

SURTEC GEOSURVEYS PTY LTD

AS OPERATOR FOR

QUEENSLAND MINES LIMITED

EXPLORATION LICENCE 2508

NABARLEK AREA - NORTHERN TERRITORY

OPERATIONS REPORT

VOLUMES 1 - 9

OPEN FILE

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Surtec Geosurveys Pty Ltd

VOLUME 1

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PLAN No. 007	SHEET 9042	TOTAL COUNT (cps)	SCALE 1:10000
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PLAN No. 090	SHEET 0028	COPPER (ppm)	SCALE 1:10000
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PLAN No. 101	SHEET 1042	THORIUM (e ppm)	SCALE 1:10000

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BELOW GROUND RADIOMETRICS - POINT POSTED VALUES

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PLAN No. 124	SHEET 1035	THORIUM (e ppm)	SCALE 1:10000

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PLAN No. 129	SHEET 1035	LEAD (ppm)	SCALE 1:10000
PLAN No. 130	SHEET 1035	ZINC (ppm)	SCALE 1:10000
PLAN No. 131	SHEET 1035	NICKEL (ppm)	SCALE 1:10000
PLAN No. 132	SHEET 1035	IRON (%)	SCALE 1:10000

RADON - TRACK ETCH RESULTS - POINT POSTED VALUES

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RADON - TRACK ETCH RESULTS - POINT POSTED VALUES

PLAN No. 152

SHEET 1028

RADON (pCi/l/day)

SCALE 1:10000

1. INTRODUCTION

This report summarises the main elements of a major programme of exploration conducted by Surtec Geosurveys Pty Ltd on behalf of Queensland Mines Limited over the period July to December 1988 in the western portion of Exploration Licence No 2508 centred on the Nabarlek Mine in western Arnhem Land.

The main phase of data processing, assessment and compilation was conducted over the period December 1988 and January and February 1989 by Surtec Geosurveys in Sydney.

Results are presented on accompanying figures and plans.

2. SUMMARY

Surtec Geosurveys Pty Ltd was contracted by Queensland Mines Limited to undertake an extensive programme of work in Exploration Licence 2508. This included surveying, aerial photography, photogrammetry, gridding, geological mapping, soil sampling, ground radiometrics, radon track etch surveying, trenching, drilling, data processing and report preparation.

Overall logistical management and project coordination was provided by Surtec Geosurveys management from Sydney and field operations were directed by their on-site senior project geologist. The project was manned by Surtec contracted personnel and staff with additional personnel hired on a daily basis locally and included at its peak some 30 people divided between various field sampling, gridding, and survey crews and associated geologists and supervisory staff.

Survey work commenced in July and gridding and sampling followed in August with the first day of data collection being the 18th August. Gridding and surveying ceased in early November with data acquisition being completed on the 14th November. Track etch cup retrieval continued until the 6th December at which time all Surtec personnel had been withdrawn.

Production for this three month period is summarised below:

Registered Geodetic Survey Stations	
established	18
Grid base line traverses	
surveyed (line km):	95
Grid lines pegged (line km):	
200 x 100 metre	379
100 x 50 metre	143
50 x 25 metre	28
Above ground radiometric stations:	57800
Soil samples analysed:	8672
Radon track etch cups put out:	8672
Rock chip samples collected:	135
Bulk leach samples collected:	63
Trenches and pits dug:	77
Trench and pit samples:	780
Percussion holes commenced:	26

3. SURVEYING

A geodetic survey was undertaken in association with Australian Aerial Mapping, Perth to establish an accurate mapping and grid base and to control preparation of a series of 1:10000 scale orthophotomosaic maps of the exploration licence.

A series of grid base lines were surveyed from a survey control network established within the licence and linked to the National AMG coordinate system. This allowed gridding to be established using the AMG coordinate system.

In addition a series of airphoto reference points were surveyed to assist in accurate scaling of orthophotomosaic maps.

Survey control data points are listed in Appendix 1.

4. DATA RECORDING AND PROCESSING

Given the very large amount of data to be recorded it was necessary to use fully electronic or computerised recording and processing procedures. To this end programmable hand held electronic 'notebooks' were used by field crews to record all information. This enabled data to be downloaded directly into the field computer system for error correcting, processing and data plotting. Data for each days production could be plotted and followed up by geologists if warranted the next day.

This method allowed rapid anomaly follow up with infill gridding, trenching and sampling.

The field computing system consisted of a Protech AT PC with a 44Mbyte hard disc, a Protech XT PC with a 20Mbyte hard disc and a Houston Instruments DMP 56 A0 size plotter for hard copy plan output. All software used was specifically written for or adapted from existing packages for the project by Surtec Geosurveys.

By the end of compilation it is estimated that the full 'raw' database for the 1988 field season will comprise some 10 to 12 Megabytes of data.

5. GEOLOGY

Delineation of surficial cover types, Kombolgie Formation and basement metamorphic lithologies (Nourlangie Schist, Myra Falls Metamorphics, Cahill Formation, Oenpelli Dolerite etc) was undertaken using uncontrolled 1:10000 scale colour photography as the field mapping control base. Field data was transferred onto overlays on survey controlled 1:10000 scale orthophotomosaic map bases and subsequently compiled and drafted for presentation.

Emphasis was given to discriminating various elements within the surficial cover which may have had significant influence on the radon track etch, radiometric and soil geochemical surveys. Features which may have indicated zones of groundwater seepage such as concentrations of iron, zones of deep lateritisation (with or without iron enrichment), black soils, zones of extensive residual Kombolgie Formation escarpment talus scree or outwash sands which could blanket basement lithologies are some of these key factors. Delineation of the edge of the Kombolgie Formation outcrop was emphasised as were structures which affected both basement and Kombolgie Formation rocks.

In areas where surficial cover was extensive and evidence of some anomalism noted (generally radiometric) pitting was undertaken with an excavator to expose bedrock for mapping and sampling.

As part of routine field sampling procedure information on soil types was logged by field crews for each sample site. This was done to discriminate between four main soil groups, namely whether predominantly sand or gravel, black soil, clay rich, or rock chip (ie essentially outcrop) and on colour as a measure of oxidation and iron enrichment, (ie light to yellow/brown, green/grey, red/brown). Parameters such as these were considered to be relevant in terms of radon transmission (or diffusion) and accumulation in the surficial or oxidised zone which accordingly influences radiometric spectrometer readings and soil geochemistry.

Distribution and correlation of metamorphic basement lithologies is difficult to achieve and it is apparent that the broad BMR classification and mapped outcrop distribution are found somewhat wanting on detailed assessment and from drill hole lithologies. The Myra Falls Metamorphics as defined represents a 'carpet bag' of mixed lithologies. This probably represents predominantly Nourlangie Schist Formation to the west and south west and possibly in part upper Cahill Formation or even Kakadu Formation rocks to the north and east. This has been intruded by at least three and possibly four phases of acidic and a similar number of basic intrusions (dykes, plugs etc) based on field mapping, petrology, drill hole information and detailed assessment of airborne magnetic data.

There appears to be far more extensive occurrence of amphibolitic units within the basement schist lithologies than would be inferred from casual field mapping (for example such as the BMR reconnaissance programme) based upon the drilling and pitting programme. These units are normally equated with the Zamu Dolerite. Their abundance if they are in any way time constrained implies intrusion of numerous thin basic dykes and sills as swarms over a broad area. Many seem parallel (or subparallel) to the schist stratigraphy.

Away from major faults and the margin of the Oenpelli Dolerite (gabbro) intrusion schist lithologies (or bedding) are not extensively folded or deformed and for the most part is gently dipping essentially to the north west. Basement faulting appears to show elements of overthrusting and several phases of movement are evident on them.

In general the grade of metamorphism of the basement rocks is upper greenschist perhaps to lower amphibolite in some areas with local gneissic (or granitic dyke - petrological description) zones. Schists and gneisses are interbedded.

Where exposed up on the side of the escarpment the Kombolgie Formation - basement schist contact is generally 'sharp' and the schists lack weathering. The bottom contact of the Kombolgie Formation is generally subhorizontal but shows local channelling into the schists. Such channels tend to be filled with conglomerate of basement lithologies, mostly vein type quartz pebbles or boulders, quartzite or less frequently schist.

Lateritisation of basement lithologies is normally restricted and reaches typically to about 20 - 25 metres depth and only occurs adjacent to areas of actively retreating escarpment. Away from such areas erosion has largely stripped away the laterite zone exposing essentially 'fresh' basement rocks. The lateritised zone includes a thin (to 2 metre) mottled zone over a well developed saprolitic zone which grades at about 20 - 25 metres into essentially fresh or unoxidised lithologies. Much of the mottled zone includes lateritised cemented outwash sands and gravels sourced from the Kombolgie Formation.

The mottled zone may not be present where Kombolgie Formation outwash lithologies are lacking. The state of preservation depends largely upon the resistate nature of the lithologies as does the depth of lateritisation. The lateritised zones are not significantly iron enriched for the most part except near zones where what appears to be essentially subhorizontal groundwater seepage reaches the surface in the vicinity of creeks or adjacent to faults.

Black soil development is limited, generally thin and does not appear to be of importance in influencing geochemistry (perhaps reflecting lack of anomalous source rocks in the drainage basin containing the black soil and the underlying geology).

A selection of rocks and drill cuttings representing a range of lithological types was collected for petrological description by Minpet Services, Sydney. Details are included in Appendix 2.

6. GEOCHEMICAL SURVEY

A limited programme of rock chip and reconnaissance bulk leach stream sediment sampling was undertaken to assess the potential for precious metal mineralisation (Au, Ag, Pt, Pd). Sampling was restricted to where major structural zones were inferred or where there was evidence of faulting or thrusting in basement lithologies.

No anomalous precious metal values were determined for any element in the bulk leach survey or in rock chips. Results are consequently not treated further here except to comment that the bulk leach samples are probably influenced strongly by containing as a major component barren quartzo-feldspathic sands derived from erosion of Kombolgie Formation rocks. However composite rock chip samples across prominent basement structures are equally discouraging.

A programme of soil sampling was undertaken on the regional 200 x 100 metre grid and 100 x 50 and 50 x 25 metre detailed grids. In total some 8672 samples were collected. Each was collected from a nominal depth of 0.5 metre using a petrol driven power or hand auger. These holes were also used as the sites for emplacement of the track etch cups. Approximately 1.5 - 2.0 kilogrammes of sample was collected and bagged from each site for dispatch to the laboratory. Sample preparation was undertaken by Classic Comlabs, Darwin who pulverised the whole sample (or took a 1 - 1.5 kg split if sample too large) and then sent an assay split to their Adelaide laboratory for assay. Elements assayed, technique and lower limit of detection are:

U XRF	4 ppm
Th XRF	4 ppm
As XRF	2 ppm
Cu AAS	2 ppm
Pb AAS	4 ppm
Zn AAS	2 ppm
Ni AAS	4 ppm
Fe AAS	0.01%

Data was received as hard copy and on floppy disc for merging with the on site exploration data base for preliminary processing and assessment in the field.

Assay results are presented as point posted values on the accompanying 1:10000 scale plans for each map sheet sampled.

7. RADIOMETRIC SURVEY

A detailed ground radiometric survey was undertaken along all grid lines. This is complimented by an airborne survey and both were reduced to the same base level in processing (eg. removal of backgrounds).

Exploranium Portable Gamma Ray Spectrometers Model GR-256 with a Model GPS-21 detector were used for radiometric measurements. This is a portable 256 channel spectrometer with a 0.35 litre (21in³) detector which has the capability to record and analyse a wide gamma ray spectrum utilising the latest microprocessor technology.

For the regional grid surveys only four window channels were used (ie total count, potassium, uranium and thorium). Full 256 channel gamma ray spectral analysis was undertaken at a number of anomaly sites to characterise their radiometric spectral responses, for example spectral response of potassic (or sericitic) alteration or thorium rich sources.

'Above ground' survey data was collected at 10 metre station intervals along the 200 x 100 and 100 x 50 metre north south grid lines and at 5 metre station intervals on the 50 x 25 metre detailed grids. The readings were taken for a 20 second integration time at a height of approximately 1.2 metres above ground ie as positioned on the operators back. At each grid peg (ie soil sample and radon cup site) an additional 'in ground' reading was taken by placing the detector down the soil sample hole. Integration time for this was 20 seconds.

All field data was recorded in electronic notebooks for later downloading into the on-site computer system for checking, processing and plotting.

The 'above ground' data is presented as stacked profiles for each measurement for each map sheet at 1:10000 scale. The 'below ground' data is presented as point posted values. In both cases the data has been reduced and plotted as equivalent ppm or % (ie ppm or %) for uranium, thorium and potassium and as counts per second for the total count data using instrument calibration factors determined from calibration test pads established and maintained by the CSIRO at Ryde, Sydney, N.S.W.

8. RADON TRACK ETCH SURVEY

Track etch cups supplied by Tech/Ops Landauer, Inc., Illinois (Terradex) through local agents Geoterrex Pty Ltd., Sydney were placed at the bottom of each soil sample hole (at each grid peg) at a depth of 0.5 metre and buried for a period of 30 days after which they were retrieved and despatched in batches to Terradex for processing. Where rock prevented digging a suitable sample hole cups were placed over a crack or joint and buried under a pile of sand.

Results were supplied on floppy disc to allow direct computer processing and plotting.

Rain fell on a number of days during the survey period which wet the ground to some depth but this does not seem to have significantly affected the radon values reported ie there does not appear to be any obvious depreciation or enhancement of reported values which can be reasonably defined, even though moisture (and condensation from ground water evaporation) was noted in many of these cups. A number of cups were retrieved in early December which had been in the ground for only 20 - 25 days and not 30 days as for the bulk of the survey. This was done as heavy rain was making access difficult and cups were being filled with ground water. As with moist cups results for these later rain affected cups do not suggest any depreciation in the radon flux as calculated on a daily basis relative to those which were recovered dry, however this has not been rigourously analysed. The 30 day (or 20 - 25 for wet cups) integration time would appear to compensate for such intermittent environmental variances to some degree.

In a number of cases track etch cups were not able to be recovered because animals had dug them up or the sample site was not locatable. This included approximately 40 samples.

9. MAGNETIC SURVEY

Ground magnetic surveying was undertaken in both north south and east west directions over each radiometric anomaly site to provide additional information on subsurface lithologies and structure. This proved to be of considerable use in interpretation for areas with thick surficial or Kombolgie Formation cover where the various basic units could be discriminated from the schists. The magnetic data provided a useful adjunct to interpretations inferred from the trenching and mapping programme.

10. TRENCHING

As indicated above a number of sites with some anomaly attribute, normally a uranium radiometric signature, were pitted or trenched with an excavator to allow sampling and exposure of bedrock lithologies where covered by Kombolgie Formation scree and residual talus or soil. This first stage follow up of anomalies gave invaluable information on uranium distribution in the soil, laterite and weathered bedrock and highlighted many aspects and problems which are likely to effect interpretation of the exploration data.

Mapping and analytical details are presented on the accompanying figures.

Figures giving results are included as Appendix 4.

11. DRILLING

Five anomaly sites were selected for reconnaissance percussion drilling. Gaden Drilling, Batchelor, undertook the drilling using a Warman 1000 drillrig. In most cases it was not practical nor in several cases warranted drilling beyond approximately 50 - 60 metres because of the influx of ground water and poor sample return given the reconnaissance nature of the drilling. For most of the lateritised areas tested 18 metres of poly pipe collar was required to allow the hole to proceed satisfactorily.

The selection of targets for follow up was based on anomaly prominence as expressed by its radiometric signature, its geochemistry or geological setting and was designed to achieve representative sampling of the rocks across the target zone for both lithological and geochemical information to aid interpretation of surface anomalies (not ignoring the chance of actually intersecting an orebody!).

The short drilling programme was not designed to test all prominent anomalies but a selection of anomaly settings and more follow up work is envisaged on most of them and other targets outlined in later programmes.

Details are given on the accompanying figures and assays included as Appendix 3.

12. REHABILITATION

Trench and drill site rehabilitation was the responsibility of Queensland Mines Limited under supervision of their environmental staff and this work was largely undertaken after completion of the seasons work programme and after the departure of Surtec Geosurveys Pty Ltd. from the site.

13. **ABORIGINAL EMPLOYMENT**

Surtec Geosurveys Pty Ltd, maintained a policy of employing and training local aboriginals as field assistants in all phases of the exploration programme ie surveying, gridding, sampling and drilling. Overall this was successful and will offer a supply of local skilled and semi-skilled assistants for future work programmes.

14. EXPENDITURE SUMMARY

A break down of expenditure made by Surtec Geosurveys Pty Ltd as exploration contractor and invoiced to Queensland Mines Ltd. for project work and management for the period 1st June 1988, to 28th February 1989, field season is given below. This includes charges for field work undertaken during the 1988 dry season and data processing and reporting over the 1988 - 1989 wet season.

1.	PROJECT MANAGEMENT & ADMINISTRATION		130,737
2.	CONSULTING FEES		
	a) Surveying	94,361	
	b) Geology	115,134	
	c) Geophysics	23,542	233,037
3.	CONTRACTING FEES		
	a) Gridding	104,220	
	b) Data Acquisition	164,252	
	c) Geophysics	5,531	274,003
4.	DATA PROCESSING		
	a) On Site	13,965	
	b) Sydney Office	29,620	43,585
5.	REPORTING & DRAFTING		
	a) Reporting	27,053	
	b) Drafting	22,748	
	c) Computer Drafting	40,900	
	d) Plan Printing/ Reprographics	4,342	95,043
6.	VEHICLES & FUEL		
	a) Vehicle Rental	94,819	
	b) Fuel	2,082	
	c) Repairs and Maintenance	16,654	113,555
7.	HELICOPTERS		24,868
8.	TRAVEL & ACCOMMODATION		48,256
9.	INSTRUMENTS & EQUIPMENT		
	a) Instrument Rental	49,058	
	b) Equipment Rental	8,484	
	c) On Site Computer Equipment	26,779	84,321
10.	ANALYSIS		
	a) Chemical Analysis	152,019	
	b) Track Etch Cups	202,797	354,816
11.	PETROLOGY		3,878

12.	AERIAL PHOTOGRAPHY		
	a) Air Photos	42,556	
	b) Orthophotomosaics	37,536	80,092
13.	CONSUMABLES		33,289
14.	PUBLICATIONS		532
15.	FREIGHT & PUBLICATIONS		25,186
16.	COMMUNICATIONS		2,133
			1,416,594



QUEENSLAND MINES LIMITED			
ARNHEM LAND EXPLORATION PROJECT			
E.L. 2508			
LOCATION MAP			
Author	NFR	Date	Jan. 89
Drawn	GLC	Scale	1:1 million
FIGURE		1	

APPENDIX 1

NABARLEK EXPLORATION PROGRAMME

Report of Survey Control
AAM Surveying and Mapping Consultants, Perth



Surveying & Mapping
Consultants

23 Hamilton St. Subiaco
Western Australia 6008
Telephone: (09) 381 4133
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SURTEC GEOSURVEYS PTY LTD
NABARLEK EXPLORATION PROGRAM
REPORT OF SURVEY CONTROL

AAM SURVEYING & MAPPING CONSULTANTS
AAM REF: 23108

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AUSTRALIAN AERIAL
MAPPING (WA) PTY. LTD.



Surveying & Mapping
Consultants

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1. Co-ordinates of Major Survey Control Station and Observations and Adjustment Residuals
2. Plan of Survey Control and Schedule of Co-ordinates
3. Co-ordinates of Orthophoto Mapping Control and Gridding Baseline Control and Observations
4. Elevations of Major Survey Control Stations and Adjustment Residuals

1. Introduction

The purpose of this report is to summarise the results of and rationale for the Nabarlek survey and mapping control.

The survey control network was established to provide a homogeneous spatial base on which all data acquired in the exploration program will be correlated. This may, in the future, extend to the mining, engineering and legal requirements.

The Department of Lands and Surveys representative Mr. John Veal, has indicated that the survey control, upon satisfactory examination, would be adopted and included into the State network, so providing official recognition of the survey.

2. Scope of Work

The scope of work was to establish a survey control network throughout the exploration leases to:-

- . provide survey control for the orthophoto mapping;
- . provide survey control for the gridding traverses/baselines; and
- . provide survey control for the transponders used in the airborne geophysical survey.

Due to the delay in authorisation to commence work outside the S.M.L., additional surveys were carried out to:-

- . locate and target the existing S.M.L. boundary corners; and
- . commence a traverse north along the Nabarlek to Nimbuwah Road for gridding base line control.

Results and observations of the additional survey activities were reported on site and are not addressed in this report.

3. Timing

The survey was carried out by Licensed Surveyor Ron Broolsma (AAM) and Surveyor David Llewellyn (Surtec). The survey team was ready to commence on the 19th July 1988. Field activities were completed on the 31st August 1988. Computations and documentation were finalised in the Perth office.

The duration of the survey activities was longer than anticipated in our proposal. Factors beyond our control which caused this overrun were:-

- . the delay in authorisation to commence work outside the existing mining lease;
- . the repeated mechanical problems of the helicopter, which was eventually replaced;
- . the partial release of authorisation to commence work throughout the project area which effectively divided the project into four separate areas, resulting in duplication of helicopter and personnel movements by up to four times at key locations;
- . the need to identify photo image points, as approximately 50% of the aerial targets could not be placed prior to photography (for the reasons above);
- . the requirement to liaise with and transport the traditional owners to locations to be surveyed in the Narbarlek 2 and Oenpelli areas; and
- . the haze and smoke caused by the constant burning-off throughout the project area.

4. Survey Control

4.1 Network Configuration

The envisaged configuration of control was based on the assumption that the existing trigonometrical stations of Howship, Magella, AM2, AM5, AM6 and AM7 could be utilized. However these sites

became classified as "sacred" or "significant" by the Northern Land Council upon inspection and consequently could not be occupied. The network was redesigned with due consideration to network strength, topographical constraints, cultural restraints and the limited number of existing control stations.

4.2 Origins

Horizontal

The reference grid for the project is the Australian Map Grid (A.M.G.). The origin of co-ordinates is trigonometrical Station AM1 317496.00m E 8641119.47mN Orientation is the azimuth AM1 to U232 (Flat Top): 66 degrees 12' 40".84.

Vertical

The reference surface for elevation is the Australian Height Datum (A.H.D.). The derived elevations are based on Bench Marks FQ41, 44.32m A.H.D.; and AM1 140.02m A.H.D.

The elevation of AM1 was derived by AAM in 1978 from a stated elevation of the QML monument at Nabarlek airstrip. This had reputedly been levelled from BM's at Oenpelli although no documentary evidence was sighted by us. Measurements from bench mark FQ41 confirm, within the limits of trigonometrical heighting, that A.H.D. is the reference surface.

4.3 Configuration and Adjustment

Horizontal

The existing survey control stations which were utilised are U232 (Flat top) AM1 and AM6. Linear measurement between these stations had been made with a MRA3 Tellurometer, an instrument of lesser accuracy than the AGA 6000 used in this survey.

Measurements were subjected to a "variation of co-ordinates" adjustment.

The initial adjustment was based on the three existing control stations. This configuration significantly distorted the observed measurements. It became apparent that this was caused by errors in distance between the existing stations. The linear differences observed are most probably due to the technology superiority of modern electronic distance meters.

The adopted adjustment is based on the co-ordinates of AM1 and the azimuth AM1 to U232 - Flat Top (a 1st Order Control Station).

AM1 was held fixed because it is in the centre of the project area and many points have already been referenced to its co-ordinates. The azimuth to U232 was held fixed because it is a 1st Order trigonometric station. AM6 is of a lesser order being "a derived station".

The co-ordinates of stations established, observations and adjustment residuals are contained in Appendix 1. The network control plan is contained in Appendix 2. Co-ordinate listing and observations for radiated control points for orthophoto mapping and gridding base lines are contained in Appendix 3.

Vertical

Height differences were determined by observing reciprocal vertical angles and slope distances. Elevations of stations were determined by subjecting the height differences to a least squares adjustment.

Elevations of network control stations and residuals are contained in Appendix 4.

4.4 Monumentation

Survey Control stations prefixed 'AAM' consist of a "Northern Territory Lands and Survey Department" brass plaque set in concrete. The station name is stamped on the face and is witnessed by a survey beacon - except for AAM13, which has no beacon.

Descriptions of marks placed for ortho-photo mapping and gridding base line control are shown on the coordinate listings.



AAM20 - a typical survey mark showing ground mark and beacon

5. Records

Field Observations are contained in Field Books TFB 3028 - 3035 (incl).

A copy of the network observations are lodged with the Northern Territory Department of Lands and Survey.



