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PLUTONIC OPERATIONS LIMITED

REPROFILMED

EXPLORATION LICENCE 10/88

GOWRIE PARK

Annual Report on Exploration Activity

August 1991 to July 1992

92-3374

EL10/88

Covering letter
see folio 33

Grant MacDonald
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July 1992

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1.0 SUMMARY AND RECOMMENDATIONS

1.1 Summary

EL 10/88, although explored for two decades, still has a large potential for VMS and epigenetic gold mineralisation to be discovered.

Previous explorers have not tested all anomalies and prospective horizons/localities adequately.

In particular there is considerable potential for a Cu-Au VMS at Lake Barrington and Pb-Zn-Cu deposit at Staverton. Furthermore, both Cethana East and West contain anomalous geophysical and/or geochemical anomalies worthy of follow-up.

The emphasis on strong anomalies defined by Asarco's stream sediment programme to locate prospects may have resulted in the overlooking of some more subtle anomalies.

The Fire Tower gold prospect, although still not well understood, may have the potential to contain sufficient tonnage at economic grades.

1.2 Recommendations

From the review of previous work and the geological mapping, both reconnaissance (Cethana East and West, Staverton and Lake Barrington) and detailed (Fire Tower prospect, Gog Range) the following work is recommended:

Gog Range

- drill the host horizon with deeper (approximately 120m) diamond drill holes from four sites to test the host horizon at depth
- continue 1:500 mapping along strike from host horizon

Lake Barrington

- re-establish the grid
- conduct a ground magnetics survey over the grid
- map the area at 1:1000
- diamond drill coincident Mise a la Masse, IP and Cu soil geochemical anomalies

Staverton

- re-establish the grid
- conduct a ground magnetics survey over the grid
- map the area at 1:1000
- diamond drill the coincident IP, and the Cu, Pb, Zn soil geochemical anomalies

Cethana East

- re-establish/re-number grid
- map at 1:2500
- re-log drill core
- determine priority of proposed drill holes

Cethana West

- re-establish/re-number grid
- attempt ground magnetics survey over grid
- map at 1:2500
- re-log drill core
- determine priority of proposed drill holes

Regional

- map at 1:10000 with reference to Dighem, aeromag and Asarco's stream sampling and with emphasis on resolution of structural/stratigraphical relationships
- determine those areas to be relinquished in 1993 (5 year statutory relinquishment)

2.0 INTRODUCTION

2.1 Tenure

EL 10/88 was held previously as a joint venture between Plutonic Operations Limited and Noranda Pty Limited. On 2 June 1992 Plutonic Operations Ltd became the sole licensee and operator.

Previously the ground was part of EL 7/73 granted to Asarco in March 1973. In 1974 Asarco relinquished 297 km² of the original 743 km². CRA Exploration Pty Ltd joint ventured into the EL in July 1976 and also pegged EL 10/76 which covered the southern part of the Lake Barrington portion of the present Gowrie Park EL. CRAE became the licence holders in December 1979, reducing the total area of 7/73 to 199 km². Asarco sold their share to Carpentaria Exploration Co Limited in June 1980. In 1983 CRAE became the sole leaseholder relinquishing the EL in 1988. Noranda Pty Ltd successfully tendered for the ground in August 1989. Noranda added another 8 km² as EL 35/88 and the Mines Dept. added another 0.9 km² in order to rationalize the boundaries with A.M.G. grid lines.

The EL is in two parts (see fig. 1), however, all exploration and reporting is conducted as if one licence.

Part 1, known as Lake Barrington, with a total land area of 37 km² runs down both sides of Lake Barrington from Wilmot/Promised Land in the north to Cethana in the south.

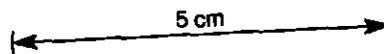
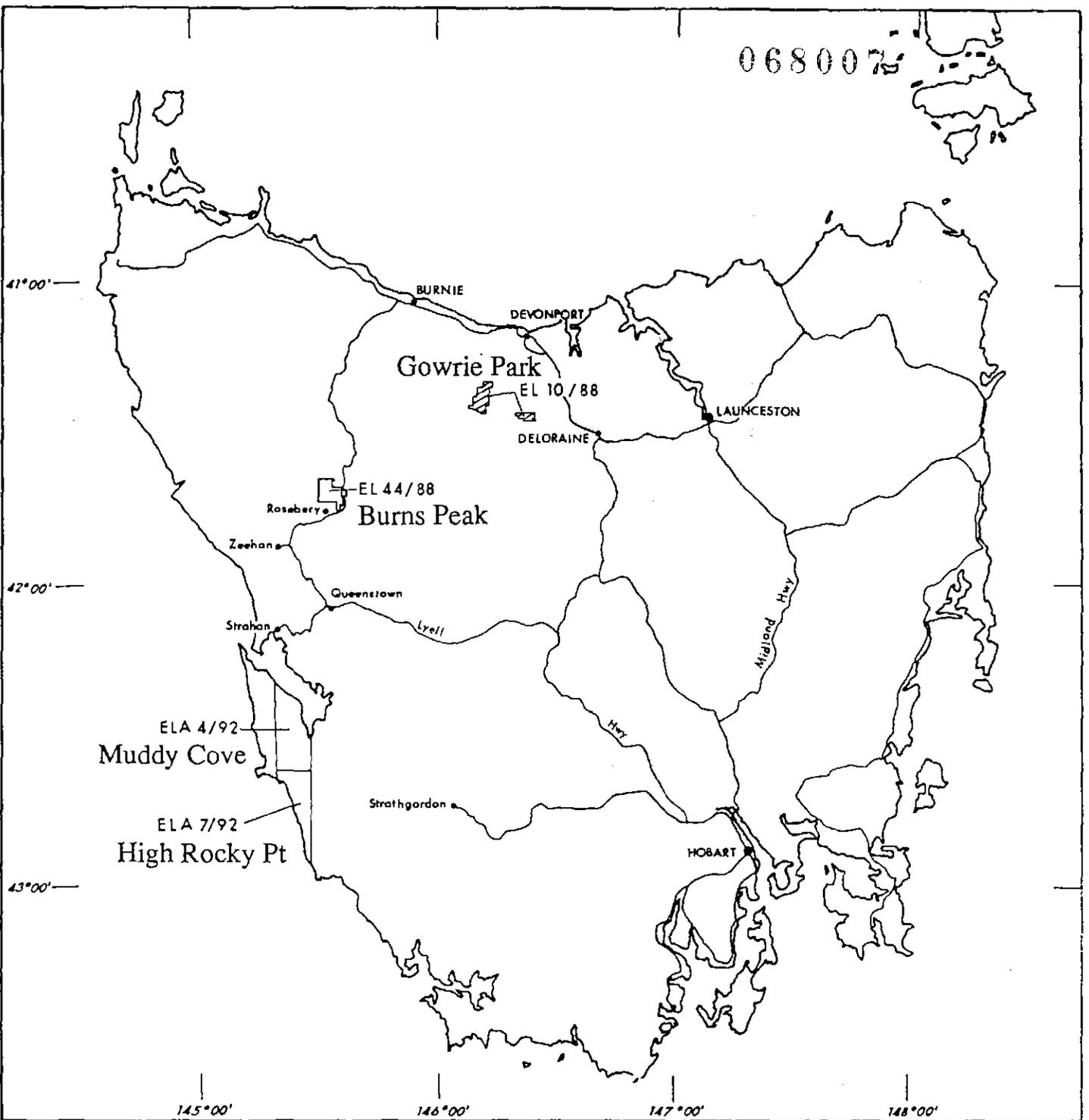
Part 2, known as Gog Range, with a total land area of 17 km² lies around 6km NNW of Mole Creek. A stone and gravel Mining Lease, 93 M/84, occupies 12 hectares towards the western end of the Gog Range.

2.2 Access and Land Usage

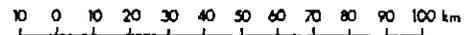
Access to both parts of the EL is very good with major roads running through them. H.E.C. and old forestry roads allow access to much of the lease, however, access to individual prospects and/or desirable drill sites is problematic, most being in areas of steep topography. Two of the prospects require access across private farmland.

Effectively all of the prospective rocks in the EL are in state forest, the exception being part of Cethana East which lies within land vested to the H.E.C. and part of the Lake Barrington prospect which overlaps onto two privately held bush blocks.

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SCALE 1:2 000 000



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REVISION	PLUTONIC OPERATIONS LIMITED A.C.N. 004 680 897	
Technical Report No:	PROJECT: TASMANIA GENERAL	
ORIG. OFFICE	PROJECT LOCATIONS	
CHECKED BY:		
DATE: APR. 1992	DRAWN BY: K.G.F. / L.H.B.	DWG. No.
SCALE 1:2 000 000	GEOLOGIST: K.M.T.	PROJECT No. 701

3.0 REGIONAL GEOLOGY

The prospective rocks within the EL are part of the Cambrian Mt Read volcanics which host five gold rich polymetallic VMS deposits. These include Mt Lyell, Hercules, Rosebery, Que River and Hellyer and the Cambrian Henty gold deposit. In addition, there are instances of sub-economic deposits and VMS style alteration throughout the belt.

All of the above deposits lie within the major north-south trending part of the belt which runs from Elliott Bay to north of Hellyer, occupying the Dundas Trough. The Mt Read Volcanics that outcrop in EL 10/88 occupy a smaller trough, the Fossey Mountain trough which trends roughly east-west from north of Hellyer to beyond Deloraine. The Fossey Mountain Trough is considered to be a branch of the Dundas Trough.

Mines Department M.R.V.P. 1:50,000 mapping stops just within the western most boundary of the EL with 1 km² included in the "Geology of the Winterbrook-Moina" area. Other than this the most recent Mines Dept. regional mapping is the Sheffield (1959) and Middlesex (1958) 1 mile to 1 inch mapping.

Early volcanism in the Main Mount Read belt was rhyolitic to dacitic in composition. This was followed by a period of andesitic-basaltic volcanism before a return to felsic volcanism. The VMS orebodies of Rosebery and Hercules are believed to have formed later in this initial felsic volcanic phase with the Que and Hellyer orebodies during the mafic-intermediate phase. The disseminated copper orebodies at Mt Lyell are hosted in the first felsic phase but are probably time correlates of the mafic intermediate phase having been deposited sub-surface, possibly due to fluid boiling.

Even within the main belt this relative aging of mineralising events is subject to considerable debate due to the overprinting of alteration and deformation over initially complex inter-fingering relationships. Placing the volcanics and associated sediments of the Fossey Mountain Trough within this stratigraphy is even less certain, however, the andesites of the Beulah Formation were quite possibly deposited during the mafic-intermediate phase. If this is the case then the north facing felsic volcanics and associated sediments to the south of these andesites may be related to the first phase of felsic volcanism with the felsic volcanics and associated sediments to the north related to the second felsic phase.

The Cambrian volcanics and associated sediments are unconformably overlain by Precambrian derived Late Cambrian-Ordovician siliciclastic conglomerates and sandstones, known as the Roland Conglomerate/Moina Sandstone in the Fossey Mountain Trough. These siliciclastics are in turn overlain by the carbonates of the Gordon Limestone.

Extensive deformation during the mid-Devonian Tabberabberan Orogeny resulted in widespread folding and faulting and the over-thrusting, in places of the Cambrian volcanics and associated sediments, by Roland Conglomerate/Moina Sandstone.

Following this deformation, the north and west of Tasmania was intruded by granitic batholiths with two such bodies intruding the rocks near EL 10/88.

In the Tertiary, basaltic lavas infilled most topographic lows, these flows now occupying topographic highs, overlying Cambrian volcanics and associated sediments in places.

4.0 EXPLORATION PHILOSOPHY

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 although equally important target is for a volcanic-hosted gold deposit. Although there are no type deposits in production 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 basement structural features (Henty Fault) and the South Hercules deposit is more akin to a gold rich low grade base metal occurrence adjacent to a mined out massive sulphide deposit.

Previous detailed surveys at the Cethana East and West prospects have failed to delineate a distinct target within the larger alteration zone. Recent IP, geochemical and geological mapping surveys have, in conjunction with a detailed assessment of previous data, shown large sections of the Cethana prospect to be highly prospective with coincident responses requiring diamond drilling.

Other explorers in the region have identified the Beulah Formation which outcrops along the Lake Barrington Rowing Course road as a probable correlate of the Que-Hellyer volcanics. This suite of mafic felsic volcanics and the underlying quartz-sericite altered felsics around Staverton are a particularly interesting horizon in the EL.

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 and epiclastics.

The style of alteration and mineralisation is somewhat enigmatic consisting of stockwork style pyrite (haematite) quartz, carbonate, base metal veining in silica-sericite-carbonate altered volcaniclastics. Pb isotopes indicate a Cambrian age for the mineralisation which is very encouraging.

5.0 LOCAL GEOLOGY

5.1 Introduction

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

5.2 Lake Barrington

Rocks in the Lake Barrington area are dominated by quartz feldspar phyric rhyolitic and minor dacitic volcanics. These include probably intrusive, extrusive and pyroclastic units with minor intercalated sequences of aphyric felsic - vitric tuffs and volcanoclastic/tuffaceous siltstones and shales. The interpreted basal portion of the sequence lying adjacent to the thrusting Roland Conglomerate - Moina Sandstone/Volcanics contact is comprised of well bedded north dipping sandstones, siltstones and shales with intercalated volcanic units 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 sub-parallel 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 merge into a volcanic dominated sequence through a transition zone of both sequences.

Alteration within the Cethana area is variable, however, a significant quartz-sericite-K spar-albite +/- pyrite-chlorite mineralogy has been mapped 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 metres wide and has minor associated base metal mineralisation occurring as disseminations, aggregates and transgressive veinlets and stringers. Results of a lead isotope survey conducted on galena rich core (CRAE drill holes) samples, predominantly late stage, cross-cutting mineralisation, produced a Cambrian signature falling within the Rosebery 95% confidence ellipse. It is possible that this style of mineralisation may be remobilised or stringer mineralisation 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 granite association is well demonstrated (F lens area).

The schistosity observed in the alteration zones at Cethana and further north at Staverton is considered to be the product of a Devonian regional deformation event where stresses appear to have been concentrated in the easily deformed mica rich sequences in preference to the less deformed and less altered more competent rocks.

The approximately east-west trending volcanics continue northward from Cethana through younger less altered dacitic and rhyolitic lavas and tuffs until a second major zone of quartz - sericite altered volcanics and sediments is encountered at Staverton. The sequence at Staverton is shown on the Mines Department 1:50,000 Cethana compilation map to be predominantly felsic agglomerate, however, cursory mapping with later petrographic work has shown the rocks to be schistose quartz phyric pumiceous and vitric tuffs, massive chloritic felsic vitric tuffs and quartz phyric crystal tuffs.

Overlying this unit to the north is the andesitic Beulah Formation. Detailed mapping along 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-volcaniclastic assemblage. Calcite-chlorite altered feldspar phyric dacitic lavas, quartz feldspar phyric glassy rhyolite lavas (with pyroclastic component) and porphyritic andesites are associated with mass flow type medium grained lithic psammites of mixed felsic-intermediate volcanic composition and minor intercalations of mixed micaceous volcaniclastic psammites and pelites.

Several sedimentary facing determinations indicate a younging generally northwards, confirming facing directions observed further south. The mixed volcanic/sediment sequence may be an equivalent to the Que-Hellyer sequence and more detailed mapping is necessary in order to ascertain its true stratigraphic position. Until May 1991, this area was covered by a recreation reserve and hence off limits to explorers, however, the reserve has been brought back under the Mining Act and exploration can now proceed.

Strong calcite-chlorite-sericite alteration was highlighted through petrographic studies on rock chips obtained from reconnaissance surveys along the access road to the Lake Barrington Rowing Course. The style of alteration is different to that observed at Cethana and Staverton.

The Beulah Formation is in turn overlain to the north by a mixed assemblage of volcaniclastic sediments, tuffaceous sediments of felsic derivation and more extensive conglomerates, grits, psammites and pelites.

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

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

5.3 Gog Range

5.3.1 Introduction

Rocks encountered in the Gog Range area have been previously mapped by Jennings 1958 as Minnow Keratophyre (volcanics) and Gog Range Greywacke (volcanics and sediments). The use of such nomenclature should not necessarily imply correlation with rocks mapped as Minnow Keratophyre and Gog Range Greywacke elsewhere.

Previous mapping and petrology has revealed that lithologies have been derived from rhyolitic to rhyodacitic magmas and include dominant quartz feldspar phyric lavas, crystal lithic and vitric tuffs, minor rhyolitic intrusives and subordinate volcaniclastic 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, which outcrop to the north of the main Mt Read Volcanics belt.

5.3.2 Prospect Geology

Recent 1:500 mapping of the Fire Tower prospect (plan 706-1) has led to a better understanding of the geology of the prospect.

Bedding orientations indicate that the lithologies dip steeply to the north and are slightly overturned in places, hence the mapping is essentially a stratigraphic section with top to the north.

The lithologies to the very south of the mapped area are the shallowly south dipping siliciclastic Roland Conglomerate which have an unconformable or faulted contact with the volcanics in the area.

To the north of the conglomerate is a thick quartz-plagioclase biotite phyric rhyolitic lava variably sericitised. In the southern part phenocrysts of feldspar and biotite are generally visible along with the quartz. In the northern part quartz is generally the only phenocryst recognisable in hand specimen. Zircon micro-phenocrysts are recognisable in thin-section.

Overlying these rhyolitic lavas to the north is a sparsely plagioclase quartz phyric crystal \pm vitric tuff shown on the map as vitric tuffs. Rare lithic fragments consist of vitric tuffs or obsidian and possibly flattened pumice. The rock is variably sericite altered and possibly silica altered. Channel sampling by the Noranda/Plutonic J.V. has revealed this unit to be barren. Although this unit contains occasional haematite veins in outcrop they are nowhere near as prevalent as in the host package to the north.

This host package consist of volcanoclastics or lithic crystal tuffs and lesser tuffaceous siltstones. Two cross sections have has been provided across this host package by DDH's GP-90-1, 4, 5, 6, 7 and 8 and DDH's GP-90-12, 13 and 14. In addition to these sections the host package has been intersected by GP-90-2, 3, 9 and 10.

In the central part of the mapped area, logging of DDH's GP-90-1, 4, 5, 6, 7 and 8 reveals the package to consist of volcanoclastics/lithic crystal tuffs overlain by tuffaceous siltstones and vitric tuffs shown on the map as vitric tuffs overlain by more volcanoclastics/lithic crystal tuffs in turn overlain by tuffaceous siltstones.

In the centre of the mapped area it is the upper volcanoclastic/lithic crystal tuff and the tuffaceous siltstone underlying it which carries the gold. To the west the tuffaceous siltstones are rarer and grades in the volcanoclastic/lithic crystal tuff are more variable and generally poorer.

The volcanoclastics/lithic crystal tuffs consist of quartz phenocrysts, fragments of quartz phenocrysts and devitrified quartz \pm plagioclase phyric felsic lavas, all in a devitrified, recrystallised and variably, though generally strongly, sericite \pm silica altered vitric ash matrix with a later calcite overprint. The rocks are possibly mass flows shed from the rhyolitic lavas and crystal \pm lithic tuffs.

The tuffaceous siltstones are also derived from the felsic volcanics with quartz and fragments of devitrified vitric ash common. Variable sericite alteration is apparently responsible for the lighter and darker banding though field relationships suggest some degree of lithological control.

The volcanoclastics/lithic crystal tuffs are extensively veined with pyrite \pm quartz \pm carbonate \pm galena \pm sphalerite \pm chalcopyrite. Haematite veining and alteration appears to be after pyrite in hand specimen, however, the petrology suggests at least some primary haematite may be present.

Late stage quartz \pm carbonate \pm sulphides cross-cut the core throughout and are seen in outcrop as shallowly north dipping tension veins.

Overlying this package of vitric tuffs and volcanoclastics is a sequence of both feldspathic and chloritic psammites, chloritic pelites and feldspathic mass flows with rounded quartz grains and lithic fragments. This latter unit has some similarities to the volcanoclastics in the host sequence but is relatively unaltered.

At the very north of the mapped area are outcrops of a chloritic lapilli tuff with large (to 20mm) chloritic fragments, possibly after pumice, and variable amounts of rounded quartz clasts.

This "hanging wall" sequence of psammites, pelites, mass flows and lapilli tuffs has occasional haematite veins but is not sericite-silica-carbonate altered like the host sequence.

Towards the western side of the mapped area outcrop becomes poorer with only the upper volcanoclastic unit and minor vitric tuffs present. As noted earlier, a quartz plagioclase biotite lava underlies this unit.

Other deviations from the stratigraphy described above are the presence of chloritic mass flows in drill hole GP-90-13 and the presence of patchy chlorite \pm silica \pm pyrite alteration in both core and outcrop. Grades are present in both core and outcrop in the west but are more inconsistent. The feeling is that mineralisation/alteration may be dying out in the west but this is yet to be proven conclusively.

A distinctive volcanoclastic consisting of quartz and feldspar (albite) was intersected in GP-90-2 and GP-90-5 near the top of the upper volcanoclastics in the centre of the mapped area.

At the eastern side of the mapped area, outcrop is sparse. Here the same suite of rocks as described in the centre of the mapped area are present with the notable exception being the volcanoclastics, however, if these were somewhat less altered they would probably be clays in this area. Bedding orientations are still steeply northern dipping suggesting a continuity along strike.

Outcrop of the host sequence is massive and stockworked with no dominant orientation of vein sets other than the shallowly north dipping tension veins. The hanging wall sediments/lapilli tuffs have a spaced cleavage which dips steeply south-west to west-south-west. The lapilli tuff/sediment and sediment/volcanoclastic contacts from east to west do not run in straight lines. This suggests that there may

be minor sinistral movement, possibly with a vertical component, along a number of planes. No discrete faulting capable of explaining such movement is seen in outcrop although minor to significant shear/breccia zones have been logged in core. However, these shears are disorientated in the core so their significance is debatable. One point of significance is that most haematite veins in the hanging wall sequence are sub-vertical and generally north-south trending.

An alternative interpretation, suggested by the form of the cliffs along the upper part of the volcanoclastic/vitric tuff package, is to have an east-north-east trending sub-vertical sinistral shear to the north of the cliff-face. This interpretation is supported by a major zone of shearing in GP-90-4 and a much lesser zone in GP-90-16 but not by the cleavage.

5.3.3 Mineralisation

With regards to the genesis of the gold, two polished sections were made from the highest grade intersection (10.0m - 11.0m, GP-90-10). Sample 10/4 is from 10.70m - 10.80m and sample 10/5 from 10.20m - 10.30m, both from GP-90-10 (see Table 2). These were analysed by Dave Huston at the University of Tasmania (see appendix D).

He concluded that the sulphides (pyrite > chalcopyrite with minor covellite and/or chalcocite) form the matrix to a brecciated quartz phenocryst rich volcanoclastic. Gold as electrum is associated with chalcopyrite masses and with chalcopyrite in fractured pyrite. Supergene processes may have enriched the gold by around 30% inferring a primary grade of around 20 g/t for this zone in GP-90-10.

5.3.4 Lead Isotope Analysis

Five samples of visible galena were submitted to SIROTOPE to determine the Pb isotope ratios (see Table 1). Preliminary results indicate the galena to be Cambrian in age. Since the galena is associated with patchy carbonate \pm silica alteration and cross-cutting carbonate \pm quartz veins, this effectively constrains alteration/mineralisation as Cambrian also. The epigenetic stockwork style of veining and the Cambrian age suggest that intrusives associated with the quartz plagioclase biotite lavas may have been responsible for the mineralisation. Leaman (see 1989-90 annual report) interprets regional gravity and magnetic data to infer that there is a major north-south intrusive spline cut by a major east-west trending basal structure. This is possibly an intrusive related to the felsic lavas, though Leaman interprets it to be part of the Beulah (granodiorite) Granite.

The Cambrian age for the mineralisation is encouraging with the possibility that the mineralisation continues at depth in the sub-vertical volcanoclastic/lithic crystal tuffs, tuffaceous siltstones and vitric tuffs.

6.0 EXPLORATION HISTORY

Asarco's initial programme was one of regional stream sediment sampling (two samples per km²) and reconnaissance mapping. Essentially all current prospects were discovered from this stream sampling.

CRAE entered into a joint venture with Asarco in 1976 and initiated ground surveys 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 led to detailed work to be conducted on the Lake Barrington, Cethana (East and West), 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	=	0.4m
	@ 8.3% Zn + 0.2% Pb		
Cethana East Hole DD 77CC5	37.8 - 38.6	=	1.0m
	@ 3.9% Zn + 0.8% Pb + 1.2% Cu		
	+ 185 ppm Ag + 0.5 g/t Au		

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

DD80 LB1	179.4 -	179.5 =	0.10m @ 14% Cu, 0.75% Pb, 0.59% Zn,
DD82 LB3	140.8 -	140.98 =	0.18m @ 9.1% Cu, 52 g/t Ag
	156.5 -	172.45 =	15.85m @ 1.2% Cu, 12 g/t Ag
	207.85 -	209.00 =	1.15m @ 1.6% Cu, 18 g/t Ag
DD83 LB4	48.0 -	49.0 =	1.00m @ 1.9% Cu, 5 g/t Ag
	225.8 -	226.3 =	0.50m @ 4.8% Cu, 36 g/t Ag, 3.2 g/t Au

A Mise a la Masse anomaly and nearly coincident IP and strong Cu soil anomaly were not tested by any of these holes.

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 base metal mineralisation. Results for this hole are as follows:

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

It should be noted that little gold assaying was undertaken 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. In particular, no detailed follow up of the Gog Range gold/tungsten panned concentrate sample - ~~now~~ the Fire Tower Prospect was undertaken. ⁶²

Some minor core re-assaying 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 mineralisation were assayed and not zones with abundant pyrite. All four Lake Barrington drill holes were assayed for gold.

7.0 WORK CONDUCTED 12 MONTHS TO JULY 1992.

7.1 Introduction

The EL 10/88, previously held under a joint venture arrangement between Plutonic Operations Ltd and Noranda Pty Ltd, became wholly owned and operated by Plutonic Operations Ltd in March 1992.

Much of the year was occupied with the transferral of ownership. Since then work has involved the following:

7.2 Review of Previous Work

A thorough review of all previous work by Asarco, CRAE and Noranda has been undertaken. This has involved a review of all geophysical data, presented as Appendix A, as well as reconnaissance checking of previous gridding, mapping and geochemistry.

The geophysical review has identified ten potential drill targets at both Cethana East and West based largely on the IP and geochemical surveys conducted by CRAE and Noranda. Brief reconnaissance mapping has indicated that some of the targets be downgraded on the basis of geology, however others appear worthy of further attention.

Two holes are proposed for the Staverton prospect, again based upon IP and geochem. This prospect is particularly interest.

A number of points other than drill targets have come out of the geophysical surveys. These can be summarised as follows:

- Lack of ground magnetics for Staverton and Cethana West and inadequate coverage of the Cethana East and Lake Barrington grids.
- Lack of correlation of co-ordinates used by previous surveys. It would appear that as many as three numbering systems were used on Cethana grids.
- A lack of consideration for the effect of topography on the location of IP anomalies.

The geological and geochemical reviews are ongoing activities, however, so far they have revealed that some previous mapping was of a relatively high standard whilst other areas require more detailed mapping.

