cambro-Ordovician Roland Conglomerate and Moina Sandstone sequences. Overlying the majority of the more gently undulating areas is a Tertiary Basalt of variable thickness.

Significant quartz - sericite - K spar - albite \pm pyrite - chlorite alteration is mapped at Cethana and Staverton associated with minor basemetal mineralisation. A different type of alteration is evident in the Lake Barrington Road Area where a strong calcite - chlorite - sericite assemblage has been defined. A somewhat unique zone of quartz stockworking associated with siliceous-sericitic volcanics occurs at the Gog Range prospect. This alteration style is accompanied by highly anomalous gold, arsenic and basemetal values.

To date Noranda has concentrated its efforts on the evaluation of the Cethana Alteration Zone and the Gog Range Prospect.

An Honours Project was initiated at Cethana to conduct detailed major and trace element studies over three road traverses located perpendicular to the overall strike of the zone. Isotope studies were also commenced along with petrographic studies and detailed geological mapping surveys. The majority of the litho geochemistry and isotope studies are continuing. The lead isotope study showed that the low grade stringer and veinlet mineralisation was of Cambrian age and not Devonian. (Appendix 3).

Detailed work was also undertaken on the Gog Range prospect with gridding, soil and rock chip sampling, petrographic and mapping surveys leading to the definition of a major soil and rock chip gold anomaly (rock chips to 5 g/t Au with associated high arsenic and basemetals). The anomaly lies in an area previously worked by CRAE and is drained by a creek from which a 320 g/t gold value was panned. Noranda also commissioned a complete reinterpretation of all of CRAE's geophysical data. The results of this showed that many of CRAE's drill targets were not reached by their holes due to the fact that no account was made for severe topographic effects on the EM and IP results. Significant targets remain to be drill tested because of this.

Other areas have also been subject to more regional surveys including the Staverton Grid area as well as the Lake Barrington prospect.

From previous surveys and surveys completed by Noranda it is evident that EL 10/88 shows great potential for the discovery of volcanogenic massive sulphide mineralisation as well as volcanic hosted precious metal deposits.

In order to locate these possible deposits, additional litho-geochemical isotopic, geological, geophysical and geochemical surveys will need to be undertaken prior to the commencement of diamond drilling. This balanced exploration programme should locate the type of mineralisation sought if it is at all present.

RECOMMENDATIONS

It is recommended that the proposed programme be initiated as soon as possible in order to make the most use of the coming summer field season.

The proposed programme is designed to assess the Lake Barrington portion of the tenement for polymetallic volcanogenic massive sulphide (VMS) deposits and the Gog Range Portion for volcanic and/or structurally hosted precious metal deposits.

Major and trace element geochemical, as well as isotopic (C, O, S) surveys will be used to assess the major alteration zones at Cethana and Staverton for possible mineralised horizons. These surveys should, in conjunction with a review of previous work, identify targets worthy of diamond drilling. An altered mixed sequence of Andesites - Rhyolites and Epiclastics (Que Hellyer Equivalents?) in the vicinity of the Lake Barrington Road will be mapped in detail and lithochemically assessed. A deep diamond hole will be completed on the Lake

Barrington copper prospect to test the major IP and Misse a la Masse target defined by CRAE.

More detailed mapping, chip and channel sampling surveys will be completed over the encouraging quartz stockworked alteration zone on the Gog Range Prospect. Highly encouraging gold results from this zone will need to be diamond drilled once the complex geology and structure are better defined.

A regional magnetic/gravity interpretation will be completed to ascertain the granite contact and also to map major structural features which may guide further exploration surveys.

TARGET CONCEPT AND OBJECTIVES

The primary exploration target on EL 10/88 is a polymetallic volcanogenic massive sulphide (VMS) body, similar to those found at the Rosebery, Que and Hellyer Mines. Large hydrothermal alteration zones at Cethana and Staverton may represent haloes around similar sulphide bodies. A secondary target is for a volcanic-hosted gold deposit. Although there are no type deposits within the Mount Read Volcanics, two major gold occurrences within the MRV are being pursued at depth to ascertain their viability. The Henty Prospect appears to be a volcanic hosted deposit which has been partly controlled and/or overprinted by major structural features and the South Hercules deposit is more akin to a gold rich low grade basemetal occurrence adjacent to a mined out massive sulphide.

Detailed lithogeochemical (major and trace element) isotopic (lead, carbon, oxygen, sulphur) and petrographic surveys have been completed or are in progress. These are designed to delineate prospective zones within the Cethana and Staverton alteration areas, in particular to highlight possible deeper

zones of interest requiring a more stratigraphic type of exploration approach.

Exploration on the Gog Range portion of the tenement has provided significant encouragement in the location of a gold anomaly hosted within altered and stockworked volcanics. This area was reported by CRAE as having a strongly anomalous (320 g/t Au) drainage response. No follow-up, other than a cursory examination, was made by CRAE. Noranda has conducted a detailed exploration programme including mapping and soil and rock chip sampling surveys which has indicated significant gold values to 5 g/t occurring in outcropping stockworked lead/zinc/arsenic/pyrite altered volcanics. More detailed mapping and channel sampling surveys will be completed prior to implementing a drilling programme. Additional significant gold values obtained from the regional bulk cyanide leach programme of CRAE will need to be investigated in detail as well.

DESCRIPTION OF THE PROPERTY AND OWNERSHIP

Exploration Licence 10/88 Gowrie Park, of approximately 46 square kilometres in area was granted to Noranda Pty Ltd for a period of 12 months from August 22, 1989. Subsequent to this application, Noranda was successful in obtaining an adjacent licence, EL 35/88 Cethana, totalling 7 square kilometres through the Mines Department tender system. Once granted, this small tenement was amalgamated into EL 10/88 which consists of two parts and is bounded by the following co-ordinates:

Part 1 - Lake Barrington, totalling 36 square kilometres.

Commencing at a north west corner of the area whose grid co-ordinates are 431 000 m E 5 416 700 m N thence grid east to 434 000 m E grid south to 5 415 000 m N grid west to 433 000 m E again grid south to 5 409 000 m N again grid west to 432 000 m E again grid south to 5 406 500 m N again grid west to 430 500 m E grid north to 5 407 000 m N again grid west to 429 500 m E again grid north to 5 407 500 m N again grid west to 428 500 m E again grid north to 5 408 000 m N again grid west to 426 000 m E again grid north to 5 409 000 m N thence grid east to 428 000 m E

again grid north to 5 412 000 m N again grid east to 429 000 m E
again grid north to 5 413 000 m N again grid east to 430 000 m E
again grid north to 5 415 000 m N aforesaid again grid east to
431 000 m E aforesaid thence again grid north to the point of
commencement.

Part 2 - Gog Range, totalling 17 square kilometres

Commencing at the northwest corner of the area whose grid
co-ordinates are 442 000 m E 5 407 000 m N thence grid east to
449 000 m E grid south to 5 404 000 m N grid west to 445 000 m E
grid north to 5 405 000 m N again grid west to 443 000 m E
again grid north to 5 406 000 m N again grid west to 442 000 m E
aforesaid thence again grid north to the point of commencement.

All exploration and reporting is now conducted as if one
licence (EL 10/88).

Government expenditure requirements for the licence total
\$122,000 for the initial 12 month period. It should be noted
that a two month gap exists between quarterly expenditure and
annual reporting for the licence. The pre-existing Mining
Lease, 93 M/84 totalling 12 hectares, is located in the western
portion of the Gog Range and covers a stone and gravel deposit
held by A.E. and K.H. Walters.

A portion of the licence is covered by the proposed Mount
Roland Protected Area which may at some stage in the future be
gazetted. Should this occur, then some additional environment
constraints will be imposed upon the explorer. The tenement is
otherwise made up of Crown Land, State Forest, Freehold Land
and some land vested in the Hydro-Electric Commission (Lake
Barrington high water mark and Cethana Dam Area).

LOCATION AND ACCESS

Exploration Licence 10/88 comprises two separate areas, these being Part 1 - Lake Barrington and Part 2 - Gog Range.

The Lake Barrington area is located 15 kilometres south west of Sheffield and 35 kilometres south south west of Devonport, a major city and port on the north coast. The Gog Range portion of the tenement lies 15 kilometres east south east of Lake Barrington and approximately 12 kilometres south south east of Sheffield.

Sheffield is a service town for the large agricultural community and is connected via a network of major bitumen roads to all major towns and ports in Tasmania.

Access within the prospective area is good with numerous gravel and bitumen roads developed by the HEC during dam construction. Subsidiary four wheel drive tracks including old logging tracks, transmission line and previous explorer tracks also add to the overall accessibility.

An excellent power and water source is available in the area through the extensive hydro-electric schemes. The area has an annual rainfall of from 120 to 200 cm dependent on location. In general the farming (grazing and cropping) land is flat to hilly with the prospective sequences being more hilly to rugged.

HISTORY AND EXPLORATION TO DATE

Asarco Australia Pty Ltd was granted EL 7/73 totalling 743 square kilometres on 15 March 1973. The licence covered the majority of the Cambrian Mount Read Volcanics within the Fossey Mountain Trough and its initial programme was one of regional stream sediment sampling and reconnaissance mapping. In March 1974 the tenement was reduced to 440 square kilometres - after targets were outlined from the previous surveys.

CRAE entered into a joint venture with Asarco on 12 July 1976 and at the same time pegged EL 10/76 which was a relinquished parcel of land within 7/73 held previously by the Tasmanian Mines Department. Title for EL 7/73 transferred to CRAE on 29 December 1977 and in 1979 the licence was reduced to 199 square kilometres. In June 1980 Asarco transferred its interest in the joint venture to Carpentaria Exploration Co. Ltd and finally in 1983 CRAE assumed sole title to the EL. The tenement was relinquished early in 1988 and was immediately put up for tender through the Mines Department ETA system.

Extensive ground surveys were initiated by CRAE to assess the targets generated through Asarco's stream sampling programme. These surveys included gridding, geological mapping, soil and rock chip sampling and geophysical surveying (gradient array IP, dipole dipole IP, Magnetics, Self Potential, and VLF-EM) on the Lake Barrington, Promised Land, Staverton, Cethana (East and West), Gog Range and Cethana Picnic Ground prospects. Encouraging results necessitated follow-up, more detailed work conducted on the Lake Barrington, Cethana, Staverton and Gog Range grids. These surveys included detailed dipole dipole IP, Genie EM, PEM, UTEM and helicopter borne EM (Dighem), results of which led to the drilling of 18 holes; 16 diamond and two percussion. Thirteen of the holes were drilled on the Cethana Prospect with seven situated at Cethana West and the remainder at Cethana East. The majority of holes intersected low grade lead-zinc mineralisation (1.2%) within pyritic altered volcanics and tuffaceous sediments. Best results are as follows:

Cethana West - Hole DD 77CC1 78.6 - 79.0 = 0.4 m
 @ 8.3% Zn + 0.2% Pb

Cethana East - Hole DD 77CC5 37.8 - 38.8 = 1.0 m
 @ 3.9% Zn + 0.8% Pb + 1.2% Cu + 185 ppm Ag

All four diamond holes drilled on the Lake Barrington prospect encountered encouraging pyritic copper mineralisation with some gold and silver credits also present, within siliceous and chlorite/sericite altered volcanics and volcanoclastics. Best results are as follows:

DD82 LB3 140.8 - 140.98 = 0.18 m @ 9.1% Cu, 52 g/t Ag
 156.5 - 172.45 = 15.85 m @ 1.2% Cu, 12 g/t Ag
 207.85 - 209.00 = 1.15 m @ 1.6% Cu, 18 g/t Ag

DD83 LB4 48.0 - 49.0 = 1.00 m @ 1.9% Cu, 5 g/t Ag
 225.8 - 226.3 = 0.50 m @ 4.8% Cu, 36 g/t Ag,
 3.2 g/t Au

A percussion hole designed to test coincident geochemical/geophysical responses on the Staverton grid intersected highly

altered pyritic quartz sericite schists with minor but significant basemetal mineralisation. Results for this hole are as follows:

PD 83 SP1 20 - 44 = 24 m @ 0.9% Pb, 0.5% Zn, 10 g/t Ag
includ. 28 - 34 = 6 m @ 1.3% Pb, 1.0% Zn, 14 g/t Ag

Importantly it should be noted that little gold assaying was attempted until extremely late in the period of tenure when an attempt was made to broadly assess the licence for fine grained volcanogenic gold deposits. Bulk Cyanide Leach sampling techniques in conjunction with standard stream sediment sampling surveys were implemented sparsely across the tenement.

Significant results were returned, however, no detailed investigations were instigated to confirm and quantify the occurrences.

Some minor core reassaying for gold was conducted very late in the period, returning values to 1 g/t Au over 1 metre. However, in general, only samples which contained visible lead-zinc were assayed for the noble metal. Extensive pyritic zones failed to be assayed. An exception to the lack of gold assaying occurred on the Lake Barrington Prospect where drillhole assaying for gold was completed on mineralised zones from all four holes.

REGIONAL GEOLOGY

The geology in the general area of the licence is poorly understood and the latest mapping is of 1958 vintage. The current Mount Read Volcanic Project is nearby to the west, and it is hoped that this mapping will continue shortly through and beyond the licence to the east.

The basement sequence within EL 10/88 includes the Fossey Mountain Trough portion of the Cambrian Mount Read Volcanics (MRV). These calc-alkaline volcanics which form the Mount Read Arc, extend in a belt over 150 kilometres long from Elliott Bay in the south-west, up through Queenstown and Hellyer and then continue easterly around the northern flank of Mt Roland toward Deloraine. The 10-15 kilometre wide belt which flanks the western margin of the Precambrian Tyennan Geanticline is divided into three main lithofacies.

The central belt sequence (central volcanics - CV) comprises rhyolitic to andesitic subaerial and subaqueous intrusive and extrusive volcanics and lacks notable sedimentary horizons. Virtually all of the known volcanogenic mineralisation is con-

finned to the central belt of massive volcanics. The sequence is flanked on the western side by volcano-sedimentary marine sequences (western sequences) which grade westward into fossiliferous middle late Cambrian turbiditic successions of the Dundas Group. Overlying the CV sequence in the north and north east is a mixed sequence of volcanoclastic sediments, rhyolitic quartz crystal tuffs and lavas as well as more intermediate volcanics labelled the Southwell Subgroup. An anomalous pile of andesites (Beulah Formation) near Sheffield which also crops out within EL 10/88 may be Que-Hellyer central volcanic equivalents, hence the surrounding areas rate highly for volcanic massive sulphide (VMS) potential.

Late Cambrian shallow marine and terrestrial siliciclastic Roland Conglomerates unconformably overlies or are thrust over the older volcanic sequences. Siluro-Ordovician siliciclastic sediments and carbonates conformably overlies the Roland Conglomerate.

This period was followed by widespread folding and faulting which culminated in the intrusion of the Devonian Dolcoath Granite. The margins to the granite are now dotted with numerous tin, tungsten, molybdenum and gold prospects.

Large flood basalt sheets were erupted on to an eroded surface during the Tertiary, infilling many valley areas. Continuing erosion via streams and glaciation has left the present day rugged and incised relief.

GEOLOGY OF THE PROPERTY

The geology of the property varies greatly from Lake Barrington to Gog Range, therefore the two areas will be discussed separately.

LAKE BARRINGTON (Enclosure 1)

Rocks encountered in outcrop in the Lake Barrington Area, centred on the Cethana Alteration Zone, comprise a sequence dominated by quartz feldspar phyric rhyolitic minor dacitic volcanics including probable intrusive, extrusive and pyroclastic units with minor intercalated sequences of fine grained (aphyric) felsic vitric tuffs and volcanoclastic/tuffaceous siltstones (Appendix 1). The interpreted basal portion of the sequence lying adjacent to the thrusting Roland Conglomerate - Moina Sandstone contact is comprised of well bedded north dipping sandstones, siltstones and shales which grade northwards into volcanoclastic and tuffaceous sediments thence conformably into volcanics.

Bedding orientations where observable in the volcanics also show a steep northerly dip which in places is subparallel to the regional cleavage. Graded bedding and scour and fill structures within the basal sediments indicate the sequence youngs to the north and that the sediments are overlain by the volcanics.

Alteration within the Cethana area is demonstrably variable, however, a significant quartz-sericite-K-spar-albite \pm pyrite-chlorite mineralogy (T. Crawford - Appendix 2) is mapped, where outcrop permits from Lake Barrington east to the Mount Claude Road where the host volcanics are hidden by extensive talus and/or fluvioglacial material. The zone of alteration is up to 500 m in width and has minor associated basemetal mineralisation occurring as disseminations, aggregates and transgressive veinlets and stringers. A lead isotope survey conducted on lead rich mineralisation sampled from a number of CRAE's diamond drillholes returned Cambrian signatures for this style of mineralisation (Appendix 3). It is envisaged that this style of mineralisation may be peripheral to a major deposit at depth.

A possible Devonian overprint has been observed complicating the picture with the addition of a biotite-tourmaline-quartz assemblage generally as veinlets and to a lesser extent as pervasive disseminations. Although this is not encountered at Hellyer, it is at Rosebery where a possible granite connection is well demonstrated.

The schistosity observed at Cethana and further north at Staverton is considered to be a Devonian overprint (regional stress) on the relatively incompetent Cambrian altered rocks.

The approximately east-west trending volcanics continue northward from Cethana through less altered dacitic and rhyolitic lavas and tuffs until a second major zone of sericitic alteration at Staverton is encountered. The sequence at Staverton is shown on the 1:50,000 Cethana compilation map to be

predominantly felsic agglomeratic, however, cursory mapping with later petrographic work has shown the rocks to be schistose quartz phyrlic pumiceous and vitric tuffs, massive chloritic felsic vitric tuffs and quartz phyrlic crystal tuffs. More detailed mapping of this area is required.

Overlying this unit to the north is the Beulah Formation. Detailed mapping by Herrmann on the Lake Barrington Rowing Course road has indicated that this formation, described previously as intermediate to mafic lavas, tuffs and breccias, in fact comprises a mixed volcanic-epiclastic assemblage. Calcite-chlorite altered feldspar phyrlic dacitic lavas, quartz feldspar phyrlic glassy rhyolite lavas (plus pyroclastic component) and porphyritic andesites are associated with mass flow type medium grained lithic wackes of mixed felsic-intermediate volcanic composition and minor intercalations of mixed micaceous/volcaniclastic greywacke and siltstone.

Several sedimentary facing determinations indicate a younging generally northwards, confirming facing directions observed further south. This mixed sequence may be an equivalent to the Que-Hellyer CV sequence and more detailed mapping should be conducted to ascertain its stratigraphic position.

Strong calcite-chlorite-sericite alteration was highlighted through petrographic studies and reference made to the alteration system responsible for this being quite unlike that which produced the sericitic style observed at Cethana.

The Beulah Formation is in turn overlain to the north by a mixed assemblage of volcanoclastic sediments, tuffaceous sediments of felsic derivation and more extensive conglomerates, grits, sandstones and shales. These units have previously been named the Minnow Keratophyre and Gog Range Greywacke, however, they are analogous to the Southwell Subgroup mixed sequence described by Corbett north and north-east of Hellyer.

Unconformably overlying in the north and thrust faulted in the south lies the Cambro-Ordovician siliciclastic sequences including the Roland Conglomerate and Moina Formation sandstones and siltstones. The contact observed on the Cethana dam road (old Lorinna Road) is interpreted as a shallow angle thrust with tuffaceous sediments immediately north of this feature being heavily ironstained (pyritic) and siliceous. In other exposures the conglomerate abuts volcanics with no evidence for movement on the contact at all.

Blanketing much of the prospective geology is the Tertiary Basalt. This unit is of variable thickness due to being extruded on to an incised surface. The present day topography is a product of Pleistocene glaciation and more recent stream erosion.

GOG RANGE (Enclosure 3)

Rocks encountered in the Gog Range area have previously been mapped by Jennings 1958 as Minnow Keratophyre (volcanics) and Gog Range Greywacke (volcanics and sediments) which Noranda has tentatively ascribed to the Southwell Subgroup sequence - see Regional Geology, as at Lake Barrington.

This conclusion was further strengthened after petrographic studies had been completed on samples submitted after detail mapping of the gridded area (Appendix A). Rocks are derived from rhyolitic to rhyodacitic magmas and include dominant quartz feldspar phyric lavas, crystal lithic and vitric tuffs, minor rhyolitic intrusives and subordinate epiclastic sediment horizons. The abundance of quartz-phenocrysts and the relative abundance of large zircons within these volcanics is a diagnostic feature of the Dundas Group - Tyndall Group - Southwell Subgroup felsic lavas and tuffs.

The mapped volcanic sequence is very proximal and coarse grained in the western portion of the grid grading into finer sequences to the east. Significant epithermal? silica-sericite-pyrite-

arsenopyrite alteration with associated quartz vein stock-working is observed at the western, coarser, fragmental portion of the gridded volcanics. Composite rock chips taken from this area returned highly encouraging gold values to 5 g/t associated with anomalous basemetals, arsenic and silver (S.N. 225220 0.3% Cu, 0.3% Pb, 0.2% Zn, 11.5 ppm Ag, 1.7% As, 5.1 g/t Au). It is hoped that this encouraging mineralised zone may be the surface expression of a major volcanic hosted gold deposit.

Widespread silica-sericite-biotite \pm chlorite alteration is observed regionally over the remainder of the volcanic sequence with local variations in intensity, possibly due to proximity to major structures.

Bedding orientations are scarce, however, when observed they show a generally very steep northerly dip in accordance with those at Lake Barrington. The majority of the prospective sequence is covered by talus material and the outcrops which are present are generally massive and textureless. Mappable contacts are few and far between.

The east-west trending sequence of volcanics and epiclastics is in fault contact to the west with Roland Conglomerate although much of this contact is also covered by scree and talus. Roland siliceous, hematitic conglomerate, conformably overlain by Moina siliceous sandstone, is mapped in faulted and possibly unconformable contact south of the volcanic sequence.

Further rhyolitic volcanics and epiclastics are mapped (CRAE, Jennings) to the west and north west of the gridded area. These will require detailed mapping surveys to be implemented in order to screen these prospective rocks for possible volcanic hosted gold deposits.

Blanketing much of the prospective sequence are widespread slope induced talus and scree deposits. These Quaternary deposits are themselves being eroded by present day weathering processes.

MINERALISATION

Highly anomalous basemetal and minor to significant noble metal mineralisation has been delineated through CRAE diamond and percussion drilling surveys over various sections of the MRV within EL 10/88.

The style of mineralisation varies from volcanic exhalative(?) pyrite at Cethana East and basemetal mineralisation within tuffaceous shale (77CC1 98.0 - 100.6 = 2.6 m @ 0.9% Zn + 0.9% Pb) at Cethana West to stringer, veinlet and disseminated mineralisation varying from one to two percent (lead + zinc) in the majority of holes drilled at Cethana (best results being from: 77CC1 78.6 - 79.0 = 0.4 m @ 8.3% Zn + 0.2% Pb and 77CC5 37.8 - 38.8 = 1 m @ 8% Pb + 3.9% Zn + 1.2% Cu + 185 g/t Ag).

Highly significant copper-silver-gold stringer style mineralisation has been drilled at Lake Barrington (DD82 LB3 156.5 - 172.45 = 15.85 m @ 1.2% Cu, 12 g/t Ag and DD83 LB4 225.8 - 226.3 = 0.5 m @ 4.8% Cu, 36 g/t Ag, 3.2 g/t Au), indicating a markedly different mineralising environment.

Percussion drilling by CRAE at Staverton encountered significant lead-zinc mineralisation within a quartz-sericite altered volcanic sequence (PD83 SP1 20-44 = 24 m @ 0.9% Pb, 0.5% Zn, 10 g/t Ag). No indication of mineralisation style was reported.

Noranda through its detailed ground surveys on the Gog Range Prospect has outlined a further distinctive style of mineralisation. At this prospect a major quartz stockworked silica-sericite-pyrite arsenopyrite (gold) mineralised zone has been delineated hosted by altered fragmental rhyolitic volcanics. This zone remains to be drill tested. Composite rock chip samples assayed up to 0.3% Cu, 0.3% Pb, 0.3% Zn, 28 ppm Ag, 1.7% As and 5.5 ppm Au.

WORK CONDUCTED BY NORANDA

Work conducted during the August 1988 to July 1989 period entailed data compilation, production of 1:10,000 base maps, regional and detailed geological mapping, regional rock chip sampling, geophysical re-evaluation (CRAE data), gridding, geochemical sampling (soil, rock, streams) surveys and petrographic and isotopic studies.

The programme to date has concentrated on the Gog Range Prospect and the Cethana Alteration Zone with limited work being conducted regionally, at Staverton and in the Lake Barrington Road Area.

1. REGIONAL WORK

Base maps of the two portions of the Licence were prepared by Tasmanian Geological Draughting Services of Sulphur Creek. Both the Lake Barrington and Gog Range sheets were produced at 1:10,000 scale.

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GEOLOGY

Reconnaissance mapping and familiarisation with the volcanic sequences was completed along the major HEC roads (Cethana Area) leading to and from the Forth River as well as at both the Staverton and Lake Barrington Road areas. Similar quartz-sericite-chlorite altered volcanics (rhyolite-dacite-epiclastic) are observed in the Cethana area as at Staverton, however, calcite-chlorite-sericite altered volcanics (rhyolite-andesite-epiclastic) in the Lake Barrington Road area are demonstrably different and may be Que-Hellyer central volcanic sequence equivalents. A number of composite rock chip samples were taken during this evaluation (Enclosure 2), some of which were despatched for assay. Results from altered volcanics in the Cethana Area show elevated base-metal values in comparison to those obtained from the younger Siluro-Ordovician sequences. Results from samples taken from the Staverton Grid returned significantly anomalous values highlighting this area's potential. Some samples were despatched to T. Crawford at the University of Tasmania for petrographic analysis (Appendix 2).

GEOPHYSICS

An immediate review of all available CRAE geophysical data was undertaken by consultant geophysicist Papken ('Pop') Zarzavatjian early in 1989 (Appendix 6). This survey proved quite frustrating with significant sections of the data package not being lodged with the Department of Mines. Approaches to CRAE over a number of months finally succeeded in getting the majority of the outstanding data which was despatched to Sydney for interpretation.

The review showed that little account was taken of the steep topography when siting drillholes particularly when testing IP anomalies. The majority of the IP data is gradient array and no reliable depth information can be obtained from this method, making interpretations difficult.

'Pop' approached this review on a report by report basis per individual prospect. The following is a summary of his findings for these prospects:

CETHANA (WEST AND EAST)

The UTEM coverage does not match the entire IP coverage nor does it cover the entire altered sequence of volcanics. However, no significant targets were identified over and above those defined by CRAE.

The IP (gradient and dipole) surveys also failed to cover the entire altered sequence and numerous anomalous results are recorded on the ends of lines, in particular the southern ends.

Some IP anomalies were not followed up, some of which had coincident anomalous basemetal geochemistry, prospective geology and anomalous EM associated with them.

CRAE selected dubious trends to follow up and missed more legitimate zones.

Significant IP zones between lines 20200E and 21800E with coincident resistivity lows require detailing as they represent good targets for sulphide mineralisation.

STAVERTON

Pop states that the very steep topography in the area was not taken into account when planning SP-1 (percussion hole) as topography can distort the resistivity picture significantly with chargeabilities being less affected. This may be the case for the Staverton hole which intersected low grade, possibly peripheral, basemetal mineralisation over wide widths (24m @ 0.9% Pb, 0.5% Zn, 10 g/t Ag). He suggests the IP zone be tested further along strike.

Crone PEM (DEEPEM Mode) was conducted over certain sections of the grid, however, the surveyed lines, were far too short to record any anomalies.

UTEM was conducted on three lines returning weak anomalies coincident with anomalous IP zones. Recommendations for further UTEM surveying were not carried out.

LAKE BARRINGTON COPPER PROSPECT

CRAE's definitive IP, Misse a la Masse and SP surveys failed to be tested by four drillholes. Three of the holes passed either beneath or were stopped short of the anomalous zone, thus intersecting probable peripheral copper-silver mineralisation as in hole 3 - 16m @ 1.2% Cu, 12 g/t Ag. A viable drill target lies untested on this prospect.

Some IP data covering critical areas for this prospect remains missing.

GOG RANGE

Only small sections of the grid were ever tested with any one technique (VLF EM, SP, Magnetics, Genie EM, PEM).

A ground magnetic survey was completed over the entire grid, however its poor presentation makes any interpretation somewhat dubious.

A significant coalescing of different anomalous (PEM, VLF EM, SP, Magnetics) zones was delineated some 100 to 150 metres immediately south of Noranda's Gold Zone. Possible additional surveys may highlight a connection between the two anomalies aiding the overall understanding of the mineralised zone.

The grid should be surveyed with a transient EM system if the host rocks look capable of supporting a volcanogenic massive sulphide system.

PROMISED LAND

A VLF EM survey returned anomalies associated with weak base-metal geochemistry which require ground assessing. A second weak VLF EM response was delineated coincident with a 200 nt magnetic anomaly which also requires ground assessing.

DIGHEM GROUND FOLLOW UP

The majority of responses identified by CRAE lie outside of the licence area. However, accurate location can only be completed with the aid of the tracking film (with CRAE?). Other anomalies lie within the Cethana area and were covered by CRAE's detailed grid surveys. Pop considers some limited work should be completed to confirm the status of several of these anomalies, in particular those lying within zones of alteration.

GEOCHEMISTRY

An assessment was made of Asarco's and CRAE's regional stream sediment sampling programmes in an attempt to define targets requiring additional work. The initial surveys (assayed for basemetals - no gold) proved their applicability by highlighting the majority of prospects which were later gridded and detail sampled, geophysically surveyed and geologically mapped. However, sections of the survey are wide spaced and require infilling to allow for an overall adequate coverage. A later, wide spaced, fine gold survey was implemented by CRAE using the Cyanide Leach method in conjunction with -80 mesh and panned concentrate techniques in an attempt to screen the tenement for volcanically hosted deposits. The survey was again too wide spaced for a definitive coverage of the licence yet a number of highly anomalous values were returned warranting ground assessment. It should be noted that a 320 g/t Au panned concentrate value was obtained draining an area of the Gog Range which CRAE failed to assess in detail. Noranda's work to date has

shown significant gold mineralisation shedding into this drainage and this prospect is discussed in detail, separately - Gog Range Prospect.

2. CETHANA ALTERATION ZONE

SUMMARY

This highly altered area of volcanics with minor associated lead-zinc mineralisation has been looked at in detail by CRAE during its period of tenure. However, Noranda's programme is designed to assess the entire area looking for untested mineralised horizons at surface as well as looking for possibly deeper mineralised horizons using major and trace element geochemical surveys as well as isotope (lead, sulphur, oxygen and carbon) studies to highlight these zones.

The majority of these surveys will be completed by December 1989 in the form of an Honours Project undertaken by D. Hicks of the University of Tasmania, supervised by Dr. R. Large. Dr G. Green of the Tasmanian Department of Mines will conduct the oxygen isotope study and SIROTOPE, a division of the CSIRO, has completed the lead isotope study.

GEOLOGY

The Honours Project was initiated to aid Noranda's deeper searching programme of the prospective Cethana Alteration Zone. The altered sequence has been geologically mapped in detail by both D. Hicks and W. Herrmann at a scale of 1:5000, in particular, along three main road traverses located roughly perpendicular to strike (Cethana Dam Road, Days Road - Round Mountain Mine track, Claude Mountain Road). W. Herrmann's mapping has been presented on the 1:10,000 scale Lake Barrington Regional Geology sheet (Enclosure 1) along with his road traverse down to the new rowing course - Lake Barrington road. Darren Hicks' detailed work will be presented separately in the following annual report.

SAMPLING (geochemical - petrographic)

The same three traverses have been rock chip sampled in detail with some 250 samples being collected. Thirty of these have been submitted for major and trace element geochemical work as well as thirty samples being submitted for petrographic analysis (Appendix 2). Petrographic results show significant Cambrian quartz-sericite-K-spar-albite + chlorite + pyrite alteration occurs at Cethana, partially overprinted by a later possible Devonian event introducing biotite, tourmaline and veinlet quartz. A similar style of overprint is observed at Rosebery.

ISOTOPE SURVEYS

The lead isotope study was completed on nine sulphide rich drill cores and four rock chip samples, locations for which are as follows:

225256	77CC-1	78.60 m	Sphaeritic qtz-ser schist
225257	77CC-1	98.75 m	Wkly mineralised fine tuff
225258	77CC-2	46.45 m	Qtz-ser-carb-Pb mineralised vein
225259	77CC-3	147.50 m	Pb-Zn mineralised qtz vein
225260	77CC-4	90.00 m	Veined, Pb mineralised tuff
225261	77CC-5	38.40 m	Wkly mineralised chloritic tuff
225262	77CC-6	41.40 m	Altered and veined cherty tuff
225263	77CC-7	62.80 m	Volc exhalitive pyrite? Semi massive
225264	77CC-13	136.00 m	Pyritic, highly altered tuff
225265	Round Hill Central Workings		- Galena, carbonate vein (Devonian?)
225266	Staverton SP - 1		Mineralised chip samples
225267	Moina - Fletchers Adit		Pb-Zn mineralisation (Devonian)
225268	Cethana West - Dam Turnoff		Altered wkly mineralised tuff

The isotopic homogeneity of diamond drill core samples 225256-264 and 225268, and their similarity to the Rosebery signature, indicate that this prospect has a high probability of representing the same mineralisation event responsible for the massive sulphide deposits in the Mount Read Volcanics.

Samples 225266-267 have significantly different isotopic compositions with 266 being more radiogenic than the Cambrian signatures and sample 267 is less radiogenic. Sample 225265 is more radiogenic than the major cluster of data from this study, but still plots just within the Hellyer signature. This may indicate that the Round Mountain mineralisation has been remobilised from a deeper Cambrian source.

Approximately 15 samples have been selected for Oxygen isotope studies and a further 25 samples have been submitted for sulphur and carbon isotope studies. Dr Geoff Green will supervise the oxygen isotope survey and will submit his results and interpretation late in 1989. This report will include some synthesis of the other isotopic work and will also draw on some of the petrographic data.

DRILL CORE LOGGING

In order to synthesise all the geochemical and isotopic data, a complete picture of the geology was necessary. In light of this, detailed logging of CRAE 's drillholes was undertaken initially by W. Herrmann and more recently by D. Hicks in an attempt to piece together the complex geological history of the area. Details of W. Herrmann's logging for holes CCl, 2 and 3 is appended to this report (Appendix 2). His observations were that the low grade basemetal mineralisation is associated with quartz-carbonate + chlorite veins and veinlets which generally appear to post date the formation of tectonic cleavage. D. Hicks' data is not yet available and will be presented in the following annual report.

CONCLUSIONS

A major data synthesis will be undertaken on the completion of all the geochemical, geological and isotopic surveys in an attempt to define targets warranting diamond drilling. This synthesis will include information derived from the geophysical review and will also draw on CRAE's and Asarco's more regional geochemical data.

3. GOG RANGE PROSPECT

SUMMARY

This portion of acid volcanics and epiclastics with associated anomalous soil geochemistry defined by CRAE/Asarco has been regrided with trial soil sampling lines completed to confirm CRAE's results. Consultant geologist, P. Ellis, was contracted to supervise the regriding programme as well as geologically map and soil sample the prospect.

GEOLOGY

A geological fact map (Enclosure 4) is produced at 1:5000 scale as well as an interpretative sheet (Enclosure 5) at the same scale. As mentioned previously in the detailed geology section, a regional interpretative geology sheet for the Gog Range portion of the tenement was produced at 1:10,000 scale utilising all available data (CRAE, Department of Mines, Noranda) (Enclosure 3).

The grid mapping has shown the basal volcanic sequence is a distinct suite of rhyolitic quartz-feldspar phyrlic lavas and rhyolitic crystal vitric tuffs with epiclastic lenses intermixed throughout. This unit is overlain(?) or is possibly in faulted contact with a major rhyolitic crystal tuff which is in part quite fragmental and pumiceous in the west grading into finer tuffs with subordinate epiclastic

horizons to the east. The possible faulted contact is manifested by a narrow gossanous strike slip(?) shear zone which assays strongly (see geochemistry). Overlying this crystal tuff is a quartz-feldspar phyric rhyolitic intrusive which was mapped by CRAE as a welded tuff. Overlying this 500 metre thick unit is a tuffaceous volcanoclastic/epiclastic sequence which outcrops poorly.

Unconformably overlying (in part faulted?) the volcanics is the Roland siliceous hematitic conglomerate which surprisingly rarely outcrops on the western portion of the grid.

The entire sequence appears to be block faulted, possibly indicative of the Devonian Tabberraberan Orogeny.

It should be noted that extensive talus or scree deposits blanket much of the volcanic terrain thus hindering detailed mapping and sampling surveys.

ALTERATION

Weak sericite-chlorite-silica alteration is observed throughout the gridded area, however, highly significant quartz stockworked silica-sericite-pyrite \pm basemetal - gold alteration is delineated throughout the 350 x 150 metre long gold zone. The stockworking appears to be strongest in association with major crush or shear zones which transect the zone. Follow up surveys will need to define these more intense zones in order to highlight possible zones of higher grade mineralisation.

GEOCHEMISTRY

A. CHECK SAMPLING

A total of 51 bedrock soil samples were hand augered through extensive talus deposits east of Line 27E in an attempt to check sample previous CRAE soil lines. (Enclosures 6, 7,

8, 9, 10 and 11 - Appendix 5). This programme has corroborated and upgraded the original values, thus confirming the existence of discrete anomalies associated with a narrow gossanous shear(?) zone. The existence of this gossanous zone was not observed by CRAE, however, gossanous float was sampled by Asarco geologists returning moderately anomalous values to 520 ppm Cu, 800 ppm Pb, 2400 ppm Zn and 22 ppm Ag.

Assay values for the 5 check soil lines ranged up to 1400 ppm Cu, 1150 ppm Pb, 2450 ppm Zn, 78 ppm As and 0.16 ppm Au. Considerable downslope hydromorphic movement of these anomalies is observed as the gossanous shear zone is generally less than one metre in width yet the anomaly varies in width up to 100 metres.

A total of 60 rock chip samples were taken along 200 metre spaced grid lines across this anomalous zone with analyses of gossanous material returning values up to 0.17% Cu, 0.22% Pb, 0.57% Zn and 7.5 g/t Ag. (Enclosures 12 and 13 - Appendix 5). Nearly all the gossanous rock chips failed to register for gold and were correspondingly low in arsenic.

B. GOLD ZONE

SUMMARY

Initial reconnaissance geological mapping drew Noranda's attention to a possible gold stockwork zone lying west of line 27E in a rugged and steeply sloping portion of altered pyroclastics, volcanics and epiclastics. The area has had no previous gold assaying completed over it other than for one panned concentrate sample being taken from a creek draining the area. This panned sample assayed 320 g/t Au. CRAE completed geological mapping and soil sampling surveys over the zone and defined a nebulous, weak to moderately anomalous zinc-copper zone. Gold was not assayed for and no further work was conducted.

SOIL SAMPLING

Noranda's first pass soil sampling programme on 200 to 300 metre spaced lines returned soil gold values to 0.36 g/t with associated high arsenic - 160 ppm. Infill sampling on 100 metre spaced lines highlighted further a major zone of gold mineralisation of dimensions 350 x 150 metres assaying up to 4.45 g/t Au with coincident significant basemetal and arsenic values (As 777 ppm, Cu 510 ppm, Pb 535 ppm, Zn 575 ppm and Ag 4.5 ppm). Of the 75 soil samples taken, some thirteen returned values greater than 0.1 g/t and three returned values greater than 1.0 g/t Au.

ROCK CHIP SAMPLING

A total of 30 rock chip samples were collected from the area bounded by lines 19E to 27E with extremely encouraging results being returned coincident with the soil response with values ranging up to 5.5 g/t Au, 0.34% Cu, 0.27% Pb, 0.35% Zn, 1.68% As and 28 g/t Ag. Four of the thirty samples collected assayed greater than 4.0 g/t Au. All of the significant results come from prominent quartz stock-worked silica-sericite-pyrite altered volcanic bluffs lying beneath a major epiclastic sequence which outcrops poorly.

The gold/basemetal/arsenic anomaly remains open to the east of line 25'8E and bedrock sampling surveys have been recently completed over lines 27E to 30E to close off the zone. Results are awaited.

STREAM SEDIMENT SAMPLING

During Noranda's detailed grid mapping programme eleven -80 mesh stream sediment samples were taken from creeks draining the entire gridded area (Enclosure 12 - Appendix 5). Weak to moderately anomalous basemetal values were recorded from

eight of the eleven sites, confirming the original Asarco stream sediment anomalies which they subsequently followed up.

EXPLORATION POTENTIAL

Exploration Licence 10/88 shows great potential for the discovery of Volcanogenic Massive Sulphide Mineralisation within the altered zones at Cethana and Staverton. A further possibility occurs in the Lake Barrington Road area within the mixed andesitic-rhyolitic-epiclastic altered sequence thought to be the Que-Hellyer CV sequence equivalent.

Noranda also believes the licence holds great promise for the location of volcanic hosted and/or structurally hosted precious metal deposits in particular at Gog Range and possibly at Lake Barrington in association with significant copper mineralisation.

EXPLORATION PROGRAMME PROPOSED

A number of areas having VMS potential have been defined and explored by the earlier lease holder, CRAE. None has been exhaustively tested at depth or along strike and little effort was expended in trying to understand the complex geological history.

Noranda to date is in the process of defining further, both the Cethana and Staverton alteration zones using detailed major and trace element geochemistry as well as isotopic (Pb, S, C, O) surveys. This has been coupled with detailed geological mapping, rock chip sampling and petrographic surveys.

The majority of the isotope and geochemical work remains to be completed as the Noranda sponsored Tasmanian University Honours Project runs on a calendar year basis ending December 1989. On the completion of the Honours Project all available geochemical/geological/petrological and isotopic data from the Cethana Area will be synthesised with special input from Dr G. Green of the Tasmanian Mines Department in reference to the isotopic work. Additional data such as CRAE's previous work and Noranda's

geophysical re-interpretation will be drawn on. This synthesis it is hoped will highlight prospective zones requiring drill testing. All drillholes will be cased and surveyed with downhole EM looking for "near miss" situations.

At Staverton the altered sequence is poorly understood and needs to be regridded prior to mapping in detail and prior to additional soil and rock chip sampling surveys being undertaken.

Subsequent to these surveys additional infill IP and possibly EM surveying will be conducted along with isotopic and major and trace element surveys, the combination of which will aid the overall data package. Synthesising this data package may generate significant targets worthy of diamond drilling. All drillholes will be cased and surveyed with downhole EM looking for "near miss" situations.

Noranda believes the near surface potential at Cethana and Staverton has been looked at in moderate detail. However, little effort has been applied to finding a possibly deeper mineralised trend.

Highly anomalous gold geochemistry on the Gog Range Prospect requires immediate detailing. A tape, compass and clinometre survey will be implemented to accurately locate all available outcrops prior to detailed geological mapping surveys being completed. The mapping data will focus on a detailed rock chip and channel sampling survey designed to define the highly anomalous gold trend assaying up to 5 g/t. Once a structural and geological picture of the mineralised horizon is defined, diamond drilling surveys will commence. Drilling is going to be difficult in this steep area with availability of water also being a problem.