Surveying & Mapping
Consultants

APPENDIX 1

Co-ordinates of Major
Survey Control Stations

and

Observations and Adjustment Residuals

23108 NARBALEK - MAJOR CONTROL

A.M.G. COORDINATES - ZONE 53 LATITUDE -12.346 DEGREES

FINAL LIST OF ADJUSTED CO-ORDINATES

STATION	STATION IDENT	EAST	NORTH	PAGE 1 of 2
1	AM1	317496.000	8641119.470	
232	U 232	360188.008	8659936.798	
101	AM1 BEACON	317494.476	8641115.777	
2	AM2	313172.810	8638975.998	
6	AM6	288413.871	8634576.109	
8	AAM8	322406.367	8642830.135	
108	AAM8 BEACON	322405.445	8642831.045	
9	AAM9	330435.514	8641815.439	
109	AAM9 BEACON	330433.943	8641817.240	
10	AAM10	302055.200	8640565.163	
110	AAM10 BEACON	302051.772	8640559.558	
11	AAM11	342308.636	8640383.250	
111	AAM11 BEACON	342308.782	8640384.290	
12	AAM12	334625.052	8636961.189	
112	AAM12 BEACON	334627.048	8636961.740	
13	AAM13	326298.078	8638069.941	
14	AAM14	317827.640	8633160.113	
114	AAM14 BEACON	317833.317	8633160.315	
15	AAM15	321883.736	8628514.004	
115	AAM15 BEACON	321881.847	8628510.678	
3015	AAM15 ECCE	321815.387	8628452.445	
16	AAM16	306549.736	8644672.834	
17	AAM17	327986.745	8617034.611	
117	AAM17 BEACON	327988.827	8617036.441	
18	AAM18	321041.725	8618616.469	

118	AAM18 BEACON	321042.009	8618612.614
19	AAM19	312867.158	8624007.034
119	AAM19 BEACON	312866.293	8624003.426
20	AAM20	304545.880	8627409.901
120	AAM20 BEACON	304546.526	8627408.855
21	AAM21	317247.588	8636056.380
121	AAM21 BEACON	317250.652	8636055.909
22	AAM22	326710.921	8636154.056
122	AAM22 BEACON	326712.170	8636155.372
23	AAM23	339643.371	8642984.730
123	AAM23 BEACON	339639.795	8642983.975
24	AAM24	308745.442	8645196.277
124	AAM24 BEACON	308748.569	8645197.549

23108 NARBALEK - MAJOR CONTROL

A.M.G. COORDINATES - ZONE 53 LATITUDE -12.346 DEGREES

ITERATION NUMBER 4

THE SOLUTION

EAST	NORTH	DE	DN	STN NO	STD. DEV.	SMJ	BRG	SMN
317496.000	8641119.470			1				
360188.008	8659936.798	.000	.000	232	.126 .056	137.7	66.21	.2
317494.476	8641115.777	.000	.000	101	.000 .001	1.0	202.43	.0
313172.810	8638975.998	.000	.000	2	.178 .197	244.0	139.28	104.5
288413.871	8634576.109	.000	.000	6	.123 .362	374.9	164.61	74.7
322406.367	8642830.135	.000	.000	8	.022 .046	48.3	162.35	17.8
322405.445	8642831.045	.000	.000	108	.022 .046	48.3	162.33	17.8
330435.514	8641815.439	.000	.000	9	.027 .110	110.0	178.05	26.6
330433.943	8641817.240	.000	.000	109	.027 .110	110.0	178.04	26.6
302055.200	8640565.163	.000	.000	10	.074 .191	192.3	173.32	71.3
302051.772	8640559.558	.000	.000	110	.175 .208	234.2	145.10	138.1
342308.636	8640383.250	.000	.000	11	.047 .202	202.6	183.29	45.2
342308.782	8640384.290	.000	.000	111	.047 .202	202.6	183.29	45.2
334625.052	8636961.189	.000	.000	12	.043 .142	146.4	193.87	25.8
334627.048	8636961.740	.000	.000	112	.043 .142	146.4	193.87	25.8
326298.078	8638069.941	.000	.000	13	.082 .148	155.3	160.56	67.9
317827.640	8633160.113	.000	.000	14	.071 .016	71.5	87.87	16.3
317833.317	8633160.315	.000	.000	114	.071 .016	71.5	87.83	16.3
321883.736	8628514.004	.000	.000	15	.113 .044	119.1	71.15	21.9
321881.847	8628510.678	.000	.000	115	.113 .044	119.1	71.16	21.9
321815.387	8628452.445	.000	.000	3015	.114 .043	119.5	71.49	22.0
306549.736	8644672.834	.000	.000	16	.063 .131	138.4	200.08	44.5
327986.745	8617034.611	.000	.000	17	.239 .120	263.9	64.66	46.2
327988.827	8617036.441	.000	.000	117	.239 .120	263.9	64.65	46.2
321041.725	8618616.469	.000	.000	18	.219 .047	221.1	82.68	38.3
321042.009	8618612.614	.000	.000	118	.219 .047	221.1	82.69	38.3

312867.158	8624007.034	.000	.000	19	.160	.086	171.5	112.32	60.1
312866.293	8624003.426	.000	.000	119	.160	.086	171.6	112.31	60.1
304545.880	8627409.901	.000	.000	20	.130	.164	198.7	143.34	65.9
304546.526	8627408.855	.000	.000	120	.130	.164	198.7	143.34	65.9
317247.588	8636056.380	.000	.000	21	.052	.016	52.1	92.04	15.9
317250.652	8636055.909	.000	.000	121	.052	.016	52.1	92.03	15.9
326710.921	8636154.056	.000	.000	22	.047	.081	91.0	208.54	21.0
326712.170	8636155.372	.000	.000	122	.047	.081	91.0	208.53	21.0
339643.371	8642984.730	.000	.000	23	.035	.178	178.7	175.58	32.0
339639.795	8642983.975	.000	.000	123	.035	.178	178.7	175.58	32.0
308745.442	8645196.277	.000	.000	24	.066	.107	118.9	207.85	40.8
308748.569	8645197.549	.000	.000	124	.066	.107	118.9	207.87	40.8

STATIONS			MEASURED			ADJUSTED			CORR	S.D.	X-X1	SD(DX)
BRG	1	232	66	12	40.84	66	12	40.84	.00	.00		
	1	114	21	5	14 5.50	5	14	7.10	1.60	3.00		
	1	114	108	253	12 20.70	253	12	19.93	-.77	3.00		
	1	14	2	66	0 45.50	66	0	45.43	-.07	10.00		
	1	14	108	253	9 50.10	253	9	52.86	2.76	3.00		
	1	14	101	24	48 25.00	24	48	25.00	.00	.10		
	1	114	15	343	14 6.80	343	14	7.15	.35	3.00		
	1	114	22	300	44 37.00	300	44	39.15	2.15	3.00		
	6	24	110	3	53 31.00	3	53	31.52	.52	3.00		
	6	16	110	5	25 4.00	5	25	3.48	-.52	3.00		
	8	101	114	314	33 8.00	314	33	5.57	-2.43	3.00		
	8	101	112	224	53 28.90	224	53	27.77	-1.13	3.00		
	8	101	9	206	26 32.00	206	26	33.72	1.72	3.00		
	8	101	115	291	20 21.80	291	20	22.29	.49	3.00		
	8	101	108	63	51 .00	63	51	.00	.00	.10		
	8	114	12	270	20 43.30	270	20	42.97	-.33	3.00		
	8	114	124	74	31 21.30	74	31	18.81	-2.49	3.00		
	8	114	22	301	52 35.20	301	52	35.03	-.17	3.00		
	8	114	123	244	10 35.50	244	10	36.88	1.38	3.00		
	9	123	112	56	25 22.20	56	25	22.68	.48	3.00		
	9	123	122	130	34 30.80	130	34	26.93	-3.87	3.00		
	9	123	108	194	26 37.10	194	26	36.89	-.21	3.00		
	9	123	109	236	7 2.00	236	7	2.00	.00	.10		
	10	6	16	161	16 37.10	161	16	36.70	-.40	5.00		
	11	108	23	37	17 43.70	37	17	41.32	-2.38	5.00		
	11	108	123	37	14 54.20	37	14	53.17	-1.03	5.00		
	11	108	111	90	59 .00	90	58	60.00	.00	.10		
	12	114	8	38	24 29.80	38	24	33.12	3.32	3.00		
	12	114	109	61	57 21.00	61	57	24.08	3.08	3.00		
	12	108	9	23	32 43.60	23	32	44.99	1.39	3.00		
	12	108	112	138	53 45.00	138	53	45.00	.00	.10		
	12	122	109	55	1 8.00	55	1	3.32	-4.68	3.00		
	12	122	23	135	36 44.50	135	36	44.00	-.50	3.00		
	14	101	21	351	4 23.00	351	4	24.78	1.78	3.00		
	14	101	114	90	21 51.00	90	21	51.00	.00	.10		
	14	101	108	27	43 47.30	27	43	43.20	-4.10	3.00		
	14	101	120	248	59 7.80	248	59	6.90	-.90	3.00		
	14	101	2	323	43 32.50	323	43	32.68	.18	3.00		

14	101	113	141	18	47.50	141	18	42.88	-4.62	3.00
14	101	13	62	18	.00	62	18	.00	.00	3.00
14	112	101	280	21	9.20	280	21	8.85	-.35	3.00
14	122	101	286	13	57.00	286	13	55.08	-1.92	3.00
14	24	108	62	22	8.50	62	22	6.72	-1.78	3.00
15	114	108	43	10	1.10	43	9	57.53	-3.57	3.00
15	114	119	284	30	26.00	284	30	25.10	-.90	3.00
15	114	115	250	40	9.00	250	40	9.00	.00	.10
15	114	118	225	56	28.50	225	56	28.41	-.09	3.00
15	122	114	286	37	52.50	286	37	55.55	3.05	3.00
3015	118	119	59	4	14.30	59	4	16.16	1.86	3.00
3015	118	15	223	29	47.00	223	29	47.03	.03	3.00
3015	118	17	327	6	51.60	327	6	53.56	1.96	3.00
16	124	6	164	19	.90	164	19	2.27	1.37	3.00
16	124	10	150	59	51.20	150	59	50.32	-.88	3.00
17	118	3015	48	48	21.30	48	48	21.37	.07	3.00
17	118	117	125	53	.00	125	53	.00	.00	.10
18	119	115	61	28	10.60	61	28	16.02	5.42	3.00
18	119	17	159	27	.00	159	27	1.74	1.74	3.00
18	119	118	232	23	54.00	232	23	54.00	.00	3.00
19	15	118	59	58	47.30	59	58	46.77	-.53	3.00
19	118	20	168	49	16.80	168	49	12.85	-3.95	3.00
19	118	119	70	3	30.00	70	3	30.00	.00	.10
20	114	119	45	40	.20	45	40	3.23	3.03	3.00
20	114	120	81	43	49.00	81	43	49.00	.00	.10
21	14	121	290	3	51.00	290	3	51.00	.00	.10
21	108	114	131	17	3.00	131	17	1.57	-1.43	3.00
21	108	101	325	30	37.70	325	30	37.04	-.66	3.00
22	115	114	39	4	44.90	39	4	46.02	1.12	3.00
22	115	123	209	52	3.60	209	52	3.08	-.52	3.00
22	114	122	152	8	40.00	152	8	40.00	.00	.10
22	114	9	141	58	30.70	141	58	29.96	-.74	3.00
22	114	1	46	57	6.00	46	57	7.72	1.72	3.00
22	114	108	75	49	8.60	75	49	9.46	.86	3.00
22	114	123	170	47	19.50	170	47	17.06	-2.44	3.00
22	114	112	192	48	27.80	192	48	32.92	5.12	3.00
23	108	22	332	40	12.30	332	40	10.01	-2.29	3.00
23	108	109	353	17	10.10	353	17	9.71	-.39	3.00
23	108	114	336	15	45.90	336	15	45.47	-.43	3.00
23	108	112	310	18	9.00	310	18	4.18	-4.82	3.00
23	108	123	348	35	30.00	348	35	30.00	.00	.10
23	108	11	224	49	1.00	224	49	2.05	1.05	3.00
23	108	232	140	58	54.40	140	58	54.40	.00	3.00
24	14	2	1	35	38.80	1	35	40.84	2.04	10.00
24	14	108	316	51	33.70	316	51	33.94	.24	3.00
24	108	124	328	2	57.00	328	2	57.00	.00	.10
24	6	108	217	24	6.80	217	24	8.90	2.10	3.00
24	6	114	260	31	32.40	260	31	31.40	-1.00	3.00
24	108	16	156	46	2.60	156	46	3.69	1.09	3.00
24	108	114	43	7	24.90	43	7	22.50	-2.40	3.00
1	21		5069.125			5069.117			-.008	.020
1	101		3.995			3.995			.000	.001
1	8		5199.810			5199.809			-.001	.020
1	15		13347.263			13347.255			-.008	.044
6	16		20754.799			20754.774			-.025	.065
6	10		14896.402			14896.370			-.032	.050
8	108		1.295			1.295			.000	.001
8	14		10699.253			10699.252			-.001	.038
8	15		14325.801			14325.792			-.009	.047
8	9		8093.237			8093.231			-.006	.029
8	12		13555.593			13555.592			-.001	.047
8	24		13864.038			13864.034			-.004	.050
8	23		17238.506			17238.499			-.007	.056
9	109		2.390			2.390			.000	.001
9	23		9282.376			9282.390			.014	.032
10	110		6.570			6.570			.000	.001

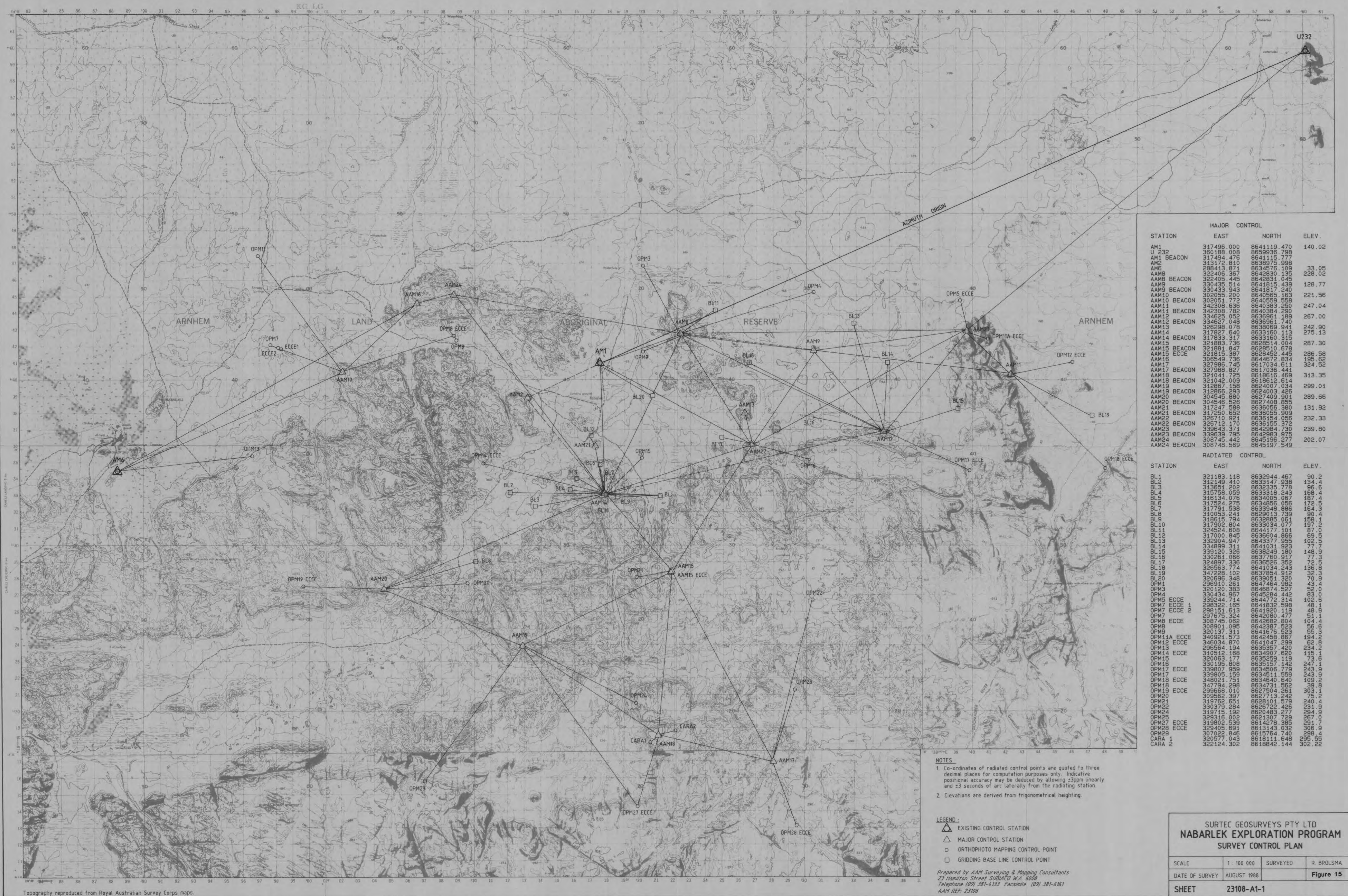
12	9	6412.534	6412.514	-.020	.023
12	112	2.070	2.070	.000	.001
12	14	17222.521	17222.565	.044	.056
12	23	7840.627	7840.625	-.002	.029
12	22	7955.545	7955.543	-.002	.029
14	114	5.680	5.680	.000	.001
14	1	7966.172	7966.173	.001	.029
14	20	14472.506	14472.485	-.021	.047
14	13	9790.623	9790.623	.000	.035
14	24	15077.842	15077.842	.000	.050
15	115	3.825	3.825	.000	.001
15	14	6167.514	6167.506	-.008	.023
3015	15	91.985	91.985	.000	.005
16	10	6088.384	6088.378	-.006	.023
17	117	2.772	2.772	.000	.001
17	3015	12979.217	12979.197	-.020	.044
18	118	3.865	3.865	.000	.001
18	15	9933.331	9933.343	.012	.035
18	17	7123.020	7123.026	.006	.026
19	119	3.710	3.710	.000	.001
19	20	8989.685	8989.696	.011	.032
19	15	10080.127	10080.123	-.004	.035
19	18	9791.769	9791.780	.011	.035
20	120	1.230	1.230	.000	.001
21	121	3.100	3.100	.000	.001
21	14	2953.751	2953.746	-.005	.014
22	122	1.815	1.815	.000	.001
22	15	9037.419	9037.425	.006	.032
22	14	9374.318	9374.325	.007	.032
22	9	6776.948	6776.961	.013	.026
22	8	7943.654	7943.655	.001	.029
22	1	10467.657	10467.662	.005	.035
22	23	14626.338	14626.351	.013	.050
23	123	3.655	3.655	.000	.001
23	11	3724.749	3724.749	.000	.019
23	232	26638.812	26638.812	.000	.086
24	124	3.375	3.375	.000	.001
24	6	22935.746	22935.847	.101	.074
24	16	2257.109	2257.107	-.002	.011

* SIGMA ZERO .76951



Surveying & Mapping
Consultants

APPENDIX 2
Plan of Survey Control
and
Schedule of Co-ordinates



MAJOR CONTROL			
STATION	EAST	NORTH	ELEV.
AM1	317496.000	8641119.470	
U 232	360188.008	8659936.798	140.02
AM1 BEACON	317494.476	8641115.777	
AM2	313172.810	8638975.998	
AM5	322406.367	8642830.135	33.05
AAM8	322405.445	8642831.045	
AAM8 BEACON	330435.514	8641815.439	128.77
AAM9	330433.943	8641817.240	
AAM10 BEACON	302055.200	8640565.163	221.56
AAM10	302051.772	8640559.558	
AAM11	342308.636	8640383.250	247.04
AAM11 BEACON	342308.782	8640384.230	
AAM12	334625.052	8636961.189	267.00
AAM12 BEACON	334627.048	8636961.740	
AAM13	326298.078	8633069.941	242.90
AAM14	317827.640	8633180.113	275.13
AAM14 BEACON	317833.317	8633160.315	
AAM15	321883.736	8628514.004	287.30
AAM15 BEACON	321881.847	8628510.678	
AAM15 ECCE	321815.387	8628452.445	286.58
AAM16	306549.736	8644672.834	195.62
AAM17	327986.745	8617034.611	324.52
AAM17 BEACON	327988.827	8617036.441	
AAM18	321041.725	8618616.469	313.35
AAM18 BEACON	321042.009	8618612.614	
AAM19	312867.158	8624007.034	299.01
AAM19 BEACON	312866.293	8624003.426	
AAM20	304545.880	8627409.901	289.66
AAM20 BEACON	304546.526	8627408.855	
AAM21	317247.588	8636056.380	131.92
AAM21 BEACON	317250.909	8636056.909	
AAM22	326710.921	8636154.056	232.33
AAM22 BEACON	326712.170	8636155.372	
AAM23	339643.371	8642984.730	239.80
AAM23 BEACON	339639.795	8642983.975	
AAM24	308745.442	8645196.277	202.07
AAM24 BEACON	308748.569	8645197.549	

RADIATED CONTROL			
STATION	EAST	NORTH	ELEV.
BL1	321183.118	8632944.467	90.2
BL2	312149.410	8633147.938	134.4
BL3	313651.202	8633318.243	168.4
BL4	315758.059	8633318.243	168.4
BL5	316134.076	8634005.067	187.4
BL6	317524.275	8634856.056	172.5
BL7	317731.538	8634856.056	172.5
BL8	310053.241	8629013.339	90.4
BL9	318615.794	8632885.061	158.1
BL10	317902.804	8633034.077	197.2
BL11	324524.808	8644177.101	87.0
BL12	317000.845	8636604.866	69.5
BL13	332904.947	8643377.955	102.5
BL14	334899.311	8641031.923	77.7
BL15	333120.326	8638249.180	149.9
BL16	330261.066	8637760.917	77.3
BL17	324897.336	8636526.352	72.5
BL18	325553.774	8641034.743	136.8
BL19	347228.102	8637864.212	32.3
BL20	320696.348	8639051.320	70.9
OPM1	296910.261	8647464.982	43.4
OPM3	320120.387	8646874.527	63.0
OPM4	330434.967	8645284.442	85.0
OPM5 ECCE	339244.714	8644772.314	102.6
OPM7 ECCE 1	298322.165	8641832.598	48.1
OPM7 ECCE 2	298151.613	8641920.119	48.9
OPM7	297675.324	8642080.477	51.1
OPM8 ECCE	308745.062	8642682.804	104.4
OPM8	308901.095	8642387.523	56.6
OPM9	320137.311	8641675.529	56.6
OPM11A ECCE	340921.573	8642458.867	194.2
OPM12 ECCE	346034.870	8641047.299	62.8
OPM13	295564.184	8639357.420	234.2
OPM14	310512.168	8639307.620	115.1
OPM15	320063.177	8635259.119	73.6
OPM16	330195.808	8635157.142	247.1
OPM17	339807.989	8634505.779	243.9
OPM17 ECCE	339805.159	8634511.559	243.9
OPM18 ECCE	348021.751	8634640.640	109.2
OPM18	347794.298	8634731.562	39.8
OPM19 ECCE	299668.010	8637574.740	39.1
OPM20	509562.397	8627713.242	75.2
OPM21	319762.651	8628101.579	240.4
OPM22	330379.284	8626722.426	231.8
OPM24	319704.463	8627043.277	231.8
OPM25	329316.002	8621307.729	267.0
OPM27 ECCE	319602.539	8614278.385	291.7
OPM28 ECCE	329405.891	8613143.032	306.9
CARA 1	307022.846	8618111.648	295.55
CARA 2	320577.043	8618111.648	295.55
CARA 2	322124.302	8618842.144	302.22

NOTES
1. Co-ordinates of radiated control points are quoted to three decimal places for computation purposes only. Indicative positional accuracy may be deduced by allowing ± 30 m linearly and ± 3 seconds of arc laterally from the radiating station.
2. Elevations are derived from trigonometrical heighting.

- LEGEND:
△ EXISTING CONTROL STATION
△ MAJOR CONTROL STATION
○ ORTHOPHOTO MAPPING CONTROL POINT
□ GRIDDING BASE LINE CONTROL POINT

Prepared by AAM Surveying & Mapping Consultants
23 Hamilton Street SUBIACO W.A. 6006
Telephone (09) 281-4133 Facsimile (09) 281-6161
AAM REF. 23108

SURTEC GEOSURVEYS PTY LTD

NABARLEK EXPLORATION PROGRAM

SURVEY CONTROL PLAN

SCALE	1 : 100 000	SURVEYED	R. BROLISMA
DATE OF SURVEY	AUGUST 1988		Figure 15
SHEET	23108-A1-1		

CR 89-423 B

APPENDIX 3

Co-ordinates of Orthophoto Mapping Control
and
Gridding Baseline Control
and
Observations

ORTHOPHOTO MAPPING CONTROL

STATION	STATION IDENT	EAST	NORTH	ELEV.	DESCRIPTION
301	DPM1	296910.261	8647464.982	43.4	TELEC. TOWER
302	DPM2	310268.453	8646099.680	64.8	
303	DPM3	320120.383	8646874.527	52.0	S.I.P. & W.P.
304	DPM4	330434.967	8645284.442	83.0	S.I.P. & W.P.
1305	DPM5 ECCE	339244.714	8644772.314	102.6	S.I.P. & W.P.
305	DPM5	339247.642	8644772.967	102.6	I.P.
306	DPM6	346628.395	8646331.405	37.4	I.P.
1307	DPM7 ECCE 1	298322.165	8641832.598	48.1	S.I.P.
2307	DPM7 ECCE 2	298151.613	8641920.119	48.9	S.I.P.
307	DPM7	297675.324	8642080.477	51.1	S.I.P. & W.P.
1308	DPM8 ECCE	308745.062	8642682.804	104.4	D.H. & W.
308	DPM8	308901.095	8642387.523	56.6	D.H. & W. & W.P.
309	DPM9	320137.311	8641676.523	55.3	S.I.P. & W.P.
310	DPM10	330449.647	8641813.264	127.9	
311	DPM11	339650.648	8643004.637	229.2	I.P.
1311	DPM11A ECCE	340921.573	8642458.867	194.2	S.I.P. & W.P.
2311	DPM11A	340922.594	8642452.661	192.0	I.P.
1312	DPM12 ECCE	346034.870	8641047.299	62.8	TEXTA MARK ON ROCK & W.P.
312	DPM12	345942.767	8641091.251	44.5	I.P.
313	DPM13	296564.194	8635357.420	234.2	S.I.P. & W.P.
1314	DPM14 ECCE	310512.168	8634907.620	115.1	D.H. & W.
314	DPM14	310172.640	8634985.005	97.0	
315	DPM15	320063.177	8635259.119	73.6	S.I.P. & W.P.
316	DPM16	330195.808	8635157.142	247.1	S.I.P. & W.P.
1317	DPM17 ECCE	339807.959	8634506.779	243.9	S.I.P. & W.P.
317	DPM17	339805.159	8634511.559	243.9	I.P.
1318	DPM18 ECCE	348021.751	8634640.640	109.2	S.I.P.
318	DPM18	347794.298	8634731.562	39.8	I.P.

ORTHOPHOTO MAPPING CONTROL (cont)

STATION	STATION IDENT	EAST	NORTH	ELEV.	DESCRIPTION
1319	OPM19 ECCE	299668.010	8627504.261	303.1	D.H.& W.& W.P.
319	OPM19	299667.628	8627506.641	303.1	
320	OPM20	309562.397	8627713.242	75.2	S.I.P.& W.P.
321	OPM21	319762.651	8628101.579	240.4	D.H.& W.
322	OPM22	330379.284	8626722.426	231.9	S.I.P. & W.P.
324	OPM24	319715.192	8620483.277	294.9	D.H.& W.& ROCK CAIRN
325	OPM25	329316.002	8621307.729	267.0	D.H.& W.
326	OPM26	310381.583	8614402.220	283.6	
1327	OPM27 ECCE	319802.539	8614278.385	291.7	S.I.P.& W.P.
327	OPM27	319798.390	8614273.446	291.7	I.P.
1328	OPM28 ECCE	329405.691	8613143.032	306.9	D.H.& W.& ROCK CAIRN
328	OPM28	329396.665	8613159.637	306.9	I.P.
329	OPM29	307022.846	8615764.740	298.4	D.H.& W.
330	OPM30	306834.774	8620660.783	85.1	I.P.
331	OPM31	313607.026	8621309.903	82.7	I.P.

Abbreviations denote : -

S.I.P. - Star Iron Picket

D.H.& W - Drill Hole and Wing

W.P. - Witness Post

I.P. - Photo Image Point

GRIDDING BASE LINE CONTROL

STATION	STATION IDENT	EAST	NORTH	ELEV.	DESCRIPTION
201	BL1	321183.118	8632944.467	90.2	S.I.P. & W.P.
202	BL2	312149.410	8633147.938	134.4	S.I.P. & W.P.
203	BL3	313651.202	8632335.778	96.6	S.I.P. & W.P.
204	BL4	315758.059	8633318.243	168.4	D.H. & W.
205	BL5	316134.076	8634005.067	187.4	D.H. & W.
206	BL6	317524.275	8634856.056	172.5	D.H. & W.
207	BL7	317791.538	8633948.886	164.3	D.H. & ROCK CAIRN
208	BL8	310053.241	8629013.739	90.4	D.H. & W.
209	BL9	318615.794	8632885.061	158.1	TOP OF S.I.P.
210	BL10	317902.804	8633034.077	197.2	TOP OF S.I.P.
211	BL11	324524.608	8644177.101	87.0	S.I.P.
212	BL12	317000.845	8636604.866	69.5	S.I.P. & W.P.
213	BL13	332904.947	8643377.955	102.5	D.H. & W.
214	BL14	334899.311	8641031.923	77.7	S.I.P. & W.P.
215	BL15	339120.326	8638249.180	148.9	D.H. & W. & W.P.
216	BL16	330261.066	8637760.917	77.3	S.I.P. & W.P.
217	BL17	324897.336	8636526.352	72.5	S.I.P. & W.P.
218	BL18	326563.774	8641034.243	136.8	S.I.P. & W.P.
219	BL19	347228.102	8637854.912	32.3	S.I.P. & W.P.
220	BL20	320696.348	8639051.320	70.9	D.H. & W. & ROCK CAIRN

Abbreviations denote : -

S.I.P. - Star Iron Picket

D.H. & W - Drill Hole and Wing

W.P. - Witness Post

I/P. - Photo Image Point

CARAMEL ORTHOPHOTO MAPPING CONTROL

STATION	STATION IDENT	EAST	NORTH	ELEV.	DESCRIPTION
501	CARA 1	320577.043	8618111.648	295.55	D.H.& W
502	CARA 2	322124.302	8618842.144	302.22	D.H.& W & ROCK CAIRN
1504	CARA 4 I.P.	322044.226	8617535.571	261.06	I.P.
1505	CARA 5 I.P.	320032.773	8617302.730	126.59	I.P.
1506	CARA 6 I.P.	319827.426	8619201.408	119.96	I.P.