7.3 Mapping - Fire Tower prospect, Gog Range

Mapping at 1:500 of the Fire Tower prospect has been completed in conjunction with the re-logging of the 17 short diamond drill holes drilled by the Noranda/Plutonic J.V. The logs are yet to be entered into Plutonic's Log II computerised logging system and will appear in the 1992-93 annual report. Re-logging essentially concurs with previous logging but involved the definition of discrete lithologic units. The mapping is presented as plan 706-1 and is discussed in Section 5.3.2. Prospect Geology, Gog Range.

The mapping and re-logging indicates that the gold as hosted with volcanoclastics/lithic crystal tuffs and, to a lesser degree, tuffaceous siltstones and vitric tuffs overlying and derived from quartz-plagioclase-biotite lavas and felsic crystal ± vitric tuffs.

7.4 Pb Isotopes - Fire Tower prospect, Gog Range

Five samples of visible galena from diamond drill core were submitted to SIROTOPE for Pb isotope analysis. Sample locations are presented in Table 1 with preliminary sample results in appendix B.

Pb isotopic ratios indicate a Cambrian age for this galena mineralisation. The implications of this age are discussed in Section 5.3.2 Prospect Geology, Gog Range.

TABLE 1
Sample Locations of Pb Isotope Samples

Sample No.	Hole No.	Depth	Description
Pb 1	GP-90-1	6.45m - 6.50m	1mm wide galena/carbonate cross-cutting veins.
Pb 2	GP-90-1	3.05m - 3.10m	fine galena filled irregular fractures associated with patchy silicification.
Pb 3	GP-90-10	15.42m - 15.45m	cross-cutting quartz-carbonate-galena veins.
Pb 4	GP-90-10	17.50m - 17.55m	galena as irregular clots in carbonate autobrecciation.
Pb 5	GP-90-5	29.85m - 29.30m	galena associated with carbonate veining and diffuse carbonate alteration.

7.5 Petrology - Fire Tower Prospect, Gog Range

A total of 12 samples were submitted for petrological analysis. 10 of these were submitted for plain thin sectioning with the other two cut as polished sections. Sample locations are described in Table 2.

The geology, incorporating these two sets of petrological analysis is described in Section 5.3.2 Prospect Geology, Gog Range, however, in summary, the gold is associated with chalcopyrite and pyrite in brecciated volcanoclastics, lithic crystal tuffs and to a lesser degree, tuffaceous siltstones and vitric tuffs derived from felsic lavas and crystal \pm lithic tuffs identical to those which outcrop to the south of the host rocks.

TABLE 2

Sample Locations for Thin Section – Fire Tower Prospect

Sample No.	Location	Grade	Rock Type
3/1	GP-90-1, 19.00m – 19.10m	4.65 g/t	volcanoclastic/lithic crystal tuff
2/3	GP-90-2, 15.65m – 15.70m	0.06 g/t	lithic crystal tuff
2/1	GP-90-2, 13.25m – 13.35m	0.50 g/t	lithic crystal tuff
5/1	GP-90-5, 13.45m – 13.55m	<0.008 g/t	tuffaceous siltstone
14/1	GP-90-14, 31.90m – 32.00m	<0.008 g/t	quartz-plag-biotite phytic lava
3B6	see plan 706-1	undetermined	plag-quartz phytic vitric crystal tuff
2LB	see plan 706-1	undetermined	quartz-plag-biotite phytic lava
2/2	GP-90-2, 2.90m – 3.00m	0.28 g/t	to be described
17/4	GP-90-17, 21.30m – 21.40m	1.37 g/t	volcanoclastic sandstone
15/5	GP-90-15, 28.10m – 28.20m	<0.008 g/t	volcanoclastic/lithic crystal tuff
10/4 (polished TS)	GP-90-10, 10.70m – 10.80m	30.0 g/t	volcanoclastic
10/5 (polished TS)	GP-90-10, 10.20m – 10.30m	30.0 g/t	volcanoclastic

APPENDIX A

**A drilling proposal over Cethana West grid, Cethana East grid
and Staverton prospect based on results of past geophysical surveys.**

Papken Zarzavatjian

068021

EXPLORATION LICENCE

NO. 10/88 GOWRIE PARK

A DRILLING PROPOSAL OVER CETHANA WEST GRID,
CETHANA EAST GRID AND STAVERTON PROSPECT
BASED ON RESULTS OF PAST GEOPHYSICAL SURVEYS

PAPKEN A. ZARZAVATJIAN

MAY-JUNE, 1992

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I N T R O D U C T I O N

In a report entitled "An Appraisal of Past Geophysical Surveys in Cethana EL(10/76) and in parts of Sheffield EL(7/73), Tasmania", dated January-February 1989, I reviewed all geophysical work done up till then over various grids and prospects within these ELs and recommended further geophysical surveys in places where I believed there was a need for them.

The present report is a follow-up of my January-February 1989 report. In the current report I review the geophysics completed since then and recommend further work, either as test drilling in places hosted by specific targets or propose additional surveys to enhance the current picture.

In my present review I make frequent references to my appraisal report of January-February 1989. In order that the material presented in the current report be properly understood, it is necessary for the reader to refer to the 1989 report first, or to use both reports in conjunction with each other as required.

During the preparation of the present report it was necessary for me to refer to past CRAE reports which had been made available to me previously and also additional reports I had not been familiar with. As I had explained on page 1 of the 1989 report, I followed the same system of assigning reference numbers to all new reports which were not available to me in the 1989 appraisal. These reports are

<u>REPORT</u>	<u>REFERENCE NO.</u>
EL10/76 Cethana, North Western Tasmania Report on Exploration for 12 months to February 1986	23
EL10/88 Gowrie Park Progress Report on Exploration Activity 22 August 1988 to 22 July 1989	24
EL10/88 Gowrie Park Progress Report on Exploration Activity August 1989 to July 1990	25
EL10/88 Gowrie Park Progress Report on Exploration Activity August 1990 to July 1991	26

GENERAL REMARKS

1--Steep Topographic Gradients

In areas dominated by steep gradients, serious errors have been made by CRAE as it implemented its recommended programmes of test drilling subsurface targets. Proposed holes with specified dip angles were sited by measuring dip angles from the horizontal down instead of from the surface of the ground which happens to be supporting medium to steep gradients. To illustrate this point the following two examples are given here. In the Cethana East grid area, the proposed drill hole DD77-CC4 on line 21750E was designed with a dip angle of 58 degrees, but it was drilled with an angle of 78 degrees relative to the ground surface. Also, hole DD77-CC6 on line 21600E had its proposed dip angle at 55 degrees, but was actually drilled with an angle of 67 degrees relative to ground surface.

It is important to keep in mind that in the course of a drilling programme where holes are designed to intersect discrete subsurface targets, it is necessary to take into account steep topographic variations in the vicinity of drill holes in order to be able to site them confidently. Otherwise similar errors may result, similar to those that occurred in the case of many CRAE holes.

2--Anomaly Identification System

The anomaly identification system which I have used in this report consists of three parts

- 1--The first part refers to the type of physical parameter measured, such as CHAR. for chargeability, RES. for resistivity and so on.
- 2--The second part refers to the grid or prospect name: for example, CW refers to Cethana West, STA refers to Staverton and so on.
- 3--The third part is the numeral which refers to the anomaly number. Each physical parameter has its independent numerical listing, e.g. CHAR.STA3 and MAG.STA3.

3--The Presentation of the 1990-1991 Induced Polarization (IP) Survey Results

The contouring of the IP survey results by the survey contractor was presented on the pseudo-sections but was of a sub-standard quality. Apart from two or three resistivity pseudo-sections, I have recontoured all the others, either completely or in part.

4--Airborne Electromagnetic/Magnetic Survey: Ground Transient Electromagnetic Survey

Both of these surveys were done before the period with which the present review is concerned.

For the purpose of this appraisal, I have reviewed both surveys in greater detail. In the case of Cethana East and Cethana West grids, I have included in this report a plan (figure 25, page 14) that illustrates the locations of the electromagnetic and enhanced aeromagnetic anomalies relative to both of these grids. For further discussion about the airborne work, the reader is referred to the section entitled "Airborne Electromagnetic/Magnetic Survey" in the chapter concerning the Cethana West grid.

A UTEM survey was apparently completed over both Cethana grids during 1984. For the convenience of the reader, I have listed in Appendix 2 my appraisal of the UTEM anomalies recorded over Cethana West and Cethana East grids. There are minor variations in the number of anomalies and their strengths between my listing in Appendix 2 and those presented on Enclosure 8, report 26.

C E I H A N A W E S T G R I D

Introduction

In my review report of January-February 1989, I discussed two areas on this grid which I felt were interesting enough as to require further work. One area is represented on plan Tc63 (report 20) by the 15mv/v chargeability contour closure, located toward the southern end of lines 700E and 800E (see item 2 at bottom of page 10 in the review report), and is labelled CHAR.CW1 in the current report. The second area is noted in item 3 on page 13 of the 1989 review and is referred to here as CHAR.CW2.

Both areas were subsequently covered by a two stage induced polarization (IP) survey in 1990-1991 that employed the dipole-dipole geometry (item 7a, page 14 in the 1989 review report). The lines included in the survey are:- 300E, 500E, 700E, 900E and 1100E (figures 1 to 6 in this report). A 50 metre spread was used for this survey.

Figure 1 illustrates the locations of the chargeability anomalies over the grid.

General Discussion

1--Extreme care must be exercised when correlating information between various surveys. It appears that the coordinate system numbers along grid lines have been altered from one survey to another.

In the IP and geochemical surveys conducted at the start of CRAE's exploration period, the coordinates used were "northings" and "southings" with the "00" coordinate for each line taken at the edge of a winding road that crosses the area of interest. In a later UTEM survey a "northings" only system was implemented with the coordinates falling within the range of 4000N to 5000N. I have not been able to find any plan that illustrates clearly the relationship of the old "northings" and "southings" grid with the later "northings" only grid. It became necessary for me to use the position of "road" marked on survey profiles and on various plans to define anomaly locations that were recorded in different surveys.

In the August 1990 IP survey, some lines, e.g. lines 300E to 700E, carry the "northing" designated coordinate system, but the adjoining group carry a different "southing" label.

In report 26, enclosure 8 shows that on line 600E an unmarked hole, which I assume it to be PD 84-009, is shown to be collared 30 metres away from the nearest tick on the survey line. No coordinate value appears next to the tick along this line and I can only assume its value is either a round hundreds or perhaps, a fifties northing. In report 23 this hole's collar is given as 1603N. However, this position is not compatible with that shown on enclosure 8 of report 26, irrespective of whether

the nearest tick is a hundreds or a fifties northing.

As a result of above uncertainties I wasted considerable time in a trial and error exercise in an attempt to find and establish a reference system common to all the information we want to use.

In the initial stages of Plutonic's exploration programmes, it will be most useful to prepare a plan that shows clearly the relationship between various grid systems used in any one area and to adhere to a specific system in all future work.

2--There are discrepancies in CRAE's reporting of the positions of holes DD86-CC12 and DD 86-13. In report 7 (February 1986-February 1987) the drill logs and the cross section show that hole CC12 is located on line 700E and hole CC13, on line 900E. In report 4 (February 1987-February 1988), page 8, the line numbers for these holes have been reversed. In report 26, enclosure 8 shows holes located on both these lines but there is no way of ascertaining which hole is meant to appear on what line as hole numbers are not shown next to hole collars.

Probably the information in report 7 is the correct version because it is the earliest of the three reports referred to above and contains the original data.

Airborne Electromagnetic/Magnetic Survey

In 1981 Dighem Limited completed airborne electromagnetic and aeromagnetic surveys over the entire exploration licences held by CRAE at that time. For technical details and the contractor's interpretation of the survey results the reader is referred to report 19.

In figure 25, page 14, I have presented the positions of the Dighem anomalies and the enhanced aeromagnetic anomalies over Cethana West, Cethana East and Gowrie Park grids. The latter grid is the eastward continuation of the Cethana East grid. The positions of the Dighem anomalies are approximate in relation to the grids shown in figure 25 and hence cannot be reliably correlated with the UTEM anomalies on the ground. The general unconfirmed observation however, is that only the following two anomalies might have corresponding chargeability anomaly expressions:- anomaly 30x0 might be related to CHAR.CW2 and anomaly 32xF might be related to CHAR.CW1.

All the electromagnetic anomalies within the limits of the two Cethana grids have been interpreted by Dighem Limited as "probable line sources". "Line source" refers to power, telephone, pipe or fence. The only exception is anomaly 36xH (near line 20200E, Cethana East) which is classified as possible conductor.

The general aeromagnetic picture of the Cethana West grid area is rather featureless apart from a conspicuous anomaly, AMAG.CW1, that dominates the western end of the grid, west of

800E. This an active area and contains several targets proposed for test drilling.

Any future work in the area of anomaly AMAG.CW1 and for that matter, anywhere within Cethana West and Cethana East grids, should be conducted at a maximum 100 metres line spacing.

Anomaly CHAR.CW1

Page 12 in the 1989 review report is a plan of the chargeability anomaly CHAR.CW1, based on the results of the 1976 gradient IP survey, performed over lines 100 metres apart (500E to 800E) and presented in profile form on plan TC56 (report 20).

In the follow-up 1990-1991 survey two of these lines, namely 500E and 700E were resurveyed using the dipole-dipole geometry. CHAR.CW1 can be recognized on line 500E at 4425N by a single chargeability value of 22.5 mv/v at n=1 which is only slightly higher than its neighbouring values (17.2mv/v to 19.4mv/v). On line 700E anomaly CHAR.CW1 can be identified by a cluster of values in the interval 4450N-4500N.

Assuming an idealized situation in which the source of anomaly CHAR.CW1 extends further east at, more or less a straight line, unhindered by structural complications, it will cross line 900E very close to 4600S where a shallow, weak anomaly can be observed at n=1 and 2 separations. It is not certain whether CHAR.CW1 extends as far east as line 1100E but it is possible that the anomalous value(s) between 4850S and 4900E might be the expression of this anomaly.

Hole DD 77-CC2, located at about 1065E and whose projection has been traced on the IP pseudo-section for line 1100E, may have intersected at its bottom half, the source of anomaly CHAR.CW1. The drill section and the logs show the hole to have penetrated tuffaceous pebble-breccia and vitric tuff-shale containing pyrite up to 2% and traces of galena, sphalerite and chalcopyrite. However, pyrite and base metal sulphide mineralization in this hole is not confined to its bottom half only. In fact its top half seems to have larger volumes of sulphides.

The above discussion can be summed up by noting that the source of anomaly CHAR.CW1 appears to be a thin, weakly mineralized zone of limited depth extent; it has a possible known length of 400 metres and its best development is on line 700E between 4450N and 4500N. Actually, at this location, the anomaly becomes conspicuous enough for one to suspect that it might represent a merger with anomaly CHAR.CW2 (discussed below) or that it is in fact a part of the latter anomaly.

ANOMALY CHAR.CW2

Anomaly CHAR.CW2 is a much more prominent target than anomaly CHAR.CW1. It was not recorded in the 1976 IP survey

because the survey lines did not extend far enough south.

In the first stage follow-up survey in 1990, anomaly CHAR.CW2 was partly recorded over lines 900E and 1100E. In the second stage follow-up these two lines were extended further south to register fully its presence.

On line 1100E, anomaly CHAR.CW2 is rather broad, about 350 metres wide (4900S-5250S). It is a complex zone and represents a multi-source target. There is some indication that the sources have northerly dips. Also, it attains its best development on this line.

On line 900E, anomaly CHAR.CW2 is present in the interval 4750S-4950S and appears considerably less complex. It may still constitute a multi-source target, although the possibility of a single target should also be considered. The anomaly pattern however, implies that it may be of limited depth extent.

Further west, on both lines 700E and 500E, the impression is that anomaly CHAR.CW2 is present but at a diminished strength. The survey on both lines appears to have been terminated half-way within an anomalous zone that may well be a part of anomaly trend CHAR.CW2. The suggested conclusion is that the trend of anomaly CHAR.CW2 very likely continues west beyond line 700E.

The same conclusion can be also reached concerning the eastward extension of anomaly trend CHAR.CW2 simply by comparing the 1976 survey profiles over line 1100E and 1200E. The remarkable similarity between these two profiles strongly suggests that the chargeable sources (expressed by anomaly CHAR.CW2) present at line 1100E, are also present at line 1200E. Furthermore, it is quite likely that those chargeable sources extend even further east beyond line 1200E. Unfortunately, lines 1300E and 1400E in the 1976 survey do not extend far enough south to confirm this.

Anomaly CHAR.CW3

This anomaly defines a zone that extends from line 300E to 1100E inclusive. All of the anomalies that make up this zone have weak to very weak signatures. On lines 700E, 900E and 1100E it consists of one to perhaps three readings at n=1 and 2 separations only, thus pointing to a source of limited depth extent. However, over lines 300E and 500E the anomaly pattern suggests a source of greater depth extent.

An alternative interpretation of CHAR.CW3 is that it is actually the expression of two discrete zones instead of only one. These two zones appear as one zone because of their spatial relationship to each other. In this alternative interpretation, one zone is present on lines 300E and 500E as a narrow, weak signature extending from n=1 to n=6. It does not appear to strike far enough east to reach line 700E. The other zone starts at line 500E immediately adjacent to and north of the first zone and strikes eastward across lines 700E to 1100E. On line 500E it is centred at 4650N-4700N and is represented by the 28 mv/v reading at n=1 separation. On line 700E it is represented by two readings

and on line 900E by three readings. On line 1100E it is defined by the 21 mv/v value at n=1 centered at 4600S-4650S. The source of this second anomaly zone is a weak chargeable horizon, of limited depth extent.

Geochemical and UTEM (Appendix 2) anomalies are closely associated with the CHAR.CW3 trend. Hole DD86-CC13 on line 9900E was drilled to investigate anomalous soil lead values over 500 ppm (plan Tash 3087, report 7) but the results were negative.

A weak UTEM anomaly on line 600E, at 4610N was drilled and intersected about 24 metres of 15% pyrite (plan Tash 2163, report 23). The projection of this hole, PD 84-CC9, is shown traced on the pseudo-sections of lines 500E and 700E.

Another hole, DD86-CC12 on line 7700E, at 20S was also targeted at a UTEM anomaly, interpreted to be the eastward extension of the UTEM anomaly on line 600E noted above. Only minor volumes of pyrite were encountered, reaching 5% in one section over 25 metres wide.

Anomaly CHAR.CW4

On page 18 of the 1989 appraisal report, I discussed line 300E and called attention to a change in background chargeability values at 200N-230N associated with anomalous lead and copper soil geochemical assay values and also a very weak UTEM anomaly interpreted as the expression of a shallow source. I recommended that a dipole-dipole survey be conducted over this interesting zone.

The results of the follow-up survey show that several minor anomalies are present. The anomaly that is of most interest is CHAR.CW4 centred at 4800N (coincides approximately with the old grid coordinate 175N) and is associated with the UTEM anomaly mentioned above.

Anomaly CHAR.CW4 can easily be the expression of a major contact, but at the same time it may well be the locus of an economic sulphide deposit.

Anomaly CHAR.CW5

This anomaly is centred at 4900N-4950N on line 300E. It is the expression of a weakly chargeable horizon and there are no anomalous geochemical soil assay values associated with it.

It is not possible to comment any further about this feature as it appears only on the last line covered in the 1990-1991 survey. Survey coverage on the other lines to the east do not extend far enough north to determine its presence.

Chargeability profiles of the 1976 IP gradient survey on line 300E and those further west give slightly elevated responses at the location of CHAR.CW5 on line 300E and at its expected west-

ward extension over neighbouring lines. However, such responses are not adequate enough to be accepted as a valid evidence for the westward extension of anomaly CHAR.CW5.

Proposed Drilling

Geochemical and geophysical surveys up till now have defined several notable and in some places, closely associated targets that are worth further investigation.

It is difficult to ascertain dips of chargeability sources from information provided by the dipole-dipole survey. Help must be sought from other sources, such as field mapping of outcrops in order to decide in which direction holes need to be drilled. In CRAE's reports and drill sections, bedding is shown to be dipping steeply north. Perhaps it is prudent for Plutonic to confirm that this is the actual dip direction in the field.

As explained in the first item under "General Remarks", in order to site drill holes confidently a knowledge of the steep topographic slope variations would be indispensable. Table 1, page 13, lists the specifications for the proposed drill holes and the targets that are recommended for test drilling. The inclination of the drill holes given in Table 1 refers to the angle measured relative to the prevailing topographic slope along the grid line. All the holes are to be drilled grid south on the assumption that the rocks in the grid area dip steeply north.

In the case of line 300E, recent field measurements of the topographic gradients over it give a v-shaped profile with steep sides. It is possible that the steep slope reversal can affect the defined positions of the anomalies to be drilled and so the interpreted positions of the chargeability anomalies may need to be confirmed. It is best to do this by computer modelling.

Conclusions and Recommendations

1--There is a pressing need to prepare a plan of the grid that illustrates the various coordinate systems used during CRAE's and Noranda's exploration periods in the past. The biggest advantage of having such a map is that much valuable time will be saved when we correlate new information with previous data. It can also be used to confirm that correlations between past survey results have been done without errors; but most of all it will considerably simplify the work of the interpreter.

2--On the basis of IP surveys conducted in 1990-1991, four chargeability zones are defined in the Cethana West grid area. In addition, a weak anomaly (CHAR.CW5) appears on the westernmost line surveyed and so it is uncertain if it continues further west. Survey coverage on the other lines to the east do not extend far enough north to determine its presence.

Although there is no concrete evidence to support it, there is a reasonable possibility that the chargeability trend CHAR.CE1 mapped in the Cethana East area is the eastward continuation of the Cethana West CHAR.CW2 anomaly and thus represents a major mineralized belt about two kilometres long and possibly even longer (figure 1). Future surveys must be conducted by extending previously surveyed lines far enough south to determine whether this possibility is real.

If zone CHAR.CW2 proves to be a worthwhile target in the future, dipole-dipole surveys are recommended to define both its eastern and western strike extensions.

3--CHAR.CW3 appears as a single zone extending from line 300E to 1100E. In the light of information available at present, it is equally likely that the apparent source of zone CHAR.CW3 actually consists of two separate sources. The two seem to be expressed as one zone only because of their spatial relationship to each other. If the distinction between the two sources becomes important in the future, detail IP surveys must be conducted on a local basis to resolve these two sources.

4--Several drill holes have been drilled by CRAE (Appendix 1) to investigate geochemical, UTEM and chargeability anomalies. Holes located within the area of the dipole-dipole survey have been traced on the IP pseudo-sections and the intersected mineralization is shown in colour.

The best sulphide intersection is the 24 metre pyrite section, including a 5 metre width of over 25% pyrite towards the bottom of hole PD 84-CC9 on line 600E. This hole targeted a UTEM anomaly; but the projected hole tracings on both lines 500E and 700E show the pyrite intersection to be also closely associated with CHAR.CW3 or what appears to be a part of CHAR.CW3 (see item 3 above).

Drill hole DD 77-CC2 was sited to test a geochemical anomaly. Its bottom section appears to have penetrated the interpreted zone CHAR.CW1. Pyrite, up to 2% and traces of galena, sphalerite and chalcopryrite have been logged in this section. However, both the pyrite and the base metal sulphides occur along the entire length of this hole and are not confined to the section where this hole intersects the interpreted anomaly CHAR.CW1.

All the other holes did not intersect mineralization worthy of note.

5--Chargeability zone CHAR.CW2 is by far the most prospective area for future drilling. The recommended holes for this zone are listed in Table 1, page 13.

All holes drilled must be cased by slotted PVC piping so that they are accessible in the future to downhole electro-magnetic and IP surveys.

6--A ground transient electromagnetic survey was conducted over the western section of Cethana West grid in 1984. The eastern section was not covered due to interference from electrical power grid lines that cross the area. Survey results over the lines in the western section appear normal with no apparent interference from extraneous sources. Unfortunately some survey lines in this section did not extend far enough south to cover the currently known position of CHAR.CW2 or its assumed westward projection.

Assuming that the eastern section of the grid is not amenable to electromagnetic surveys, there still exists the need to cover the southern extensions of lines 700E and 500E by an electromagnetic survey to investigate the responses of the assumed extension of CHAR.CW2 further west. This area is too small for Pitonic to engage an electromagnetic survey contractor to carry out the work on its own. It would be best to make it a part of a larger programme that encompasses several areas.

7--If any of the holes in the proposed drilling programme interests economic base metal sulphides, there would be a need to conduct more dipole-dipole IP surveys, especially in areas that are inaccessible to electromagnetic methods due to extraneous interference problems.

In such a situation, follow-up surveys would be recommended not only as infill lines (if thought necessary) but also to map along strikes, extensions of any targets that might extend beyond the area currently covered by dipole-dipole surveys.

8--To the best of my knowledge Cethana West has not been covered by any magnetic surveys. The reason, most likely, is because of the presence of electrical power grid lines. Nevertheless, an attempt should be made to do so on a test basis. In localities where UTM and chordality anomalies are marked for further investigation, the aim of the test survey initially is to determine if magnetic survey results are contaminated by extraneous factors, such as the power grid lines, and if so, determine what is the safe distance away from the power lines where the readings are free of such contamination.

The most important section of the grid that needs to be covered by a ground magnetic survey is the area west of line 800E where the aeromagnetic anomaly AMAG.CW1 is located (Figure 25, page 14).

As the area hosts a suite of acid volcanic rocks, it is unlikely that high amplitude anomalies are present. Therefore care should be exercised to make sure that nothing subtle is overlooked.

9--My recommendation is that there are enough targets at Cethana West grid at present to support a drilling programme without initiating new induced polarization or electromagnetic surveys.

Pitonic will be in a better position to decide as to what the next step will be after the recommended holes have been drilled.