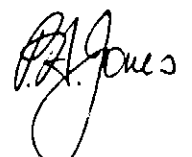
A geophysical re-evaluation of CRAE's data from the Lake Barrington Prospect has shown the four holes drilled on the copper, silver, gold show failed to test the major IP and Misse a la Masse target due to being pulled up short. A deeper hole

is planned to test this hypothesis. Downhole EM will be completed in the cased drillholes to test for a "near miss" situation.

Additional areas requiring assessment are the Promised Land and Cethana Picnic Ground Prospects. Both these areas have not yet been located on the ground.

It should also be noted that CRAE's stream sediment gold coverage is not adequate and where they did find an anomaly (Gog Range - 320 g/t Au) they simply wrote it off without exploring it further. There are a number of anomalous results requiring testing albeit not quite as significant as at the Gog.

A regional magnetic/gravity interpretation will be undertaken to find the granite contact at depth and also to map major structural features which may guide further exploration surveys.



CONSULTANT GEOLOGIST.
for NORANDA.

APPENDIX 1

Detailed Mapping - Cethana/Lake Barrington Road

W. Herrmann

Notes on the Geology of the Cethana and Staverton Areas

E.L. 10/88 N.W. Tasmania

for: NORANDA
by: W. Herrmann, R.S.D. 1066, Devonport...7310
date: January 1989

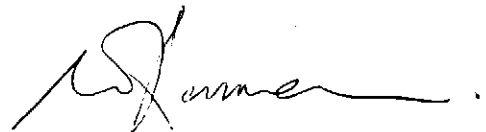


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LIST OF PLANS

Fig No 1: E.L. 10/88 Parts 1 and 2 - Geology Scale 1:10 000

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1. INTRODUCTION

This report is intended as explanatory notes to cover a short roadside outcrop mapping and preliminary drill core re interpretation program on E.L. 10/88 carried out under contract arrangements to NORANDA during November 1988.

The aims of the program were to produce a preliminary geological map and to assess the style and significance of previously known minor base metal sulphide occurrences and extensive zones sericitic alteration in felsic volcanics.

Approximately 8 days mapping in the Cethana and Staverton areas and 2 days core logging of diamond drill holes CC1, CC2, CC3 at Cambridge (Tasmania) was carried out.

2.

SUMMARY AND CONCLUSIONS

A preliminary geological mapping program in Noranda's E.L. 10/88, N.W. Tasmania has indicated that basement rocks in the Gethana area comprise an assemblage of proximal felsic extrusives, intrusives and pyroclastics with subordinate volcanolithic epiclastics and fine grained tuffaceous siltstones. These appear to be in thrust faulted contact with a folded sequence of siliciclastic conglomerate and quartz arenites correlated with the Late Cambrian - Ordovician Denison Group.

Strong sericitic alteration associated with intense cleavage development and minor disseminated pyrite mineralization is of district scale extent and appears to be partly structurally controlled occurring in broad belts and narrow shears essentially parallel to the faulted Denison Group /volcanic contact and partly lithologically controlled tending to be associated with felsic pumiceous tuffs.

A brief examination of core from three CRAE drill holes (CC1, CC2, CC3) suggested that low grade base metal sulphide mineralization is associated with quartz + carbonate + chlorite veins/veinlets which generally appear to postdate the formation of tectonic cleavage.

Mapping of the Lake Barrington Rowing Course Road indicates that the basement rocks there are of a rather different suite comprising andesitic extrusives and pyroclastics, felsic pumiceous tuffs and coarse to fine grained epiclastic wackes of mixed andesitic + felsic volcanic provenance.

Although generally rather weathered this group does not appear to be associated with significant sericitic alteration but the presence of andesitic volcanics may suggest an analogy with the VMS bearing environment of the Que River-Hellyer Volcanics.

3. GENERAL GEOLOGY AND STRUCTURE

The rocks encountered in outcrops in the Cethana area comprise a sequence dominated by quartz + feldspar phyric "rhyolitic" volcanics including probable intrusive, extrusive and pyroclastic members with minor intercalated units of fine grained (aphyric) felsic vitric tuffs and volcanoclastic/tuffaceous siltstones. Not recognized in outcrop but prominent in diamond drill hole CC2 are pebbly felsic volcanic lithic wackes of epiclastic-mass flow type origin.

The internal structure of this felsic volcanic-epiclastic assemblage is obscure but bedding orientations and lithological contacts where observable are generally steep and often appear to be subparallel to the regional north westerly trending cleavage; ie are probably partly transposed.

The volcanics are in contact to the south with siliciclastic sediments correlated with the Late Cambrian-Ordovician Denison Group; ie: coarse siliclastic conglomerate (Roland Congl.) and overlying quartzose medium to fine grained arenites (Moina Sandstone). In the Cethana Dam area the latter are locally quite pyritic (2-5% dissem. Py) and form broad open folds with axes subparallel to the WNW trend of the contact with the volcanics.

The contact between the clastics of the Denison Group and the (presumably older) volcanic sequence appears to be faulted. Near Cethana Dam the plane of contact dips northwards at about 35° implying a reverse movement but is complicated by a steeply dipping NE striking fault which offsets the contact by about 100m (in plan).

At this location also there is an approx 100m thick unit of flinty, pyritic quartz rich siltstone sandwiched within feldspar porphyry. I interpret this to represent an imbricate thrust fault bounded "sliver" of "Moina Sandstone" but will concede that it compositionally also resembles some of the siliceous fine grained tuffaceous siltstones evidently interbedded with the volcanic sequence near Day's Road. On the eastern side of the Forth River the northern contact of the "sliver" is semi parallel to the main volcanics/Denison Group contact. At Oliver's Road east of Round Hill, the volcanics/Denison Group contact dips steeply northwards and again a thin fault bounded "sliver" of cleaved siliceous sandstone is present at the contact.

Cleavage development in the volcanics is extremely variable in intensity. The orientation is universally semi vertical with a NW trend except close to the Denison Group contact where cleavage tends to be WNW sub parallel to the strike of the contact.

Some of the volcanic lithotypes, notably the Feldspar Porphyry (fqp) which is probably intrusive and Quartz Porphyritic Rhyolite (fqr) are virtually massive and unclesaved whilst others, interpreted to represent pumiceous pyroclastics, are intensely cleaved and are best described now as quartz + sericite schists often associated with upto 1% disseminated pyrite.

Similarly sericitic and pyritic schists occur in narrow bands or shear zones of a few metres width within the otherwise massive feldspar porphyry (Eqfbp) opposite Bellana Picnic Area (400m SW of Forth River Bridge below Cethana Dam). The impression here is that cleavage development, sericitization and pyrite mineralization are shear related (Compare Specimens C1, C2). Elsewhere in the Cethana and Olivers Road areas cleavage development etc appears to be more or less stratabound but due to the masking effect of sericitization and foliation on rocks of essentially similar chemical composition the mapped boundaries of extrusive (Eq) and pyroclastic (St) units are rather conjectural.

The section exposed along the Rowing Course Road north of Staverton is of rather different character. The rocks exposed here comprise a mixed volcanic-epiclastic assemblage including porphyritic andesites and associated pyroclastics, a thick unit of pumiceous quartz phyric felsic tuff/ignimbrite with associated mass flow type medium grained lithic wackes of mixed felsic-intermediate volcanic parentage and minor intercalations of mixed micaceous/volcaniclastic greywacke and siltstone. The sequence appears to be tightly and complexly folded. Several sedimentary facing determinations indicate a younging generally northwards. I have a not very well founded impression that the andesites are basal and are overlain by the mixed epiclastic/sedimentary/felsic pyroclastic sequence.

Cleavage trends here are also semi vertical and have North to North Westerly trends. Some of the rocks, notably the andesites and mass flow lithic wackes, are essentially massive and unaffected by cleavage development whilst in the finer sediments cleavage is weakly to moderately developed.

Although extensively and deeply weathered, none of the exposures in this section seem to be notably (hydrothermally) altered.

4.

ALTERATION AND MINERALIZATIONAlteration

One of the most striking aspects of the volcanic assemblage exposed in the Cethana area is the almost regional extent of strong sericitic alteration associated with minor disseminated pyrite mineralization. There are lengthy road sections where the rocks consist of intensely foliated quartz + sericite schist with relict quartz phenocrysts/crystal fragments being the only recognizable ex volcanic component.

As noted in the preceeding section these schists appear to be largely stratabound related to units of pumiceous felsic tuffs (?).

This type of lithological control is also evident in the three drill holes examined.

In CC1, virtually the entire hole (106.4m) was drilled through foliated sericitic schist containing 0.5-1% disseminated pyrite except for a five metre thick unit of dark grey flinty siliceous vitric tuffaceous siltstone. This siltstone unit is not foliated but instead is characterised by a fine network of intersecting quartz and carbonate veinlets which seem to indicate that this more competent (?) rock type has yielded under tectonic stress by brittle failure rather than by ductile shear. The veinlets carry variable amounts of pyrite, galena and dark brown sphalerite and although this siltstone unit is geochemically anomalous with respect to the enclosing schist (included 2.6m @ 0.98%Pb, 0.92%Zn, 11g/tAg), the sulphides may be interpreted to be stratabound fracture controlled rather than stratiform/syngenetic.

In CC2 the upper 20m of core consists of a quartz + sericite and carbonate schist possibly derived from magnetite bearing feldspar porphyry. The lithotypes further down the hole comprise an alternating sequence of felsic vitric tuffs, pebbly epiclastic lithic wackes of mass flow type and a thin unit of porphyritic rhyolite. These latter are essentially unaltered and weakly cleaved except for a few narrow (shear related ?) zones of more intense cleavage with associated sericitization and 0.5% disseminated pyrite in one of the epiclastic lithic wacke units.

CC3 intersected a thick unit of felsic pumiceous tuff succeeded below 162.7m by alternating fine grained siliceous vitric tuff/siltstones and felsic pumiceous tuff. In the oxidized zone above 35m the core appears quite schistose and sericitic and somewhat argillaceous. The unoxidized pumiceous tuffs are moderately foliated with pumiceous and feldspathic components partly altered to an assemblage of quartz + sericite + carbonate ⁺ minor chlorite. The intensity of alteration seems to decrease down hole. The intercalated vitric tuffs are by contrast quite unaltered and rather massive with very weak cleavage development.

In a broader structural context CC1 seems to have been drilled entirely within a more or less stratabound zone of strong sericite alteration/cleavage development whilst CC's 2 and 3 (drilled south westwards) seem to have intersected the south western margin of this zone and progressed on into relatively unaltered (more competent) rocks.

Although the exposures mapped are not sufficient to tightly constrain the form of this and other nearby zones of strong sericitization and cleavage development, the distribution is consistent with an interpretation that the alteration/deformation zones are generally semi parallel to the regional trend of the volcanics/Denison Group contact. Since this contact appears to be largely thrust faulted the implication of "stacked", perhaps partly lithologically controlled, ductile shear zones within the volcanics adjacent and parallel to the main thrust plane seems reasonable.

Mineralization

In the process of relogging drill cores from CC1, 2 and 3 particular attention was directed to noting the styles of base metal sulphide mineralization.

In CC1 the interval 78.6 - 79.0m assayed at 0.2%Pb, 8.2%Zn, 3g/tAg. In the core fine granular galena, sphalerite and pyrite are associated with quartz in thin (< 5mm) veins or shears running parallel to the LAOC which are superimposed on (ie: post date) the cleavage foliation.

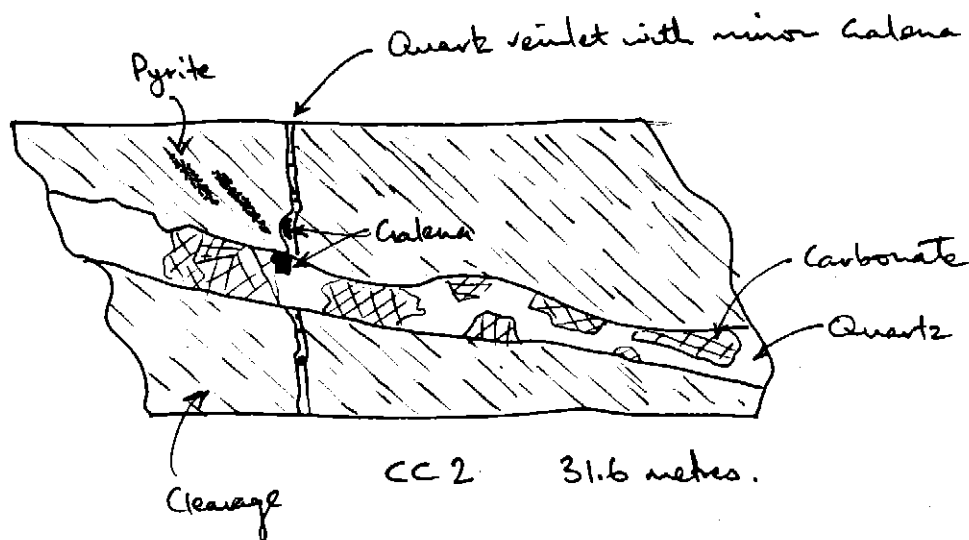
Likewise in the siltstone unit between 95.8-100.5m sulphides occur within a network of fine quartz carbonate veinlets which appear to represent a local concentration of open space fracture fillings due to brittle failure of this apparently relatively competent lithotype.

00 60

In CC2 there are three geochemically anomalous zones as follows:

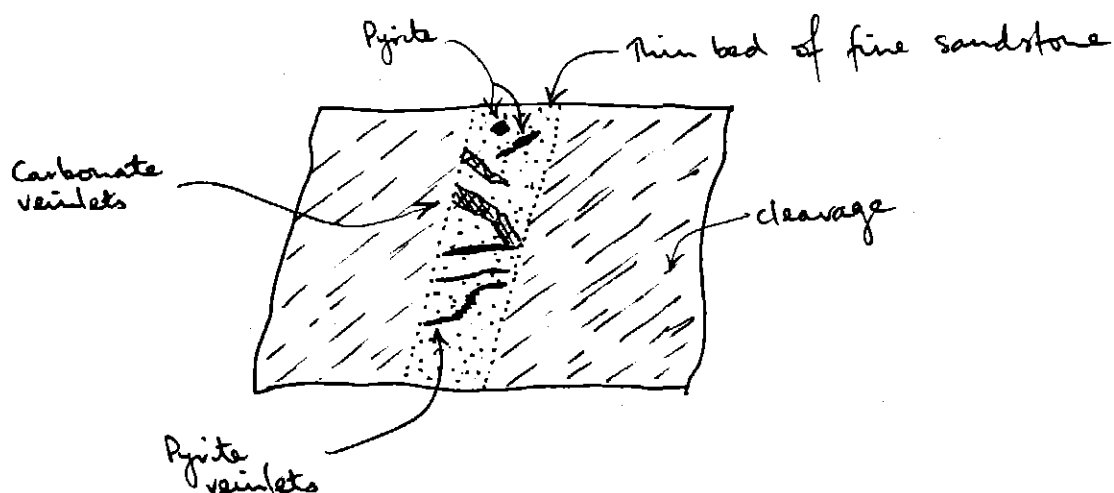
12.5 - 23.0m	0.07%Pb,	0.12%Zn
38.0 - 40.0m	0.04%Pb,	0.20%Zn
45.0 - 47.0m	0.1%Pb,	0.33%Zn

The upper anomalous zone shows no visible sulphides and I am rather surprised at the Pb, Zn values assayed. The two lower anomalous intervals both include numerous small veinlets and coarse veins of quartz + carbonate + minor chlorite with specks and sometimes coarse slugs of pyrite, chalcopyrite and galena. The veins commonly cross cut the cleavage foliation and are sometimes subparallel to it.



At 59.4m in CC2 at the lower contact of a lithic epiclastic wacke unit there is a 1cm "bed" of fine sandy sediment which encloses a number of small intratransformational dilation veinlets of carbonate and pyrite which do not extend beyond the margin of the bed. This suggests a competency control with formation of open fractures allowing focus for sulphide deposition.

61



CC2 59.4 metres.

Most of the core from CC3 is devoid of megascopically visible pyrite or galena mineralization and the several (CRAE) quoted anomalous zones are a little surprising.

Generally speaking, most visible occurrences of base metal sulphides are associated with quartz + carbonate \pm chlorite veinlets which are interpreted to be late stage tectonic tensional fracture fillings. I have not observed any convincing indications of stratiform or syngentic (volcanogenic) mineralization.

62

5.

REFERENCE

Purvis, G.J. 1977 Diamond Drill Sections
CC1, CC2, CC3; 1:500 scale
in: CRAE Report No 9041
"E.L.'s 7/73 and 10/76,
Exploration at Western
Cethana, August 1976-77".

APPENDIX 6.1

Description of Lithotypes

€qfbp

Feldspar Porphyry

In the freshest exposures (eg: C1, C8) this rock type consists of coarse tabular phenocrysts of whitish grey plagioclase (1-4mm, 25%), randomly oriented prisms of (chloritized) ferromagnesian (1-3mm, 10%), occasional small rounded phenocrysts of grey quartz and accessory specks of magnetite contained in a pale rosy pink matrix of granular k-feldspar and quartz in the proportion about 2:1.

The rock is moderately magnetic.

The composition and fabric is uniform and massive without notable grain size variation or layering.

Compositionally and texturally this rock tends toward a porphyritic microgranodiorite and is interpreted to be of felsic intrusive origin.

The feldspars generally appear to be quite fresh except in localized zones of strong cleavage development (west of the Forth Bridge below Cethana Dam) in which the phenocryst and matrix feldspars are altered to pale greenish grey sericite.

€qr

Quartz Porphyritic Rhyolite

In the freshest exposures (eg: C7, C11, C34) this rock type is composed of large equant subangular to subrounded phenocrysts of translucent pale grey quartz (2-5mm, 10%), smaller tabular phenocrysts of pinkish to greenish white plagioclase (1-2mm, 5-10%) and small prisms of chloritized ferromagnesian (hornblende?) (< 2mm, < 2%) evenly distributed in a uniform, pale pinkish grey, very finely granular to aphanitic glassy-feldspathic? matrix.

Rarely (eg: C15) the matrix displays a fine-glassy planar fabric resembling flow banding.

On this basis, this lithotype is interpreted to be of rhyolitic extrusive origin although the more massive types could be high level subvolcanic intrusives.

Ext

Quartz Phyric Rhyolitic Tuffs/Ignimbrite

In fresh exposures (eg: C48) this lithotype consists of small crystals of quartz and plagioclase (generally <3mm size and 5-10% volume) contained in a pale greenish grey fine grained-glassy siliceous matrix usually displaying a wavy eutaxitic planar fabric. In places small wispy volcanic glassy and collapsed pumiceous fragments are a minor component.

This lithotype, however, seems very susceptible (in the areas mapped) to deformation related (?) sericitic alteration.

Consequently, in most exposures, the only primary features still recognizable are the quartz grains scattered about in a white to buff coloured finely schistose matrix of sericite, sometimes dusted with pyrite. (eg: C13, C18 etc.)

Because of the general compositional similarity to the quartz porphyritic rhyolitic extrusives (Eqr) it is difficult, in the field, to confidently identify the precursor lithotype for these quartz phyric quartz-sericite "schists".

Evt

Felsic Vitric Tufs

Rocks of this category occur in several thin units amidst the (schistose) quartz phyric tuffs in the Cethana area. These are essentially aphyric fine grained quartz + sericite schists generally without recognizable clastic stratification. They are interpreted to represent fine grained felsic vitric tuffs.

Ets

Fine Grained Tuffaceous Siltstones

These are fine grained well stratified clastic rocks of essentially felsic volcanic provenance probably largely composed of fine siliceous vitric ash. They vary from pale to dark grey in colour (eg: C22) to banded grey-buff colour (eg: C49) and commonly have a rather cherty appearance although a fine silty clastic texture can usually be distinguished.

They generally occur as thin units of a few to a few tens of metres thickness interbedded with felsic pyroclastics in the Cethana area and with intermediate volcanoclastic wackes in the cuttings of the Lake Barrington Rowing Course Road.

Esg

Turbiditic Micaceous-Feldspathic Wackes/Siltstones

Rocks of this category occur along the Rowing Course Road in association with coarser mass flow type lithic wackes and finer vitric? tuffaceous siltstones. They are generally well stratified or laminated or turbiditic varying from fine grained siltstone ($\sim 0.02\text{mm}$) to fine sandstone (0.1mm) grain size and commonly exhibit grain size grading.

The composition appears to consist largely of volcanoclastic feldspar and quartz but the common (although minor) occurrence of detrital? mica as small pearly flakes lying flat on the bedding plane suggests some clastic input from a PreCambrian metasedimentary provenance.

66

€es

Volcaniclastic Lithic Wackes

These are prominent along the Lake Barrington Rowing Course Road. They mostly massive and unstratified, poorly to moderately sorted in the medium to coarse arenite grain size range (0.5-2.0mm). The composition is dominated by immature subangular grains of feldspar, chloritized ferromagnesians, small volcanic lithics and minor quartz.

The lithic fragments are mostly of similar arenaceous grain size but occasional well rounded clasts to about 40mm occur. These are mostly of pale grey to pinkish grey fine grained felsic volcanic or tuff.

The abundance of feldspar and (lesser) ferromagnesians combined with paucity of quartz grains suggests an at least partly "andesitic" intermediate volcanic origin. These rocks are interpreted to represent thick epiclastic mass flow units.

€pa

Porphyritic Andesite

These are prominent along the Rowing Course Road and although most exposures are extremely weathered the distinctive feldspar phyrlic relict fabric is usually distinguishable.

The fresh rocks consists of tabular prismatic phenocrysts of pale greenish grey plagioclase (2-4mm, ~20% volume) and elongate prisms of ferromagnesian (hornblende?) (1-4mm, 10% volume) evenly scattered about in a very fine grained medium greenish grey matrix consisting partly of a fine meshwork of plagioclase laths (<0.05mm). Small grains of magnetite are present as a minor accessory and the fresh rocks are weakly magnetic.

These rocks are massive in outcrops; in some specimens (eg: C54) the elongate ferromagnesians display a weak preferred orientation suggesting an igneous flow fabric.

I consider them to represent thick andesitic extrusive flows although intrusive members may also be present.

↳at

Andesitic Lithic Tuff and Breccia

These are of variable grain size with fragments from a few millimetres to a few centimetres in size.

They consist essentially of angular clasts of fine grained sometimes rather glassy, porphyritic andesite as well as small crystal fragments of feldspar and ferromagnesian constituting about 50% of the rock volume supported in a fine granular or glassy pale grey (silicified?) to purplish grey matrix. They are generally weakly magnetic.

These are interpreted to be fine pyroclastics and volcanic breccias clearly compositionally related to the porphyritic andesites.

APPENDIX 6.2

Summary Drill Logs: CC1, CC2, CC3

CC1

Depth (m)

0 - 5	No core
5 - 7	Oxidized qtz + sericite schist ex quartz phyric felsic volcanic, weakly iron stained.
7 - 17.6	Quartz + sericite schist; as above but unoxidized with about 0.5% disseminated pyrite.
17.6 - 40	Brecciated/sheared qtz + sericite schist. Lithology as above but intensely brecciated and sheared with shear planes generally subparallel to 20° to LAOC. Widespread disseminated pyrite averaging about 1% often concentrated in trains and small slugs <u>especially</u> associated with strongly brecciated zones and shear planes.
40 - 95.8	Quartz + sericite schist. As above, apparently derived from quartz phyric felsic volcanic. Averages <0.5% dissem. pyrite.
95.8 - 100.5	Vitric Tuffaceous Siltstone. A very fine grained dark grey siliceous flinty rock probably originally composed largely of fine siliceous vitric ash. There is no convincing grain size stratification or bedding to suggest a clastic/sedimentary origin; both upper and lower contacts appear to be gradational with narrow slivers and bands of fine sericitic material.

Cleavage/foliation is poorly developed in this unit which appears to have yielded during tectonic deformation by brittle fracture rather than laminar shear. There is a fine network of intersecting narrow carbonate \pm quartz veinlets which carry variable amounts of pyrite, galena and dark sphalerite. The sulphide mineralization appears to be fracture controlled.

100.5 - 106.4	Quartz + Sericite Schist Similar to lithology above 95.8m, averages < 0.5% disseminated pyrite.
106.4	E.O.H.

70

CC2

Depth (m)

0 - 5

No core

5 - 19.7

Quartz + Sericite + Carbonate Schist

A medium grained mottled greenish grey rather foliated rock consisting of relict phenocrysts of quartz, lensoidal streaks of greenish grey sericite and small lensoidal/interstitial domains of fine granular straw coloured carbonate and accessory disseminated fractured granules of magnetite.

The presence of magnetite suggests the rock is a strongly deformed feldspar + quartz + ferromagnesian porphyry (fqp) similar to that occurring near the Forth River Bridge below Gethana Dam.

19.7 - 52.7

Vitric Tuff

A pale greenish grey fine grained siliceous rock, reasonably well cleaved but not particularly sericitic.

Traces of pyrite, chalcopyrite, galena associated with post cleavage veins and veinlets of quartz + carbonate + chlorite.

52.7 - 59.4

Epiclastic Breccia

Essentially a coarse grained volcanoclastic wacke consisting of grains of feldspar, quartz and small lithic grains of fine grained felsic vitric tuff supported in a weakly foliated murky greenish grey siliceous, weakly sericitic, matrix.

There are occasional well rounded pebbles, to 20mm, of "cherty" siliceous volcanic lithics as well as numerous bands and irregular clasts of fine grained vitric tuff/siltstone which appear to be the result of soft sediment

brecciation and deformation.

The rock has an overall appearance suggesting an epiclastic mass flow type depositional origin.

Near the lower contact at 59.4m there is convincing grain size stratification in gritty "sandstone" indicating bedding at about 80° to LAOC.

59.4 - 70.7

Vitric Tuff

As for interval 19.7 - 52.7m.

70.7 - 80.6

Epiclastic Breccia

Similar to interval 52.7 - 59.5m.

Generally relatively unaltered, with only about 0.2% disseminated accessory pyrite.

However there are some short intervals, notably 73 - 75.5m and 76.4 - 77.8m in which the core is of paler pinkish-buff-grey colour appears to be more sericitic and has stronger cleavage development. These zones have higher pyrite content (around 0.5%Py) and characteristic small veinlets of hematite + pyrite.

80.6 - 81.9

F.g. Vitric Tuff/Siltstone

81.9 - 99.9

Porphyritic Rhyolite

M.g. phenocrysts of grey quartz and partly altered greenish grey plagioclase

(2-4mm, 10%qtz, 10% plag.) contained in a pale pinkish brown felsic/siliceous matrix.

Minor accessory of chloritized? small prisms of ferromagnesian biotite or

hornblende. Rock closely resembles

Quartz Porphyritic Rhyolite (Qpr) outcropping at Forth River Bridge below Cethana Dam.

Relatively unaltered and with out strong

foliation or penetrative cleavage development.

99.9 - 164.1 E.O.H.

Remainder of hole is an alternating sequence of pebbly felsic epiclastics and fine grained felsic vitric tuffs/tuffaceous siltstones as logged by G. Purvis. (1977)

These are essentially unaltered; the fine grained tuffs and tuffaceous siltstones in particular do not show any significant cleavage development or sericitization. G. Purvis' estimates of pyrite content, (generally 2-3%) are I would suggest about an order of magnitude too high.

The pebbly epiclastics contain a variety of commonly well rounded quartz feldspar phyrlic acid volcanics, fine grained vitric tuff/tuffaceous siltstone and occasional flattened pumiceous clasts? They are locally a weak purplish colour from hematitic staining. These zones contain upto a couple of percent of magnetite/hematite as disseminated grains within lithic fragments as well as the matrix and as fuzzy interstitial patches in the matrix. These zones are distinctly magnetic.

73

CC3

Depth (m)

0 - 24

Oxidized Quartz-Sericite Schist

Pinkish-buff grey coloured; schistose, partly argillic, commonly with 2-3% fine disseminated limonite after pyrite (?), some in veinlets. Rock rather resembles the q + ser schist in outcrops and in CC1 but with somewhat less abundant relict quartz phenocrysts.

24 - 35

Partly oxidized Quartz - Sericite Schist

Similar to above but with pale greenish grey colouration, only partly oxidized, less argillic. Limit of oxidation at about 35m.

35 - 162.7

Felsic Ignimbrite

A medium grained texturally fairly uniform pyroclastic composed of small wispy flattened fragments of greenish brown devitrified/sericitized pumice (1-10mm, ~15% volume) and small crystals of quartz and feldspar (generally 1-3mm, approx 5-10% volume) in a murky siliceous/sericitic/calcareous/chloritic matrix. There is moderate foliation, principally defined by flattened pumice clasts but also by moderate cleavage development in the sericite/chlorite component of the matrix, which intersects the core at about 45° to LAOC. There is considerable, perhaps about 10%, white to straw coloured carbonate in the matrix.

Small discrete grains of hematite, probably derived from oxidation of magnetite are present as a minor accessory (< 0.5%)

Locally the core is stained a weak purplish colour by fine pervasive hematite staining of the matrix.

This unit is probably similar to the precursor for the quartz + sericite schists outcropping along Cethana Road and intersected extensively in CC1. In this unit sericitization of feldspathic components is only partial.

162.7 - 172.6 F.g. Siliceous Vitric Tuff/Siltstone

Massive fine grained pale grey siliceous rock similar to units in CC2 but not visibly stratified.

172.6 - 190.0

E.O.H.

Alternating sequence of weakly sericitized m.g. felsic ignimbrite and fine grained vitric tuff as above.

The fine grained vitric tuffaceous units are essentially massive without significant cleavage development on apparent sericitization; the ignimbritic units by contrast are moderately to well foliated with pumiceous and feldspathic components partly sericitized.

Pyrite not present in significant concentrations.

APPENDIX 2

Petrographic Study

Cethana Alteration Area/Staverton/Lake Barrington Road

Tony Crawford

PETROGRAPHIC REPORT

Rocks from CETHANA EL

For Noranda Ltd. 3/5/89

Attn. Phil Jones, Darren Hicks

by

**Anthony J. Crawford
Geology Department
University of Tasmania**

SAMPLE: C2**SUMMARY:**

This is a crushed and recrystallized quartz-phyric rhyolitic lava or crystal tuff containing a strongly sericitized but non-foliated groundmass.

SPECIMEN:

On a freshly-cut surface, this sample is a mottled cream, green and grey highly altered felsic lava(?) with a relatively coarse-grained extensively recrystallized groundmass, although no cleavage or foliation is obvious.

THIN SECTION DESCRIPTION:

In thin section, this sample is seen to be a strongly deformed and recrystallized formerly quartz-phyric rhyolitic lava or crystal tuff. Former quartz phenocrysts, possibly constituting around 20 modal% of the sample, have been fractured, rotated and extensively recrystallized. Former crystal shapes have often been preserved, but subgrain recrystallization has been extensive, so that euhedral crystal outlines may contain polygonal quartz intergrowths made up of 20 to hundreds of crystals. Sparse former feldspar euhedra are totally replaced by very fine-grained sericite, so that they are difficult to discern from the strongly sericitized groundmass.

The groundmass of this sample is rather heterogeneous in texture, and is composed of a murky very fine-grained sericite-rich material that shows no preferred orientation or foliation. A very narrow veinlet of quartz along one side of the slide shows a few fairly cubic-shaped opaque grains that are probably pyrite.

SAMPLE: C4**SUMMARY:**

This is a former feldspar+quartz-phyric felsic lava or tuff, the former glassy groundmass of which has crystallized to a distinctively coarse-grained intergrowth of quartz and green biotite, with abundant interstitial sericite.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a highly altered dark pink quartz-phyric felsic lava or tuff with quartz phenocrysts up to 2mm across.

THIN SECTION DESCRIPTION:

This sample in thin section is a highly recrystallized and strongly altered former feldspar+quartz-phyric felsic lava or tuff. The feldspar phenocrysts are slightly more modally abundant than the quartz phenocrysts (~10-15 modal%); they are totally sericitized. Margins of most quartz phenocrysts have recrystallized during groundmass recrystallization.

The groundmass of this sample is distinctive, in that it is a quite coarse-grained intergrowth of polygonal, multicrystalline quartz, fine-grained sericite and unusual patches of green strongly pleochroic metamorphic biotite. The extent of alteration and recrystallization of the matrix makes positive identification as a tuff or a lava impossible, but most of the feldspar phenocrysts are entire euhedra, indicating that a lava precursor may be more likely.

SAMPLE: C5**SUMMARY:**

This is a former quartz-rich greywacke or sandstone that has recrystallized as an impure quartzite that shows a weak preferred orientation of recrystallized quartz grains.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a fractured and Fe-stained siliceous sandstone or quartzite.

THIN SECTION DESCRIPTION:

This sample in thin section is a sandstone with a framework-supported texture dominated by intimately intergrown quartz grains that have undergone extensive subgrain recrystallization to produce a slight foliation defined by long axes of recrystallized quartz. Former clayey matrix in this sample has recrystallized as mottled narrow patches and trains of very fine-grained sericite that make up about 20 modal% of the rock. Occasional fuzzy grains of altered Fe oxide or hydroxide (goethite?) are scattered through the rock, and occasional fractures are defined by reddish-stained sericite and Fe oxide-hydroxide dust. Several 0.5mm-wide brittle fracture zones cut the rock, and within these zones quartz grains have been granulated and rotated.

SAMPLE: C7**SUMMARY:**

This is a dacitic crystal lithic tuff dominated by sericitized and albitized plagioclase crystal fragments and phenocrysts, and less abundant phenocrysts of biotite and quartz. Lithic fragments were mainly formerly felsic glass, which has been sericitized.

HAND SPECIMEN:

On a freshly-cut surface, this sample is an altered, mottled brown-green and pinkish massive felsic crystal lithic tuff with sparse poorly defined lithic fragments to about 7mm across. It is sericitized and quite altered by surficial weathering.

THIN SECTION DESCRIPTION:

The fragmental nature of this sample is immediately obvious in thin section. Most fragments are either single crystal fragments of feldspar (phenocrysts) or quartz, or subordinate altered lithic fragments of felsic lava. Quartz crystal fragments are much less abundant than feldspar crystals, and are rounded euhedral crystals clearly derived from a rhyolitic magma. Former feldspar (plagioclase) phenocrysts are either euhedral or subhedral prisms to 1.5mm long which show either of two styles of alteration; some have entirely recrystallized internally to a mosaic of secondary albite that often forms intergrown rosettes, whereas others are thoroughly sericitized. Large euhedral plates of sericitized and chloritized biotite, to 0.5mm across, are an interesting and distinctive component of this rock. Occasional curved angular fragments of totally sericitized material were probably glassy lithic fragments.

The matrix of this sample is a vitric ash, highly variable in texture, grain size and degree and style of alteration. Some areas are highly sericitized, others are chloritized, and some areas are relatively 'clean' quartz-albite±Kspar(?). The matrix forms only 10-20 modal% of the sample, which is dominated by crystal and rock fragments. Areas of sericite, and to a lesser extent chlorite, are speckled and stained by Fe oxide/hydroxide dust.

The abundance of plagioclase (albeit altered) and biotite phenocrystal fragments in this rock suggest it was produced by explosive dacitic volcanism, although some input from a rhyolitic source is indicated by the subordinate quartz phenocrysts.

SAMPLE: C9**SUMMARY:**

This is a fairly well-preserved quartz-phyric rhyolitic lava, with a groundmass of devitrified silicic glass

HAND SPECIMEN:

This is a massive, pale green-cream coloured felsic lava or tuff with small quartz phenocrysts. It is transected by a 5mm-wide quartz vein.

THIN SECTION DESCRIPTION:

This rock is composed of approximately 5-8 modal% of rounded and broken quartz phenocrysts, never more than 1mm across, set in a 'clean' fairly even-textured groundmass composed of a very fine-grained mosaic intergrowth of quartz, albite and chlorite, with minor sericite; this almost certainly formed by devitrification of felsic glass. There are no signs that plagioclase was a former phenocryst in this rock. There is some suggestion, indicated by subparallel bands of slightly variable texture and grain size in the groundmass, that the rock had a weak magmatic banding, although this is not evident in the hand specimen. It is not an ignimbritic texture. Sparse FeTi oxide microphenocrysts were present in this sample, but are invariably altered to a red Fe oxide-hydroxide mixture. Relatively large and common zircon microphenocrysts are notable in this sample.

The quartz vein cutting this sample is composed of strongly deformed, almost ribbon quartz, showing intense subgrain recrystallization.

SAMPLE: C14**SUMMARY:**

This is a poorly-sorted quartz wacke derived from Precambrian metamorphics, with little or no input from Mount Read Volcanics sources.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey, fairly fresh fine-grained tuff or clastic sediment with a weak foliation more apparent on the weathered surfaces. Several larger, reddish clasts or fragments up to 8mm long are evident on the cut surface.

THIN SECTION DESCRIPTION:

This is obviously a clastic quartz-rich sedimentary rock in thin section. Quartz framework grains make up more than 80 modal% of the rock, are mainly less than 0.5mm across, are subangular to subrounded, and show complex internal strain features indicative of quartz derived from a deformed metamorphic source. Sorting is poor. Margins of quartz grains are scalloped, reacted and resorbed on a small scale, and many inter-grain boundaries have been produced by pressure solution and reduction of rock volume. Tiny insoluble opaque grains residual from pressure solution of matrix, are concentrated on grain boundaries. Other clastic grains include occasional very fine-grained cherty or siltstone fragments less than 0.2mm across. The large reddish fragment evident on the cut surface of this sample is composed of an almost isotropic limonite or goethite mass which incorporates several tiny detrital angular quartz grains. It is not possible to determine whether this is a clast, or a concretion formed in the sample in situ. The matrix of this rock is very fine-grained sericite after clays. The rock shows well developed high strain zones marked by subparallel foliation planes defined by very fine-grained Fe oxide concentrations. Several green pleochroic tourmaline grains support derivation from the Precambrian metamorphics in western Tasmania. There is no definitive evidence for any component of this rock being derived from the Mount Read Volcanics.

SAMPLE: C28**SUMMARY:**

This is a former quartz sandstone that has a component of the detrital fraction derived from a felsic volcanic source, and a component derived from a pelitic metamorphic source. The sample has suffered extensive pressure solution and reprecipitation of silica cement around detrital quartz grains.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a uniform light grey quartzite or quartz-rich sandstone mottled to a small degree by darker grey chlorite spots.

THIN SECTION DESCRIPTION:

This is a recrystallized quartz sandstone. More than 95 modal% of the sample is composed of poorly sorted and extensively recrystallized quartz grains to around 1 mm maximum grainsize. Ghost outlines of former well-rounded grains have been overgrown by quartz fringes, so that the rock is made up of a completely interlocking network of angular quartz grains. Both unstrained and strained quartz grains are present, and quartz grains that contain rounded melt inclusions, indicating a volcanic origin, and grains containing muscovite, indicating a pelitic metamorphic origin.

A second type of former framework grain, making up most of the rest of the rock, is composed of exceptionally fine-grained polycrystalline quartz and minor sericite. These generally slightly rounded inclusions are probably cherty sediment, although the possibility that they represent devitrified glassy felsic volcanics cannot be excluded. Small almost rounded grains of intergrown pale green chlorite flakes and occasional brownish biotite are not uncommon, but their origin remains uncertain. They may also be chloritized glass, or perhaps more likely, accumulations of former impure clayey matrix isolated during silica cementation and grain overgrowth.

SAMPLE: C78

SUMMARY:

This is an altered and recrystallized quartz-phyric rhyolitic lava which shows stronger than normal sericitization, and the development of tourmaline in quartz veinlets.

HAND SPECIMEN:

On a freshly-cut surface, this sample is an altered, mottled brown-green massive felsic lava or tuff with angular quartz phenocrysts, narrow, disrupted quartz veinlets, and areas of strong sericite development (although not foliated).

THIN SECTION DESCRIPTION:

This sample is a formerly glassy rhyolitic lava dominated by quartz phenocrysts, with only a few plagioclase phenocrysts. The latter are totally sericitized, and difficult to distinguish in the sericite-rich, messy groundmass. Although the rock does not appear to be very deformed in hand specimen, the quartz phenocrysts are almost all broken in situ in small, jigsaw-fit pieces, and most of these are extensively sub-grain recrystallized, although there is no foliation or preferred recrystallization direction evident.

The groundmass of this sample is heterogeneous in texture, and is derived largely from devitrification and recrystallization of rhyolitic glass to a quartz-albite-sericite mixture. Local variations in the abundance of sericite and Fe-hydroxide dust produce the mottled appearance of the hand specimen. Discontinuous narrow veinlets of quartz, much of it showing subgrain recrystallization, cut the rock. Zircons are relatively common and quite large euhedral pale greenish crystals in this sample.

An important feature of this sample is the presence of several tourmaline crystals in one of the quartz veinlets. These are elongate prismatic crystals showing a striking deep blue to colourless pleochroism. Their presence suggests that the alteration and deformation in this and related samples may be Devonian granite-related. For instance, no tourmaline is known from the Hellyer deposit, which is unaffected by Devonian granite-related alteration, but it is widespread at Rosebery, where the granite connection is well demonstrated.

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SAMPLE: C88**SUMMARY:**

This is a strongly sericitized quartz-phyric rhyolitic lava with a weak fracture cleavage.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a pink-brown quartz-phyric rhyolitic lava transected by a weak fracture cleavage that gives the rock an 'ignimbritic' appearance.

THIN SECTION DESCRIPTION:

This rock in thin section is seen to be a felsic lava with around 10 modal% of quartz phenocrysts in a strongly sericitized groundmass. Sparse phenocrysts of feldspar have been totally sericitized. The quartz phenocrysts are up to 2mm across, and most are slightly rounded and resorbed euhedral crystals; only a few are broken crystals. All quartz phenocrysts show strong internal deformation features, usually manifested as almost chequerboard, highly irregular and patchy extinction. A few crystals that are cut by major fractures show extensive subgrain recrystallization. Former feldspar phenocrysts are less than 1mm long and have been so thoroughly sericitized along with the groundmass that it is difficult to discern their crystal shapes in most cases. Only absence of the fine-grained quartz blebs which characterize the groundmass define former feldspar phenocryst sites. Two former biotite phenocrysts have been totally altered to sericite and an opaque Fe(Ti?) oxide phase.

The groundmass of this sample was probably highly glassy originally. It probably devitrified to a quartz-albite mosaic intergrowth, as typically seen in better preserved Mount Read Volcanics rhyolites, but this has been thoroughly sericitized. Dirty yellowish-brown exceptionally fine-grained sericite has riddled the groundmass, leaving only tiny irregular blebs and grains of quartz.

A variably but mainly weakly developed fracture cleavage pervades this rock, and where best developed is manifested as matted and orientated masses of sericite along fractures up to 1mm wide. Along these fractures, sericite is often stained red-brown.

The extent of sericitization in this sample is greater than normally seen in Mount Read Volcanics felsic lavas that have suffered only regional burial metamorphism, and implies more intense hydrothermal interaction has affected this sample.

SAMPLE: C93**SUMMARY:**

This is a former quartz-phyric felsic lava or tuff that has been extensively altered to a quartz-albite-biotite-chlorite-tourmaline assemblage.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a mottled dark green and brown quartz and feldspar-phyric lava, with a strongly altered groundmass.

THIN SECTION DESCRIPTION:

This sample in thin section is seen to be dominated by entire and broken phenocrysts of quartz in an extensively recrystallized and altered groundmass. Quartz phenocrysts are mainly broken and slightly resorbed euhedra to about 2mm across.