** HORIZONTAL SURVEY ADJUSTMENT ** 8/9/88 10:59 ** by AAM (WA) **

23108 NARBALEK - RADIATIONS

A.M.G. COORDINATES - ZONE 53 LATITUDE -12.346 DEGREES

ITERATION NUMBER 3

THE SOLUTION

EAST	NORTH	DE	DN	STN NO	STD. DEV.	SMJ	BRG	SMN
317496.000	8641119.470			1				
360188.008	8659936.798			232				
317494.476	8641115.777			101				
313172.810	8638975.998			2				
288413.871	8634576.109			6				
322406.367	8642830.135			8				
322405.445	8642831.045			108				
330435.514	8641815.439			9				
330433.943	8641817.240			109				
302055.200	8640565.163			10				
302051.772	8640559.558			110				
342308.636	8640383.250			11				
342308.782	8640384.290			111				
334625.052	8636961.189			12				
334627.048	8636961.740			112				
326298.078	8638069.941			13				
317827.640	8633160.113			14				
317833.317	8633160.315			114				
321883.736	8628514.004			15				
321881.847	8628510.678			115				
321815.387	8628452.445			3015				
306549.736	8644672.834			16				
327986.745	8617034.611			17				
327988.827	8617036.441			117				

321041.725	8618616.469				18					
321042.009	8618612.614				118					
312867.158	8624007.034				19					
312866.293	8624003.426				119					
304545.880	8627409.901				20					
304546.526	8627408.855				120					
317247.588	8636056.380				21					
317250.652	8636055.909				121					
326710.921	8636154.056				22					
326712.170	8636155.372				122					
339643.371	8642984.730				23					
339639.795	8642983.975				123					
308745.442	8645196.277				24					
308748.569	8645197.549				124					
321183.118	8632944.467	.000	.000	201	.009	.049	48.9	183.68	8.0	
312149.410	8633147.938	.000	.000	202	.010	.083	82.6	179.88	10.0	
313651.202	8632335.778	.000	.000	203	.015	.061	61.9	168.83	10.0	
315758.059	8633318.243	.000	.000	204	.007	.030	30.2	184.37	7.0	
316134.076	8634005.067	.000	.000	205	.013	.024	26.2	206.44	7.0	
317524.275	8634856.056	.000	.000	206	.023	.008	23.4	79.83	7.0	
317791.538	8633948.886	.000	.000	207	.011	.006	11.5	87.38	6.0	
310053.241	8629013.739	.000	.000	208	.025	.080	83.4	163.76	10.0	
318615.794	8632885.061	.000	.000	209	.012	.058	58.0	178.99	12.1	
317902.804	8633034.077	.000	.000	210	.012	.048	47.7	181.55	11.5	
324524.608	8644177.101	.000	.000	211	.020	.031	36.5	147.55	7.0	
317000.845	8636604.866	.000	.000	212	.008	.007	8.7	65.78	6.0	
332904.947	8643377.955	.000	.000	213	.089	.025	92.1	75.49	10.7	
334899.311	8641031.923	.000	.000	214	.059	.010	59.3	93.85	9.0	
339120.326	8638249.180	.000	.000	215	.063	.218	226.6	164.02	10.0	
330261.066	8637760.917	.000	.000	216	.015	.063	64.5	190.38	10.0	
324897.336	8636526.352	.000	.000	217	.009	.026	26.9	191.60	7.0	
326563.774	8641034.243	.000	.000	218	.049	.093	103.8	206.88	15.0	
347228.102	8637854.912	.000	.000	219	.043	.072	80.4	207.20	25.0	

320696.348	8639051.320	.000	.000	220	.033	.047	55.4	212.87	15.0
334626.277	8636962.367	.000	.000	1012	.001	.001	.7	45.68	.2
334634.779	8636962.095	.000	.000	2012	.001	.000	1.0	87.33	.1
296910.261	8647464.982	.000	.000	301	.102	.079	125.2	53.29	30.0
310268.453	8646099.680	.000	.000	302	.016	.023	25.8	149.32	10.0
320120.383	8646874.527	.000	.000	303	.196	.111	225.1	60.49	10.0
330434.967	8645284.442	.000	.000	304	.038	.117	122.1	163.00	14.0
339244.714	8644772.314	.000	.000	1305	.026	.011	26.6	77.43	10.0
339247.642	8644772.967	.000	.000	305	.026	.011	26.7	77.54	10.0
346634.909	8646310.164	.000	.000	1306	.088	.067	106.7	126.13	30.0
346628.395	8646331.405	.000	.000	306	.088	.067	106.9	125.98	30.0
298322.165	8641832.598	.000	.000	1307	.026	.055	57.3	198.75	20.0
298151.613	8641920.119	.000	.000	2307	.029	.057	60.2	198.96	22.3
297675.324	8642080.477	.000	.000	307	.032	.065	68.6	198.98	24.5
308745.062	8642682.804	.000	.000	1308	.042	.098	102.1	162.44	30.0
308901.095	8642387.523	.000	.000	308	.040	.100	103.5	165.24	30.4
320137.311	8641676.523	.000	.000	309	.018	.033	37.0	153.05	7.0
330449.647	8641813.264	.000	.000	310	.100	.015	101.0	98.75	.2
339650.648	8643004.637	.000	.000	311	.003	.009	10.0	200.08	.3
340921.573	8642458.867	.000	.000	1311	.012	.019	20.1	202.36	10.0
340922.594	8642452.661	.000	.000	2311	.012	.021	22.0	195.45	11.1
346034.870	8641047.299	.000	.000	1312	.022	.054	55.0	169.90	20.0
345942.767	8641091.251	.000	.000	312	.024	.053	54.2	167.74	21.5
296564.194	8635357.420	.000	.000	313	.032	.119	119.1	174.52	30.0
310172.640	8634985.005	.000	.000	314	.036	.079	81.1	193.41	31.6
320063.177	8635259.119	.000	.000	315	.063	.085	105.1	143.57	10.3
330195.808	8635157.142	.000	.000	316	.016	.051	52.7	195.96	8.0
339807.959	8634506.779	.000	.000	1317	.040	.076	83.3	205.40	20.0
339805.159	8634511.559	.000	.000	317	.040	.076	83.2	205.36	20.0
348021.751	8634640.640	.000	.000	1318	.086	.086	117.8	45.15	30.0
347794.298	8634731.562	.000	.000	318	.085	.083	114.7	46.06	31.4
299667.628	8627506.641	.000	.000	319	.009	.050	50.2	181.13	8.9
309562.397	8627713.242	.000	.000	320	.011	.073	73.1	176.54	10.0

321784.095	8628434.289	.000	.000	5015	.004	.003	5.0	52.71	1.9
319762.651	8628101.579	.000	.000	321	.012	.030	29.8	170.77	11.0
330379.284	8626722.426	.000	.000	322	.141	.049	145.1	103.87	35.0
319715.192	8620483.277	.000	.000	324	.058	.101	112.0	207.23	30.0
329316.002	8621307.729	.000	.000	325	.062	.027	65.1	107.28	20.0
310381.583	8614402.220	.000	.000	326	.140	.050	144.3	104.51	35.0
319802.539	8614278.385	.000	.000	1327	.119	.099	150.3	50.82	36.8
319798.390	8614273.446	.000	.000	327	.119	.099	150.3	50.87	36.8
329405.691	8613143.032	.000	.000	1328	.057	.028	60.2	69.97	20.0
329396.665	8613159.637	.000	.000	328	.057	.028	60.0	70.01	20.0
307022.846	8615764.740	.000	.000	329	.122	.090	147.0	125.34	35.0
306620.187	8620626.719	.000	.000	1330	.056	.092	103.3	151.58	30.0
306834.774	8620660.783	.000	.000	330	.056	.089	100.4	150.74	31.5
313568.042	8621320.122	.000	.000	1331	.039	.018	40.4	75.38	15.0
313607.026	8621309.903	.000	.000	331	.039	.018	40.7	74.56	15.0
310512.168	8634907.620	.000	.000	1314	.034	.076	77.4	193.43	30.0
318324.063	8633982.347	.000	.000	1315	.012	.009	13.3	121.24	6.0
320058.933	8635261.743	.000	.000	2315	.063	.085	105.0	143.45	10.3
299668.010	8627504.261	.000	.000	1319	.009	.050	50.2	181.11	8.9
322407.149	8642834.287	.000	.000	1008	.000	.001	1.0	190.63	.2

STATIONS			MEASURED		ADJUSTED		CORR	S.D.	X-X1	SD(DX)
14	1	201	96	3	51.00	96	3	51.00	.00	3.00
14	101	202	272	16	34.30	272	16	34.30	.00	3.00
14	101	203	261	14	1.60	261	14	1.60	.00	3.00
14	101	204	276	46	6.00	276	46	6.00	.00	3.00
14	101	205	298	54	52.50	298	54	52.25	-.25	3.00
205	101	121	17	44	5.00	17	44	9.06	4.06	10.00
205	101	14	105	41	6.80	105	41	8.98	2.18	10.00
14	101	206	352	15	25.80	352	15	25.94	.14	3.00
206	101	14	170	7	57.00	170	7	55.75	-1.25	10.00
14	101	207	359	46	42.00	359	46	42.00	.00	3.00
20	114	208	7	9	56.30	7	9	56.30	.00	3.00
201	114	209	354	59	17.80	354	59	15.63	-2.17	10.00
209	201	114	200	42	24.00	200	42	21.77	-2.23	20.00
201	114	210	357	52	40.80	357	52	40.80	.00	3.00
8	101	211	166	47	16.50	166	47	16.50	.00	3.00
21	108	212	298	29	45.60	298	29	45.60	.00	3.00
12	108	213	49	20	11.30	49	20	9.11	-2.19	3.00
213	112	109	72	44	54.00	72	44	47.25	-6.75	3.00
12	108	214	68	11	48.00	68	11	48.00	.00	3.00
1012	108	215	138	22	15.50	138	22	15.50	.00	10.00
12	108	216	344	43	38.20	344	43	38.20	.00	3.00
22	114	217	30	14	8.00	30	14	8.00	.00	3.00

12	122	218	32	37	11.56	-2.44	3.00
11	123	219	162	56	30.70	.00	3.00
1	108	220	52	5	31.70	.00	3.00
218	123	112	35	16	41.40	.70	10.00
218	123	108	211	51	9.80	-10.50	10.00
12	1012	112	28	27	.00	7.87	30.00
14	101	1314	285	50	1.60	.00	3.00
14	101	1315	33	31	13.00	.32	3.00
1315	101	2315	60	13	37.00	.00	10.00
1315	101	114	217	28	20.00	-3.22	10.00
2315	1315	315	248	8	17.00	.00	10.00
20	114	1319	204	30	38.00	.00	3.00
1319	20	319	259	46	35.00	.00	10.00
20	114	320	19	56	30.90	.00	3.00
8	101	309	352	17	26.90	.00	3.00
1008	101	303	79	46	11.80	.00	10.00
1008	101	8	299	57	12.00	.00	10.00
8	101	304	182	14	29.20	.00	3.00
22	114	316	214	35	57.20	.00	3.00
24	108	302	319	30	4.00	.00	3.00
10	6	301	76	59	27.30	.00	3.00
23	108	1305	77	56	18.80	.00	3.00
1305	23	305	270	0	.00	.00	3.00
11	123	1306	81	52	2.30	.00	3.00
1306	11	306	126	49	20.00	.00	3.00
10	6	1307	42	27	20.00	.00	3.00
1307	110	2307	188	19	6.20	.00	3.00
2307	1307	307	171	26	32.70	.00	3.00
10	6	1308	186	8	14.00	.00	3.00
1308	110	308	259	44	48.40	.00	3.00
9	123	310	15	59	3.00	.00	3.00
23	108	311	110	35	25.00	.00	3.00
23	111	1311	338	4	9.70	.00	3.00
1311	23	2311	238	17	30.00	.00	3.00
11	123	1312	125	38	10.50	.00	3.00
1312	11	312	35	36	55.00	.00	3.00
6	110	313	18	12	49.70	.00	3.00
14	101	1314	285	50	1.60	.00	3.00
1314	114	314	179	24	57.00	.00	3.00
2012	123	1317	75	39	35.50	.00	3.00
1317	2012	317	34	15	.00	.00	3.00
2012	123	112	227	38	27.00	.00	3.00
11	123	1318	180	53	20.50	.00	3.00
1318	11	318	336	38	30.00	.00	3.00
20	114	1319	204	30	38.00	.00	3.00
1319	20	319	259	46	35.00	.00	3.00
5015	114	321	300	32	54.50	.00	3.00
5015	114	15	91	14	4.00	.00	3.00
17	118	322	91	4	11.50	.00	3.00
19	120	324	184	59	34.40	.00	3.00
17	118	325	94	28	39.70	.00	3.00
19	120	326	262	16	26.10	.00	3.00
19	120	1327	212	16	47.10	2.89	3.00
1327	119	118	51	27	31.80	-4.44	3.00
1327	118	327	204	4	5.00	.00	3.00
17	118	1328	237	9	58.60	.00	3.00
1328	17	328	351	30	20.00	.00	3.00
19	120	329	283	6	13.90	.00	3.00
19	120	1330	309	20	44.70	.00	3.00
1330	19	330	19	23	56.00	.00	3.00
19	120	1331	233	8	38.90	.00	3.00
1331	19	331	119	18	34.00	.00	3.00
14	201		3362	390		.000	.008
14	202		5678	110		.000	.010
14	203		4256	928		.000	.010
14	204		2075	582		.000	.007

14	205	1892.618	1892.618	.000	.007
14	206	1722.843	1722.843	.000	.007
14	207	789.590	789.590	.000	.006
20	208	5735.801	5735.801	.000	.010
201	209	2568.008	2568.008	.000	.008
201	210	3281.528	3281.528	.000	.008
8	211	2510.268	2510.268	.000	.007
21	212	601.423	601.423	.000	.006
12	213	6643.708	6643.702	-.006	.011
12	214	4080.216	4080.216	.000	.009
12	1012	1.700	1.700	.000	.001
112	1012	.995	.994	-.001	.001
1012	215	4674.982	4674.982	.000	.010
12	216	4436.892	4436.892	.000	.010
22	217	1851.449	1851.449	.000	.007
12	218	9032.237	9032.237	.000	.015
12	1012	1.700	1.700	.000	.001
14	1315	960.462	960.462	.000	.006
1315	2315	2155.594	2155.594	.000	.007
2315	315	4.990	4.990	.000	.001
20	1319	4878.370	4878.371	.001	.010
1319	319	2.410	2.410	.000	.001
20	320	5025.376	5025.376	.000	.010
8	309	2545.486	2545.486	.000	.007
1008	303	4642.526	4642.526	.000	.010
1008	8	4.225	4.225	.000	.001
8	304	8395.587	8395.587	.000	.014
22	316	3624.806	3624.806	.000	.008
24	302	1770.704	1770.704	.000	.010
10	301	8606.013	8606.013	.000	.030
23	1305	1831.646	1831.646	.000	.010
1305	305	3.000	3.000	.000	.001
11	1306	7338.651	7338.651	.000	.030
1306	306	22.220	22.220	.000	.001
10	1307	3941.957	3941.957	.000	.020
1307	2307	191.677	191.677	.000	.010
2307	307	502.507	502.507	.000	.010
10	1308	7016.545	7016.545	.000	.030
1308	308	333.955	333.955	.000	.010
9	310	14.300	14.300	.000	.101
23	311	21.197	21.197	.000	.010
23	1311	1382.264	1382.264	.000	.010
1311	2311	6.290	6.290	.000	.010
11	1312	3785.318	3785.318	.000	.020
1312	312	102.063	102.063	.000	.010
6	313	8186.600	8186.600	.000	.030
14	1314	7521.092	7521.092	.000	.030
1314	314	348.220	348.220	.000	.010
2012	1317	5726.700	5726.700	.000	.020
1317	317	5.540	5.540	.000	.001
2012	112	7.740	7.740	.000	.001
11	1318	8101.285	8101.285	.000	.030
1318	318	244.980	244.980	.000	.010
20	1319	4878.373	4878.371	-.002	.020
1319	319	2.410	2.410	.000	.001
5015	321	2048.647	2048.647	.000	.010
5015	15	127.605	127.605	.000	.005
17	322	9979.267	9979.267	.000	.035
19	324	7701.321	7701.321	.000	.030
17	325	4475.258	4475.258	.000	.020
19	326	9920.830	9920.830	.000	.035
19	1327	11947.463	11947.433	-.030	.041
1327	327	6.450	6.450	.000	.001
17	1328	4142.350	4142.350	.000	.020
1328	328	18.900	18.900	.000	.001
19	329	10103.555	10103.555	.000	.035

19 1330	7102.559	7102.559	.000	.030
1330 330	217.260	217.260	.000	.010
19 1331	2776.733	2776.733	.000	.015
1331 331	40.300	40.300	.000	.001
1 220	3810.424	3810.424	.000	.015
11 219	5531.715	5531.715	.000	.025

* SIGMA ZERO .90022

** HORIZONTAL SURVEY ADJUSTMENT ** 13/9/88 14:53 ** by AAM (WA) **

23108 NARBALEK 2 - CAMEL

A.M.G. COORDINATES - ZONE 53 LATITUDE -12.346 DEGREES

FINAL LIST OF ADJUSTED CO-ORDINATES

STATION	STATION IDENT	EAST	NORTH	PAGE 1 of 1
117	AAM 17 BEACON	327988.827	8617036.441	
118	AAM 18	321041.725	8618616.469	
118	AAM 18 BEACON	321042.009	8618612.614	
119	AAM 19 BEACON	312866.293	8624003.426	
501	CARA 1	320577.043	8618111.648	
502	CARA 2	322124.302	8618842.144	
503	CARC 3	321722.447	8618246.383	
504	CARA 4	322023.965	8617528.919	
505	CARA 5	320034.430	8617306.425	
506	CARA 6	319828.039	8619199.067	
1018	AAM 18 ECCE	321044.059	8618615.903	
1501	CARA 1 ECCE	320573.715	8618110.051	
1504	CARA 4 I.P.	322044.226	8617535.571	
1505	CARA 5 I.P.	320032.773	8617302.730	
1506	CARA 6 I.P.	319827.426	8619201.408	

** HORIZONTAL SURVEY ADJUSTMENT ** 13/9/88 14:53 ** by AAM (WA) **

23108 NARBALEK 2 - CAMEL

A.M.G. COORDINATES - ZONE 53 LATITUDE -12.346 DEGREES

ITERATION NUMBER 2

THE SOLUTION

EAST	NORTH	DE	DN	STN NO	STD. DEV.	SMJ	BRG	SMN
327988.827	8617036.441			117				
321041.725	8618616.469			18				
321042.009	8618612.614			118				
312866.293	8624003.426			119				
320577.043	8618111.648	.000	.000	501	.010 .010	10.0	223.68	10.0
322124.302	8618842.144	.000	.000	502	.010 .016	16.1	168.17	10.0
321722.447	8618246.383	.000	.000	503	.010 .011	11.3	208.53	10.0
322023.965	8617528.919	.000	.000	504	.021 .018	24.4	53.56	13.7
320034.430	8617306.425	.000	.000	505	.024 .020	28.0	126.13	14.1
319828.039	8619199.067	.000	.000	506	.020 .024	28.6	218.47	11.9
321044.059	8618615.903	.000	.000	1018	.000 .000	.1	94.49	.0
320573.715	8618110.051	.000	.000	1501	.010 .010	10.1	117.17	10.0
322044.226	8617535.571	.000	.000	1504	.023 .019	26.3	55.90	14.0
320032.773	8617302.730	.000	.000	1505	.024 .020	28.1	126.11	14.1
319827.426	8619201.408	.000	.000	1506	.020 .024	28.6	218.50	12.0

STATIONS	MEASURED	ADJUSTED	CORR	S.D.	X-X1	SD(DX)
1018 117 501	119 59 28.80	119 59 28.80	.00	3.00		
1018 117 18	180 49 10.00	180 49 10.14	.14	3.00		
1018 117 502	335 21 29.00	335 21 29.00	.00	3.00		
1018 117 118	109 7 40.50	109 7 40.09	-.41	3.00		
503 118 504	218 54 53.50	218 54 53.50	.00	3.00		
501 118 505	171 6 33.20	171 6 33.20	.00	3.00		
501 118 1501	201 30 6.00	201 29 47.62	-18.38	30.00		
1501 118 501	21 22 43.00	21 23 1.47	18.47	30.00		
1501 118 506	282 37 16.00	282 37 16.00	.00	3.00		
504 503 1504	94 37 15.00	94 37 15.00	.00	3.00		
18 119 503	175 9 2.00	175 9 2.00	.00	3.00		
505 501 1505	170 11 23.00	170 11 23.00	.00	3.00		
506 1501 1506	199 43 35.00	199 43 35.00	.00	3.00		
1018 501	687.299	687.299	.000	.010		

1018	502	1103.687	1103.687	.000	.010
1018	118	3.875	3.876	.001	.001
18	1018	2.400	2.402	.002	.001
18	503	774.824	774.824	.000	.010
503	504	778.252	778.252	.000	.010
504	1504	21.326	21.326	.000	.010
501	1501	3.691	3.691	.000	.001
501	505	970.986	970.986	.000	.010
505	1505	4.050	4.050	.000	.001
1501	506	1319.844	1319.844	.000	.010
506	1506	2.420	2.420	.000	.001

* SIGMA ZERO 1.35267



Surveying & Mapping
Consultants

APPENDIX 4
Elevation of Major Survey Control Stations
and
Adjustment Residuals

SURVEY HEIGHT ADJUSTMENT ** 9/ 6/88 ** by AAM (WA) **

23108 NARBALEK - MAJOR CONTROL

INAL LIST OF ADJUSTED HEIGHTS

PAGE 1 of 1

TATION	IDENT	HEIGHT	STATION	IDENT	HEIGHT
1	AM1	140.02	41	FQ41	44.32
6	AM6	33.05	8	AAM8	228.02
9	AAM9	128.77	10	AAM10	221.56
11	AAM11	247.04	12	AAM12	267.00
13	AAM13	242.90	14	AAM14	275.13
15	AAM15	287.30	16	AAM16	195.62
17	AAM17	324.52	18	AAM18	313.35
19	AAM19	299.01	20	AAM20	289.66
21	AAM21	131.92	22	AAM22	232.33
23	AAM23	239.80	24	AAM24	202.07
3015	AAM15 ECCE	286.58	3024	AAM24 ECCE	175.10

** SURVEY HEIGHT ADJUSTMENT ** 9/ 6/88 ** by AAM (WA) **

23108 NARBALEK - MAJOR CONTROL

THE DATA

FIXED STATIONS

1	140.020	AM1
41	44.324	FQ41

OTHER STATIONS

6	0.000	AM6
8	0.000	AAM8
9	0.000	AAM9
10	0.000	AAM10
11	0.000	AAM11
12	0.000	AAM12
13	0.000	AAM13
14	0.000	AAM14
15	0.000	AAM15
16	0.000	AAM16
17	0.000	AAM17
18	0.000	AAM18
19	0.000	AAM19
20	0.000	AAM20
21	0.000	AAM21
22	0.000	AAM22
23	0.000	AAM23
24	0.000	AAM24
3015	0.000	AAM15 ECCE
3024	0.000	AAM24 ECCE

MEASUREMENTS

1	8	88.0140	0.130
1	14	134.9570	0.190
1	15	147.4370	0.320
1	21	-8.0650	0.120
1	22	92.2700	0.250
6	10	188.1480	0.360
6	16	162.5520	0.500
6	24	169.4790	0.400
8	9	-99.1670	0.200
8	12	38.8520	0.330
8	14	47.0900	0.270
8	15	59.1100	0.350
8	22	4.2230	0.190
8	23	12.1040	0.420
8	24	-25.7420	0.340
9	12	138.2510	0.150
9	23	111.0940	0.220
10	16	-26.0020	0.150
11	23	-7.2440	0.090
12	22	-34.6790	0.190
12	23	-27.2150	0.190
14	13	-32.2270	0.240
14	15	12.1280	0.150

14	20	14.7350	0.350
14	21	-143.2270	0.070
14	22	-42.7870	0.230
14	24	-73.2870	0.370
3015	17	37.7750	0.320
15	18	26.0400	0.240
15	19	11.7100	0.030
15	22	-54.9750	0.220
16	24	6.4460	0.050
17	18	-11.2080	0.170
18	19	-14.4480	0.240
19	20	-9.4300	0.220
22	23	7.0900	0.360
23	11	7.2440	0.100
41 3024		130.7710	0.050
3024	24	26.9780	0.030
3015	15	0.7190	0.010
-1	0	0.0000	0.010

** SURVEY HEIGHT ADJUSTMENT ** 9/ 6/88 ** by AAM (WA) **

23108 NARBALEK - MAJOR CONTROL

2 FIXED STATIONS
20 OTHER STATIONS
40 MEASUREMENTS

STATIONS	MEASURED	ADJUSTED	CORR	ST.DEV
1 8	88.0140	-140.0200	-228.0340	0.130
1 14	134.9570	-140.0200	-274.9770	0.190
1 15	147.4370	-140.0200	-287.4570	0.320
1 21	-8.0650	-140.0200	-131.9550	0.120
1 22	92.2700	-140.0200	-232.2900	0.250
6 10	188.1480	0.0000	-188.1480	0.360
6 16	162.5520	0.0000	-162.5520	0.500
6 24	169.4790	0.0000	-169.4790	0.400
8 9	-99.1670	0.0000	99.1670	0.200
8 12	38.8520	0.0000	-38.8520	0.330
8 14	47.0900	0.0000	-47.0900	0.270
8 15	59.1100	0.0000	-59.1100	0.350
8 22	4.2230	0.0000	-4.2230	0.190
8 23	12.1040	0.0000	-12.1040	0.420
8 24	-25.7420	0.0000	25.7420	0.340
9 12	138.2510	0.0000	-138.2510	0.150
9 23	111.0940	0.0000	-111.0940	0.220
10 16	-26.0020	0.0000	26.0020	0.150
11 23	-7.2440	0.0000	7.2440	0.090
12 22	-34.6790	0.0000	34.6790	0.190
12 23	-27.2150	0.0000	27.2150	0.190
14 13	-32.2270	0.0000	32.2270	0.240
14 15	12.1290	0.0000	-12.1290	0.150
14 20	14.7350	0.0000	-14.7350	0.350
14 21	-143.2270	0.0000	143.2270	0.070
14 22	-42.7870	0.0000	42.7870	0.230
14 24	-73.2870	0.0000	73.2870	0.370
3015 17	37.7750	0.0000	-37.7750	0.320
15 18	26.0400	0.0000	-26.0400	0.240
15 19	11.7100	0.0000	-11.7100	0.030
15 22	-54.9750	0.0000	54.9750	0.220
16 24	6.4460	0.0000	-6.4460	0.050
17 18	-11.2080	0.0000	11.2080	0.170
18 19	-14.4480	0.0000	14.4480	0.240
19 20	-9.4300	0.0000	9.4300	0.220
22 23	7.0900	0.0000	-7.0900	0.360
23 11	7.2440	0.0000	-7.2440	0.100
41 3024	130.7710	-44.3240	-175.0950	0.050
3024 24	26.9780	0.0000	-26.9780	0.030
3015 15	0.7190	0.0000	-0.7190	0.010

** SURVEY HEIGHT ADJUSTMENT ** 9/ 6/88 ** by AAM (WA) **

2310B NARBALEK - MAJOR CONTROL

THE SOLUTION

HEIGHT	DZ	STATION	S.DEV (APRIORI SIGMA ZERO OF 1.000)
140.020		1	
44.324		41	
33.051	33.051	6	0.2523
228.023	228.023	8	0.0990
128.770	128.770	9	0.1650
221.560	221.560	10	0.1610
247.043	247.043	11	0.1948
267.004	267.004	12	0.1586
242.902	242.902	13	0.2566
275.129	275.129	14	0.0908
287.301	287.301	15	0.1276
195.620	195.620	16	0.0756
324.517	324.517	17	0.2308
313.354	313.354	18	0.2000
299.011	299.011	19	0.1306
289.661	289.661	20	0.2156
131.915	131.915	21	0.0908
232.330	232.330	22	0.1202
239.799	239.799	23	0.1829
202.073	202.073	24	0.0569
286.582	286.582	3015	0.1280
175.095	175.095	3024	0.0491

STATIONS	MEASURED	ADJUSTED	CORR	ST.DEV
1 8	88.0140	88.0026	-0.0114	0.130
1 14	134.9570	135.1090	0.1520	0.190
1 15	147.4370	147.2806	-0.1564	0.320
1 21	-8.0650	-8.1045	-0.0395	0.120
1 22	92.2700	92.3095	0.0395	0.250
6 10	188.1480	188.5087	0.3607	0.360
6 16	162.5520	162.5694	0.0174	0.500
6 24	169.4790	169.0225	-0.4565	0.400

1	21	-8.0650	-8.1045	-0.0395	0.120
1	22	92.2700	92.3095	0.0395	0.250
6	10	188.1480	188.5087	0.3607	0.360
6	16	162.5520	162.5694	0.0174	0.500
6	24	169.4790	169.0225	-0.4565	0.400
8	9	-99.1670	-99.2522	-0.0852	0.200
8	12	38.8520	38.9813	0.1293	0.330
8	14	47.0900	47.1064	0.0164	0.270
8	15	59.1100	59.2780	0.1680	0.350
8	22	4.2230	4.3069	0.0839	0.190
8	23	12.1040	11.7764	-0.3276	0.420
8	24	-25.7420	-25.9493	-0.2073	0.340
9	12	138.2510	138.2335	-0.0175	0.150
9	23	111.0940	111.0286	-0.0654	0.220
10	16	-26.0020	-25.9394	0.0626	0.150
11	23	-7.2440	-7.2440	0.0000	0.090
12	22	-34.6790	-34.6744	0.0046	0.190
12	23	-27.2150	-27.2049	0.0101	0.190
14	13	-32.2270	-32.2270	-0.0000	0.240
14	15	12.1290	12.1716	0.0426	0.150
14	20	14.7350	14.5318	-0.2032	0.350
14	21	-143.2270	-143.2135	0.0135	0.070
14	22	-42.7870	-42.7995	-0.0125	0.230
14	24	-73.2870	-73.0557	0.2313	0.370
3015	17	37.7750	37.9354	0.1604	0.320
15	18	26.0400	26.0538	0.0138	0.240
15	19	11.7100	11.7099	-0.0001	0.030
15	22	-54.9750	-54.9711	0.0039	0.220
16	24	6.4460	6.4531	0.0071	0.050
17	18	-11.2080	-11.1627	0.0453	0.170
18	19	-14.4480	-14.3440	0.1040	0.240
19	20	-9.4300	-9.3497	0.0803	0.220
22	23	7.0900	7.4695	0.3795	0.360
23	11	7.2440	7.2440	-0.0000	0.100
41 3024		130.7710	130.7713	0.0003	0.050
3024	24	26.9780	26.9781	0.0000	0.030
3015	15	0.7190	0.7188	-0.0002	0.010

* SIGMA ZERO (SQRT OF VARIANCE FACTOR) : 0.63163

* APRIORI SIGMA ZERO : 1.000 REDUNDANCY : 20

APPENDIX 2

PETROLOGY REPORTS - MINPET SERVICES, SYDNEY

Report 61/88	November 1988
Report 70/88	December 1988
Report 2/89	February 1989

MINPET REPORT 61/88

November 1988

PETROGRAPHIC DESCRIPTIONS OF NUMBERS
30867 AND 30877 AND MISCELLANEOUS
SAMPLES FROM NABARLEK, N.T.