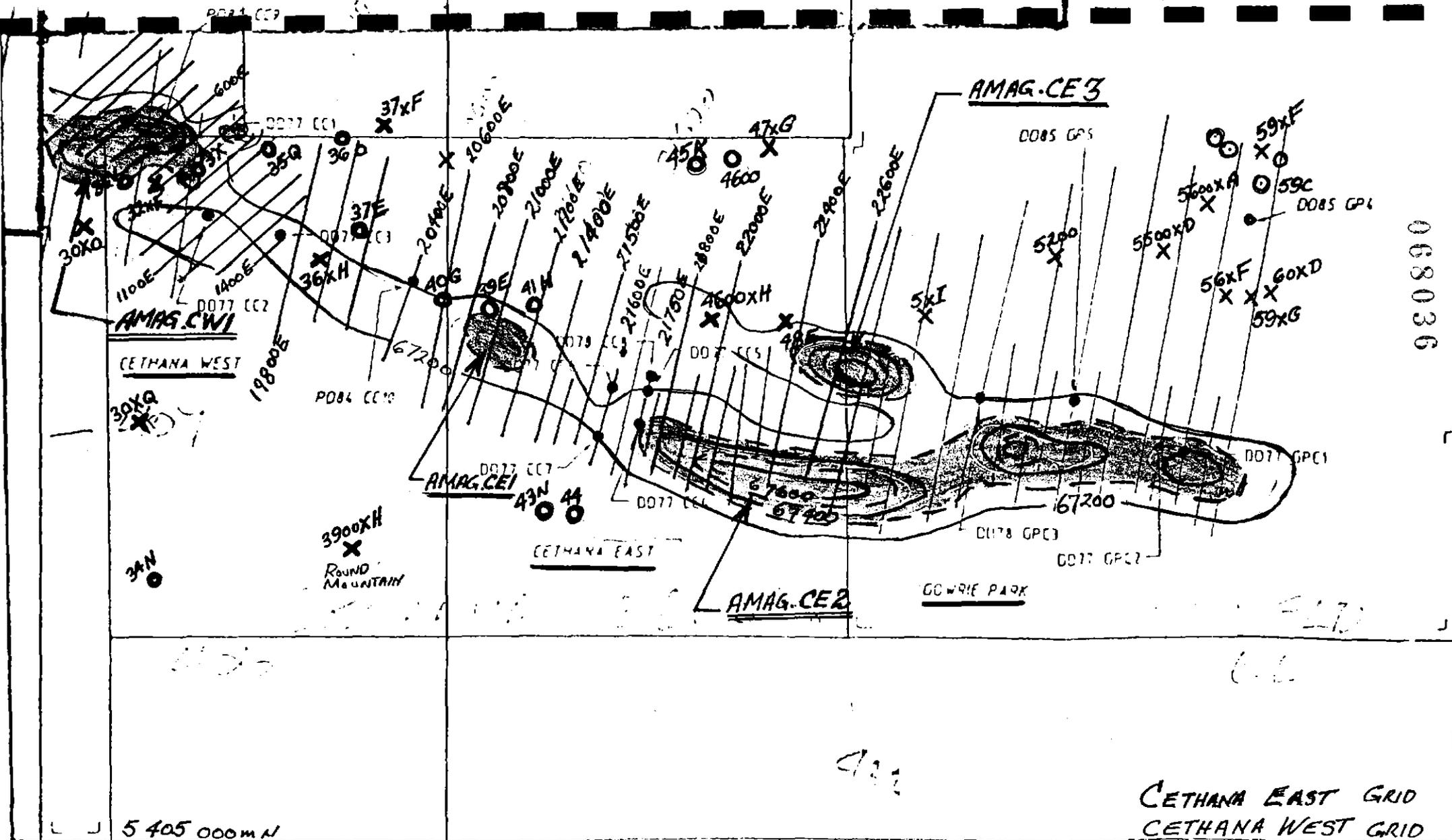
10--All future surveys over any part of Cathana West grid should be conducted at a maximum 100 metres line spacing. This is specially relevant in the area of anomaly AMAG.CW1 where survey coverage should include the lines up to 100E and perhaps more lines even further west.

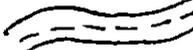
11--It is advisable to prepare a computer plot of the IP survey results over line 300E and to take into consideration the effect of the steep v-shaped topography on the positions of the chargeability anomalies.

TABLE 1

PROPOSED DRILL HOLES CETHANA WEST

Anomaly	Line No.	Anomaly Co-ord	Priority	Hole Collar Co-ord	Inclination (Degrees)	Depth (m)
CHAR.CW3	300E	4675N	low	4690N	60	100
CHAR.CW4	300E	4750N--4825N	moderate	4840N	60	180
CHAR.CW5	300E	4925N	low	4970N	60	100
CHAR.CW3	500E	4625N--4675N	?moderate	4700N	50	150
CHAR.CW1	700E	4450N--4500N	moderate	4515N	50	250 max
CHAR.CW2	900E	4750S--4950S	high	4795S	60	150
CHAR.CW2	1100E	4950S--5250S	high	4890S	60	200
			high	4960S	60	200
			high	5050S	60	200
			high	5110S	60	200



 aeromagnetic contours
 100 nT intervals
 ○ Conductor
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 14
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DIGHEM II ELECTROMAGNETIC AND ENHANCED
 AEROMAGNETIC ANOMALIES OVER CETHANA
 WEST, CETHANA EAST and GOWRIE PARK GRIDS
 REFERENCE: REPORT 19, July 1981

CETHANA EAST GRID
 CETHANA WEST GRID
 GOWRIE PARK GRID

1: 25000

Figure 25

068036

TE

068037

C E I H A N A E A S I G R I D

Introduction

In the 1990-1991 follow-up IP survey, the following lines were completed using the dipole-dipole geometry and a 50 metre dipole spread:- 19800E, 20200E, 20400E, 20800E, 21700E, 21800E, 22200E, 22400E and 22600E (figures 7 to 10, 14, 19 to 22). No reason is given in report 26 as to why these lines were surveyed.

In my 1989 review, I referred to an earlier gradient IP survey and recommended (page 6) that certain locations over lines 19800E and 20800E "be checked to ensure that the recorded chargeability responses can be satisfactorily explained by cultural features noted in their proximities". The idea here was to run a visual field inspection for identifiable cultural features but not necessarily perform an IP survey. I assume my recommendation was taken to mean that a follow-up survey was required over these two lines.

On page 6 of the 1989 report I recommended the detailing of certain sections over lines 20200E, 20400E and 21800E because the earlier IP gradient survey had given encouraging responses. I assume my recommendation was enacted in part by including lines 20200E and 20400E only, in the 1990-1991 follow-up survey.

Lines from 21500E to 21800E inclusive had been surveyed in 1979, using the dipole-dipole geometry and a 20 metre dipole spread (figures 11, 12, 15, 17, 18). In my discussion of these lines in the 1989 report (pages 25 to 28), I pointed out that a major chargeability anomaly (labelled CHAR.CE1 in the current report) had been only partially surveyed. Apparently, lines 21700E, 21800E were included in the 1990-1991 survey to record the complete anomaly and the remaining three lines (22200E, 22400E and 22600E), to map its eastward extension.

Lines 19800E, 20200E, 20400E, 20800E

For correlation purposes, positions of the UTEM anomalies on these lines are shown on Enclosure 8, report 26.

On line 19800E the areas of interest occur at 2970S and 3300S as recorded in the 1979 IP gradient survey. The follow-up 1990-1991 survey confirmed the presence of a shallow, weak to moderate anomaly centred at 2950E and a second moderate anomaly at 3300E-3400E that extends from n=1 to n=6. A weak UTEM anomaly is apparently associated with it (Enclosure 8, report 26).

On line 20200E, the area of interest, 3400S-3500S, occurs at the very edge of the section detailed in the 1990-1991 survey, but there is sufficient coverage to indicate that there are no interesting anomalous signatures here. However, a UTEM anomaly does appear at this location.

Two chargeability anomalies worth noting have been recorded

elsewhere on this pseudo-section. The first one is a weak but well defined feature, centred at 3000E. The second one is also weak but has a broad signature and is at its shallowest at 3250E-3300E.

On line 20400E, the 1977 gradient survey registered a local chargeability high coinciding with a resistivity low; but the follow-up survey recorded a shallow, very weak chargeability anomaly at 3500E-3550E within a broad area of resistivity highs.

Another moderate to strong chargeability anomaly occurs at 3150E-3350E. A narrow, well defined resistivity low coincides with the major part of this anomaly. If the possibility of structural dislocations can be discounted in the vicinity of this anomaly, then it would be an area worthy of further investigation.

On line 20800E, the point of interest is at 3200E. The follow-up survey covered a section from 2950E to 3700E and registered several anomalies as shown on the pseudo-section. Unfortunately this line had not been covered by the UTEM survey.

In practical terms, it is difficult to discuss these anomalies confidently unless more information is acquired about them. According to Enclosure 9, report 26, the major part of line 20800E, where all the chargeability anomalies are located has not been covered by a geochemical soil survey. The magnetic picture as presented on plate 3, report 21, is quite meaningless.

On appearance alone, I think the following anomalies are interesting and merit further work:-

- CHAR.CE2, line 19800E, at 3300E-3400E
- CHAR.CE3, line 20200E, at 3000E
- CHAR.CE4, line 20600E, at 3400E-3550E
- CHAR.CE5, line 20800E, at 3250E-3350E
- CHAR.CE6, line 20800E, at 2950E-3000E

Area of Lines 21700E, 21800E, 22200E, 22400E, 22600E

A strong, broad and well defined chargeability anomaly is recorded over each of these lines. Although there is a lack of survey information over a section 400 metres long in the central part of the area bounded by lines 21800E and 22200E, anomaly characteristics in each of the surveyed lines give the distinct impression that they are the expressions of the same source(s) labelled as anomaly zone CHAR.CE1. At both its extremities this zone displays high amplitudes and well defined characteristics, thus indicating that it most likely continues well beyond its currently known position.

The 1979 dipole-dipole survey recorded only a part of this anomalous zone. It was conducted over the following six lines:- 21500E, 21600E, 21700E, 21750E and 21800E. The shorter 20 metre dipole spread used for this survey provided greater resolution but less depth penetration than the 1990-1991 survey. The greater resolution permitted the identification of a minor anomaly B, related to the major anomaly A (the two features are labelled CHAR.CE1 in the current report).

The three new lines 22200E, 22400E and 22600E are covered by the 1990-1991 survey only. The patterns recorded over these lines also permit identification of a minor signature intimately related to the major feature which constitutes the bulk of anomaly CHAR.CE1. I have taken the minor signature on these lines to be equivalent to anomaly B and the major feature to be the equivalent of anomaly A. I have also marked them as such on the pseudo-sections of these lines.

It can be seen from my tracing of the drill holes on the pseudo-sections for lines 21600E and 21750E that none of them have satisfactorily tested the chargeability anomalies. Obviously, future drilling needs to be targeted at the chargeability anomalies, the idea being that the poorly chargeable sulphides such as galena and sphalerite are intimately associated with the more chargeable pyrite. I have discounted here, maybe prematurely, the presence of chalcopyrite in appreciable quantities because surface geochemical soil and rock surveys do not record high copper values. However, it is just as possible that the chargeability anomalies reflect the presence of pyrite only, with the base metal sulphides, if present at all in appreciable quantities or otherwise, occurring as a separate entity nearby. In such an instance, targeting chargeability anomalies will produce largely pyritic sulphide intersections.

The five holes drilled in Cethana East are all located on lines 21600E and 21750E (figures 13 and 16). They were sited to test the gradient chargeability anomalies recorded in the 1977 IP survey. With the probable exception of hole DD 77-CC4, all holes failed to intersect anomalies outlined by the 1979 dipole-dipole survey. Figures 12 and 17, included with this report, illustrate the correct relationships of the chargeability anomalies to the drilled holes.

It is interesting to note that hole DD 77-CC4, which is likely to come very close to the edge or perhaps even just inside the edge of the source of anomaly A has intersected most of the sulphides which are pyrite with minor amounts of galena, sphalerite and chalcopyrite. The other four holes which do not appear to have intersected any of the high chargeability zones, not only carry sulphides as such, but also greater volumes of galena, sphalerite and chalcopyrite than hole DDH 77-CC4.

Airborne Electromagnetic/Magnetic Survey

The reader is referred to sections bearing the same title as this section in the chapters entitled "General Remarks" and "Cethana West Grid" for part of the discussion on the airborne survey over the Cethana East grid.

I have already commented on the Dighem electromagnetic anomalies in the discussion given in the chapter "Cethana West Grid" (figure 25, page 14).

The aeromagnetic picture consists mainly of two elongate

east-west trends that extend into the Cethana grid areas from the Gowrie Park grid to the east. The stronger southern trend strikes westward across the Cethana East grid and projects further west into the Cethana West grid. These two trends support three local anomalies AMAG.CE1, AMAG.CE2 and AMAG.CE3.

The overall aeromagnetic pattern over the three grids gives the impression that the trends and probably anomaly AMAG.CE2 are more likely to be the expressions of rock types and are not related to the presence of sulphides. This observation is supported by drawing upon the results of a ground magnetic survey completed in 1977. It was conducted by Scintrex Pty. Ltd. on behalf of CRAE (report 21). All the lines from 19600E to 22200E inclusive were surveyed. Apart from a multitude of small weak to very intense anomalies that reflect shallow, near surface sources, the ground magnetic survey also recorded anomaly AMAG.CE1 over line 21600E and the northern flank of anomaly AMAG.CE2.

The ground magnetic profile over line 21800E suggests that it is unlikely for the source of anomaly AMAG.CE2 to be shallower than 100 metres. Furthermore, correlation of the position of anomaly CHAR.CE1 recorded over various lines with the ground magnetic profiles filed with report 21 failed to define any diagnostic magnetic signatures that can be reliably associated with the chargeability anomalies. Yet, if anomalies AMAG.CE1, AMAG.CE2 and AMAG.CE3 are located in areas hosted by acid volcanic rocks, they deserve closer scrutiny because they might define geological environments favourable for the presence of volcanogenic massive sulphide deposits. Obviously, this statement also applies to anomaly AMAG.CW1 in the Cethana West grid.

It is recommended that anomalies AMAG.CE1, AMAG.CE2 and AMAG.CE3 be covered by ground magnetic surveys at a maximum 100 metres line spacing.

Proposed Drilling

The known strike length of zone CHAR.CE1 at present is about 1000 metres. As there is hardly any information available concerning the source(s) of this anomalous zone, there is undoubtedly scope for drilling a number of holes along its strike length as well as across it.

It is not difficult to recommend drill hole targets to test the chargeability highs along the trend of CHAR.CE1. However, as discussed in the section entitled "General Remarks", in order to site the holes confidently a knowledge of the steep topographic slope variations would be almost necessary.

The chargeability anomalies over both lines 21600E and 21750E still need to be tested and the following holes are recommended.

line 21600E

1--A hole at 3548S, dipping grid south and making a 60 degree angle relative to the topographic slope. A depth of 100 metres is

sufficient to investigate the merits of the recorded chargeability anomaly. Obviously, if the hole bottoms in sulphides, drilling must continue until it encounters a reasonable section of barren ground.

2--A hole at 36276, with similar specifications as the proposed drill hole at 35488.

line 21750E

1--A hole at 498 with similar specifications as the proposed hole at 35488 on line 21600E.

2--A hole at 1658 with similar specifications as the proposed hole at 35488 on line 21600E.

As for lines 22200E, 22400E and 22600E, if the topographic gradients in their vicinity are assumed to be uniform, the following drill holes are recommended, to be drilled grid south at inclinations measured relative to the general slope of the topography:-

Hole coord.	Inclination (degrees)	Depth (m)
22200E/6758	60	250 max.
22200E/830E	60	250 max.
22400E/690S	60	220-250
22400E/870S	50	300 or deeper
22600E/875S	60	220-250
22600E/985S	50	250 max.

Conclusions and Recommendations

1--Several chargeability anomalies were recorded on lines 19800E, 20200E, 20400E and 20800E in the 1990-1991 dipole-dipole survey. In order to evaluate properly the significance of these anomalies, information from other sources is required. However, on the basis of appearance alone, the following anomalies are worthy of further investigation-

- CHAR.CE2, line 19800E, at 3300S-3400S
- CHAR.CE3, line 20200E, at 3000S
- CHAR.CE4, line 20800E, at 3400S-3550S
- CHAR.CE5, line 20800E, at 3250S-3350S
- CHAR.CE6, line 20800E, at 2950E-3000S

2--In the 1990-1991 dipole-dipole survey, a major, well defined, medium to high amplitude chargeability zone CHAR.CE1 was recorded over each of the surveyed lines from line 21700E to line 22600E inclusive. A 50 metre dipole spread was used for the survey. Although there is a 400 metre section in the centre of this area where IP survey coverage is lacking, the similar anomaly characteristics on all the lines strongly suggest that the recorded anomalies are the expressions of the same chargeable horizon(s).

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Although there is no concrete evidence to support it, there is a reasonable possibility that the chargeability trend CHAR.CE1 is the eastward continuation of the Cethana West CHAR.CW2 anomaly and thus represents a major mineralized belt about two kilometres long and possibly even longer (figure 1). Surveys must be conducted by extending previously surveyed lines far enough south to determine whether this possibility is valid.

3--The western portion of CHAR.CE1 was also partially mapped in the 1979 diacole-dipole survey in which a 20 metre diacole spread was used. The lines covered by this survey are confined to the area between 21500E and 21800E inclusive. Line 21500E does not extend far enough south to record the likely presence of CHAR.CE1. The survey specifications were detailed enough to resolve minor anomalies within zone CHAR.CE1. It is also possible to recognize what seems to be similar, minor features in the results of the 1990-1991 survey over lines 22200E, 22400E and 22600E.

The chargeability highs are very likely to be the expressions of pyrite. Associated with the pyrite, it is expected that weakly chargeable base metal sulphides such as galena and sphalerite would be found. However, it is equally likely that the bulk of the high chargeability areas reflect the presence of pyritic horizons with the base metal sulphides, if present at all in appreciable quantities or otherwise, occurring in adjoining zones.

4--In the section entitled "Proposed Drilling", recommended drill hole positions are given over lines 21600E, 21750E, 22200E, 22400E and 22600E. In the case of the last three lines it is assumed that the topographic slopes in their vicinity are uniform in general. All the recommended hole inclinations are to be measured relative to the prevailing topographic slopes along each line.

4--Ground magnetic surveys should be conducted to map anomalies AMAG.CE1, AMAG.CE2 and AMAG.CE3 at a maximum 100 metres line spacing.

068043

STAVERTON PROSPECT

Introduction

No new work has been performed in this Prospect since my appraisal in January-February 1989. The centrepiece here is the remarkable coincidence between anomalous geochemical soil assay values and chargeability values derived from a dipole-dipole survey over a strike length of about 600 metres, from line 400E to line 1000E (figures 23 and 24).

CRAE reports on the geology note the presence of alteration in the form of sericitic and quartz sericite schists, slates and phyllites in the area of the anomalous chargeability and geochemical trends.

General Discussion

Apart from an IP survey a Pulse Electromagnetic survey was carried out over short segments of line 600E, 700E, 900E and 1000E with negative results. A UTEM small test survey, at a later date, over lines 400E, 500E and 600E registered weak to very weak signatures coincident or nearly coincident with chargeability highs.

In report 12, page 21, it states that "The area is magnetically flat, as witnessed by the Dighem-aeromagnetic survey. No ground magnetometry has been attempted". According to my past experience I feel that it is not prudent to draw conclusions based completely on results of airborne surveys. Ground magnetic surveys must be conducted in the vicinity of targets recommended for further work. It must always be kept in mind that magnetic responses over acid volcanic rocks are, more or less, rather subtle and therefore weak anomalies may not be recorded by an airborne survey, especially when we take into account flightline separation...etc.

In 1983 CRAE drilled hole PD 83-5F1 on line 600E (report 13) to test an area where geochemical, IP and a minor UTEM anomaly coincided. However, as I have indicated in the 1989 appraisal report, perhaps a decisive factor in CRAE's choice to drill line 600E was because it recorded the most "meaningful" chargeability expression in the entire survey. By "meaningful" I refer to the well defined outline of the chargeability anomaly which can be reliably interpreted as due to a rectangular-like source of limited depth extent. I have sketched in pencil on the pseudo-section the probable position of the source of the IP anomaly. An unknown factor which might alter considerably this interpretation is the severe topography whose profile along line 600E is shown on the pseudo-section. However, I cannot be sure whether this profile is drawn to scale or is just sketched.

Past reports have drawn attention to the remarkably good coincidence between the high lead, zinc and copper soil assay values and chargeability anomalies almost along the entire length of the anomalous chargeability trend. However, the best assays

are found on lines 500E and 900E. In the June 1980 dipole-dipole survey, nearly all the lines were covered using the 25 metre dipole spread. In addition, three lines, 500E, 1000E and 1100E were resurveyed with a 50 metre dipole spread. I have marked the details of the lines covered by the survey, the interpreted anomalies and their trends on the geological plan TASH 1140 (report 12), a copy of which is included as figure 24 with this report.

No Dighem anomalies could be detected within the grid area.

PROPOSED DRILL TARGETS

I recommend that the following holes be drilled:-

- 1--Line 900E, a hole at 25S dipping 60 degrees grid south to a depth of at least 100 metres.
- 2--Line 1000E, a hole at 60S dipping 50 degrees grid south to a depth of 120 metres. It is probable that mineralization will be found at greater depths as shown by anomalous chargeabilities at the larger separations (n=4,5,6) for the 50 metre dipole.

On the basis of the results of the drill holes above a second hole may be drilled on each of the above lines, as follows:-

- 1--Line 900E, a hole at 75N, dipping 60 degrees grid south, to a depth of at least 100 metres.
- 2--Line 1000E, a hole at 00N, dipping 60 degrees grid south to a depth of at least 100 metres.

All holes should be cased by slotted PVC piping so that they are accessible in the future to any downhole electromagnetic or IP surveys.

It is difficult to ascertain dips of chargeability sources from information provided by the dipole-dipole survey. Help must be sought from other sources, such as field mapping of outcrops in order to decide in which direction the holes should be drilled. Geological plan TASH 1140 (report 12), contains only a single steep dip and is located just north of coordinate 100N on line 1100E. Also, the hole PD 83-SP1 on line 600E was drilled with a south dip. The drill section (report 13) does not interpolate between the mapped surface rocks and those intersected in the drill holes. Furthermore, there are no comments in the report as to whether the hole direction was correct or otherwise. Therefore it would be logical to conclude that until further evidence is provided to the contrary, dips of all holes to be drilled in the future, would be in a southerly direction.

An alternate approach to line 900E would be to postpone the drilling of the holes recommended above until after a 50 metre dipole IP survey is completed over it. The greater depths of up to nearly 150 metres probed by this survey would help guide the drill programme at greater depths.

In situations where severe topographic variations are present such as shown on the pseudo-section of line 600E, the interpreted position for the source of the chargeability anomaly

may need to be confirmed. It is best to do this by computer modelling. However, in the case of lines 900E and 1000E which are included in the current drilling recommendation, the topography in the region of the proposed drilling is much less severe than that along line 600E and therefore the computer modelling exercise is not warranted.

Conclusions and Recommendations

1--Staverton Prospect is marked by a remarkable coincidence of anomalous geochemical soil assays of lead, zinc and copper values with anomalous chargeability trends over a 600 metre strike length in an area marked by sericitic and quartz sericitic alterations.

2--The anomalous chargeability trends(s) are still quite readily recognizable on the easternmost line (1000E). If future drilling of the IP anomalies proves that they are valid indicators of economic sulphides, the IP survey coverage needs to be extended further east. Also, it is likely that any of the previously surveyed lines which have been covered only with the 25 metre dipole spread may require to be resurveyed with the larger 50 metre dipole spread.

3--Although it is worthwhile to perform electromagnetic surveys over lines not covered satisfactorily by such surveys up till now, there is actually no pressing need for it at present because firstly, drill targets can and have already been recommended on the basis of information available to us at present, and secondly, the volume of survey work to be done is not sufficiently large to justify an electromagnetic survey contractor to be engaged. It would be best to make it a part of a larger future programme that encompasses several areas.

4--Ground magnetic surveys are recommended, initially on a test basis, over areas of interest.

5--Holes recommended for drilling have been discussed in the section entitled "Proposed Drilling". Initially, two holes are recommended, one on each of the lines 900E and 1000E. Depending on the results obtained, two more holes are recommended, one over each of the same lines.

An alternate approach would be for the holes on line 900E to be drilled after this line is covered by a dipole-dipole IP survey, using the 50 metre dipole spread.

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APPENDIX 1

CRAE DRILL HOLE INFORMATION

068047

TABLE 1

CETHANA WEST AND CETHANA EAST GRIDS

References: -CRAE reports 3, 4, and 7

Hole Number	Collar coordinates	Depth (m)	Inclination (degrees)	Azimuth(1) (degrees)
DD77001	825E/35S	106.4	55	45
DD77002	1075E/154.5S	164.1	61	210
DD77003	1400E/20N	190	65	208
DD77004	21750E/140S	149.7	58	180MN
DD77005	21750E/8S	164.2	55	180MN
DD77006	21600E/3505S	200.5	55	180MN
DD77007	21600E/3718S	137.4	50	180MN
DD77008	21750E/44N	157.6	55	180MN
PD84009	600E/4602N	102	60	360
PD84010	20400E/73945(2)	96	60	180
DD860011	? 700E/20S(3)	77	55	232AMG
DD860012	? 700E/20S(3)	190	55	232AMG
DD860013	? 900E/00(3)	229.5	60	232AMG

(1) Except where indicated, it is uncertain whether the azimuth refers to true north (TN), magnetic north (MG), grid north (GN) or Australian Metric Grid (AMG).

In the Cethana area magnetic north is approximately 12 degrees east of AMG.

(2) The southing coordinate given in above table appears on page 7, report 4. This position is different from that which is shown on plan TASH2662 (report 4). The collar on this plan is located at 3655S. The latter position is also confirmed by drill log information which gives the equivalent AMG coordinates for the hole collar (report 3).

(3) The line numbers for holes CC11, CC12 and CC13 shown in above table appear on the drill logs and sections in report 7. The line numbers however are reversed on page 8 and plan on TASH 2662 in report 4.

TABLE 2

STAVERTON GRID

Reference: Report 13

Hole Number	Collar Coordinates	Depth (m)	Inclination (degrees)	Azimuth (degs. M.N.)
PD83SP1	600E/165N(1)	102	65	225

068048

(1) Text and drill hole logs show that the hole is located over line 600E. Plan TASH 1947 has the hole positioned over line 500E.

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A P P E N D I X 2

U T E M A N O M A L I E S R E C O R D E D
O V E R C E T H A N A W E S T A N D C E T H A N A E A S T
G R I D S

068030

The number that appears in the parenthesis refers to latest channel number at which the presence of the anomaly is apparent. The smaller the number the more conductive the source.