Rare small former feldspar phenocrysts are replaced by fine grained sericitic masses. The groundmass of this sample is exceptionally heterogeneous in mineralogy and texture. It is composed of essentially three types of mineralogical domains that occur intergrown on a scale of millimeters. The first domain is probably representative of the least-altered groundmass of the original rock, and consists of a patchy fine-grained intergrowth of quartz and albite that appear quite 'clean', and may represent recrystallized devitrified glassy matrix. A second and least modally abundant domain is coarser-grained polygonal quartz-dominated patches that probably represent annealed and recrystallized areas of domain 1. The remainder of the groundmass is replaced by a dense mat of yellow-brown relatively fine-grained biotite. Narrow seams and veinlets of biotite are riddled through the rock, and minor areas and veinlets of pale green chlorite are not uncommon.

An important feature of this sample is the presence of a small amount of strongly pleochroic Fe-rich tourmaline. This is not associated with quartz in veins, but occurs as fairly rare discrete, irregular small crystals dispersed in the groundmass.

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SAMPLE: C98**SUMMARY:**

This is a strongly sericitized but relatively fresh crystal lithic tuff of rhyolitic composition, dominated by large quartz phenocrysts and crystal fragments.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a grey-green crystal lithic tuff with quartz phenocrysts and small, poorly defined and fine-grained felsic rock fragments to about 1cm long set in a heterogeneous fairly dark matrix.

THIN SECTION DESCRIPTION:

In thin section, this sample is seen to be a quartz-phyric rhyolitic lava or crystal tuff. The few lithic fragments observed in hand-specimen are certainly not evident in thin section, although this is often the case for altered fragmental Mount Read Volcanics. Large (to 2mm) quartz phenocrysts form at least 10 modal% of the rock, and are generally fragmented and partly resorbed. In high strain zones, quartz phenocrysts are often granulated and show extensive subgrain development and irregular extinction. The few large former plagioclase phenocrysts present in the rock are totally replaced by fine-grained sericite, and the same material has completely replaced the fine-grained formerly glassy groundmass of this sample. Sericite is commonly stained and dotted by fine-grained Fe oxide-hydroxides which do not appear to be derived from FeTi oxide alteration. In some areas of the rock, rounded blebby polycrystalline quartz - albite intergrowths are distributed unevenly throughout the sericite matrix. These are considered to be a secondary feature that formed during sericitization of the formerly quartz-albite±sericite groundmass characteristic of devitrified formerly glassy felsic lavas. The amount of sericitization of this sample is notably greater than normally observed in regionally burial-metamorphosed Mount Read Volcanic felsic lavas, and implies local hydrothermal activity.

SAMPLE: C103**SUMMARY:**

This is an almost ignimbritic-textured rhyolitic crystal vitric tuff.

HAND SPECIMEN:

On a freshly-cut surface, this pinkish sample shows a few lighter coloured elongate flattened pumice fragments(?) in a slightly foliated matrix containing small quartz phenocrysts.

THIN SECTION DESCRIPTION:

Thin section examination of this sample shows a texture typical of a crystal vitric tuff. About 10 modal% of the sample is composed of small (<0.5mm) angular and broken quartz grains that show marginal resorption and rounding. Occasional small feldspar euhedra are totally replaced by very fine-grained sericite.

The groundmass of this sample has a pronounced primary layering that approaches an ignimbritic texture, defined by diffuse flattened and thoroughly sericitized felsic pumice fragments that may have welded into the original rhyolitic matrix. These former pumice fragments form the light coloured sericite-rich areas embedded in a darker, quartz-albite-dominated very fine-grained matrix that probably originally consisted of vitric ash and shard material.

Common anastomosing fractures across the rock also are sites of local sericite development. Much of the sericite in this rock is variably but fairly intensely replaced by dirty red-brown Fe-oxide-hydroxide material (limonite?), that gives the rock and the section the strong reddish colour.

SAMPLE: C106**SUMMARY:**

This was a quartz+feldspar-phyric glassy rhyolitic lava; It has devitrified and then been severely sericitized during an event which generated a slight foliation in the rock.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a weathered, mottled cream felsic tuff or lava which has been thoroughly sericitized; quartz phenocrysts are quite common, and the sample shows a significant, though not strong foliation.

THIN SECTION DESCRIPTION:

This sample was originally a quartz+feldspar-phyric rhyolitic lava containing around 5 modal% of quartz phenocrysts and probably a similar amount of plagioclase phenocrysts, although the latter have been obliterated by sericitization. Quartz phenocrysts are rounded, partially resorbed euhedra that sometimes contain devitrified melt inclusions. Sparse ghost outlines of former plagioclase phenocrysts are preserved, but almost all the plagioclase in the rock has been totally replaced by sericite; in many cases, shearing accompanying sericitization has streaked out and deformed former sericitized plagioclase euhedra. Apatite and zircon microphenocrysts are both not uncommon.

The groundmass of this sample was probably formerly a fairly homogeneous rhyolitic glass. However, as in most ancient felsic glassy volcanics, the glass has devitrified to a very fine-grained quartz-albite-sericite mosaic. This has been superposed by an intense sericite-dominated alteration which has produced a slightly foliated, sericite-rich heterogeneous groundmass marked by areas stained dark red-brown by abundant Fe oxide-hydroxide dust. It does not appear likely that these Fe oxide-hydroxide concentrations result from sulphide oxidation. Rather, they appear to be concentrated along zones of more intense foliation development, marking sites of more intense fluid activity. The Fe was presumably transported in these fluids from elsewhere, rather than leached and remobilized solely within this rock.

The relative paucity of phenocrysts and the absence of lithic clasts and abundant broken quartz and feldspar grains, both suggest to me that this sample was a rhyolitic lava rather than a felsic crystal tuff. The intensity of alteration suffered by this sample is considerably greater than normally encountered in Mount Read Volcanics felsic

rocks, and implies operation in the area of significant hydrothermal activity, which seems to have accompanied deformation. The relatively abundant zircon and apatite, and the dominance of quartz phenocrysts are all very reminiscent of rocks occurring in the Gog Range area (see TS descriptions of stuff done for Peter Ellis).

SAMPLE: C161

SUMMARY:

This is a quartz-phyric rhyolitic lava with a sericitized devitrified glassy groundmass.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a pale brown coloured quite strongly fractured quartz-phyric rhyolitic lava, with abundant pale coloured sericite along fracture networks.

THIN SECTION DESCRIPTION:

This is a quartz-phyric rhyolitic lava with around 10 modal% slightly rounded and resorbed quartz phenocrysts to about 1 mm across set in a devitrified formerly glassy groundmass. The groundmass had recrystallized as quartz-albite mosaic intergrowths, but has a highly variable grainsize over distances of only a few mm. Networks of sericite veinlets and angular sericite fracture fillings pervade the sample

SAMPLE: C164**SUMMARY:**

This is a well-preserved formerly glassy quartz-phyric rhyolitic lava.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a pale grey-green quartz-phyric rhyolite with quite abundant quartz phenocrysts to 2mm across in a very fine-grained even-textured matrix.

THIN SECTION DESCRIPTION:

This sample is a well-preserved quartz-phyric rhyolitic lava. It consists of around 5-8 modal% of formerly euhedral to subhedral quartz phenocrysts to 1mm across and rare altered feldspar phenocrysts also to around 1mm across in a recrystallized glassy matrix. The texture of this sample is quite distinctive, in that the each quartz phenocryst has more than 20 % resorbed into the groundmass, leaving slightly rounded relics; however, some of the resorbtion reaction has probably occurred post-solidification, as all quartz grains are surrounded by narrow areas of groundmass that is more fine-grained and more quartz-rich than the remainder of the groundmass. The few former feldspar phenocrysts present have been totally replaced by very fine-grained murky sericite. There is no evidence that this sample ever contained either biotite or FeTi oxide phenocrysts.

The groundmass of this sample shows a very well-preserved mosaic texture, approaching a 'snowflake' texture, characteristic of recrystallization of devitrified silica-rich glass. It is now composed of fairly equidimensional intergrown albite and quartz grains that contain abundant tiny sericite inclusions. The sample is clearly a quartz-phyric highly evolved rhyolitic lava.

SAMPLE: C169**SUMMARY:**

This is a quartz+feldspar-phyric rhyolitic lava with a formerly glassy groundmass. The extent of alteration is less than seen in many of the other samples in this set.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a light to medium brown coloured quartz-phyric rhyolitic lava.

THIN SECTION DESCRIPTION:

This sample is dominated by euhedral quartz phenocrysts to about 3mm across that form about 15 modal% of the sample. They are embedded in a very uniform groundmass that has an excellent relatively coarse-grained quartz-albite mosaic texture that is characteristic of devitrification of rhyolitic glass. Subordinate phenocrysts of feldspar are thoroughly sericitized, and in some areas of the rock appear to be replaced by reddish biotite, rather than sericite. The rock is cut by a lacework of fractures that are always sericitized, and again biotite seems to replace sericite in some parts of the rock. Small concentrations of altered opaque grains are common in the matrix, often forming small veinlets and trains as well as occurring as abundant tiny discrete grains peppering parts of the groundmass. This sample was clearly a quartz+feldspar-phyric rhyolitic lava, and the degree of sericitization of the sample is notably less than in many of the other samples described above.

SAMPLE: C174**SUMMARY:**

This is a fine-grained, uniform-textured vitric tuff. The amount of sericitization of this sample is less than that in many of the other felsic volcanics described above, and it is texturally better preserved.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a light grey well-preserved, relatively fine-grained vitric tuff that contains dark green-grey flattened pumice fragments to about 2mm long and 0.3mm thick, and a weak primary (?) foliation.

THIN SECTION DESCRIPTION:

This rock is a texturally well-preserved vitric tuff composed of about 5-10 modal% of very elongate flattened pumice fragments that have sharp, often drawn-out terminations and are composed of high-birefringent relatively well-crystallized sericite. Sparse small former feldspar crystals are totally sericitized and difficult to discern from the sericite-rich groundmass. Quartz phenocrysts or crystal debris are conspicuously absent. A very strange feature of this sample is that former biotite phenocrysts, which make up about 1-2 modal% of the rock, are almost always orientated perpendicular to the flattening (compaction) direction of the rock. I can think of no reasonable explanation for this feature, since similarly shaped pumice fragments are aligned with "bedding"; the biotite clearly has not grown after 'deposition' of this sample. Occasional small lithic clasts (felsic lava) are present in the sample.

SAMPLE: C175**SUMMARY:**

This is a fine-grained and uniform-textured aphyric vitric tuff, that probably was water-sorted and redeposited after initial eruption.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a

THIN SECTION DESCRIPTION:

This is a very fine-grained and even-textured tuff with the only structure or texture visible being due to development of a weak fracture cleavage and fairly intense but patchy and streaky ferruginization of sericite developed along the cleavage. Where the rock has suffered strong replacement by dirty red-brown Fe oxides and hydroxides, the latter minerals appear to have picked out curved and cusped former glassy shards that probably were replaced at an earlier stage by quartz-albite devitrification products. The rock was probably a resedimented and sorted vitric tuff.

SAMPLE: C179**SUMMARY:**

This is a former vitric tuff that has devitrified to a very fine-grained quartz-albite intergrowth; it shows a fairly well-developed fracture cleavage with sericite concentrations along the fracture planes.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a very fine-grained uniform-textured by highly fractured cream coloured tuff.

THIN SECTION DESCRIPTION:

In thin section, this sample is seen to be a fine-grained, uniform rock composed of a dense mosaic intergrowth of quartz and albite, with a grainsize much less than 0.05mm. Only the presence of relatively abundant (maybe 25 grains in the section) euhedral to subhedral zircon crystals, as typically seen in felsic Mount Read Volcanics, indicate a volcanic derivation for this sample. It is probably a rock formerly composed of very fine-grained felsic volcanic glass particles that devitrified to the present dense intergrowth of quartz and albite.

The sample is cut by abundant subparallel fractures that in places are so closely spaced as to form a fracture cleavage. Sericite is developed along the fracture planes, and often occurs as quite coarse-grained monomineralic seams defining fracture traces.

SAMPLE: C184**SUMMARY:**

This is a totally sericitized and recrystallized former rhyolitic vitric tuff or aphyric glassy lava, that has a well-developed foliation defined by both sericite and quartz grain elongation.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a pinkish cream coloured, fractured fine-grained aphyric tuff or siltstone.

THIN SECTION DESCRIPTION:

Thin section examination shows that this sample does not display a clastic sedimentary texture. Rather, it is composed of abundant single and multicrystalline quartz grains sitting in a foliated matrix of sericite. The quartz grains are angular and rarely more than 0.1 mm across, and most are elongate parallel to the cleavage. They probably form around 35 modal% of the sample. The remainder of this rock is a dense mass of foliated sericite that grows quite coarse-grained and highly birefringent along some cleavage/fracture planes. Scattered cubes of sericitized and ferruginized pyrite are notable but not common.

SAMPLE: C190**SUMMARY:**

This is a very strongly sericitized quartz+feldspar-phyric crystal lithic tuff.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a cream coloured crystal tuff containing phenocrysts of both quartz and feldspar and some dark coloured felsic volcanic lithic fragments mainly less than 2mm long.

THIN SECTION DESCRIPTION:

This sample is dominated by phenocrysts of quartz and feldspar in a totally sericitized groundmass. Quartz phenocrysts make up about 10-15 modal% of the rock, and are up to 3mm across. They are often broken, and show marginal resorption and rounding. Feldspar phenocrysts were blocky prisms to 2mm long that are now thoroughly replaced by dense, quite well-crystallized and relatively coarse-grained sericite. They are slightly less modally abundant than the quartz phenocrysts.

These phenocrysts are embedded in a totally recrystallized and sericitized groundmass composed of very fine-grained heterogeneous quartz, albite and sericite. The latter forms meshworks and felted masses that pervade the entire rock. Areas of groundmass that are peppered with tiny opaques appear to define former elongate lithic clasts, possibly pumiceous. Although the original texture of the groundmass of this sample is almost totally obliterated, the broken phenocrysts and possible pumiceous fragments suggest that it was originally a crystal-lithic tuff.

SAMPLE: C194**SUMMARY:**

This is a fairly coarse-grained epiclastic sediment containing clasts of felsic lithic volcanics and abundant detrital quartz grains. The sample has been strongly chloritized, but also contains abundant sericite.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey-green porous epiclastic sediment or volcanic breccia with a maximum grain size of at least 1-2cm.

THIN SECTION DESCRIPTION:

The clastic nature of this sample is immediately obvious in thin section. Lithic fragments up to almost 2cm across are present in the sample, although most are much smaller, and not really well-defined. The largest lithic fragments are composed of a highly sericitized shale or tuff characterized by an abundance of small opaque oxides. These fragments, like the rest of the rock, are cut by abundant subparallel fractures that are sites of extensive chloritization. Chlorite along fractures and replacing areas of groundmass is quite deep green and becomes more strongly pleochroic as it becomes more coarse-grained. I think the chloritization event post-dated sericitization. Other lithic clasts include recrystallized felsic fine-grained lavas or tuffs, and abundant monocrySTALLINE quartz grains. These are mainly highly angular and quite deformed, and show complex internal deformation-recrystallization features. However, less recrystallized grains occasionally show subhedral outlines and slight rounding typical of volcanic quartz.

This rock is cut by fairly dense networks of fractures that are invariably sites of intense ferruginization and oxidation. This sample is a chloritized and strongly altered former epiclastic sediment.

SAMPLE: C200**SUMMARY:**

This is an almost cherty massive featureless very fine-grained metapelite or meta-vitric tuff.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a massive extremely fine-grained unbedded and fractured buff-coloured rock, possibly a devitrified vitric tuff or a silicified mudstone.

THIN SECTION DESCRIPTION:

This sample in thin section is massive, uniform and featureless, very fine-grained and free of any identifiable detrital grains. The exceptionally fine-grained 'matrix' of the sample is irresolvable with respect to its mineralogy, and this is flecked by tiny sericite flakes and trains of flakes that are often arranged in almost en echelon sets or bands, suggesting they grew during deformation and recrystallization of this rock. It is possible that this rock was originally a mudstone with a high vitric component (vitric ash), although it may equally well have been originally a typical mudstone composed of very fine-grained clayey material that has recrystallized during burial metamorphism to this featureless massive almost cherty rock. Occasional meandering quartz veinlets cut the sample.

SAMPLE: C204**SUMMARY:**

This is a weakly bedded silty shale containing narrow quartz veinlets parallel to the bedding.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey very fine-grained, weakly-bedded shale that is cut by a series of quartz veins up to 4mm thick which parallel bedding. A weak cleavage is present in the rock.

THIN SECTION DESCRIPTION:

This sample is a very fine-grained shale containing a 1cm-wide band of siltstone containing tiny detrital quartz grains. The shale is a uniform murky rock with a vague fissility defined by sparse narrow seams of tiny detrital quartz grains. The siltstone band is made up of abundant tiny detrital quartz grains in a similar murky matrix to the shale. The detrital grains are not so abundant as to form a framework-supported aspect for this sample. The grainsize of the detrital grains is not large enough to determine whether the quartz is of volcanic or (Precambrian) pelitic metamorphic derivation.

This sample is cut by several bifurcating quartz ^{veins} grains that roughly parallel the bedding. These are composed of a highly variable in grainsize intergrowth of polygonal quartz crystals that show strong internal deformation, suggesting that they grew in a high-strain situation.

SAMPLE: C210**SUMMARY:**

This is a muddy sandstone with a large detrital component derived from a pelitic metamorphic source.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey uniform fine sandstone with no obvious bedding or cleavage development in handspecimen.

THIN SECTION DESCRIPTION:

Thin section examination shows this sample to be an even-textured well-sorted muddy sandstone containing framework grains of quartz and muscovite flakes in a dirty formerly clayey matrix. Bedding is very poorly defined in the sample by occasional stringers and trains of detrital opaque grains, and general subparallel orientation of the detrital muscovite flakes. The relatively small size of the angular quartz grains makes it impossible to determine whether it is of Precambrian metamorphic or local felsic volcanic derivation. However, the relatively abundant and coarse-grained detrital muscovite and the occasional small rounded deep green pleochroic tourmaline grains suggest that a large part of the sample is metamorphic- or granite-derived. Not uncommon framework grains of an altered opaque phase may be former FeTi oxide phenocrysts from felsic or intermediate volcanics, although not necessarily so. The sample is not framework-supported, but contains at least 50 modal% sericite that occurs as a fine-grained phase that premeates the rock; it probably represents recrystallized clayey matrix in the original sandstone.

SAMPLE: C215

SUMMARY:

This is a weakly graded bedded siltstone with a predominant detrital component derived from pelitic metamorphics, but a minor tuffaceous component from a felsic volcanic source is also present.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a banded fine-grained sedimentary rock with pinkish silty shale layers and irregular light green layers of much finer-grained tuffaceous (?) material less than 5mm thick.

THIN SECTION DESCRIPTION:

This sample in thin section is clearly a fine-grained sediment that shows slight graded bedding. Maximum grain size is in the silt range, but most of the sample is extremely fine-grained clayey or sericitic material that is impossible to identify optically that contains tiny detrital quartz grains. Coarser layers in the rock are composed of subhedral and mainly angular detrital quartz that almost form framework supported bands that are mainly less than 5mm thick. The detrital quartz appears to be mainly small polycrystalline grains of probable metamorphic derivation, but grains with one or more crystal faces are not uncommon, suggesting some input (tuffaceous) from a felsic volcanic source. Occasional detrital muscovite grains also indicate a component from a metamorphic source. The rock lacks any sign of cleavage or foliation development, but contains a few meandering pressure solution stylolites along which insoluble opaque minerals have been concentrated.

SAMPLE: C218**SUMMARY:**

This is a strongly sericitized quartz-phyric rhyolitic lava or crystal tuff that shows a fairly strong fracture cleavage.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a cream-pink quartz-phyric felsic lava or tuff with a pronounced irregular fracture cleavage and strong localized sericitization.

THIN SECTION DESCRIPTION:

This sample is very similar to some of the other sericitized and foliated former quartz-phyric rhyolitic lavas and crystal tuffs described earlier in this report. It is dominated by fractured and partly resorbed angular quartz grains that show complex internal deformation features. These make up around 15 modal% of the sample and are set in a very heterogeneous matrix that was most likely originally glassy. The groundmass is now composed dominantly of recrystallized tiny intergrown quartz and albite, and is transected by abundant subparallel but rather discontinuous fracture cleavage planes defined by foliated masses of sericite. The latter are stained red-brown in places and resemble biotite, but show almost no pleochroism and are not 'speckled' at extinction. The degree of obliteration of the groundmass of this sample is such that it is impossible to tell whether this sample was originally a crystal tuff or a lava. The dominant broken phenocrysts suggest the former.

SAMPLE: C225

SUMMARY:

This is a quartz+feldspar-phyric rhyolitic crystal tuff that has suffered fairly intense recrystallization and sericitization of the former glassy groundmass.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a light grey quartz+ sparsely feldspar-phyric felsic volcanic with irregular patches of intense cream coloured sericite alteration.

THIN SECTION DESCRIPTION:

This sample is very similar to sample C93 described above except for two main points. Firstly, the biotite that pervades C93 is far more restricted in occurrence in this sample. Secondly, this sample shows a notably stronger degree of sericitization than seen in C93, with the groundmass quartz-albite intergrowths also being slightly coarser-grained. I have little doubt that this sample was originally a quartz+feldspar-phyric rhyolitic crystal tuff.

SAMPLE: C232**SUMMARY:**

This is a former pumice- or vitric tuff that has been extensively recrystallized and highly sericitized.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a grey medium-grained and extensively fractured and altered tuffaceous(?) rock

THIN SECTION DESCRIPTION:

In thin section, this sample is seen to be a highly altered sparsely feldspar-phyric felsic volcanic. Former feldspar phenocrysts make up probably less than 1 modal% of the sample, and are totally replaced by fine-grained sericite, and since the groundmass is also strongly sericitized, only ghost outlines of the former phenocrysts are discernible. Extensive recrystallization and sericitization of the groundmass has produced a heterogeneous groundmass that leaves no textural clues as to whether it was formerly a glassy lava, a holocrystalline intrusive or a tuff. However, several areas of sericite replacement to about 7mm long are too elongate and anhedral to have been former feldspar phenocrysts and may well have been flattened pumice fragments. The groundmass is now a relatively coarse-grained and highly irregular intergrowth of quartz and albite that is completely riddled by sericite. The latter mineral also lines fractures in the sample, and is patchily stained redd-brown rusty shades by ferric oxide impregnation and replacement. This sample was probably a dacitic to rhyolitic pumice tuff, or vitric tuff containing a few pumice fragments. As for many of these samples, the extent of sericitization of the altered groundmass is far more intense than seen in 'normal' regionally altered tuffs and lavas within the Mount Read Volcanics, and implies local hydrothermal alteration.

SAMPLE NUMBER: 225101

SUMMARY:

This rock is an indeterminate very fine-grained structureless rock with abundant chlorite riddling a quartz-sericite matrix; it may be a meta-tuff.

HAND SPECIMEN:

This is a

THIN SECTION DESCRIPTION:

This is an fine-grained, massive and featureless rock composed of exceptionally fine-grained intergrowth of quartz, sericite and possibly albite that is riddled by tiny vermiform to acicular chlorite crystals. Sparse small angular detrital (?) quartz and leucoxenized FeTi oxide grains are also present. No trace of a primary texture is preserved in this sample, nor is there any cleavage or foliation, and the present mineralogy suggests that it may be a meta-tuff. For this rock, outcrop information would probably be more informative than thin section description.

SAMPLE: 225106

SUMMARY:

This is a foliated formerly glassy quartz-phyric crystal tuff with both sericite and biotite common along the foliation planes.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a pale brown uniform quartz-phyric felsic lava or tuff.

THIN SECTION DESCRIPTION:

This sample is made up of around 10 modal% of slightly rounded but mostly broken quartz phenocrysts in a fairly strongly foliated formerly glassy matrix. The foliation is not strong enough to be called a cleavage, but is well-defined by both matted sericite and red-brown metamorphic biotite growing along the subparallel fractures. Most of the groundmass is a fairly uniform though foliated fine-grained quartz-albite-sericite intergrowth.

SAMPLE: 225221

SUMMARY:

This is a former feldspar-phyric dacitic lava or shallow intrusive that has been thoroughly carbonated. The alteration assemblage, dominated by calcite and chlorite, is unlike the sericite-dominated assemblages seen in the majority of samples described above.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey fairly fine-grained felsic or intermediate volcanic with apparently no phenocrysts; it is massive and not foliated.

THIN SECTION DESCRIPTION:

This sample is seen in thin section to have been a sparsely feldspar-phyric probably dacitic lava, with a few modal percent of totally pseudomorphed plagioclase phenocrysts in a fine grained groundmass that has been almost totally carbonated. The feldspar crystals are small, mainly less than 1mm long, and they have been albitized, and then largely replaced by fine sericite and abundant calcite. The original groundmass texture of this sample has been obliterated by pervasive calcite-chlorite alteration, but small furry-edged opaque grains are abundant in the groundmass and probably represent altered primary FeTi oxides. Calcite and pale green chlorite are intimately intergrown, and pervade more than 95 modal% of the groundmass.

This sample was almost certainly a dacitic lava or shallow intrusive. The style of alteration in this sample, dominated by calcite and chlorite, contrasts strongly with the style noted in most of the other samples described above (sericite-quartz), despite the fact that primary compositions of the dacites and rhyolites described herein probably showed little significant variation. This means that the alteration system responsible for the alteration of this sample was quite unlike that which produced most of the other sericitic (and commonly foliated) samples described above.

SAMPLE: 225222

SUMMARY:

This is a formerly quartz+feldspar-phyric glassy rhyolitic lava or crystal tuff that has suffered fairly extensive calcite alteration, although it lacks the chlorite that occurs intergrown with calcite in the previously described sample (225113).

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey-green mottled felsic lava or tuff with sparse small quartz phenocrysts and some angular patches of calcite filling fractures in the rock.

THIN SECTION DESCRIPTION:

This sample is made up of around 3-5 modal% of generally quite rounded and resorbed small quartz crystal fragments, mostly less than 0.5mm across. Similar sized feldspar phenocrysts are albite replaced by calcite and minor sericite in most cases. A small percentage of altered former FeTi oxide phenocrysts, now composed of leucoxene and chlorite, are scattered through the rock.

The groundmass of this sample, as for many of those described above, is a fine-grained quartz-albite-sericite intergrowth almost certainly replacing an originally glassy matrix. Unlike many of the samples described above, however, calcite is a fairly abundant phase replacing groundmass and parts of feldspar phenocrysts.

This sample was either a crystal tuff or a rhyolitic lava with a glassy groundmass; on the basis of the textural evidence left after alteration of this sample I can't make any more definitive assignment of this rock.

SAMPLE: 225223

SUMMARY:

This is an epiclastic sandstone derived from a mixed andesitic-felsic lava pile; it contains detrital igneous hornblende and augite, and may be a useful marker horizon.

HAND SPECIMEN:

On a freshly-cut surface, this sample is a dark grey green epiclastic sediment or lithic crystal tuff with a maximum grainsize of around 2mm.

THIN SECTION DESCRIPTION:

This sample shows a clear clastic sedimentary texture, being composed of about 75 modal% framework grains, and the remainder a strongly chloritized matrix. Framework grains include about 25 modal% fractured volcanic quartz crystals, about 40-45 modal% totally sericitized slightly rounded former feldspar euhedra (to about 1.5mm across), and the remainder being partially altered primary igneous hornblende and leucoxenized FeTi oxide phenocrysts. The hornblende grains are small irregular crystal fragments, and show characteristic pale green to deeper olive green pleochroism. Several small crystal fragments of fresh augite were also noted, but the rock appears to contain no lithic fragments..

The matrix of this sample is very fine-grained and largely overprinted by pale green chlorite. The source area of this epiclastic sandstone was probably a mixed andesite-dacite-rhyolite lava pile. The presence of hornblende in the sample is interesting, as the only rocks from this northern section of the Mount Read Volcanics known to carry fresh hornblende is the Bond Range Porphyry. This epiclastic sandstone should be a good marker horizon in the sequence from which it was taken, as it is the first detrital hornblende-bearing sample I have seen from this part of the Mount Read Volcanics, after examining several hundred thin sections.

APPENDIX 3

CSIRO - Lead Isotope Report, Cethana Area

G. Carr

Sirotope**CSIRO**
AUSTRALIA

597114

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Chief: Dr. B.J.J. Embleton

THE METALLOGENIC ASSOCIATION OF SULFIDE MINERALIZATION**FROM THE GOWRIE PARK PROSPECT****NORTHWESTERN TASMANIA****-A REPORT TO NORANDA PTY LTD****GRAHAM R. CARR****JUDITH A. DEAN**

2/5/89

R e s e a r c h A d v a n c i n g A u s t r a l i a

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SUMMARY

The Pb isotopic composition of 9 drill core samples and one rock chip sample (225268) from the Gowrie Park prospect in northwestern Tasmania is homogeneous and consistent with derivation from hydrothermal solutions active during the major Cambrian metallogenic event that was responsible for the massive sulfide deposits of the Mt Read Volcanics.

The rock chip samples 225266-267 have only a very low probability of representing Cambrian massive sulfide mineralization. Sample 225265 is enigmatic, but is also unlikely to represent Cambrian massive sulfide mineralization.

1. AIM

The aim of this study has been to determine the likely metallogenic association of exploration drill core and rock chip samples from the Gowrie Park prospect in northwest Tasmania by comparing their Pb isotopic compositions with those of known mineralization in the region.

2. SAMPLES

Nine samples of sulfide-rich drill core and 4 rock chip samples were provided by Phil Jones on behalf of Noranda Pty Ltd. Brief descriptions provided by Phil Jones are presented in Table 1. Galena was extracted and analysed from 8 of the samples. For the remainder, a subsample was pulverised and the whole rock powder analysed.

3. TARGET SIGNATURES

All major Cambrian ore deposits of western Tasmania have very similar Pb isotopic compositions confirming that they formed as part of a major metallogenic event (see Gulson and Porritt, 1987). A homogeneous isotopic composition over such a region suggests the hydrothermal systems were very large, leaching Pb and other elements from a significant volume of crust and thus averaging local variations in the Pb isotopic composition of the source rocks. The Cambrian massive sulfide ("target") signature is represented in this study by the overlapping fields for Rosebery, Que River and Hellyer (Figs 1 to 4.) The fields are 95% confidence ellipses which depict the mean \pm 2 x standard deviations of deposit data.

Minor mineralization in western Tasmania commonly consists of discontinuous pods or veins. The isotopic composition of such mineralization varies between occurrences (with the exception of

the Ordovician carbonate-hosted deposits) indicating the hydrothermal systems were probably much smaller. Most examples of this mineralization have isotopic compositions more radiogenic than the Cambrian target (i.e. higher $^{206}\text{Pb}/^{204}\text{Pb}$, $^{207}\text{Pb}/^{204}\text{Pb}$ and $^{208}\text{Pb}/^{204}\text{Pb}$ ratios) and some can be associated with Devonian plutonism (e.g. Queen Hill, Mt Farrell; Figs 1 and 2).

However, other examples have isotopic compositions that are less radiogenic than the Cambrian target (Figs 1 and 2). In some, the low $^{206}\text{Pb}/^{204}\text{Pb}$ ratios may result from leaching of Pb from nearby Precambrian source rocks (e.g. WOW/CAB, old Comstaff prospect in Oonah Formation, Geopeko prospect in the Mackintosh East area).

In some instances both the more radiogenic and less radiogenic populations may be present in the same prospect, for example at Marionoak and WOW/CAB (Figs 1 and 2). This indicates either the effect of different local source rock compositions or overprinting of two separate mineralization episodes.

Although it is likely that Devonian thermal events were responsible for the generation of these relatively localized hydrothermal systems, it is possible they developed at other times, even during the Cambrian. Irrespective of the age, it is unlikely that such mineralization would have significant economic potential.

4. METHODS

Galenas were hand picked, dissolved in HNO_3 and Pb was electroplated onto Pt electrodes. The whole rock powders were analysed by one or both of the following methods: i) About .3g of sample was leached in 1N HCl for 15min. The sample was centrifuged and Pb was electroplated from the supernatant as

above. ii) About 0.2g of sample was digested in hot 7N HCL + 7N HNO₃ prior to ion exchange and electroplating as above. Lead isotope ratios were measured on an ISOMASS 54E solid source mass spectrometer run in fully automated mode. Precision estimates representing 2 standard deviations about the mean of over 1000 analyses of international standards and natural samples are shown as error bars in the upper left hand corner of the diagrams.

5. RESULTS

The results are presented in Table 2 and in Figures 3 and 4. The Pb isotopic composition of a majority of the samples (Pt nos "2-10" in the figures) plot as tight clusters on the two diagrams and overlap the fields for Cambrian massive sulfide mineralization. Sample 225266 is significantly more radiogenic than the Cambrian signatures and sample 225267 less radiogenic. Sample 225265 (duplicate galena analyses) is more radiogenic than the major cluster of data from this study, but still plots just within the Hellyer signature. Point 7 in Figures 3 and 4 represents the analysis of a sulfide-poor, low-Pb portion of sample 225261. Its high $^{206}\text{Pb}/^{204}\text{Pb}$ ratio compared with the galena from the same sample results from the radiogenic addition of ^{206}Pb since the Cambrian.

6. DISCUSSION

The isotopic homogeneity of diamond drill core samples 225256-264 and 225268, and their similarity to the Rosebery signature, indicate that this prospect has a high probability of representing the same mineralization event responsible for the massive sulfide deposits in the Mount Read Volcanics. The isotopic compositions are indistinguishable from those of other

occurrences in the Sheffield region analysed in previous studies.

Samples 225266-267 have significantly different isotopic compositions (both from one another and from the Cambrian target) and have only a very low probability of representing significant mineralization. Rather, they are similar to the minor veins found elsewhere in the Mount Read Volcanics and discussed in Section 3.

Sample 225265 is somewhat more enigmatic. Its isotopic composition falls just within the Hellyer signature but close to the range for minor vein mineralization. However it is not part of the diamond drill core population, nor is it similar to the other Cambrian mineralization from the Sheffield area. Thus we contend it has a relatively low probability of representing a Cambrian event in this area.

7. REFERENCE

- Gulson, B.L. and Porritt, P.M., 1987. Base metal exploration of the Mount Read Volcanics, Western Tasmania: Part II. Lead isotope signatures and genetic implications. *Econ. Geol.* 82, pp. 291-307.

TABLE 1.

1	225256	Sphaleritic altered schist	2000 ppm
2	225257	Weakly mineralized (Pb) fine tuff	9000 ppm
3	225258	Mineralized (Pb) veined schist	1700 ppm
4	225259	Mineralized (Pb) veined schist	2800 ppm
5	225260	Pyritic wkly Pb mineralized veined tuff	1000 ppm
6	225261	Pyritic wkly mineralized tuff	1500 ppm
7	225262	Weakly Pb mineralized altered tuff	1500 ppm
8	225263	Highly pyritic altered (no visible Gn) tuff	1400 ppm
9	225264	Pyritic altered tuff (no visible Gn)	1000 ppm
10	225265	Pb mineralized veined schist	Solid Gn
11	225266	Pyritic minor Pb mineralized tuff	2000 ppm
12	225267	Pb mineralized vein material	% Lead
13	225268	Pb mineralized altered tuff	% Lead

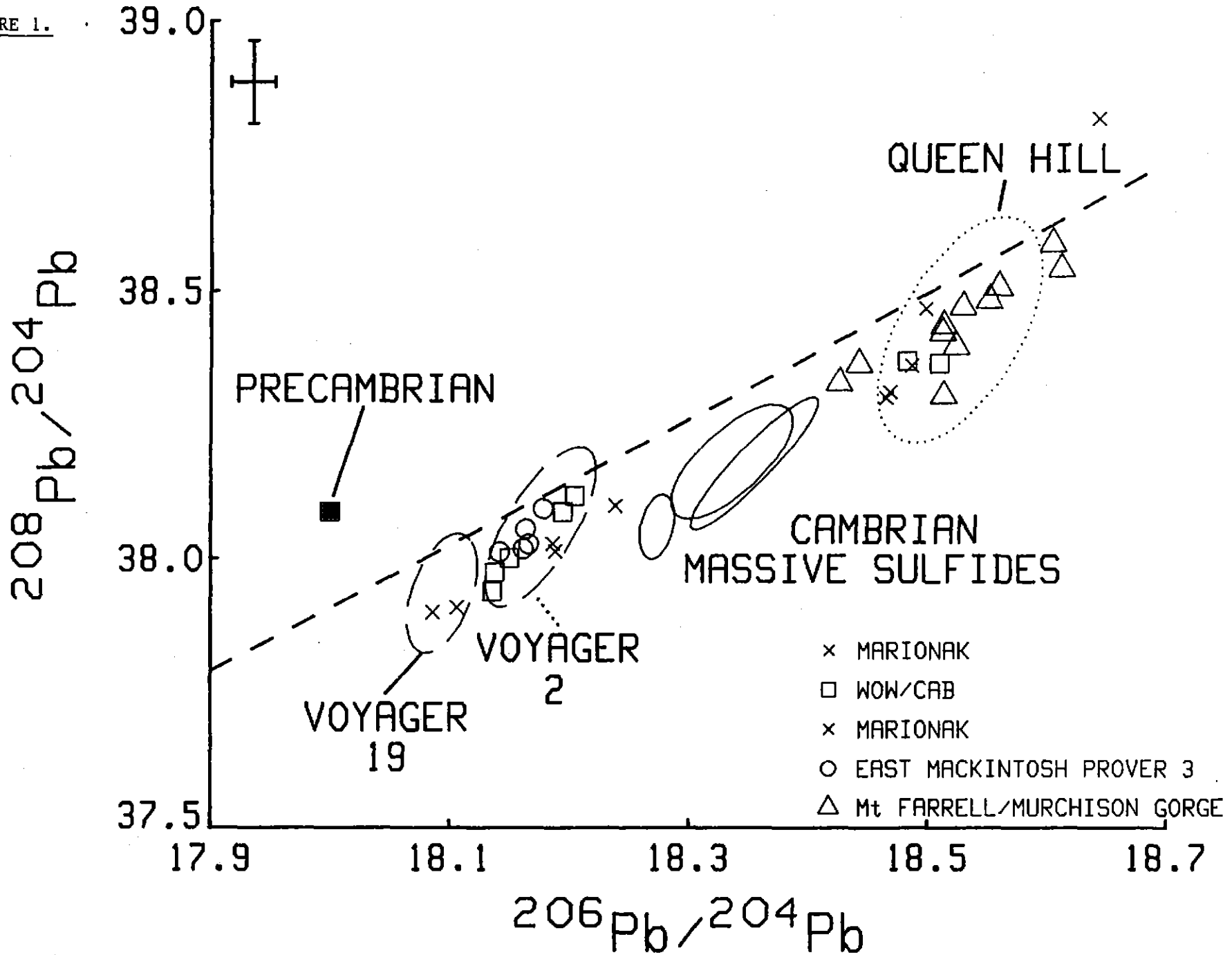
TABLE 2. LEAD ISOTOPE RATIOS OF SAMPLES FROM THE GOWRIE PARK PROSPECT.

Sample	$\frac{208 \text{ Pb}}{206 \text{ Pb}}$	$\frac{207 \text{ Pb}}{206 \text{ Pb}}$	$\frac{206 \text{ Pb}}{204 \text{ Pb}}$	$\frac{207 \text{ Pb}}{204 \text{ Pb}}$	$\frac{208 \text{ Pb}}{204 \text{ Pb}}$
1 225256	2.0832	0.8527	18.291	15.597	38.104
2 225257Gn	2.0876	0.8551	18.241	15.597	38.079
3 225258Gn	2.0872	0.8542	18.268	15.605	38.129
4 225259Gn	2.0874	0.8548	18.244	15.595	38.082
5 225260Gn	2.0866	0.8545	18.249	15.594	38.079
6 225261Gn	2.0878	0.8548	18.265	15.613	38.133
7 225261	2.0808	0.8451	18.460	15.601	38.411
8 225262Gn	2.0874	0.8550	18.243	15.597	38.080
9 225263	2.0868	0.8548	18.232	15.584	38.047
10 225264	2.0884	0.8548	18.259	15.607	38.131
11 225265Gn	2.0811	0.8488	18.400	15.619	38.293
12 225265Gn R	2.0804	0.8487	18.386	15.603	38.250
13 225266	2.0896	0.8583	18.159	15.585	37.945
14 225267Gn	2.0746	0.8455	18.454	15.602	38.285
15 225268	2.0857	0.8541	18.258	15.594	38.080

Sample No prefixes refer to points plotted in Figures 1 and 2.
 Gn represents a galena analysis
 R represents replicate analysis

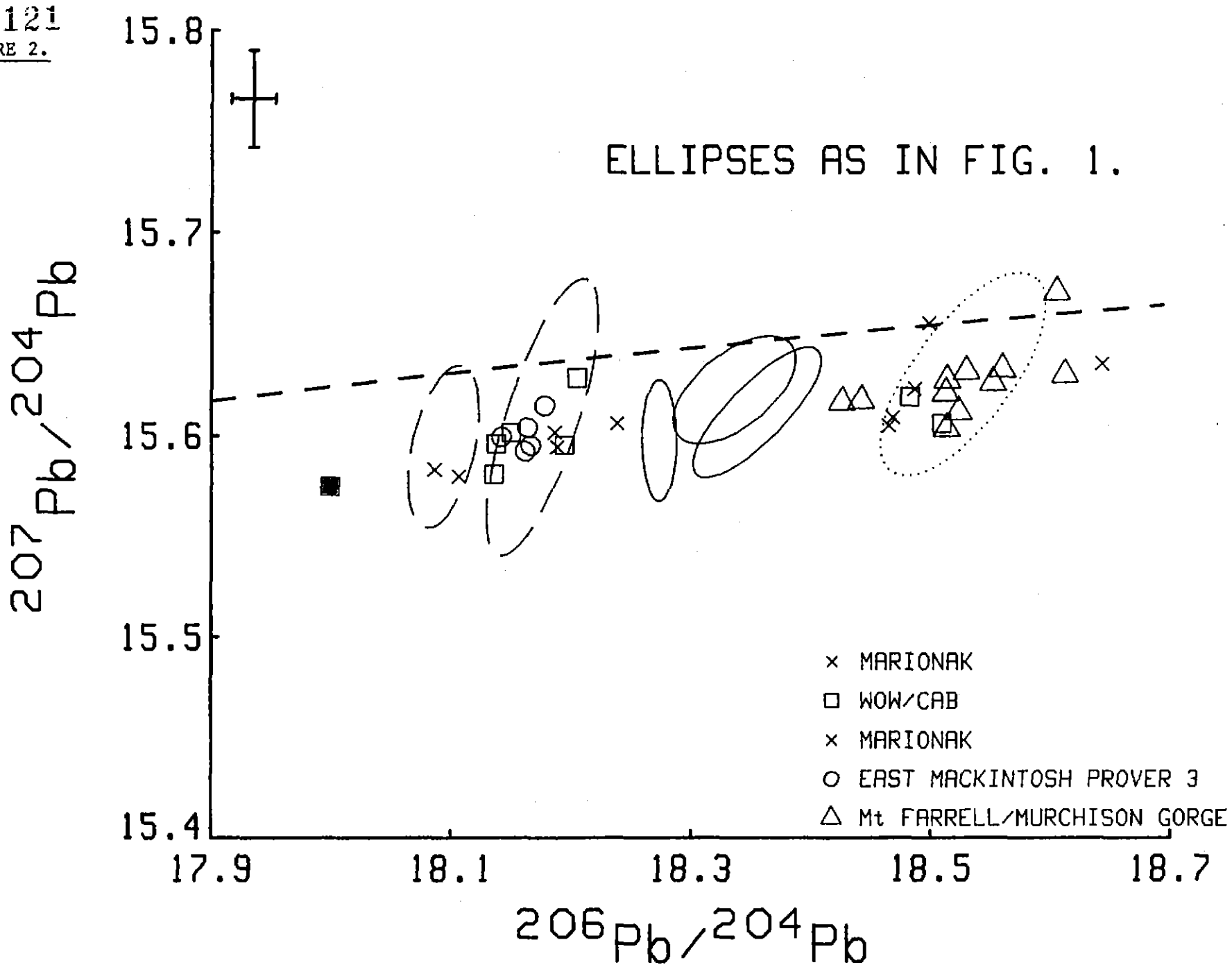
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FIGURE 1.