(prepared for Dr. N.F. Rutherford of
Rutherford Mineral Resource Consultants)

MINPET SERVICES

659 Botany Road

ROSEBERY 2018

REPORT NO. 61/88

PETROGRAPHIC DESCRIPTIONS OF
NOS. 30867 TO 30877 AND MISCELLANEOUS
SPECIMENS FROM NABERLEK, N.T.

[prepared for Dr. N.F. Rutherford of
Rutherford Resources Consultants]

November 1988

CONTENTS

	<u>PAGE NO.</u>
1. INTRODUCTION	1
2. SUMMARY	2
3. PETROGRAPHIC DESCRIPTIONS	4

APPENDIX

- 1 LETTER DATED 24/9/88 FROM DR. N.F. RUTHERFORD TO MINPET SERVICES,
INDICATING WORK REQUIRED ON SAMPLES.

1. INTRODUCTION

Fourteen rock specimens from the Naberlek uranium prospect were described briefly and observations on alteration vs. weathering were tabulated.

2. SUMMARY

Names for rock samples were determined where possible, though many of the rocks were strongly metamorphosed, and identifiable only with difficulty.

Formation of illite with other physical weathering features, including leaching and also contraction fractures have been caused by weathering. Although in this rock series, illite formed prior to sericite (and chlorite) and could be either deuteric or hydrothermal.

Magnesium metasomatism was possible in Specimen 30872 (talc + chlorite), not formed by weathering.

Other rock specimens show moderate propylitic alteration (30875, 30877).

Strong sericitisation (as muscovite), (38202, 38216).

Strong chloritic alteration (30874 and 38214, where chlorite is both iron and magnesium rich).

Kaolinite occurs as fine scaley aggregates and is identifiable only in Specimen 38216 - probably due to weathering although migratory limonite is not associated.

<u>NUMBER</u>	<u>ROCK NAME</u>	<u>ALTERATION</u>	<u>WEATHERING</u>	<u>METAMORPHISM</u>
30867	Chlorite:muscovite schist.	-	Iron oxides	Sheared, chlorite, muscovite.
30868	Porphyritic volcanic extrusive.	1. Hydromuscovite. 2. Silicification - very strong. 3. Muscovite.	Iron oxides along fractures.	Strongly brecciated, sheared, post-vein. Strong brecciation -> shear (post vein).
30869	Greisen(?)	1. Illite. 2. Muscovite.	Iron oxide penetration - along cleavages, fractures.	Hornfelsing, brecciation - moderate shear.
30870	Porphyritic granite.	1. Illite - weak. 2. Sericite - weak. 3. Chlorite - deuteric?	Biotite -> vermiculite.	Weakly deformed.
30871	Talc chlorite schist	Mg metasomatised sediment (marl) including chlorite (iron rich).	Iron oxide staining.	Strongly sheared.
30872	Chlorite:talc: quartz rock.	Mg metasomatised carbonate?	Iron oxide stained, along thin fractures.	Strongly sheared.
30873	Chlorite:muscovite schist.	-	Iron rich penetration (or iron exsolved from biotite -> chlorite.	Strong shear.
30874	Chlorite:muscovite schist (argillite sediment).	Biotite -> magnesian chlorite. Brookite.	Biotite -> vermiculite.	Strongly sheared.
30875	Welded acid tuff extrusive.	Propylitic + sericite. (locally to sericite). Illite - strong. Epidote - weak. Chlorite (iron rich) - weak. Brookite.	Iron oxide penetration/ replacement.	Load shear.

<u>NUMBER</u>	<u>ROCK NAME</u>	<u>ALTERATION</u>	<u>WEATHERING</u>	<u>METAMORPHISM</u>
30876	Syenite or monzonite intrusive.	Illite - strong. Chlorite - weak. Brookite Hematite?	Uniform iron oxide penetration by hematite - but could be hydrothermal.	Contact.
30877	Porphyritic dolerite intrusive.	Plagioclase mainly labradorite with minor oligoclase. Otherwise propylitic strong -> biotite replacement - weak -> chlorite - weak.	-	Regional green schist only.
38202	Granodiorite porphyry, Hypabyssal intrusive.	Sericitisation - strong.	Limonite penetration strong.	-
38214	Porphyritic acid volcanic extrusive.	Strongly chloritic (magnesium rich). Illite - strong.	Limonite penetration.	Load shear -> strong dynamomorphism.
38216	Porphyritic (quartz) volcanic extrusive.	Muscovitised.	Kaolinite and illite - both strong.	Load shear.

3. PETROGRAPHIC DESCRIPTIONS

Specimen No.: 30867/MPS 5214

Nabarlek Pit

Petrographic Summary: Chlorite: muscovite schist with fragments of quartz: hematite vein and contains dispersed hematite, now much fragmented. Chlorite is iron rich. Hematite is widely dispersed and where rock is most weathered there is a greater abundance of the mineral.

<u>Mineralogy</u>	<u>Vol.%</u>
Chlorite	60
Muscovite	28
Hematite	7
Quartz	5

Texture: A characteristic muscovite: chlorite schist mixed laminae, variably muscovite and chlorite rich. Laminae that are particularly chlorite rich contain an abundance of hematite as euhedral prisms ($\sim 0.18 \times 0.05$ mm) and fine needles of the mineral. The hematite occurs most often as concentrates but may also be scattered as fragments and aggregates throughout. Hematite may also be embedded in fragments of quartz vein showing grains with mutual boundaries. Other quartz takes on the form of augen shapes (to 1.2×0.6 mm) as intergrowths with chlorite.

Alteration: Could be fragmented and sheared quartz: hematite vein with dispersed hematite distributed throughout an altered iron-rich, sheared ferruginous claystone? However where rock is most weathered there occurs most abundant hematite.

Metamorphism: Strong dynamometamorphism.

Note: Chlorite shows positive elongation and is therefore iron-rich.

Specimen No.: 30868/MPS 5215

314300E/8636000N

Petrographic Summary: Porphyry volcanic of brecciated quartz and plagioclase phenocrysts (now altered to hydromuscovite and muscovite), with a similarly altered groundmass of feldspar and quartz. Early alteration is indicated by the presence of quartz and muscovite (ex feldspar?) vein systems.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	87
Muscovite	4
Hydromuscovite	6
Limonite	3

Texture: A silicified and brecciated porphyry volcanic where occur fragments of quartz phenocrysts with characteristic crystal forms showing broad marginal embayments to the groundmass. The groundmass is now mostly cherty quartz containing embedded scattered specks of fine hydromuscovite. Quartz fragments as described above are abundant with less common plagioclase fragments altered to hydromuscovite. Locally, crystal forms of plagioclase are outlined by a border zone of penetrating exotic limonite. Present elsewhere are large plates of muscovite commonly attached to coarse quartz vein fragments or muscovite that have developed within a deformed hydromuscovitised plagioclase phenocryst. Coarse quartz vein (0.8 mm wide) of transverse quartz prism aggregates (caused by shear) is assimilated by another boundary vein (0.3 mm) of muscovite (ex feldspar?). Networks of finer quartz vein fill brecciation fractures. Quartz is polyhedral with mutual quartz.

Alteration: A silicified, hydromuscovitised and muscovitised porphyry. Includes quartz and later muscovite vein networks followed by a weathering overprint of limonite.

Metamorphism: Strong brecciation followed by moderate shear - post vein.

Note: Using subdued plain light a groundmass of silicified and muscovitised microlites of feldspar and quartz are visible.

Specimen No.: 30869/MPS 5216

Anomaly N2 (G2)

314700E/8636480N
314700E/8636900N

Petrographic Summary: Greisen with remnants of plagioclase altered to hydromuscovite. Coarse muscovite:quartz intergrowths show relict mutual quartz (after hornfelsing). Hematite:quartz intergrowths have survived brecciation.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	54
Muscovite	35
Hydromuscovite	7
Hematite:limonite	4

Texture: A brecciated and moderately sheared coarse, muscovite:quartz intergrowth. The median quartz grain size is around 0.5 mm. Several fragments of plagioclase (0.2 to 1.2 mm) are seen, altered to fine hydromuscovite. Between quartz breccia fragments, often augen shaped (to 3 x 1.5 mm) occur coarse (up to 5 x 3 mm) sheafs of muscovite growths.

Where quartz is not augen structured and flanked by muscovite it occurs as subparallel lenticles of breccia but includes quartz mosaics of grains with mutual grain boundaries. Lenticles of muscovite are separated by sheafs of the mineral. Along fractures, between quartz and muscovite are hematite laths and crushed hematite. Fine fractures across sheaf growths of muscovite contain hematite 'breccia flour'. Coarse laths of hematite (to 1 x 0.25 mm) are embedded in quartz mosaics.

Alteration: Greisenisation of granitic(?) material was followed by penetrating quartz vein. Brecciated. Weathering with hematite established along shrinkage (quartz) fractures).

Metamorphism: Hornfelsing. Brecciation and moderate shear.

Specimen No.: 30870/MPS 5217

338500E / 636500N

Petrographic Summary: Porphyritic granite with an interlocking quartz: feldspar groundmass. Shows weak alteration of plagioclase to fine illite clay, and alteration of biotite to chlorite.

Mineralogy (vol.%)

Phenocrysts Groundmass

Primary recognisable

Quartz	4	21
K feldspar	10	45
Plagioclase	5	10
Biotite	-	5

Alteration

Sericite/muscovite	2
Hydromuscovite	4
Chlorite	3
Iron oxides	1

Texture: A moderately deformed porphyritic granite that shows random plagioclase phenocrysts (2.5 x 1.2 mm) orthoclase (2 x 2 mm) and quartz (1.5 x 1.5 mm) embedded in a 'groundmass' of faintly interlocking subhedral orthoclase and plagioclase (varies 0.2 to 1 mm) with anhedral quartz (0.1 to 0.5 mm). Biotite (0.1 to 0.8 x 0.4 mm) as subhedral laths follows grain boundaries of feldspars and quartz and occurs fairly uniformly throughout the section. Traces of biotite are also embedded in the plagioclase. Orthoclase is pegmatitic with fine quartz (0.1 to 0.2 mm).

Plagioclase is dusted with fine illite, coarser sericite and occasional aggregates of tiny flakes are limonite stained. Biotite originally brown and highly birefringent has altered to bundles of fine, green iron-rich chlorite and shows exsolved limonite specks.

Groundmass feldspars and quartz show an even texture.

Alteration (summary):

Plagioclase -> hydromuscovite -> muscovite - weak.

Biotite -> chlorite and vermiculite.

Weak hydrothermal/deuteric - adjoining an ore zone?

Metamorphism: Weak deformation.

Specimen No.: 30871/MPS 5218

Nabarlek Pit

Petrographic Summary: Talc:chlorite intergrowths, becoming schistose. Talc rich rock shows variably intense vein networks of chlorite. Hematite (from weathering?) is deposited along fractures, includes traces of K feldspar. Possibly an altered marl sediment.

<u>Mineralogy</u>	<u>Vol. %</u>
Talc	55
Chlorite	39
Leucoxene	2
Hematite	3
K feldspar	1

Texture: A talc-chlorite rock of fine lenticular magnesian chlorite that veins fine matted talc. In section the colourless talc forms sectors (to 3 x 7 mm) of fibrous aggregates separated by narrow irregular networks (~1.2 mm) of chlorite of similar grain size. Around the edges of the section, the chlorite contains an abundance of fine (0.03 mm) hematite as squat red-brown crystals concentrated in areas adjoining fractures. Hematite occurs less densely scattered through the chlorite felts over the whole section.

Narrow (0.03 mm) fractures in the section contain traces of K feldspar and selvages of hematite, but mostly the fractures are vacated, therefore iron oxide staining is probably due to weathering.

Observation by subdued plain polarised light shows no primary textures.

Origin of the rock is not therefore definitely known.

Alteration: Marl(?) = magnesian metasomatised, strongly sheared -> talc:chlorite rock.

Metamorphism: Strong dynamometamorphism.

Specimen No.: 30872/MPS 5219

Nabarlek Pit

Petrographic Summary: A chlorite:quartz:talc metamorphic. Metamorphosed (and strongly weathered) chlorite (iron rich with positive elongation) with minor intergrowths of fine talc and beds containing appreciable amounts of mainly subangular very fine to fine sand size clastic quartz. Fractured and veined by quartz before shear and quartz vein formed after shear. A possible carbonate rich shale, metamorphosed, veined (by quartz) and strongly weathered.

<u>Mineralogy</u>	<u>Vol.%</u>
Chlorite	66
Talc	10
Quartz	20
Iron oxides	4

Texture: A finely foliated rock of abundant chlorite with thin networks of talc and subangular quartz which tends to align in the foliation direction. Chlorite often occurs as broad lenticles (0.6 mm wide) to the exclusion of all other minerals. Chlorite is fine, fibrous and specked with iron oxides. The mineral is randomly oriented in bundles of parallel fibres, often shows parallel intergrowths of talc. In adjoining bands, sedimentary quartz mineral (0.05 to 0.2 mm) present is worn, subrounded, but mainly subangular, varying to angular fragments. Quartz grains are separated by a liberal cement of chlorite:talc intergrowths.

Strongly sheared (perpendicular to vein axis) veins (0.4 mm wide) of quartz strike across the foliation and are flanked by a chlorite selvage, 0.16 mm wide.

Other quartz vein (0.5 mm - post tectonic) also cuts across the foliation and contains quartz (0.19 mm) in mosaics of mutual composite grains.

Alteration: Magnesium metasomatism?

Metamorphism: Strongly dynamothermal.

Specimen No.: 30873/MPS 5220

Nabarlek Pit

Petrographic Summary: Chlorite: muscovite schist. Muscovite is finely sheared in places and the resulting fine sericite, weathered to illite (hydromuscovite). Iron oxides appear to exsolve from a more iron rich chlorite (or biotite). Chlorite remains iron rich.

<u>Mineralogy</u>	<u>Vol. %</u>
Chlorite	55
Muscovite	30
Hydromuscovite	12
Iron oxides	3

Texture: Strongly foliated parallel intergrowths of muscovite as elongate flakes with similar size chlorite. Chlorite has positive elongation (iron rich). Flakes of chlorite and muscovite, vary 0.3 x 0.03 to 4 x 0.25 mm) mostly around 1.3 x 0.3 mm, and as intergrowths in places are deflected from the foliation direction. Large areas of foliated muscovite and chlorite are broken down to fine fibrous illite (areas, 7 x 6 mm), containing groups (1 x 0.7 mm) of fine chlorite aggregates and lenticles of even finer fibrous intergrowths of chlorite: hydromuscovite and with uniformly diffuse fine prisms of hematite (0.005 x 0.002 mm). Variable size, subhedral to anhedral crystals of goethite (0.005 x 0.01, 0.1 x 0.1 mm) occur as translucent yellow grains.

Close to the edge of section, strong oxidation weathering has deposited limonite densely within masses of fine hydromuscovite.

Alteration: Metamorphic only followed by weathering.

Metamorphism: Strong dynamometamorphic. Muscovite sheared to fine sericite which was altered by weathering to hydromuscovite.

Specimen No.: 30874/MPS 5221

Nabarlek Pit

Petrographic Summary: Chlorite: muscovite schist which was a biotite rich argillite sediment. Alteration of biotite was to magnesian chlorite, and also by weathering to vermiculite. Muscovite altered to hydromuscovite - part sheared and part hydrothermal or by a combination of both processes.

<u>Mineralogy</u>	<u>Vol. %</u>
Chlorite (iron rich)	37
Chlorite (Mg rich)	14
Muscovite (sericite)	16
Hydromuscovite	29
Leucoxene	3
Rutile needles	1
Apatite	<1
Iron oxides	<1
Brookite	<1

Texture: Lenticular lath like growths (0.3 x 0.02 mm to 0.8 x 0.2 mm, most often around 0.4 x 0.15 mm) are brownish green and appear to be of biotite origin. Many laths are bent to variable orientation, several form fan-shaped growths. Laths are of moderate birefringence and could be vermiculite, and are elongate positive as is biotite. Between the mineral growths described are finer tufts of low birefringent chlorite, which are pale green, of negative elongation, as magnesium rich chlorite; and surrounding the coarser vermiculite with chlorite tufts are fine laths of aggregated sericite that in places are altered to equally fine lower birefringent hydromuscovite. Fine chlorite and hydromuscovite are commonly intermixed and appear to make inroads (replace) chlorite:vermiculite as does fine magnesian chlorite.

Within the chlorite:vermiculite flakes is an abundance of rubbly fine leucoxene, very fine needles of rutile and occasional rectangular shapes of

brookite (0.08 mm). Apatite of anhedral low birefringence occurs as grains (0.05 to 0.08 mm) surrounded by wispy chlorite. Thin skeletal (0.015 mm width low birefringent structures) often as ovoid encapsulation of pale magnesian chlorite enclose aggregates of fine, pale scaley magnesian chlorite.

Alteration:

- i) Biotite → vermiculite:iron rich chlorite + traces of leucoxene → fine tufted magnesian chlorite.
- ii) Hydromuscovite → muscovite.
- iii) Leucoxene → brookite, which is partly due to hydrothermal activity partly to weathering.

Metamorphism: Strong shear (dynamometamorphism).

Specimen No.: 30875/MPS 5222

Nabawlek Pit

Petrographic Summary: Welded acid tuff with feldspar and hornblende fragments. Strongly sericitised, moderately chloritised, epidotised and contains hematite, mainly as a product of weathering.

<u>Mineralogy</u>	<u>Vol.%</u>
Muscovite	3
Sericite/illite	84
Epidote	2
Chlorite	5
Limonite	1
Hematite	2
Leucoxene/brookite	3

Texture: Thixotropic structured in plain polarised light, and most likely rhyolite. Most of the section is altered to aggregates of fine (~ 0.007 mm) scaley sericite containing irregularly distributed sheafs of muscovite ($\sim 0.3 \times 0.1$ mm, 0.5×0.8 mm etc). The flakes are mostly bent and adjoin chlorite pseudomorphs including fan shaped aggregates (0.1×0.08 mm) of anomalous birefringence, very pale green and iron rich. The latter chlorite surrounds very fine stellate groups (0.01 mm diameter) of a different kind of chlorite showing yellow-brown interference but also iron rich. These chloritic minerals with rubbly brookite(?) (0.5×0.24 to 3×1.6 mm) pseudomorph possible hornblende shapes. Most often the chlorite aggregates are pseudomorphing lenticular banding of an acid tuff. The tuff is specked with scattered blebs (0.04 , 0.08 , 0.2 mm) of limonite and leucoxene/brookite. Epidote has pseudomorphed an aggregate of feldspar shapes (0.6×0.4 , 0.8×0.6 mm).

In plain light, lenticular structures represent glassy welded forms and vitric flow patterns.

Alteration: Strong to sericite, weaker to epidote, chlorite and hematite
(but the latter may be due to weathering).

Metamorphism: Load compaction only.

Specimen No.: 30876/MPS 5223

Nabarlek Pit

Petrographic Summary: Syenite or monzonite, shows retrograde alteration to illite and chlorite. Contact metamorphosed(?) illite -> muscovite.

<u>Mineralogy</u>	<u>Vol.%</u>
Muscovite	30
Illite	49
Chlorite	8
Leucoxene:brookite:rutile	3
Hematite	8
Zircon	2

Texture: A muscovite (0.08 to 0.6 x 0.2 mm) schist of packed muscovite flakes showing a preferred orientation. Situated between the muscovite laths are acicular hematite (0.05 x 0.01 to 0.5 x 0.1 mm), rounded zircon (0.08, 0.12, 0.03 mm) and secondary leucoxene, also yellow brookite (0.02, 0.03 mm) and stubby, striated rutile prisms.

The muscovite flakes are feeding off aggregates of feldspar occurring as subhedral shapes (0.2 x 0.2, 0.5 x 0.3 to 1.6 x 0.5 mm), altered to illite as matted flakes that show further patchy alteration to muscovite flakes.

Between the feldspars are pale chlorite flakes (0.1 x 0.03, 0.1 x 0.08 mm, etc) as random aggregates with hematite needles and leucoxene as narrow networks (0.1 to 0.02 mm) wide.

The rock shows a transition from illite to muscovite altered feldspars and a matrix of chloritised biotite (exsolved leucoxene, etc).

The equigranular feldspars and matrix biotite indicate a possible altered syenite or monzonite.

Alteration:

- i) Plagioclase(?) -> illite; biotite -> chlorite.
- ii) Muscovite + chlorite; recrystallisation.
- iii) Hematite? strongly crystalline shows uniform distribution.

Metamorphism: Contact to muscovite porphyroblasts.

Specimen No.: 30877/MPS 5224

314600E/ 8636700N

Petrographic Summary: Porphyritic dolerite that shows no actual relict clinopyroxene. Contains large phenocrysts of plagioclase and a groundmass of subophitic plagioclase embedded in squat actinolite, pseudomorphs of clinopyroxene formed in crystal mosaics. Some biotite alteration of actinolite was followed by chloritisation.

<u>Mineralogy (vol.%)</u>	<u>Phenocrysts</u>	<u>Groundmass</u>
Primary recognisable		
Plagioclase (An52 where fresh)	20	30
Diopside (shapes only)	49	-
Ilmenite	-	1
Secondary		
Actinolite		45
Oligoclase?		20
Sericite		17
Clinozoisite		8
Biotite		4
Chlorite		-
Magnetite		3
Leucoxene		3

Texture: Coarse squat and also elongate subhedral phenocrysts of clinopyroxene (2.5 x 3.0, 1.5 x 1.5 mm etc) and plagioclase (2.4 x 1.6, 10 x 4 mm and 1.5 x 2 mm) occur alongside a completely random intergrowth of fine plagioclase in pyroxene grains (now actinolite). Where plagioclase is 0.04 x 0.04 mm to acicular 1 x 0.12 mm grains, therefore pegmatically intergrown with the squat altered pyroxene grains (1.2 x 1.0 mm) that form a mosaic of clinopyroxene shapes of similar size.

Parallel sets of bars and blebs of magnetite formed along prismatic cleavages of altered clinopyroxene. Bars vary to 0.4×0.08 mm and are in places set at almost 90 degrees. Locally pyroxene shapes (now altered to actinolite) have been replaced by festoons of acicular actinolite laths (to maximum 0.6×0.08 mm) and fine tufts of actinolite; also the festoon intergrowths and coarse actinolite are locally replaced by radiate fine masses of pale chlorite that show anomalous interference and positive elongation (iron abundant). The chlorite is formed from earlier biotite growths. Plagioclase phenocrysts vary from a light dusting by scaley sericite along cleavages to dense sericitisation and fine granular deposits of clinozoisite. Groundmass plagioclase shows strong sericitisation.

Alteration: Propylitic strong $\rightarrow$ biotite, weak $\rightarrow$ chlorite. Clinopyroxene has broken down entirely to actinolite, although in places, this occurs now as festoons of fine laths of actinolite tufts.

Metamorphism: Retrograde green schist.

Specimen No.: 38202/MPS 5225

318500E/8633000N

Petrographic Summary: Granodiorite porphyry of quartz, plagioclase and minor biotite phenocrysts. Strongly muscovitised, then weathered.

<u>Mineralogy (vol.%)</u>	<u>Phenocrysts</u>	<u>Groundmass</u>
Primary recognisable		
Quartz	8	38
Plagioclase	10	15
Biotite	2	3
Alteration		
Sericite		25
Iron oxides		4
Leucoxene		2

Texture: Quartz phenocrysts are abundantly distributed throughout and vary in size from 0.12 to 4 x 4 mm, show typical β crystal forms, and pores within quartz are filled with groundmass minerals (in this case, sericite) and strong marginal embayment of forms is caused by groundmass attack. Plagioclase phenocrysts are somewhat larger and elongate, vary 0.3 to 8 x 3 mm and have altered entirely to small (0.1 to 0.4 mm) bundles of sericite as aggregates; and in places plagioclase and embayed quartz (to 0.3 x 0.1 mm) form granophyric bodies (to 3 x 2.4 mm). Smaller granophyric intergrowths (1.6 x 2.4 mm) also occur within the groundmass. Simple random aggregates of plagioclase phenocrysts (now muscovite with prismatic cleavages marked by thin limonite), and quartz phenocrysts are glomeroporphyritic. Occasional muscovite laths (0.6 x 0.2 mm) with strongly separated leucoxene are assumed to be altered biotite.

Groundmass is of fine quartz ($\sim$ 0.02 mm), separated by limonite stained and also clear sericite (after plagioclase) and muscovite flakes ($\sim$ 0.06 x 0.015 mm etc) after biotite.

Alteration: Strong sericitisation is more likely hydrothermal alteration followed by weathering (kaolinite?). Overprinted by limonite penetration during weathering.