CETHANA WEST

<u>Line Number</u>	<u>Anomaly Coordinate</u>
100E	4840N(8) 4700N(8)
200E	4840N(8)
300E	4800N(76)
400E	4800N(8)
500E	4800N(8)
600E	4610N(7)
700E	4635N(4) 4710N(9) 4840N(9)
800E	the 4700N-4975N section only surveyed--no anomalies detected
900E	not surveyed
1000E	not surveyed
1100E	not surveyed
1200E	4210N(8) 4360N(8) 4540N(8)
1300E	4490N(8)

CETHANA EAST

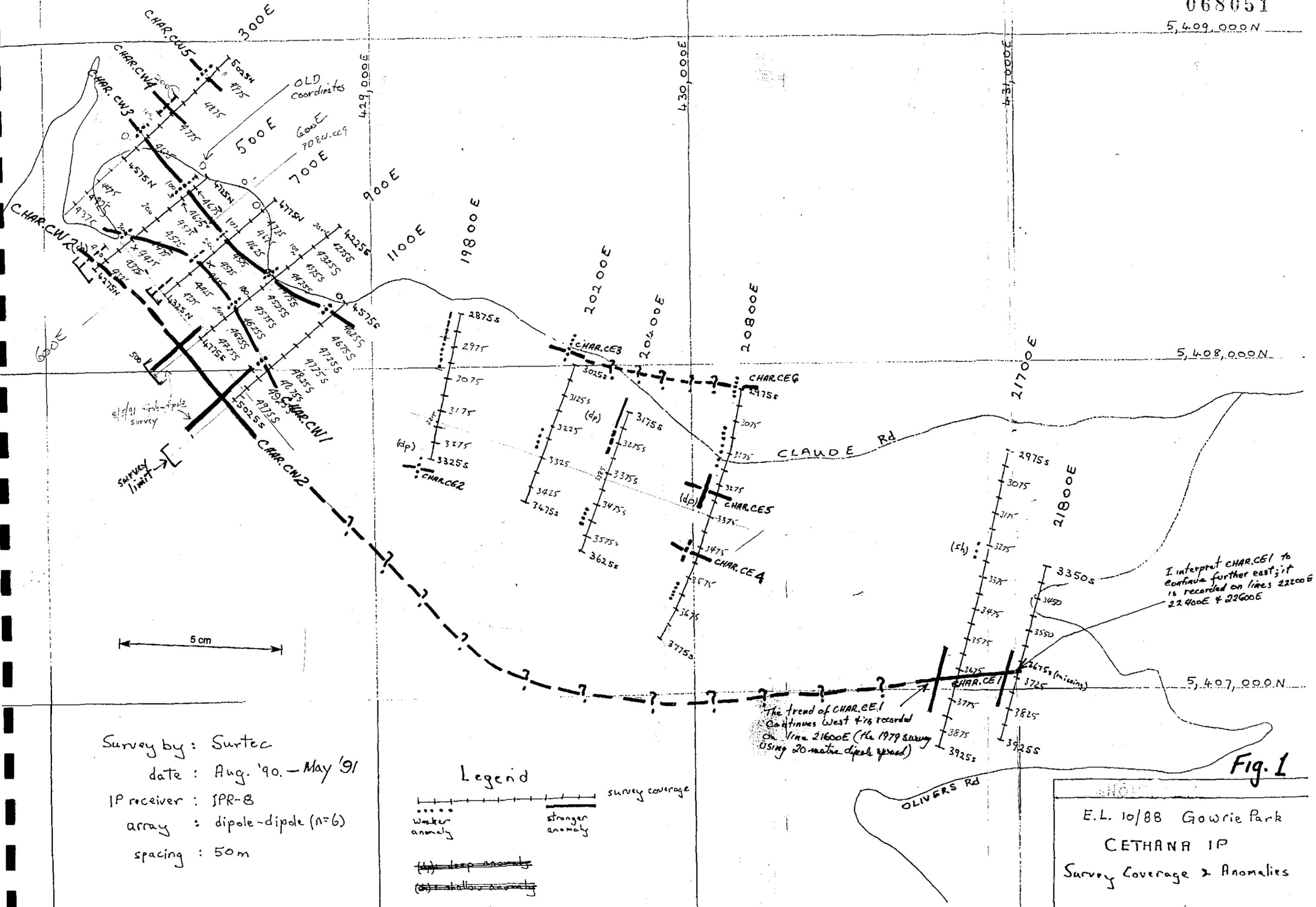
19800E	210S(8)
	375S(9)
20000E	340S(7)
	410S(7)
20200E	350S(8)
20400E	265S(8)
	415S(7)
20600E	450S(8)

The following lines are located within the Cethana East grid but are shown as Gowrie Park grid on the UTEM survey plots:-

21100E	4600N(7)
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Lines 21300E to 22600E at 200 metre intervals have also been surveyed but appear to have been distorted by excessive noise.

The available UTEM survey results are shown with different coordinate markings than those used for other surveys. Consequently, the anomaly listing in Appendix 2 cannot be used directly to transfer UTEM anomaly positions to other survey plots. Other sources must be relied upon, such as enclosure 3, report 26.



Survey by: Surtec
 date: Aug. '90. - May '91
 IP receiver: IPR-8
 array: dipole-dipole (n=6)
 spacing: 50m

Legend

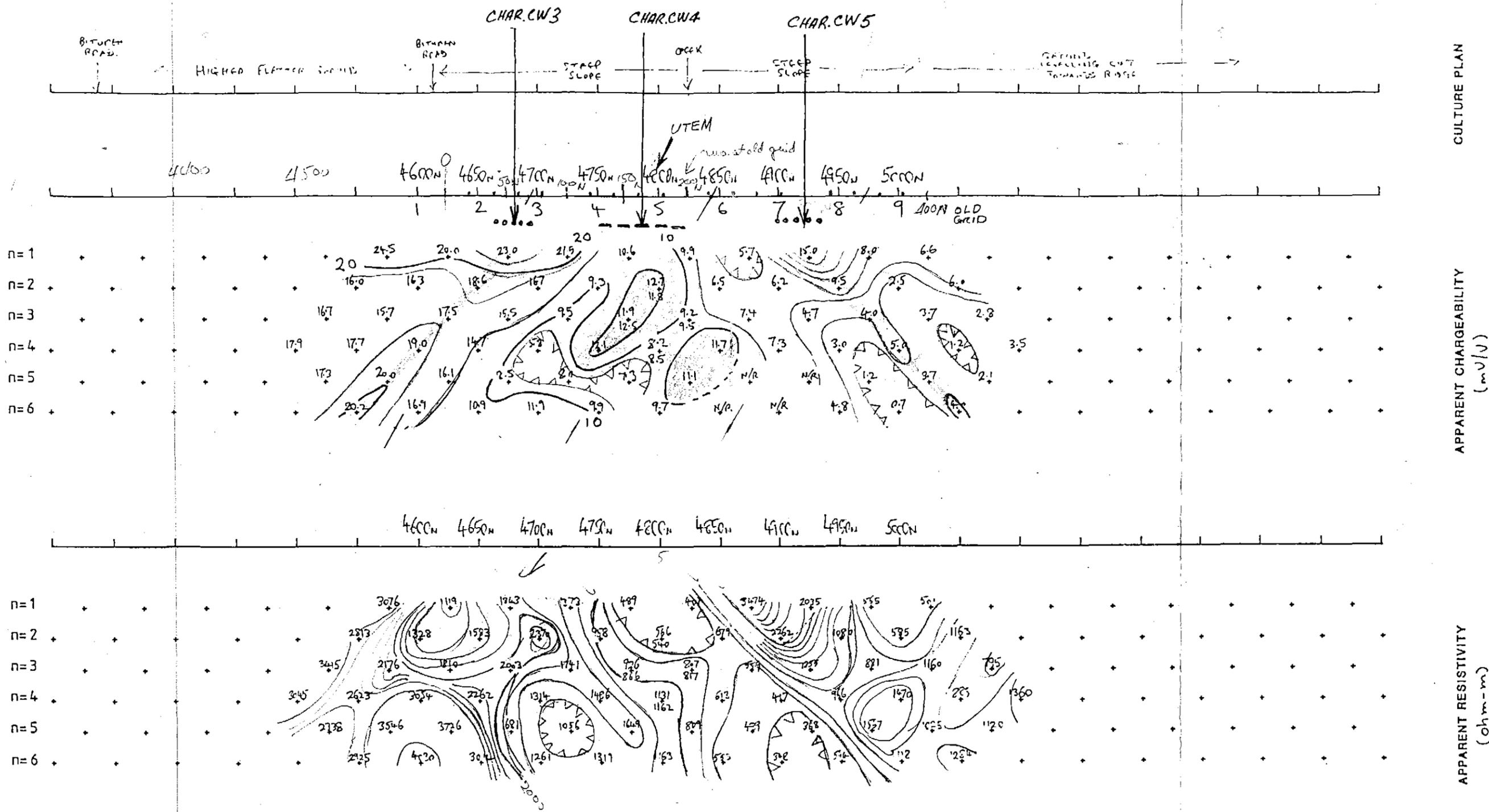
survey coverage
 weaker anomaly
 stronger anomaly
 deep anomaly
 shallow anomaly

The trend of CHAR.CE1 continues west & is recorded on line 21600E (the 1979 survey using 20 meter dipole spread)

I interpret CHAR.CE1 to continue further east; it is recorded on lines 22200E & 22400E & 22600E

Fig. 1

E.L. 10/88 Gowrie Park
 CETHANA IP
 Survey Coverage & Anomalies



EQUIPMENT DETAILS

Transmitter Type: SCINTREX 1PCE 250W
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX 1PR2
 Integration Time:
 I.P. Measured Over One Current

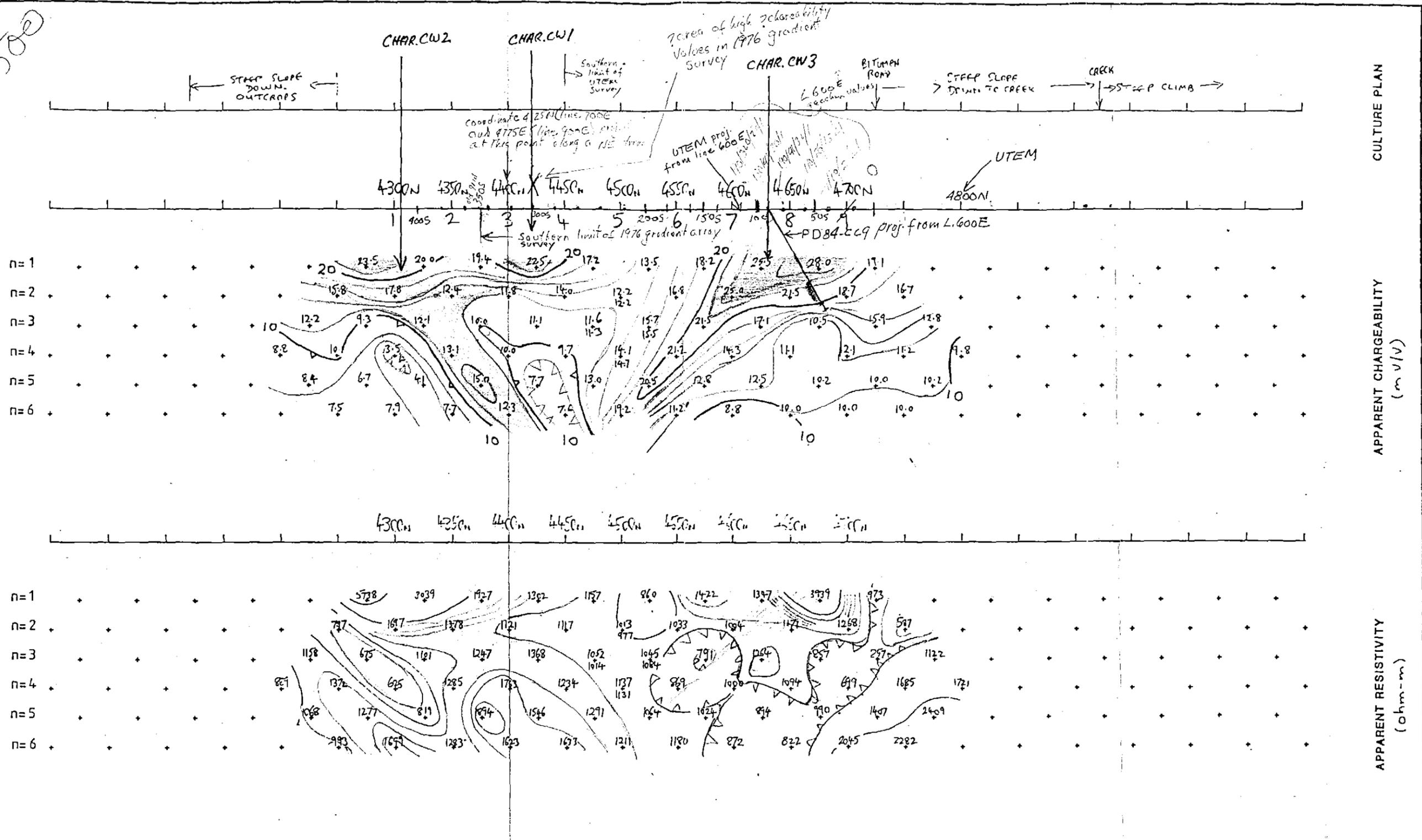
SURVEY DETAILS

Array: Dipole-Dipole
 Dipole Length: 50m.
 Date: 3.8.90
 Job No.:
 Scale: 0 50m

PROJECT NAME: CETHANA (E.L. 10/88)
 CLIENT: NORANDA

SURTEC GEOSURVEYS PTY LTD		
INDUCED POLARISATION & RESISTIVITY		
CETHANA		
LINE: 300E		
Author:	File Number:	Figure Number:
Drawn:		2.
Date:		

500



EQUIPMENT DETAILS
 Transmitter Type: SCINTREX 1PC8 250w
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX 1PR2
 Integration Time:
 I.P. Measured Over One Current

SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50m
 Date: 4.8.90
 Job N°:
 Scale: 0 50m

PROJECT NAME: CETHANA (E.L. 10/88)
 CLIENT: NORANDA

SURTEC GEOSURVEYS PTY LTD			
INDUCED POLARISATION & RESISTIVITY			
CETHANA			
LINE: 500E			
Author:	P. LECT	File Number:	Figure Number:
Drawn:	P. LECT		3.
Date:	4.8.90		

sulphides intersected in drill holes

ref: Nor/MG90/12

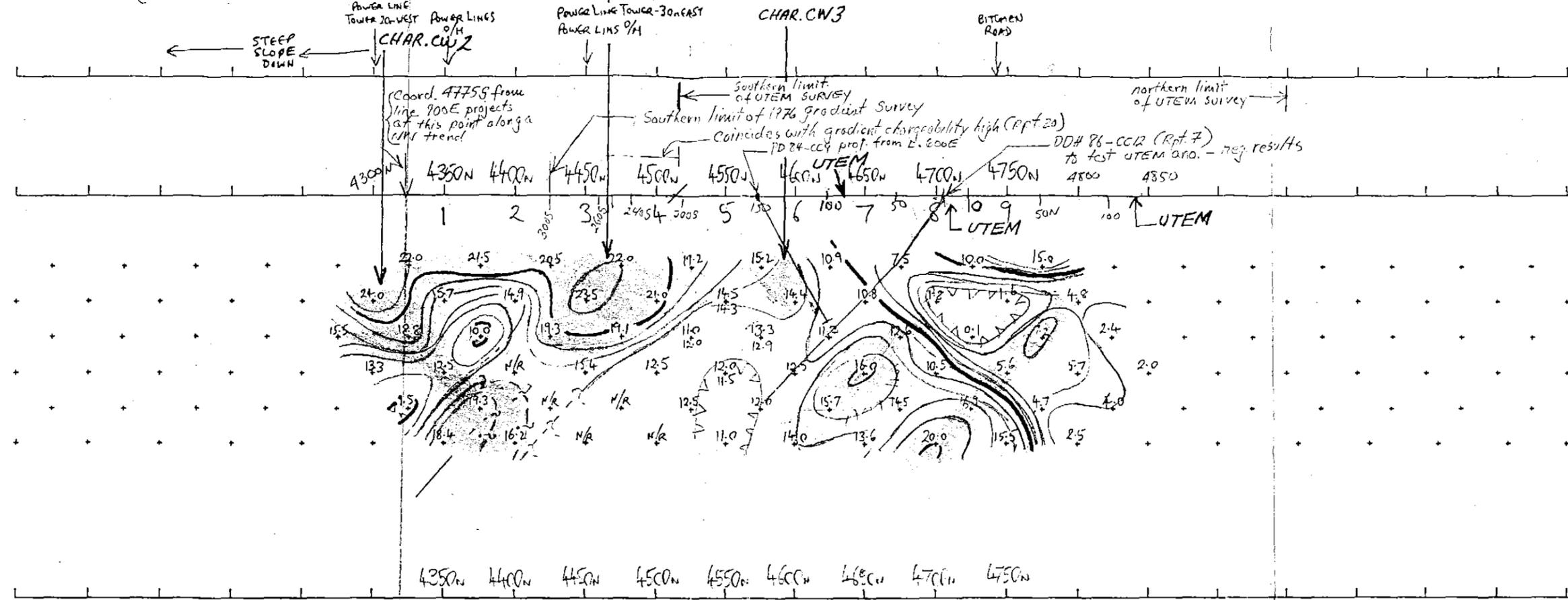
Fig. 3

CULTURE PLAN

APPARENT CHARGEABILITY (mV/V)

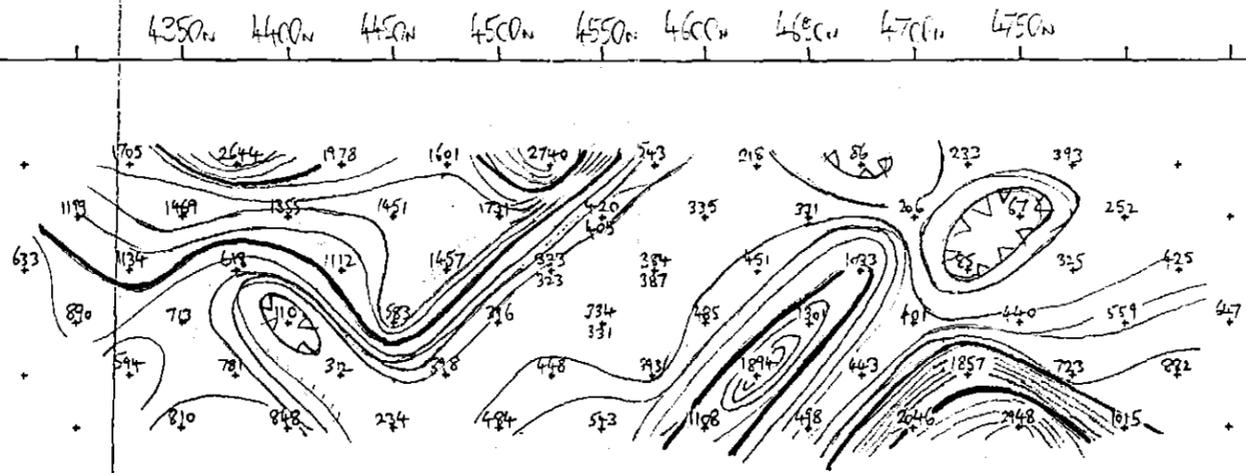
APPARENT RESISTIVITY (ohm-m)

(NB. 2 major sets of power lines cross line from NNE to SSW) CHAR. CW1



n=1
n=2
n=3
n=4
n=5
n=6

n=1
n=2
n=3
n=4
n=5
n=6



CULTURE PLAN

APPARENT CHARGEABILITY (msecs)

APPARENT RESISTIVITY (ohms)

EQUIPMENT DETAILS
 Transmitter Type: SCINTREX RCR 250w
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX PR8
 Integration Time:
 I.P. Measured Over One Current

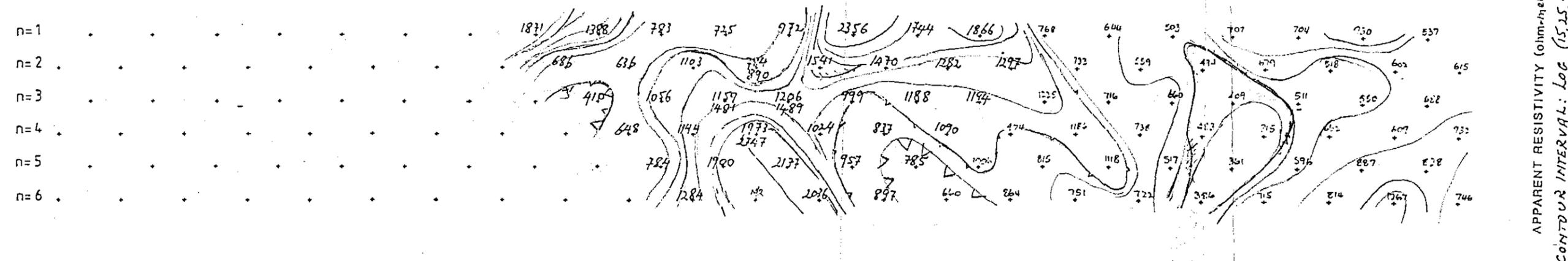
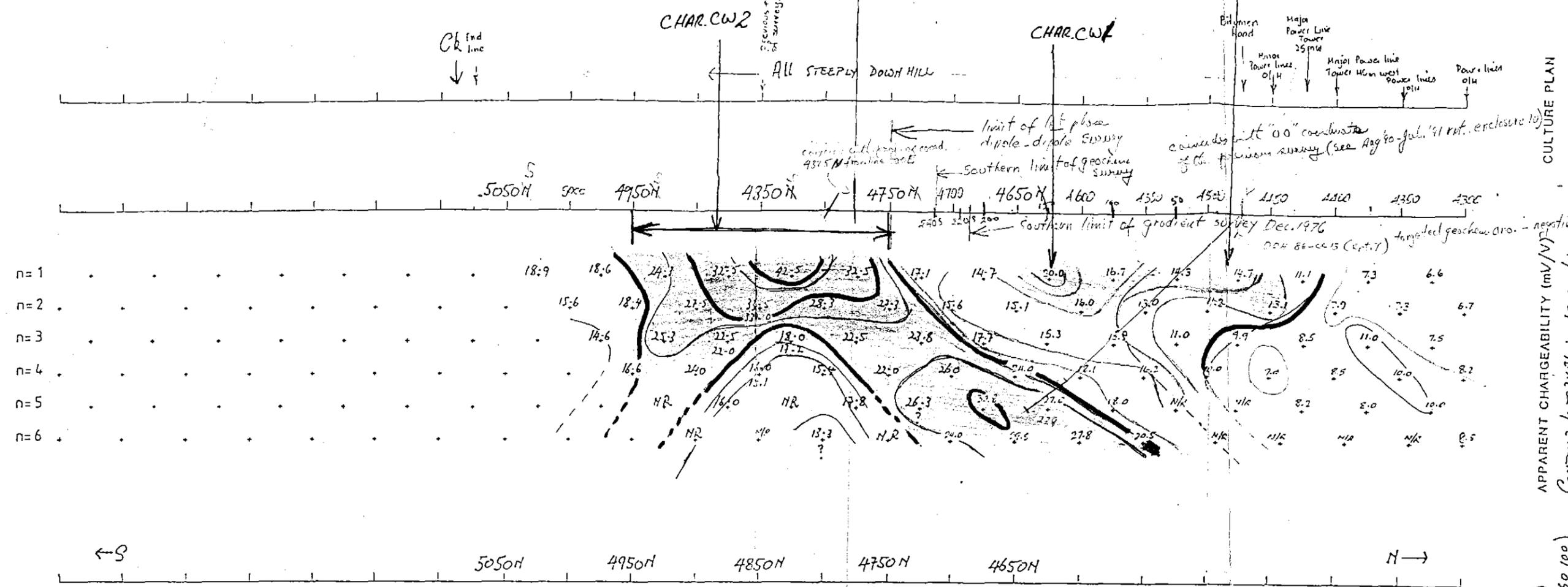
SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50m
 Date: 5.8.90
 Job No.:
 Scale:

PROJECT NAME: CETHANA
 CLIENT: NORANDA

SURTEC GEOSURVEYS PTY LTD			
INDUCED POLARISATION & RESISTIVITY DIPOLE - DIPOLE ARRAY			
LINE: 700E			
Author:	P. LIST	File Number:	Figure Number:
Drawn:	P. LIST		
Date:	5.8.90		

Fig. 4

NOTE - This line is NOT covered by UTEM Survey



APPARENT CHARGEABILITY (mV/V)
 APPARENT RESISTIVITY (ohm-metres)
 CONTOUR INTERVAL: 10 mV/V
 CONTOUR INTERVAL: Log (15, 25, 40, 60, 100)

CR End line

CHAR.CW2

CHAR.CW1

ALL STEEPLY DOWN HILL

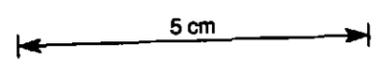
Billmen Road
 Major Power Line Tower 25 MW
 Major Power Line Tower 140 MW
 Power line 01H

CULTURE PLAN

limit of 1st phase dipole-dipole survey
 Southern limit of geochrone survey
 Southern limit of gradient survey Dec. 1976
 coincides with "00" contour of the previous survey (see Aug 90 - Jul 91 ref. enclosure 10)
 targeted geochrone - negative results

← S

N →



EQUIPMENT DETAILS
 Transmitter Type: ZOMBE GGT-2.5
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX IPR-8
 Integration Time: 650 - 1170 msec.
 I.P. Measured Over One Current

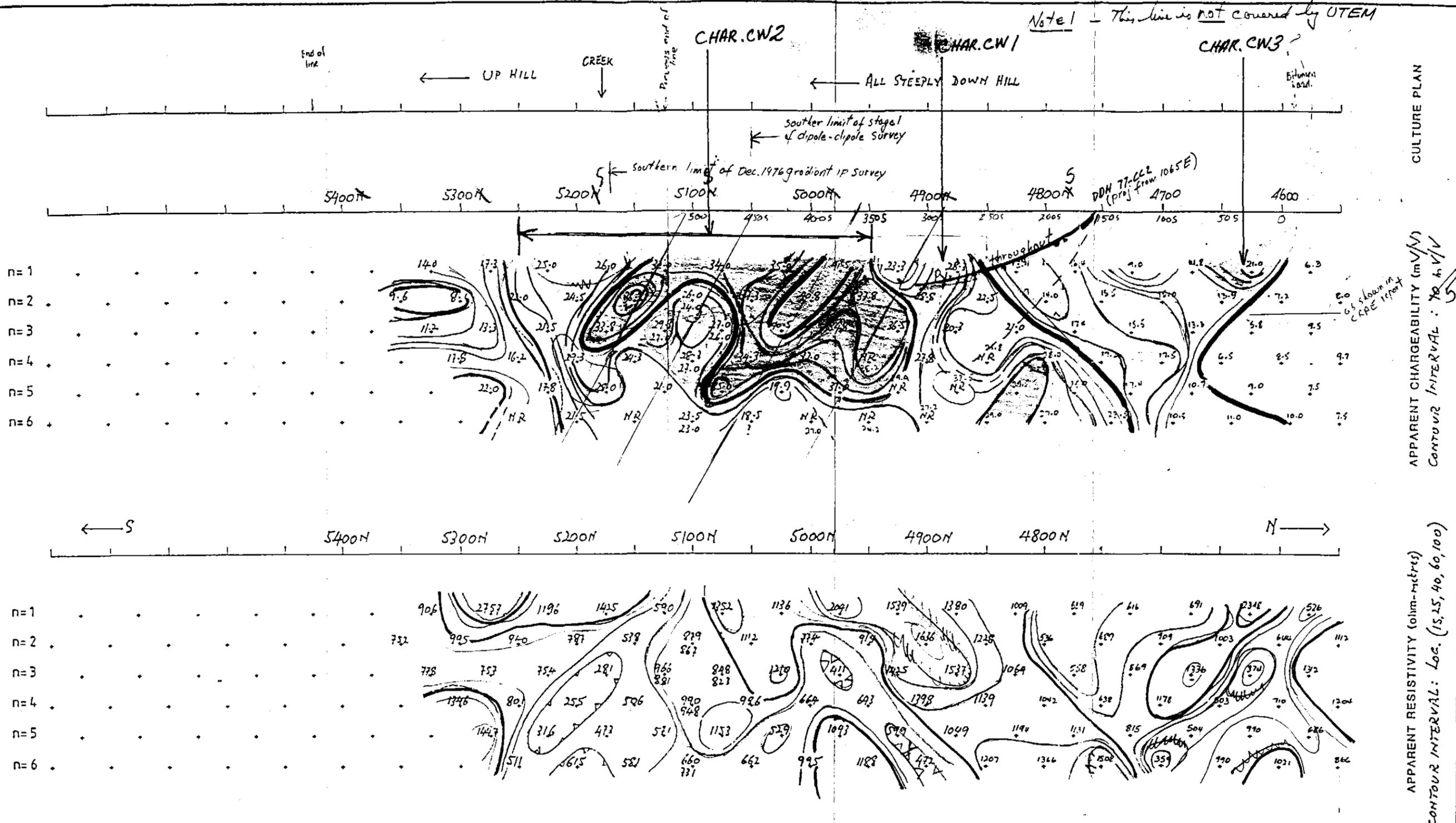
SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50 m
 Date: 9-5-91
 Job N°:
 Scale: 0 50 m