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FIGURE 2.



GOWRIE PARK TASMANIA

FIGURE 3.

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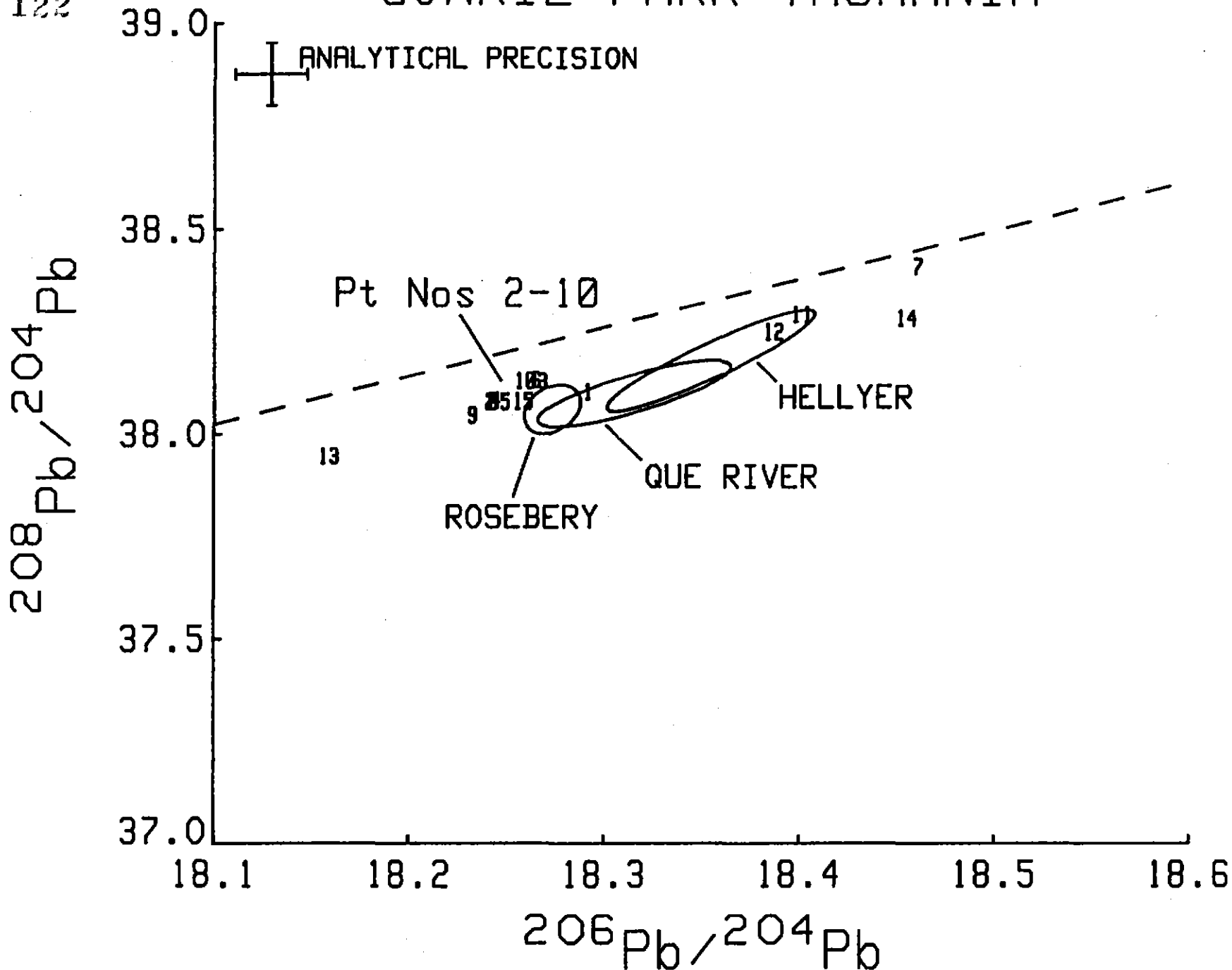
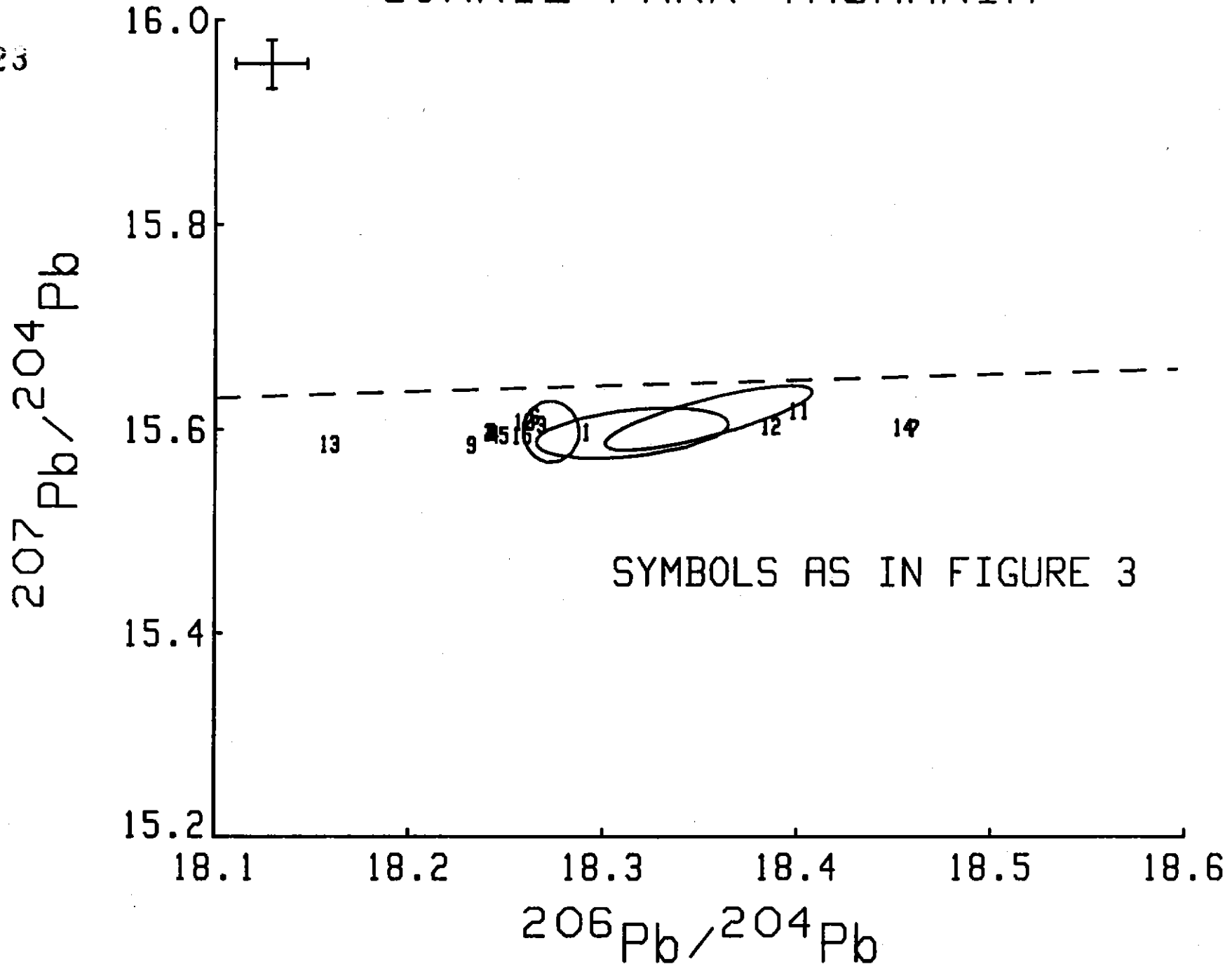


FIGURE 4.

GOWRIE PARK TASMANIA

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APPENDIX 4

Petrographic Study

Gog Range

T. Crawford

SUMMARY REPORT ON 36 PETROGRAPHIC SAMPLES FROM THE GOG RANGE AREA, FROM NORANDA E/L: Attn. Peter Ellis

All rocks examined in thin section are derived from rhyolitic magmas, and included dominant lavas and crystal lithic tuffs, and subordinate epiclastic sediments. The lavas are typically quartz+feldspar (albitized plagioclase)+biotite+FeTi oxide-phyric massive rocks with formerly glassy or vitrophyric groundmasses which have devitrified and recrystallized to quartz-albite-sericite-chlorite mosaics. Tuffs in the sequence are essentially identical in mineralogy to the lavas, and are undoubtedly derived from the same magmas, albeit via explosive eruptions. The main textural features useful or diagnostic in differentiating between the lavas and the crystal lithic tuffs are:

1. the generally notable to abundant presence of formerly vitric lithic fragments in the tuffs, which are rarely present in lavas,
2. the abundant broken crystal fragments in the tuffs compared with the more typical slightly rounded, resorbed euhedra in the lavas,
3. the more even-textured, homogeneous and equigranular groundmasses in the lavas compared with the tuffs.

There is no evidence that any of these rocks were less felsic than rhyodacites; andesites or more basic lithologies are definitely not present. An unusual feature of the lavas and tuffs from this sequence is the relatively abundant and large zircon euhedra in these rocks. This is, in my experience, more characteristic of the Dundas Group - Tyndall Group - Southwell Subgroup felsic lavas and tuffs, than of those similar lithologies in the Central Volcanic Complex. The abundance of (ubiquitous) quartz phenocrysts and crystal fragments in these rocks is also more typical of the Dundas Group - Tyndall Group - Southwell Subgroup felsic lavas and tuffs than the typically feldspar-phyric Central Volcanic Sequence lavas.

In attempting to find similarities between individual samples to enable tracing of stratigraphic units, several problems were noted. The only lithologies which could be readily discerned were (a), rhyolite lavas, (b) rhyolitic crystal lithic tuffs with vitric ash matrix, and (c) some epiclastic to fine-grained tuffaceous sediments. Small-scale heterogeneities and local outcrop-scale variations in texture and crystal content in Mount Read tuffs rule out drawing certain correlations between individual tuff samples examined. This problem is less severe with lavas, where phenocryst assemblages

and modal abundances are more diagnostic. Even so, it is difficult to judge for certain that rock A is identical to rock B, given that rhyolitic lavas from the sequence examined are pretty much similar whether from the southern or northern end of the area sampled. I suggest that those samples from the northern traverse (225163-168) are broadly from the same map unit.

Samples 225093 and 098 are different from the above in that they have significantly coarser groundmasses, suggestive of derivation from a more slowly cooled, possibly shallow intrusive rhyolitic body.

Several of the samples from the two southeasternmost traverses across the grid baseline were so similar that I suggested in the section descriptions that they may be from the same units. Notably, sample 225154 and 226160 are very similar lavas, and samples 225155 and 225161 are very similar crystal lithic tuffs.

Samples with higher than 'normal' (or 'background') alteration include: 225171, which is a highly deformed and silicified crystal lithic tuff (?) which is almost certainly from a fault zone. Samples 225151, 152, 087 and 167 are all more sericitized or chloritized than typical similar lithologies from elsewhere in the sequence. An interesting feature of the alteration of some of these samples is that hematite (goethite?) has replaced groundmass alteration calcite, and even vein calcite and calcite replacing feldspar phenocrysts in some samples. This is presumably a near-surface, low-temperature phenomenon, as the effect is most intense in the most weathered samples.

Sample 225164, a very fresh rhyolite, has been retained (part thereof) for wholerock major and trace element analysis as part of our on-going Mount Read Volcanics project.

Tony Crawford

Tony Crawford
27/2/89

SAMPLE No. E225087

SUMMARY:

This is a weathered formerly quartz+feldspar+biotite-phyric rhyolite which has been fairly thoroughly sericitized.

HAND SPECIMEN:

This is a quite weathered pink rhyolite with phenocrysts of quartz, altered feldspar and some altered biotite in a very fine grained even-textured groundmass.

THIN SECTION:

This is a rhyolitic lava which contains abundant large (to 4mm) subhedral to euhedral quartz phenocrysts, subordinate totally sericitized feldspar phenocrysts (mainly <2mm long) and rare chloritized biotite flakes. The groundmass, although quite heavily sericitized in places, is typical of a recrystallized felsic glass, and is dominated by an equigranular quartz-feldspar intergrowth through which wispy to felted sericite has pervaded. The rock contains a notable number of large subhedral zircons.

Occasional narrow veinlets of quartz, sericite and calcite have been partially or completely replaced by hematite or goethite, which also has stained or replaced groundmass sericite, giving the rock its quite strong pink colour.

SAMPLE No. E225088

SUMMARY:

This is a felsic crystal lithic tuff dominated by quartz crystal fragments, which has been extensively silicified and sericitized so that lithic fragments cannot be discerned from altered groundmass in thin section.

HAND SPECIMEN:

This is a pale grey-green silicified crystal lithic tuff with abundant quartz phenocrysts and lithic clasts to 8mm long of fine-grained felsic volcanics. Diffuse margins on the lithic clasts suggest that the groundmass has been silicified.

THIN SECTION:

This is a crystal tuff dominated by broken angular crystal fragments of volcanic quartz, which make up around 30 modal% of the rock. These have margins which show extensive reaction with the siliceous groundmass, and also show significant internal strain features suggesting that this sample has undergone some degree of deformation post-solidification. Occasional albitized plagioclase phenocrysts to 2mm across are heavily sericitized. Lithic fragments identifiable in hand specimen are not at all obvious under the microscope; they were probably aphyric or quartz-phyric glassy vitric tuffs or rhyolites which underwent the same silicification/sericitization as the groundmass of the rock, thus losing their definition in thin section.

The groundmass of this sample is a fine-grained mesh of silica and sericite, and shows no former volcanic or glass devitrification texture. Rather, the groundmass is almost certainly the result of silicification and sericitization of some formerly vitric ash. Diffuse meandering veinlets of silica abound and grade into the groundmass in places.

SAMPLE No. E225089

SUMMARY:

This sample is a quartz+feldspar+biotite+FeTi oxide-phyric rhyolite which has had its feldspar phenocrysts sericitized and carbonated, then largely replaced in turn by a Fe oxide-hydroxide.

HAND SPECIMEN:

This sample is a fawn to pinkish-brown quartz+feldspar-phyric felsic lava or crystal tuff in which the feldspars have been replaced by limonite or goethite, and the latter also forms local pockets and veinlets.

THIN SECTION:

This is a quartz+feldspar+biotite+FeTi oxide-phyric rhyolitic lava which, despite the replacement of feldspar by an Fe oxide/hydroxide, is texturally very well preserved. Quartz phenocrysts are partially resorbed euhedra to 3mm across that make up around 5 modal% of the sample. Feldspar phenocrysts are less abundant than quartz, and are replaced by sericite and an Fe oxide/hydroxide phase. Occasional rhombs of the latter phase suggest that it may have replaced calcite.

The groundmass is a very even-textured quartz-feldspar mosaics with minor sericite and a Fe(Ti) oxide dust; it is clearly derived from a devitrified felsic glass.

SAMPLE No. E225090

SUMMARY:

This rock is a somewhat silicified vitric crystal tuff composed of angular fragments of quartz and devitrified vitric tuff or rhyolite in a fine-grained devitrified matrix. The absence of feldspar phenocrysts is notable.

HAND SPECIMEN:

This is an altered (silicified?) and fractured pinkish quartz-phyric felsic lava or tuff.

THIN SECTION:

This sample is a silicified and veined vitric crystal tuff. Framework grains include angular crystal fragments of quartz phenocrysts and more abundant subrounded to angular grains of devitrified glassy rhyolite or rhyolitic vitric tuff. The latter are up to 5mm long and are composed of a chequered mosaic of granular quartz and albite with minor sericite, in which occasional small albitized plagioclase phenocrysts are set. The matrix between the quartz and vitric tuff fragments is extremely fine-grained and has probably formed from devitrified glass. The rock is extensively transected by veinlets of secondary quartz, often ribbon quartz, and even narrower veinlets of sericite. This sample is unusual in the absence of blocky feldspar phenocrysts which are so common in most of the rocks described above.

SAMPLE No. E225091

SUMMARY:

This sample is a crystal lithic tuff dominated by angular quartz crystal fragments and subordinate lithic fragments of vitric crystal tuff or devitrified glassy rhyolite.

HAND SPECIMEN:

This is a medium grey chlorite-rich felsic crystal lithic tuff or lava breccia with a suggestion of quite large angular fragments up to 1cm across, but better defined smaller (<2mm) lithic clasts of chert or formerly glassy felsic lava/tuff.

THIN SECTION:

The coarser fragments hinted at in hand specimen are certainly not discernible in thin section in this rock; in fact, very few smaller lithic clasts easily seen in hand specimen are obvious in thin section. The rock is composed of about 30 modal% of angular fragments of volcanic quartz set in a matrix composed of a heterogeneous intergrowth of quartz, albite chlorite and sericite. Occasional large feldspar crystal fragments are totally sericitized. The presence of lithic fragments is only defined by slight variation in the amount of chlorite, and subtle textural differences from the matrix of the rock. All lithic fragments were felsic tuff or rhyolite.

A remarkable feature of this rock is the large number of large euhedral zircons, which almost qualify as microphenocrysts.

SAMPLE No. E225092

SUMMARY:

This sample is a tuffaceous siltstone with components from both a felsic volcanic source and a metasedimentary source.

HAND SPECIMEN:

This is a white, porcellanous, porous and massive fine-grained sediment or tuff.

THIN SECTION:

In thin section, this sample is seen to be very similar to 225095 with the exception that sparse detrital grains of volcanic quartz and quite abundant muscovite are present in 092. There is little doubt that the muscovite in this sample is detrital, suggesting some input from a pelitic metamorphic or metasedimentary source.

SAMPLE No. E225093

SUMMARY:

This is a quartz+feldspar-phyric rhyolitic lava or shallow intrusive virtually identical to sample 225098.

HAND SPECIMEN:

This sample is a medium brown feldspar+quartz-phyric rhyolitic lava with brownish feldspar phenocrysts up to 4mm long.

THIN SECTION:

This sample is a well-preserved rhyolitic lava or shallow intrusive dominated by quartz and feldspar phenocrysts in a relatively coarse-grained quartz-feldspar-chlorite-sericite groundmass. It is essentially identical to sample 225098.

SAMPLE No. E225094

SUMMARY:

This is a crystal lithic tuff dominated by quartz and feldspar phenocryst fragments and abundant felsic glassy lava and tuff fragments.

HAND SPECIMEN:

This sample is an olive-green to brown lithic crystal tuff or epiclastic sediment with lithic clasts to 8mm long.

THIN SECTION:

This is a well-preserved crystal lithic tuff with abundant quartz and feldspar phenocrysts in a devitrified vitric ash groundmass. Most quartz phenocrysts are broken crystal fragments up to 2mm long. Feldspars are also up to 2mm long and are thoroughly sericitized., and in the weathered part of the rock the sericite is Fe-stained.

Lithic clasts are subrounded and devitrified formerly glassy felsic volcanics now composed of quartz-albite±sericite±chlorite intergrowths. Occasional slightly vesicular streaked-out sericite-rich fragments are strongly reminiscent of flattened pumice.

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SAMPLE No. E225095

SUMMARY:

This sample is a silty formerly vitric tuff which was probably sorted and winnowed by currents and deposition through a column of water.

HAND SPECIMEN:

This is an olive green extremely fine-grained, almost cherty tuff.

THIN SECTION:

This is an exceptionally fine-grained devitrified vitric tuff composed of an almost irresolvable mesh of quartz, albite and sericite with feint banding (bedding?), and abundant small zircon crystals, many of which are euhedral, suggesting minimal erosional transport. Tiny muscovite or clay or sericite flakes throughout the rock may be either detrital or the result of devitrification of felsic glass. I suggest this rock is a waterlain silty vitric ash.

SAMPLE No. E225096

SUMMARY:

This is a volcanogenic sandstone derived from a proximal felsic volcanic source, and is dominated by detrital quartz and feldspar, with subordinate chloritized felsic glassy lava fragments.

HAND SPECIMEN:

This sample is an olive-green volcanoclastic or epiclastic sandstone with lithic clasts to 5mm of dark, fine-grained felsic volcanic lithologies.

THIN SECTION:

This is a coarse sandstone dominated by slightly rounded to angular volcanic quartz phenocrysts to 2mm across, and larger and more abundant feldspar phenocrysts which are totally sericitized. Other framework grains are mainly fine-grained lithic volcanic clasts, 1 to 2mm long, which were mainly felsic glassy lavas with sparse quartz and feldspar phenocrysts. One distinctive and well represented clast type has the glassy groundmass replaced by deep green chlorite; these clasts are often sheared and merge into the chloritic matrix of the rock.

This is a volcanogenic sandstone derived from a proximal felsic volcanic source which had undergone local intense chloritization.

SAMPLE No. E225097

SUMMARY:

This sample is a fractured and veined quartz+feldspar-phyric rhyolitic lava with a recrystallized formerly glassy groundmass.

HAND SPECIMEN:

This is a white to cream coloured quartz and feldspar-phyric rhyolitic lava or crystal tuff cut by abundant fractures and veinlets.

THIN SECTION:

In thin section, this is seen to be a rhyolitic lava dominated by quartz phenocrysts which are often euhedral to slightly resorbed, and are up to 4mm long. Feldspar phenocrysts are sericitized and generally smaller than quartz. Sparse biotite phenocrysts are totally altered to sericite (which has probably replaced chlorite as an intermediate alteration product). The formerly glassy groundmass is texturally variable due to different degrees of recrystallization (ie. different grainsizes) of quartz-albite mosaics, and local variations in the abundance of sericite. Tiny quartz-healed fractures pervade the rock, and some are also filled by a yellowish, non-pleochroic chlorite and blocky yellow epidote euhedra less than 0.1mm across.

SAMPLE No. E225098

SUMMARY:

This sample is a weathered quartz+feldspar+FeTi oxide+biotite-phyric rhyolitic lava.

HAND SPECIMEN:

This is a weathered, olive green and brownish well-preserved quartz+feldspar-phyric rhyolitic lava. Feldspar phenocrysts have been altered to a pinkish clay(?) mineral.

THIN SECTION:

This sample is a well-preserved rhyolitic lava with around 15 modal% feldspar and 5 modal% feldspar phenocrysts, and around 1 modal% of smaller (<0.5mm) FeTi oxide phenocrysts, with only a few pseudomorphed biotite microphenocrysts. Feldspar phenocrysts are albitized plagioclase with distinct rounded cores and euhedral rim overgrowths; they are slightly flecked by sericite and up to 4mm long. Quartz phenocrysts are rounded euhedra to 1mm. FeTi oxide phenocrysts, also <1mm long, are skeletal and result from ilmenite exsolution and chlorite replacement of remaining magnetite. Rare biotite microphenocrysts are chloritized with Fe oxide dust along cleavages.

Groundmass is vitrophyric, with stubby plagioclase microlites and laths in a relatively coarse-grained quartz-feldspar-chlorite intergrowth. It is possible that this groundmass texture is primary and due to slower cooling in the core of a flow or a shallow intrusive body; it does not appear to be a devitrification texture.

Several veins of polygonal quartz and minor calcite cut the rock, and some of the calcite is replaced by hematite.

SAMPLE No. E225⁰99

SUMMARY:

This sample is a crystal vitric tuff dominated by quartz crystal fragments and lithic fragments of devitrified felsic vitric tuffs or lava.

HAND SPECIMEN:

This is a highly-altered felsic tuff with a sericitic pale grey matrix and black streaks of chloritized pumice (?).

THIN SECTION:

This is a quartz crystal + pumice fragment-rich vitric crystal tuff very similar in most respects to 225162. The only major points of difference are the generally larger grain size of the quartz phenocryst fragments (up to 2mm), and the more extensive sericitization of groundmass areas in this sample, and the more abundant unsericitized, devitrified vitric tuff or rhyolitic lithic fragments in this sample compared to 225162.

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SAMPLE No. E225100**SUMMARY:**

This sample is a weathered lithic crystal tuff dominated by rounded quartz and albite crystal fragments and lithic fragments of devitrified felsic vitric tuffs or lava.

HAND SPECIMEN:

This is a dark grey, weathered lithic tuff with lithic clasts of fine-grained volcanic lithologies and chert(?) up to 6mm long in a relatively coarse matrix containing plentiful crystal debris.

THIN SECTION:

This is a fairly difficult rock to diagnose. The choice is whether it is an epiclastic sandstone or a lithic crystal tuff. The rock contains abundant angular to rounded volcanic quartz grains; most of the angular grains are clearly crystal fragments, and are sand-sized. These make up around 15 modal% of the rock. Slightly sericitized albite phenocrysts, also frequently broken, are less abundant than quartz. An interesting feature of this sample is that the quartz grains in places seem to be recrystallizing as interlocking relatively coarse-grained mosaics of albite which retain the quartz phenocryst outlines. Abundant diffuse veins of albite traverse the rock, and suggest that Na-rich solutions pervaded this sample post-burial.

Lithic fragments are up to 4mm across and are dominantly relatively fine-grained aphyric dacitic to rhyolitic lavas. They are always well rounded, and have quartz-albite mosaic textures suggestive of an origin involving recrystallization of devitrified glass.

The groundmass of this sample is very heterogeneous, varying from

extremely fine-grained pale green chlorite, which seems to be replacing a former vitric ash component, to almost sand-sized detritus dominated by quartz and albite grains and crystal fragments. The groundmass has fairly extensive sericite and calcite alteration, and calcite also occurs in a number of veinlets cutting the sample. The calcite is partially replaced by hematite or goethite in both the veins and groundmass, most notably in the more weathered parts of the rock.

The rounded grains and the diversity of lithic clasts suggests that this may have been a proximal epiclastic sediment rather than a lithic crystal tuff, although the poor state of preservation of the sample renders it difficult to make a certain diagnosis.

SAMPLE No. E226151

SUMMARY:

This sample is a highly altered vitric crystal tuff of rhyolitic composition which has been carbonated and veined by calcite, with subsequent local alteration of the calcite to hematite; the latter mineral occurs in veins with quartz.

HAND SPECIMEN:

This is a fine-grained highly altered felsic lava or tuff which has been bleached to a cream-yellow colour in some areas, and elsewhere stained a red-grey. It is transected by several mm-wide bands of hematite.

THIN SECTION:

This is a highly altered felsic vitric crystal tuff. Phenocryst fragments of quartz and albitized plagioclase up to 0.5mm long are embedded in a very fine-grained, extremely heterogeneous former glass-rich matrix composed of a mosaic of quartz, albite, sericite and minor calcite. The variable texture of the matrix is due to local concentrations of sericite relative to quartz and albite, and the presence of small lithic fragments of highly altered glassy rhyolite. The rock is riddled with fine-grained rhombs of calcite which have been altered to goethite or hematite in localized areas; some of the hematite-rich areas may represent small lithic fragments.

This sample is cut by numerous quartz, quartz-calcite and quartz-hematite veins to 3mm wide. In the largest vein, the quartz is strained and has a ribbon texture, and is intimately intergrown with

well-crystallized hematite; this vein probably represents a high-strain zone along which the quartz+hematite-dominated groundmass recrystallized in situ.

SAMPLE No. E225152

SUMMARY:

This sample is thoroughly sericitized and recrystallized quartz+feldspar+biotite-phyric rhyolitic lava with unusually coarse-grained recrystallized quartz in the groundmass, which imposes a 'detrital epiclastic' appearance to the rock in thin section.

HAND SPECIMEN:

This is a highly weathered quartz+feldspar-phyric crystal tuff or rhyolitic lava with extensive sericitization and Fe-stained clay alteration of groundmass and feldspar phenocrysts.

THIN SECTION:

At first glance, this rock is deceptively like an epiclastic sandstone dominated by fine sand-sized angular quartz grains. However, careful examination shows this rock to be a thoroughly recrystallized and sericitized formerly quartz+feldspar+biotite-phyric rhyolitic lava which probably had a glassy groundmass.

Quartz phenocrysts make up only about 5 modal% of the rock and are mainly quite resorbed, and have clearly reacted extensively with the groundmass during the recrystallization (devitrification) of the latter. Slightly more abundant feldspar phenocrysts are totally sericitized. Biotite plates to 0.8mm are not uncommon, but have been totally replaced by sericite (probably after chlorite) and Fe oxide dust along cleavages.

The groundmass of the sample is now composed of unusually coarse-grained interlocking secondary quartz grains around 0.2mm long which are immersed in a bed of sericite and Fe-stained clayey material. There is no doubt that this was originally a rhyolitic lava.

SAMPLE No. E225153

SUMMARY:

This is a highly weathered and sericitized quartz+ plagioclase - phyric vitric crystal tuff.

HAND SPECIMEN:

This is a very weathered brownish tuffaceous felsic volcanic with olive green lithic(?) fragments in a quartz-phyric sericitized matrix.

THIN SECTION:

This is a weathered quartz+feldspar-phyric crystal vitric tuff . The main component easily identifiable is about 5-10 modal% of large quartz grains to 1.5mm across. These vary from rounded subhedra to angular fragments, and are commonly fractured, with subgrain recrystallization along fracture planes. Feldspar phenocrysts, usually less than 0.5mm long, are subordinate to quartz grains volumetrically, and are entirely sericitized or altered to yellowish almost isotropic clayey material. Due to the extensive alteration, it is impossible to tell if mafic phenocrysts were originally present.

The groundmass of this sample is a highly sericitized and clay-altered fine-grained quartz-feldspar aggregate containing abundant isotropic brownish grains and dust which are probably Fe-stained clays and sericite. High strain zones are defined by small sericite-dominated shears through the rock. Although an origin as a rhyolitic lava cannot be ruled out for this sample, I prefer that it was a vitric crystal tuff, mainly because the quartz grains are mostly crystal fragments rather than unbroken phenocrysts.

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SAMPLE No. E225154**SUMMARY:**

This is a very well-preserved quartz+plagioclase+biotite-phyric rhyolitic lava with a devitrified glassy groundmass which has started to recrystallize to quartz and albite±sericite and chlorite.

HAND SPECIMEN:

This is a grey-green speckled felsic lava with sparse quartz and feldspar phenocrysts.

THIN SECTION:

This is a quartz+plagioclase+biotite-phyric rhyolitic lava. It contains around 5 modal% of quartz phenocrysts up to 3mm long which are well-formed partially resorbed euhedra or subhedra containing relatively abundant devitrified melt inclusions. Feldspar phenocrysts, usually less than 1mm long, are subordinate and always totally replaced by fine-grained to well-crystallized sericite. Former biotite plates to 1mm long are replaced by fibrous green pleochroic chlorite-Fe oxide intergrowths which make up 1-2 modal% of the rock.

The groundmass of this sample is a very even-textured quartz-albite-sericite-chlorite mosaic after devitrified felsic glass. Several veinlets of pleochroic green chlorite similar to that replacing biotite cut the rock, and have been oxidized to foxy red where the sample is weathered.

SAMPLE No. E225155

SUMMARY:

This is a well-preserved rhyolitic vitric crystal tuff dominated by quartz phenocryst fragments, with subordinate feldspar and chloritized biotite phenocrysts.

HAND SPECIMEN:

This is a fairly fresh fine-grained dark green felsic lava or tuff in which the only identifiable phase in hand specimen is small feldspar fragments.

THIN SECTION:

This sample is a quartz+biotite+feldspar-phyric vitric crystal tuff composed of at least 10 modal% of phenocrysts of quartz and less than 5 modal % of the other phenocryst phases. The quartz crystals are all anhedral or subhedral crystal fragments, mainly less than 0.5mm long. They show very fine-grained, reacted and resorbed scalloped margins in contact with groundmass. Feldspar phenocrysts are large albitized euhedra to 1mm long which are highly sericitized. Former mafic phenocrysts constitute less than 1 modal% of the sample and were dominantly small biotite plates which have been thoroughly chloritized; they often contain quite large zircon euhedra.

The groundmass of this sample is fairly homogeneous, and is composed of a mosaic intergrowth of quartz, albite and pale green chlorite, with minor sericite and leucoxene. Quartz blebs in this groundmass are generally coarser than albite-chlorite; the texture suggests growth from devitrified felsic glass.

Although this sample is generally more 'even-textured' than many

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vitric crystal tuffs in the Mount Read Volcanics, the abundance of quartz phenocrysts, and their fragmental nature, suggests that this rock is likely to have been a tuff rather than a rhyolitic lava.

SAMPLE No. E225156

SUMMARY:

This sample is a well-preserved plagioclase+quartz+FeTi oxide +biotite-phyric rhyolite or rhyodacite lava with perlitic cracks in the very fine-grained devitrified glassy groundmass.

HAND SPECIMEN:

This is a dark grey-green quartz+feldspar-phyric felsic lava very similar to 225154.

THIN SECTION:

This is a well-preserved plagioclase+quartz+FeTi oxide +biotite-phyric rhyolitic or rhyodacitic lava with an extremely fine-grained devitrified glassy groundmass. Plagioclase phenocrysts make up around 30 modal% of the rock and are generally blocky to elongate prisms less than 1mm long. They are always totally replaced by a fine-grained sericite mesh. Quartz phenocrysts make up only 5-8modal% of the rock, and are partially resorbed subhedra up to 3mm long. FeTi oxide phenocrysts appear to be relatively fresh compared to other samples (163-168) of similar rocks from this area, and make up 1-2 modal% of this rock; they are up to 0.7mm long and are quite euhedral. Biotite phenocrysts are less abundant than FeTi oxide phenocrysts and are always replaced by a dark intergrowth of chlorite and FeTi oxide; they are usually less than 0.4mm long. Small apatite microphenocrysts are notable in this sample, although not abundant.

The groundmass of this rock is exceptionally fine-grained and irresolvable. It is traversed by long thin fracture planes which may be perlitic cooling cracks in the former glass from which the present groundmass formed by devitrification.

SAMPLE No. E225157

SUMMARY:

This sample is a very distinctive epiclastic sandstone, almost matrix-free, composed of detrital lithic fragments of devitrified vitric tuffs, quartz crystal fragments and abundant FeTi oxide grains which occur as layers probably representing heavy mineral swash bands.

HAND SPECIMEN:

This is a coarse gritty sandstone with detrital grains of quartz and red ferric stained detrital grains of ?.

THIN SECTION:

This sample in thin section is an epiclastic sandstone characterized by a remarkable abundance of detrital FeTi oxide grains. Most FeTi oxide grains are subrounded and around 0.2-0.8mm across, and when cut thinly enough, they show well-developed skeletal alteration involving exsolution of ilmenite and replacement of remaining magnetite by chlorite. These Fe Ti oxide grains constitute at least 20 modal% of the rock and occur in discrete layers. Other detrital grains, usually less than 1mm long, include angular volcanic quartz crystal fragments and polycrystalline lithic fragments mainly represented by devitrified vitric felsic tuffs showing variable degrees of recrystallization (ie. variable grainsize) and and sericitization. Plagioclase phenocrysts or crystal fragments are notably rare. A single 8mm long lithic fragment is a strongly sericitized epiclastic siltstone or fine-grained tuff. The matrix component of this rock is almost non-existent, as detrital grains and lithic fragments have been intimately intergrown during pressure solution accompanying burial and diagenesis.

SAMPLE No. E225158

SUMMARY:

This is a weakly-bedded epiclastic siltstone composed of detrital volcanic quartz fragments and chloritized glass shards in a very fine-grained matrix.

HAND SPECIMEN:

This is a dark grey-green, massive, very fine-grained sedimentary rock with poorly-defined bedding

THIN SECTION:

This sample is a massive, unfoliated fine-grained siltstone or shale with a significant tuffaceous component represented by small detrital quartz crystal fragments and abundant curved chloritized former glass shards in an irresolvable quartz- and sericite-rich matrix. The quartz grains, generally < 0.02mm long are often subhedral, and always show even extinction; they lack strain features and polycrystalline grains have not been observed. Bedding is defined by bands of slightly coarser detrital quartz. The altered glass shards are always less than 0.05mm long and are composed of rusty red-brown chlorite. They are aligned roughly parallel with bedding.

Sparse narrow veinlets and fractures through this rock are marked by concentrations of chlorite and goethite (limonite?).

SUMMARY:

This is a rhyolitic vitric crystal tuff dominated by crystal fragments of quartz and minor sericitized plagioclase. The former glassy groundmass has been somewhat granulated and recrystallized as relatively coarse-grained quartz-albite-sericite domains.

HAND SPECIMEN:

This is an unusual pink and green quartz- and feldspar-phyric felsic lava or tuff, with green streaks of chlorite-dominated alteration in a pink fine-grained matrix.

THIN SECTION:

This sample is a highly recrystallized vitric crystal tuff with around 20 modal% of quartz phenocrysts and a few modal % of altered plagioclase phenocrysts in a devitrified and recrystallized groundmass. The quartz phenocrysts are generally subhedral crystal fragments which often show internal deformation, fragmentation and granulation, and common subgrain recrystallization. Former plagioclase phenocrysts are totally sericitized and often rounded euhedra to 1mm across.

The matrix of this sample is very heterogeneous, with domains of variably recrystallized quartz-chlorite-sericite defined by grainsize variations perhaps representing former fragments of vitric tuff. Other former fragments of vitric tuff are defined by areas of matrix rich in Fe oxide 'dust'. Most of the groundmass is a granular quartz-albite-sericite mosaic interpreted to have crystallized from rhyolitic glassy debris. There are occasional chloritic ghosts of former pumice fragments discernible in the rock, though these are uncommon. Four or five large zircon microphenocrysts are notable in this sample.

SAMPLE No. E225160

SUMMARY:

This sample is a well-preserved plagioclase+quartz+FeTi oxide +biotite-phyric rhyolite virtually identical in every respect to sample 225154

HAND SPECIMEN:

This is a slightly weathered but well-preserved grey quartz+feldspar-phyric rhyolitic lava.

THIN SECTION:

This rhyolitic lava is identical to 225154.

SAMPLE No. E225161

SUMMARY:

This is a weathered vitric crystal tuff dominated by quartz crystal fragments; it is identical to sample E 225155, and may come from the same unit as that sample.

HAND SPECIMEN:

This is a weathered brown felsic tuff in which the only identifiable phases are sparse quartz phenocrysts and altered feldspar phenocrysts.

THIN SECTION:

This sample is essentially a more weathered version of sample E225155. It is dominated by angular quartz phenocryst fragments and subordinate totally sericitized feldspar phenocrysts in a devitrified rhyolitic matrix which has recrystallized to some degree with growth of subrounded grains of quartz in a very fine-grained groundmass of sericite and quartz. The rock shows several chloritized and oxidized former biotite phenocrysts, and groundmass sericite is extensively stained orange-red on the weathered margin of the rock. There is no petrographic criteria to differentiate this sample from E225155, and the samples may have come from the same unit.

SAMPLE No. E225162

SUMMARY:

This sample is a quartz crystal fragment-rich vitric crystal lithic tuff with abundant sericitized pumice fragments.

HAND SPECIMEN:

This is a grey-green crystal lithic tuff with occasional lithic fragments to 1cm long.

THIN SECTION:

This sample is a crystal vitric tuff containing a large proportion (around 40 modal%) of fragments of volcanic quartz and pumice in subequal proportions. The quartz crystal fragments are up to 0.5mm long and angular to subrounded, and they frequently show internal strain features and limited subgrain recrystallization along across-grain fractures. Former pumice fragments are ragged-edged sericite-rich areas to about 1mm across which show occasional well-preserved typical flattened pumice shapes defining a broad bedding, but are often relatively massive and un-flattened. They are not vesiculated (at least not now, as this structure may have been obliterated during alteration). Some of the more blocky sericite fragments may be totally sericitized plagioclase phenocrysts, although if this is the case, it is unusual that the phenocrysts have not maintained their former outlines. The several large dark green lithic fragments in the handspecimen are not obvious in the thin section, and have not been sampled in the section.

The matrix of this sample is a very fine-grained intergrowth of quartz, albite and sericite after a former dominant vitric ash component.

SAMPLE No. E225163

SUMMARY:

This is a well-preserved quartz+plagioclase+FeTi oxide +biotite-phyric rhyolitic lava with a devitrified vitrophyric groundmass.

HAND SPECIMEN:

This is a brown, slightly weathered but well-preserved quartz+feldspar-phyric rhyolitic lava

THIN SECTION:

This sample is a quartz+feldspar-phyric rhyolitic lava dominated by 5-10 modal% of large phenocrysts of quartz to 5mm long. These are slightly rounded euhedra often with chloritized melt inclusions. Plagioclase phenocrysts are slightly less abundant than the quartz phenocrysts and are blocky, slightly rounded euhedra to 2mm across which are always partially altered to very fine-grained sericite. They sometimes occur in multi-crystal clusters. A few totally altered microphenocrysts now composed of chlorite and concentrations of sphene crystals were almost certainly large FeTi oxide phenocrysts. A few small microphenocrysts composed of green chlorite may have been former biotite flakes.

The groundmass of this lava is vitrophyric and very uniform. It is composed of tiny albitized plagioclase microlites in a fine-grained quartz-albite-chlorite and minor sericite matrix which has formed from devitrification of rhyolitic glass. Occasional slightly coarser-grained pools of secondary quartz are also growing from the devitrified glass.

SAMPLE No. E225164

SUMMARY:

This is a quartz+plagioclase+FeTi oxide +biotite-phyric rhyolitic lava identical to E225163.

HAND SPECIMEN:

This is an excellent, fresh quartz+feldspar-phyric grey rhyolitic lava.

THIN SECTION:

This sample is a quartz+plagioclase+biotite+FeTi oxide-phyric rhyolitic lava essentially identical to E225163, but even less weathered.

Minor points of difference are:

1: this sample has a groundmass texture slightly coarser than 225163, suggesting that devitrification-related recrystallization has proceeded to a greater degree in this sample than 225163.

2: this sample has more sphene-chlorite grains replacing former FeTi oxide phenocrysts.

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SAMPLE No. E225165

SUMMARY:

This is a quartz+plagioclase+FeTi oxide +biotite-phyric rhyolitic lava identical to the two preceding lavas in every respect except that this sample is notably more sericitized.

HAND SPECIMEN:

This is a well-preserved brown quartz+feldspar-phyric rhyolite lava identical to 225163.

THIN SECTION:

This sample is identical to E225163 and 64 except that it shows considerably more sericitization of plagioclase phenocrysts and greater sericite development in the groundmass than the previous two samples.