Metamorphism: -

Specimen No.: 38214/MPS 5226

Nabarlek DDH 232

21-22m

Petrographic Summary: Porphyritic acid volcanic. Strongly chloritised (magnesium rich chlorite) and argillised (to illite). Sheared strongly. Strongly weathered showing impregnation by exotic limonite along 'bedding' fractures.

<u>Mineralogy</u>	<u>Vol.%</u>
Chlorite	65
Muscovite	2
Illite	20
Leucoxene	8
Limonite	5

Texture: A finely sheared scaley chlorite is intergrown with similar textured colourless illite. The chlorite shows negative elongation and is magnesium rich. Following the growths of chlorite and illite are laminae (0.08 to 0.4 mm wide) of fine bars of parallel iron oxide permeation subparallel and branching, have penetrated along narrow fractures following flow/shear direction.

Sheared phenocrysts of (?) (0.4 x 0.4, 0.8 x 0.4 mm etc) of chlorite and abundant fine leucoxene are not identifiable.

In plain polarised light, texture is more than just shear and indicates flow banding of altered vitric matter and augen development of phenocrysts. Groundmasss include illite and chlorite and shows a distinct thixotropic structure.

Alteration: Strong chloritic alteration of a porphyry rhyolitic volcanic.

Metamorphism: Load shear -> strong dynamometamorphism.

Specimen No.: 38216/MPS 5227

Nabarlek DDH 88

28-30m

Petrographic Summary: Muscovitised sheared volcanic with quartz phenocrysts, followed by argillisation and strong limonite staining during weathering.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz phenocryst fragments and shapes	7
Illite	20
Muscovite	50
Kaolinite	23

Texture: Quartz phenocrysts (0.1 to 3 x 1.5 mm) are fragmented and deformed to augen shapes, and segregated into bands. The matrix is varied as very fine lenticles of intermixed illite and kaolinite, commonly limonite stained and containing fine (0.04 to 0.16 mm) fragments of quartz. These lenticles, several millimetres in length to 1 mm wide, are flanked by felts and bundles of illite and illite:muscovite intergrowths.

Wider areas of section are of very fine (0.001 to 0.004 mm) platelet aggregates of kaolinite and contain quartz phenocrysts as fragments and healed fractured phenocrysts, also cavities (~0.15 mm) lined by thin limonite.

Another area of section (several millimetres length and depth) consists of felts of muscovite (to 1 mm) in aggregates, heavily limonite stained.

Also along shear laminae are feldspar(?) fragments (0.12 x 0.10 to 0.8 x 0.5 mm), now replaced by very fine irregular platy kaolinite.

Viewed by plain polarised light, section appears to represent a sheared tuffaceous vitric volcanic.

Alteration:

Hydrothermal -> muscovitised.

Weathering - illite + kaolinite (but does not include migratory limonite).

Metamorphism: Load shear.

PETROGRAPHIC DESCRIPTIONS OF SPECIMENS

NOS. 38218 TO 41358 (27 ROCKS)

FROM NABARLEK, N.T.

(prepared for Dr. Neil Rutherford, consulting
for Surtec Geosurveys Pty. Ltd.)

MINPET SERVICES

659 Botany Road

ROSEBERY 2018

REPORT NO. 70/88

PETROGRAPHIC DESCRIPTIONS OF
ROCK SPECIMENS NOS. 38218 TO 41358 (27)
FROM NABARLEK, N.T.

[prepared for Dr. N.F. Rutherford
consulting for
Surtec Geosurveys Pty Ltd, Sydney]

November 1988

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APPENDIX 1 : Letter dated 21 October 1988 from Dr. Neil Rutherford
Project Geologist for Surtec Geosurveys Pty. Ltd., Nabarlek.

1. INTRODUCTION

Twenty-seven rock specimens from Nabarlek, N.T. were submitted by Dr. N.F. Rutherford, for brief petrographic descriptions; particularly important are chloritic hydrothermal changes and presence of graphite.

2. SUMMARY

<u>No.</u>	<u>Name</u>	<u>Alteration</u>	<u>Metamorphism</u>
38218	Coarse sandstone.	Silicification. Cementation of quartz. Weathering - moderate.	Moderate contact, shows porphyro- blasts.
38219	Fine sandstone, weakly bedded.	Silicification, cementation of quartz. Weathering moderate.	Moderate contact.
38228	Claystone with silty quartz bands.	Kaolinite -> illite (authigenesis). Weathering strong.	-
38229	Granodiorite coarse grained.	Plagioclase -> sericite, strong. Weathering strong.	-
38230	Sandstone - coarse.	Feldspar -> sericite, strong. Silicification overgrowths to quartz.	Cataclasis.
38234	Rhyodacite porphyry intrusive.	Plagioclase sericitisation strong. Silica cementation of holocrystalline groundmass.	Weak deformation.
38235	Microgranite (migmatitic?)	Feldspar -> sericite + epidote. Hornblende -> actinolite. Biotite -> chlorite.	Deformation. Weak brecciation.
38245	Granodiorite porphyry intrusive.	Feldspar -> illite. Biotite -> muscovite. Biotite -> chlorite.	Deformation.
38246	Metadolerite.	Plagioclase -> saussurite. Hornblende -> actinolite.	Weak shear.
38250	Claystone with fine sand bands.	Kaolinite -> sericite + smectite. Weathering.	Slumping.
40351	Medium sandstone	Muscovitisation and chloritisation, weak.	Weakly foliated.
40352	Metadolerite	Plagioclase -> saussurite. Hornblende after clino- pyroxene?.	Moderate shear.
40353	Porphyritic basalt (holocrystalline)	Propylitic - strong.	Regional Green Schist.
40356	Medium sandstone.	Clay? -> sericite. Weathering.	Moderately to strongly foliated.

<u>No.</u>	<u>Name</u>	<u>Alteration</u>	<u>Metamorphism</u>
40365	Mudstone with fine sand bands.	Kaolinite -> sericite. Weathering	Moderate brecciation and shear.
40366	Claystone with fine to medium sand quartz bands.	Weak silicification of adjoining quartz - authigenesis.	Weak deformation.
40375	Sandstone, medium to coarse.	Silicification authigenesis. Illite -> muscovite.	Moderate foliation, with shear.
40376	Sandstone, medium	Silicification authigenesis, strong. Illite -> muscovite	Moderate foliation selectively strong with muscovite intervals.
40377	Sandstone	Illite -> muscovite. Quartz silicification.	Strong shear muscovite:quartz lenses.
40378	Coarse sandstone with biotite matrix.	Illite -> muscovite. Quartz - silicification. Weathering oxidation.	Moderate brecciation, shear.
41351	Fine sandstone, moderately chloritic.	Illite -> muscovite. Anatase presence.	Weakly foliated.
41352	Medium sandstone, unbedded.	Illite -> sericite + muscovite. Weathered.	Very weakly foliated.
41353	Medium and fine sandstone.	Illite -> muscovite Biotite -> chlorite. Weathered.	Moderately sheared but quartz segregated.
41354	Grit, medium, coarse sandstone.	Silicification cementation of quartz. Biotite -> chlorite.	Early - weak foliation cataclasis.
41355	Medium sandstone.	Chlorite -> muscovite + iron oxides. Strong weathering.	Quartz, sericite porphyroblasts. Moderate shear, cf. 41353 - similar.
41357	Fine sandstone.	Illite -> muscovite. Biotite -> muscovite + anatase.	Moderate foliation
41358	Metadolerite.	Hornblende -> diopside. Weak carbonate.	Strongly sheared. Early amphibolite metamorphism.

Early, with the exception possibly of Specimen 41358, Green Schist is the maximum metamorphic grade. Most specimens show the effects of brecciation and shear; and silicification cementation of quartz may be diagenetic except

where hydrothermal alteration is proven to occur. In several specimens 38230, 38245, 38246 and 38234, strong sericitic alteration of feldspars is noted or otherwise feldspar is saussuritised as in 38235, 38246. Recrystallisation from sericite to muscovite in this series of specimens is a metamorphic (dynamometamorphic) effect.

Anatase occurs in 41351 and 41357 of foliated sandstones - probably derived from biotite? Weathering overprints alteration, particularly in the claystone with the exception of Specimen 40366 which shows only weak silicification authigenesis.

No graphite was identified.

Chloritic alteration is mainly after biotite except in 40357, 41355(?). Chlorite also occurs in 38235 and 41354.

3. BRIEF PETROGRAPHIC DESCRIPTIONS

Specimen No.: 38218/MPS 5278

318800E / 8642170N

Petrographic Summary: Coarse sandstone with porphyroblastic muscovite and network patterns of groundmass illite after original clay mineral. Weak graded bedding. Weak contact metamorphism

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	67
Muscovite	20
Illite	10
Iron oxides ($\pm$ leucoxene)	3

Texture: Even grained of subangular quartz and few rounded grains (0.5 to 2 mm) silicified into mosaics with clear muscovite that has grown into pore spaces to engulf quartz, varies 0.5 to 3 x 2 mm. Muscovite replaces pockets of fibrous illite with specks of iron oxides. The latter constitutes original groundmass clay mineral. Shows a feeble graded bedding.

Alteration:

Silicification cementation of quartz.

Exsolution of iron oxides along cleavages in muscovite and illite.

Metamorphism: Weak contact.

Specimen No.: 38219/MPS 5279

318800E / 8642160N

Petrographic Summary: Weakly bedded, fine mainly even sandstone with muscovite porphyroblasts; and illite, silt quartz and iron oxide as a thin groundmass. Quartz grains show silica cementation.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	75
Muscovite	6
Illite	15
Iron oxides	4
Zircon	<1

Texture: Similar to 38218 but finer grained and shows a very weak graded bedding. Quartz is subangular to subrounded in shape and varies 0.2 to 1.1 mm, median size 0.3 mm. A fine channel sand. Spaces between quartz contain muscovite flakes, median size 0.6 x 0.1 mm, illite and illite with silt size quartz often threaded with thin prisms of iron oxide, form partial thin networks where quartz is not silicified-cemented. In upper part of section is a strongly silicified 'pebble' of grain ~1.2 mm of coarse sandstone with trapped interstitial illite.

Alteration: Silica cementation between quartz.

Metamorphism: Weak contact.

Specimen No.: 38228/MPS 5280

Anomaly N41

314550E / 8632000N

Petrographic Summary: Mudstone or claystone with bands of quartz clasts and dewatering structures filled by illite. Possible thin pyrite veins occur. Thin networks are present showing kaolinite → illite alteration. Lagoonal beds.

Mineralogy

Vol.%

Quartz

4

Kaolinite

72

Illite

12

Leucoxene

7

Limonite (after pyrite)

2

Limonite

3

Texture: A sediment of fine kaolinite in pellet aggregates, separated by fine laths of sericite:illite in networks. The illite contains abundant fine leucoxene, often as aggregates (~ 0.007 mm) dispersed throughout the clay. Otherwise limonitised pyrite as cube and pyritohedral forms are dispersed or follow narrow fractures in the sediment. Claystone fragments (0.4, 0.6 mm) show fracture where narrow beds have slumped and broken up. Similarly, slumped and fractured quartz (0.08 to 0.8 mm) follow recumbent folds, and subvertical dewatering structures (0.15 to 0.3 mm wide) are now filled by illite and break through single quartz laminae.

Alteration: Kaolinite → illite (authigenic).

Metamorphism: -

Specimen No.: 38229/MPS 5281

311600E / 8641500N

Petrographic Summary: Granodiorite, coarse grained and deformed contains ferrohastingsite, sericitised plagioclase and strongly deformed quartz. The amphibole and quartz are both transected by irregular fractures filled by sericite.

<u>Mineralogy:</u>	<u>Vol.%</u>
Primary recognisable	
Ferrohastingsite	30
Plagioclase(?)	50
Quartz	20
Secondary	
Sericite	40
Limonite	4

Texture: A coarse grained texture of granodiorite comprising deformed lenticular and squat quartz grains distributed between strongly sericitised plagioclase and a dark blue-green ferrohastingsite. The latter has a 2V, ~18 degrees.

An irregularly brecciated amphibolite that contains recrystallised quartz flour and abundant sericite and has begun to develop radiating muscovite structures that partly replaced plagioclase.

Alteration:

Sericitisation of plagioclase.

Weathering -> iron oxides.

Metamorphism: -

Specimen No.: 38230/MPS 5282

311840E/8641650N

Petrographic Summary: Coarse sandstone shows strong deformation and rolling of some quartz clasts. Clays were altered to muscovite. Welded quartz during shear enveloped segregated particles of sericite.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	63
Sericite	35
Iron oxides	2

Texture: A strongly deformed quartz sediment. Shows quartz that varies in size from <0.1 to 3 x 2 mm, ~1.2 mm and is presently unevenly distributed as laminar (0.7 mm wide) aggregates of quartz that form approximate networks to some strongly sericitised and deformed sericitised feldspar, otherwise is interstitial to segregated quartz. The sericite fills fractures in the quartz and sericite embayments occur in marginally fractured grains. Several larger quartz as single grains or mosaics have been rolled during shear and are made up of more than one welded clast. Finer quartz grains (0.3 mm laminae) show moderate shear. Iron oxides as specks (0.06 to 0.24 mm) and aggregates occupy areas of sericite (0.5 to 2 x 2 mm between quartz). Shapes (as rectangles and rectangles with basal pinacoids) are replaced by sericite and are most likely altered feldspar.

Alteration:

Feldspar -> sericite.

Quartz - moderate authigenic overgrowths.

Metamorphism: Some cataclasis and rolling with moderate shear.

Specimen No.: 38234/MPS 5283

318600E/8683500N

HIDDEN VALLEY
VOLCANICS

Petrographic Summary: Rhyodacite intrusive with a fine holocrystalline quartz:feldspar (now sericite) groundmass, sericitised plagioclase and quartz phenocrysts.

Mineralogy:

Groundmass Phenocrysts

Primary

Quartz	63	13
Plagioclase	14	10

Secondary

Sericite		78
Iron oxides		1

Texture: A porphyritic volcanic, including euhedral and rounded quartz phenocrysts (vary 0.1 to 5.5 x 4 mm) showing very thin marginal resorption and often glomeroporphyritic. Plagioclase is replaced by fine sericite, often has an outer contact of small quartz phenocrysts (~0.4 mm) or the feldspar is intergrown extensively with finer quartz of phenocryst size and includes grains (~0.8 mm) of quartz granophyre where sericite after feldspar is largely silica replaced. Sericitised plagioclase varies 0.3 x 0.2 to 7 x 4.5 mm, and retains a semblance of euhedral shape as slightly elongate prisms. The overall distribution of phenocrysts is even.

Groundmass is of fine silt quartz (0.015 to 0.08 mm) as polyhedral mosaics where sericite is absent. Otherwise a thin discontinuous network of sericite flakes is engulfed by outer quartz overgrowths around matrix quartz.

Alteration:

- i) Sericitisation of feldspar.
- ii) Silica cementation of fine groundmass quartz.

Metamorphism: Weak fracturing.

Specimen No.: 38235/MPS 5284

318600 E / 8633500 N

HIDDEN VALLEY
VOLCANICS

Petrographic Summary: Microgranite, moderately brecciated and strongly sheared shows segregation of minerals at one end of the section that has a coarser grain size. No sharp contact between (a) and (b) is identifiable.

<u>Mineralogy</u> (vol.%):	(a)	(b)
Primary		
Quartz	40	30
K feldspar	15	55
Plagioclase	-	15
Alteration		
Chlorite	10	-
Epidote	5	-
Actinolite	30	3
Sericite	5	30
Iron oxides	4	3

Texture: A banded microgranitic rock. K feldspar readily stained and the 40 mm depth of (b) indicates a medium to fine grained granitic rock of quartz, orthoclase and plagioclase with a pink (iron oxide) hue as seen in thin section. Feldspars (to 3 x 1.8 mm) are subhedral and unoriented as typical of granite and show a cloudy hematite and fine illite development. Similar alternate quartz is also commonly subhedral and shows brecciation and strain patterns in doubly polarised light.

At the boundary of (b) lower with (a) upper (30 mm), there is more deformation, segregation banding of feldspar and quartz, brecciation, shear and occurrence of chlorite and fibrous clusters of actinolite with some epidote.

Alteration:

Feldspar -> sericite $\pm$ epidote.

Hornblende(?) -> actinolite [not present to any extent in (b)].

Biotite -> chlorite [not present to any extent in (b)].

Metamorphism: Weak brecciation and deformation of quartz in (b).

Specimen No.: 38245/MPS 5285

Petrographic Summary: Granodiorite porphyry. Shows strong weathering of feldspars and limonite staining. Sericite alteration is scaley and vermicular suggestive of weathering. Alteration of biotite could have been deuteric. Even textured muscovite is scaley and is present also as fibrous radiating forms.

Mineralogy:

Groundmass Phenocrysts

Primary

Quartz	28	20
Plagioclase	15	30
Biotite(?)	5	2

Alteration (weathering except muscovite)

Silicification	?
Sericite	35
Muscovite	10
Iron oxides	5

Texture: A crowded porphyry rock of brecciated fractured, but unstrained quartz phenocrysts (vary 0.3 to 8 x 5 mm) show where large scattered sericite-filled pores and rounded crystal forms, occur with vague outlines of completely sericitised, vermicular - illite after plagioclase phenocrysts (vary in size 0.2 x 0.3 mm to 8 x 5+ mm), show a fairly even distribution with quartz. At one end of the section the plagioclase is strongly deformed. Biotite (0.6 x 0.2 mm) is muscovitised.

Matrix consists of an even intergrowth of quartz (0.03 mm), sericitised (illite) plagioclase and flecks of muscovite (after biotite?).

Weathering has resulted in the deposit of limonite which is mostly with the illite and muscovite.

Alteration:

Feldspar -> illite - partly due to weathering.

Biotite -> muscovite - hydrothermal?

Fine networks of fractures contain limonite stained muscovite.

Metamorphism: Deformation of sericitised plagioclase.

Specimen No.: 38246/MPS 5286

308800E/8628100N

ZAMU DOLERITE

Petrographic Summary: Metadolerite or epidiorite of medium grain size.

Shows strong saussuritisation of plagioclase; hornblende is mainly fresh.

Weakly sheared.

<u>Mineralogy</u>	<u>Vol.%</u>
Primary recognisable	
Plagioclase	30
Hornblende (after clinopyroxene?)	70
Secondary	
Albite	12
Sericite	18
Clinozoisite	5

Texture: A fairly equigranular metadolerite of subhedral hornblende as squat grains (vary 0.2 to 2.0 x 1.4 mm, median 0.7 x 0.5 mm), as single grains and aggregates with mutual grain boundaries are occasionally twinned, where alteration is to thin actinolite ($\pm$ clinozoisite) along cleavages, also traces of magnetite. Interstitial plagioclase shows irregular alteration to muscovite, finer clinozoisite and albite. Recrystallised grains of labradorite (optically) occur strongly twinned with no included alteration minerals.

Plagioclase varies in grain size up to 0.8 x 0.5 mm, though alteration mainly obscures grain boundaries.

Alteration:

Saussuritisation of plagioclase - strong.

Hornblende to actinolite + iron oxides - weak.

Metamorphism: Weakly sheared.

Specimen No.: 38250/MPS 5287

314537E/86321989N

(N41)

Petrographic Summary: Claystone or mudstone of kaolinite shows periodic emplacement of single quartz thickness of fine sand size beds. Veined by quartz:pyrite along or at a slight angle to bedding. Dispersed pyrite adjoins alteration of kaolinite to sericite ($\pm$ chlorite). Lagoonal or lacustrine sediment.

<u>Mineralogy:</u>	<u>Vol.%</u>
Quartz	20
Sericite	15
Chlorite	5
Kaolinite	53
Iron oxides	7

Vein: Quartz:pyrite.

Texture: Similar to Specimen 38228.

Bedded, includes almost parallel bands of subangular quartz mineral grains mostly between 0.04 to 0.12 mm that vary in abundance and periodicity with depth. Between the quartz beds occurs fine and vermicular kaolinite, also scattered iron oxide pseudomorphs to 0.4 mm, many of which are pyrite replaced. Also veins of iron oxides transect the bedding. Other grains associated with 'pyrite' mineralisation adjoin porphyroblasts of muscovite (0.1 x 0.04 to 0.3 x 0.16 mm), commonly vermicular aggregates of sericite - probably hydromuscovite. Quartz veins of weakly sutured grains to 0.8 mm are associated with oxidised pyrite and a selvage of sericite.

Alteration: Kaolinite, sericitised but leaves some fibrous chlorite + clay.

Metamorphism: Weak deformation or slumping.

Specimen No.: 40351/MPS 5288

312500E / 8634700N

Petrographic Summary: Weakly foliated sandstone. Quartz arenite or may be called a fine, varying to medium sandstone. Shows early foliation and alteration of feldspar present to muscovite, also biotite altered to chlorite and muscovite. Channel sand.

<u>Mineralogy</u>	<u>Vol.%</u>
Primary	
Quartz	77
Feldspar	1
Illite	15
Chlorite	3
Zircon	1
Magnetite	<1
Iron oxides	3
Alteration	
Muscovite	3
Quartz	1

Texture: A quartz arenite of mainly fine, varying to medium sandstone. The quartz is mainly subangular and varies in size, 0.1 to 0.6 mm. The quartz shows development as foliae with fine (0.02 mm wide), parallel iron oxide partitions between foliae. Coarse foliae contain quartz to maximum 3 x 0.6 mm wide.

Between the quartz clasts is hydromuscovite that is itself becoming segregated into bands to 0.2 mm (but variable) width. Where small rectangular shapes contain tufts of muscovite and some exsolved quartz, these are most likely altered feldspar. Specks of magnetite and subrounded zircon occur within the illite matrix.

Bundles of pale radiating chlorite laths occur in pores (to maximum 1.4 x 0.6 mm) between quartz, with muscovite and quartz (after biotite?).

Alteration: Moderate muscovitisation and chloritisation.

Metamorphism: Crushing of larger quartz in foliae of coarser quartz.

Specimen No.: 40352/MPS 5289

301000E / 8644000N

ZAMU DOLERITE

Petrographic Summary: Metadolerite (medium grain) shows alteration, altering to actinolite:plagioclase gneiss. Foliation was moderate to strong, depending on sector of section studied. There is moderate pyrite replacement.

<u>Mineralogy</u>	<u>Vol.%</u>
Primary	
Pyroxene(?)	55
Plagioclase	43
Alteration	
Actinolite	55
Sericite	7
Clinozoisite	4
Carbonate	2
Pyrite	2

Texture: A brecciated, sheared and moderately foliated metadolerite. The subangular hornblende (after clinopyroxene) has altered to acicular actinolite (0.08 x 0.04 to 0.4 x 2.4 mm). Grains are mainly parallel with foliation direction but show cross growths of actinolite (0.8 x 0.8 mm) that have retained a squat shape. One large hornblende (4 x 1.6 mm) that crosses foliation is extensively brecciated and recrystallised to a mosaic of finer grains.

Plagioclase shows fracture, and fill of fractures with thin sericite breccia and with formation of fine clinozoisite intermixed with fine tufts of sericite. Many grains have brecciated and recrystallised into plagioclase mosaics. Larger plagioclase laths (2.8 x 1.2 mm) are poikiloblastic with fine (0.12 mm) rounded actinolite and contains pyrite blebs (0.12 mm) and laths (0.4 x 0.12 mm).

Other pyrite present as groups (0.3 x 0.2 mm) have replaced both plagioclase and actinolite.

Alteration:

Hornblende -> actinolite (metamorphic).

Plagioclase -> saussurite.

Pyrite.

Metamorphism: Regional brecciation with moderate shear.

Specimen No.: 40353/MPS 5290

301000E/8643000N

Petrographic Summary: Porphyritic basalt with a holocrystalline groundmass of altered plagioclase and clinopyroxene microlites. Alteration was to sericite and also propylitic.

Mineralogy (vol.%)

Phenocrysts Groundmass

Primary recognisable

Plagioclase	7	50
Clinopyroxene	-	40
Magnetite	-	3

Secondary

Actinolite	30
Clinozoisite	15
Magnetite/leucoxene	5

Texture: A porphyritic basalt or andesite, but more likely the former.

Phenocrysts of plagioclase (1.2 x 0.7 mm, 1 x 0.8 mm etc) have retained their original shapes, and include glomeroporphyritic aggregates of phenocrysts. Elsewhere phenocrysts are deformed and subrounded and were probably deformed after alteration. The alteration of plagioclase was to fine felts of sericite, although one form contains thin layers of cross growths of actinolite.

The groundmass consists of random plagioclase microlites (0.2 x 0.04 mm but of variable length), interstitial prisms of actinolite (0.16 x 0.12 mm) and patchy granular clinozoisite and sericite clusters after feldspar, also fine scattered granular leucoxene as a decomposition product of altered pyroxene(?).

Alteration: Strong. Propylitic with associated sericite affects both phenocrysts (mainly to sericite only) and groundmass to actinolite, clinozoisite and leucoxene.

Metamorphism: Regional Green Schist.

Specimen No.: 40356/MPS 5291

Nabank 2

Petrographic Summary: Foliated sandstone. Medium grained sandstone with muscovite matrix. Shows early foliation and segregation of mostly quartz, otherwise mostly sericite into separate foliae or bands.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	77
Sericite (muscovite)	20
Iron oxides	3

Texture: A foliated quartz arenite of median quartz clast size 0.4 mm. However along foliae, quartz has welded into grains to 2 x 0.8 mm excluding muscovite which has begun to segregate and form coarse lenticles of fine muscovite to 4 mm thick and short en-echelon lenticles of quartz of single thickness and single grains. Elsewhere quartz retained its medium sand size and has an almost continuous thin matrix of muscovite. Otherwise quartz and muscovite are almost completely segregated into parallel bands, varying 0.8 to 5 mm thickness.

Iron oxides occur along thin lenticles in sericite, parallel to foliation or occur as blebby (0.4 x 0.1 mm) cement between quartz in quartz bands and also as an alternate matrix mineral to sericite.

Alteration:

Clay(?) -> muscovite.

Weathering oxidation of iron.

Metamorphism: Regional moderate brecciation and shear. Green Schist.

Specimen No.: 40365/MPS 5292

314555E / 8631940N

(N41)

Petrographic Summary: Mudstone, including medium to fine sand size quartz. Shows boudinisation of the more quartz rich bands. Clay altered to sericite has been strongly stained by limonite of weathering, as have abundant deformed sulphide blebs. Altered pyrite occurs as veins or as segregated iron oxides with sericite rich layers. There are shattered pyrite veins and distinct pyrite shapes.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	22
Sericite	65
Kaolinite	5
Chlorite	-
Iron oxides	8

Texture: Refer to similar Specimens 38228 and 38250. A mudstone with fine and medium size quartz (0.1 to 0.3 mm) mineral grains as periodic thin bands of single grains or as dispersed clasts in beds of mainly iron oxide stained laminae of fine sericite, or otherwise as fine kaolinite. The latter mineral is abundant around iron oxide pseudomorphs and as thin laminae around pyrite shapes. Embedded in the quartz and limonite stained sericite are subrounded boudins (2.5 x 1.8 mm) of silicified quartz breccia with thin partings of sericite and an abundance of deeply iron oxide stained sericite(?).
Silicification prevented spreading of limonite stain.

In areas of intense brecciation, sericite is fine intermixed with cherty quartz breccia. Also in areas of strong brecciation, kaolinite is intermixed with fine sericite and cherty quartz.

Alteration:

Kaolinite -> sericite.

Pyritisation.

Silicification was localised to boudins.

Metamorphism: Regional brecciation in more quartzose beds.

Specimen No.: 40366/MPS 5293

314534E / 8631990N

(N41)

Petrographic Summary: Sandy claystone with fine to medium quartz clasts of varying density along beds indicates a variation of quartz contribution depending on current velocity of water medium at time of sedimentation. Deformation is weak. Lagoonal environment.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	18
Illite	76
Iron oxides	6

Texture: A much less deformed example of specimen 40365. Shows bedding of various densities, subangular to subrounded quartz clasts (vary mostly 0.04 to 0.24 mm) along bands or tending to be evenly dispersed in some beds with abundant fibrous illite containing lenticular iron oxide (stain and fine blebs of limonite and less often continuous laminae (0.08 mm wide) of iron oxides along the bedding.