MORANDA
SURTEC GEOSURVEYS PTY LTD
 CETHANA W.
 INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY
 LINE: 900 E

Author	R. BENNETT	File Number	Figure Number
Drawn	R. BENNETT		
Date	10-5-91		

Fig. 5

Note 1 - This line is NOT covered by UTEM



CULTURE PLAN

APPARENT CHARGEABILITY (mV/V)
CONTOUR INTERVAL: 10 & 4 V/V

APPARENT RESISTIVITY (ohm-metres)
CONTOUR INTERVAL: Loc. (15, 25, 40, 60, 100)

EQUIPMENT DETAILS

Transmitter Type: ZONCE GGT-2.5
Timing Sequence: 2 sec. on / 2 sec. off
Receiver Type: SCINTREX IPR-8
Integration Time: 650 - 1170 msec.
I.P. Measured Over One Current

SURVEY DETAILS

Array: Dipole - Dipole
Dipole Length: 50 m
Date: 8-5-91
Job No.:
Scale: 0 50 m

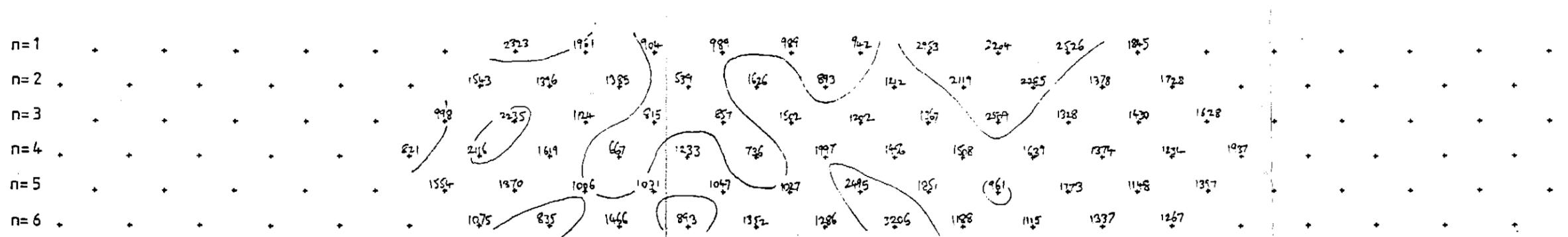
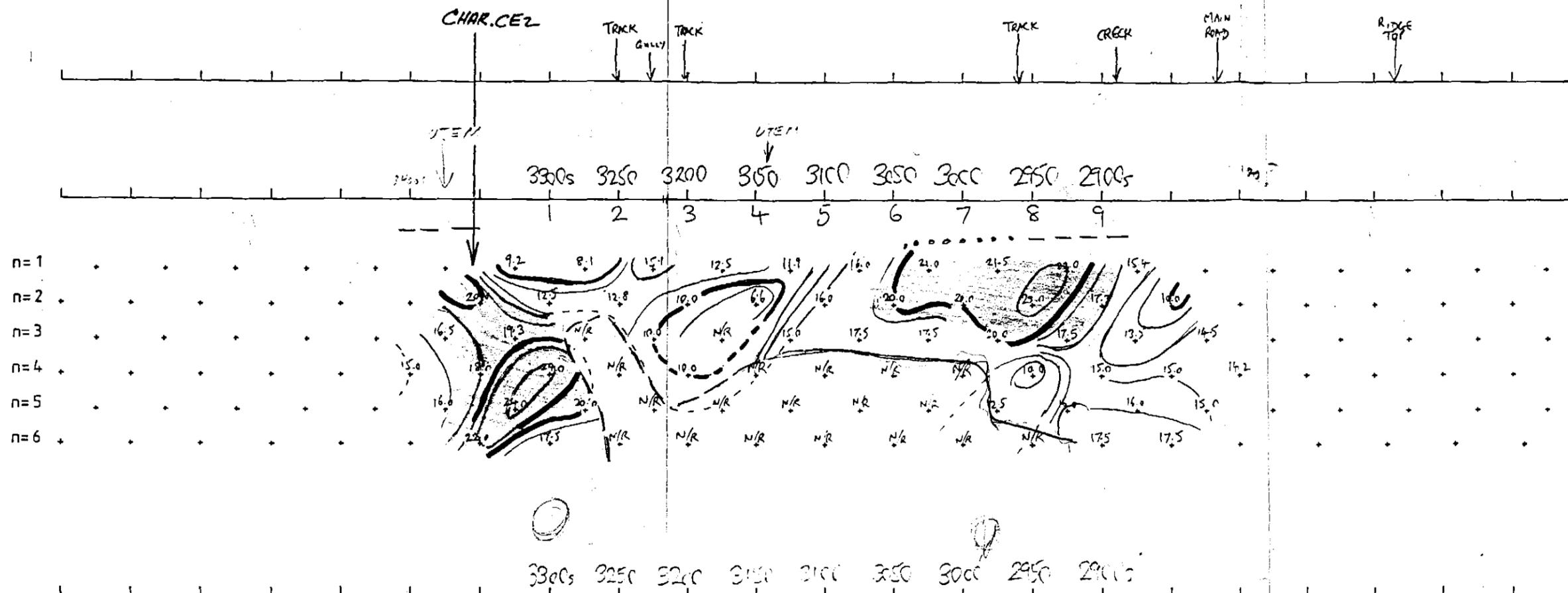
NORANDA
SURTEC GEOSURVEYS PTY LTD

CETHANA W
INDUCED POLARISATION & RESISTIVITY
DIPOLE - DIPOLE ARRAY

LINE: 1100 E

Author	R. BENNETT	File Number	Figure Number
Drawn	R. BENNETT		
Date	10-5-91		

Fig. 6



EQUIPMENT DETAILS

Transmitter Type: SCINTREX IPC8 250W
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX IPR8
 Integration Time:
 I.P. Measured Over One Current

SURVEY DETAILS

Array: Dipole - Dipole
 Dipole Length: 50M
 Date: 15-16/8/90
 Job No:
 Scale:

PROJECT NAME: CETHANA
 CLIENT: NORANDA

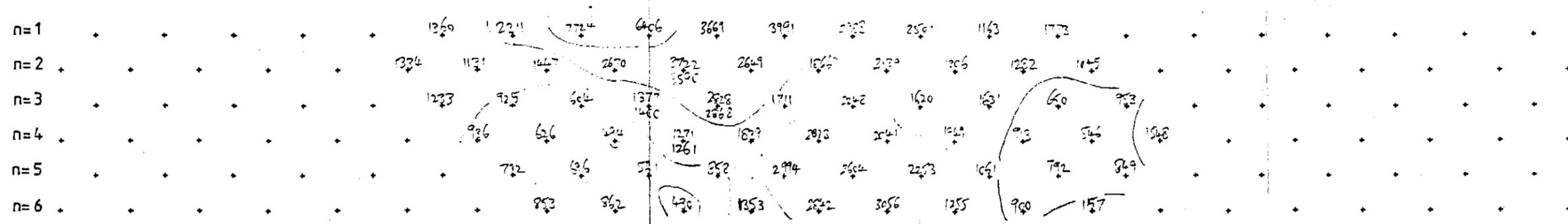
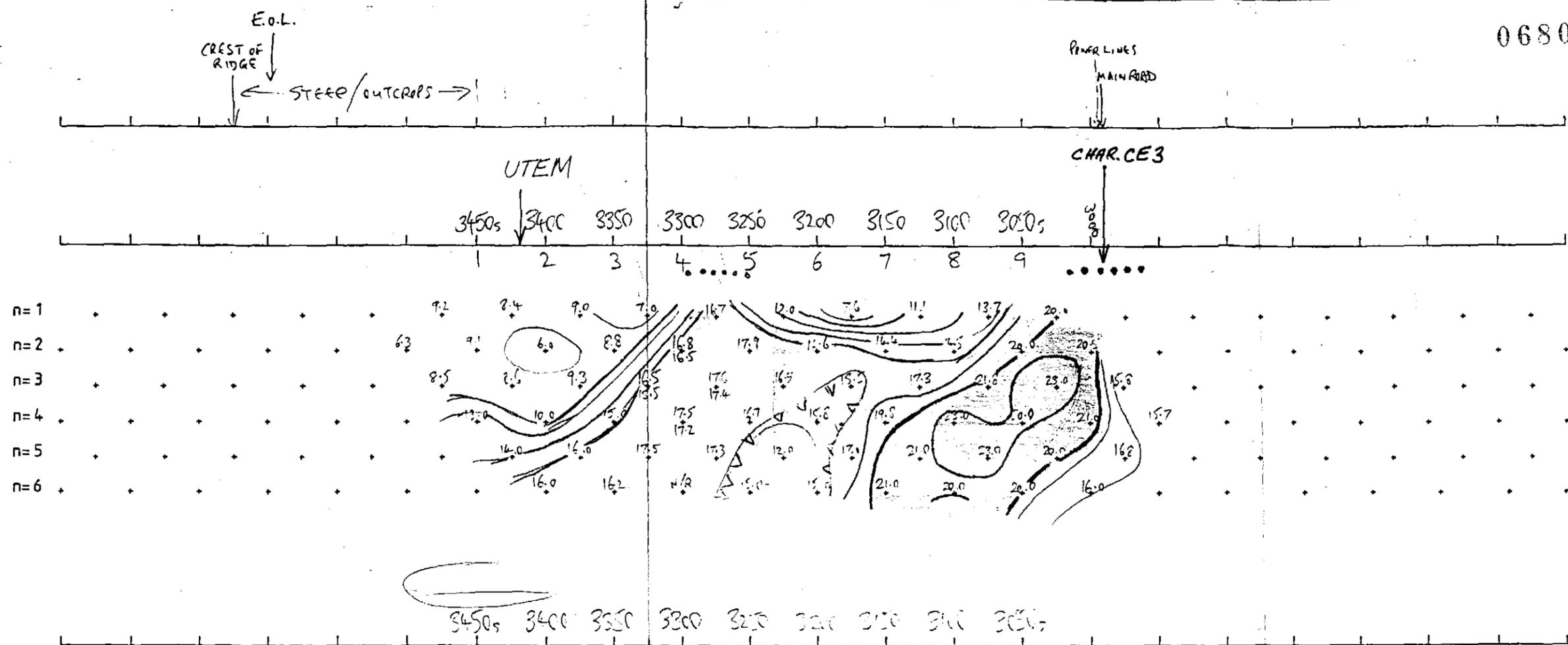
SURTEC GEOSURVEYS PTY LTD

INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY

LINE: 19800E

Author:	P. L. S.	File Number:	Figure Number:
Drawn:	P. L. S.		
Date:	16. 2. 90		

Fig. 7



EQUIPMENT DETAILS
 Transmitter Type: SCINTREX IPC2 250w
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX IPR 8
 Integration Time:
 I.P. Measured Over One Current

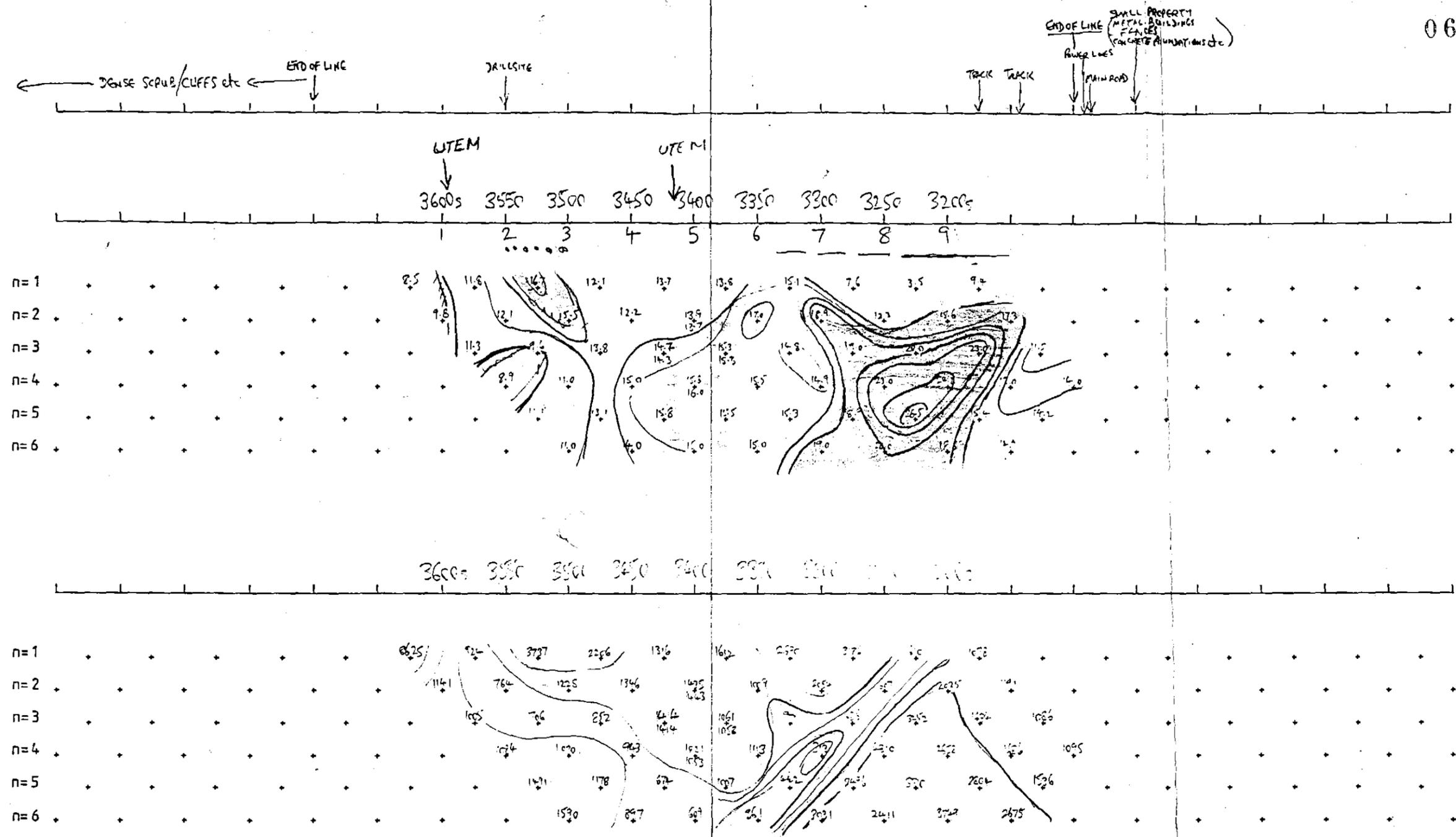
SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50m
 Date: 14.8.90
 Job No:
 Scale:

PROJECT NAME: CETHANA
 CLIENT: NORANDA

SURTEC GEOSURVEYS PTY LTD
 INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY
 LINE: 2020PE

Author:	W. LEST	File Number:	Figure Number:
Drawn:	P. LEST		
Date:	14.8.90		

Fig. 8



EQUIPMENT DETAILS
 Transmitter Type: SCINTREX IPR8 250w
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX IPR8
 Integration Time:
 I.P. Measured Over One Current

SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50m
 Date: 13.8.90
 Job N°:
 Scale:

PROJECT NAME: CETHIANA
CLIENT: NORANDA

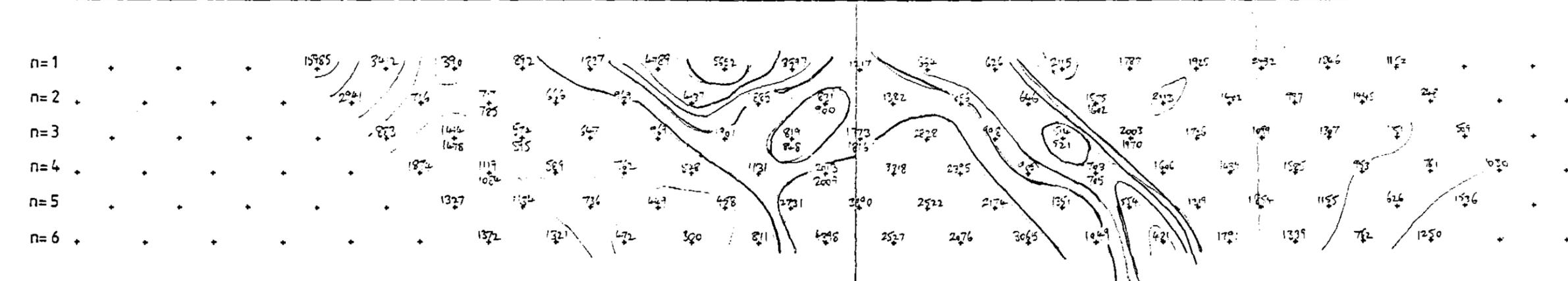
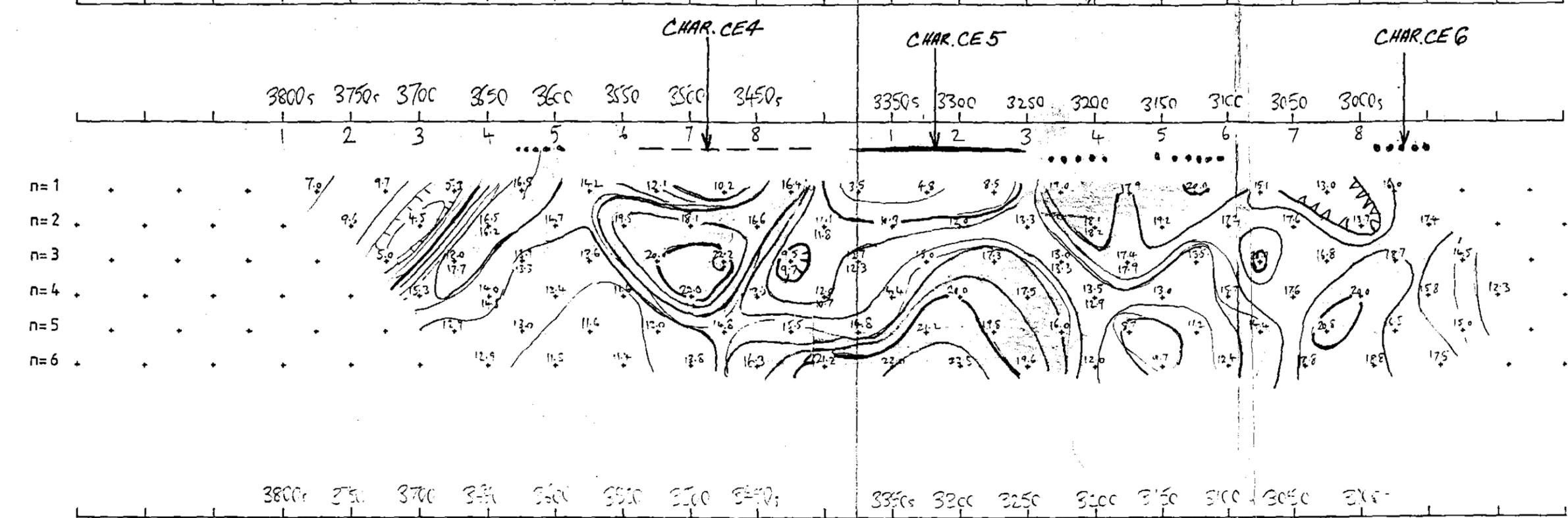
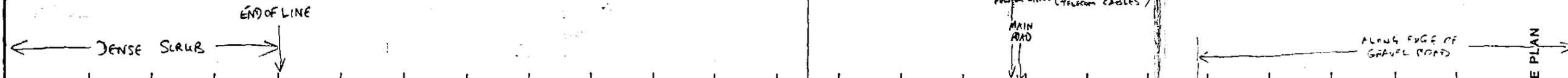
SURTEC GEOSURVEYS PTY LTD

INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY

LINE: 20400E

Author:	P. LIST	File Number:	Figure Number:
Drawn:	P. LIST		
Date:	13.8.90		

Fig. 9



NOTE - This line is not covered by UTEM

EQUIPMENT DETAILS
 Transmitter Type: SCINTREX 1PC2 250W
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX 1PR8
 Integration Time:
 I.P. Measured Over One Current

SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50m
 Date: 10-12/8/90
 Job No:
 Scale:

PROJECT NAME: CETHANA
 CLIENT: NORANDA

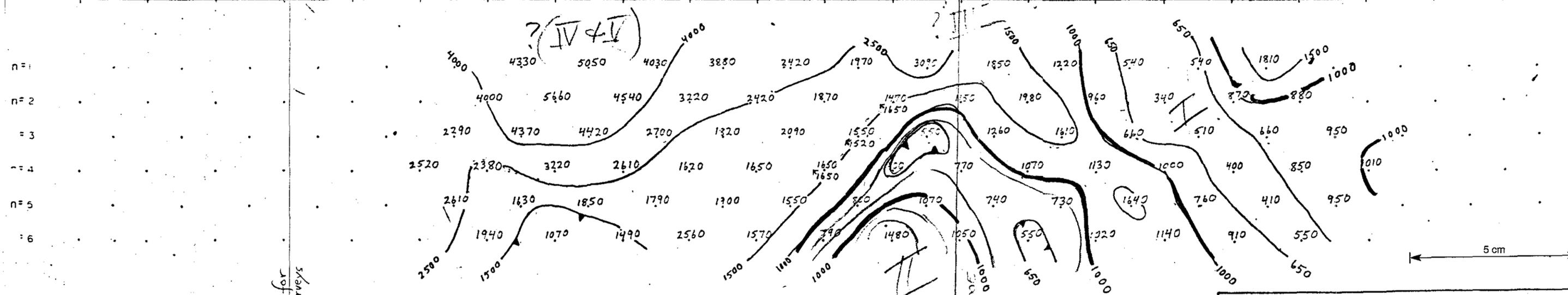
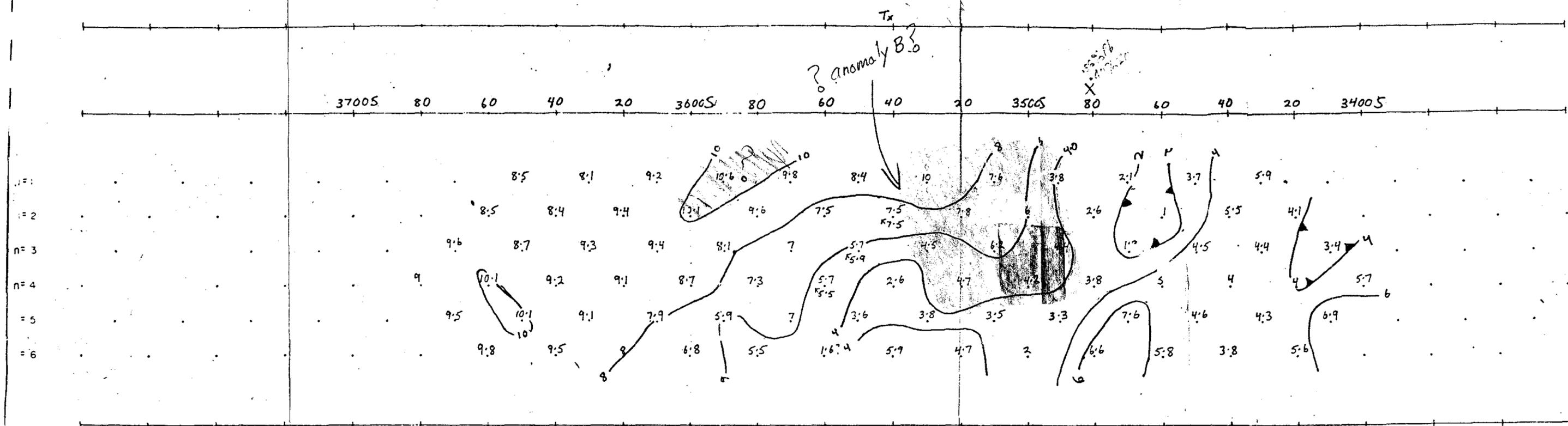
SURTEC GEOSURVEYS PTY LTD			
INDUCED POLARISATION & RESISTIVITY			
DIPOLE - DIPOLE ARRAY			
LINE: 20800E			
Author:	P. LIST	File Number:	Figure Number:
Drawn:	P. LIST		
Date:	12-8-90		

Fig. 10

Culture Plan

Apparent Chargeability (msecs)

Apparent Resistivity (ohm m)



reference line for
1979 & 1982 Surveys

reference line for
pseudo-sections
21500E - 21800E

5 cm

transmitter type	HUNTEC 5000
Timing sequence	2 sec on / 2 sec off
receiver type	Scintrex HUNTEC Mk IV
Integration time	450 to 1100 msecs after cut off
P measured over one current pulse	



Fig. 11

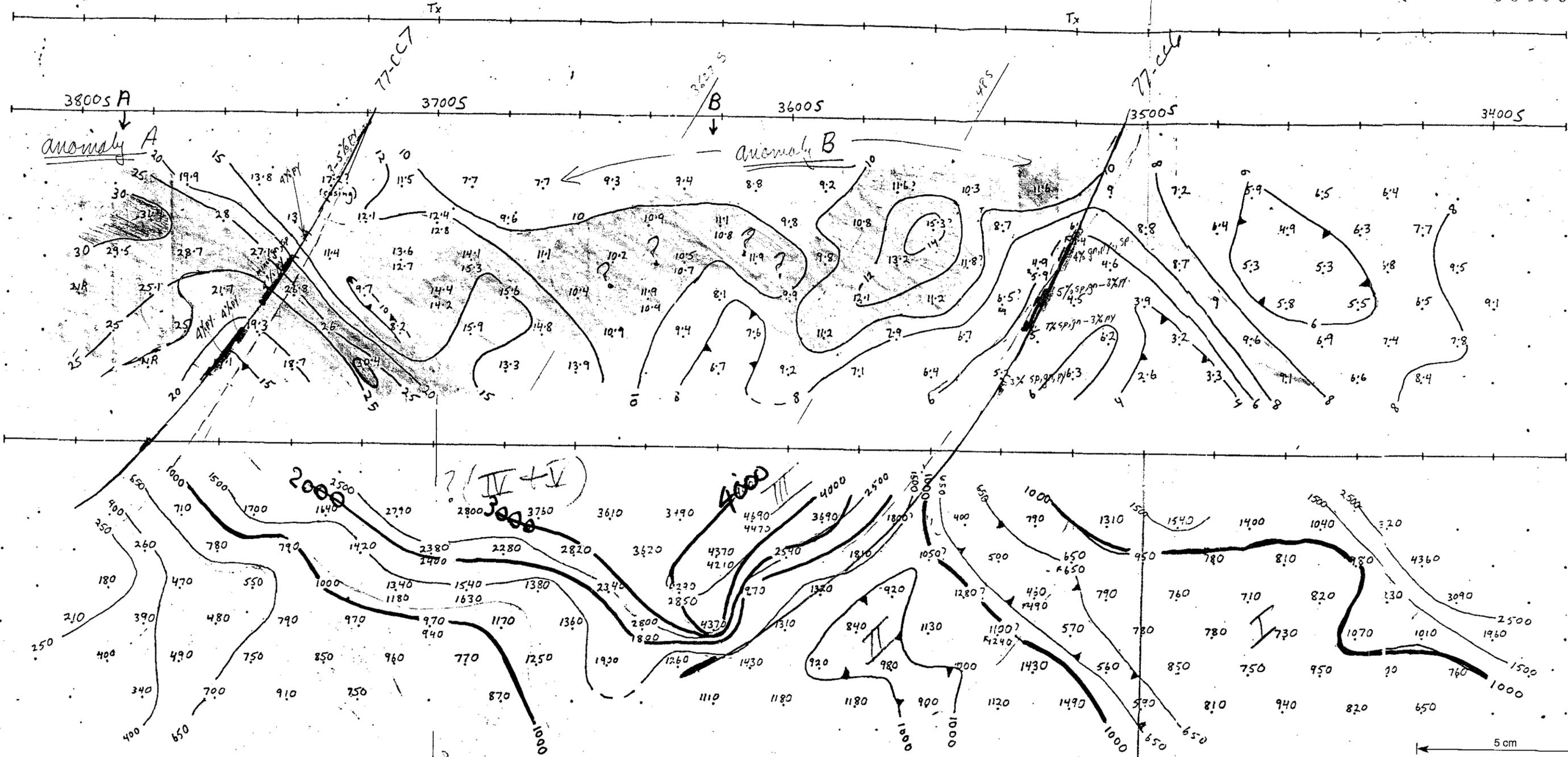
INDUCED POLARIZATION and RESISTIVITY SURVEY		
EAST CETHANA		
LINE: 21500E		4085
Array	Dipole - Dipole	Dipole length 20 metres
Date	18-2-79	Job No 85
Scale 1:1000		