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SAMPLE No. E225166

SUMMARY:

This is a quartz+plagioclase-phyric rhyolitic lava with rounded quartz phenocrysts and slightly sericitized plagioclase phenocrysts.

HAND SPECIMEN:

This is a well-preserved brown quartz+feldspar-phyric rhyolite lava identical to 225163 and 225165.

THIN SECTION:

This quartz+plagioclase-phyric rhyolitic lava differs from those described above in several notable and distinctive respects. Firstly, unlike in the others, most quartz phenocrysts in this sample are almost perfectly rounded, indicating extensive reaction with the host magma. Secondly, the groundmass is a rather chequered, mosaic intergrowth of quartz, feldspar, chlorite and sericite and shows no plagioclase microlites: it may have been totally glassy before devitrification and recrystallization. Thirdly, altered FeTi oxide and biotite phenocrysts are less abundant in this sample than in the previous three rhyolites.

Although this sample may be from different unit than the previous three samples, it is nevertheless very similar to them.

SAMPLE No. E225167

SUMMARY:

This sample is a well-preserved quartz+plagioclase +FeTi oxide +biotite-phyric rhyolite lava which has suffered strong hematite/limonite alteration of the groundmass, but is otherwise very similar to sample 225166.

HAND SPECIMEN:

This is a weathered, pale pink-orange, porous quartz+ feldspar-phyric rhyolitic lava with a highly altered sericitic(?) groundmass.

THIN SECTION:

This sample is a quartz+plagioclase+FeTi oxide + biotite-phyric rhyolite in which the quartz phenocrysts are notably rounded and reacted compared with many of the other sample of rhyolite examined for this study. In this respect, and also with respect to the relatively sparse large plagioclase phenocrysts, this sample is reminiscent of 225166. Plagioclase phenocrysts are slightly rounded blocky euhedra which are totally altered. Biotite phenocrysts are rare and chloritized, and FeTi oxide phenocrysts, also rare, are replaced by sphene and chlorite.

The devitrified glassy to vitrophyric groundmass of this sample is most distinctive in that it has been stained bright brick red. The main locus of the pervasive Fe-staining is relatively fine-grained sericite scattered evenly throughout the groundmass. This is probably a weathering feature.

SAMPLE No. E225168

SUMMARY:

This sample is a quartz-phyric rhyolitic lava with a thoroughly recrystallized, very slightly foliated formerly glassy groundmass. It lacks the plagioclase phenocrysts present in the previous 4 rhyolitic lavas, and almost certainly is from a different unit.

HAND SPECIMEN:

This is a light green-brown sparsely quartz+feldspar-phyric rhyolitic lava.

THIN SECTION:

This is a quartz-phyric rhyolitic lava with quartz phenocrysts to 3mm across which show fairly extensive rounding and reaction with the groundmass, and the development of narrow rims of incipient breakdown and resorption into the groundmass. Only two very small, totally sericitized plagioclase phenocrysts were noted, and in this respect, this sample contrasts strongly with the four preceding rhyolites. Many of the quartz phenocrysts show granulation and subgrain recrystallization along fracture planes.

The groundmass of this sample is relatively coarse-grained (compared to the preceding 4 rhyolites) and extensively sericitized, with sericite defining a weak foliation as it wraps around quartz and albite grains which have grown from the formerly vitric groundmass.

The degree of recrystallization (coarseness) of the groundmass in these 5 rhyolite samples seems to reflect the extent to which the formerly vitrophyric to glassy groundmasses were strained during devitrification and recrystallization. Those lavas with the coarsest groundmass now (this sample) have the most deformed quartz

phenocrysts, whereas those with essentially pristine quartz phenocrysts have well-preserved vitrophyric or mildly devitrified-recrystallized groundmasses (eg. 225163).

SAMPLE No. E225169

SUMMARY:

This is a plagioclase+quartz-phyric rhyodacitic lava with extensively sericitized, weathered clayey plagioclase phenocrysts.

HAND SPECIMEN:

This is a light green brown quartz+feldspar-phyric rhyolitic lava essentially identical to 225168 except that this sample has highly altered (clay? sericite?) feldspars.

THIN SECTION:

This sample is a highly weathered plagioclase+quartz-phyric rhyodacitic lava in which the plagioclase phenocrysts, usually 0.5 - 2mm long, are totally replaced by a dense yellow-orange mesh of oxidized or Fe-stained sericite or clay. Altered plagioclase phenocrysts make up around 20 modal% of the rock. Quartz phenocrysts are smaller than plagioclase phenocrysts and constitute only around 5 modal% of the sample. They are often fractured and rounded grains which show extensive reaction with groundmass. The thorough alteration of this sample involving reddish, stained sericite has obliterated any sign of mafic phenocrysts, if indeed they were originally present.

The groundmass of this sample is a quartz-albite-minor chlorite mosaic intergrowth which has been variably and strongly sericitized.

The dominance of plagioclase phenocrysts and the relative paucity of quartz phenocrysts in this sample relative to the preceding 5 samples suggests that it may be better classified as a rhyodacite than a rhyolite.

SAMPLE No. E225170

SUMMARY:

**This sample is a plagioclase+quartz+FeTi oxide
+biotite-phyric rhyolitic lava with an extremely fine-grained
devitrified groundmass.**

HAND SPECIMEN:

THIN SECTION:

**This is a rather distinctive plagioclase+quartz +FeTi oxide
+biotite-phyric rhyolite with a very fine-grained, fractured groundmass.
Quartz phenocrysts make up around 5-8 modal% of the rock and are mainly
fractured and slightly rounded euhedra to 1mm long. Plagioclase
phenocrysts are blocky to elongate prisms up to 1mm long, and are
slightly more abundant than quartz phenocrysts. They are totally replaced
by fine-grained sericite which has altered to a rusty clayey material in
the more weathered parts of the section. Former FeTi oxide phenocrysts
are replaced by chlorite and sphene, with the sphene clearly replacing
aligned ilmenite exsolution lamellae in some grains. Chloritized biotite
flakes are a minor constituent, and several more prismatic pseudomorphs
now composed of olive green chlorite may have been small augite (?)
phenocrysts.**

**The groundmass of this sample is very fine-grained and shows limited
flow texture in places. It has devitrified from a formerly glassy matrix.**

SAMPLE No. E225171

SUMMARY:

This is a deformed and silicified rock composed almost exclusively of recrystallized quartz and minor sericite. Its original lithology (protolith) remains uncertain.

HAND SPECIMEN:

This is a highly, fractured and altered and silicified pink and green felsic lava or tuff.

THIN SECTION:

This sample appears at first glance to be an almost monomineralic quartz aggregate composed of slightly foliated and deformed quartz grains to 0.4mm but showing a remarkable grainsize and grainshape variation over very small areas. Grains are intimately sutured one against the other, and show extensive subgrain recrystallization. In adjacent domains, relatively coarse, polygonal quartz grades to streaked out areas of very fine-grained quartz. Very fine-grained colourless sericite is the only other constituent, and is more abundant than it seems at a cursory examination; it forms occasional small localizations, but mainly occurs as meandering wisps throughout the quartz-dominated framework.

It is impossible to tell whether this rock was originally a quartzite or quartz sandstone, or a felsic vitric tuff which has been silicified and deformed. There is no sign of the former presence of either detrital grains or quartz+feldspar phenocrysts.

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SAMPLE No. E225172**SUMMARY:**

This sample is a sericitized quartz+plagioclase+biotite+FeTi oxide-phyric rhyolitic crystal tuff with a relatively large biotite component relative to the other samples described above.

HAND SPECIMEN:**THIN SECTION:**

This is a rather distinctive quartz+feldspar+biotite-phyric crystal tuff characterized by relatively large and abundant plates of chloritized biotite relative to other felsic rocks described above. Quartz phenocrysts are generally angular crystal fragments usually much less than 1mm long. They make up about 15 modal% of the rock, as do thoroughly sericitized plagioclase crystals. The latter are blocky euhedra to 2mm long, and are replaced by very fine-grained sericite. As similar sericite replaces the groundmass, outlines of former plagioclase grains are often difficult to distinguish. Biotite forms quite large plates, to around 1mm across, which have been chloritized, and had Fe oxide films and dust form along former cleavage traces. It probably makes up 2-3 modal% of this rock. Sparse large FeTi oxide phenocrysts have exsolved ilmenite along octahedral planes and then been altered to chlorite-sphene aggregates.

The groundmass of this sample has been obliterated by sericitization, but was probably formerly quite glassy (vitric ash).

APPENDIX 5

Analytical Data Sheets

Analabs/SGS

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Telex AA92560

ANALYTICAL REPORT No.

999.59.08.05926

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

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Kettering.
Tasmania 7155

ORDER No.	PROJECT
0001	Gowrie Park
DATE RECEIVED	RESULTS REQUIRED
06/01/88	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
1	12/01/89	1	10

STATE OF SAMPLES	SAMPLE NUMBERS	PRE-TREATMENT							ANALYSIS			
		DRY	CRUSH	SPLIT	PUL-VERISE	SEIVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD	
	225102/105, 225107/112	RD	Prep: 006,009,011,012,013,016							Cu, Pb, Zn, Ag/101		
	225102/105, 225107/112	RD								Au, AuChk/313		

RESULTS TO

RESULTS TO

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Kettering.
Tasmania 7155

REMARKS

STATE OF SAMPLES	ANALYSIS — PREPARATION	ANALYSIS — METHOD
whole core WC	perchloric acid A1	atomic absorption AAS
split core SC	hydrochloric acid A2	x-ray fluorescence XRF
cutting CU	nitric acid A3	spectrophotometry SPEC
rock Ro	aqua regia A4	colorimetry COL
soil SO	nitric-perchloric A5	chromatography CHR
pulp PU	HF mixture A6	titration ITN
water WA	HF under pressure A7	other chemical means CHEM
tissue TI	fusion A8	miscellaneous MISC
stream sediment SS		fluorescence FLUOR
heavy mineral HM		inductively coupled plasma ICP

AUTHORISED OFFICER *[Signature]*

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

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TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	Au	AuChk	Regional rock chips	
1	225102	65	880	575	0.5	0.007	0.008	Staverton	
2	225103	105	220	145	<0.5	<0.005	-	"	
3	225104	60	1050	195	<0.5	0.011	-	"	
4	225105	160	180	175	<0.5	<0.005	-	"	
5	225107	30	535	125	4.5	0.023	-	Cathana West	
6	225108	15	15	50	<0.5	<0.005	-	"	
7	225109	10	<5	40	<0.5	<0.005	-	"	
8	225110	<5	20	15	<0.5	<0.005	-	"	
9	225111	40	305	25	2.5	<0.005	-	"	
10	225112	165	370	520	1.0	<0.005	-	"	
11									
12									
13									
14									
15									
17									
18									
19									
20									
21									
22									
23	DETECTION	5	5	5	0.5	0.005	0.005		
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM		
25	METHOD	101	101	101	101	313	313		

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

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

Phone (09) 458 7999

52 Murray Road, Welshpool, W.A. 6106

Telex AA92560

FAX: 04 31 8890

ANALYTICAL REPORT No.

999.59.08.06084

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

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Kettering,
Tasmania 7155

ORDER No.	PROJECT
0003	
DATE RECEIVED	RESULTS REQUIRED
20/03/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
10	04/04/89	1	117

STATE OF SAMPLES	REFER BELOW	SAMPLE NUMBERS	PRE-TREATMENT						ANALYSIS					
			DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD		
	Various		RC	Prep: 005,009,011,012,013,016								Cu,Pb,Zn,Ag/101		
	Various		RC									Au,AuChk/313		
	Various		RC	Prep: 005,009,011,012,013,016								Cu,Pb,Zn,Ag/104		

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Kettering,
Tasmania 7155

RESULTS TO

RESULTS TO

REMARKS

STATE OF SAMPLES	ANALYSIS — PREPARATION	ANALYSIS — METHOD
whole core WC	perchloric acid A1	atomic absorption AAS
split core SC	hydrochloric acid A2	x-ray fluorescence XRF
cutting CU	nitric acid A3	spectrophotometry SPEC
rock Ro	aqua regia A4	colorimetry COL
soil SO	nitric-perchloric A5	chromatography CHR
pulp PU	HF mixture A6	titration TTN
water WA	HF under pressure A7	other chemicals means CHEM
tissue TI	fusion A8	miscellaneous MISC
stream sediment SS		fluorescence FLUOR
heavy mineral HM		inductively coupled plasma ICP

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Rock chips
GOG RANGE.

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TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au
1	225087	15	-	15	-	30	-	<0.5	-	0.005
2	225088	5	-	105	-	105	-	<0.5	-	<0.005
3	225089	15	-	245	-	390	-	<0.5	-	<0.005
4	225090	10	-	<5	-	20	-	<0.5	-	<0.005
5	225091	15	-	<5	-	50	-	<0.5	-	<0.005
6	225092	10	-	165	-	105	-	<0.5	-	<0.005
7	225093	10	-	<5	-	205	-	<0.5	-	<0.005
8	225094	15	-	<5	-	155	-	<0.5	-	<0.005
9	225095	15	-	<5	-	105	-	<0.5	-	<0.005
10	225096	100	-	<5	-	130	-	<0.5	-	<0.005
11	225097	5	-	<5	-	20	-	<0.5	-	<0.005
12	225098	5	-	<5	-	345	-	<0.5	-	<0.005
13	225099	5	-	<5	-	30	-	<0.5	-	<0.005
14	225100	30	-	<5	-	160	-	<0.5	-	
15	225113	30	-	<5	-	90	-	<0.5	-	<0.005
16	225114	40	-	1600	-	100	-	0.5	-	
17	225115	45	-	105	-	355	-	0.5	-	<0.005
18	225116	5	-	<5	-	40	-	<0.5	-	<0.005
19	225117	230	-	<5	-	80	-	2.5	-	<0.005
20	225118	15	-	<5	-	30	-	<0.5	-	<0.005
21	225119	20	-	<5	-	45	-	0.5	-	<0.005
22	225120	160	-	15	-	80	-	2.0	-	<0.005
23	225121	1700	-	1150	-	1900	-	7.5	-	<0.005
24	225122	325	-	800	-	1150	-	0.5	-	0.005
25	225123	65	-	495	-	345	-	<0.5	-	<0.005

Results in ppm unless otherwise specified

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-- = element not determined

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TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au
1	225124	1900	-	925	-	5650	-	<0.5	-	<0.005
2	225125	55	-	<5	-	70	-	<0.5	-	<0.005
3	225126	160	-	<5	-	195	-	0.5	-	<0.005
4	225127	10	-	<5	-	85	-	<0.5	-	<0.005
5	225128	70	-	<5	-	45	-	<0.5	-	<0.005
6	225129	10	-	<5	-	15	-	<0.5	-	<0.005
7	225130	10	-	<5	-	25	-	<0.5	-	<0.005
8	225131	50	-	130	-	50	-	<0.5	-	<0.005
9	225132	45	-	<5	-	50	-	<0.5	-	
10	225133	15	-	<5	-	25	-	<0.5	-	<0.005
11	225134	30	-	<5	-	55	-	<0.5	-	<0.005
12	225135	20	-	<5	-	125	-	<0.5	-	<0.005
13	225136	10	-	<5	-	35	-	<0.5	-	<0.005
14	225137	45	-	<5	-	40	-	0.5	-	0.005
15	225138	325	-	<5	-	25	-	<0.5	-	<0.005
16	225139	30	-	<5	-	45	-	<0.5	-	<0.005
17	225140	35	-	<5	-	40	-	<0.5	-	<0.005
18	225141	1150	-	<5	-	45	-	<0.5	-	<0.005
19	225142	100	-	<5	-	55	-	<0.5	-	<0.005
20	225143	20	-	<5	-	115	-	0.5	-	<0.005
21	225144	65	-	<5	-	140	-	0.5	-	<0.005
22	225145	10	-	250	-	75	-	<0.5	-	<0.005
23	225146	30	-	70	-	35	-	<0.5	-	<0.005
24	225147	10	-	160	-	110	-	<0.5	-	<0.005
25	225148	5	-	155	-	375	-	<0.5	-	<0.005

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

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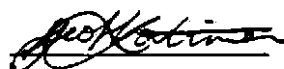
TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au
1	225149	55	-	1750	-	340	-	1.0	-	<0.005
2	225150	10	-	<5	-	35	-	<0.5	-	<0.005
3	225151	25	-	100	-	1250	-	0.5	-	<0.005
4	225152	15	-	<5	-	30	-	<0.5	-	<0.005
5	225153	5	-	<5	-	40	-	<0.5	-	<0.005
6	225154	5	-	<5	-	95	-	<0.5	-	<0.005
7	225155	10	-	650	-	185	-	0.5	-	<0.005
8	225156	10	-	50	-	60	-	<0.5	-	<0.005
9	225157	45	-	40	-	55	-	<0.5	-	<0.005
10	225158	5	-	365	-	345	-	1.0	-	<0.005
11	225159	5	-	<5	-	65	-	<0.5	-	<0.005
12	225160	60	-	2200	-	140	-	3.5	-	<0.005
13	225161	25	-	250	-	70	-	<0.5	-	<0.005
14	225162	10	-	135	-	180	-	<0.5	-	<0.005
15	225163	<5	-	<5	-	170	-	<0.5	-	<0.005
16	225164	5	-	<5	-	500	-	<0.5	-	<0.005
17	225165	<5	-	<5	-	470	-	<0.5	-	<0.005
18	225166	<5	-	<5	-	340	-	<0.5	-	<0.005
19	225167	<5	-	<5	-	115	-	<0.5	-	<0.005
20	225168	<5	-	<5	-	45	-	<0.5	-	<0.005
21	225169	15	-	<5	-	155	-	<0.5	-	<0.005
22	225170	5	-	<5	-	100	-	<0.5	-	<0.005
23	225171	5	-	<5	-	50	-	<0.5	-	<0.005
24	225172	5	-	<5	-	20	-	<0.5	-	<0.005
25	225173	5	-	<5	-	60	-	<0.5	-	<0.005

Results in ppm unless otherwise specified

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

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TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au
1	225174	455	-	<5	-	305	-	<0.5	-	<0.005
2	225175	35	-	<5	-	155	-	<0.5	-	<0.005
3	225176	85	-	<5	-	105	-	<0.5	-	<0.005
4	225177	25	-	<5	-	155	-	<0.5	-	
5	225178	55	-	<5	-	130	-	<0.5	-	<0.005
6	225179	85	-	<5	-	110	-	<0.5	-	<0.005
7	225180	165	-	<5	-	80	-	<0.5	-	<0.005
8	225181	5	-	<5	-	155	-	0.5	-	<0.005
9	225182	25	-	<5	-	90	-	<0.5	-	<0.005
10	225183	125	-	60	-	125	-	5.0	-	
11	225184	65	-	<5	-	140	-	0.5	-	<0.005
12	225185	35	-	<5	-	90	-	<0.5	-	0.005
13	225186	15	-	<5	-	90	-	<0.5	-	<0.005
14	225187	-	1600	-	0.23	-	3500	-	28	
15	225188	40	-	<5	-	30	-	0.5	-	0.005
16	225189	595	-	<5	-	330	-	1.0	-	<0.005
17	225190	40	-	<5	-	40	-	<0.5	-	<0.005
18	225191	20	-	35	-	50	-	<0.5	-	<0.005
19	225192	35	-	275	-	65	-	0.5	-	<0.005
20	225193	225	-	255	-	115	-	2.0	-	<0.005
21	225194	85	-	515	-	380	-	<0.5	-	
22	225195	10	-	5	-	75	-	<0.5	-	<0.005
23	225196	30	-	<5	-	30	-	<0.5	-	<0.005
24	225197	15	-	<5	-	25	-	<0.5	-	<0.005
25	225198	10	-	<5	-	25	-	<0.5	-	<0.005

Results in ppm unless otherwise specified

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- = element not determined

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OFFICER*Scotty B. time*

597176

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

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TUBE No.	SAMPLE No.	Cu	Cu	Pb	Pb	Zn	Zn	Ag	Ag	Au
1	225199	20	-	<5	-	15	-	<0.5	-	<0.005
2	225200	10	-	50	-	290	-	<0.5	-	<0.005
3	225201	85	-	35	-	95	-	<0.5	-	<0.005
4	225202	20	-	10	-	60	-	<0.5	-	<0.005
5	225203	15	-	35	-	345	-	<0.5	-	<0.005
6	225204	45	-	35	-	180	-	<0.5	-	<0.005
7	225205	10	-	5	-	70	-	<0.5	-	<0.005
8	225206	40	-	25	-	200	-	<0.5	-	<0.005
9	225207	30	-	65	-	35	-	<0.5	-	<0.005
10	225208	10	-	45	-	155	-	<0.5	-	<0.005
11	225209	5	-	5	-	160	-	<0.5	-	<0.005
12	225210	15	-	15	-	115	-	<0.5	-	<0.005
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23	DETECTION	5	25	5	0.05	5	25	0.5	2	0.005
24	UNITS	PPM	PPM	PPM	%	PPM	PPM	PPM	PPM	PPM
25	METHOD	101	104	101	104	101	104	101	104	313

Results in ppm unless otherwise specified

T = element present; but concentration too low to measure

X = element concentration is below detection limit

-- = element not determined

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

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TUBE No.	SAMPLE No.	AuChk								
1	225087	-								
2	225088	-								
3	225089	-								
4	225090	-								
5	225091	-								
6	225092	-								
7	225093	-								
8	225094	-								
9	225095	<0.005								
10	225096	-								
11	225097	-								
12	225098	-								
13	225099	-								
14	225100	-								
15	225113	-								
16	225114	-								
17	225115	<0.005								
18	225116	-								
19	225117	-								
20	225118	-								
21	225119	<0.005								
22	225120	-								
23	225121	<0.005								
24	225122	-								
25	225123	-								

Results in ppm unless otherwise specified

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

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TUBE No.	SAMPLE No.	AuChk								
1	225124	-								
2	225125	-								
3	225126	-								
4	225127	-								
5	225128	-								
6	225129	-								
7	225130	-								
8	225131	-								
9	225132	-								
10	225133	-								
11	225134	-								
12	225135	-								
13	225136	<0.005								
14	225137	-								
15	225138	-								
16	225139	-								
17	225140	-								
18	225141	-								
19	225142	-								
20	225143	-								
21	225144	-								
22	225145	-								
23	225146	-								
24	225147	-								
25	225148	-								

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

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

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TUBE No.	SAMPLE No.	AuChk							
1	225149	-							
2	225150	-							
3	225151	-							
4	225152	-							
5	225153	-							
6	225154	-							
7	225155	-							
8	225156	-							
9	225157	-							
10	225158	-							
11	225159	-							
12	225160	-							
13	225161	-							
14	225162	-							
15	225163	-							
16	225164	-							
17	225165	-							
18	225166	-							
19	225167	<0.005							
20	225168	-							
21	225169	-							
22	225170	-							
23	225171	-							
24	225172	-							
25	225173	-							

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

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

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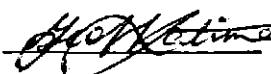
TUBE No.	SAMPLE No.	AuChk							
1	225174	-							
2	225175	<0.005							
3	225176	-							
4	225177	-							
5	225178	-							
6	225179	-							
7	225180	-							
8	225181	-							
9	225182	<0.005							
10	225183	3.680							
11	225184	-							
12	225185	-							
13	225186	-							
14	225187	5.070							
15	225188	-							
16	225189	-							
17	225190	-							
18	225191	-							
19	225192	<0.005							
20	225193	-							
21	225194	-							
22	225195	-							
23	225196	-							
24	225197	-							
25	225198	-							

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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TUBE No.	SAMPLE No.	AuChk								
1	225199	-								
2	225200	-								
3	225201	-								
4	225202	-								
5	225203	-								
6	225204	-								
7	225205	-								
8	225206	-								
9	225207	<0.005								
10	225208	-								
11	225209	<0.005								
12	225210	-								
13	225251									
14	225252									
15	225253									
16	225254									
17	225255									
18										
19										
20										
21										
22										
23	DETECTION	0.005								
24	UNITS	PPM								
25	METHOD	313								

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



597182

ANALABS

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

Phone (09) 458 7999

52 Murray Road, Welshpool, W.A. 6106

Telex AA92560

FAX: 004 31 8890

ANALYTICAL REPORT No. 999.59.08.05962

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

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Ketettering,
Tasmania 7155

ORDER No.	PROJECT
0002	Gowrie Park
DATE RECEIVED	RESULTS REQUIRED
24/01/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
4	08/02/89	1	97

STATE OF SAMPLES	REFER BELOW	SAMPLE NUMBERS	PRE-TREATMENT						ANALYSIS					
			DRY	CRUSH	SPLIT	PULVERISE	SEIVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD		
		225001/88	SS	Prep: 00,010,013,016								Cu, Pb, Zn, Ag/101, As/114		
		225001/88	SS									Au, AuChk/313		
		225087/97	SS	Prep: 00,007,016								Cu, Pb, Zn, Ag/101, As/114		
		225087/97	SS									Au, AuChk/309		

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Ketettering,
Tasmania. 7155

REMARKS

RESULTS

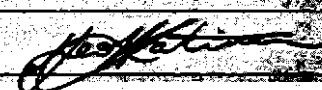
TO

RESULTS

TO

STATE OF SAMPLES	ANALYSIS — PREPARATION	ANALYSIS — METHOD
whole core WC	perchloric acid A1	atomic absorption AAS
split core SC	hydrochloric acid A2	x-ray fluorescence XRF
cutting CU	nitric acid A3	spectrophotometry SPEC
rock Ro	aqua regia A4	colorimetry COL
soil SO	nitric-perchloric A5	chromatography CHR
pulp PU	HF mixture A6	titration TIN
water WA	HF under pressure A7	other chemicals means CHEM
sludge SL	fusion A8	miscellaneous MISC
stream sediment SS		fluorescence FLUOR
heavy mineral HM		inductively coupled plasma ICP

AUTHORISED OFFICER



ANALABS

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

ANALYTICAL DATA

SAMPLE PREFIX REPORT NUMBER REPORT DATE CLIENT ORDER No. PAGE

999.59.08.05962

08/02/89

0002

1 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	As	Au	AuChk	Gold LINE	UNIT SOILS
1	225001	135	165	115	<0.5	19	<0.005	-		4900 N
2	225002	140	135	130	<0.5	19	<0.005	-		4875 N
3	225003	200	251	185	<0.5	27	<0.005	-		4850 N
4	225004	215	220	125	<0.5	25	0.005	-		4825 N
5	225005	50	75	55	<0.5	15	<0.005	-		4800 N
6	225006	545	390	135	1.5	46	0.005	-		4775 N
7	225007	45	65	65	<0.5	9	<0.005	-		4750 N
8	225008	25	65	145	<0.5	20	<0.005	-		4725 N
9	225009	15	35	60	<0.5	9	<0.005	-		4700 N
10	225010	75	215	185	0.5	15	<0.005	-	LINE 637E	4900 N
11	225011	95	195	175	<0.5	18	0.015	-		4875 N
12	225012	65	150	130	1.0	15	<0.005	-		4850 N
13	225013	245	345	220	0.5	17	0.005	-		4825 N
14	225014	175	425	355	<0.5	15	0.010	0.010		4800 N
15	225015	465	450	665	<0.5	20		0.040		4775 N
16	225016	1400	760	2450	2.5	15	0.010	-		4750 N
17	225017	620	360	650	1.0	14	<0.005	-		4725 N
18	225018	40	135	240	0.5	11	<0.005	-		4700 N
19	225019	10	55	145	1.0	7	<0.005	-		4675 N
20	225020	35	320	215	<0.5	34	<0.005	-		4650 N
21	225021	15	70	160	0.5	37	0.005	-		4625 N
22	225022	10	45	80	<0.5	11	<0.005	-		4600 N
23	225023	25	125	100	0.5	14	<0.005	-	LINE 633E	4900 N
24	225024	20	180	205	<0.5	14	<0.005	-		4875 N
25	225025	35	75	650	<0.5	24	<0.005	<0.005		4850 N

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

AUTHORISED OFFICER



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

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

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PAGE

		999.59.08.05962				08/02/89		0002		2 OF 4	
TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	As	Au	AuChk			
1	225026	50	340	1700	<0.5	46	<0.005	-	LINE 633E	4825N	
2	225027	75	165	180	<0.5	16	<0.005	-		4800N	
3	225028	115	305	390	<0.5	78	0.030	-		4775N	
4	225029	30	90	145	<0.5	19	<0.005	-		4750N	
5	225030	230	75	350	0.5	18		-		4725N	
6	225031	30	55	85	<0.5	14	<0.005	0.005		4700N	
7	225032	25	60	135	<0.5	23	<0.005	-		4675N	
8	225033	10	25	190	<0.5	13	<0.005	-		4650N	
9	225034	10	40	75	<0.5	10	<0.005	-		4625N	
10	225035	10	30	90	<0.5	20	<0.005	-		4600N	
11	225036	110	60	130	<0.5	19	<0.005	-	LINE 625/8E	4700N	
12	225037	235	215	180	<0.5	87	<0.005	-		4725N	
13	225038	95	75	140	<0.5	44	<0.005	-		4750N	
14	225039	210	90	125	0.5	41	<0.005	-		4775N	
15	225040	115	150	170	<0.5	90	0.010	-		4800N	
16	225041	105	235	140	<0.5	90	0.010	-		4825N	
17	225042	55	250	135	0.5	65	0.020	-		4850N	
18	225043	185	535	145	1.0	160	0.030	-		4875N	
19	225044	30	100	95	<0.5	110		0.035		4900N	
20	225045	30	55	90	<0.5	200		-		4925N	
21	225046	40	70	70	<0.5	420	0.005	0.005		4950N	
22	225047	15	15	55	<0.5	11	<0.005	-		4975N	
23	225048	10	5	35	<0.5	6	<0.005	<0.005		5000N	
24	225049	55	55	65	<0.5	16	<0.005	-	LINE 645E	4900N	
25	225050	190	100	100	<0.5	16	<0.005	-		4875N	

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

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

REPORT DATE

CLIENT ORDER No.

PAGE

999.59.08.05962

08/02/89

0002

3 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	As	Au	AuChk		
1	225051	160	110	70	<0.5	25	<0.005	-	LINE 645 E	4850N
2	225052	55	10	35	<0.5	8	<0.005	-		4825N
3	225053	280	15	40	<0.5	10	<0.005	-		4800N
4	225054	910	20	60	0.5	13	0.010	-		4775N
5	225055	130	10	25	0.5	4	<0.005	-		4750N
6	225056	120	10	35	<0.5	9	<0.005	-		4725N
7	225057	240	30	50	<0.5	9	<0.005	-		4700N
8	225058	30	25	55	<0.5	12	<0.005	-		4675N
9	225059	5	10	25	<0.5	6	<0.005	-		4650N
10	225060	75	70	40	<0.5	33	<0.005	-	LINE 648 E	4800N
11	225061	220	575	175	<0.5	11	0.010	-		4775N
12	225062	125	1150	715	3.0	25	0.010	-		4750N
13	225063	10	160	115	<0.5	7	<0.005	<0.005		4725N
14	225064	<5	40	20	<0.5	6	<0.005	-		4700N
15	225065	<5	5	35	<0.5	4	<0.005	-	LINE 623 E	5100N
16	225066	60	5	40	<0.5	6	<0.005	-		5075N
17	225067	30	20	50	<0.5	31	<0.005	-		5050N
18	225068	110	20	130	<0.5	8	0.005	-		5025N
19	225069	270	15	115	<0.5	16	0.015	0.010		5000N
20	225070	105	40	75	1.0	27		-		4975N
21	225071	175	25	95	<0.5	20	0.130	-		4950N
22	225072	35	5	70	<0.5	17	0.020	-		4925N
23	225073	105	10	110	<0.5	54	0.025	-		4900N
24	225074	65	230	160	<0.5	160		-		4875N
25	225075	340	60	175	0.5	36	0.015	-		4850N

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



185

597186

ANALABS

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

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

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CLIENT ORDER No.

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999.59.08.05962

08/02/89

0002

4 OF 4

TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	As	Au	AuChk		
1	225076	40	50	150	0.5	7	<0.005	<0.005	LINE 623 E	4825 N
2	225077	25	15	90	<0.5	7	<0.005	-		4800 N
3	225078	150	95	215	<0.5	60		-	LINE 622 E	4850 N
4	225079	90	10	240	0.5	15	0.010	-		4875 N
5	225080	50	15	120	0.5	8	0.010	-		4900 N
6	225081	85	15	115	0.5	9	0.010	-		4925 N
7	225082	245	30	140	<0.5	18	0.015	-		4950 N
8	225083	90	45	85	<0.5	48		-		4975 N
9	225084	135	15	95	<0.5	36		-		5000 N
10	225085	20	5	45	<0.5	9	<0.005	-		5025 N
11	225086	15	10	55	<0.5	6	<0.005	-		5050 N
12		20	20	370	<0.5	5	<0.005	<0.005	STREAM SEDIMENT	1
13		20	70	415	<0.5	13	<0.005	-		2
14		250	210	560	0.5	10	<0.005	-		3
15		20	40	325	<0.5	7	<0.005	-		4
16		45	25	130	<0.5	3		-		5
17		5	40	35	<0.5	3	<0.005	<0.005		6
18		<5	20	50	<0.5	3	<0.005	-		7
19		270	300	610	<0.5	11	<0.005	-		8
20		90	40	80	<0.5	7	<0.005	-		9
21		20	25	295	<0.5	5	<0.005	-		10
22		55	15	210	<0.5	10	0.005	-		11
23	DETECTION	5	5	5	0.5	1	0.005	0.005		
24	UNITS	PPM	PPM	PPM	PPM	PPM	PPM	PPM		
25	METHOD	101	101	101	101	114	313	313		

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


Our Reference: ES2898

Order:

ANALYTICAL REPORT ON SAMPLES SUBMITTED BY / ON BEHALF OF

NORANDA PTY LIMITED

PO BOX 433

NORTH SYDNEY NSW 2059

Attn: TOM O'DEA

Date Received 14.Apr.1989

Date Completed 26.Apr.1989

Number of Samples 3

Number of Repeats

Julie Gray
.....
Issued at Sydney on 26.Apr.1989

SGS Australia Pty Ltd
74 McEvoy Street
Alexandria, N.S.W. 2015
Telephone: (02)-699-7625
Telex: SGSSYD AA122395
Fax: (02)-698-3596

ANALYTICAL REPORT

137

Our Reference: ES2898

Order:

Analysis No/Sample Reference	Au ppm
1 GOSSANOUS GOG RG	0.23
2 ALTERED ACID VOL	0.21
3 GOSSANOUS MATER.	0.34
LD	0.01
Method Code	M5/FB
Preparation	P22

Our Reference: ES2898

Order: 597189

188

METHOD OF PREPARATION AND ANALYSIS USED

P22 Pulverising (Chrome steel mill ring grinder) -200 mesh
M5/FB 50 g Fire assay / AAS - flame or HGA

26. Apr. 1989

189

NORANDA PTY LIMITED

Dear Sir/Madam:

Ref: Attached Report ES2898

Please take a moment to advise us regarding the disposition of your samples by completing the following and returning to us.

Yours Faithfully

SGS Australia

SGS Australia Pty Ltd
PO BOX 163
REDFERN NSW 2016

Ref: ES2898

Order:

Tick one

- 1....Discard residues after three months, and pulps after one year.
- 2....Keep residues and pulps until further notice.
- 3....Return samples (now / after 3 months - delete one).
- 4....Other requirements or standing instructions.

Signed.....Date.....

For NORANDA PTY LIMITED

Note:

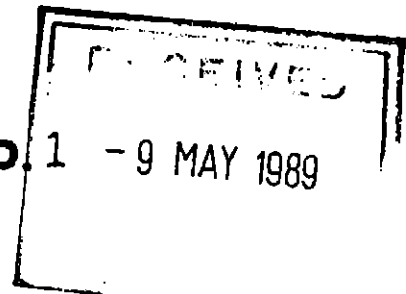
If this advise slip is not received within 3 months, residues will be stored at your expenses thereafter. Rate for storage is \$25.00 per cubic meter per month with a minimum monthly charge of \$25.00 .

Our Reference: ES2580

597191

Order:

RE-ISSUE No. 1 - 9 MAY 1989



ANALYTICAL REPORT ON SAMPLES SUBMITTED BY / ON BEHALF OF

NORANDA PTY LIMITED

PO BOX 433

NORTH SYDNEY NSW 2059

Attn: TOM ODEA

Date Received 29.Nov.1988

Date Completed 15.Dec.1988

Number of Samples 3

Number of Repeats

Sally Gray

.....
Issued at Sydney on 05.Jan.1989

SGS Australia Pty Ltd
74 McEvoy Street
Alexandria, N.S.W. 2015
Telephone: (02)-699-7625
Telex: SGSSYD AA122395
Fax: (02)-698-3596

Our Reference: ES2580

Order:

Analysis No/Sample Reference	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppm	Au ppb
1 ALTERED ACID VOL	85	630	57	0.8	0.20	230
2 GOSSANOUS MATER.	240	132	58	0.7	0.29	400
3 " " GOG RG	240	134	62	1.0	0.25	275

Method Code Preparation

AAS AAS AAS AAS AAS M5/FB



192

Our Reference: ES2580

Order:

METHOD OF PREPARATION AND ANALYSIS USED

AAS Atomic Absorption Spectrometry.

M5/FB 50 g Fire assay / AAS - flame or HGA

193

NORANDA PTY LIMITED

Dear Sir/Madam:

Ref: Attached Report ES2580

Please take a moment to advise us regarding the disposition of your samples by completing the following and returning to us.

Yours Faithfully

SGS Australia

SGS Australia Pty Ltd
P.O. Box 163
Redfern NSW 2016

Ref: ES2580

Order:

Tick one

- 1....Discard residues after three months, and pulps after one year.
- 2....Keep residues and pulps until further notice.
- 3....Return samples (now / after 3 months - delete one).
- 4....Other requirements or standing instructions.

Signed.....Date.....

For NORANDA PTY LIMITED

Note:

If this advise slip is not received within 3 months, residues will be stored at your expenses thereafter. Rate for storage is \$25.00 per cubic meter per month with a minimum monthly charge of \$25.00 .

ANALABS

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

Phone (09) 458 7999

52 Murray Road, Welshpool, W.A. 6106

FAX: 004 31 8890

Telex AA92560

ANALYTICAL REPORT No. 999.59.08.06125

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

Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Kettering.
Tasmania 7155

ORDER No.	PROJECT
0004	
DATE RECEIVED	RESULTS REQUIRED
11/04/89	ASAP

No. OF PAGES OF RESULTS	DATE REPORTED	No. OF COPIES	TOTAL No. OF SAMPLES
2	27/04/89	1	43

STATE OF SAMPLES	REFER BELOW	SAMPLE NUMBERS	PRE-TREATMENT						ANALYSIS				
			DRY	CRUSH	SPLIT	PUL-VERISE	SIEVE	OTHER SEE REMARKS	NONE	REFER TO ANALYSIS SECTION	PREPARATION	METHOD	
Various			RD	Prep: 006,010,011,012,013,016							Cu, Pb, Zn, Ag/101		
Various			RD								As/401		
Various			RD								Au, AuChk/313		
Various			RD								As/404		

RESULTS TO
Mr. P. Jones
Noranda Pty., Ltd.,
Saddle Road,
Kettering.
Tasmania 7155

RESULTS TO

REMARKS

STATE OF SAMPLES	ANALYSIS — PREPARATION	ANALYSIS — METHOD
whole core WC	perchloric acid A1	atomic absorption AAS
split core SC	hydrochloric acid A2	x-ray fluorescence XRF
cutting CU	nitric acid A3	spectrophotometry SPEC
rock Ro	aqua regia A4	colorimetry COL
soil SO	nitric-perchloric A5	chromatography CHR
pulp PU	HF mixture A6	titration TTN
water WA	HF under pressure A7	other chemicals means CHEM
tissue TI	fusion A8	miscellaneous MISC
stream sediment SS		fluorescence FLUOR
heavy mineral HM		inductively coupled plasma ICP

AUTHORISED OFFICER

ANALABS

A Division of Macdonald Hamilton & Co. Pty Ltd.

ANALYTICAL DATA

SAMPLE PREFIX

REPORT NUMBER

REPORT DATE

CLIENT ORDER No

PAGE

GOG RANGE
SOILS

999.59.08.06125

27/04/89

0004

1 OF 2

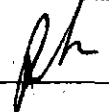
TUBE No.	SAMPLE No.	Cu	Pb	Zn	Ag	As	As	Au	AuChk	
1	225211	315	20	75	<0.5	9	-	0.010	25 E	4800 N
2	225212	475	50	85	0.5	20	-	0.010	0.010	4825 N
3	225213	510	75	160	1.0	24	-	0.010	-	4850 N
4	225214	80	130	110	0.5	17	-	<0.005	-	4875 N
5	225215	55	270	215	<0.5	212	-	0.245	-	4900 N
6	225216	145	320	200	4.0	648	-	4.450	-	4925 N
7	225217a	55	185	135	1.0	669	-	0.225	rock chip	4950 N
8	225217b	260	945	300	4.5	540	-	0.700	soil -	"
9	225218	170	400	575	4.0	777	-	0.425	rock chip 0.420	4975 N
10	225219	1400	2200	650	14.0	-	1.36	5.500	rock chip 24 E -	4935 N
11	225220	3350	2700	2400	11.5	-	1.68	5.060	" -	"
12	225269	5	5	30	<0.5	12	-	0.010	21 E -	4800 N
13	225270	5	<5	20	<0.5	12	-	<0.005	-	4825 N
14	225271	140	15	175	<0.5	11	-	0.030	-	4850 N
15	225272	140	55	255	<0.5	20	-	0.030	-	4875 N
16	225273	310	65	195	<0.5	63	-	0.095	-	4900 N
17	225274	85	20	90	<0.5	34	-	0.055	-	4925 N
18	225275	100	25	80	<0.5	19	-	0.040	-	4950 N
19	225276	30	<5	70	<0.5	<2	-	<0.005	-	4975 N
20	225277	15	<5	65	<0.5	<2	-	<0.005	-	5000 N
21	225278	20	<5	75	<0.5	<2	-	0.010	-	5025 N
22	225279	15	<5	80	<0.5	<2	-	<0.005	-	5050 N
23	225280	<5	<5	15	<0.5	3	-	<0.003	20 E <0.005	4850 N
24	225281	<5	5	20	<0.5	5	-	<0.005	-	4875 N
25	225282	110	20	165	<0.5	7	-	0.025	-	4900 N

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 Macdonald-Hamilton & Co. Pty. Ltd.