Rarely, beds (0.8 mm depth) consist of larger quartz clasts (0.15 to 0.3 mm) with minimal illite matrix or in places quartz is silicified into mosaics of mutual composites which are conformable with the bedding. Upper band (5 mm) and an intermediate bed (1.5 mm) contain few or no quartz clasts and are illite with thin en-echelon laminae or blebs of limonite.

Alteration: Weak silicification occurred where quartz clasts are adjoining along beds.

Metamorphism: Weak deformation - Regional, only.

Specimen No.: 40375/MPS 5294

311250E/8635550N

Schists at
Kombolgie contact

Petrographic Summary: Foliated sandstone. Sandstone consists mostly of medium to coarse sand size clasts with a liberal muscovite matrix that contains abundant iron oxides (exotic from weathering). There is segregation of quartz and illite along foliae.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	77
Illite	16
Muscovite	1
Iron oxides	6

Texture: A medium to coarse sandstone of quartz clasts with grain size variation 0.08 to 0.8 x 0.8 mm, median size 0.3 mm. Grains are subangular but include some subrounded grains and with silica cementation and pressure show formation of parallel lenticular mosaics all of quartz with illite segregated into parallel but finer lenticles. Some illite (0.2 to 0.5 mm wide) including rectangular shapes, often contain muscovite and may be altered feldspar.

Iron oxides follow a muscovite/illite prismatic cleavage or spaces between parallel fibres and are abundant. The upper side of the section shows coarser (3 x 1.3 mm) illite segregation which indicates a change of earlier primary mineralogy texture rather than differentiation due to shear.

Alteration:

Silicification.

Illite -> muscovite (weak).

Metamorphism: Early shear with contact shown by silicified quartz mosaics with grains showing mutual boundaries. Regional.

Specimen No.: 40376/MPS 5295

311250E/8635550N

Petrographic Summary: Sandstone of medium quartz size with illite matrix. Shows strong foliation into muscovite and quartz lenticles. Silicification of quartz into mosaics occurs less commonly than for 40375. Coarser lenticles than for 40375.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	69
Illite	9
Muscovite	15
Iron oxides	6
Magnetite	1

Texture: Similar to specimen 40375 but shows a greater component of coarse lenticular muscovite at 1 to 3 mm intervals parallel to foliation direction.

Quartz varies 0.15 to 1.0 mm, median size 0.3 mm where not welded with other quartz clasts into silicified lenticles, to 2 mm width at greatest widths. The welding and amalgamation of quartz into lenticles is less common for Specimen 40376 but as mentioned above muscovite lenticles, 0.8 mm wide that contain laminae of iron oxides along cleavages are actually illite growths between quartz interstices.

Illite forms small pockets (to 0.8 mm maximum) to 0.05 mm and shows less continuity through the section than for 40375. A stronger foliation but with less uniform structure than for 40375.

Alteration:

Silicification - strong.

Illite -> muscovite along lenticles.

Metamorphism: Strong shear - regional. Segregation of muscovite.

Specimen No.: 40377/MPS 5296

311250E / 8635550N

Petrographic Summary: Metamorphosed sandstone with abundant muscovite.

Quartz:muscovite gneiss. Iron oxides as in previous similar sections are abundant as laminae along cleavages or along muscovite grain margins separating muscovite laths.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	68
Illite	7
Muscovite	20
Iron oxides	5
Magnetite	<1

Texture: Similar in mineralogy but distinct from Specimens 40375, 40376 and 40377 in that shear has produced a quartz gneiss of fine, elongate muscovite segregations (0.15 to 0.30 mm wide) are separated 1 to 3 mm by silicified clastic quartz varying to 1 to 1.5 mm as silicified cemented foliae. The quartz foliae contain short laths ($\sim 0.3 \times 0.1$ mm wide) of muscovite parallel to foliation.

Residual illite often engulfs muscovite or is continuous along the foliation direction with muscovite laths. The mineral fills pores but does not form networks between the quartz clasts. Quartz is more porphyroblastic than for 40375 and 40376.

Iron oxides occur mostly within or form parallel laminae with muscovite.

Alteration:

Illite $\rightarrow$ muscovite (metamorphic).

Quartz silicification cementation (metamorphic).

Metamorphism: Greater deformation than for Specimens 40375, 40376.

Specimen No.: 40378/MPS 5297

311250E / 8635550N

Schist similar
to that at N41.

Petrographic Summary: Coarse sandstone - sheared. Quartz:biotite:muscovite schist in a matrix of fine illite. Shows metamorphism of iron-stained, potassic rich shale with quartz beds. Lacustrine or lagoonal origin.

cf. 40366, 38250
38228

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	30
Illite	45
Muscovite	5
Biotite	20
Magnetite	<1

Texture: Consists of laminae of silicified cemented quartz (to maximum 2.5 mm wide) forming bulging foliae with interstitial biotite strongly stained by iron oxides. The biotite occurs as subparallel and parallel laminae (0.2 to 0.3 mm wide) and fragments in a generous matrix of fine illite.

Below the coarse foliae described are embayed subangular and subrounded quartz along beds 3 mm wide and silicified quartz foliae, 9 x 1.5 mm, flanked by finer quartz aggregate, laminae embedded in illite.

In strongly illitic beds are flakes of iron stained biotite where some appear to have exfoliated as vermiculite, upwards to fine quartz aggregates of breccia (~0.3 mm), a layer (2 mm depth) of quartz (0.3 to 0.7 mm) with biotite cement and above this clear brown biotite as discontinuous lenticles embedded in fine illite (4 mm deep).

Alteration:

Illite -> muscovite.

Silicification of quartz.

Biotite -> vermiculite (weathering).

Metamorphism: Moderate shear and brecciation. Regional.

Specimen No.: 41351/MPS 5298

302200 E / 8643200 N

(Nourlangie Schist)

Petrographic Summary: Quartz: muscovite → weakly foliated. Bedded sandstone with abundant illite matrix and patchy chlorite and muscovite fill. Beds alternate as medium and coarse sand size. Brecciation of quartz occurred along finer bands. Early foliation.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	63
Illite (pale green)	23
Muscovite	5
Chlorite	4
Anatase	2
Iron oxides	1
Zircon	2

Texture: Shows weakly foliated quartz (0.08 to 0.8 x 0.6 mm). Quartz clasts are commonly silicified, cemented to form approximately parallel laminae (0.12 to 0.4 mm wide). Quartz where coarse (~1.2 mm wide) is continuous across the section and shows weakly sutured quartz in mosaics of fairly even grains.

Elsewhere, quartz (0.2 to 0.4 mm) forms short laminae flanked by ruptured finer quartz in parallel laminae or occurs as bands of quartz (0.04 mm, etc) breccia. Quartz is embedded in fine sericite or illite but occasionally radiating structures (0.2, 0.1 mm) are of chlorite embedded in quartz or cemented to quartz. Similarly for radiating muscovite laths 0.16, 0.12 mm attached to or embedded in quartz.

In spite of early incipient foliation, coarser and finer quartz are present in beds, with less and more illite groundmass respectively. Rounded zircon and anatase in aggregate blebs occur in illite.

Alteration: Coarsening of illite. Presence of anatase aggregates suggests minor hydrothermal activity.

Metamorphism: Moderate shear.

Specimen No.: 41352/MPS 5299

302200E / 8643300N

(Nourlangie Schist)

Petrographic Summary: Medium sandstone, unbedded but quartz has been compacted into networks with thin sericite, quartz and iron oxide cement and sericite migrated into areas of finer quartz giving clear networks of the mica with weathering and staining by iron oxides.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	69
Muscovite	3
Sericite (pale green)	24
Iron oxides	4

Texture: Subangular to subrounded clastic quartz, varies 0.08 to 0.8 x 0.6, median 0.4 mm and is not particularly well bedded, but where many clasts closely adjoin, these are silicified or iron oxide cemented into networks, often finely brecciated, with thin sericite and iron oxides forming cement (0.01 to 0.04 mm wide). Quartz porphyrotopes (1.3 mm) are scattered irregularly through the finer quartz. The iron oxide:sericite filled fractures form a close network passing through more than one clast. The sericite occurs as random aggregates of finer flakes with coarser muscovite and some patchy limonite staining of the mica.

The tightening of quartz into mosaics has left areas of quartz including medium sand grain size with a strong silicified quartz network (0.04 to 0.8 x 0.4 mm wide) but with a lack of uniform thickness. Silicified mosaics are uniformly distributed outside an overall network of silica, thin iron oxide and sericite cemented quartz grains.

Alteration:

Illite -> sericite and muscovite.

Iron oxides - weathering effect.

Metamorphism: Regional shear. Early compaction, brecciation and movement of sericite into areas of mainly finer quartz.

Specimen No.: 41353/MPS 5300

302200E / 8643550N

(Nourlangie Schist)

Petrographic Summary: Quartz:chlorite:moscovite semi gneiss. Fine and medium bedded sand size quartz contains segregations of muscovite and chlorite with finer quartz beds, leaving only pockets and thin cement of muscovite and chlorite in the coarser quartz beds of mainly deformed silicified cemented clasts.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	72
Muscovite (pale green)	12
Chlorite	15
Iron oxides	1

Texture: Moderately foliated quartz:moscovite rock that contains minimal iron oxides (<0.01 mm) within thin muscovite foliae. Chlorite as thin fibrous chlorite as aggregate and as short foliae substitute for muscovite in some mica foliae

Muscovite and chlorite fill wide (to 0.4 mm) interspaces between fine (0.08 to 0.3 mm, median 0.16 mm) foliae 1.6 mm wide rich in quartz. Alternate foliae are 2.0, 1.2 mm thick of coarse 1.2 mm and finer quartz 0.12 mm thick, silica cemented into irregular sutured quartz in mosaics where sericite is segregated into pores (0.4 and 1.5 x 0.3 mm). Between the parallel foliae are thin continuous iron oxide stained chlorite bands with clear segregations of muscovite and chlorite of variable width.

Alteration:

Illite -> muscovite tufts.

Biotite(?) -> chlorite - weathering?

Metamorphism: Moderate to strong shear with early segregation of muscovite and chlorite and broad quartz foliae.

Specimen No.: 41354/MPS 5301

302200E/8643550N

(Nourlangie Schist)

Petrographic Summary: Sandstone sediment of grit with medium and coarse sand bands. Fine and coarse sandstone with a band of granule size quartz, muscovite and biotite towards bottom of the section. Deformation, strong silicification and brecciation of quartz to rock flour in places. Illite with scattered embedded muscovite and chloritised biotite laths mostly made up the interstices between quartz.

<u>Mineralogy</u>	<u>Vol.%</u>
Primary	
Quartz	78
Illite (pale green)	15
Muscovite	2
Biotite	5
Zircon	<1
Tourmaline	<1
Secondary	
Muscovite	1
Iron oxides	2
Chlorite	4

Texture: The quartz is quite irregular in shape and some grains show a 0.2 mm depth of quartz overgrowth (varies 0.06 to 1.5 x 0.6 mm) with median size which may have been 0.4 to 0.6 mm and is better seen where quartz clasts are isolated in pores filled with illite. Bedding as such is not identifiable except at bottom and top of thin section, and there is a coarsening in quartz grain size to 3 x 2 mm size towards base of section. Grain sizes are very irregular but some coarse biotite (2 x 0.3 mm) and muscovite (1 x 0.8 mm) are embedded in the quartz overgrowths. Finer quartz (0.2, 0.5-0.7 mm) shows strong deformation and is embedded in the almost continuous networks of

illite showing growths of muscovite flakes and chloritised biotite as short well formed prisms (0.8 x 0.16, 1.2 x 0.4 mm etc).

Narrow (0.1 to 0.4 mm) almost continuous fracture planes across and also oblique to section contain silicified quartz flour breccia formed during cataclasis. Tourmaline (0.15 x 0.08 mm) is embedded in quartz. Also rounded large zircon crystals occur in the illite.

Alteration: Silicification cementation of quartz and weathering of biotite to chlorite + iron oxides.

Metamorphism: Early incipient foliation and cataclasis. Regional. Shows porphyroblastic quartz.

Specimen No.: 41355/MPS 5302

301600E / 8642700N

(Nourlangie Schist)

Petrographic Summary: Quartz: muscovite: chlorite? schist. Probably sandstone of medium size quartz clasts with abundant sericite matrix. Metamorphism resulted in porphyroblastic growth of quartz and sericite (to muscovite). Weathering iron oxidation was patchy and involved mica minerals.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	67
Muscovite	4
Illite (pale green)	26
Muscovite*	1
Chlorite*	2

* Both strongly stained by limonite.

Texture: Quartz: muscovite gneiss. Consists of parallel with fewer subparallel lenticles of quartz (0.4 to 1.3 mm wide). The latter tend to link the parallel lenticles. Quartz varies from polyhedral where fine to sutured and irregular where grains are large. Grain size variation is 0.15 to 4 x 2 mm, median size 0.5 mm. Spaces between the lenticles vary from 0.3 to 2.0 mm and shorter lenticles strongly taper at each end. Spaces between quartz lenticles are occupied by scattered fine quartz, also fine sericite to growths of coarser muscovite with crystal habit of parallel aggregates varying to stellate growths. Limonite stained (chlorite?) alternates with sericite since in most cases there is a sharp boundary between limonite stained and clear micas but includes some muscovite with light limonite staining. Apart from the brown stain of mica minerals, specks (0.002 mm) of red hematite are distributed along mica cleavages.

Alteration:

Chlorite? to muscovite + iron oxides.

Strong weathering and iron oxide staining.

Metamorphism: Green Schist regional - shear.

Specimen No.: 41357/MPS 5303

301600E/8643000N

(Naurlangie Schist)

Petrographic Summary: Quartz: muscovite schist as a metamorphosed fine sandstone sediment. Much of the mica groundmass is illite. Continuous quartz lenticles are rare - mostly lenticles occur en-echelon within illite: muscovite growths.

Mineralogy:

Vol. %

Quartz	71
Muscovite	4
Illite (pale green)	22
Chlorite	-
Iron oxides	3
Anatase	<1

Texture: Similar to 41355 but with less foliation and shows porphyroblastic growth of minerals.

Continuous quartz foliae vary 0.5 to 1.2 mm and dilate. Quartz grains show both strongly sutured and mutual grain boundaries. Quartz between continuous laminae occur as shortened en-echelon distributed sublaminae (but of similar thickness) and abundant fine illite between all laminae.

Quartz varies 0.05 to 0.9 x 1.5 mm, median grain size is 0.2 mm of fine sand size.

Muscovite within mica rich laminae is rare as isolated tufts (0.4 x 0.15 mm), occasionally laths (1 x 0.15 mm) attached latterly to quartz laminae or occur as cement between adjoining quartz clasts.

Iron oxide staining of mica is noted, but chlorite is absent. Occasional oxidised pyrite ($\pm$ hematite) replicas filled with limonite are present.

Alteration:

Illite -> muscovite (porphyroblastic).

Biotite -> muscovite + anatase.

Metamorphism: Regional. Strong shear.

Specimen No.: 41358/MPS 5304

302200E/8643700N (Zamu Dolerite)

Petrographic Summary: Metadolerite. Diopside, retrograded to actinolite in actinolite:plagioclase schist. This was followed by rare reverse metamorphism of actinolite to diopside, local. Plagioclase retrograded and saussuritised.

Mineralogy

Vol.%

Metadolerite (from dolerite)

Actinolite	56
Plagioclase	30
Quartz	3
Diopside	10
Sphene	1

Alteration

Carbonate	2
Sericite	3
Clinozoisite	5
Iron oxides	1

Texture: A very strongly sheared amphibolite, metamorphic rock. Shows foliae of pale green actinolite as crystals with tapered terminations, vary 0.4 x 0.25 to 2 x 0.3 mm. The laminae are seldom even and are elongate with many actinolite crystals fitting end to end. Between the actinolite crystals are abundant plagioclase laminae of clear, mildly sericitised, varying to strong alteration to clinozoisite, as fine granular aggregates. Rare albite twinning of plagioclase shows twin lamellae to be very fine. Other grains present are squat prisms (0.2 x 0.6 mm) and cross sections (0.2 x 0.2 mm) of fresh diopside which show a cleavage parallel to '110'. Occasional laminae of quartz and carbonate occur as clear nodular granules that impinge into actinolite laminae. Diopside is poikiloblastic with subrounded actinolite inclusions.

● Alteration:

Plagioclase is saussuritised to clinozoisite and sericite – moderate.

Actinolite -> diopside local.

Carbonate alteration – weak.

Metamorphism: Strong shear but with brief amphibolite metamorphism – retrograded.

MINPET REPORT 2/89

February 1989

PETROGRAPHIC DESCRIPTIONS OF ROCK CHIP
SAMPLES FROM NABARLEK AND RANGER

(prepared for Dr. N.F. Rutherford, consulting
for Surtec Geosurveys Pty. Ltd., Sydney)

MINPET SERVICES

659 Botany Road

ROSEBERY 2018

REPORT NO. 2/89

PETROGRAPHIC DESCRIPTIONS OF

ROCK CHIP SAMPLES

FROM NABARLEK, AND RANGER PROSPECTS, N.T.

[prepared for Dr. N.F. Rutherford

consulting for

Surtec Geosurveys Pty Ltd, Sydney]

January 1989

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APPENDICES

- I LETTER DATED 9/12/88 FROM DR. N.F. RUTHERFORD, REGARDING WORK REQUIRED
ON SECTIONS OF ROCK CHIPS

- II XRD REPORT ON ILMENORUTILE IN SAMPLE MPS 5410

1. INTRODUCTION

Specimens including mixed rock chips are grouped in 27 samples for naming and alteration characteristics. Where rock chips are of mixed origin, a representative example of each rock type was mounted for thin section, one slide per sample.

Rock sample numbers are 40393 to 40396 and QML 1, 2 and 3.

Mixed rock chip drill fragments are series: DAP, LAP and MAP.

One specimen was included for XRD identification of 'coarse' heavy mineral.

2. SUMMARY

<u>NO.</u>	<u>NAME</u>	<u>ALTERATION</u>	<u>METAMORPHISM</u>
DAP 1/1(A)	Major: Quartz:biotite: muscovite. K feldspar gneiss.	-	Moderate shear.
	Minor: Hornblende granite.	Hornblende -> actinolite - total. ± actinolite -> chlorite - strong. ± feldspar -> sericite - strong and weak. Adularia vein.	Strong shear Upper chlorite retrograde.
DAP 1/1(B)	Major: Quartz:chlorite: schist.	Biotite -> chlorite - strong. Plagioclase -> sericite	Strongly sheared + crenulation (1 fragment)
	Minor: Quartz: muscovite:biotite schist.	Biotite unaltered.	Moderately sheared.
	Quartz:muscovite biotite gneiss.	Unaltered.	Weakly sheared
DAP 3/1	Major: Quartz: muscovite:biotite: plagioclase gneiss. Metamorphosed granite.	Biotite -> chlorite weak, one specimen.	Contact -> shear.
	Minor: Tremolite: quartz schist. Metamorphosed calc silicate sediment.	Tremolite - major. Carbonate - minor.	Shear.
DAP 4/1	Plagioclase:biotite: quartz gneiss.	Sericite - weak to strong. Chlorite - weak to strong. Tourmaline - moderate.	Moderate shear
DAP 4/2	Actinolite:plagioclase: quartz amphibolite.	Sericitisation - strong.	Strong shear.
DAP 4/3	Actionolite:plagioclase: quartz amphibolite.	Sericitisation, chlorite - moderate to strong. Hematite - weak.	Strong shear.

<u>NO.</u>	<u>NAME</u>	<u>ALTERATION</u>	<u>METAMORPHISM</u>
LAP 2/1(A)	Granite.	Sericite, chlorite and hematite - weak.	-
	Plagioclase:biotite: quartz gneiss.	Chlorite - weak, otherwise unaltered.	Moderately sheared.
	"	Chlorite, sericite - strong. Carbonate - weak.	Moderately sheared.
LAP 2/1(B)	Granite - variable.	Illite - very strong. Muscovite, carbonate - moderate.	Strongly sheared.
		Muscovite, chlorite - moderate. Illite - weak.	Moderately sheared. -
LAP 8/1	Andesite.	Illite - strong. Kaolinite - very strong. Carbonate - weak (ferroan calcite).	-
LAP 8/2	Quartz:plagioclase: biotite gneiss. Metasediment.	Illite - strong. Chlorite - moderate to strong. Muscovite - weak to moderate.	-
	Sheared granite or granodiorite.	Illite - strong. Chlorite, muscovite - moderate. Carbonate - weak (ferroan calcite).	-
LAP 8/3	Metadolerite/meta-basalt. Actinolite:plagioclase: quartz: $\pm$ biotite gneiss.	Sericite - weak to strong. Chlorite - nil to moderate.	Moderate shear with evidence of contact metamorphism in coarser gneiss.
MAP 1/1	Actinolite:plagioclase schist.	Sericite - weak.	Moderately to strongly sheared.
	Actinolite:plagioclase: biotite:quartz schist.	Sericite - strong. Chalcedony - very strong. Carbonate - vein (ferroan calcite).	

<u>NO.</u>	<u>NAME</u>	<u>ALTERATION</u>	<u>METAMORPHISM</u>
MAP 1/2	Quartz wacke Porphyritic volcanic.	Pyrite porphyroblasts oxidation - weathered. Cherty silicification + pyrite + illite.	Contact -> retrograded.
MAP 3/2	Chlorite:quartz: plagioclase schist.	Chlorite + hematite.	Weak shear.
	Chlorite:orthoclase: quartz muscovite schist.	Chlorite + hematite.	Moderate to strong shear.
	Colloform hematite.	Hematite.	-
MAP 4/1	Chlorite:quartz schist.	Chlorite - strong.	Sheared.
MAP 4/3	Chlorite:biotite: muscovite quartz schist.	(Hornblende) + biotite -> chlorite - very strong.	Brecciated and sheared (incl. brecciation of quartz vein).
MAP 5/1	Hornblende:biotite: quartz orthoclase gneiss.	Chlorite - very strong. Hematite - strong to nil. Carbonate - strong to nil (ferroan calcite).	Strongly sheared.
MAP 5/2	Actinolite:biotite: quartz schist.	Chlorite, sericite - very strong. Biotite - partly chloritised, includes hornblende -> chlorite - strong.	Strongly sheared.
MAP 9/1	Greisen.	Weak tourmalinisation.	
	Quartz:illite: muscovite.	Biotite -> muscovite - weak to moderate, but to illite very strong.	Contact(?) -> moderate shear.
MAP 9/3	Granodiorite.	KF, sericite - deuteric.	Weakly brecci- ated, locally sheared.
	Sandstone with ilmenorutile.	Silicification + ilmenorutile (XRD). Weak kaolinite, vermi- culite (weathering), hematite.	-

<u>NO.</u>	<u>NAME</u>	<u>ALTERATION</u>	<u>METAMORPHISM</u>
QML 1	Granite porphyry.	Silicified, kaolinite - strong. Sericite, hematite - weak.	Very weak shear.
QML 2	Granite, medium grained.	Low grade hydrothermal. Illite - very strong. Kaolinite - strong. + weak alunite + limonite.	Very weak
QML 3	Adamellite.	Illite, kaolinite - very strong. + weak alunite + limonite.	-
40393	Chlorite:quartz schist.	Chloritised - very strong. Graphite + pyrite. Modified syngenetic? Carbonate - vein only. Vein pyrite sheared and segregated syngenetic material?	Strongly sheared.
40394	Chlorite:quartz gneiss.	Chlorite - very strong.	Strongly sheared.
40395	Chlorite:quartz schist.	Chlorite - very strong. Quartz vein(?). Shows trace baryte.	Brecciated - strongly sheared.
40396	Dolomite:chlorite quartz rock.	Dolomite sparite replacement of an earlier chlorite schist.	?

Most sections show shear with abundant actinolite and/or chlorite. Chlorite replacement of actinolite and biotite is considerable (except for fresh granitic specimens where biotite is fresh and clear brown). Granitic specimens that remain unsheared show clear to cloudy plagioclase, strongly altered to illite.

Pyrite occurs mostly with quartz (as vein) or segregations with quartz with possible syngenetic pyrite with graphite and chlorite in specimen 40393.

Alunite alteration in QML2 and QML3 is associated with strong illite and kaolinite alteration of feldspar in granitic rock. Original hornblende no longer exists though in places a brownish tinge is imparted to actinolite as in specimen DAP 4/3 where also occurs garnet (often chloritised) and hematite alteration (after hornblende).

Garnet also is seen in DAP 4/2 where the mineral is fresh and is embedded in actinolite and rock is thought to be an amphibolitised calc-silicate.

Therefore DAP 4/2 and DAP 4/3 are the closest to an earlier(?) amphibolite grade status.

Most specimens show an Upper Green Schist grade but since many specimens are sheared, an earlier amphibolite grade for some is possible.

It was indicated that the presence of dense chalcedony in MAP 1/1 was related with silicification along a fault.

Metamict zircon grains with radiogenic halos are commonly seen in chloritised biotite and also in fresh biotite.

Present along cleavages of chloritised biotite(?) are tiny lozenge shapes of sphene. Often these are quite abundant.

Strong hematite alteration is seen in MAP 3/2 as rhombohedral forms. A quartz-hematite vein is seen in MAP 4/1. MAP 5/1 with strong hematite is associated with altered hornblende although rhomb forms are present in biotite after hornblende.

Epidote occurs in two fragments of DAP 1/1B but is a minor component and is replacing or has replaced feldspar.

A narrow adularia vein follows cleavage direction in specimen DAP 1/1(A) as b(2) in b(1).

Metamorphism in the present state of retrograde shear is no more than Upper Green Schist.

3. PETROGRAPHIC DESCRIPTIONS

Specimen No.: DAP 1/1(A). MPS 5390. 6 fragments.

Field Note: Various schists, amphibolite.

Petrographic Summary: Most abundant fragments present are those of unaltered quartz:biotite:moscovite:K feldspar gneiss; the remaining fragments are of aplitic(?) granite moderately sheared, showing hornblende altered to actinolite and in one fragment altered to chlorite and iron oxides; also K feldspar is moderately altered to sericite.

<u>Mineralogy</u> (vol.%)	(a)	(b) (1) (2)		(c)
Quartz	77	10	-	34
Muscovite	11	-	-	-
Sericite/illite	-	15	-	3
K feldspar	3	28	97	10
Biotite	9	3	-	15
Chlorite (after an amphibole mineral)	-	38	-	-
Magnetite	-	5	-	4
Limonite	-	-	3	5
Clinopyroxene	?			
Actinolite	-	-	-	29
Zircon	<1	-	-	-
Martite	-	1	-	-

Three different rock types:-

- (a) Texture: The most abundant is a lepidoblastic textured quartz: muscovite:biotite gneiss with quartz of variable grain size (median 0.6 x 0.3 mm) often, but not invariably elongate and contains mutual composite boundaries with any adjoining quartz.

Muscovite flakes ($\sim 0.5 \times 0.05$ mm) even squat and some elongate laths occupy cement zones between quartz and the mica is commonly parallel, and intergrown with that of muscovite of a similar size and texture, light brown biotite, which adjoins zircon, occurs as subangular grains (0.1×0.06 mm).

Metamorphism: Regional.

Alteration: -

- (b) Texture: A weakly banded chlorite:quartz:K feldspar rock that contains an abundance of magnetite of irregular grain size (0.04 to 0.4×0.3 mm) as aggregates associated with bright green chlorite. Quartz:KF in bands (0.08 to 0.24 mm) of composites (0.4 to 1.2 mm) are disturbed by porphyroblastic bladed chlorite growths (1.6×0.12 mm) with a secondary cleavage pattern. Chlorite therefore shows parallel and almost 90 degree (to first cleavage) cross growths after hornblende? Feldspars, largely anhedral show alteration to biotite followed by alteration to chlorite and yellow-brown illite.

Below the quartz:KF:chlorite:magnetite layers is a layer ($+2.4$ mm) of rhombic K feldspar which has the appearance of adularia (0.3 to 0.8 mm), and occurs as random intergrowths.