068062

Culture Plan

Apparent Chargeability (msecs)

Apparent Resistivity (ohm m)



Transmitter type	Lopo
Pulsing sequence	2 sec on / 2 sec off
Receiver type	Sumtec MK4
Integration time	450 to 1100 msecs after cut off
Measurement	measured over one current pulse

Topo sheets general 12.3
1:50000

Reference line for 1979 & 1992 surveys



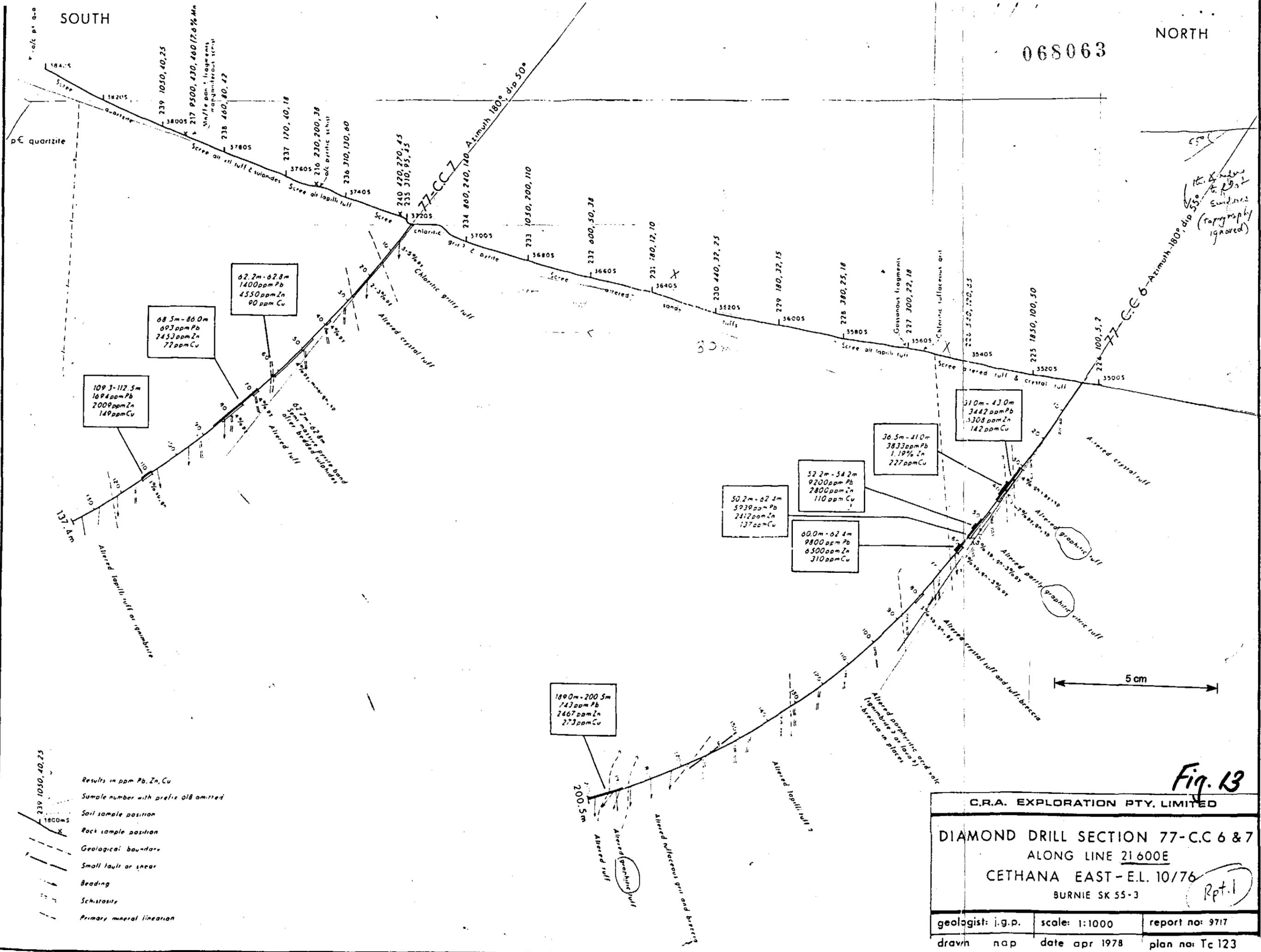
base meta sulphides
pyrite

Reference line for pseudo-sections 21500E - 21700E

INDUCED POLARIZATION and RESISTIVITY SURVEY		
CETHANA EAST LINE: 21600E		
Array	Dipole - Dipole	Dipole length 20 metres
Scale	3.79	Job No 85
		Page 1:1000

Fig. 12

4086



Min/trace fragments
magnesian
217 9500, 430, 460 (7.6% Mn)
238 460, 80, 42
37805
237 170, 40, 18
236 310, 130, 60
235 310, 95, 45
234 800, 240, 140 Azimuth 180°, dip 50°
233 1050, 200, 110
232 600, 50, 38
231 180, 12, 10
230 440, 32, 75
229 180, 32, 15
228 380, 25, 18
227 300, 22, 18
226 540, 120, 35
225 1850, 100, 50
224 100, 5, 2

62.2m - 62.8m
1400ppm Pb
4550ppm Zn
90ppm Cu

68.5m - 86.0m
693ppm Pb
2453ppm Zn
72ppm Cu

109.3 - 112.5m
1694ppm Pb
2009ppm Zn
149ppm Cu

62.2m - 62.8m
5m mafic purple band
after brecciated tuff
Altered tuff

31.0m - 43.0m
3442ppm Pb
5308ppm Zn
142ppm Cu

36.5m - 41.0m
3833ppm Pb
1.19% Zn
227ppm Cu

52.2m - 54.2m
9200ppm Pb
2800ppm Zn
110ppm Cu

50.2m - 62.4m
5939ppm Pb
2412ppm Zn
137ppm Cu

60.0m - 62.4m
9800ppm Pb
6500ppm Zn
310ppm Cu

180.0m - 200.5m
743ppm Pb
2467ppm Zn
273ppm Cu

200.5m
Altered tuff
Altered mafic and breccia
Altered lapilli tuff 2

15. & 16
to 19
Swire
(topography
ignored)

- Results in ppm Pb, Zn, Cu
- Sample number with prefix 018 omitted
- Soil sample position
- Rock sample position
- Geological boundary
- Small fault or shear
- Bedding
- Schistosity
- Primary mineral lineation

Fig. 13

C.R.A. EXPLORATION PTY. LIMITED		
DIAMOND DRILL SECTION 77-C.C. 6 & 7		
ALONG LINE 21600E		
CETHANA EAST - E.L. 10/76		
BURNIE SK 55-3		
geologist: j.g.p.	scale: 1:1000	report no: 9717
drawn: nap	date: apr 1978	plan no: Tc 123

MAIN ROAD E.O.L.

← STEEPER CLIMB ←

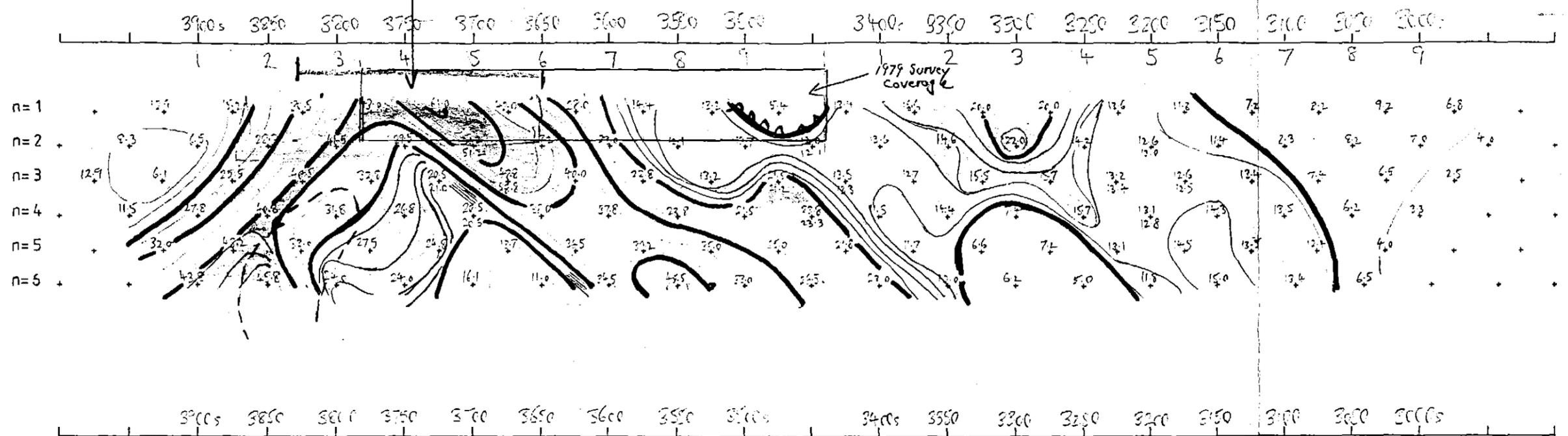
← GRADUAL CLIMB TO SOUTH ←

TO EAST SIDE OFF E.O.L. SEEKING MAIN ROAD INTERSECTION.

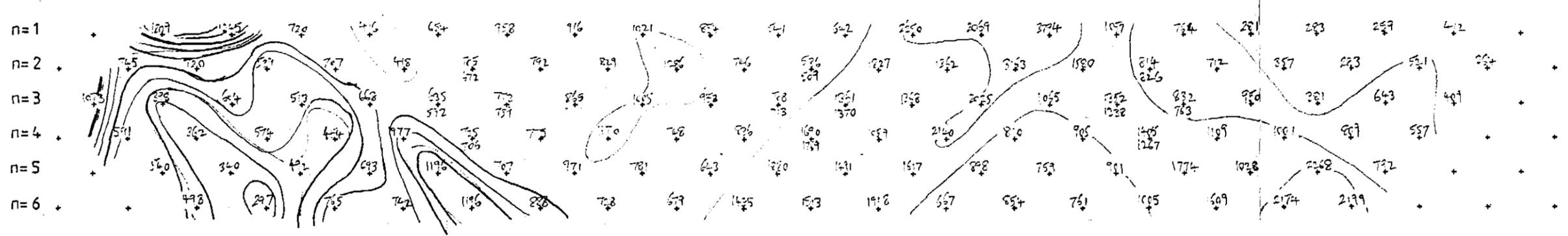
E.O.L. MAIN ROAD THICK SCOUR

CULTURE PLAN

CHAR. CEI



APPARENT CHARGEABILITY (msecs)



APPARENT RESISTIVITY (ohms)

reference line for 1990-1991 survey

EQUIPMENT DETAILS
 Transmitter Type: SCINTREX IPR8 250w
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX IPR8
 Integration Time:
 I.P. Measured Over One Current

SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50m
 Date: 9.8.90/10.8.90
 Job No.:
 Scale:

PROJECT NAME: CETHANA
 CLIENT: NORANDA

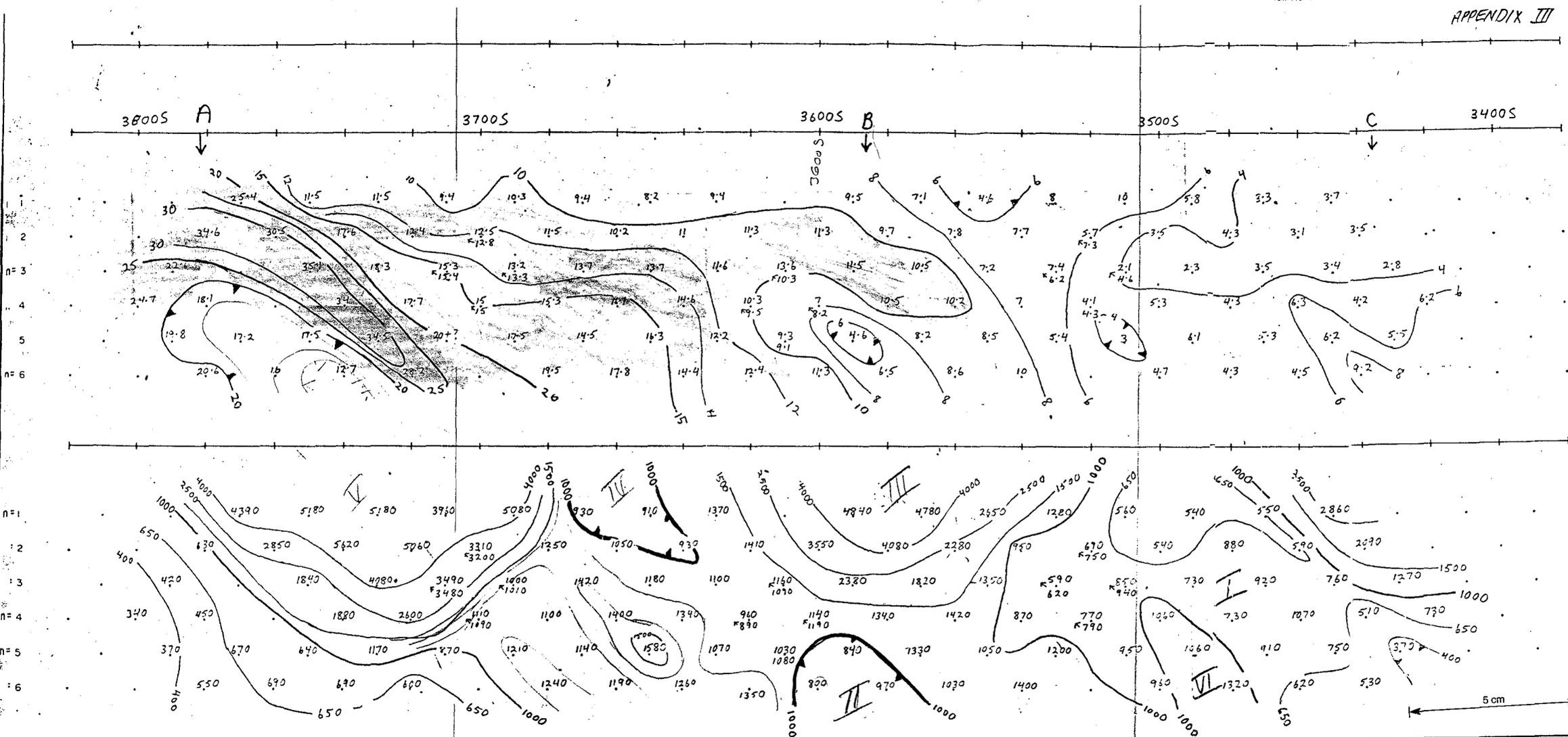
SURTEC GEOSURVEYS PTY LTD

INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY

LINE: 21700E

Author:	V. LIST	File Number:	Figure Number:
Drawn:	P. LIST		
Date:	10.8.90		

Fig. 14



transmitter type LoPa 5VVA
 Timing sequence 2sec on / 2 sec off
 Receiver type Semtec PA → HUNTEC MKII
 Integration time 450 to 1100msecs after cut off
 P measured over one current pulse

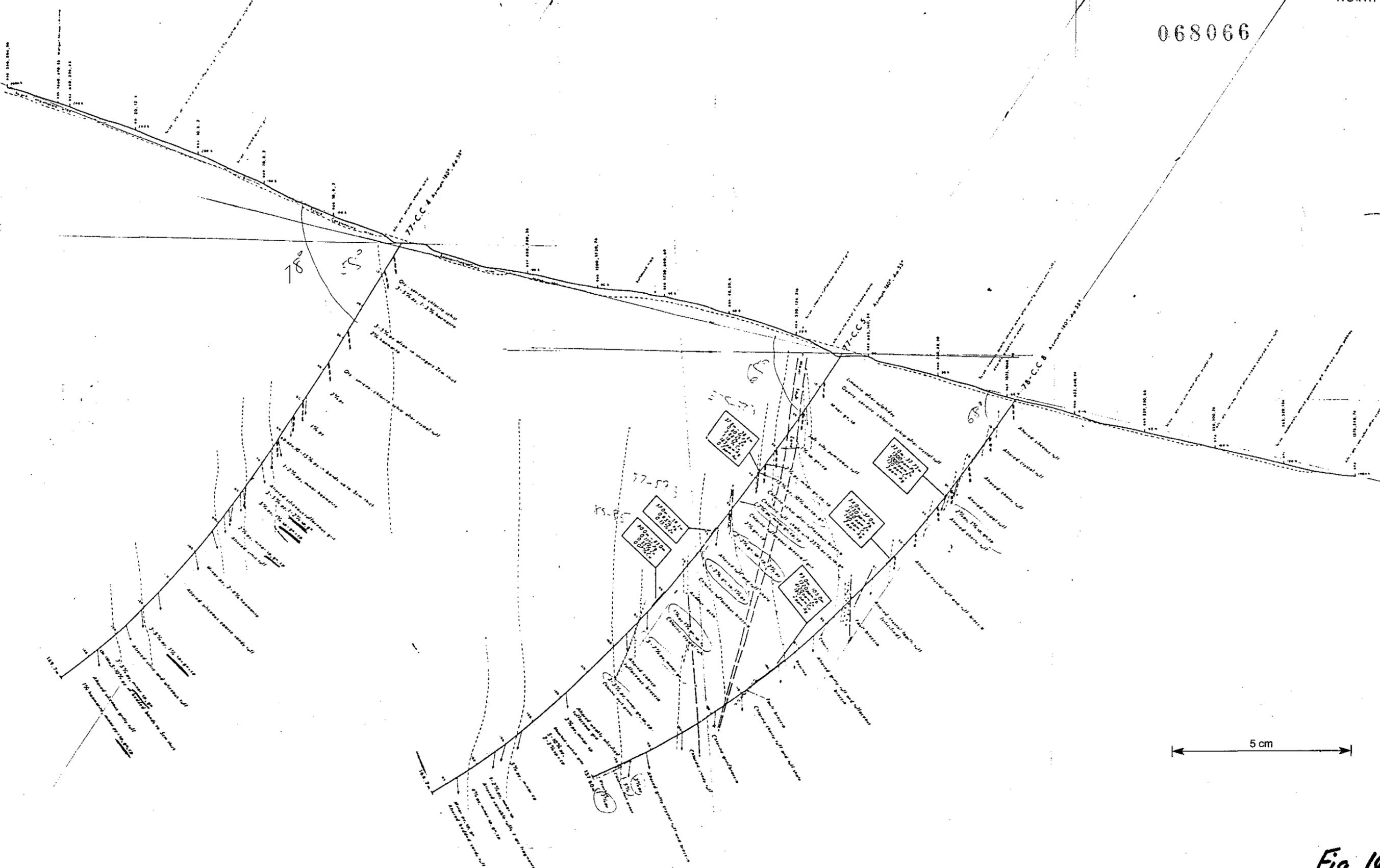
reference line for
 1979 & 1991 surveys



reference line for
 pseudo-sections
 d1500E - 21800E

INDUCED POLARIZATION and RESISTIVITY SURVEY		
CETHANA EAST LINE: 21700E		
4087		
Array Dipole - Dipole	Dipole length 20 metres	
Date 22-3-79	Job No. 85	Scale 1:1000

Fig. 15



- Siltstone dip
- Sandstone dip
- Shale dip

N.B. Drillhole locations for CC 4, 5 & 8 are as indicated

5 cm

Fig. 16

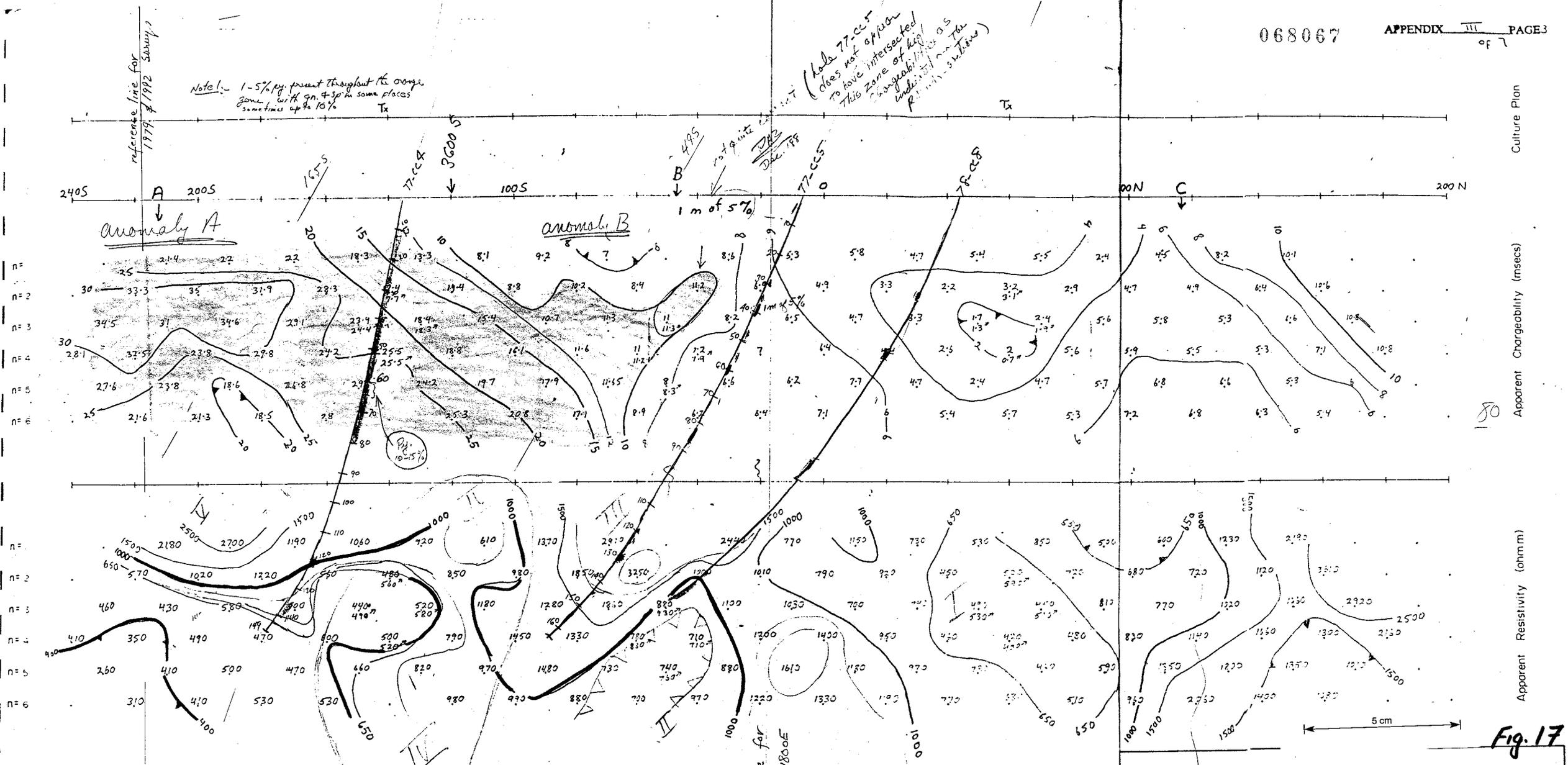
CRA EXPLORATION PTY. LIMITED
 DIAMOND DRILL SECTION C.C. 4, 5 & 8
 ALONG LINE 21750E LOOKING W.
 CETHANA EAST - E.L. 10/76
 NORTH - WEST TASMANIA
 BURNIE SK 55-3

Ret 1

SCALE 1:1000
 GEOPHYSICIST: J.G.P.
 DATE: May 1977
 DRAWN: N.A.P.
 REPORT NO: 9044.9717
 APRIL 1978
 PLAN NO: Tc 52

Note: 1-5% py present throughout the zone
gone with gn. + sp in some places
sometimes up to 10%

(Note 77-cc-5
does not appear
to have intersected
this zone of high
chargeability. This
is probably due to
the R. (min. - surface)