ANALYTICAL DATA

SAMPLE PREFIX REPORT NUMBER REPORT DATE CLIENT ORDER No. PAGE

999.59.08.06125

27/04/89

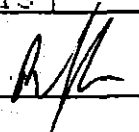
0004

2 OF 2

TUBE No	SAMPLE No.	Cu	Pb	Zn	Ag	As	As	Au	AuChk	
1	225283	125	30	180	<0.5	28	-	0.160	20E-	4925N
2	225284	10	5	60	<0.5	3	-	<0.005	-	4950N
3	225285	30	5	75	<0.5	6	-	<0.005	-	4975N
4	225286	25	<5	80	<0.5	2	-	<0.005	-	5000N
5	225287	15	<5	75	<0.5	<2	-	<0.005	-	5025N
6	225288	15	10	75	<0.5	2	-	<0.005	-	5050N
7	225289	45	10	100	<0.5	2	-	<0.005	24E-	4800N
8	225290	140	25	130	<0.5	<2	-	<0.005	-	4825N
9	225291	420	70	245	0.5	9	-	<0.005	-	4850N
10	225292	175	305	250	0.5	162	-	0.200	-	4875N
11	225293	135	35	425	<0.5	231	-	0.145	-	4900N
12	225294	55	65	360	1.0	360	-	1.450	-	4925N
13	225295	20	45	160	<0.5	137	-	1.650	-	4950N
14	225296	60	20	100	<0.5	16	-	0.005	-	4975N
15	225297	150	25	110	<0.5	33	-	0.005	0.010	5000N
16	225298	40	30	105	<0.5	15	-	0.005	25E 0.005	5000N
17	225299	25	70	75	<0.5	12	-	<0.005	-	5025N
18	225300	5	5	35	<0.5	<2	-	<0.005	-	5050N
19										
20										
21										
22										
23	DETECTION	5	5	5	0.5	2	0.01	0.005	0.005	
24	UNITS	PPM	PPM	PPM	PPM	PPM	%	PPM	PPM	
25	METHOD	101	101	101	101	401	404	313	313	

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 6

Geophysical Summary of CRAE Data

P. Zarzavatjian

**AN APPRAISAL OF PAST GEOPHYSICAL
SURVEYS IN CETHANA EL (10/76)
AND IN PARTS OF SHEFFIELD EL (7/73)
TASMANIA**

PAPKEN A. ZARZAVATJIAN

JANUARY - FEBRUARY, 1989

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INTRODUCTION

This report is an appraisal of past geophysical surveys conducted over certain areas within two exploration licences relinquished recently by CRA Exploration Proprietary Limited. The areas discussed in this report are included at present within EL 10/88 owned by Noranda Proprietary Limited.

My appraisal is based on CRAE reports and plans forwarded to me by Phil Jones & Associates, Saddle Road, Kettering, Tasmania.

In my appraisal I have followed chronologically the various stages of exploration activity in each area. This approach involved the review of several reports in cases where work in an area continued for periods longer than that covered by a single report. In such instances, the need frequently arose in the text of my report to refer to various CRAE reports for one reason or another. In order to facilitate reference to these reports in my text, I have assigned reference numbers to CRAE's reports. These numbers appear in red at the top right hand corner of the cover page. Instead of referring to the lengthy title of CRAE's report which might become cumbersome through repetition, I have instead quoted the reference number. For the sake of the record, I have listed below CRAE's reports and their corresponding reference numbers.

<u>Report</u>	<u>Reference No:</u>
EL's 7/73 and 10/76 Exploration at Western Cethana - August 1976-1977	5
Exploration at East Cethana EL 10/76 Sept.1977 - Sept.1979	1

<u>Report</u>	<u>Reference No:</u>
Exploration at Western Cethana Report No.2 Aug.1977 - Nov.1979 - EL's 7/73 and 10/76	6
Exploration of Cethana EL 10/76 - 1981-1982	2
EL 10/76 Cethana Area - Report on Exploration for 12 months to 28 Feb.1985	3
EL 10/76 Cethana - Report on Exploration for 12 months to Feb.1987	7
EL 10/76 Cethana - Relinquishment Report Incorporating Exploration for period Feb.1987 to Feb.1988	4
Exploration at Lake Barrington Copper Prospect Sheffield EL 7/73:- July 1979 - March 1981	8
Exploration at Lake Barrington Copper Prospect Sheffield EL 7/73:- May 1981 - Dec.1982	9
Exploration at Lake Barrington Copper Prospect Sheffield EL 7/73 for period ending Dec.1983	10
Initial Exploration on Staverton Prospect EL 7/73 - 18 Feb.1978	11

<u>Report</u>	<u>Reference No.</u>
EL 7/73, Sheffield - Report on Exploration during 1982	12
Memorandum: Electromagnetic Surveys on Beulah Baryte and Staverton Prospects, Sheffield EL 7/73	18
Exploration Results, Beulah, Staverton, Gog Range and Ireland Prospects - Sheffield 7/73, Tasmania, Report for the 12 months ending 15 Feb. 1984	13
Sheffield EL 7/73 - Electromagnetic Surveys in Sheffield area EL (7/73) in Tasmania during 1985	17
EL 7/73 Sheffield area - Report on Exploration for 12 months to 15 Feb. 1985	14
EL 7/73 Sheffield Area - Report on Exploration for 12 months to Feb. 1986	15
EL 7/73 Sheffield Area - Report on Exploration for 12 months to Feb. 1987.	16
Dighem II Surveys in Sheffield Area, Tasmania for CRA Exploration Pty Ltd. by Dighem Ltd - 16 July 1981	19
Phase I Induced Polarization Surveys - Cethana EL 10/76 1976-1977.	20

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<u>Report</u>	<u>Reference No.</u>
A Report on Gradient Array Electrical Induced Polarization, MMR, and Total Magnetic Field Surveys over East Cethana Grid, August 1977	21
Brief comments on a Gradient EIP Survey over the Staverton Grid - October 1977	22

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CONCLUSIONS AND RECOMMENDATIONS

CETHANA WEST GRID

The most promising areas on this grid are:

1. Southern ends of lines 500E to 900E inclusive, where a partly recorded chargeability anomaly requires detailing by induced polarization and electromagnetic methods. The UTEM survey on this grid in 1984 stopped short of covering it.
2. Line 300E, 200N-220N, contains moderately high geochemical soil assays coincident with a weak UTEM anomaly and a change in the level of background chargeability values.
3. Southern ends of lines 1000E-12000E inclusive show close association, between high chargeability and high soil assay values. IP detailing and a more complete electromagnetic survey coverage will, most likely, prove useful.

CETHANA EAST GRID

1. Induced polarization targets have not been tested satisfactorily between lines 21600E and 21800E.
2. A method should be found to correlate UTEM survey results with those from the VLF-EM and induced polarization surveys.

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3. The following areas should be checked to ensure that the recorded chargeability responses can be satisfactorily explained by cultural features noted in their proximities:-
 1. Line 20800E, close to 3200S
 2. Line 19800E, near 2970S and 3300S.

4. In the following areas chargeability highs coincide directly with resistivity lows and require detailing because they present good targets to explore for sulphide mineralization.
 1. Line 20200E, 3400S-3500S
 2. Line 20400E, 3500S
 3. Line 21000E, 3700S-3800S

LAKE BARRINGTON COPPER PROSPECT

1. Induced polarization, mise-a-la-masse and self-potential surveys combine to produce a viable target that has not been satisfactorily tested.

2. It would be very useful if the missing 50 metres spread IP pseudo-section for line 4600E can be located. It would then be possible to correlate chargeability values with sulphides intersected at depth in hole DD80LB2.

STAVERTON PROSPECT

1. In the case of drill hole PD83SP1, the influence of steep topography on the choice of the most promising drill intersection within an IP target

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needs to be investigated before a satisfactory decision can be made as to whether the IP target on line 600E has been properly tested.

2. Exploratory drilling should be undertaken away from hole PD83SP1 along the strike of the induced polarization anomaly zone.

GOG RANGE PROSPECTS

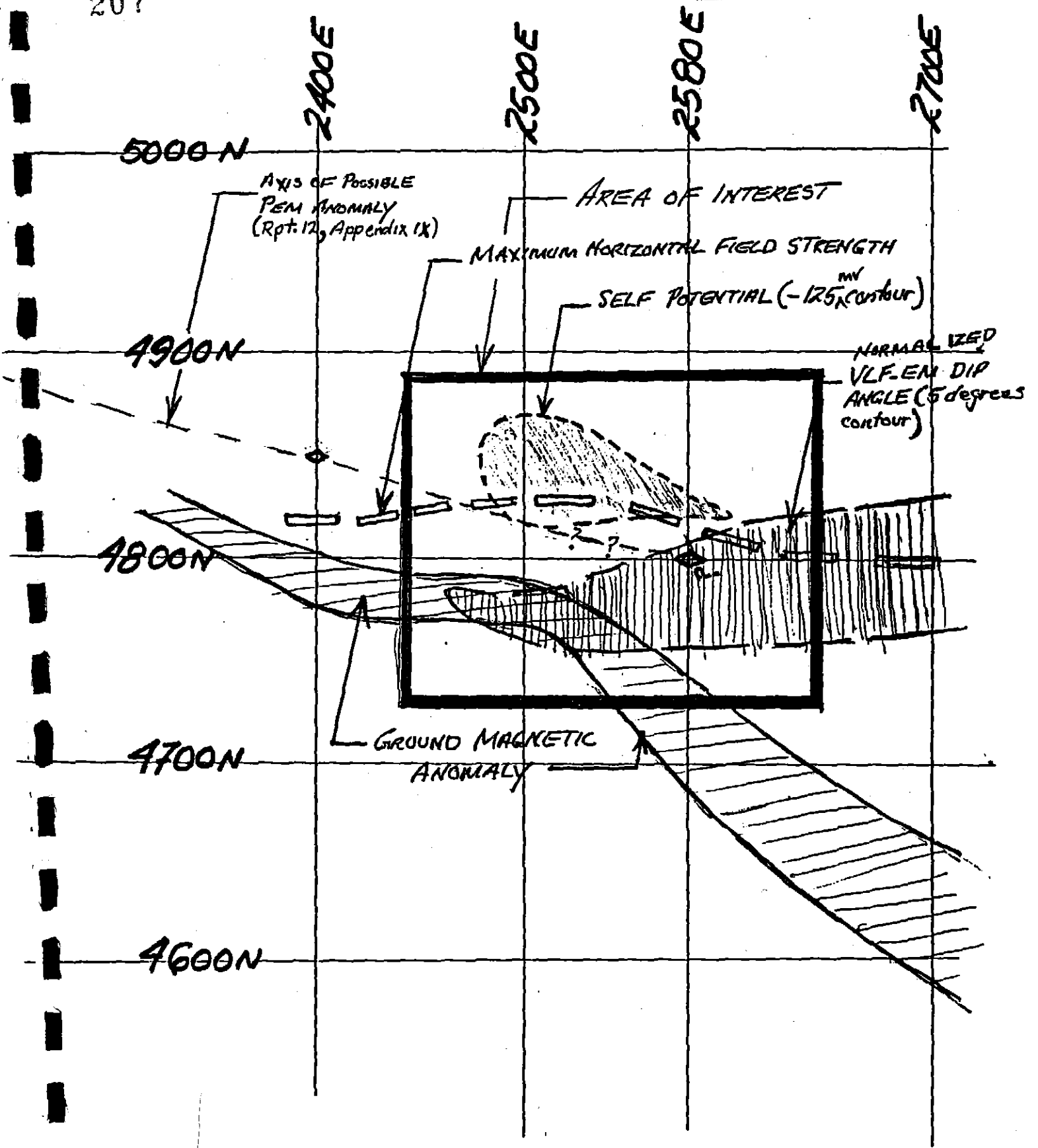
The points outlined below refer primarily to Gog Range West (geochemical anomaly 4):-

1. Apart from VLF-EM, only small sections of selected grid lines were covered by the pulse electromagnetic (PEM) system using the separated loop geometry.

If the geological environment is still thought to be favourable for the occurrence of massive sulphide deposits, consideration should be given in the future towards covering the entire grid (including areas away from geochemical anomaly 4) with transient electromagnetic surveys.

2. Area outlined on the diagram on Page 8 contains several anomalous or near anomalous parameters which require closer investigation.
3. The contouring of magnetic survey results is not up to standard and in view of the recommendation made in item 2 above, it might require re-contouring.

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GOG RANGE WEST
 TASMANIA
 Scale 1:2500

This diagram forms a part
 of a report (171)

PROMISED LAND PROSPECT

The following areas require further field appraisal:

1. Southern ends of lines 4400E, 4500E and 4600E where a weak VLF-EM trend occurs in the vicinity of high geochemical soil values.

2. Line 4300E at 5025N where a partly recorded VLF-EM anomaly coincides with the peak of a 7200nT magnetic anomaly.

GROUND FOLLOW-UP OF DIGHEM ANOMALIES

It would be prudent to conduct a limited amount of work to confirm the status of several anomalies classified at present under low to very low order of priorities.

GENERAL

- a) If future exploration programmes are to include induced polarization surveys, I recommend that the dipole-dipole geometry be employed so that there will be depth information regarding anomaly sources.

- b) If future drill targets are to include results of induced polarization surveys, care should be exercised so as not to overlook the effect of steep topography on the zone where the hole is likely to intersect the target at depth.

CETHANA WEST GRID

This Grid forms the southwest section of three contiguous grids extending roughly in a west-northwesterly direction. The other two grids are named Cethana East Grid and Gowrie Park Grid, the latter being the easternmost extension. Gowrie Park Grid is situated outside Noranda's present EL 10/88 (Part 1) boundary. Locations of these grids in relation to CRAE's Cethana and Sheffield EL's are best illustrated on plan TASH 2661 which accompanies Report 17.

REPORT 20 (Phase 1, Induced Polarization Surveys 1976-1977)

1. This report discusses results of IP surveys conducted by CRAE staff over Cethana West and Cethana East Grids. Results of the Cethana West Grid are given as profiles on plan TC56 and as chargeability (plan TC63) and resistivity (plan TC64) contours.

The salient results of this survey are also shown on the "Geophysical and Geochemical Anomaly Compilation" plan TASH 2925 (Report 4). Correlation of the compiled data with those presented on plans of Report 20 shows that there is little evidence for two high chargeability trends shown to coincide with the UTEM anomalies on the compilation plan. Both trends are marked in the northern half of the Grid, one trending over lines 100E to 300E and the second over lines 400E to 600E. I have noted the dubious nature of these trends on the compilation plan.

2. Perhaps the best IP feature on the Grid is shown on plan TC63 and is outlined by the 15 millisecond contour closure located at the southern ends of lines 700E and 800E. This anomaly can be seen on the profiles

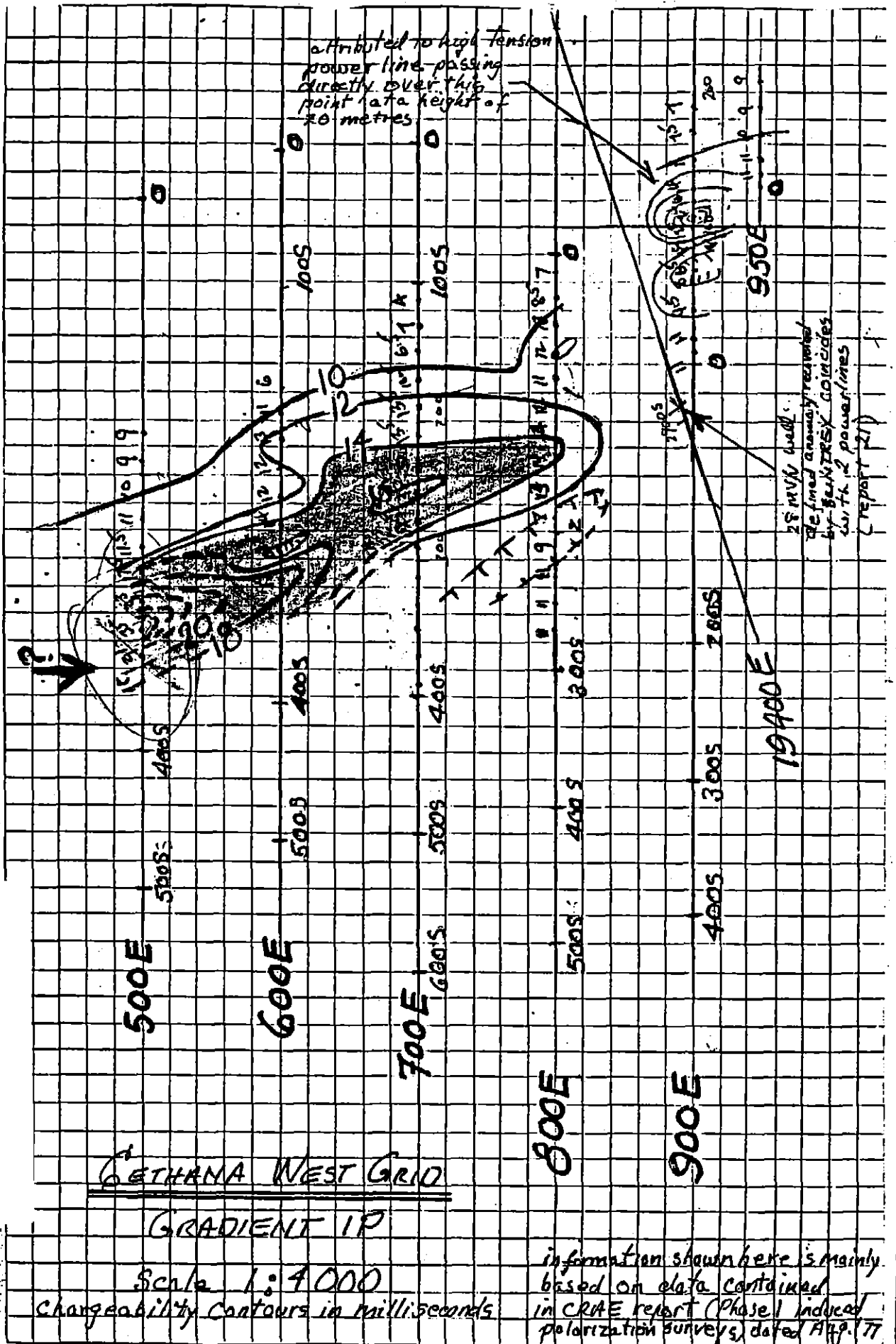
(plan TC56) as a weak to medium amplitude response and appears to continue further west than its portrayed limit on the contour plan. Its westerly extension is only partly recorded on line 600E. At the southernmost limit of line 500E several discrete values are plotted, but not joined by a continuous line to the chargeability profile. Thus there can be some doubt as to whether these "unattached" values form part of the chargeability profile. I have taken the liberty of assuming that this is the case and have prepared a sketch-like diagram (see page 12) at a scale of 1:4000 showing my version of the chargeability anomaly and its westward extension.

Rock types in the area of this chargeability anomaly are mapped (plan TC85, Report 5) as moderately to highly altered acid volcanics consisting of chlorite schists, quartz-sericite schists and siliceous quartz-sericite schists.

The chargeability anomaly partly coincides with a soil geochemical anomaly defined on the compilation plan as an area where lead to copper ratio is 30 to 1 according to CRAE. I have traced this anomaly on the chargeability plan TC63 to illustrate the very close relationship between the two parameters. Individual assay values are given in Appendix 4 of Report 5. Within the area of interest, both lead and copper values are moderately high, but are not consistently so. Also, high assays are by no means confined to the chargeability anomaly in question. Nevertheless, an area of moderately to highly altered acid volcanic rocks where a moderate chargeability anomaly coincides with above background geochemical soil assays should constitute a valid target for future exploration.

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5 cm



This diagram forms a part of a report by P.A. KARZAVATIAN

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3. Another area worth checking occurs at the southern ends of lines 1000E to 1200E where there is a rather close association between high chargeability values of 20 to 25 mv/v and anomalous lead and zinc soil assays.
4. The 20 millisecond bulls-eye anomaly at 900E/110N is attributed to a high tension power line passing directly over this point at a height of 20 metres (Page 2, Report 6)
5. Holes DD77CC1 to DD77CC3 were drilled to test geochemical anomalies (Page 1, Report 20). Downhole resistivity/chargeability surveys in holes DD77CC2 and DD77CC3 give background resistivities of the order of several hundred, perhaps close to 1000 ohm-metres and background chargeabilities less than 12 milliseconds.

It must be understood that the discussion and the conclusions reached in section 3.1.4 in Report 20 on Page 3, are largely qualitative and are related to pyrite. It would be difficult indeed to relate these figures to mineral assemblages of economic sulphides.

6. Selected core specimens from holes DD77CC1 to DD77CC3 were measured for their chargeabilities, resistivities and magnetic susceptibilities. The measurements also included core from holes in Cethana East. My comments regarding these measurements appear on Page 21 under my discussion of Cethana East Grid.

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7. Finally, I would like to draw attention to the following points:
- a) If future exploration programmes are to include induced polarization surveys, I recommend that the dipole-dipole geometry be employed so that there will be depth information regarding anomaly sources.
 - b) If future drill targets are to include results of induced polarization surveys, care should be exercised so as not to overlook the effect of steep topography on the zone where the hole is likely to intersect the target at depth.

REPORT 6 (Exploration at Western Cethana, Report No.2, August-November 1979)

In November 1977 a three line IP gradient survey was completed over lines 800E, 850E and 900E designed to investigate extensions to mineralization intersected in drillhole DD77CC1 (Page 2). Plots of the results are included with the report. Those sections of lines 800E and 900E covered by this survey must be regarded as a re-survey since they were already covered by the survey already discussed in Report 20.

I have traced bole DD77CC1 on the chargeability-resistivity profile for line 850E. Unfortunately the gradient-type survey does not provide depth information and it is therefore difficult to confirm whether the hole has actually intersected the subsurface anomalous zone(s) that cause chargeabilities to rise from about 6 to 13 mv/v in its vicinity.

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In August 1979, the IP survey over line 900E was extended north to investigate the contact between highly altered acid volcanics and unaltered dacitic tuffs. The dipole-dipole geometry was used for the survey. Plot of the results is included with the report and is only partly legible. It shows the presence of a weak chargeability anomaly centred at 440N. Position of the contact to be investigated is not mentioned in the report, but it states that the results were negative (page 2).

REPORT 3 (Exploration for 12 months to 26/2/1985)

1. Surface Electromagnetic Surveys)

The UTEM coverage of Cethana West Grid forms part of a major survey encompassing Cethana East and Gowrie park Grids as well. Plots of all the results are available for appraisal and a general discussion can be found in Appendix 1 of Report 3.

I have examined the UTEM profiles and categorized the anomalies qualitatively in terms of their strengths and depths to their sources. My markings appear on plans TASH 1732 and TASH 1733. CRAE has indicated on these plans the positions of the UTEM anomalies by plotting the latest channel number (in the UTEM System 9 is the earliest channel and 1 the latest) which has registered the presence of the anomaly. My classification of anomaly source depths is "very shallow" (0-20 metres); "shallow" (20-60 metres); "moderate" (60-150 metres). Nearly all the marked anomalies fall in the "very shallow" to "shallow" and "very weak" to "weak" (with perhaps a couple of exceptions) classification.

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CRAE-defined anomalies which I have not classified on above plans appear to me as too insignificant to be included in the interpretation.

Some difficulty was encountered in relating the results of the UTEM survey with those from other surveys because the "northings" used to identify UTEM survey stations are different from those used to present the results of previous work. As a final measure, I decided that the position of "road" marked on nearly all survey plots to be a reliable reference to use for scaling distances to within 10-15 metres. Positions of UTEM anomalies that I have marked on chargeability plan TC56 (Report 20) have been scaled in this manner.

I suspect that the majority of the defined anomalies represent "geological noise" originating in the overburden and weathered rocks. I have outlined below the salient features of the survey results:-

1. On line 300E at 200-220N a UTEM anomaly coincides with above background level soil geochemical values and also a change in chargeability background values from about 10 milliseconds to over 20 milliseconds.
2. The UTEM anomaly on line 600E which was tested by drill hole PD84CC9 is not associated with anomalous chargeability values.
3. The southern limit of the UTEM survey coverage comes very close, but does not include the chargeability anomaly discussed in item 2 under Report 20. I have marked the southern limits of the UTEM survey for lines 500E, 600E and 700E on plan TC56 included with Report 20.

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4. The area of line 1200E contains several UTEM and chargeability anomalies as well as high geochemical soil values that coincide or partly overlap the UTEM and IP anomalies.

Lines on either side of 1200E were either not covered (Line 1100E) by the UTEM survey, or only partly covered (Line 1300E). Hence we cannot at this point in time define any possible electromagnetic anomaly trends in the same manner as for the IP survey.

5. The most definite UTEM anomaly recorded over Cethana West Grid is the one located over line 600E and its weaker eastward extension on line 700E. The anomaly on line 600E was tested by hole PD84CC9. It intersected pyrite ranging from 7% to 15% in chloritic phyllites at depths from 72 to 96 metres.

A downhole electromagnetic survey was conducted in this hole and the results are discussed below.

The anomaly on line 700E was drilled at a later date and the results are discussed in Report 7 on the following pages.

2. Downhole Geophysics

Part of Appendix 3 discusses downhole electromagnetic survey in hole PD84CC9 conducted with the EM-37 system. Plots of survey results are also included in Appendix 3. Although the hole had caved at 89 metres, it was still expected to give responses from depths in excess of 70 metres

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because it had intersected pyrite mineralization ranging between 7% and 15% at a depth from 72 to 96 metres. All the loops positioned around the hole in fact gave negative results. CRAE concluded on Page 2 of Appendix 3 that the surface "... anomalies might actually have been due to shallow responses which were complicated by current channelling and intermittent layers of conductive material on the surface".

Elsewhere in Report 3 it states (page 7) "the failure to detect conductors downhole in PD84CC9 where massive sulphides were intersected suggests that problems either may have existed with the EM-37 machine, or that the EM-37 system is not as capable as the UTEM system in detecting subtle anomalies".

Assuming that the EM-37 system used for the survey was in good operational condition and the operator a trained experienced technician, my suggestion is to:-

- Percussion hole
1. Re-log the core from 72 to 96 metres to confirm the presence of pyrite in volumes logged initially.
 2. Carry out conductivity measurements on the pyrite-bearing core. It has come to my attention in the past that it is possible for pyrite sometimes to be non-conductive.
 3. Re-survey the hole, if it is still open, using a different electromagnetic system.

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4. If the presence of conductive pyrite in volumes up to 15% is satisfactorily established from the first two points above, but results are still negative from point 3, we have no choice but to venture into the unknown and to accept, provisionally, the conclusion given in CRAE's Appendix 3 which I have quoted above.

REPORT 7 (Exploration for 12 months to February 1987)

1. Drilling

The UTEM anomaly on line 700E (115S) was also tested with hole DD86CC11 which was abandoned at a depth of 77 metres and replaced with hole DD86CC12, completed to a depth of 190.0 metres. Drill logs show 1-3% pyrite disseminated throughout the core. No economic sulphide mineralization of any significance was observed, the only exception being 4.3 metres of 0.3% combined lead-zinc intersected between 69.0 and 73.3 metres.

2. Downhole Geophysics

Downhole electromagnetic surveys in holes DD86CC12 and DD86CC13 (the latter was targeted at a geochemical anomaly) were abandoned because of noise problems associated with nearby high tension power lines.

CETHANA EAST GRID

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REPORT 5 (August 1976-1977)

At the bottom of Page 3 and on Page 6, the report refers to induced polarization survey(s) completed over "Western Cethana". It is not clear whether this term refers to "Cethana West Grid" as separate from "Cethana East Grid" or includes the entire area which, in the early exploration stages comprised both grids.

Two IP interpretation reports (numbers 20 & 21) both dated August 1977 are discussed below:

REPORT 20 (Phase 1 induced polarization surveys)

This report discusses gradient surveys conducted by CRAE staff over Cethana West and Cethana East Grids.

Results of Cethana East Survey are shown as profiles on plans TC65 and TC55. Anomalies of interest occur on:

1. Line 21400E, at 3600S and 3700S.
2. Lines 21700E-22000E, between 3550S and 3800S.

Two diamond drill holes, 77CC4 and 77CC5 were drilled to test major chargeability targets on line 21750E. Pyrite is pervasive in both holes ranging mostly between 1% and 5%, increasing in places up to 10%-15% (hole 77CC4, 60 to 62 metres). Hole 77CC4 did not intersect any significant economic sulphide mineralization, but hole 77CC5 did in three different sections. Assays and

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positions of these intersections are illustrated on Plan 52 included with Report 1 (to be discussed later).

Downhole resistivity and chargeability measurements were taken in hole 77CC4 (plan TC68). Also, selected core specimens from both holes 77CC4 and 77CC5 were measured for their chargeabilities, resistivities and magnetic susceptibilities.

The results of core measurements are tabulated in Appendix 1. At the start, the statement is made that magnetic susceptibilities of all samples, with rare exceptions, were below the detection limit (1×10^{-3} units) of the instrument used (CTU-2 core tester) to conduct the tests. I am under the impression that the instrument is capable of measuring susceptibilities lower than the limit noted above. This point needs to be confirmed if magnetics in the future proves to be a viable method in the search for ore.

Chargeability core measurements illustrate in general terms the direct relationship between the sulphide volumes and the high background chargeability values. Results of resistivity measurements lead one to conclude that sulphides up to 5% have no discernible effect on resistivity values. Apparently sulphides of the order of 10% are required before resistivities register deviations from the norm. This observation is made taking into consideration all core measurements listed in Appendix 1 which also includes cores from drill holes in Cethana West.

REPORT 21 (Gradient array EIP, MMR and magnetic surveys)

Scientrex Pty Ltd was contracted to conduct above surveys over Cethana East Grid. Plots of all survey results are available.

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1. Magnetometric Resistivity (MMR) Survey over eight lines from 21400E to 22200E line were completed. No anomalous patterns of any note were recorded by the survey.

2. A gradient induced polarization survey was completed over the entire grid. This survey largely duplicated results of similar survey discussed in Report 20 above. The main difference between the two surveys is that an IPR-7 receiver was used for the former and an IPR-8 receiver for the latter. IPR-8 is more versatile and permits the recording of several chargeability slices, whereas IPR-7 records only one slice. The recording of several slices makes it possible to generate more information at any station occupied during the survey. Hence, in Scintrex's survey we are presented with five profiles for each line instead of two as in the survey of Report 20. Unfortunately, the extra data generated by the second survey does not seem to have added any more meaningful information than what was obtained in the first survey.

Results of the induced polarization survey are presented in profile form and as plan contours. There are two contour plans, one for the chargeability and another for the resistivity values.

Before I discuss the results of the IP survey, I would like to draw attention to the fact that some grid lines in Cethana East are actually 150 to 180 metres apart instead of the expected 100 metres as implied by the grid numbering system.

On the chargeability contour plan I have coloured the major trends in order to achieve better definition of the displayed patterns. The

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resulting picture clearly defines areas of most interest so far as high chargeabilities are concerned. The zone of interest consists of a 200 metre wide belt located towards the southern half of lines 21400E to 22100E and contains several closures that register 35 mv/v and over against a 10 mv/v background. This belt continues further east, apparently beyond the survey area, in a less coherent form and with diminished intensity.

A total of five drill holes were completed over two lines within this chargeability zone. Three holes, 77CC4, 77CC5 and 77CC8 were drilled on line 21750E and two holes 77CC6 and 77CC7 on line 21600E. Brief comments regarding the drilling results of 77CC4 and 77CC5 were made above under the discussion of Report 20. Comments regarding the remaining three holes will be made later when Report 1 is discussed below.

Other localities of high chargeabilities occur on line 20800E, close the 3200S and on line 19800E near 2970S and 3300S. All these localities contain cultural features in the form of powerlines and/or wires (see profile plots), thus raising doubt as to the validity of the recorded anomalies. Any future exploration work involving electrical methods in these localities must record the presence of such cultural features so that spurious survey results can be accounted for.

Other localities worth further investigation are:

1. Line 20200E, 3400S-3500S
2. Line 20400E, 3500S
3. Line 21000E, 3700S-3800S

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In these areas chargeability highs coincide directly with resistivity lows and present good targets to explore for sulphide mineralization.

It should be stated here that any future work involving induced polarization surveys in the Cethana East area should be conducted at 100 metres maximum line spacing.

3. Magnetic survey results are presented both as profiles and as contours. According to the profiles no significant anomalies are present in the grid area. None of the chargeability anomalies noted above have coincident magnetic signatures that can be convincingly attributed to the same source. In spite of lack of meaningful responses in the survey area, it would still be worthwhile in the initial stages of any exploration programme that magnetic surveys be performed on an experimental basis over localities selected for detailed investigation. Such surveys can be discontinued if initial results consistently show lack of useful information. A 50 metres line spacing would be the ideal specification for this type of survey.

REPORT 1 (Sept.1977-Sept.1979)

According to this report holes 77CC6 and 77CC7 were targeted to test gradient IP anomalies (Page 2). The report also notes that hole 78CC8 was sited to investigate deeper extensions of mineralization encountered in hole 77CC5. As mentioned earlier, holes 77CC4 and 77CC5 were targeted on IP gradient anomalies (Report 20, Page 3)

Assay results show all holes, apart from hole 77CC4, to have intersected anomalous base metal values that are not high enough to be of economic significance. Pyrite is pervasive throughout including hole 77CC4 which was

224 drilled on the same section (Plan TC 52) as holes 77CC5 and 77CC8. Generally, it ranges between 1% and 2%; in places it increases up to 10%-15%.

Appendix III discusses six lines of dipole-dipole IP survey completed after above holes were drilled. The purpose of the survey was to clarify and to confirm results of the previous IP survey. In general, this discussion is satisfactory. However, I would like to add the following comments:-

1. Anomaly A can be easily traced westward from line 21800E to 21600E. It is not present on pseudo-section 21500E presumably because the survey did not extend far enough south over this line to record its presence. However, I feel its presence here should not be assumed, but must be confirmed by actually performing the IP survey.

Anomaly A is very broad. On line 21800E I suspect only its top part is recorded. Along its strike westward it becomes shallower. On lines 21750E-21600E it is evident that only a part of it has been mapped. The source of anomaly A may well be a poorly defined polarizable body that is of limited depth extent. Given the incomplete picture presented by available information, it is difficult to comment reliably on its position. However, for the sake of the present exercise, one might infer its northern edge to be very close to 160S on line 21750E and 3760S-3780S on line 21600E. On both lines, as well as line 21700E, the source extends southward beyond the limits of the recorded survey.

On pseudo-sections 21750E and 21600E, I have traced all the holes drilled on Cethana East Grid. On the basis of above discussion, it is evident that both holes 77CC4 and 77CC7 have not tested the chargeable

source proper, but have intersected proximal mineralization only, which consists of sub-economic base metals and pyrite.

If, for any reason, the area of anomaly A becomes of interest in the future, it is recommended that a new IP survey be conducted to record clearly the extent of anomaly A instead of using the presently available data for any planned drilling.

2. Anomaly B, as described in the last paragraph of CRAE's Report 1 (Appendix III), is a lobe-like feature that projects northward from the well defined anomaly A. I have shaded anomaly B lightly in pencil on all pseudo-sections.

Whereas on line 21800E anomaly B is nothing more than an insignificant bulge that largely forms a part of anomaly A, the lobe-like appearance is very definite on lines 21750E and 21700E. On line 21600E it has expanded into a very wide zone although I have some doubt whether I am justified in classifying the southern section as part of anomaly B. I have qualified this part by question marks on the pseudo-section.

It is quite possible that anomaly B is still present on line 21500E, but it is clear that it has become very weak. Alternatively, what I have marked as "?Anomaly B" on the pseudo-section might be the end-effect from the source of anomaly B. In other words, anomaly B's source ends somewhere between lines 21600E and 21500E.

Traces of holes 77CC5 and 7CC8 on pseudo-section 21750E and of hole 77CC6 on pseudo-section 21600E show clearly that these holes and their

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base metal intersections fall outside the interpreted anomaly B. It is fair to say that the source of anomaly B has not been tested properly.

At best, anomaly B's intensity may be described as weak to possibly moderate. If we like to think of its source in terms of volcanogenic economic massive sulphides, the most likely mineralization would be a lead-zinc-silver sulphide association. Otherwise, disseminated pyrite in volumes intersected in the holes drilled so far can adequately explain the anomalous chargeability values.

3. Anomaly C is a weak chargeability response marked on lines 21750E and 21700E. However, it is obvious that its appearance on line 21700E is considerably different than on line 21750E. Whether the two anomalies are expressions of the same source is a matter of conjecture. Report 1 on Page 3 refers to anomaly C as present on line 21800E also. However, I find it difficult to agree with this statement. The noisy readings (N.R.) at the northern extremity are quite possibly caused by high tension powerline as noted on page 3 of the report.

CRAE believed (second last paragraph, page 3) that anomaly C is situated in a geologically favourable environment. Line 21750E was resurveyed at a later date using 40m dipole spreads (20m dipole spreads were used for the earlier work). On the basis of high resistivities recorded in the second survey, CRAE decided (Report 6, Appendix III) that the subtle chargeability anomaly in the earlier survey could be attributed to a contact zone rather than to presence of sulphides. The 40m dipole plot is not available for appraisal.

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REPORT 3 (Exploration for 12 months to 26/2/1985)1. Surface Electromagnetic Surveys

The UTEM survey was conducted as part of a larger survey that also included Cethana West Grid to its west and Gowrie Park Grid to its east. General comments I made in my discussion of Cethana West Grid also apply here.

As in the case of Cethana West Grid, station identification numbers used for the UTEM survey are different from those used for past surveys. However, in contrast to Cethana West Grid, IP and UTEM survey plots of the Cethana East Grid do not show common reference points that can be reliably used to correlate anomalies from both surveys with each other.

Survey results over this Grid are very similar to those recorded over Cethana West in terms of anomaly strengths and interpreted depths to anomaly sources. I have classified on plans TASH 1732 and TASH 1733 those anomalies which I have considered to be the most significant.

The area between lines 21600E and 21100E where some of the highest chargeabilities were recorded in the grid area was not surveyed due to noise from powerline. Line 21600E was surveyed and the presence of any anomalies worth further investigation is not apparent. It appears that the results on this line are also contaminated to some extent by ?powerline noise.

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Hole PD84CC10 was targeted at a very weak (channel 8) UTEM anomaly on line 20400E. No mineralization was encountered apart from pyrite in some sections in volumes ranging from 1% to 3%.

2. Downhole Geophysics

Appendix 3 discusses downhole electromagnetic survey results in hole PD84CC10. Survey plots are available. No downhole anomalies were detected. The surface anomaly was explained as having probably ".... a surficial source which has been enhanced by current channelling along the edge of a resistive unit to the south which can be seen on the IP/resistivity survey".

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LAKE BARRINGTON COPPER PROSPECTREPORT 8 (July 1979-March 1981)

During the period covered by this report CRAE completed an induced polarization survey over the established grid and conducted a limited amount of magnetic survey. Both surveys are discussed in Appendix 5 of the report. My comments regarding above work are given below:-

1. Induced Polarization Survey

The interpretation presented in Appendix 5 is satisfactory. The results are shown both as pseudo-sections and as plan contours. The only missing piece of data is the pseudo-section for the 50m spread for line 4600E.

Apart from the two anomalous zones labelled A and B in the report, I would like to draw attention to another such feature. It is a weak shallow zone recorded over lines 4900E (4850-4900N) and 4800E (4900N) and appears as a lobe-like northerly extension of the definite anomaly A.

Zone A is the most prominent feature in the survey area. It is clearly defined on most lines and gives the impression of becoming progressively shallower as it extends westward. There is an abrupt major change in the chargeability pattern between lines 4600E and 4500E leading one to suspect the presence of a possible structural discontinuity or lithological change between these two lines.

2. Magnetic Survey

A small magnetic survey was conducted over IP Zone A to determine whether the anomalous IP responses were caused by pyrrhotite or pyrite.

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Results are included as profiles in the report. As the magnetic picture appears to lack coherent anomalous pattern, it was concluded that the IP responses could not have been caused by pyrrhotite.

I do not believe the magnetic survey provides conclusive evidence because pyrrhotite's magnetic property is variable and ranges from non-magnetic to weakly and sometimes to moderately magnetic.

3. Drilling

Two diamond drill holes were completed to investigate the source of IP anomaly A.

- i) Hole DD80LB1 (Plan No. TV377) was drilled on line 4700E to a depth of 187.5m. Pyrite appears to be common over large sections of the drill hole. Three anomalous copper intersections are shown in the top 46.7m of the hole in the zone where no IP values are also recorded. High copper, zinc, lead, silver and gold values are also encountered from 179.4m to 181.8m. This interval, which includes a 0.1m section of massive sulphides, occurs approximately 6m from the end of the hole.

I have traced hole LB1 on the IP pseudo-section and marked the high assay intervals in red. It is evident that the hole was stopped just short of the high chargeability zone as defined by the 45msec. chargeability contour. To have tested the IP anomaly properly the hole should have been extended to a depth of about 250m. CRAE notes towards the bottom of Page 5 of the report that hole LB1 "...was stopped prematurely...."

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Furthermore, my tracing on the pseudo-section does not take into account the topography gradient which averages about 24 degrees on the north side of the valley. Probably its symmetrical outline (see plan TV 377) does not affect the pattern of the chargeability anomaly, but would most likely diminish its magnitude.

- ii) Pyrite is pervasive in hole DD80 LB2 on line 4600E (Plan No. TV 377), ranging from 1% to 10% throughout its entire length. In addition, LB2 intersects anomalous copper values at various depths. I have traced LB 2 on the pseudo-section of the 25m dipole spread. It encounters the broad zone of high chargeabilities at some distance away and below the maximum recorded values and appears to extend parallel to them.

It is unfortunate that the pseudo-section for the 50m dipole for line 4600C is not available to correlate the chargeabilities with the sulphides intersected at depth. It would be very useful if this pseudo-section can be located as I believe correlation of the chargeability results with the copper values intersected at the deeper levels of the hole might play a vital role in any future decisions taken about this prospect.

REPORT 9 (May 1981-December 1982)

Several geophysical surveys and one diamond drill hole were completed during this period. Although positive responses were obtained from some of the surveys, drilling results were rather disappointing. All the geophysical surveys are discussed in Appendix 3 of the Report.

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1. Electromagnetic Survey

The EM survey was conducted by Crone Geophysics (Aust) Pty Ltd using the DEEPEM mode. The survey was of a local nature; only the most promising lines were covered in the near vicinity of IP anomaly A. No anomalies of any consequence were recorded.

On Page 2 of the interpretation memorandum dated 5/8/1981, several reasons are given for the lack of EM anomalies. One of these is the possibility of lack of coupling between the sulphides, if any are present at all, and the magnetic field. If we take into consideration the positions of the loop and the IP anomaly A*, this reason would be valid if the sulphides occur at depths in excess of 350m and have moderate grid-southerly dips.

2. Mise-a-la-Masse Survey

Results show a well defined broad anomaly with an oblong central high situated between lines 4700E and 4800E. The coincidence of the mise-a-la-masse anomaly axis with the chargeability values at n5 and n6 is quite evident from the plans and sections included with the report. However, I concur with the note of caution expressed in the interpretation memorandum dated 3/6/1981 that the pattern may simply reflect a lithological effect.

* The assumption made here is that, if there is any electromagnetic anomaly at all, it might possibly coincide with the position of the induced polarization anomaly A.

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3. Self-Potential Survey

This survey is discussed in a memorandum dated 18/5/1981 and the results are shown as profiles that accompany the memorandum. The small survey covered critical sections of lines 4600E, 4700E and 4800E where positive IP (Anomaly A) and misc-a-la-masse responses were observed.

The results for each line are plotted once separately and again as stacked profiles. The patterns for the latter plot are shown reversed upside-down compared with the individual plots. I have assumed the stacked profiles are the correct presentation because SP anomalies are characterized by negative values.

The profiles show negative values of about 120 mV located over the central high of the misc-a-la-masse anomaly. Although no negative values are recorded on line 4600E the SP profile shows a definite low centred at 4850N which coincides both with the northwest extension of the misc-a-la-masse central high axis and also with the shallowest (n1) chargeability high recorded by the 25m spread.