Sheared and retrograded aplite(?). Contains abundant biotite now altered to chlorite. Shows secondary cleavage of chlorite-filled fractures.

Alteration: Retrograded during shear.

Metamorphism: Weakly sheared, cross fractured (~ 90 degrees), secondary cleavage was filled with chlorite after hornblende.

(c) Texture: A banded, weakly sheared quartz:K feldspar:actinolite chlorite schist. Quartz:K feldspar bands (0.2 to 0.32 mm wide) are subparallel as foliae and are separated by lenticles of actinolite laths ($\sim 0.2 \times 0.08$ mm) often elongate (to 2 mm), includes some short fibre (0.03×0.01 mm) aggregates of chlorite. Several cross sections of actinolite with characteristic obtuse cross cleavages are also seen. K feldspar shows alteration to sericite along cleavages.

Alteration: Sericitisation of feldspar - moderate. Chloritisation of biotite - strong.

Metamorphism: Strong shear.

Specimen No. DAP 1/1(B). MPS 5391. 5 fragments.

Field Note: Various schists, amphibolite.

Petrographic Summary: Sheared, quartz:plagioclase:biotite. Where crenulation occurs as in (c), (d) and (e), biotite altered to chlorite; plagioclase to sericite. Metamorphosed granite, or granodiorite.

<u>Mineralogy</u> (vol.%):	(a)	(b)	(c)	(d)	(e)
Quartz	58	25	-	-	-
Plagioclase	20	27	40	40	-
Biotite	15	33	3	3	60
Muscovite	7	15	-	-	-
K feldspar	-	-	20	20	40
Chlorite	-	-	37	-	-

Alteration

Sericite	3	30	-	-	-
Magnetite	-	3	-	-	-
Limonite	-	-	20	20	-
Epidote	-	-	2	2	-
Chlorite	-	-	-	-	20
Iron oxides	-	-	-	-	4

(a) Texture: Similar to (a) of DAP 1/1(A). Lepidoblastic textured quartz (0.2 to 0.6 mm) shows as mosaics of interlocking quartz that includes mutual and embayed grain margins with adjoining quartz. Along margins of quartz grain and often "impaling" recrystallised quartz grains is brown biotite as small laths (0.08 x 0.02 to 0.5 x 0.2 mm) which less commonly occurs as parallel intergrowths with similar size muscovite laths. The latter (~0.8 x 0.15 mm) are usually larger than biotite and occupy a position between two or more quartz grains. Plagioclase laths

of similar size and shape to quartz are partly altered to sericite along feldspar cleavages.

Alteration: Sericitisation - moderate.

Metamorphism: Weakly sheared, recrystallised.

- (b) Texture: Similar to (a), but with a greater abundance of feldspar altered to sericite. Feldspar is present in mosaics up to 0.8 x 0.6 mm with fine tufted sericite as cross growths along cleavages. Brown biotite occurs as sheared laths (up to 1.7 x 1.2 mm) which include specks of iron oxides. Laths are in parallel growths with clear muscovite laths of similar size and shape.

Quartz often occurs as ovoid grains (1.2 to 3 mm) in aggregates with biotite and with muscovite as interstitial laths. Where composites of quartz occur these show mutual to weakly sutured grain boundaries.

Quartz lenticles (2 mm long x 0.2 mm wide) as composites of aligned single quartz width are the result of shear.

Alteration: Strong sericitisation of plagioclase feldspar.

Metamorphism: Regional shear.

- (c) Texture: A sheared banded rock of quartz (with chlorite), sericitised plagioclase and chlorite lenticles with exsolved iron oxides.

Lenticles (0.08 to 0.14 mm wide) alternate as quartz, quartz:chlorite, sericitised plagioclase and K feldspar bands. Iron oxide lenticles (0.8 x 0.08 mm) are flanked by and contain thin brown biotite lenticles, which continue through the section as fewer iron oxide particles flanked by chlorite.

A retrograded schist with a strong crenulation cleavage, which varies from 45 to 75 degrees to main cleavage.

Alteration: Biotite -> chlorite + iron oxides. Plagioclase -> scaly sericite.

Metamorphism: Strong shear -> strong crenulation.

- (d) Strongly sheared muscovite/sericite laminae alternate with pale brown biotite on one edge of the section where biotite is altered to chlorite and iron oxides. Lenticles of iron oxide (0.05 mm wide) alternate with biotite in 'fresh' part of the section.

Alteration: Trends - (a) = (b) = (d) in part metamorphics -> (c) and partly (d) biotite retrograded to chlorite, muscovite -> illite, also retrograded.

Specimen No.: DAP 3/1. MPS 5392. 8 fragments.

Field Note: Various schists.

Petrographic Summary: Largely quartz: muscovite: biotite: plagioclase gneiss (or schist), metasomatised; one fragment of calc-silicate sediment with weak upper chlorite metamorphism - retrograde.

<u>Mineralogy</u> (vol.%):	(a)	(b)	(c)	(d)	(e)
Quartz	25	70	As for (b)	69	10
Muscovite	20	15	chlorite~	15	-
Biotite	15	10	filled	10	2
Plagioclase	40	5	fractures	7	-
Apatite	<1	-		-	-
Zircon	-	<1		-	-

Alteration

Sericite	40	-		7	-
Chlorite	-	7	15	2	2
Tourmaline	-	-	-	<1	-
Carbonate	-	-	-	-	15
Kaolinite	-	-	-	-	5
Garnet	-	-	-	-	3
Tremolite	-	-	-	-	63
Zircon	-	-	-	-	<1

Texture: (a), (b), (c) and (d). These are all very similar regional metamorphosed schists.

(a) Coarser grained with great irregularities in grain size (0.08 to 1.6 x 1.8 mm) of quartz showing complex sutured boundaries between quartz and other quartz. Thin muscovite and biotite are strongly parallel oriented

and intergrown. Plagioclase laths, nodular and rectangular (0.2 x 0.16 mm etc) are altered to fine matted muscovite. Strongly sericitised.

(b) Finer grained, more equant quartz (~ 0.3 mm) with many mutual quartz boundaries within quartz lenticles. Includes thin (0.2 x 0.02 mm), muscovite showing preferred orientation, intergrown with similar textured biotite. Plagioclase occurs as sericitised rectangular structures (0.2 x 0.16 mm). Biotite is mostly altered to chlorite. One rock fracture contains chlorite. Strongly sericitised and chloritised.

(c) As for (b).

(d) Somewhere between (a), (b) and (c) shows an irregular quartz texture and grain size variation. Biotite (0.4 x 0.08 $\rightarrow$ 0.2 x 0.08 mm) is dark brown, shows parallel to subparallel orientation and is interstitial to quartz. Muscovite occurs as large (0.8 x 0.2 mm) prisms with a similar habit to biotite. Plagioclase (0.3 x 0.2 mm) occurs as aggregates of rectangular shapes.

Alteration: Sericitisation of plagioclase is weak. Biotite is weakly altered to chlorite along cleavages.

(e) Completely different from fragments (a) to (d) as tremolite blades (1.2 x 0.4, 0.8 x 0.4 mm, etc) which show terminal pointed pinacoids with laths varying parallel to subparallel oriented along a preferred schistosity direction with scattered subangular to subrounded quartz grains (0.08 to 0.6 x 0.4 mm) and carbonatised amphibole (0.5 x 0.2, 1.1 x 0.2 mm) spread throughout the section. Brown biotite laths (0.3 x 0.05 mm), also chloritised biotite laths (0.5 x 0.05 mm) are both parallel and oblique to cleavage. Pale, ovoid garnets are present.

Alteration: Metamorphosed calcareous sedimentary rock. Kaolinised feldspar(?).

Specimen No. DAP 4/1. MPS 5393. 6 fragments.

Field Note: Gneiss.

Petrographic Summary: Sheared granodiorite or tonalite, shows moderate tourmalinisation, chloritisation of biotite, and strong sericitisation of plagioclase after KF entry into a cross fracture. Chloritisation of biotite is strongest where sericitisation is also strong.

<u>Mineralogy</u> (vol.%):	(a) to (f)
Quartz	5
Plagioclase	varies 90 to 80
Biotite	5 to 15

<u>Alteration</u>	
Tourmaline	2 to 10
Sericite	5 to 20
Chlorite	5 to 15
Magnetite	- to 5

Vein: Potash feldspar.

Texture: Six sections of cuttings, contain slightly sheared quartz and plagioclase (0.1 to 1.6 x 0.6 mm). These are probably sheared, fine grained granodiorite or tonalite.

Minute prisms of brown biotite (0.1 x 0.8, 0.2 x 0.1 mm, etc) show variable replacement to chlorite along prismatic cleavages. Plagioclase shows variable replacement by fine tufted illite. Accompanying the illite is tourmaline as squat prisms (0.03 to 0.3 x 0.15 mm) and cross sections of the mineral. Tourmaline has formed along mineral interstices as have trails of magnetite (0.12 mm) in one section. Fresh K feldspar follows a fracture (0.08 mm), perpendicular to shear direction in three cuttings that are most sericitised. The KF vein has entered fractures in adjoining tourmaline.

Alteration:

- i) Deuteric sericite.
- ii) Tourmalinisation - moderate.
- iii) KF veins + abundant sericitisation + chlorite (after biotite) + a KF selvage.

Metamorphism: Strongly sheared prior to KF entry.

Specimen No. DAP 4/2. MPS 5394. 2 fragments.

Field Note: Amphibolite.

Petrographic Summary: Actinolite:plagioclase:quartz amphibolite. Finely sheared and with the presence of so much quartz the fragment could be an amphibolitised calc silicate sediment. Minor garnet only is noted. Upper Green Schist metamorphism.

<u>Mineralogy:</u>	<u>Vol.%</u>
Plagioclase	33
Actinolite	52
Quartz	8
Magnetite	5
Garnet	2

Alteration

Sericite	15

Texture: A strongly sheared quartz amphibolite. Plagioclase is biaxial negative (~ 70 degrees), could be oligoclase and shows partial to total alteration to sericite along cleavages, grains vary around 0.3×0.12 mm.

Bands from 0.2 to 1.2 mm depth contain an abundance of plagioclase and quartz with only minor amphibole.

Actinolite is present mostly as short grains tapered at both ends (mostly about 0.2×0.08 mm, but variable to 0.8×0.15 mm). Strongly layered and occurs as layers of alternate growths of actinolite of similar size to plagioclase and anhedral clear quartz (0.04 to 0.12×0.04 mm).

Fresh garnet, faintly pink and rounded (0.24 mm) is embedded in actinolite.

Rhombohedral forms of garnet (0.6×0.3 mm) are embedded in both

feldspar:quartz and the main actinolite in the feldspar bands. Magnetite is

elongate (0.12 x 0.04 mm) and rarely squat and commonly intergrown with actinolite.

Alteration: Plagioclase -> sericite - strong.

Metamorphism: Strongly sheared.

Specimen No.: DAP 4/3. MPS 5395. 4 fragments.

Field Note: Amphibolite with hematite alteration.

Petrographic Summary: An amphibolite of actinolite:plagioclase:quartz and iron oxides (after hornblende). Shows strong sericitisation of plagioclase and chloritisation of amphibole mineral in fragments containing iron oxides as hematite/limonite. Alteration is not from cross-cutting veins or along shear planes.

<u>Mineralogy</u>	<u>Vol.%</u>
Actinolite	45
Plagioclase	38
Quartz	5
Iron oxides	7
Garnet	5

Veins: (a) Quartz:feldspar, (b) Quartz:carbonate.

Alteration: Varies in drill fragments:-

Sericite	varies 5-30
Chlorite	4-15
Hematite	0-3

Texture: A strongly sheared amphibolite of actinolite (0.05 to 0.1 x 0.05 mm) with magnetite intergrowths that show close intergrowths with augen of quartz (0.1 x 0.06 mm) and similarly sheared, part-sericitised plagioclase. Along a shear plane was intruded a quartz (0.05 to 0.5 x 0.25 mm): plagioclase vein (0.8 mm wide) containing occasional trapped actinolite grains. A quartz:carbonate vein (b) of coarse grains and fan-shaped stressed quartz (0.5 x 0.3 mm) cuts across vein (a) in one fragment, but shows no alteration selvage. The other fragment shows extensive sericitisation and moderate chloritisation of actinolite (ex hornblende?) and also a part chloritised

garnet and hematite staining of feldspar (1 x 1 mm). Iron oxides after hornblende are present as hematite in places. It is assumed therefore that the alteration did not emanate from quartz:K feldspar veins.

Alteration: Minor sericite and chlorite varying to extensive sericite and chlorite in fragments containing garnets.

Metamorphism: Strong shear.

Specimen No.: LAP 2/1(A). MPS 5396. 3 fragments.

Field Note: Schists, gneiss, various.

Petrographic Summary: Fragments are of sheared, sericitised and chloritised fine grained granite; plagioclase:biotite:quartz gneiss, weakly chloritised; and a gneiss of quartz:plagioclase:biotite and muscovite. Sphene shows strong development along biotite cleavages where the latter is altered to chlorite.

<u>Mineralogy</u> (vol.%)	(a) 'Granite'	(b) Gneiss	(c)
Quartz	43	25	40
K feldspar	30	-	-
Plagioclase	20	40	30
Biotite	7	35	23
Muscovite	-	-	7
<u>Alteration</u>			
Sericite	4	-	30
Chlorite	4	3	10
Hematite dust	3	-	-
Carbonate	-	-	3
Sphene	-	-	3

(a) Texture: Granitic and of evenly distributed anhedral quartz (0.3 to 4 x 3 mm) with strong podia like overgrowths around quartz grain perimeters. Quartz is separated by similar size subhedral to anhedral weakly sericitised orthoclase and strongly sericitised plagioclase. A faintly brown, fine haze of hematite pervades the feldspars, which otherwise are altered to sericite. Ragged brown biotite (0.3 to 2.5 x 1.0 mm) occupies the interstices of feldspar and quartz and shows alteration to chlorite along cleavages and within peripheral areas of the biotite.

Alteration: Weak to strong sericitisation (+ brown hematite) of feldspars, and moderate to strong chloritisation of biotite.

Metamorphism: Moderate shear.

- (b) Texture: A gneiss of red-brown, weakly chloritised biotite (up to 4 x 0.5 mm) foliae are distributed throughout the section. Biotite is separated by shorter subrounded foliae of weakly twinned plagioclase (4 x 1 mm) and smaller clear quartz (to maximum 1.5 x 0.6 mm) often as composite quartz grains with mutual boundaries. Poikiloblastic rounded quartz and also biotite (0.2 to 0.4 mm) are embedded in plagioclase.

Alteration: Weak chloritisation of plagioclase only.

Metamorphism: Moderate shear.

- (c) Texture: A gneiss as for (b) and of similar texture though the mineralogy is different. Squat and lenticular quartz grains (variable 0.12 to 1.6 x 1.0 mm) that are ovoid but generally subhedral where in mosaics composite grains show mutual boundaries.

Between the quartz grains are totally sericitised (illite form) plagioclase laths (0.5 x 0.3 mm) in aggregates and also sheared bundles of biotite (1.2 x 0.6 to 0.4 x 0.3 mm) partly chloritised along biotite cleavages. Scattered throughout the biotite are fragmented lenticular particles ($\sim$ 0.03 x 0.008 mm) of sphene.

Muscovite as clear prisms (0.4 x 0.2 mm) and lenticles (0.8 x 0.2 mm) are interleaved with the biotite laths.

Alteration: Strongly sericitic and chloritic, with separation of sphene along biotite cleavages.

Metamorphism: Regional shear and recrystallisation of quartz.

Specimen No.: LAP 2/1(B). MPS 5397. 6 fragments.

Field Note: Schists, gneisses, various.

Petrographic Summary: Shows strong phyllic alteration of 'granite' with formation of minor carbonate; quartz K feldspar:biotite schist shows chlorite replacement of biotite interleaved with muscovite after feldspar with granophyric textures. Quartz:plagioclase:biotite schist, shows weak alteration of biotite to scaley illite.

<u>Mineralogy</u> (vol.%)	(a)	(b)	(c)
Quartz	40	50	40
Plagioclase	50	-	40
K feldspar	5	30	-
Biotite	5	20	20
Zircon	-	<1	-
<u>Alteration</u>			
Muscovite	7	10	-
Carbonate	5	-	-
Illite	48	-	3
Chlorite	-	10	-
Sphene	-	1	-

(a) Texture: A fine grained, sheared 'granite' (although only small parts of two fragments remain, after section preparation). Strained anhedral quartz mosaics (0.8 x 0.8, 2.4 x 2.4 mm) adjoin strongly sericitised masses of plagioclase, also in mosaics. Although indistinct parts of the 'sericitised' mass stained strongly potassic, the mineral is thought to be sericitised K feldspar; remaining unstained feldspar is plagioclase. Sheafs of yellowish muscovitised biotite (0.16 x 0.20 to 2.4 x 1.0 mm) occupy spaces between quartz and altered plagioclase.

Carbonate alteration of plagioclase emanated from fractures in the quartz and carbonate flanks muscovitised biotite.

Alteration: Plagioclase and K feldspar → sericite. Plagioclase → carbonate. Biotite → sericite.

Metamorphism: -

- (b) Texture: Quartz:KF:biotite schist. An irregular texture of anhedral potash feldspar (4 x 3.2 mm) shows fracture and replacement of the feldspar by muscovite and quartz. Adjoining the K feldspar is anhedral quartz (2.4 x 2+ mm) that shows a strongly sutured boundary with the K feldspar, a quartz:muscovite intergrowth occurs as runic quartz in muscovite (1.2 x 1.6 mm) and accompanies sheafs of pale chloritised biotite laths (0.2 x 0.12 to 1.6 x 0.16 mm). The chloritised biotite contains splintery sphene (to 0.06 x 0.007 mm) and fine acicular rutile. Specks of zircon present in biotite are surrounded by a faint brown radiogenic halo.

Alteration: To chlorite and muscovite.

- (c) Texture: A fresh, quartz:plagioclase:biotite schist. Quartz is anhedral (0.1 to 0.8 x 0.6 mm) and where grains adjoin they show weakly sutured grain boundaries and grains are associated with clear subhedral plagioclase blades (0.2 x 0.6, 0.8 x 0.8 mm, etc) of oligoclase composition showing weak albite twinning. Grains are brecciated, weakly sheared and recrystallised. Biotite has a preferred orientation and bladed (3.2 x 0.8, 3.2 x 0.4 mm etc.) shows a concentration of the mineral along subparallel planes with intermediate intergrowths of quartz and plagioclase (~ 2 mm depth).

In places biotite is altered to aggregates of scaley illite. Elsewhere where fresh, brown biotite is seen to contain fine slivers of sphene and scattered specks of radiogenic zircon (0.004 mm).

Alteration: Very weak. Biotite → illite.

Metamorphism: Moderate shear.

Specimen No.: LAP 8/1. MPS 5398. 3 similar fragments.

Field Note: Volcanic dyke.

Petrographic Summary: A porphyritic hypabyssal intrusive (andesite?) contains plagioclase phenocrysts altered to illite situated within a holocrystalline groundmass of fine plagioclase microlites argillised (to illite and kaolinite), traces of carbonate and a ferromagnesian mineral (hornblende?) is altered to leucoxene and kaolinite.

Mineralogy (vol.%):

	<u>Phenocrysts</u>	<u>Groundmass</u>
Plagioclase	10	60
Hornblende(?)	-	30

Alteration

Illite	20
Leucoxene	20
Rutile	1
Kaolinite	50
Carbonate	2

Texture: Euhedral phenocrysts of plagioclase or fragments vary 0.24 to 1.6 x 0.6 mm, are completely altered to muscovite/illite, blotchy with tiny areas of platy kaolinite. Groundmass shows a framework of randomly oriented fine plagioclase microlites altered to very fine kaolinite, a rhombic section (0.03 x 0.03 mm) of plagioclase altered to sericite, and interstitial biotite(?) prism structures altered to fine leucoxene and kaolinite.

Alteration: Strongly argillic.

Metamorphism: -

Specimen No.: LAP 8/2. MPS 5399. 3 fragments.

Field Note: Quartz:feldspar:biotite:gneiss. Three fragments.

Petrographic Summary: (a) Quartz:plagioclase:biotite gneiss that shows differentiation to more quartz and more biotite rich layers. Alteration is to illite, chlorite and muscovite. (b) Weakly sheared and brecciated granitic rock (granodiorite?) shows strong illite and chlorite alteration.

<u>Mineralogy:</u>	(a)		(b)
	(i)	(ii)	
Quartz	60	30	55
Plagioclase(?)	30	30	25
Biotite	10	40	-
Muscovite	-	-	17
Zircon	-	-	3

Alteration

Illite	30	30	25
Chlorite	9	32	9
Carbonate	-	-	3
Muscovite	1	8	5
Rutile	-	-	3
Sphene	-	-	4

(a) Texture: Shows a strong alignment of mica minerals. Adjoining foliae in two fragments are quite different. Uppermost(?) (i) 17 mm depth has a granitic appearance of anhedral quartz (0.1 to 0.8 mm), with grains subrounded and amoeboid, bound by both sutured and mutual grain boundaries. Between quartz grains are situated completely sericitised plagioclase as squat prisms (0.1 to 0.8 mm) and deformed flakes and sheafs of biotite (0.04 to 0.6 mm) altered to pale chlorite.

Below the upper zone (i) is a fine grained biotite-rich layer. Biotite (0.4 x 0.1 mm etc) is altered to chlorite and less commonly to interleaved muscovite. Also in the interstices is subhedral plagioclase (0.1 to 0.6 x 0.3 mm) altered to fine scale illite. Section shows a layered gneiss of differentiated minerals.

With the greater abundance of biotite in layer (ii) the chlorite is thus of greater volume and similarly muscovite formed from the biotite.

Alteration: Plagioclase → illite completely. Biotite → chlorite and muscovite.

Metamorphism: Strong regional, including shear.

- (b) Texture: Granite breccia, altered. The texture of this rock chip is very irregular with quartz varying up to 5 x 3 mm and within the largest grains are intimate granophyre intergrowths of quartz and muscovite (after feldspar). The remainder of the section includes evenly distributed quartz (0.05 to 0.1 mm) of irregular grain size. Muscovite as elongate laths (6 x 0.3 mm) are sandwiched into a recrystallised quartz crush zone. Biotite showing muscovite intergrowths is interleaved between quartz and illite replaced plagioclase shapes (1.2 x 0.8 mm) including crushed plagioclase lenticles that are now illite.

There is preferred orientation of minerals only locally and the rock is a brecciated and partly sheared medium granite or biotite granodiorite. Irregularity of quartz shapes interfere with the preferred orientation of biotite.

Biotite contains abundant, including large (to 0.08 mm) zircons with surrounding broad brown radiogenic halo zones and trails of fine particles of sphene along cleavages, also fine acicular cross patterns of rutile in some laths.

Alteration: Plagioclase $\rightarrow$ illite/muscovite. Biotite $\rightarrow$ chlorite +
rutile + sphene $\rightarrow$ muscovite.

Specimen No.: LAP 8/3. MPS 5400. 5 fragments.

Field Note: Amphibolite.

Petrographic Summary:

Drill fragments include:-

- (a) Finely sheared actinolite:plagioclase quartz intergrowths, a moderately sericitised plagioclase.
- (b) Foliated actinolite:biotite:quartz:plagioclase rock that shows biotite alteration to chlorite and moderate alteration of plagioclase to sericite.
- (c) Coarse foliae of actinolite:quartz:plagioclase growths which include post-shear biotite porphyroblasts. Plagioclase is strongly sericitised.

<u>Mineralogy:</u>	(a)	(b)&(c)	(d)&(e)
Actinolite	60	58	45
Plagioclase	30	12	22
Biotite	-	15	4
Quartz	10	15	26
Zircon	<1	-	-
Magnetite	-	-	3

Alteration

Sericite	7	4	22
Chlorite	-	9	3
Sphene	3	<1	-

- (a) Texture: Fine grained, finely sheared actinolite (greenish with a faintly brown tinge, range 0.05 x 0.02 to 0.8 x 0.05 mm, exceptionally to 0.24 mm wide). Actinolite laths alternate with parallel oriented quartz as squat lamellae (to 0.24 x 0.1 mm maximum size) along shear direction, including augen shapes and partly sericitised plagioclase of similar size and shape, and quartz associated with actinolite where

uncrushed. If crushed, part sericitised plagioclase forms a matrix to the more competent actinolite and quartz.

Alteration: Moderate sericitisation of plagioclase.

Metamorphism: Strong shear with brecciation of feldspar.

(b) & (c)

Texture: Coarser grained and more differentiated into mineral bands than for (a), includes elongate biotite (to 1.6 x 0.4 mm) in sheafs oriented parallel to shear. Bands of plagioclase, quartz with minor actinolite (~0.4 mm wide) are separated by thicker bands of actinolite and biotite.

Much of the biotite is bleached to muscovite but some remains brown and highly birefringent. Biotite is sheared between layers of actinolite. Fine zircon (or radiogenic sphene?) with brown radiogenic haloes occur in both actinolite and biotite.

Plagioclase augen forms (0.4 x 0.1 mm), are partly altered to scattered sericite flakes. Plagioclase poikiloblasts occur in some actinolite laths. Less quartz (0.05 to 0.16 mm) forms subangular grains occasionally cemented to parallel growths of fine actinolite.

Alteration: Biotite -> muscovite - mostly. Plagioclase -> sericite - weakly to moderately strong.

Metamorphism: Strong shear.

(d) & (e)

Texture: Lenticular fragments of coarse, weakly sheared actinolite (size range, 0.16 x 0.05 to 0.64 x 0.16 mm) are foliated and include lobate and subangular quartz (vary, 0.1 to 0.4 x 0.2 mm), and plagioclase (vary, 0.1 x 0.05 to 0.6 x 0.2 mm) is strongly sericitised.

Some segregation banding of plagioclase (altered to sericite) and quartz as 0.6 mm bands alternate with a similar width of mosaics of actinolite intergrowths.

Fine poikiloblasts of quartz and plagioclase are embedded in actinolite. Magnetite as sheared elongate opaque grains (0.3 x 0.08 mm) are intergrown with quartz along foliae.

One difference of (d) and (e) from (b) and (c) is the appearance of porphyroblastic biotite (0.6 x 0.3, 1 x 0.6 mm) that strikes across the foliation, and is poikiloblastic with quartz and small actinolite laths.

Alteration: Plagioclase -> sericite - strong. Biotite -> chlorite - strong.

Metamorphism: Moderate shear -> contact.

Specimen No.: MAP 1/1. MPS 5401. 10 fragments.

Field Note: Altered schist.

Petrographic Summary: Actinolite:plagioclase and actinolite:plagioclase: quartz, schist fragments. Plagioclase was moderately altered to sericite during shear. With introduction of coarse pyrite the lenticles were ruptured and pyrite present was surrounded by a zone of fine chalcedonic chert. Plagioclase within the selvage is altered to fine brownish sericite aggregates. A decussate plagioclase:actinolite intergrowth suggests some regional contact metamorphic activity.

<u>Mineralogy</u> (vol.%):	(a)	(b) -> (j)
Actinolite	90	65
Plagioclase	10	15
Biotite	-	10
Zircon (metamict?)	<1	-
Quartz	-	10
<u>Alteration</u>		
Sericite	2	15
Magnetite	2	-
Sphene	-	5
Chalcedony	-	30

(a) is more fresh than fragments (b) to (j).

Texture:

(a) Fresh tabular actinolite (0.2 x 1.0 mm to 5.2 x 0.5 mm), pale green with abundant tiny brown haloes surrounding minute metamict zircon (maybe sphene?) grains. Along foliae and sandwiched between larger actinolite laths are small subhedral plagioclase laths (0.08 up to 0.16 x 0.4 mm), weakly sericitised. Anhedral magnetite present is lenticular, embayed

and subhedral, varies 0.04 to 0.2 x 0.08 mm, embedded in actinolite and is probably a secondary decomposition product after hornblende.