Location	Lopo
Scale	1:1000
Project	Hunter Mkt
Map No.	
Drawn by	
Checked by	

Topo Slope cca 78°
cca 68°



reference line for
pseudo-sections
21500E - 21800E

basa metal sulphides
pyrite

80

Fig. 17

INDUCED POLARIZATION and RESISTIVITY SURVEY

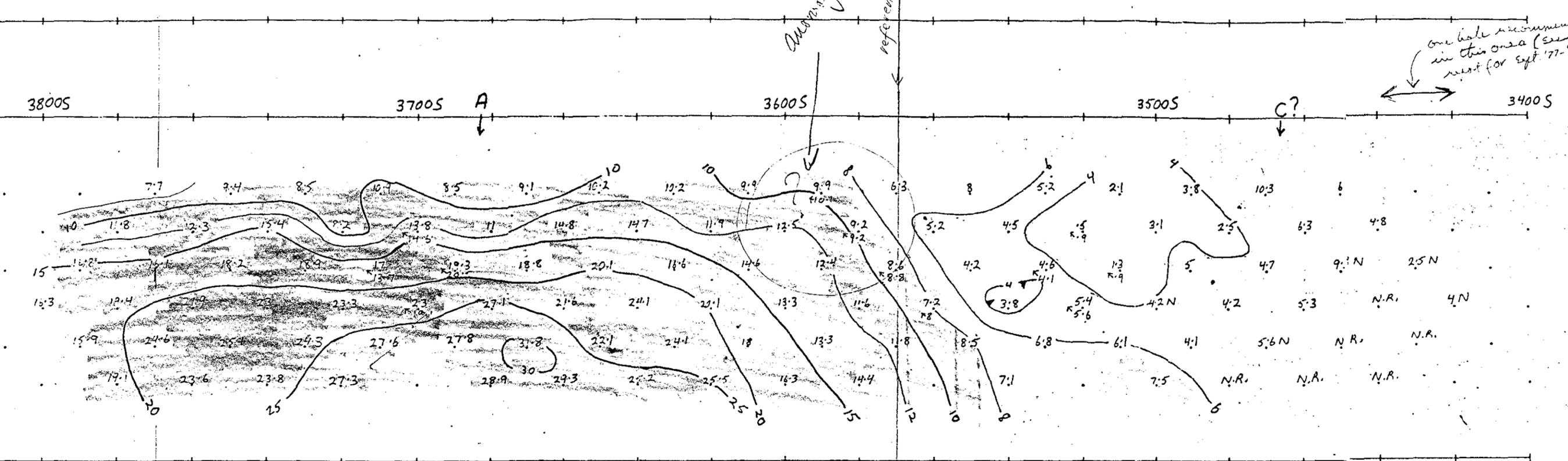
1:1000 CETHANA EAST
LINE: 21750E 4083

Scale length 20 metres

Culture Plan

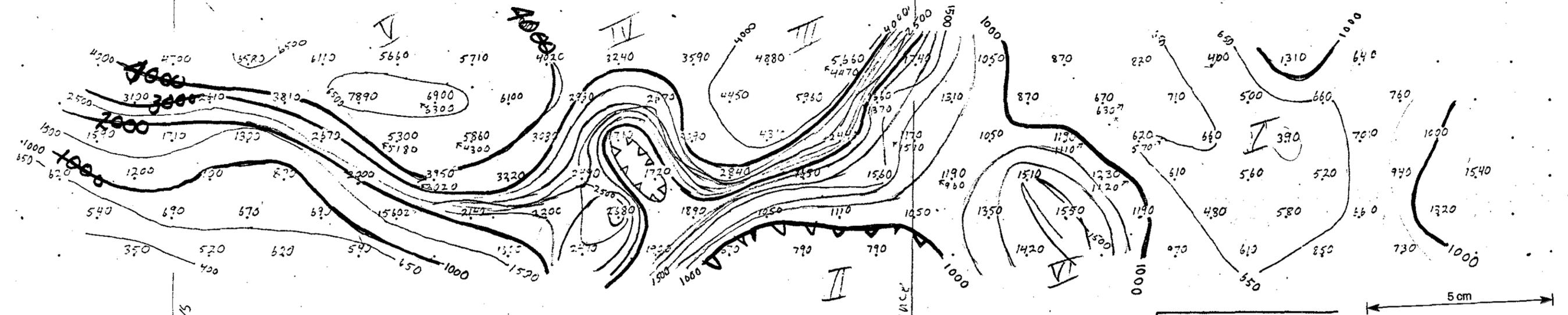
Apparent Chargeability (msecs)

Apparent Resistivity (ohm.m)



Culture Plan

Apparent Chargeability (msecs)



Apparent Resistivity (ohm m)

Series type	Lopo
Sequence	2 sec on / 2 sec off
Series type	Huntec Mk4
Time	450 to 1100msecs after cut off
Notes	Read over one current pulse

reference line for 1979 & 1992 surveys



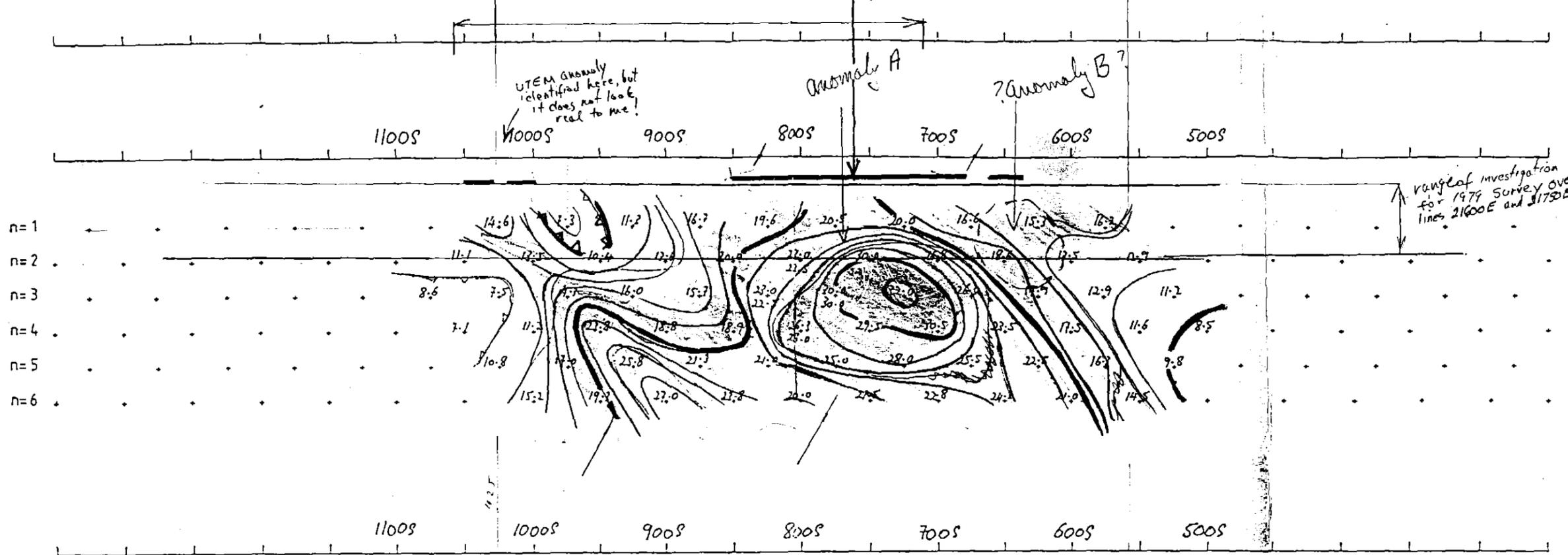
Fig. 18

INDUCED POLARIZATION and RESISTIVITY SURVEY		
CETHIANA EAST LINE: 21800 E		
Array	Dipole - Dipole	Dipole length 20 metres
Date	3.79	Job No 85
		Scale 1:1000

4084

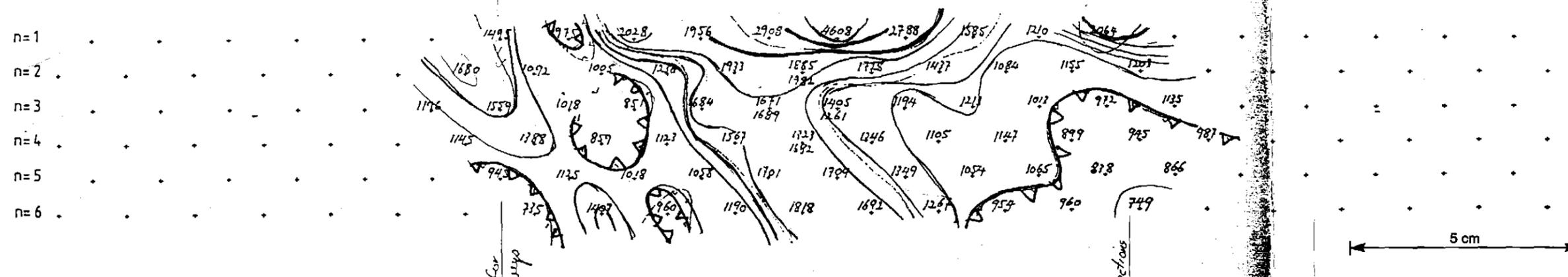
CHAR. CE 1

CULTURE PLAN



range of investigation for 1979 survey over lines 21600E and 21750E

APPARENT CHARGEABILITY (mV/V)
CONTOUR INTERVAL: 70 mV/V



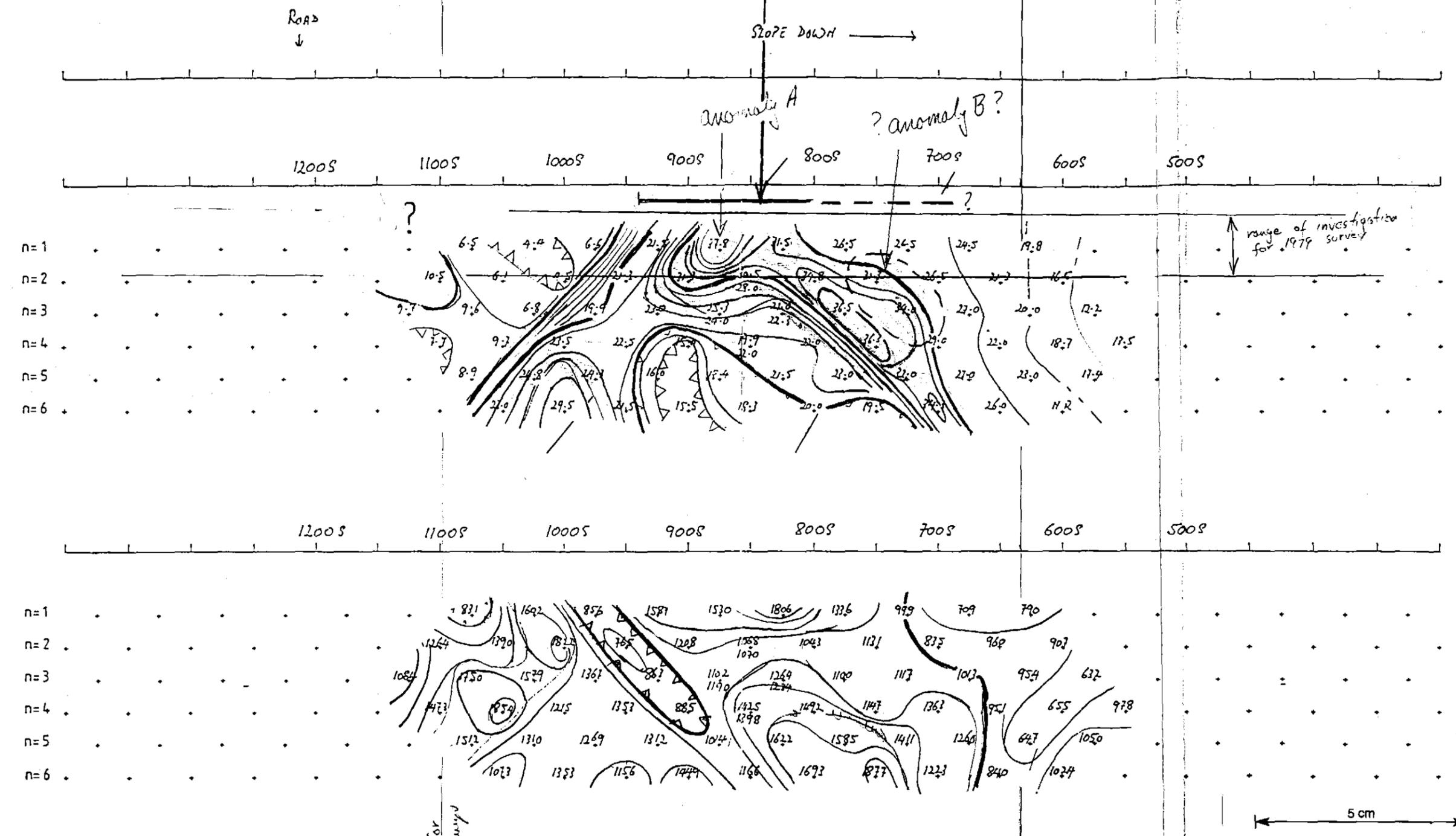
APPARENT RESISTIVITY (ohm-metres)
CONTOUR INTERVAL: LOG (15, 25, 40, 60, 100)

EQUIPMENT DETAILS
 Transmitter Type: ZONCE GBT-2.5
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX 17R-8
 Integration Time: 650 - 1170 msec.
 I.P. Measured Over One Current

SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50 m
 Date: 4. 5. 91
 Job No:
 Scale: 1:3333

NORANDA
SURTEC GEOSURVEYS PTY LTD
CETHANA E.
 INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY
 LINE: 22200 E

Author	R. B. HENRY
Drawn	R. B. HENRY
Date	4. 5. 91



CULTURE PLAN
 APPARENT CHARGEABILITY (mV/V)
 CONTOUR INTERVAL: 10 mV/V
 APPARENT RESISTIVITY (ohm-metres)
 CONTOUR INTERVAL: 10, 25, 40, 60, 100

EQUIPMENT DETAILS
 Transmitter Type: ZOHBE CCT-2.5
 Timing Sequence: 2 sec. on / 2 sec. off
 Receiver Type: SCINTREX IPR-8
 Integration Time: 650 - 1170 msec.
 I.P. Measured Over One Current

SURVEY DETAILS
 Array: Dipole - Dipole
 Dipole Length: 50 m
 Date: 3-5-91
 Job No.:
 Scale: 0 50 m

reference line for 1979 & 1991 surveys

reference line for pseudo-section 22400E - 22600E

NORANDA

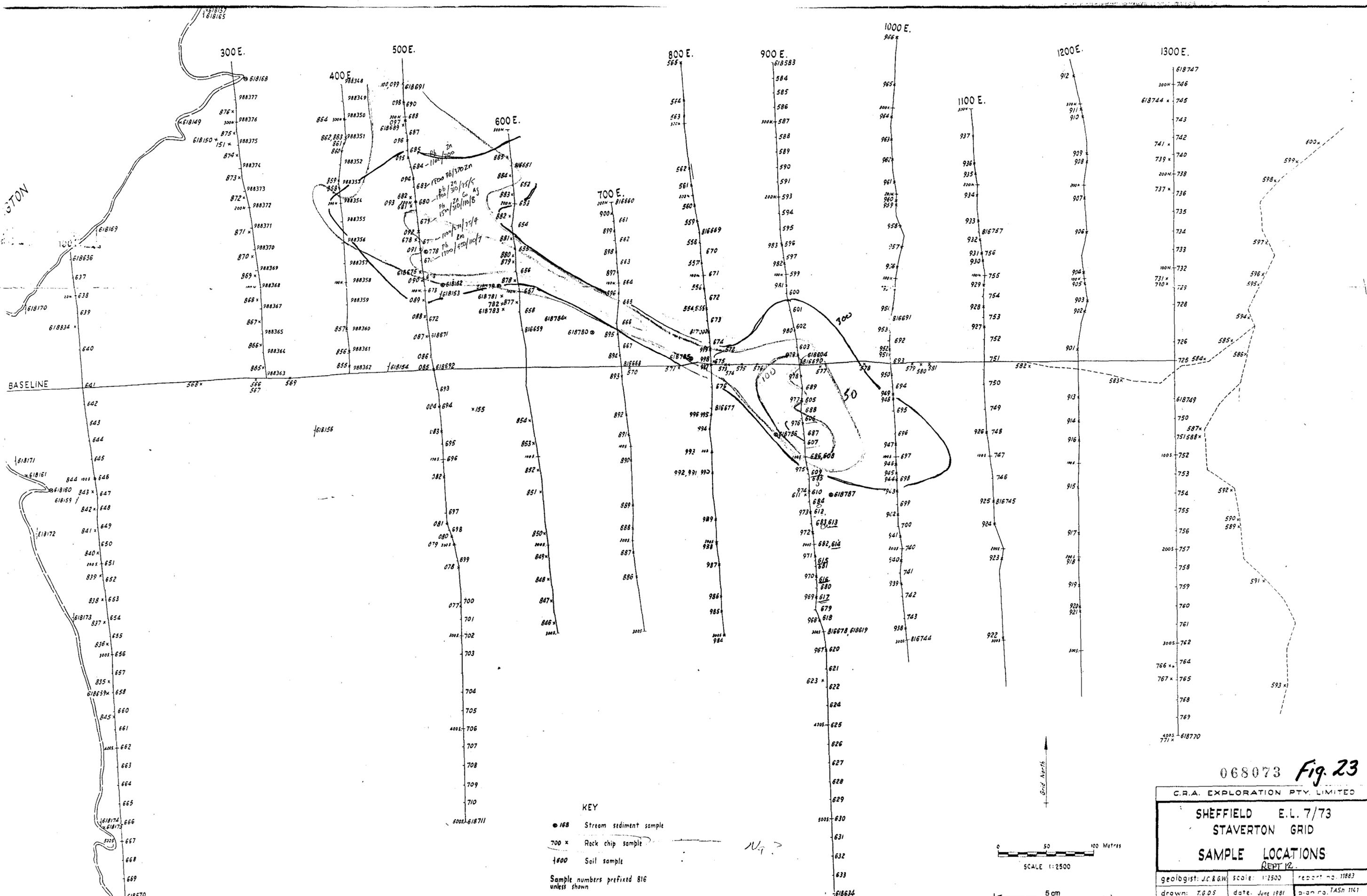
SURTEC GEOSURVEYS PTY LTD

CETHANA E.
 INDUCED POLARISATION & RESISTIVITY
 DIPOLE - DIPOLE ARRAY

LINE: 22400E

Author	K. BENNETT	File Number	Figure Number
Drawn	R. BENNETT		
Date	3-5-91		

Fig. 21



068073 Fig. 23

C.R.A. EXPLORATION PTY. LIMITED

SHEFFIELD E.L. 7/73
STAVERTON GRID

SAMPLE LOCATIONS
REPT 12.

geol. J.C. & G.W.	scale: 1:2500	report no. 11883
drawn: T.G.D.S.	date: June 1981	plan no. TASH 1147

92-3374

068075

APPENDIX B

Pb Isotope Survey - Fire Tower Prospect

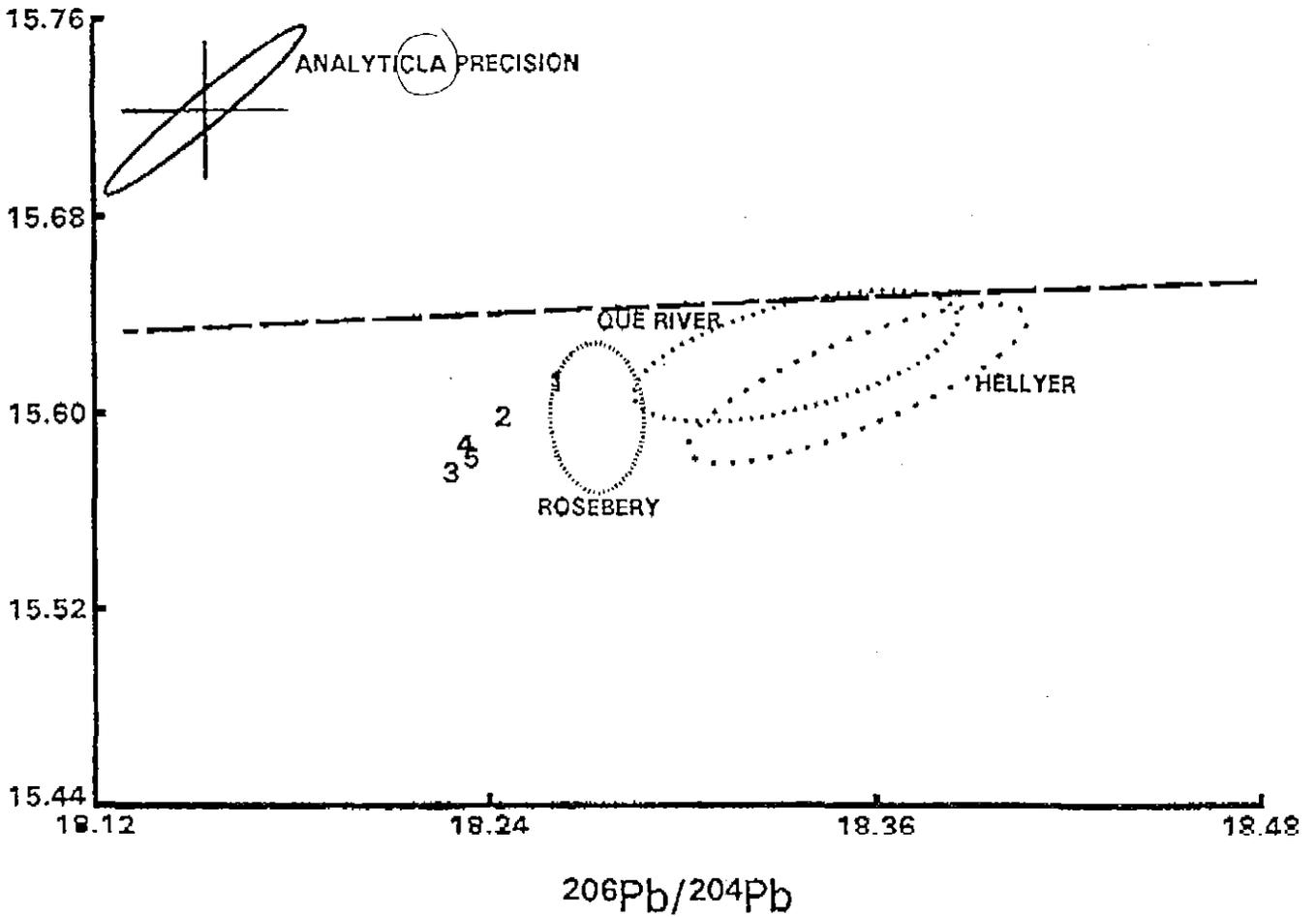
Graham Carr, SIROTOPE

LEAD ISOTOPE RESULTS

SIROTOPE *Can.*

068076

Sample	$\frac{203\text{Pb}}{208\text{Pb}}$	$\frac{207\text{Pb}}{208\text{Pb}}$	$\frac{206\text{Pb}}{204\text{Pb}}$	$\frac{207\text{Pb}}{204\text{Pb}}$	$\frac{208\text{Pb}}{204\text{Pb}}$	Pb(ppm)
<u>CETHANA AREA</u>						
1 PB1 GP-90-1	2.0872	0.8550	18.260	15.613	38.113	
2 PB2 GP-90-1	2.0867	0.8550	18.244	15.599	38.070	
3 PB3 GP-90-10	2.0849	0.8545	18.228	15.576	38.004	
4 PB4 GP-90-10	2.0862	0.8549	18.233	15.587	38.037	
5 PB5 GP-90-5	2.0854	0.8545	18.235	15.582	38.027	



068077

APPENDIX C

Thin Section Summary Report, Gog Range
(Fire Tower Prospect)

Tony Crawford

THIN SECTION SUMMARY REPORT, GOG RANGE

SAMPLE NUMBER: 3/1

068078

THIN SECTION SUMMARY:

This is an intensely altered volcanoclastic or lithic crystal tuff composed of fragments of devitrified and recrystallized felsic, formerly glassy lava, often with phenocrysts of quartz, and probably fragments of crystal tuffs (as judged by the common quartz angular crystal fragments). The fragments are strongly sericitized, and overprinted by messy brown calcite. Several veinlets of polycrystalline quartz cut the rock, and more than half the thin section is composed of an aggregate of relatively fine-grained pyrite and calcite overprinting a silicified and recrystallized matrix. There is no way the structure observed in this core is fiammae, as the sample probably formed from a mass flow off felsic glassy lava and tuffs, and is therefore likely to be volcanoclastic.

SAMPLE NUMBER: 2/3

THIN SECTION SUMMARY:

This is a quite strongly sericite+calcite-altered lithic crystal tuff, with abundant 1-5mm sized fragments of devitrified felsic lava, and less abundant detrital(?) quartz phenocrysts in a very fine-grained and uniform matrix pervaded by small veinlets of quartz and calcite that give it a brecciated appearance. The matrix was probably felsic vitric ash that has devitrified. The rock is probably what the previous sample looked like before it was near 'terminally altered'.

SAMPLE NUMBER: 2/1

THIN SECTION SUMMARY:

This sample is petrographically almost identical to sample 2/3, being a lithic crystal tuff with a devitrified vitric ash matrix. It is cut by intersecting veinlets of quartz and quartz and calcite, and a single larger vein of polycrystalline quartz and hematite. The latter seems unlikely to have derived via oxidation of pyrite, as typical pyrite shapes are not present; it may rather have formed originally as hematite, or possibly as magnetite that has oxidized to hematite.

SAMPLE NUMBER: 5/1

THIN SECTION SUMMARY:

This is a volcanogenic shaley siltstone . Detrital quartz grains are common and quite angular, and lithic clasts composed mainly of devitrified felsic glassy lava are also common. The entire rock is pervaded by very fine-grained, parallel sericite streaks that are much more abundant and closely spaced in the finer-grained beds. Weak calcite overprinting and calcite veining is present. This is a tuffaceous sediment derived from glassy quartz-phyric felsic lavas and tuffs. The darker beds in the core are simply less sericitized than the paler-coloured beds, despite the fact that their detrital component and matrix seem to have been basically the same.

ADDITIONAL COMMENTS

Epiclastic should be used only for rocks where it is clear that the volcanic particles in any particular rock were liberated by weathering processes, not by primary volcanic processes. In terrains such as the Mount Read Volcanics, or modern volcanic chains such as island arcs, most clastic material of volcanic origin is either hyaloclasts (glassy fragments spalled off flows), bombs, autoclastic brecciation debris, and crystal debris. In all these cases, rocks composed of such material should not be referred to as epiclastic, since the clasts/fragments/particles were not liberated by weathering, but by primary explosive volcanic processes. In this framework, the rocks described above in all instances are *volcaniclastic* sediments or lithic crystal tuffs; I don't believe it is generally possible to choose between these alternatives in such altered rocks, and the implications are little different anyway.

The rocks are generally rather more altered than typical of regional metamorphic degradation of felsic volcanics, implying local hydrothermal alteration. Particular samples 3/1, 2/3, 2/1 show quite strong silica-sericite-calcite alteration, and vitric tuff 3B6 may be silica-altered. My feeling is that these rocks represent lithologies expected in the vicinity of a felsic lava dome that is composed of quenching glassy rhyolitic lavas and shallow intrusives that provide hyaloclastitic debris and crystal debris to mass flows and slides that move under gravity off the dome to accumulate as unsorted volcaniclastic debris. To decide whether these rocks are dominantly *volcaniclastic* sediments, or primary tuffs is very difficult even in much less altered rocks than these, but the implications of either suggested origin are little different.

SAMPLE NUMBER: 2/2

068080

THIN SECTION SUMMARY:

This is a coarse-grained volcanogenic, fairly poorly-sorted sandstone composed almost totally of detrital blocky albitized plagioclase phenocrysts and quartz phenocryst fragments that vary from subrounded to subhedral. The average grainsize is around 1mm, and the rock is completely framework-supported, probably because of extensive pressure solution and elimination of the small amount of matrix that was originally present. Secondary quartz commonly occurs in interstitial areas along some grain boundaries, and veinlets of quartz are not uncommon. A 1cm-wide veinlet composed of prismatic narrow barite(?) crystals intergrown with hematite cuts this rock. At least some of the hematite has probably derived via oxidation in situ of pyrite.

SAMPLE NUMBER: 17/4

THIN SECTION SUMMARY:

This is a coarse-grained volcanoclastic sandstone derived entirely from quartz-phyric glassy rhyolitic lavas and tuffs. It is composed of about equal proportions of quartz phenocrysts and quartz phenocryst fragments, and angular fragments of devitrified and recrystallized formerly glassy felsic lavas. The matrix of this sample was probably felsic vitric ash, and it has also devitrified and recrystallized, making it difficult to locate the margins of many lithic fragments against the matrix. The rock is strongly overprinted by calcite, and has occasional polycrystalline quartz veinlets.