It is difficult to comment reliably on the merits of the self potential survey because it can be affected by quite a few factors as noted in CRAE's interpretation memorandum. The maximum recorded amplitude of about 120 millivolts is actually classified as a weak anomaly. It has been noted in the literature that 50 millivolts usually indicates about 5% conductive sulphides or possibly less. If this is true, the SP feature discussed here might reflect the presence of 12% conductive sulphides at the most. Furthermore, presence of SP anomalies generally imply

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sulphides present at depths as shallow as depths to the water table. However, situations contrary to this have been noted in the literature.

The plan on which the stacked SP profiles are shown also displays the positions of the IP anomalies and the mise-a-la masse anomaly. IP anomaly A is shown to occur at the outer edge of the mise-a-la-masse central high axis. This position refers to that part of anomaly A which occurs at shallow depth (n1). However, its position at greater depths (n5 and n6) coincides squarely with the central high axis of the mise-a-la-masse anomaly and with the SP lows.

4. Drilling Results

DD82 LB3 was drilled to intersect the centre of the mise-a-la-masse anomaly at a depth of 100m. Apart from several small anomalous copper and silver intersections, no-economic massive sulphides were encountered. Mineralization is described as fracture filling within a stringer zone.

The rocks in the area of hole LB3 display more intense alteration associated with mineralization than in holes LB1 and LB2. Alteration in hole LB3 is described as strong to very strong chloritic alteration with considerably more carbonate (calcite-siderite) veining.

I have traced hole LB3 and the high assay values on the IP pseudo-sections for lines 4700E and 4800E (See Report 8). It must be kept in mind that the bottom part of the hole is actually situated between these two lines. It is evident that this hole does not reliably tap the central chargeability high recorded on both lines.

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REPORT 10 (December 1982 - December 1983)

No geophysics was done during this period. One hole, DD83 LB4 was drilled between lines 4800E and 4900E to a depth of 281m. I have traced this hole onto the IP pseudo-sections of these lines filed with Report 8. The position shown on the pseudo-section is doubtful as I do not have enough information about the topography to place the hole collar at the correct height when I project it onto the adjoining grid lines. It is difficult to comment reliably on the position of hole LB4 at depth in relation to the source of IP anomaly A.

REPORT 17 (Electromagnetic surveys in the Sheffield Area During 1985)

A general description is given on Page 10 in the report of UTEM survey results over the old and the extended grid. Plots of the results are also available. As stated in the report, the only definite responses occur over the extended portions of the grid lines. All the lines from 4500E to 4800E record very weak channel 8 and in one or two cases channel 7 or 6 anomalies in the section from 5600N to 5900N. Their sources appear to be at a shallow depth, ranging between 20 to 30 metres. These anomalies are interpreted in the report to be expressions of the edge of basalt that forms the northern boundary of the grid lines.

There is no other information at hand in the area of the UTEM anomalies that we can use to correlate the UTEM results with.

Reference is also made to downhole EM on one of the holes. No data have been supplied.

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REPORT 14 (12 months to 15 February 1985)

Lake Barrington Prospect is discussed on Page 14 of the report. Appendix 4 contains a short discussion on EM downhole logging results for hole DD82 LB3.

No data are included.

REPORT 15 (12 months to February 1986)

Lake Barrington Prospect is discussed briefly on Pages 9 & 10. The geophysics part is a repeat of work mentioned earlier in Reports 17 & 14 above.

The discussion concludes by stating that no further work is recommended on this prospect.

STAVERTON PROSPECTREPORT 22 (Comments on Induced Polarization Survey, 1977)

This report by Scintrex Pty Ltd outlines very briefly a gradient IP survey conducted over four lines. Plots of all the results are included with the report.

The four lines surveyed are 400 metres apart and as noted in Scintrex's report, it is difficult to draw conclusions about continuity of anomaly trends from line to line. Several chargeability anomalies are present on each line averaging about 6 to 8 mv/v. The exception to this occurs on line 900E where an approximately 200 metre (60N-150S) wide zone attains amplitudes of the order of 16 to 18 mv/v. Some of these anomalies have coincident resistivity lows while others have resistivity highs.

Such surveys cannot be useful in practical terms unless they are related to results from other surveys, particularly geochemical and geological.

This survey was followed by a more detailed dipole-dipole induced polarization survey along with geochemical soil and rock chip sampling and geological mapping. Results of this work are discussed in Report 12 below.

REPORT 12 (1982)

Staverton Prospect is discussed in Section 8 of this report, commencing on Page 8. During the period of this report the following geophysical surveys were completed:

1. Induced-Polarization Survey

Interpretation and pseudo-sections for a dipole-dipole survey are presented in Appendix V. The feature of interest in this survey is a poorly defined, weak chargeability anomaly that is rather closely associated with the general trend of surface soil geochemical anomalies from line 300E to line 1000E.

On plan TASH 1140, included with the report, I have outlined the trend of the high chargeability zone and marked its close association with the high copper, lead and zinc soil assays. Although the pattern developed here appears encouraging, a word of caution might be warranted concerning the geochemical results. The high soil assays correlate very well with high values obtained from rock geochemistry and they also correspond closely with the presence of high iron, noted in the legend of plan TASH 1140 as hematite and limonite. On a more encouraging note, the legend describes the limonite as "massive or banded gossanous limonite".

The chargeability anomaly attains its best definition on line 600E where a shallow (725m deep) discrete source of limited depth extent can be assigned to its source. Hole PD83 SP1 (TASH 1571, Report 13), which was drilled to test the anomaly, intersected lead and zinc sulphides at sub-economic grades at depths between 20 and 44m. Pyrite, in volumes up to 3% is present at various depths, but its occurrence becomes less frequent towards the bottom of the hole.

The point of major concern is the effect of topography on the results of the IP survey. Gradients as high as 36 degrees are shown on the cross-

section of hole PD83 SP1 (Report 13). It is well known that severe topographic variations introduce distortions and spurious anomalies into the resistivity picture. Chargeabilities are much less affected than resistivities. However, for the purposes of defining drill targets, care should be exercised to ensure that the strongest parts of the anomaly are explored. It cannot be ascertained at this stage to what degree the chargeability pattern (or its ? exact position) on the section of Hole SP1 is affected by the topography. I believe this point requires further investigation.

2. Electromagnetic Survey

A very small PEM survey was completed by Crone Geophysics (Aust) Pty Ltd over certain sections of some grid lines using the DEEPEM mode. The survey lines are too short for any clearly defined patterns to be recorded. The longest line contains six stations, the shortest (line 600E) only three (Appendix VI). No responses were recorded on any of the lines.

REPORT 18 (Memorandum dated 5/9/1983)

REPORT 13 (12 months ending 15 February 1984)

Three lines of UTEM survey were completed. A brief discussion of the results is given on Pages 5 & 6 of Report 18. The plots are also available. On line 400E a poorly defined response is recorded in the vicinity of 125N-175N. The responses are more clearly recognisable on lines 500E and 600E between 125N and 175N. The UTEM anomalies on all these lines have corresponding IP anomalies recorded on a previous survey (Report 12, discussed above).

In report 13 it is recommended that lines 700E to 1000E be also covered by UTEM survey. Apparently this recommendation was not implemented.

REPORT 15 (12 months to February 1986)

Staverton Prospect is discussed on Pages 10 & 11 of this report.

Recommendation is made that no further work be done on the IP/UTEM anomaly because its source is likely "to be shallow and of too low conductivity to reasonably be expected to be a large sulphide body."

GOG RANGE PROSPECTREPORT 12 (1982)

Discussion of geophysical work conducted over this prospect commences on Page 23 in the report. All the work discussed in this report relates to the area of geochemical anomaly 4, known as Gog Range West.

The following surveys were completed during the period of this report:-

1. Pulse Electromagnetic Survey

A small PEM survey was conducted over the best geochemical anomalies and over the Dighem anomaly 126xB. The survey produced only a slight anomaly coincident with a reconnaissance survey magnetic anomaly and high copper/zinc soil geochemical values (geochemical anomaly 4, see page 23). The separated transmitter-receiver (slingram) geometry was used in the survey.

Appendix IX in the report lists the station values but no plots are provided. The number of stations on each line varies between five and ten at 50 metres spacing.

My plot (not included in this report) of the PEM values over lines 72580E (given as G25/8E in Appendix IX), 2400E and 2200E gives a vague impression of a very weak response present on Channel 1. I have plotted the axis of this response on the diagram on Page 8. Channel 2 readings are so low that they might be taken as noise.

Furthermore, it does not appear that the interpreted PEM anomaly axis coincides with geochemical anomaly 4 because the position of the latter is given as 4675N on line 2580E (Report 12, Page 23).

2. Magnetic Survey

The survey was conducted in the area of geochemical anomaly 4 where slight PEM responses were recorded as noted above. Survey results are presented as contours, but the 100nT interval is not adequate to bring forth the full character of the area. Furthermore, it would have been advantageous to have the results also presented as profiles so that as much information as possible could be extracted from the results.

3. VLF-EM Survey

I believe the discussion of survey results on page 24 of the report is satisfactory. The results are presented as profiles and contours of normalized dips and also as maximum horizontal field strength (%).

The survey records a well defined, weak to moderate cross-over zone (plan TASH 1112) that strikes west-northwest across the entire grid area and appears to extend beyond it in both directions. It is located towards the southern ends of the grid lines and is very closely associated (plan TASH 1113) with a high zone of the maximum horizontal field. On page 24 of the report, these trends are attributed to the contact between the Cambrian Volcanics in the north and the Ordovician Roland Conglomerate in the south. Unfortunately I cannot confirm this interpretation as Gog Range's geological plan (TASH 1226) is not available with the report.

On plan TASH 1112 I have shaded all the cross-over zones. The second most prominent (after the one discussed above) is the one that cuts across lines 2400E to 2700E between 4800N-4900N. If the maximum horizontal field contours on plan TASH 1113 are slightly modified as I have done in

pencil on the plan, one can see a trend present, albeit very subtle, that is closely associated with the cross-over trend.

Another significant VLF-EM response occurs on line 2400E at 5000N-5100N where a northwesterly trending cross-over zone intersects a bulls-eye type maximum horizontal field closure.

In the diagram on Page 8 of my report I have outlined the relationships of the VLF-EM responses with the magnetic survey and self-potential results within an area centred over lines 2500E-2580E. In this area, anomalous or near anomalous parameters from various surveys appear to relate rather closely to each other and therefore I feel this area warrants further investigation.

4. Self-Potential Survey

This survey is mentioned at the bottom of Page 24 in the report and the results are presented in contour form (TASh 883). The discussion notes that the most significant response occurs on lines 2500E and 2580E at 4850N where a weak (not moderate as is stated in CRAE's report), -144 millivolt anomaly is present.

I cannot confirm whether this weak SP anomaly coincides with any geochemical anomalies as is stated in the report because I do not have plots of the data to correlate with the SP survey. Plan TASh 2969 (Report 16) shows the distribution of geochemical anomalies over all the Gog Range Prospects at a scale of 1:10,000. This plot suggests that there are no geochemical anomalies coincident with the SP anomaly on line 2500E. However, the presentation scale is not quite suitable for detailed correlation.

I cannot agree with the statement made in the report regarding the coincidence of the SP anomaly with a VLF-EM anomaly. A more accurate observation would be that the SP anomaly occurs about 40 to 60m north of a weak VLF zone (hatched lightly in pencil on plan TASH 1112) that strikes grid east-west and extends eastward beyond the limits of the gridded area.

REPORT 17 (Electromagnetic Surveys in the Sheffield Area during 1985)

Contains a discussion on Page 11 of an electromagnetic survey performed by using the Scintrex - 88SE (Genie) system. The surveyed area is located east of that discussed in Report 12 (Gog Range West). Plots of only four lines (35E, 37E, 39E and 41E) out of the five lines are available. The only feature worth noting on these lines is the weak anomaly centred at 4750N on line 35E. This anomaly must be of limited strike length because it is not present on either line 37E or line 34E. Line 34E was surveyed at a later time.

Line 35E is shown on the soil geochemistry Summary plan TASH 2969 (Report 16) as free of any geochemical anomalies.

I cannot confirm the interpreted parameters given in CRAE's report for the source of the anomaly on line 35E because I do not have access to the model curves for the Genie system as yet.

REPORT 15 (12 months to February 1986)

There is a brief mention on Page 10 of this report about the electromagnetic survey discussed in Report 17 above.

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REPORT 16 (12 months to February 1987)

Appendix 5 in the report discusses an electromagnetic Genie survey over geochemical anomalies not covered by past geophysical surveys. A total of 9 lines were covered in this survey and plots of all the results are available. None of the responses shown on the profiles give the impression of a genuine anomaly being present. As in the case of the previous survey, I believe they are more likely to be geological or operational noise.

PROMISED LAND PROSPECTREPORT 12 (1982)

This prospect is discussed on Page 7 of the report. Several plans are also included at a scale of 1:5000. They show results of geophysical (VLF-EM, magnetics) and geochemical (copper, lead, zinc, manganese) surveys completed over a small grid. Sample locations and geology is also shown on a separate plan.

The main feature of interest occurs towards the southern end of grid lines 4400E, 4500E and 4600E where a weak VLF zone occurs in the vicinity of high copper, zinc and lead values. It is not clear from the geology plan the type of rocks present in the area of these anomalies. They could be greywackes, conglomerates and grits or siltstones and shales.

A second feature of interest occurs on line 4300E about 5025N where a partly recorded VLF-EM anomaly coincides with the peak of a 200-300 nT magnetic response.

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GROUND FOLLOW UP OF DIGHEM II ANOMALIES

In Report 19 the contractors, Dighem Limited, discuss the results of the airborne survey and recommend anomalies favourable for ground follow-up.

Parts of Reports 12 & 2 discuss the outcome of CRAE's ground follow-up surveys of the recommended Dighem anomalies in Cethana EL and Sheffield EL respectively. Other electromagnetic and aeromagnetic anomalies, not recommended by Dighem were also investigated in the ground follow-up. In several instances this work was based on knowledge of the local geology where the anomalies occur.

SHEFFIELD EL 7/73 (Report 12)

I have examined all the Dighem follow-up anomalies discussed on Page 5 to 19 except for the following because plots of the results are either not available or no geophysics was performed.

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|--------------|--|
| Section 6.13 | EM anomalies 98xG, 100xE, 1000E, 1010M; apparently no geophysics were performed. |
| Section 6.19 | EM anomalies 143xA, 146xB (Garden of Eden).
Detailed work conducted over a proper grid discussed elsewhere. |
| Section 6.22 | EM 126xB falls within the Gog Range Grid |

Section 6.25 Aeromagnetic anomaly 2600-3695 (Cethana Picnic Area
Grid)

No ground geophysics were performed.

Section 6.27 Aeromagnetic anomalies 15-2781, 2100-3643, 29, 1614
(Dalcoath Margin anomalies).

Positions of all the Dighem follow-up anomalies are shown on plans TASH 1119
and TASH 1120.

On the basis of the geophysical results presented, none of the anomalies can be
justifiably recommended as a good or even a fair target for future exploration.
However, I have noted below several anomalies which might be classified as
third or fourth category responses and therefore require a limited amount of
field investigation.

In nearly all cases the method employed in the investigation consisted of
reconnaissance geophysical (VLF-EM, magnetics) surveys, geochemical soil
surveys and brief geological checks. I would like here to point out that the
VLM-EM surveys are affected by topography, but to have the results corrected
we need to know the variations in the topography. However, in many instances,
topographic effects are manifested by slow variations in the VLF-EM profile
whereas anomalies caused by mineralization are usually local and steep.

As I noted above, the following low priority anomalies might warrant further
field checks:-

Section 6.5

EM anomaly 27xJ

- two lines of magnetics, VLF-EM and geochemistry in an area of fresh quartz porphyries of Bull Creek Volcanics.
- Line A records two weak VLF-EM responses about 100 to 150 metres inside the edge of 400 metres wide anomaly that averages 400nT. Geochemical assays gave negative results.

Section 6.7

EM anomalies 56xF, 59xG, 60xD

- four lines of VLF-EM and magnetics; no geochemistry.
- several weak VLF-EM cross-overs are present as well as magnetic anomalies in the range of 100 to 250nT. Anomalies 56xF and 59xG are located within the Gowrie Park Grid already investigated by CRAE (Pervis, 1978, Report 9160). CRAE concludes that the geophysical responses are caused by conductive lithology.

Section 6.8

EM anomaly 63C

- two lines of VLF-EM and magnetics; no geochemistry.
- area is situated over a river alluvium. The feature of interest is a weak but definite VLF-EM anomaly that coincides with the edge of a 40-60nT local magnetic anomaly.

-
- Section 6.10 EM anomaly 66xC
- three lines of VLF-EM and magnetics.
 - weak VLF-EM anomalies coincide with pronounced magnetic responses and correlate with low, boulder covered ridge, presumably reflecting a resistive lithology, e.g. basic dyke.
- Section 6.11 EM anomaly 73xA
- three lines of VLF-EM, magnetics and geochemistry.
 - magnetic anomalies of 500-600nT give impression of a dyke-like source with weak but definite VLF-EM anomalies at their western edges. Magnetic anomaly source is possibly ?dolerite dyke. Geochemistry results are negative. The geology consists of an inlier of fresh Cambrian shales and tuffs surrounded by Roland Conglomerate.
- Section 6.12 EM anomaly 75A
- three lines of VLM-EM, magnetics and geochemistry.
 - one line (100W) records a weak VLF-EM anomaly and coincides with the edge of a 200nT magnetic anomaly.
- Section 6.17 EM anomalies 119xB, 121xA
- four lines of VLF-EM, magnetics and geochemistry.
 - one line was established over anomaly 119xB. A ?partly recorded moderate cross-over coincides with the edge of a magnetic anomaly of about 150nT. This information cannot be taken as significant because

there is only one line to consider. Maximum soil assay results were 110 ppm copper, 32 ppm lead and 147 ppm zinc.

- three lines were surveyed to investigate anomaly 121xA. All lines show moderate to strong VLF-EM cross-overs at the northern edges of pronounced, partly recorded magnetic anomalies of the order of several hundred nanoteslas. Soil samples assayed up to 70 ppm copper, 58 ppm lead and 130 ppm zinc.

Section 6.23

Aeromagnetic anomalies 19-2686, 24-1816, 29-1607.

- profiles for anomaly 29-1607 are not available.
- each of the remaining two anomalies were surveyed with one ground traverse. It was concluded they were caused by Bull Creek porphyries.
- above anomalies were investigated because of their alignment with Bismuth Creek Fault zone which is located outside the EL and has known mineralization. The position of the Fault and/or its projection is neither stated in the discussion in CRAE's report, nor is it shown on the profiles. In general, this type of approach to exploration, whereby single, widely spaced traverses are established to investigate mineralization or structures projected from a distance is neither logical nor practical so far as serious exploration is concerned.

CETHANA EL 10/76 (Report 2)

Four Dighem anomalies were followed up on the ground. They are discussed on Pages 2 to 5 of the report. Plots of all the results are also included with the report. Two of these follow-up anomalies are interesting enough to warrant brief comments.

Anomaly 3900xH

A three line grid was established to investigate a weak Dighem anomaly situated half-way between Round Hill and Round Hill Extended silver-lead workings. Grab samples in and around adits from Moina Sandstone gave high lead, zinc, copper, silver and gold assays.

Weak to moderate VLF-EM anomalies are recorded on all lines. On line 5500E, the VLF-EM response coincides with a 10nT change in the level of magnetic background values, the latter being the only meaningful magnetic response in otherwise featureless survey results.

CRAE's report notes that the possibility of a "blind" orebody within the Moina Sandstone is high and that a structural interpretation followed by ground EM survey is the best way to approach the problem. To the best of my knowledge no such programme was undertaken.

Anomaly 36xH

This weak anomaly is located on the western end of Cethana East Grid. This area has been the subject of IP and UTEM survey coverages as I discussed earlier under the section on Cethana East Grid.

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In the ground follow-up the same grid lines were used as in the IP survey (Reports 20 and 21). A VLF-EM survey was completed over lines 20000E to 20800E at 200 metre intervals. The profiles record moderate to strong, well defined cross-over anomalies close to their southern ends. I have plotted their positions on Scintrex's IP profiles (Report 21). Almost all anomalies correlate either directly or very closely with resistivity lows/chargeability highs. No correlation could be made on line 20200E because a different co-ordinate system was used for the VLF-EM survey.

The VLF-EM survey was followed by a pulse electromagnetic (PEM) survey using the separated loop geometry. Survey plots are not available, but the results are tabulated in Appendix II. My plot of a couple of the lines did not reveal any discernible responses that can be associated with the VLF-EM anomalies.

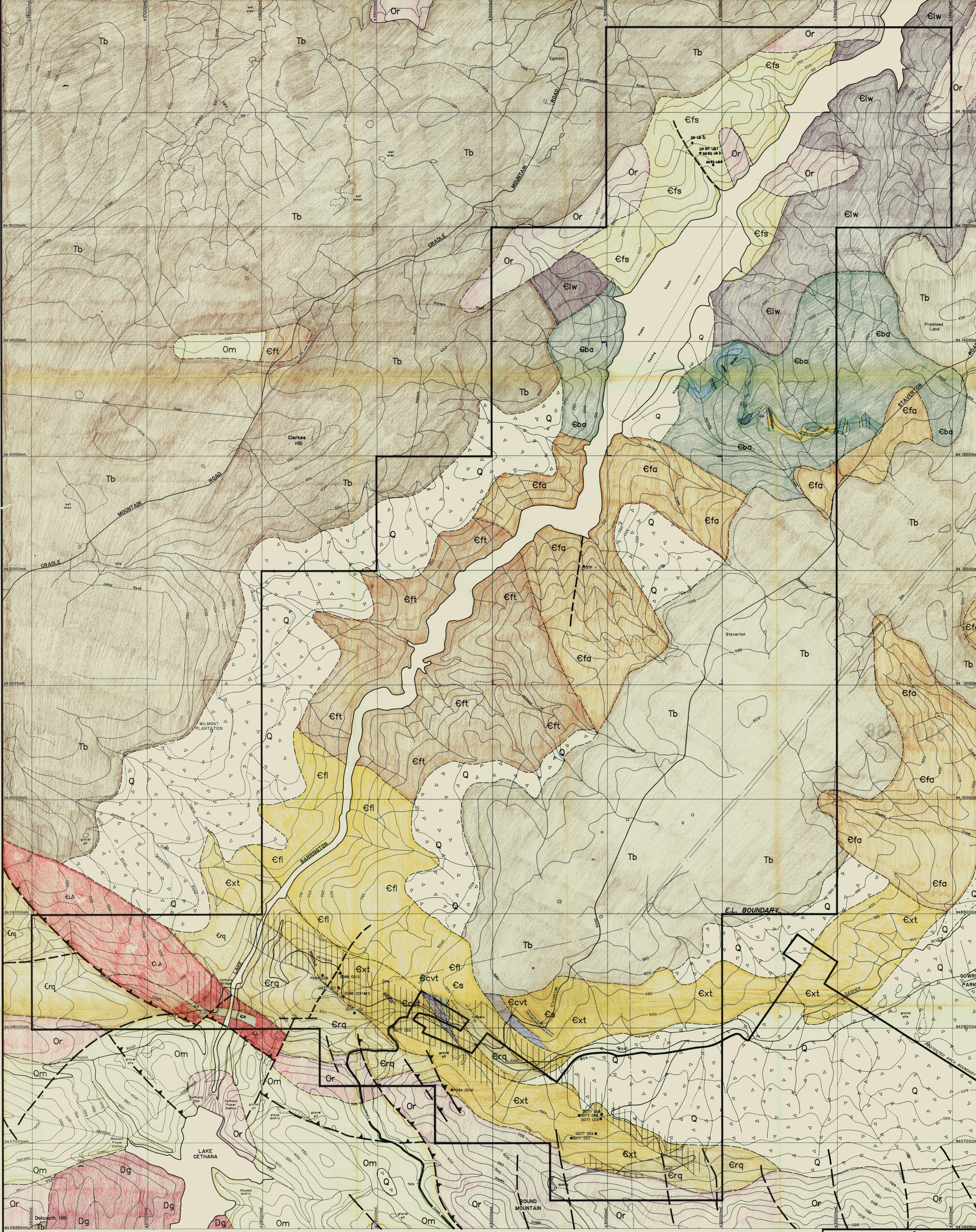
This area was subsequently covered by the UTEM survey (discussed on Page 28 in this report). All the lines, apart from line 20800E, which was not surveyed, recorded very weak to weak anomalies, but it is difficult to relate them to the VLF-EM and IP information because, as I have already mentioned elsewhere, different co-ordinate systems were used for these surveys.

In the case of line 20200E, both the VLF-EM and UTEM profiles employ the same co-ordinate identification system, but I cannot be sure that any one station in both surveys is identified by the same co-ordinate number.



PAPKEN A. ZARZAVATJIAN

January/February 1989



LEGEND

<p>QUATERNARY</p> <ul style="list-style-type: none"> Q - alluvial Qc - scree cover <p>TERTIARY</p> <ul style="list-style-type: none"> Tb - basalt <p>LATE CAMBRIAN</p> <ul style="list-style-type: none"> Om - Malina Sandstone <p>EARLY ORDOVICIAN</p> <ul style="list-style-type: none"> Or - Roland Conglomerate 	<p>CAMBRIAN</p> <ul style="list-style-type: none"> Ea - intrusive rhyolite Eba - quartz phytic rhyolite lava Ecb - rhyolitic crystal vitro tuff Ecc - tuffaceous siltstone Ecd - rhyolitic crystal tuff Ece - felsic tuff Ecf - felsic lava Ecg - felsic agglomerate <p>ULTRACRYSTALLINE</p> <ul style="list-style-type: none"> U - tuffitic greywacke/siltstone Ua - volcaniclastic tuffaceous greywacke Ub - porphyritic andesite Uc - andesitic lithic tuffs <p>Beulah Formation</p> <ul style="list-style-type: none"> Ba - tuffitic greywacke/siltstone Bb - porphyritic andesite Bc - andesitic lithic tuffs 	<p>CAMBRIAN</p> <ul style="list-style-type: none"> Elw - lithic wacke, mudstone, conglomerate Efs - felsic volcanoclastic tuff/lava Eft - Undifferentiated felsic volcanics <p>DEVONIAN</p> <ul style="list-style-type: none"> Dg - Dolcoath Grant 	<p>Geological Symbols</p> <ul style="list-style-type: none"> Zone of intense cleavage / foliation with alteration to quartz - sericite schist STP - 1 - Diamond Drill Hole
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8441

noranda

E.L.10/88 - PART 1
LAKE BARRINGTON

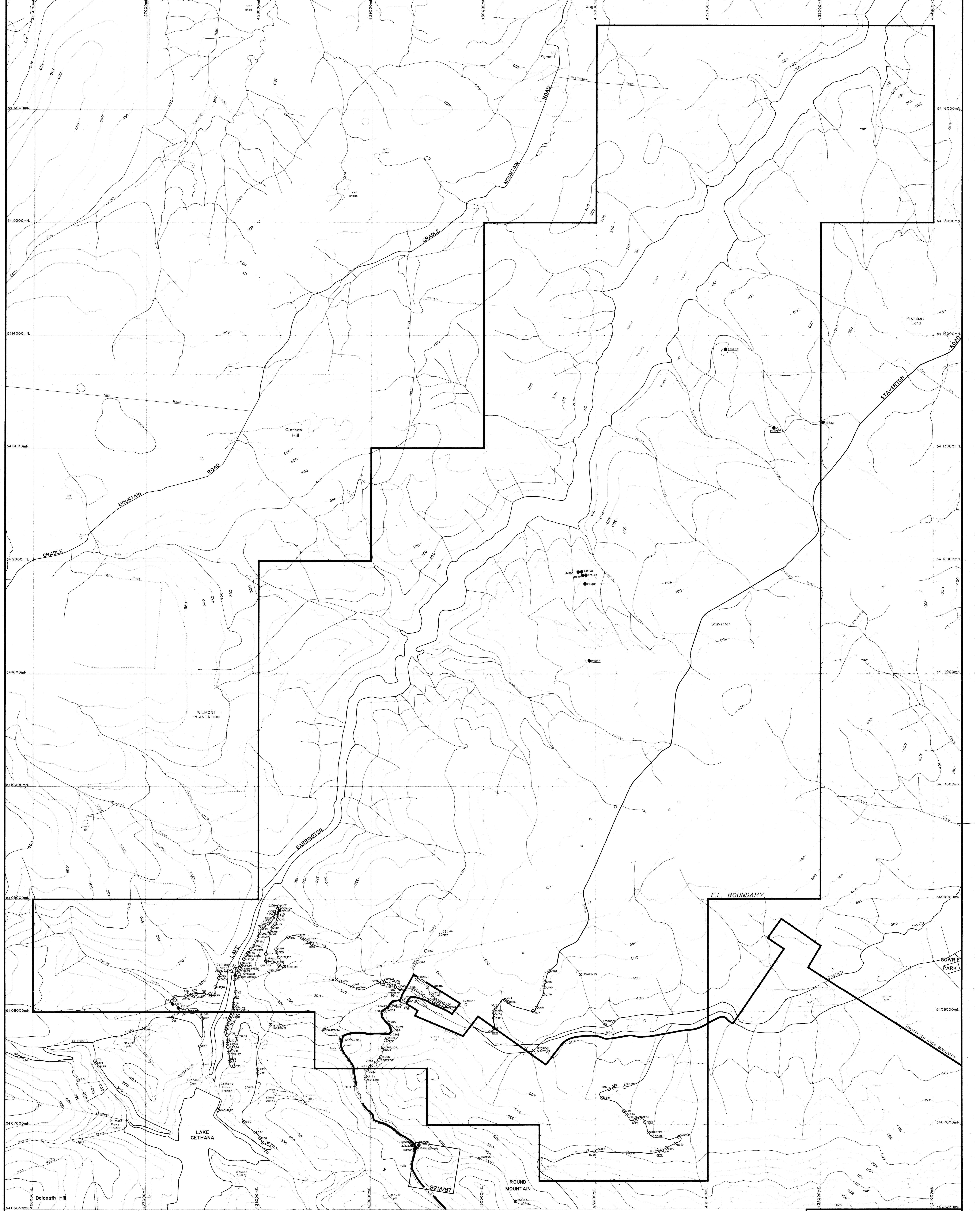
INTERPRETIVE GEOLOGY

SCALE 1:10000

SCALE BAR: 0 100 200 METRES

ENCLOSURE 1

DRAWN BY: P.J.
DRAFTSMAN: T.G.D.S.
DATE: July 89
REVISIONS:
FILE NO.



ROUND MOUNTAIN

Sample No.	Co	Pb	Zn	Ag	Au
225251	790	926	55	275	005
252	905	1350	105	269	041
253	2175	5170	145	348	1132
254	105	148	50	22	004
255	35	525	10	9.5	0005

ROUND MOUNTAIN CHEP

Sample No.	Co	Pb	Zn	Ag	Au
225102	65	890	575	05	0007
103	105	220	145	x	0011
104	60	1050	195	x	0011
105	160	180	175	x	0011
107	30	335	125	4.5	0003
108	15	15	50	x	x
109	10	5	40	x	x
110	5	20	15	x	x
111	40	305	25	2.5	x
112	165	370	320	1.0	x

- KEY:**
- CRME Stream Sediments
 - Noranda Rock Chips
 - Honour's Project
 - Underlined Paragraphic only

8442

noranda

E.L.10/88 - PART 1
LAKE BARRINGTON
SAMPLE LOCATIONS

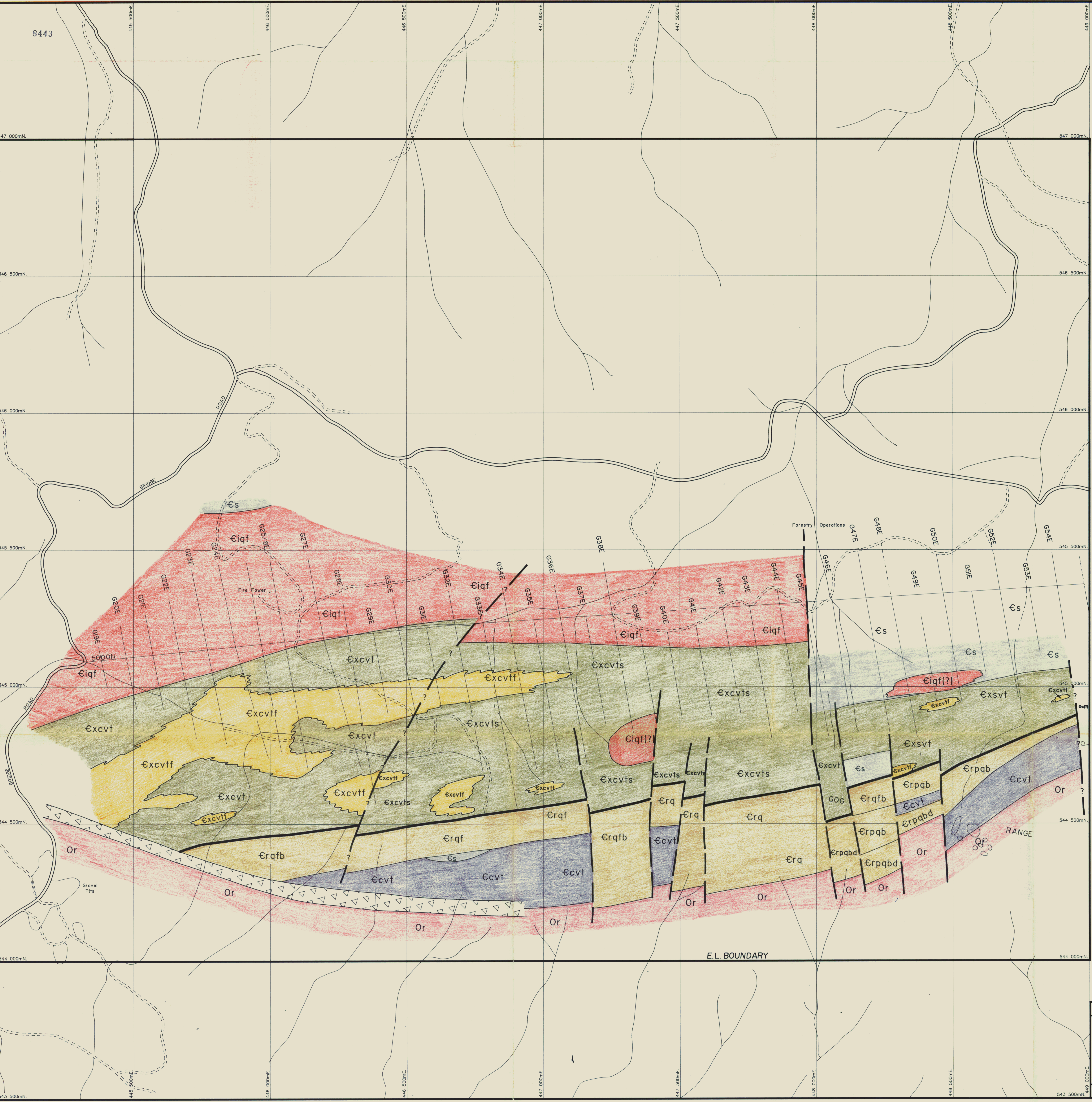
SCALE 1:10000

8442
20.2.255

DRAWN BY: P.J.
DRAFTSMAN: T.G.D.S.
DATE: July 89
REVISIONS:
FILE No.

ENCLOSURE 2

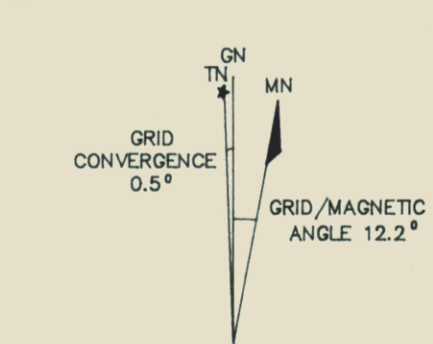
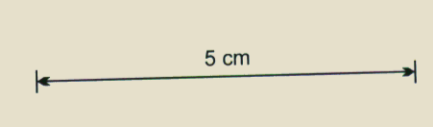
8443



LEGEND

- Or Owen Conglomerate equivalents
- Ecvf Rhyolitic crystal vitric tuff (including some tuffaceous sediment horizons)
- Erqfb Quartz + feldspar + biotite phryic rhyolitic lava
- Erqf Quartz + feldspar phryic rhyolitic lava
- Erq Quartz phryic rhyolitic lava
- Erqbbd Plagioclase + Quartz + biotite phryic rhyolitic to rhyodacitic lava
- Erqpb Plagioclase + Quartz biotite phryic rhyolitic lava (with some crystal vitric tuff units)
- Excvtf Rhyolitic crystal tuff fragmental/pumiceous in western area
- Excvts Rhyolitic crystal tuff interbedded with siltstone and shales (central)
- Exsvt Dominantly rhyolitic derived siltstones with some interbedded crystal vitric tuffs
- Eiqf Quartz + feldspar phryic rhyolitic intrusive
- Es Tuffaceous siltstone

- Mineralized Shear/Fault Zone
- Inferred fault
- Probable fault
- Possible fault
- Rock Boundary
- Scree Covered Contact
- Road/Track
- Streams
- G45 E Grid lines



8443

597257

noranda

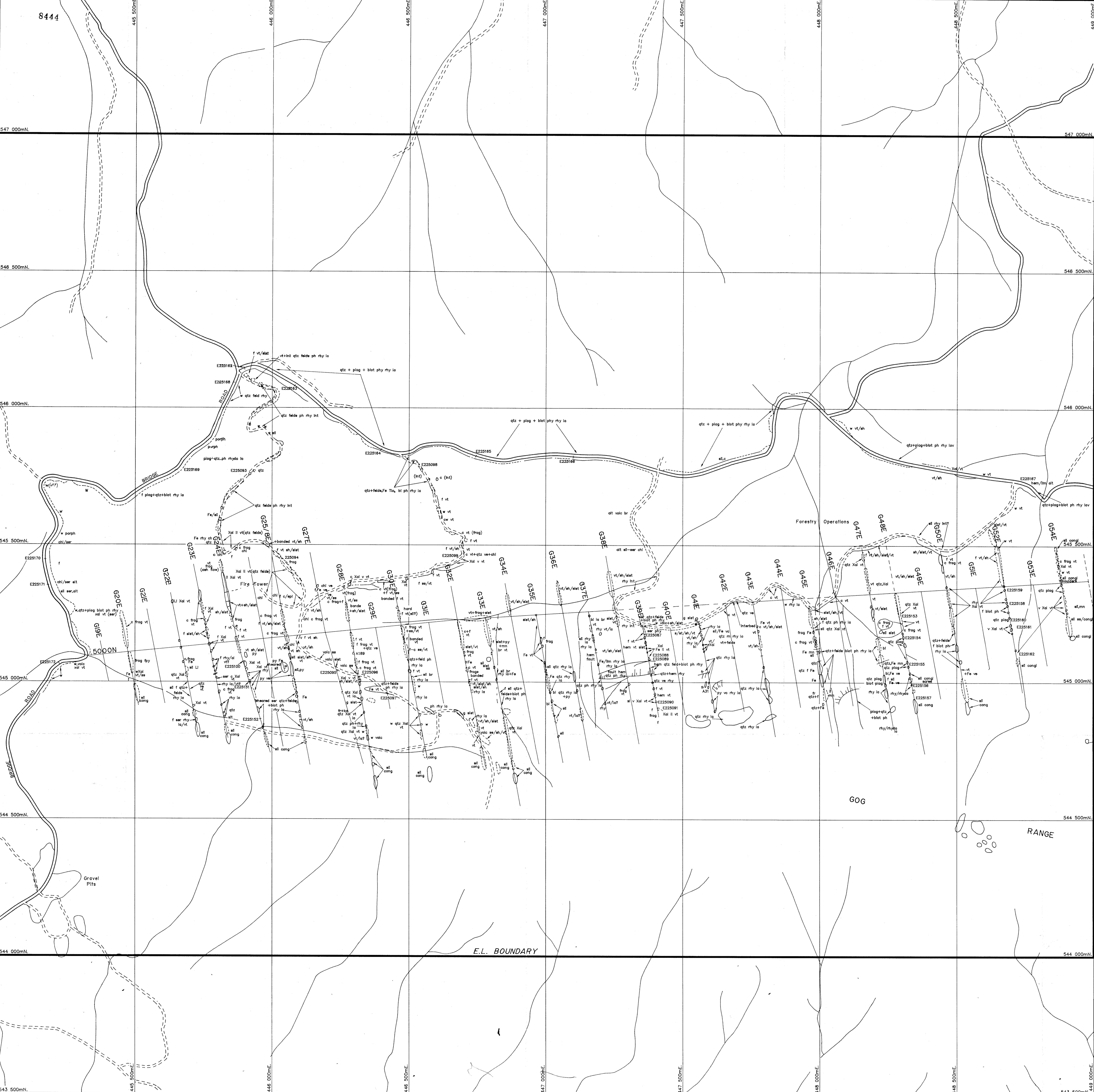
E.L. 10/88 - PART 2
GOG RANGE

INTERPRETIVE GEOLOGY

DRAWN BY: P.J. DRAFTSMAN: T.G.D.S. DATE: July '89 REVISIONS:	FILE No. ENCLOSURE 3
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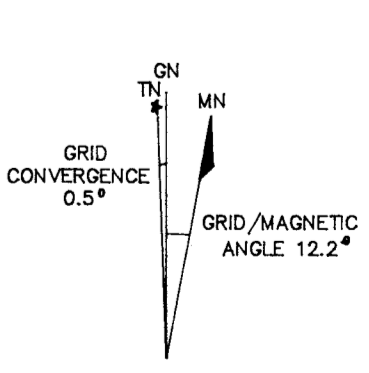
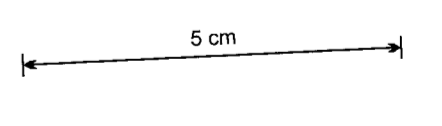
SCALE 1:5,000

8444



- KEY:**
- dit - alteration
 - bl - biotite
 - br - breccia
 - c - coarse
 - chl - chlorite
 - congl - conglomerate
 - ep - epidote
 - f - fine
 - Fe - iron
 - fel - feldspar
 - fr - fractured
 - frag - fragmentals
 - gr - gray
 - hem - hematite
 - int - intrusive
 - ka - kaolin
 - li - lithic
 - lim - limonite
 - mn - manganese
 - ph - phyllite
 - plg - plagioclase
 - porph - porphyritic
 - py - pyrite
 - qtz - quartz
 - rhy - rhyolite
 - rhyd - rhyodacite
 - ser - sericite
 - sh - shale
 - sl - siltstone
 - st - sandstone
 - vt - vitric
 - volc - volcanic
 - w - vein
 - wth - weathered
 - Xal - crystal