SAMPLE NUMBER: 15/5

THIN SECTION SUMMARY:

This sample is slightly better preserved texturally than many of the others, and is either an volcanoclastic derived from quartz+ plagioclase-phyric glassy felsic lavas, or a lithic crystal tuff with a recrystallized formerly vitric ash matrix. One difference from the foregoing samples is the presence of totally sericitized plagioclase phenocrysts in some of the lithic fragmentss in this rock. The matrix of this sample is probably recrystallized and silica-altered vitric ash, and in places it is quite strongly sericitized. There are no quartz veinlets through this sample, but except for these few trivial differences, I can see

SAMPLE NUMBER: 14/1

068081

THIN SECTION SUMMARY:

This is a texturally well-preserved quartz+plagioclase+ biotite-phyric felsic lava, with not uncommon well-formed zircon microphenocrysts. The groundmass was probably largely glassy and is now a sugary even-grained and anhedral quartzo-feldspathic mosaic. The greenish 'fragments' in the rock are difficult to identify. In this section, one patch seems to be an aggregate of totally sericitized plagioclase phenocrysts, in which case it represents a small cognate inclusion probably plucked from the magma chamber wall or conduit during passage to eruption. The other patch of (probable) green stuff in this rock is also a dense and extremely fine-grained sericitic intergrowth, probably after a glassy fragment of the margin of this flow, incorporated into the flow by overturning during eruption. This sample shows weak to moderate calcite overprinting and minor veining.

SAMPLE NUMBER: 3B6

THIN SECTION SUMMARY:

This is a sparsely plagioclase+quartz-phyric vitric crystal tuff, with wavy banding of the devitrified and recrystallized formerly glassy groundmass suggesting the probable former presence of flattened pumice fragments. The plagioclase phenocrysts are albitized, and a few 3-6mm-wide lithic fragments of recrystallized vitric tuff or obsidian are present. The greenish patches are strongly sericitized areas of the rock, probably formerly glassy lithic fragments, as based on experience rather than being obvious from this particular section. The rock may be somewhat silica-altered, since there is an abundance of plagioclase-free sugary polycrystalline silica throughout the groundmass.

SAMPLE NUMBER: 2L8

THIN SECTION SUMMARY:

This rock is a strongly quartz+plagioclase+biotite-phyric formerly glassy rhyolitic lava, with a quartzo-feldspathic even-textured groundmass derived from recrystallization of original glass. The rock is identical to sample 14/1, with the proviso that the quartz phenocrysts are slightly larger and more abundant in this rock than 14/1.

APPENDIX D

Polished Section Petrology - Fire Tower Prospect

Dave Huston

The mineralogy of two gold bearing samples from northwest Tasmania

by David L. Huston
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Report submitted to Plutonic Resources Ltd

16 July 1992

Introduction

Two samples from a Plutonic Resources gold prospect in northwest Tasmania were examined to: (1) determine the mineralogy of gold, (2) assess the style of mineralization, and (3) assess the effects of supergene enrichment on gold grades. The two samples provided, samples 10/4 and 10/5, came from a drill core interval that assayed 30 g/t over 1 meter. The samples exhibited strong oxidation of sulfide minerals to iron oxides owing to weathering.

Hand specimen descriptions

Both samples displayed evidence of an epigenetic origin for the sulfide mineralization. In sample 10/4, the mineralization occurs as infill around 2-5 cm, angular blocks of sericitized volcanic rocks. In sample 10/5 the mineralization occurs as a probable vein through the same rock type. Both samples were oxidized, and this oxidation penetrated into blocks of sericitized volcanic rock, leaving an unoxidized core. The volcanic rock contains common quartz eyes that are visible in hand specimen.

Mineralogy and alteration of the wall rock

In thin section the wall rocks to the vein or the breccia consist of 0.2-2 mm quartz and feldspar phenocrysts in a sericite-quartz groundmass. The feldspar phenocrysts are commonly dusted by sericite, and may be strongly sericitized. The phenocrysts are generally angular and lack resorption textures, which suggests that the rock has a volcanoclastic origin.

Mineralogy of the sulfide veins

The sulfide veins/breccia fill consists dominantly of pyrite with lesser quartz and chalcopyrite. Trace sulfide minerals observed include iron-poor sphalerite, galena, pyrrhotite and bismuthinite(?). Electrum and barite also occur as trace minerals. The sulfides are moderately to strongly oxidized to iron hydroxides and/or supergene copper minerals.

Paragenetically, pyrite and quartz were introduced at the time of wall rock brecciation. The pyrite was then fractured, and the fractures were infilled with chalcopyrite and electrum. This infilling may have resulted from primary introduction or from remobilization of pre-existing minerals. Quartz and possibly barite were also introduced at this time. The quartz in the samples is strongly undulose and fiber quartz is present, which suggests that this assemblage was strained during or after mineralization.

The sulfide minerals were oxidized later during weathering to form mainly goethite and lepidocrocite. Chalcopyrite altered to chalcocite and/or covellite prior to forming iron hydroxides. Lepidocrocite commonly was the first iron hydroxide to form (particularly after chalcopyrite), and it is commonly replaced by goethite. The latest oxidation product is botryoidal goethite which forms the rims to open vugs.

Sample 10/4 seems to be less oxidized than sample 10/5. In sample 10/4 covellite is the most common supergene copper mineral, supergene pyrite occurs in late stage veins, and hypogene pyrite is not extensively altered. Conversely, in sample 10/5 chalcocite is the most common supergene copper mineral, supergene pyrite is not present, and hypogene pyrite is extensively replaced by iron hydroxides.

Mineralogy of gold

Electrum is a ubiquitous trace mineral within the sulfide-rich zones in both samples. It has both a hypogene occurrence, and a supergene occurrence. In the hypogene occurrence electrum occurs with chalcopyrite as veinlets in the fractured pyrite grains. The electrum tends to have a moderate to high fineness (700-850) and occurs as elongate 5-30 μm grains.

In the supergene occurrence, electrum of apparently lower fineness (650-750) occurs with iron hydroxides and quartz. The electrum occurs within zones of massive goethite-quartz as well as with goethite and lepidocrocite (after chalcopyrite) that fill fractures in pyrite. The latter occurrence suggests that while there has been supergene migration of gold (as suggested by the former occurrence), most gold has not move very far from its hypogene occurrence.

From the data on grain size collected in this study, it is possible to estimate the gold content of the samples accounted for by visible electrum. For this estimation the following parameters were assumed: electrum fineness = 750, specific gravity of electrum = 15, and specific gravity of the sample = 3. Using these parameters and the area of the thin section examined, electrum can account for 42 g/t Au in 10/4 and 47 g/t Au in 10/5. Both these values are slightly above the assay of 30 g/t for the interval from which the samples were collected from. This may result from the sampling of sulfide-rich portions of the interval, from an inhomogeneous distribution of gold, or from the incorrect estimation of parameters used in the calculations. In any case, the observed electrum can account for most or all of the assayed gold. With the exception of pyrite, no other possible host mineral for gold was observed.

Conclusions

Based on the examination of sections 10/4 and 10/5 the following conclusions may be drawn regarding the style of mineralization:

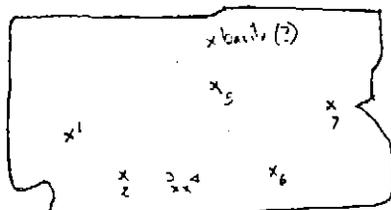
- (1) The mineralization is probably epigenetic.
- (2) The wall rocks are sericitized felsic volcanoclastic rocks.
- (3) The hypogene mineral assemblage was pyrite-chalcopyrite-quartz-barite(?) -electrum.
- (4) Electrum was introduced (or remobilized) with chalcopyrite into cracks in highly fractured pyrite.
- (5) Oxidation resulted in the replacing of chalcopyrite, and then pyrite, by iron oxides. Chalcocite and covellite were produced as intermediate products in the oxidation of chalcopyrite. In section 10/4 supergene pyrite was also produced.
- (6) The apparent extent of oxidation in 10/5 is greater than 10/4 as indicated from relative mineral abundances and from mineral textures.
- (7) Although some supergene migration of gold is evident, the common retention of a hypogene siting by supergene electrum (i.e. in fractures in pyrite) suggests this migration was not extensive.
- (8) The observed electrum grains can account for most or all of the gold assay of 30 g/t for the two samples.

- PETROGRAPHIC DESCRIPTION

Sample: 10/4

Date: 13 July 1992

Textural description: Breccia; with sulfides and oxides forming the matrix to angular blocks of sericitized felsic volcanics. The dominantly sulfide is pyrite which itself is brecciated and infilled by chalcopyrite. The chalcopyrite, is strongly oxidized, first being replaced by covellite, and then by goethite and lepidocrocite. The felsic volcanic blocks are strongly sericitized, but contain relic quartz eyes. The felsic volcanic blocks also have minor disseminated chalcopyrite.



Mineralogy:

Mineral	Volume percent	Grain size (mm)	Description/habit
Pyrite	30-40	0.01-0.5	Two types of pyrite are present: (1) early, brecciated pyrite, which is infilled by chalcopyrite, and (2) late, supergene pyrite (= marcasite) which occurs in late stage veins which cut everything, except possibly late stage, tabular goethite. Type (1) pyrite is strongly brecciated, with angular fragments ranging in size from 10 μ m to 500 μ m. In places type (1) pyrite has a gross curved-linear habit suggestive of a recrystallized, originally tetragonal habit. Type (1) pyrite occurs as the infill to brecciated, sericitized felsic volcanics. Type (2) pyrite is much less common; and the grain size varies from 10 μ m to 50 μ m.
Goethite	20-25	0.001-0.62	Two types of goethite are present: (1) spongy goethite, which replaces chalcopyrite and covellite, and (2) tabular goethite, which occurs along the walls of open space and in late supergene veins. The spongy goethite primarily forms most of the matrix around brecciated type (1) pyrite, however type (2) pyrite veins cut spongy goethite. The spongy goethite also contains blocks of undulose quartz. Goethite is intergrown with lepidocrocite in places.
Sericite	7-10	<0.001-0.01	Flakes which form the groundmass to the felsic volcanic blocks with quartz. Sericite also alters and dusts feldspar phenocrysts.
Quartz	15-20	0.001-2	Quartz occurs as strongly undulose grains with three habits: (1) quartz in the groundmass to the felsic volcanic blocks, (2) quartz phenocrysts in the felsic volcanic blocks, and (3) quartz fragments in the breccia groundmass. The quartz phenocrysts do not show evidence of resorption. The quartz in the breccia groundmass commonly has a lath-like habit - possibly from replacement of barite. Some quartz also occurs in fiber veins.
Feldspar	2-3	0.2-1	Sericitized phenocrysts within the felsic volcanic blocks.
Chalcopyrite	2-3	0.001-0.05	Anhydrous grains that occur as infilling in fractured type (1) pyrite or in the matrix of the breccia. Altered to covellite, minor chalcocite and Fe hydroxides.
Lepidocrocite	1-2	0.01-0.05	Massive patches of lepidocrocite, with minor intergrown goethite. These patches appear to have replaced patches of chalcopyrite.
Covellite	1/6-1	0.005-0.02	Anhydrous grains that replace chalcopyrite.

Name: Oxidized breccia, with blocks of felsic volcanic rock infilled by brecciated pyrite, chalcopyrite and supergene goethite.

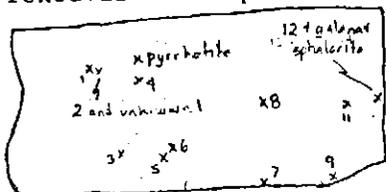
Mineral	Volume percent	Grain size (mm)	Description/habit.
Barite(?)	tr-1/4	0.05-0.2	A few grains of possible barite occur in the matrix of the breccia among goethite. The lath-like habit of quartz in the breccia matrix indicates that it may have replaced barite.
Chalcocite	tr	0.001-0.05	Anhedral grains that replace chalcopryite. Much less important as the supergene copper mineral than covellite.
Electrum	tr	0.001-0.0	Seven occurrences of electrum were observed, as follows (all occurrences circled on section and numbered on sketch): (1) two grains ($4\mu\text{m} \times 7\mu\text{m}$ and $7\mu\text{m} \times 7\mu\text{m}$) with chalcopryite and covellite in a vein in fractured pyrite; (2) eleven grains ($1\mu\text{m} \times 1\mu\text{m}$, $1\mu\text{m} \times 1\mu\text{m}$, $1\mu\text{m} \times 2\mu\text{m}$, $1\mu\text{m} \times 2\mu\text{m}$, $1\mu\text{m} \times 2\mu\text{m}$, $2\mu\text{m} \times 2\mu\text{m}$, $3\mu\text{m} \times 3\mu\text{m}$, $2\mu\text{m} \times 5\mu\text{m}$, $1\mu\text{m} \times 4\mu\text{m}$, $5\mu\text{m} \times 5\mu\text{m}$, and $10\mu\text{m} \times 15\mu\text{m}$) with quartz (and lepidocrocite); (3) ten grains ($1\mu\text{m} \times 1\mu\text{m}$, $1\mu\text{m} \times 1\mu\text{m}$, $1\mu\text{m} \times 2\mu\text{m}$, $1\mu\text{m} \times 3\mu\text{m}$, $1\mu\text{m} \times 3\mu\text{m}$, $2\mu\text{m} \times 2\mu\text{m}$, $2\mu\text{m} \times 5\mu\text{m}$, $3\mu\text{m} \times 4\mu\text{m}$, $2\mu\text{m} \times 6\mu\text{m}$, and $5\mu\text{m} \times 20\mu\text{m}$) with lepidocrocite and goethite; (4) nine grains ($1\mu\text{m} \times 2\mu\text{m}$, $1\mu\text{m} \times 3\mu\text{m}$, $1\mu\text{m} \times 3\mu\text{m}$, $2\mu\text{m} \times 2\mu\text{m}$, $2\mu\text{m} \times 10\mu\text{m}$, $2\mu\text{m} \times 10\mu\text{m}$, $4\mu\text{m} \times 10\mu\text{m}$, $5\mu\text{m} \times 10\mu\text{m}$, and $7\mu\text{m} \times 35\mu\text{m}$) associated with chalcopryite that is almost entirely replaced by lepidocrocite and goethite; (5) two grains ($7\mu\text{m} \times 10\mu\text{m}$ and $12\mu\text{m} \times 35\mu\text{m}$) associated with chalcopryite, covellite and spongy goethite in a fracture in type (1) pyrite; (6) a single grain ($4\mu\text{m} \times 7\mu\text{m}$) with chalcopryite and minor goethite in a fracture in type (1) pyrite; and (7) five grains ($0.5\mu\text{m} \times 1.5\mu\text{m}$, $1\mu\text{m} \times 2\mu\text{m}$, $1.5\mu\text{m} \times 2\mu\text{m}$, $2\mu\text{m} \times 2\mu\text{m}$ and $5\mu\text{m} \times 7\mu\text{m}$) in spongy goethite. The color indicates a fineness range of 650 to 850. The total area of electrum is $\sim 1400\mu\text{m}^2$. If a fineness of 750, s.g. electrum ~ 15 , s.g. sample ~ 3 , sample area $\sim 1.25 \times 10^3\text{mm}^2$, the assay indicated by the visible electrum is $42\text{g/t} \left(\frac{1.4 \times 10^{-3}\text{mm}^2}{1.25 \times 10^3\text{mm}^2} \left(\frac{0.15\text{g/mm}^2}{0.13\text{g/mm}^2} \right) (0.75) \right) = 42\text{g}/10^6\text{g} = 42\text{g/t}$.

PETROGRAPHIC DESCRIPTION

Sample: 10/5

Date: 15 July 1992

Textural description: Sericitized, felsic volcanics in contact with sulfides and oxides. The major sulfide is pyrite, which is strongly brecciated and altered to iron hydroxides. Minor chalcopyrite, which is supergene altered to chalcocite, also occurs in the fractured pyrite. The oxides are dominantly goethite, with lesser lepidocrocite, and alter the sulfide minerals. The felsic volcanics are sericitized, but retain relic quartz eyes.

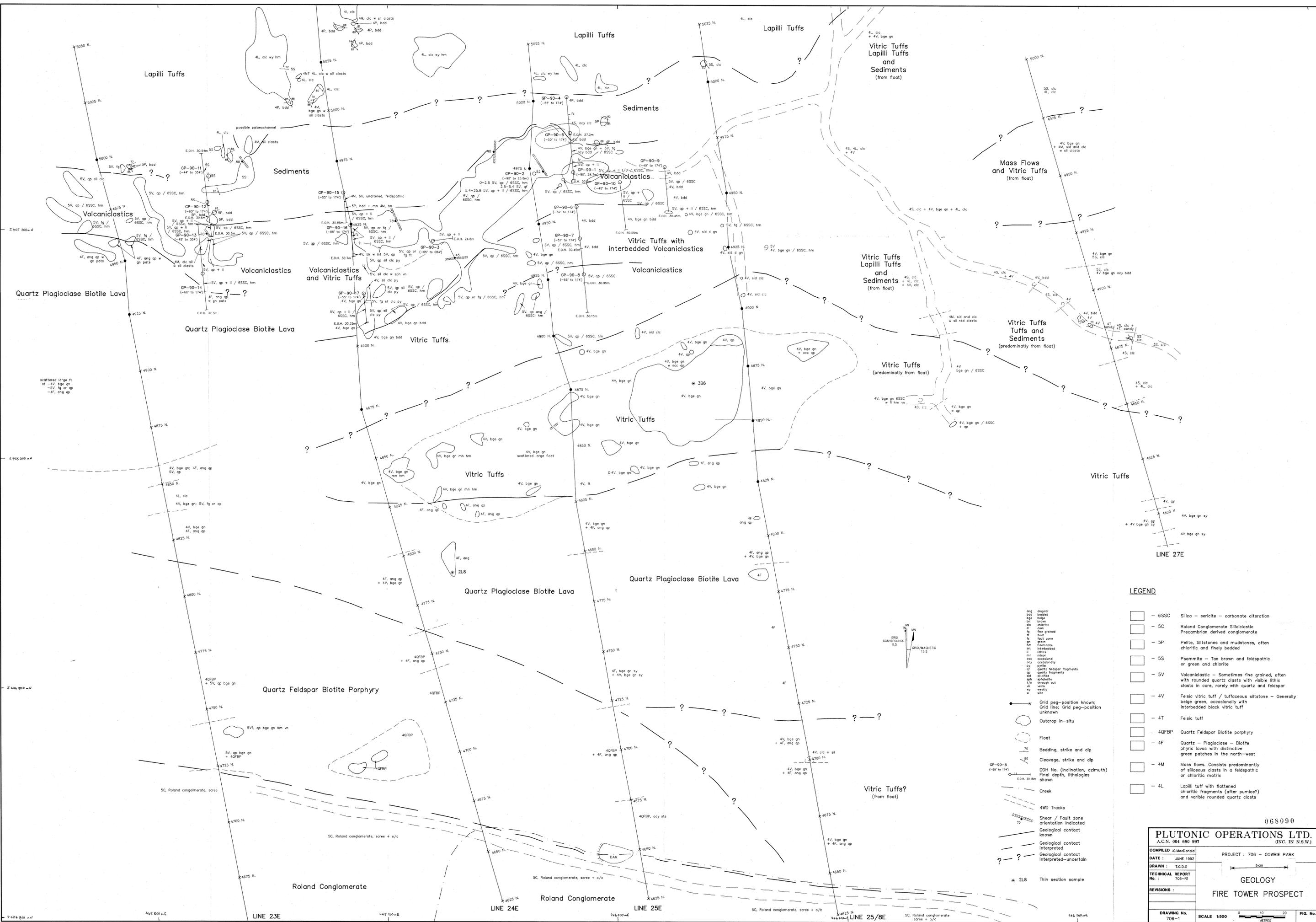


Mineralogy:

Mineral	Volume percent	Grain size (mm)	Description/habit
Pyrite	30-40	0.01-0.5	Pyrite occurs as strongly brecciated subhedral grains, with fragments varying in size from 10 μ m to 5 mm. Locally the fractures are filled by chalcopyrite, but in general the fractures are filled by goethite. In many instances the goethite is replacing the pyrite, and local atoll structures are present.
Goethite	20-30	0.001-0.01	Goethite, which is the dominant oxide, has two habits: (1) spongy goethite, which is dominant and replaces pyrite and chalcopyrite, and (2) botryoidal goethite, which form rims around open voids. The spongy pyrite replaces lepidocrocite.
Quartz	10-15	0.001-2	Quartz has four habits: (1) fine grained quartz in the groundmass to the altered felsic volcanic, (2) quartz phenocrysts in the altered felsic volcanic, (3) lath-like quartz in the groundmass to the sulfide-oxide zone, and (4) as fibrous quartz (fiber veins) in the sulfide-oxide zone. The quartz phenocrysts are angular and do not show evidence of resorption.
Sericite	7-10	<0.001-0.01	Flakes which form part of the groundmass to the felsic volcanic, and also dust feldspar phenocrysts.
Feldspar	1/2-1	0.2-0.5	Sericitized, angular phenocrysts within the altered felsic volcanic.
Lepidocrocite	1/2-1	0.005-0.02	Subhedral grains or masses that seem to have replaced chalcopyrite and are themselves replaced by goethite.
Chalcopyrite	1/2-1	0.01-0.05	Anhydrous grains which occur in fractures in pyrite or as isolated masses. Commonly altered to chalcocite and replaced by lepidocrocite and goethite.
Chalcocite	tr	0.001-0.01	Anhydrous grains that replace chalcopyrite along the edges.
Electrum	tr	0.001-0.	Eleven occurrences of electrum, as follows (all occurrences circled on sections and numbered on sketch): (1) a single grain (3 μ m x 12 μ m) in goethite; (2) nine grains (2 μ m x 2 μ m, 2 μ m x 2 μ m, 3 μ m x 8 μ m, 3 μ m x 7 μ m, 2 μ m x 12 μ m, 4 μ m x 8 μ m, 5 μ m x 6 μ m, 4 μ m x 13 μ m, and 7 μ m x 7 μ m) with goethite and quartz; (3) three grains (1 μ m x 2 μ m, 1.5 μ m x 3 μ m and 6 μ m x 7 μ m) in quartz with goethite; (4) two grains (4 μ m x 7 μ m and 3 μ m x 5 μ m) with quartz, and quartz and goethite, respectively; (5) three grains (4 μ m x 10 μ m, 5 μ m x 12 μ m and 5 μ m x 13 μ m) in goethite veinlets in fractured pyrite; (6) a single grain (5 μ m x 75 μ m) - lepidocrocite-goethite veinlet in fracture pyrite; (7) five grains (2 μ m x 2 μ m, 4 μ m x 8 μ m, 4 μ m x 20 μ m, 5 μ m x 18 μ m, and 7 μ m x 18 μ m) with chalcopyrite and covellite in a vein in fractured pyrite; (8) nine grains (1 μ m x 1 μ m, 1 μ m x 2 μ m, 2 μ m x 2 μ m, 2 μ m x 4 μ m, 3 μ m x 7 μ m, 5 μ m x 10 μ m, 5 μ m x 10 μ m, and 7 μ m x 7 μ m).

Name: Oxidized and brecciated massive pyrite vein (?) cutting sericitically altered felsic volcanic rock.

Mineral	Volume percent	Grain size (mm)	Description
Electrum (continued)			with quartz and goethite; (9) three grains ($3\mu\text{m} \times 5\mu\text{m}$, $3.5\mu\text{m} \times 17\mu\text{m}$, and $4\mu\text{m} \times 17\mu\text{m}$) with goethite in a vein in fractured pyrite; (10) eight grains ($2\mu\text{m} \times 2\mu\text{m}$, $2\mu\text{m} \times 2\mu\text{m}$, $2\mu\text{m} \times 2\mu\text{m}$, $3\mu\text{m} \times 3\mu\text{m}$, $3\mu\text{m} \times 3\mu\text{m}$, $3\mu\text{m} \times 6\mu\text{m}$, $6\mu\text{m} \times 15\mu\text{m}$ and $6\mu\text{m} \times 13\mu\text{m}$) with quartz and goethite; and (11) two grains ($2\mu\text{m} \times 10\mu\text{m}$, and $8\mu\text{m} \times 9\mu\text{m}$) in quartz with chalcopyrite, sphalerite and galena. The color indicates a fineness variation of 650 to 850. Many of the grains associated with goethite were pale colored, indicating a low fineness. This is unusual as most electrum is of very high fineness (>950); electrum from supergene enriched zones can have low (600-700) fineness however. The total area of the electrum is $\sim 1760\mu\text{m}^2$. If a fineness of 750, 5g. electrum ~ 15 , 5-g. sample ~ 3 , sample area $\sim 1.4 \times 10^3\text{mm}^2$, the assay indicated by visible electrum is $47\text{ g/t} \left(\left(\frac{1.76 \times 10^{-3}\text{mm}^2}{1.4 \times 10^3\text{mm}^2} \right) \left(\frac{0.15\text{g/cm}^3}{0.03\text{g/cm}^3} \right) (0.75) \right) = 47\text{ g/t} = 47\text{ g/t}$.
Covellite	tr	0.001-0.01	Anhedral grains which replace chalcopyrite and are replaced by iron hydroxides.
Galena	tr	0.005-0.02	Anhedral grains with chalcopyrite, sphalerite and electrum in quartz.
Sphalerite	tr	0.01	A single anhedral with chalcopyrite in quartz. The color in transmitted light is very pale, suggesting a low iron content.
Unknown 1	tr	0.005-0.03	Two grains in goethite, near electrum grains. The mineral is soft, moderately reflective, bluish or brownish white in color and anisotropic (blue gray/reddish brown). It may be bismuthinite.
Pyrrhotite	tr	0.005-0.1	Two anhedral grains included in pyrite.



- LEGEND**
- 6SSC Silica - sericite - carbonate alteration
 - 5C Roland Conglomerate Siliclastic Precambrian derived conglomerate
 - 5P Pelite, Siltstones and mudstones, often chloritic and finely bedded
 - 5S Psammite - Tan brown and feldspathic or green and chlorite
 - 5V Volcaniclastic - Sometimes fine grained, often with rounded quartz clasts with visible lithic clasts in core, rarely with quartz and feldspar
 - 4V Felsic vitric tuff / tuffaceous siltstone - Generally beige green, occasionally with interbedded black vitric tuff
 - 4T Felsic tuff
 - 4QFBP Quartz Feldspar Biotite porphyry
 - 4F Quartz - Plagioclase - Biotite phytic lavas with distinctive green patches in the north-west
 - 4M Mass flows. Consists predominantly of siliceous clasts in a feldspathic or chloritic matrix
 - 4L Lapilli tuff with flattened chloritic fragments (after pumice?) and variable rounded quartz clasts

068090

PLUTONIC OPERATIONS LTD.
A.C.N. 004 680 997 (INC. IN N.S.W.)

COMPILED - gMacDonald	PROJECT - 706 - GOWRIE PARK
DATE - JUNE 1992	
DRAWN - T.O.S	
TECHNICAL REPORT No. 706-R1	GEOLOGY
REVISIONS :	FIRE TOWER PROSPECT
DRAWING No. 706-1	SCALE 1:500
	FIG. No.