- == Road/Track
- Streams
- 045E Grid lines



8444 597258

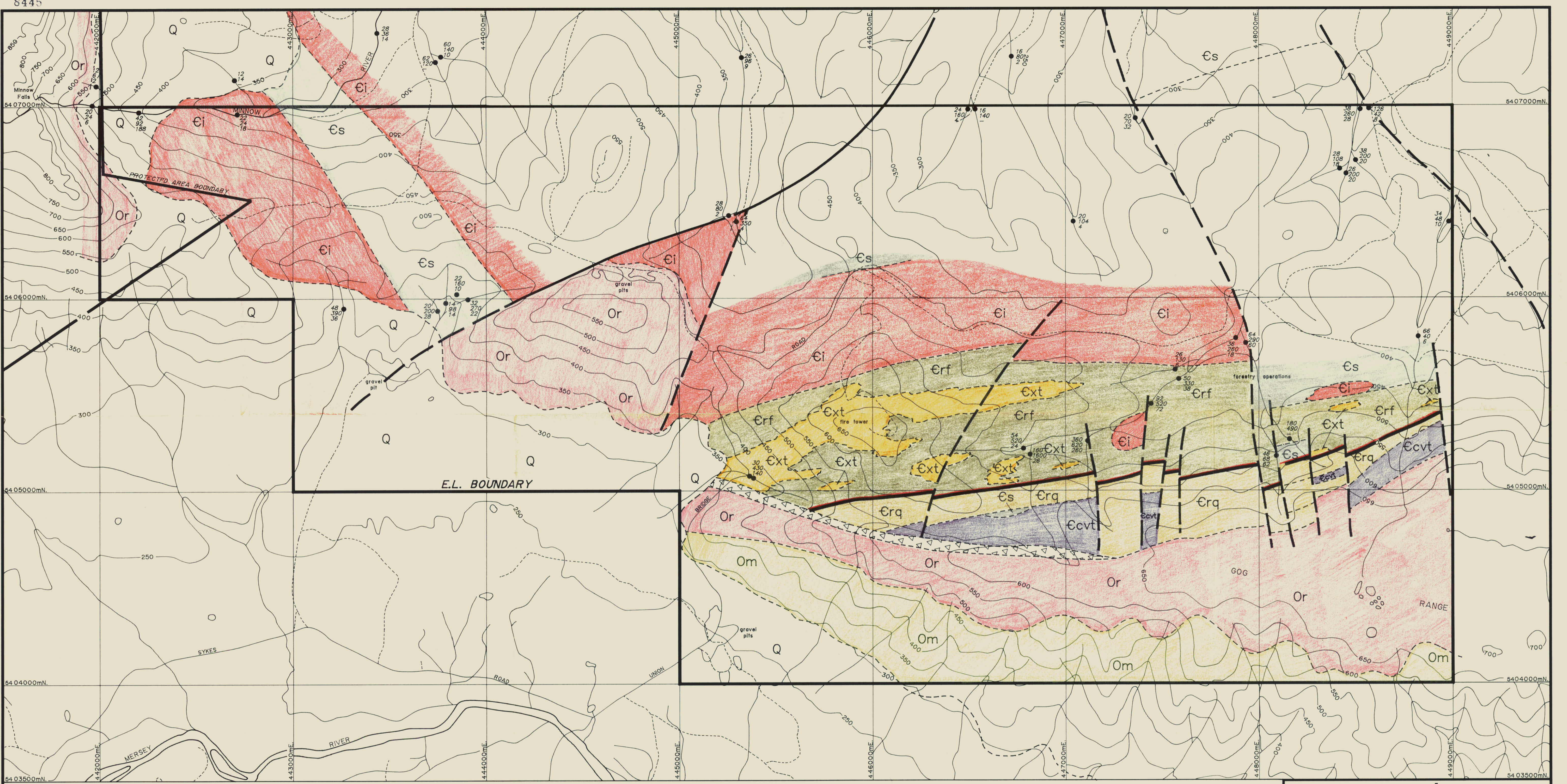
noranda

E.L. 10/88 - PART 2
GOG RANGE

FACTUAL GEOLOGY

SCALE 1 : 5,000

DRAWN BY: P.J.
DRAFTSMAN: T.G.O.S.
DATE: July '89
REVISIONS:
FILE No.
ENCLOSURE 4



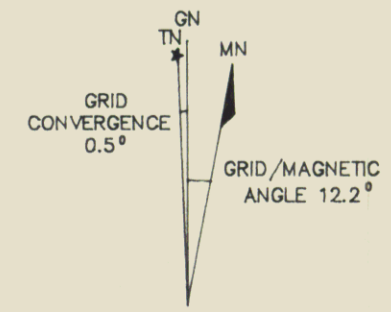
LEGEND

QUATERNARY
Q - Alluvial, gravel, talus
LATE CAMBRIAN - EARLY ORDOVICIAN
Om - Moira Sandstone
Or - Roland Conglomerate

CAMBRIAN
Ecvt - Rhyolitic crystal vitric tuff
Erq - Quartz phyric rhyolitic lava
Erf - Feldspar phyric rhyolitic lava
 (Minnow Karatophyre - Gog) Range Greywacke

Ext - Rhyolitic Crystal tuff [Fragmental in West Fluer to East]
Ei - Intrusive Rhyolite
Es - Tuffaceous Siltstone

Scree Covered Contact
 Stream Sediment Sample point
 Fault - Interpreted
 Mineralized Shear / Fault Zone



5 cm

597259 **noranda**

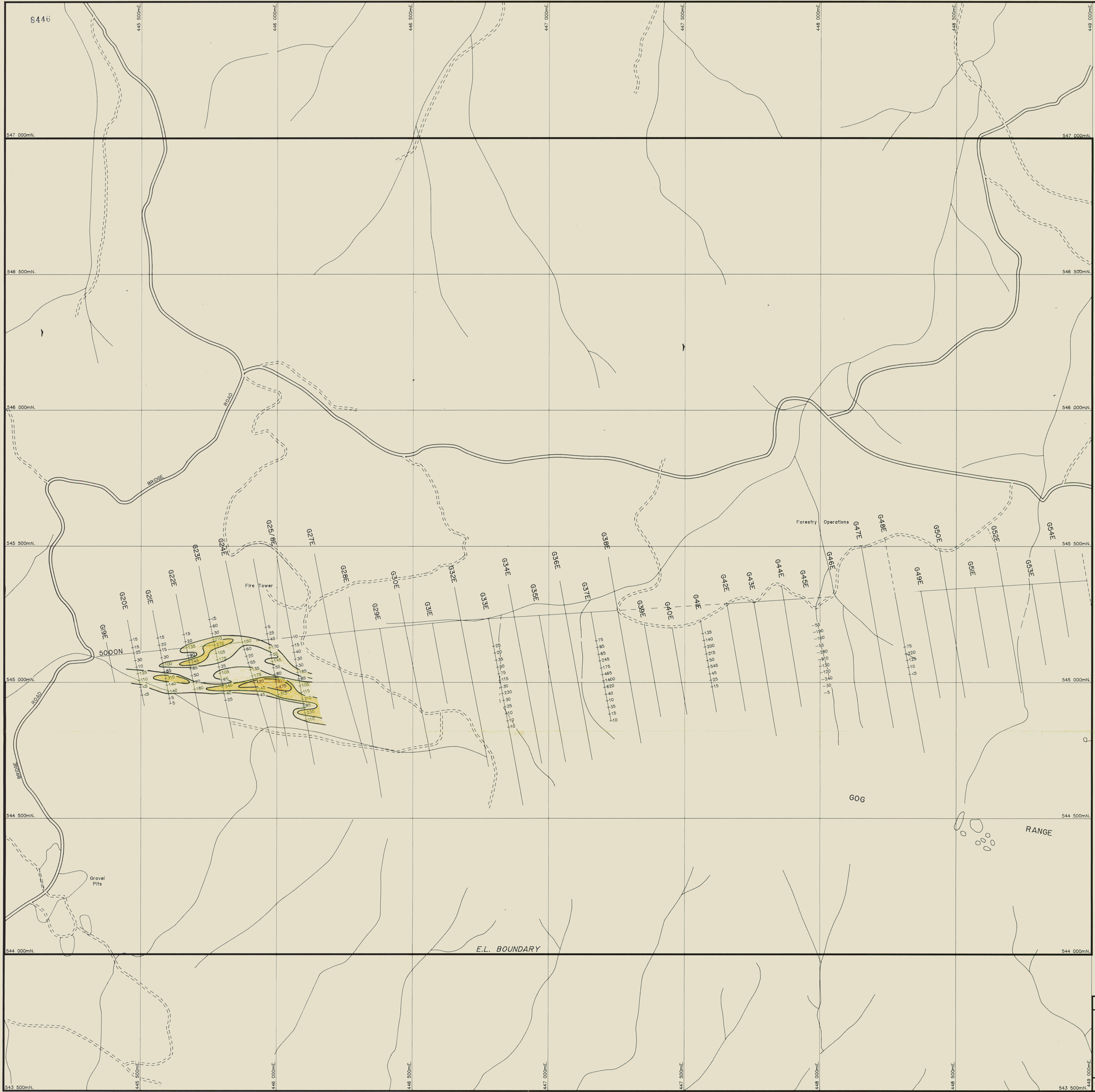
E.L. 10/88 PART 2
 GOG RANGE

INTERPRATIVE GEOLOGY

SCALE 1 : 10000

DRAWN BY : P.J.
 DRAFTSMAN : T.G.D.S.
 DATE : July '89
 REVISIONS :
 FILE No.

ENCLOSURE 5

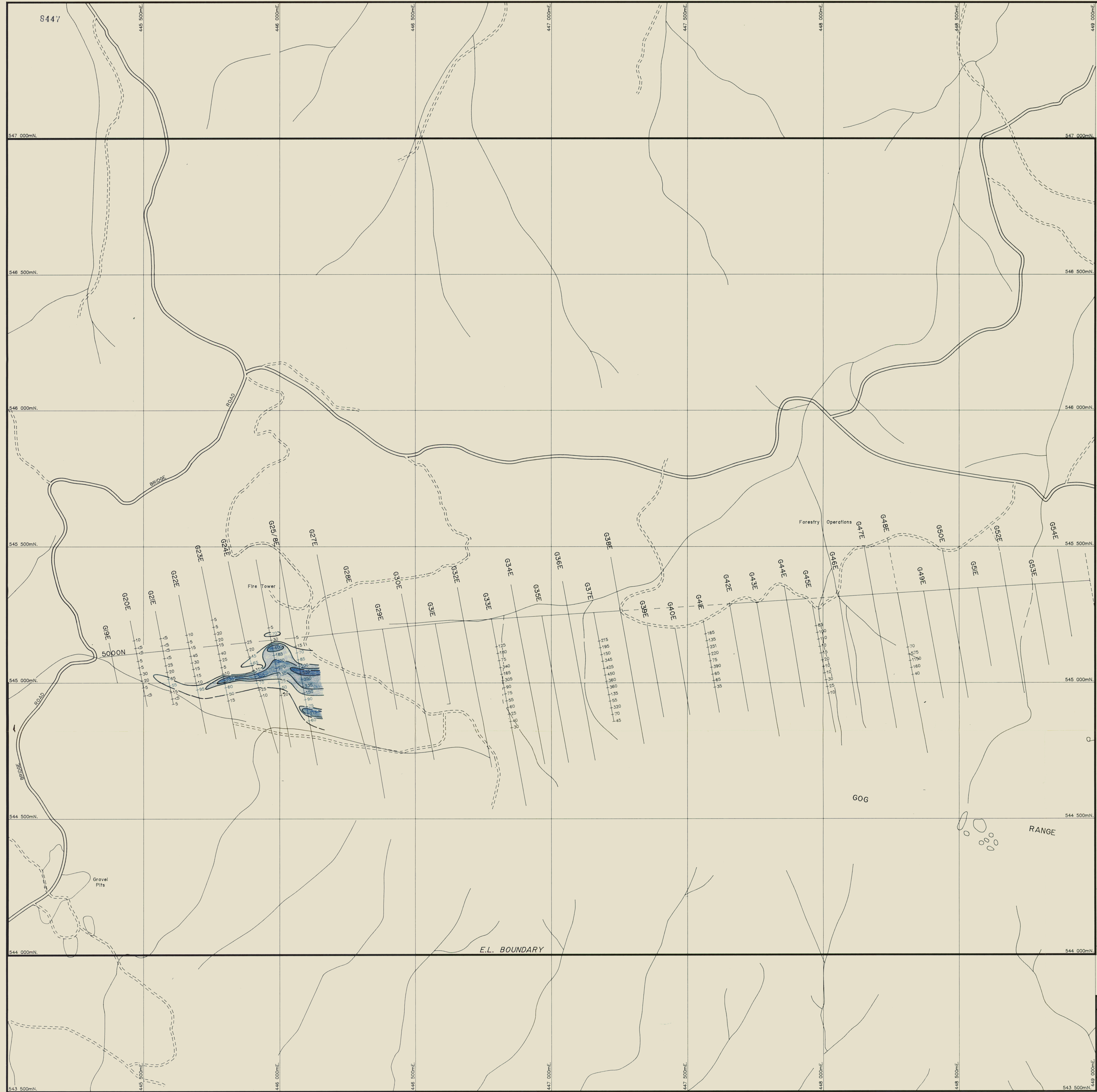


CONTOUR INTERVAL
 > 400 ppm
 200 - 400
 100 - 200
 < 100 ppm

5 cm

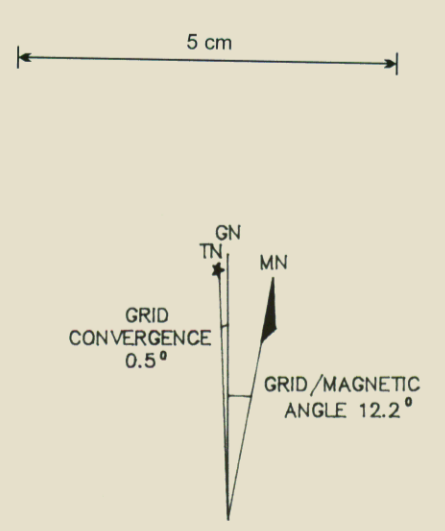
GRID CONVERGENCE 0.5°
 GRID/MAGNETIC ANGLE 12.2°

noranda		597260
E.L. 10/88 - PART 2		DRAWN BY: P.J.
GOG RANGE		DRAFTSMAN: T.G.D.S.
SOIL GEOCHEMISTRY		DATE: July '89
COPPER		REVISIONS:
		FILE No.
SCALE 1: 5,000		ENCLOSURE 6

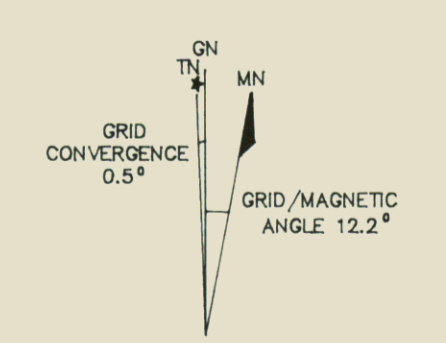
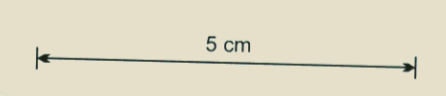
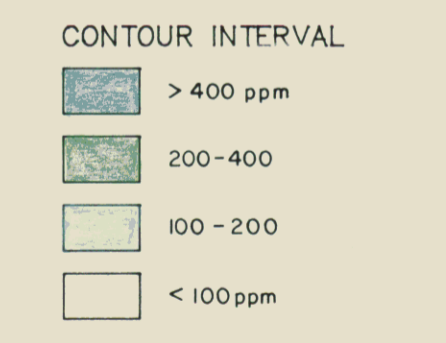
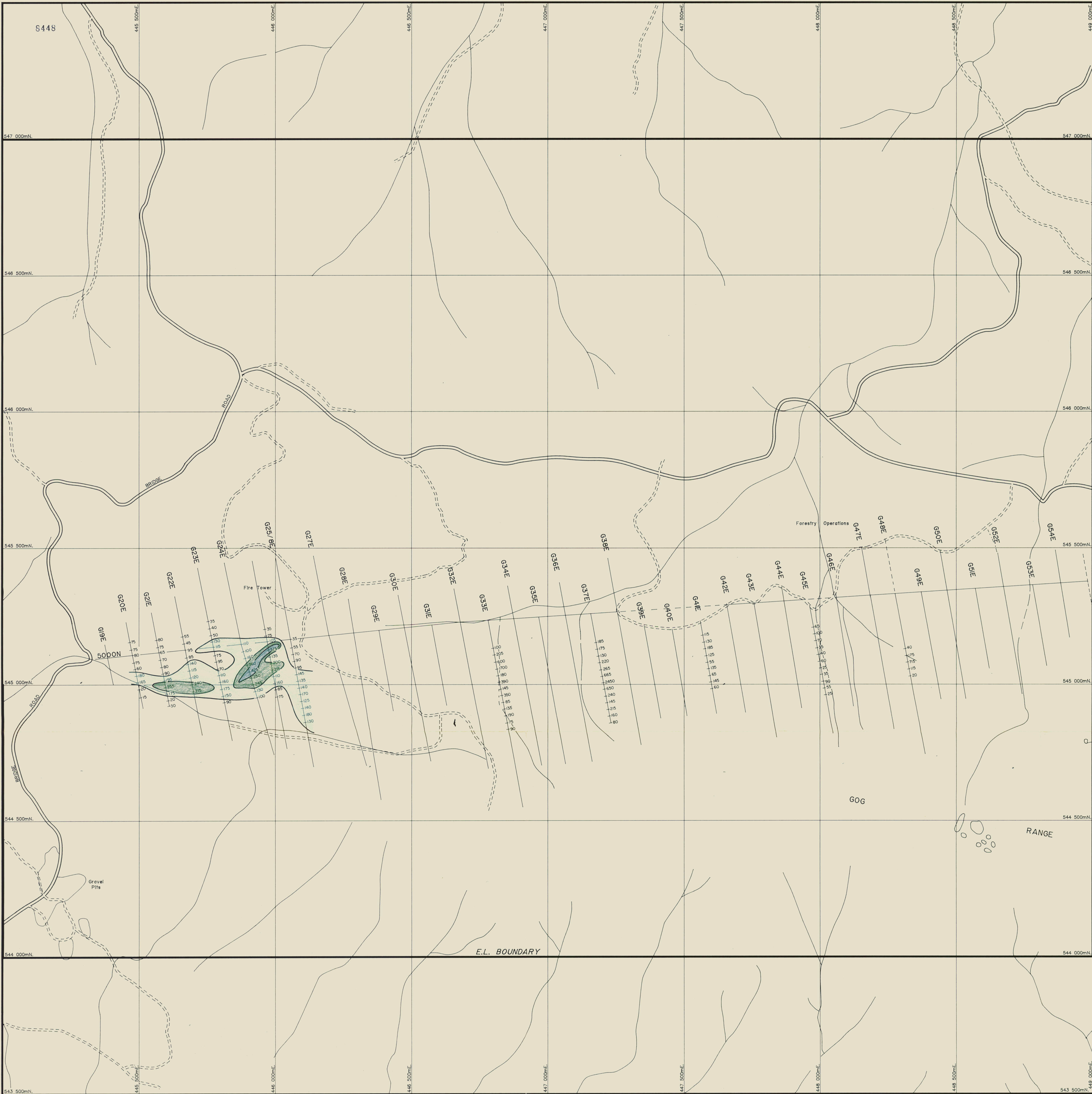


CONTOUR INTERVAL

- > 400 ppm
- 200 - 400
- 100 - 200
- 50 - 100
- < 50 ppm

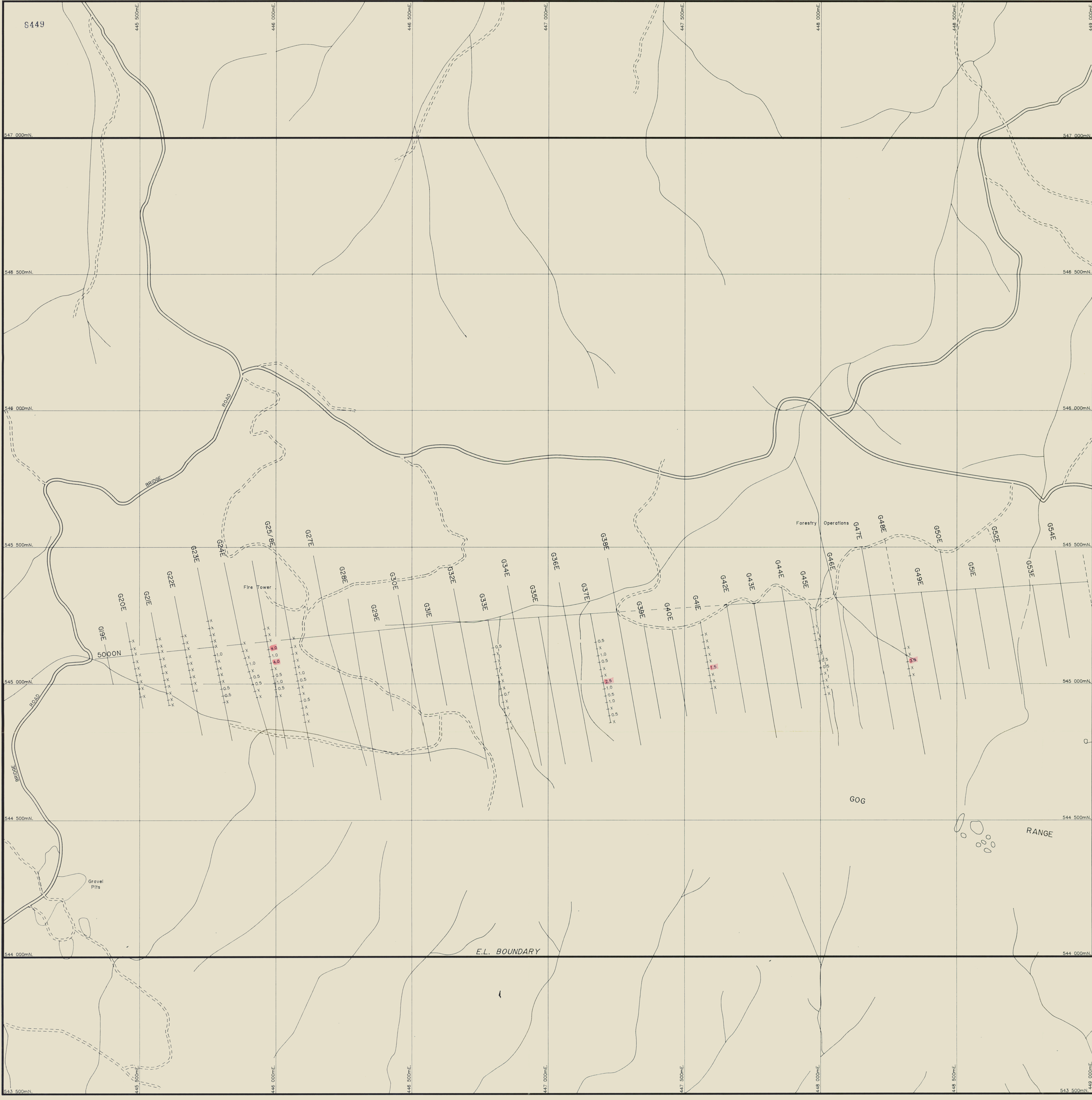


noranda		597261
E.L. 10/88 - PART 2		
GOG RANGE		
SOIL GEOCHEMISTRY LEAD		
SCALE 1 : 5,000		ENCLOSURE 7
DRAWN BY : P.J.		DRAFTSMAN : T.G.D.S.
DATE : July '89		REVISIONS :
FILE No.		



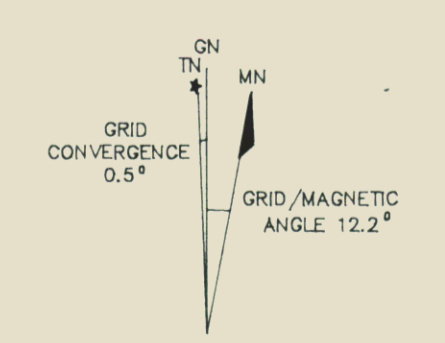
noranda		597262
E.L. 10/88 - PART 2		
GOG RANGE		
SOIL GEOCHEMISTRY		
ZINC		
SCALE 1:5,000		ENCLOSURE 8
DRAWN BY: P.J.		DATE: July '89
DRAFTSMAN: T.G.D.S.		REVISIONS:
FILE No.		

8449

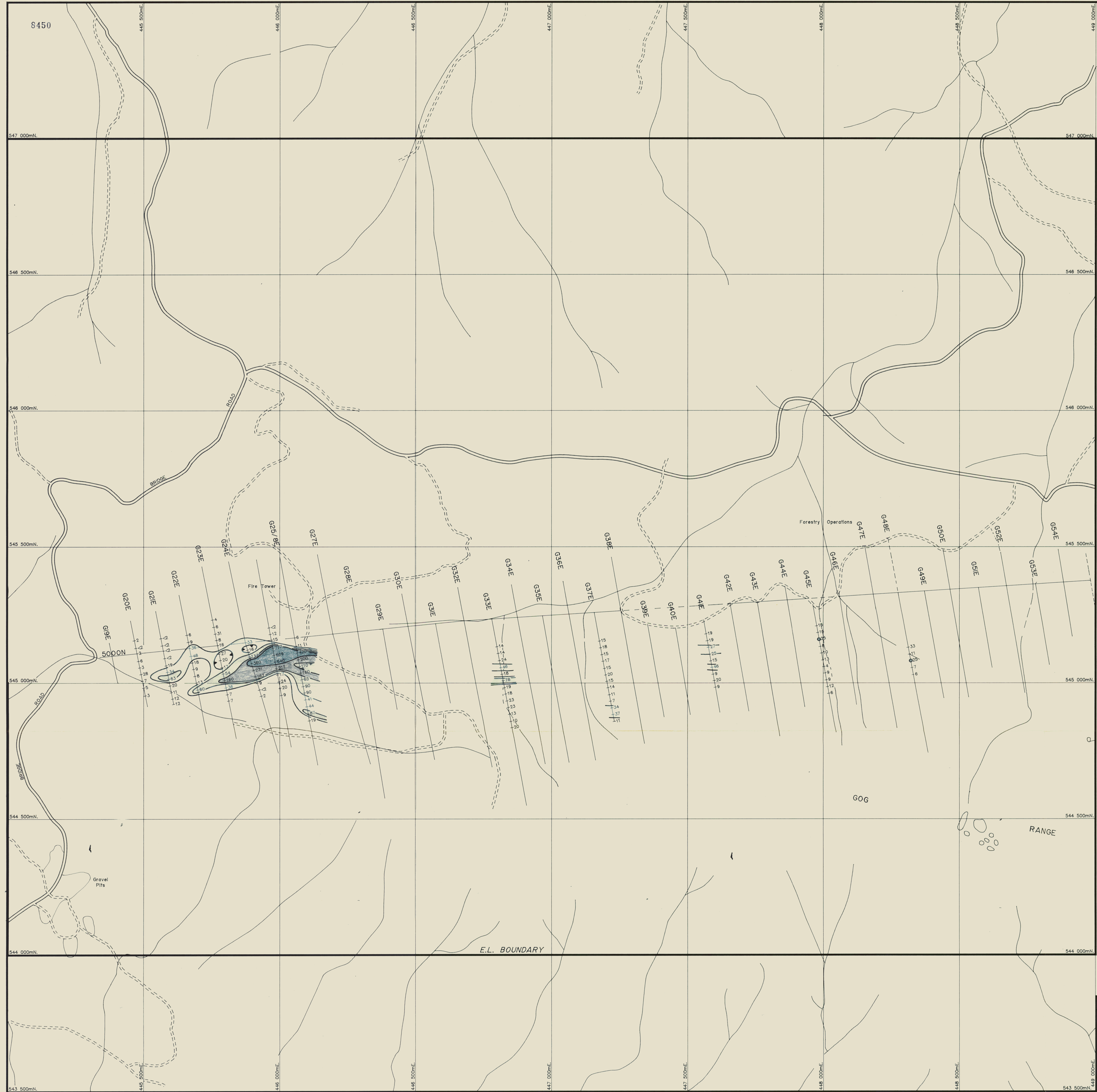


5 cm

89-3009



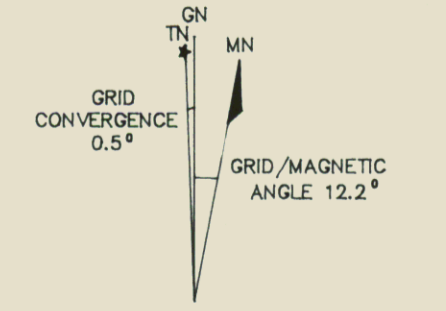
noranda		597263
E.L. 10/88 - PART 2		DRAWN BY: P.J.
GOG RANGE		DRAFTSMAN: T.G.D.S.
SOIL GEOCHEMISTRY		DATE: July '89
SILVER		REVISIONS:
SCALE 1:5,000		FILE No.
ENCLOSURE 9		



CONTOUR INTERVAL
 >250 ppm
 150 - 250
 50 - 150
 25 - 50
 < 25 ppm

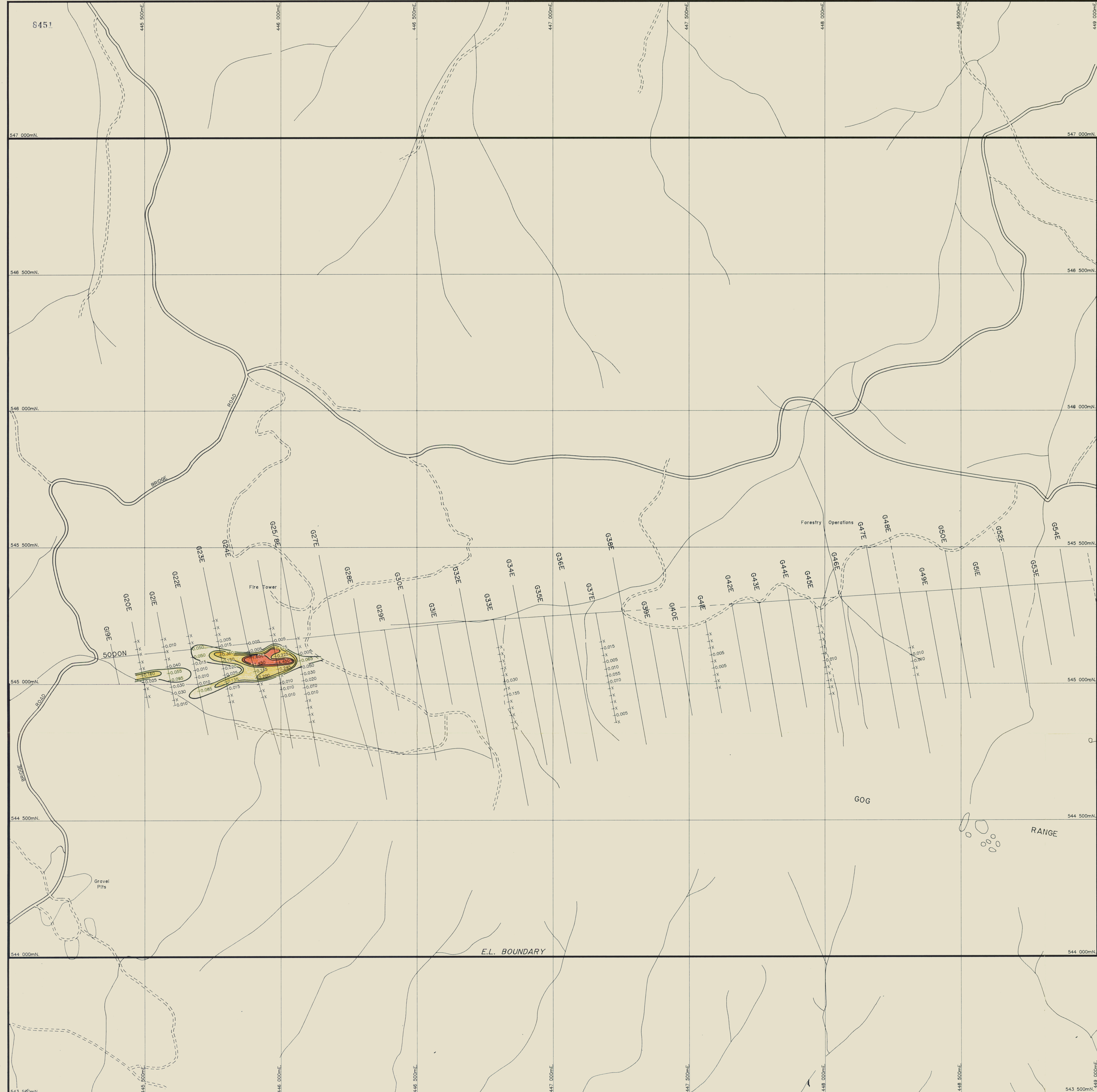
5 cm

89-3009



noranda		587264
E.L. 10/88 - PART 2 GOG RANGE		
SOIL GEOCHEMISTRY ARSENIC		
DRAWN BY: P.J.		DRAFTSMAN: T.G.D.S.
DATE: July '89		REVISIONS:
FILE No.		ENCLOSURE 10

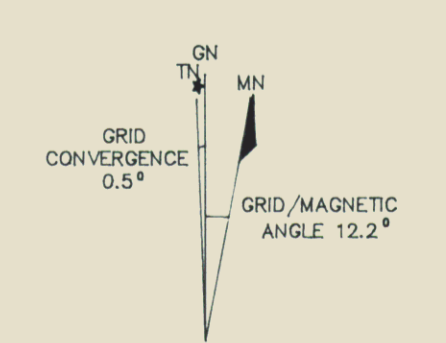
SCALE 1:5,000



- CONTOUR INTERVAL
- >1.400
 - 0.400 - 1.400
 - 0.200 - 0.400
 - 0.100 - 0.200
 - 0.005 - 0.100
 - <0.005

5 cm

89-3009



noranda		597265
E.L. 10/88 - PART 2		DRAWN BY: P.J.
GOG RANGE		DRAFTSMAN: T.G.D.S.
SOIL GEOCHEMISTRY		DATE: July '89
GOLD		REVISIONS:
SCALE 1:5,000		FILE No.:
ENCLOSURE II		

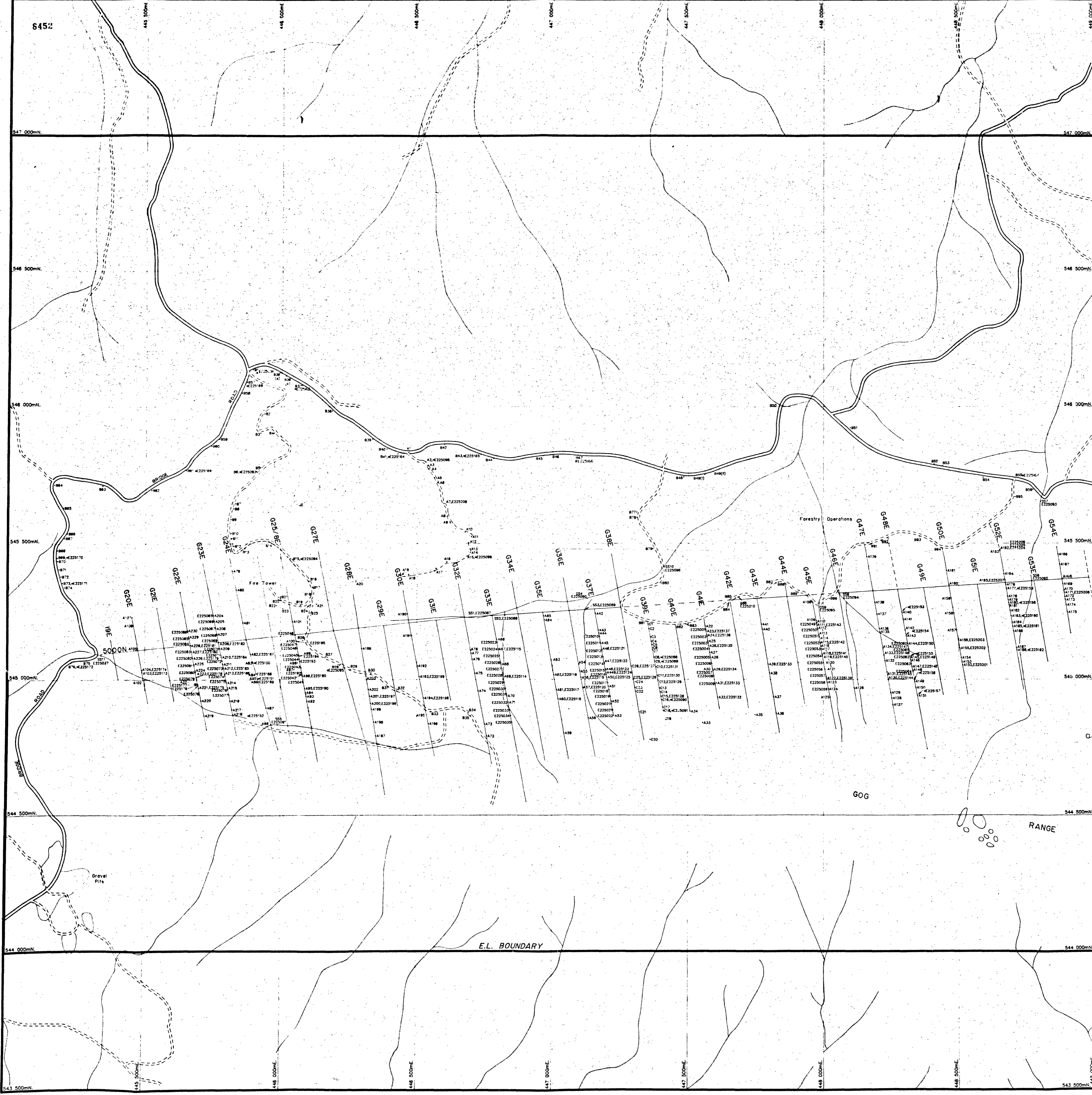
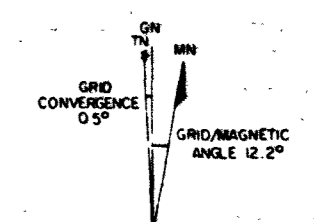


FIGURE 8
CENTRE

KEY:
 Sample Nos. commencing with A,B,C or SS - Field Sample Nos.
 Sample Nos. commencing with E - Laboratory Sample Nos.
 * Denotes Thin Section and Geochemistry
 All other samples - Geochemistry only
 Samples E225001 to E225088 - Soil Samples
 Samples E225087 to E225097 - Stream Sediment Samples
 All other samples - Rock Samples

NOTE: Lines not slope corrected



597266 89-3009

noranda

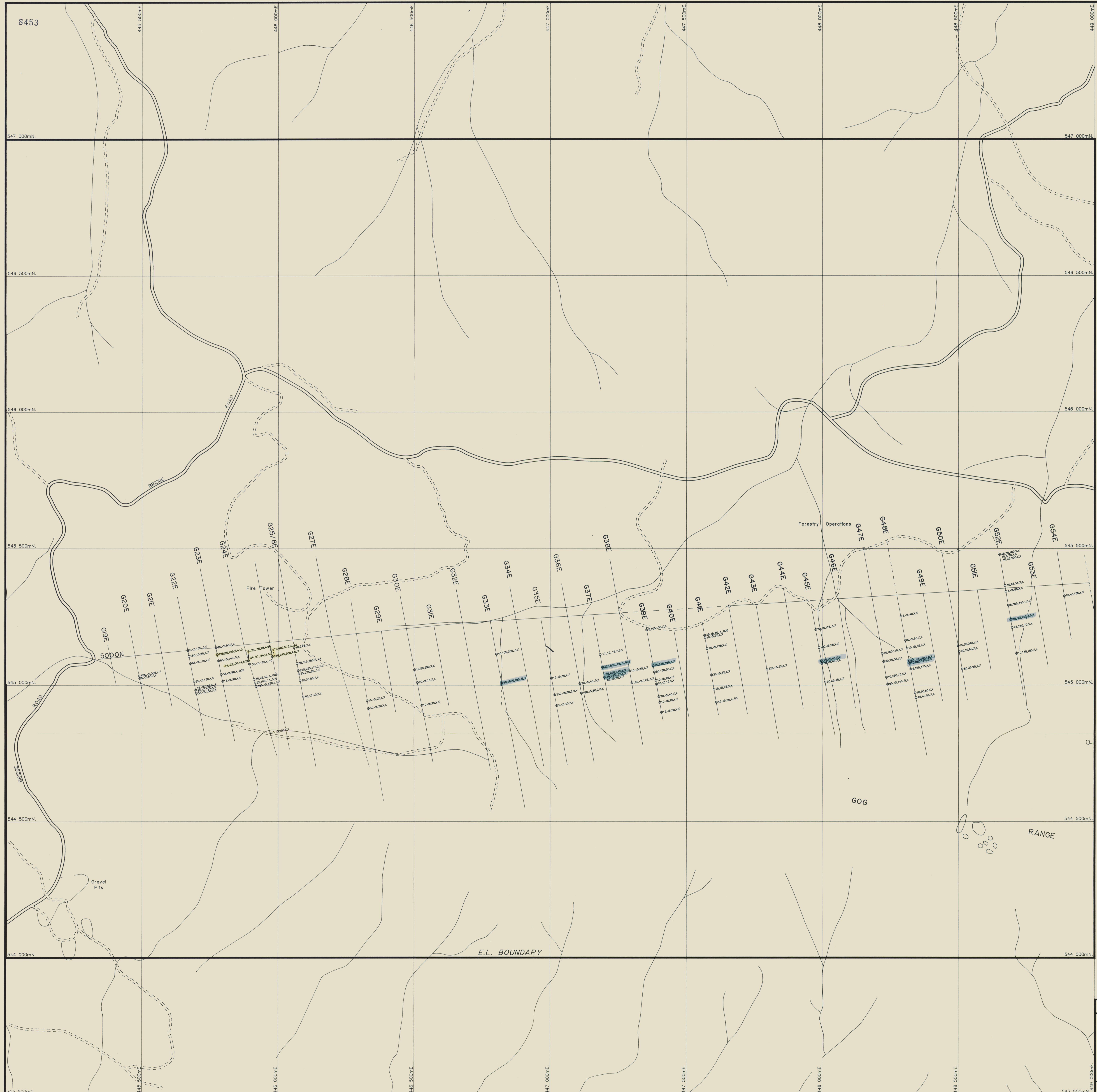
E.L. 10/88 - PART 2
GOG RANGE

SAMPLE LOCATIONS

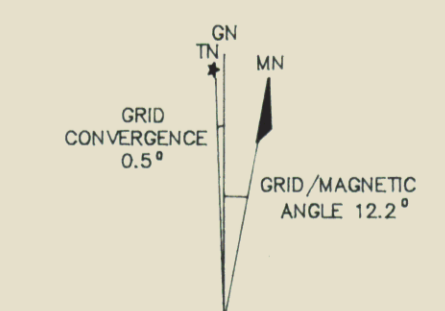
SCALE 1:5,000

ENCLOSURE 12

DRAWN BY: P.J.
DRAFTSMAN: T.G.D.S.
DATE: July '89
REVISIONS:
FILE No.:



NOTES
 x = below detection limit
 Cu,Pb,Zn 12 = %
 300 = ppm
 Ag 5 = ppm
 Au 200 = ppm



107267 **89-3009**

noranda	
E.L. 10/88 - PART 2	
GOG RANGE	
ROCK GEOCHEMISTRY	
Cu,Pb,Zn,Ag and Au	
DRAWN BY : P.J.	DRAFTSMAN : T.G.D.S.
DATE : July '89	
REVISIONS :	
FILE No.	
SCALE 1 : 5,000	
ENCLOSURE 13	