(b) to (j)

A tabular arrangement of approximately parallel actinolite laths (0.12 x 0.3 to 2 x 0.6 mm) that include evenly distributed very fine specks of magnetite, and aggregates of fine magnetite are distributed as lenticles between actinolite.

Porphyroblasts of brown biotite (0.5 x 0.4, 0.6 x 0.5 mm), cut across the foliation and have partly entrapped lenticles of actinolite and quartz. Biotite shows alteration to chlorite and contains exsolved fine iron oxides along cleavages.

Quartz, as lobate shaped grains (0.12 to 0.3 x 0.2 mm) is scattered irregularly through the section among other minerals. Muscovitised plagioclase laths are barely recognisable as pale brownish green laths (up to 0.5 x 0.4 mm) that contain uniformly distributed specks of iron oxides are situated between green actinolite.

The actinolite observed by crossed polars is strongly fibrous and occurs as fine parallel aggregates.

Trending with the foliation is a vein (0.15 mm) of cloudy carbonate that shows fragmentation with strong displacement and microfaulting (weak crenulation?).

Alteration: Strong sericitisation of plagioclase.

Metamorphism: Strong shear and some cross microfaulting of a plagioclase vein.

Other drill fragments contain introduced coarse pyrite (to 1.8 x 1.2 mm) embedded in fine chalcedonic silica. Plagioclase in one zone is altered to

dense fine brownish illite. The introduction of pyrite:chalcedony is post-shear and the minerals disturbed the main foliation.

One fragment consists of decussate laths of pale actinolite (vary 0.6 x 0.4 to 1 x 0.6 mm) shows fine magnetite exsolution and brownish sericite aggregates of similar size to actinolite.

Specimen No.: MAP 1/2. MPS 5402. 24 fragments.

Field Note: Pyritic quartzite.

Petrographic Summary:

- (a) Fragments of quartz wacke with fine sand size alluvial quartz are situated in a matrix of illite and muscovite, intruded by pyrite and pyrite:quartz vein. Since brecciated and sheared.
- (b) Fragments of illite-replaced feldspar as deformed feldspar shapes, also quartz in a flow banded matrix of illite and fine chert, contains pyrite in pools of chert, and pyrite encapsulated by fibrous chalcedony. An acid volcanic strongly silicified and sericitised.
- (c) Pyrite porphyroblasts in quartz wacke.

<u>Mineralogy</u> (vol.%):	(a)	(b)	(c)
Quartz	5-70	0-2	40
Illite	30	15	30
Muscovite	2-15	-	-
Chert	-	83	-
Pyrite	5-30	2-5	-
Limonite	1	-	15*
Kaolinite	-	-	15
Leucoxene	5	-	-
Apatite	-	1	-

* Altered pyrite.

Quartz:pyrite vein.

- (a) Texture: A quartz wacke of weakly banded subangular quartz clasts (0.08 to 0.8 x 0.2, 0.4 x 0.4 mm, median 0.2 x 0.16 mm); some quartz grains are quite splintery. Quartz rests in a matrix of scaley illite containing occasional flakes or aggregates of muscovite with trails and

rhomb-shaped aggregates of limonite after pyrite (or hematite?) and truncated quartz laminae (1.2 x 0.08 mm, etc), with or without pyrite, altered to limonite.

Some fragments contain more muscovite and show greater quartz shear; sheared pyrite lenticles (0.5 x 0.05 mm) are embedded in muscovite.

- (b) Other drill fragments contain pyrite (~ 1 mm) as intergrowths of pyritohedra surrounded by an even periphery (0.08 mm depth) of cross fibre chalcedony, also cherty masses as lenticles and masses to 0.8 x 0.8 mm. The chert is divided by networks of iron oxide stained, scaley illite with few separated subrounded and subangular quartz (0.15 to 0.2 mm) and fragments of quartz vein attached to pyrite. Apatite as even prisms (0.5 x 0.015 mm) and hexagonal cross sections (0.015 mm) are partly replaced by pyrite. In plain light, the above section appears to be a flow banded volcanic. Iron oxide stained illite clusters are rectangular, 0.24 x 0.20, 0.06 x 0.06 mm (after feldspar).

Alteration: Sericitisation of feldspar. Quartz:pyrite vein, pyrite replacement of apatite. Cherty silicification of vitric groundmass.

Metamorphism: Shear.

- (c) Texture: One fragment contains a rectangular shape (2.8 x 1.8 mm) of limonite which is well studded with alluvial quartz of subangular and subrounded shapes (0.043 to 0.5 x 0.5 mm) and attached to a matrix of similar, abundant detrital quartz containing illite and kaolinite, with a limonite stained matrix. A possible large pyrite porphyroblast lies embedded in quartz wacke, since weathered.

Specimen No.: MAP 3/2. MPS 5403. 9 fragments.

Field Note: Hematite alteration. Chlorite schist without (a), with (b) KF.

Petrographic Summary:

- (a) Chlorite:quartz:plagioclase schist with minor to strong iron oxide separation in chlorite, also subhedral hematite grains show mutual intergrowths with quartz.
- (b) Chlorite:orthoclase:quartz :muscovite schist. Biotite shows alteration to chlorite and iron oxides with alternate '(a)' morphologically different chlorite, quartz and subhedral hematite.
- (c) Colloform hematite fills in between coarse sand size quartz.

<u>Mineralogy</u> (vol.%):	*(a)	*(b)	*(c)
Chlorite	50	50	-
Quartz	20	15	40
K feldspar	-	5-20	-
Hematite	15	5-10	60
Marcasite	-	2	-
Muscovite	-	10-15	-
Plagioclase	15	-	-

* (a) 5 fragments; (b) 11 fragments; (c) 1 fragment.

(a) and (b) are very similar, as quartz:chlorite schist, with K feldspar (b) or without KF (a). Hematite is most abundant as a colloform cement between quartz (~ 1 mm) in (c). Shear structures vary with the abundance of micaceous minerals.

- (a) Texture: A moderately sheared quartz:chlorite schist of subangular quartz mineral grains (0.08 to 0.8 mm, mostly around 0.15 mm) cemented by abundant laths (0.15 to 0.6 mm) of chloritised biotite; with partly sheared and partly decussate plagioclase as squat grains (to 0.2 x 0.08

mm) that are intergrown with quartz and chlorite but only lightly dusted by fine sericite. Iron oxides commonly show a rhombohedral structure, vary 0.04 to 0.3 x 0.15 mm as aggregates joined with chloritised biotite ($\pm$ muscovite) and occur as segregations of migratory limonite to one edge of the slide.

Alteration: Iron-rich biotite $\rightarrow$ chlorite + iron oxides recrystallised to hematite + muscovite.

Metamorphism: Weak shear.

- (b) Texture: Sheared, iron oxide dusted orthoclase laths (0.4 x 0.08 mm, 0.5 x 0.24 mm) remain fresh and are intergrown with or occur as alternate parallel growths with quartz. The quartz grains are subangular and strongly embayed, also sharply angular and have a size variation of 0.05 to 0.5 x 0.24 mm. In places the larger quartz grains are fractured and fractures are filled with K feldspar ($\sim$ 0.1 x 0.02 mm) which also filled fractures within chlorite. Chlorite (0.03 to 0.3 x 0.24 mm) fills most other spaces, is irregularly platy and locally fibrous in appearance; similarly, chloritised and muscovitised biotite occur as alternate "lenticles" (0.3 to 1.0 mm wide).

Where biotite is present as abundant broad aggregates there are laminal segregations of iron oxide (to 1.1 x 0.06 mm wide) separated along biotite cleavages in direction of shear. One grain of fractured marcasite present is associated with orthoclase.

Other iron oxides, mainly magnetite occur as subhedral squat prisms or rhombs (0.16, 0.24, 0.2 x 0.05 mm, etc).

Alteration: Very strong chloritisation of biotite, and fibrous iron-rich chlorite that shows the relatively high birefringence of illite; also alteration to iron oxides with or without muscovite.

Strong chloritisation between biotite foliae with quartz indicates a different chlorite showing blue-grey anomalous birefringence.

Metamorphism: Moderate to strong shear.

- (c) Texture: Hematite occurs as colloform structures between coarse and medium size sedimentary quartz.

Iron oxides are decomposition products of biotite but also occur after rhomb-shaped hematite grains associated with similar size quartz grains and platy chlorite.

Specimen No.: MAP 4/1. MPS 5404. 2 similar fragments.

Field Note: Schist.

Petrographic Summary: Finely sheared chlorite:quartz schist contains scattered bundles of leucoxene with chlorite, and brownish muscovite with chlorite. Veins of quartz with hematite, occasionally run with and also cross the foliation. Biotite (now chlorite) porphyroblasts cut across the foliation indicating a late contact metamorphism that followed shear.

<u>Mineralogy:</u>	<u>Vol. %</u>
Quartz	17
Chlorite	71
Leucoxene	7
Muscovite	5

Vein: Quartz:hematite.

Texture: A finely sheared rock of chlorite and intermixed fine muscovite with alternate en-echelon disposed quartz (0.05 to 0.32 x 0.15 mm) sharply angular but mostly subangular, approaching subrounded shapes. Where in single lenticles of one grain width, 0.25 mm wide and to 3 mm length, grains are present as mutual composites. Several chloritised biotite porphyroblasts (~ 0.8 x 0.6 mm) lie at 30 to 90 degrees to foliation.

Abundant fine lenticles and granules of leucoxene (limonite stained, to maximum 0.24 x 0.08 mm) are intergrown with chlorite and indicate the decomposition of hornblende and/or biotite. Light-brown stained muscovite flakes occur as bundles with chlorite (after biotite?). Quartz veins (0.4 to 0.6 mm wide) follow the foliation and in places quartz is intergrown with rhombs of hematite (to maximum 0.1 x 0.06 mm); hematite grains are commonly aggregates with quartz as mutual composites.

Alteration: Biotite -> chlorite + leucoxene ± muscovite.

Metamorphism: Shear -> contact (cross-cutting biotite, now chlorite altered porphyroblasts).

Specimen No.: MAP 4/3. MPS 5405. 3 similar fragments.

Field Note:

Petrographic Summary: Coarse stumpy and strongly cleaved, hornblende altered to chlorite shows low birefringence and contains relict biotite along prismatic cleavages. Breccia of muscovite, chlorite and biotite occupies spaces between coarse chlorite pseudomorphed prisms. Shows brecciation, shear and recrystallisation.

Mineralogy:

	<u>Vol.%</u>
Hornblende (now chlorite)	varies 85 to 67
Biotite	2 to 20
Muscovite	5
Quartz	5
Sphene	3

Texture: Bladed hornblende, now altered to chlorite is arranged as parallel prismatic growths; prisms vary 0.3 x 0.1 mm to 3 x 0.6 mm, are inelastic and fractured in places. There are several interpenetrant and decussate intergrowths. The mineral is pale green with faint pleochroism and slightly anomalous (blue) interference. Locally relict brown biotite as coloured parallel growths (0.3 x 0.05 mm) show blue:yellow:green interference colours. Biotite prisms are flexible.

Between the parallel and decussate intergrowths of chlorite replacement are pockets of faintly brownish, otherwise bleached grains as fine fibrous bundles of altered biotite. Also, scattered throughout the chlorite are short lozenge or prismatic sphene (0.001 to 0.05 x 0.02 mm) as recrystallised leucoxene. Quartz veins present as recrystallised breccia (0.015 to 0.3 x 0.2 mm) are subparallel, varying to parallel and are oriented in a weak shear direction.

Specimen No.: MAP 4/3. MPS 5405. 3 similar fragments.

Field Note:

Petrographic Summary: Coarse stumpy and strongly cleaved, hornblende altered to chlorite shows low birefringence and contains relict biotite along prismatic cleavages. Breccia of muscovite, chlorite and biotite occupies spaces between coarse chlorite pseudomorphed prisms. Shows brecciation, shear and recrystallisation.

Mineralogy:

Vol.%

Hornblende (now chlorite)	varies 85 to 67
Biotite	2 to 20
Muscovite	5
Quartz	5
Sphene	3

Texture: Bladed hornblende, now altered to chlorite is arranged as parallel prismatic growths; prisms vary 0.3 x 0.1 mm to 3 x 0.6 mm, are inelastic and fractured in places. There are several interpenetrant and decussate intergrowths. The mineral is pale green with faint pleochroism and slightly anomalous (blue) interference. Locally relict brown biotite as coloured parallel growths (0.3 x 0.05 mm) show blue:yellow:green interference colours. Biotite prisms are flexible.

Between the parallel and decussate intergrowths of chlorite replacement are pockets of faintly brownish, otherwise bleached grains as fine fibrous bundles of altered biotite. Also, scattered throughout the chlorite are short lozenge or prismatic sphene (0.001 to 0.05 x 0.02 mm) as recrystallised leucoxene. Quartz veins present as recrystallised breccia (0.015 to 0.3 x 0.2 mm) are subparallel, varying to parallel and are oriented in a weak shear direction.

In one fragment, the minerals are more strongly sheared and show more residual biotite growths along cleavages of the coarse bladed chlorite. Rare amphibole-styled cleavage sections (60 x 30 degrees), dark in hexagonal section, and are almost isotropic.

Alteration: Biotite -> (chloritised) chlorite + sphene.

Metamorphism: Brecciation and shear; brecciation of quartz vein.

Specimen No.: MAP 5/1. MPS 5406. 8 fragments.

Field Note: Hematite alteration.

Petrographic Summary: Hornblende:biotite:quartz:K feldspar gneiss or quartz:biotite amphibole, evenly banded. Hornblende and biotite altered to chlorite, biotite also contains exsolved sphene. Hematite penetrated biotite along foliation and in places the development of hematite rhomb forms occurred.

<u>Mineralogy</u> (vol.%):	(a)	(b)	(c)
Quartz	15	5	3
K feldspar	-	-	5
Hornblende	60	74	75
Biotite	10	20	15
Muscovite	7	1	-
Chlorite	70	89	90
Hematite	15	10	-
Muscovite	7	1	15
Carbonate	-	-	20
Sphene	-	-	3

(a) Texture: Aggregates of partly aligned but mainly random intergrowths of hornblende (to 0.8 x 0.4 mm), cross sections (0.6 x 0.5 mm) are now altered to a pale green chlorite but are often replaced by dense hematite. Studding the hornblende are subhedral and embayed quartz (0.08 to 0.2 x 0.15 mm) that include intergrowths of euhedral prism:pyramid crystal forms.

Completely aligned and bent biotite shows some pale pleochroic yellow-brown to colourless biotite (0.6 x 0.13, 0.3 x 0.06 mm) which contain parallel replacement chlorite and cleavages are penetrated by hematite. Otherwise biotite is replaced only by pale chlorite or muscovite.

Alteration:

Hornblende -> chlorite + hematite.

Biotite -> chlorite $\pm$ muscovite $\pm$ hematite.

Metamorphism: Moderate shear.

(b) Similar to (a) but with less quartz, and more biotite as parallel growths with hornblende which is sheared in this specimen.

(c) Texture: Hematite absent, section shows foliated ragged biotite flakes (0.6 x 0.6 mm) and biotite altered to a low birefringent pale green fibrous chlorite. Scattered through the section and occupying chlorite replaced biotite are wedge shaped stained sphene lozenge shapes, slightly opaque with iron oxide. Alternate foliae include 0.6 x 0.32 mm subhedral hornblende and disseminated carbonate replaced feldspars (0.3 x 0.15, 0.2 x 0.15 mm) as subhedral prismatic shapes. Where clear of carbonate replacement, colourless grains are strongly strained lenticles but include rectangular quartz shapes.

In parts of the section quartz and hornblende form parallel foliae (0.16 to 0.20 mm wide).

Alteration:

Feldspar -> carbonate.

Hornblende, biotite -> chlorite.

Biotite -> sphene + chlorite.

Metamorphism: Strongly foliated.

Specimen No.: MAP 5/2. MPS 5407. 8 fragments.

Field Note: Chloritic alteration.

Petrographic Summary:

- (a) Eutectic of quartz with biotite and biotite alone after strong shear metamorphism and recrystallisation.
- (b) Quartz:actinolite:biotite schist - strongly chloritised.
- (c) Actinolite:quartz:biotite schist, strongly sheared to give quartz curious lenticular deformation intergrowths with biotite and chlorite.

<u>Mineralogy</u> (vol.%):	*(a)	*(b)	*(c)
Actinolite	60	25	65
Quartz	10	70	20
Biotite	15	5	15

Vein: Chlorite

Alteration

Chlorite	60	30	15
Sericite	25	-	-
Magnetite	-	5	-
Sphene	5	-	-

* (a) Schist; (b) Eutectic?; (c) Schist.

- (a) Texture: A schist of strongly sheared actinolite altered to pale chlorite showing anomalous interference. A basal 'actinolite' section shows the characteristic 60/30 degree cleavage.

Intergrown with the chloritised amphibole is a pale brownish green biotite as lenticular forms (0.24 mm wide) occurring almost continuously along intermittent foliae, and along prism cleavages of very pale biotite are precipitated tiny lozenge shaped and short lenticles of

sphene. Often sphene grains (0.015 x 0.04 mm, 0.05 x 0.03 mm etc) are present as clusters on the site of muscovitised biotite. Blebs of secondary quartz (0.08, 0.15 x 0.07 mm, etc) occupy sites of pale chloritised actinolite. On opposite side of fragment bands of muscovite tufts (0.05, 0.08 mm) alternate with pale chlorite and brown muscovite as altered biotite.

Alteration:

Actinolite -> chlorite + quartz.

Biotite -> muscovite + chlorite + sphene.

- (b) Texture: A curious quartz:muscovite:hornblende:biotite (now chlorite) intergrowth as granophyre.

Quartz occurs as granophyric forms of lobate and embayed grains singly or in lenticles (0.015 to 1.6 x 0.5 mm) subparallel and arranged en-echelon. Between the quartz are aggregates of limonite stained muscovite alternating with thin biotite (0.4 x 0.05 mm) following the quartz orientation and grossly chloritised actinolite as coarser grained laths and rhombohedral cross section with typical ~ 60/30 degree cleavage but altered to chlorite and scattered magnetite grains (0.05 to 0.08 mm) and thin lenticles of magnetite. Section is cut across by a chlorite vein (0.15 to 0.30 mm) that dilates and laterally dispersed the chlorite.

Alteration:

Biotite -> chlorite.

Actinolite -> chlorite.

- (c) Texture: Banded schist with apple-green chlorite (0.6 to 0.8 mm) of replaced biotite or actinolite (no cleavage structures), contain embedded, embayed subrounded quartz (0.08 to 0.3 x 0.15 mm) as loose lenticular or single grains. The latter alternate with bismark brown coloured ragged biotite as curious thin lenticular intergrowths with

quartz augen (0.3 x 0.1 mm). Quartz with biotite and chlorite is strongly dislocated and stressed.

Alteration:

Actinolite -> chlorite.

Biotite -> partly chloritised.

Metamorphism: Strong shear.

All other fragments are variations of (a), (b) and (c).

Specimen No.: MAP 9/1. MPS 5408. 4 similar fragments.

Field Note: Pyritic quartz, etc.

Petrographic Summary: Greisen type section of quartz:illite:muscovite, with traces of anatase and sphene, and less tourmaline. Moderate shear of muscovite, then to illite (retrograde alteration). A weak foliation formed. Pyrite with quartz is brecciated, and is encapsulated by thin spicular chalcedony embedded in dense illite (after altered retrograded feldspar).

<u>Mineralogy:</u>	<u>Vol.%</u>
Quartz	varies 60 to 70
Muscovite	2 to 10
Illite	34 to 20
Pyrite	2 to 0
Anatase	2
Sphene	1
Tourmaline	<1

Vein: Pyrite > quartz.

Texture: Somewhat similar as quartz:illite:muscovite rock of partly formed foliae (0.6 to 0.8 mm) of quartz showing strain patterns. These alternate with very fine illite and muscovite laths (0.4 x 0.12 mm). The muscovite which often forms as cement particles between quartz grains is approximately oriented (to 30 degrees) to the foliation and which similarly applies for the quartz. Quartz to quartz cementation is often a narrow zone of brecciation, although mutual to weakly sutured grain boundaries also are present. The micaceous mineral between quartz is low birefringent illite spottily developing into fine higher birefringent tufts of muscovite. There are networks of illite and fine muscovite between quartz, vary 0.03 to 0.3 x 0.4 mm. Pyrite varies 0.08 to 2 x 0.4 mm is brecciated and grains have a

periphery (0.08 mm depth) of transverse chalcedony fibres and sulphide is embedded in illite. Pyrite forms a vein breccia with minimal mutual quartz.

Very fine 'cube-like' brownish anatase (0.01×0.05 , 0.1×0.02 mm etc) and some interpenetrant twins of the mineral occupy quartz overgrowths and illite interstices.

Alteration: Biotite (?) $\rightarrow$ muscovite + anatase.

Metamorphism: Contact $\rightarrow$ moderate shear.

Specimen No.: MAP 9/3. MPS 5409. 4 similar fragments.

Field Note: Quartz:biotite:feldspar gneiss.

Petrographic Summary: Granodiorite, weakly foliated. Shows K feldspar and deuteric alteration of plagioclase and biotite to sericite. Muscovitisation of biotite occurs along grain boundaries. Biotite is highly radiogenic and contains an abundance of metamict zircon with alteration halos, and some sphene.

<u>Mineralogy:</u>	<u>Vol.%</u>
Biotite	17
Plagioclase (oligoclase)	58
Quartz	25
Zircon	<1
<u>Alteration</u>	
K feldspar	5
Muscovite	2
Sericite	3
Sphene	<1

Texture: Mildly sheared, granitic, with subhedral faintly albite twinned oligoclase (1.5 x 1.5 to 6.0 x 2.5 mm), anhedral quartz (0.2 to 7 x 3.5 mm) and biotite - pleochroic pale red-brown to very pale yellow subhedral laths (0.3 x 0.5 to 3 x 1 mm) often clustered and elongate or present as subparallel intergrowths of laths (15 x 6 mm). The biotite contains an abundance of fine (~ 0.01 mm) metamict zircon grains surrounded by dark brown radiogenic halos. The biotite may extend to a diameter of 0.2 mm of black-brown altered mineral that shows intimate intergrowths with other minerals, also there are mutual quartz composites with plagioclase. The mineral intergrowths are random. Biotite is poikiloblastic to quartz and plagioclase; plagioclase is poikiloblastic to quartz.

In the stained section, fine specks of K feldspar riddle plagioclase and under high power magnification, thin veins (0.05 mm wide but irregular) form discontinuous networks of fractures through the plagioclase laths. These are of dark birefringent K feldspar. The fractures also contain fine specks and laths of sericite. K feldspar is seen to penetrate biotite cleavages from plagioclase:biotite grain boundaries.

Alteration: Deuteric with plagioclase to K feldspar and sericite along fine irregular fractures; K feldspar penetrated biotite along cleavages.

Metamorphism: Mild brecciation and healing preceded deuteric alteration.

309400E/8641700N

Chris's Anomaly

Specimen No.: -/MPS 5410 (for XRD of brown mineral).

Field Note: Monazite?

Petrographic Summary: Squat prisms of yellow-orange translucent ilmenorutile showing approximate prism cleavages and twin banding, occurs in fissures with vermiculite and kaolinite, or where smaller grains occur, these are embedded in quartz silicification. Ilmenorutile was confirmed by XRD.

<u>Mineralogy</u>	<u>Vol. %</u>
Quartz	91
Kaolinite	2
Vermiculite	3
Ilmenorutile	2
Hematite	1
Limonite	<1
Rutile	1

Texture: That of a silicified bimodal and bedded sandstone or quartzite. Beds are of coarse to very coarse sand and fine to medium quartz clasts as (a) 0.1 to 0.7 mm that forms an abundant groundmass to (b) subrounded and subangular quartz clasts 10 to 25 x 15 mm. Most quartz clasts show a more subrounded shape with irregular overgrowths of the mineral which filled most pores. Where unsilicified pores occur they are filled with brown fibrous vermiculite aggregates or with fine sheafs of low birefringent clay (kaolinite?).

The ilmenorutile varies as yellow subrounded grains (0.28 to 0.32 mm) with high relief, embedded in quartz overgrowths; also present as squat prisms aggregated along one side of the section (0.4 x 0.4, 0.6 x 0.2 mm, etc) showing a prismatic cleavage, yellow-brown colour and cross twin banding and

embedded in a large pore containing kaolinite and vermiculite. A bright-red hematite as fine slivers (0.1×0.004 mm and smaller) is embedded in quartz.

Alteration: Very strong authigenic silicification.

Specimen No. QML 1/MPS 5411

~~Ranger Deposit~~
Nabarlek Granite ~~Gabbro Formation~~
323500E/8640500N

Field Note: -

Petrographic Summary: Granite porphyry or microgranite. Regionally metamorphosed, silicified and argillised, with altered groundmass mineralogy.

<u>Mineralogy:</u>	<u>Vol. %</u>
Quartz	75
Muscovite	3
Sericite	3
Kaolinite	15
Hematite	2
Magnetite	2

Texture: An argillised, silicified and regionally metamorphosed granitic porphyry containing medium sized quartz (0.1 to 0.5 mm) often as aggregates in a groundmass of fine platy kaolinite, separated by thin sericite flakes. Quartz phenocrysts (1 to 5 x 4 mm) are brecciated and recrystallised to mosaics of crystals (0.5 to 1.2 mm) showing mutual to weakly sutured grain boundaries. Quartz phenocrysts tend to be glomeroporphyritic.

One large feldspar phenocryst (5 x 5+ mm), is rectangular and is replaced by aggregates of fine platy kaolinite patchily sericitised with muscovite.

Muscovite in section commonly shows iron oxide exsolution along cleavages and may be altered biotite.

Alteration: Argillic/silicification - retrograde.

Metamorphism: -

Specimen No. QML 2/MPS 5412.

323500E/8640500N

Field Note: -

Petrographic Summary: A medium grained granitic rock, completely argillised to mixed illite and kaolinite with iron oxides. Quartz remains unaltered. Shows the presence of minor alunite. Retrograde alteration, could be hydrothermal rather than retrograde metamorphism.

<u>Mineralogy:</u>	<u>Vol. %</u>
Quartz	36
Muscovite	1
Illite	40
Kaolinite	15
Alunite	2
Magnetite	1
Limonite	5

Texture: Granitic, as random quartz (0.3 to 2.5 x 1.5 mm) in mosaics to 20 x 8 mm as grains with mutual boundaries, also simple mosaics of two quartz grains and single quartz (1.2 mm) with perfect crystal forms in a matrix of mixed illite and fine kaolinite clay in masses to maximum 10 x 9 mm of altered feldspars. Iron oxides, dense with mixed clays may indicate the earlier presence of prisms of biotite (2.5 x 1.0, 1.5 x 1.0 mm, etc). This would give an original composition of 7% biotite.

Muscovite ($\sim$ 0.7 x 0.4 mm) has replaced mixed clays, and has formed in a mixed clay mass.

In places within the clays are prisms (0.15 x 0.04, 0.12 x 0.5 mm) with a birefringence similar to muscovite but with strong positive elongation, high relief and uniaxial positive figures, and are assumed to be alunite. Groups of magnetite crystals are associated with limonite.

Alteration: Feldspars -> illite = kaolinite -> muscovite; biotite -> mixed clays + limonite.

Metamorphism: Moderate shear.

Specimen No.: QML 3/MPS 5413 (3 fragments - similar).

Field Note: -

323500E / 864050 N

Petrographic Summary: Adamellite, fine grained. Brecciation is shown by the quartz component. Feldspars are argillised and biotite muscovitised with exsolved iron oxides. Alunite crystals as clusters have formed in muscovite and are attached to quartz.

<u>Mineralogy</u>	<u>Vol.%</u>
Quartz	37
Muscovite	4
Illite	28
Kaolinite	24
Alunite	2
Magnetite	2
Limonite	3

Texture: Similar to QML 2 but finer grained. Consists of loose networks of loose quartz grains (0.2 to 1.0 mm) and mosaics of similar grains (to maximum size 1.5 mm). Between the quartz mosaics are argillised grains (1 x 1.5, 0.4 x 0.4 mm etc) of distinctive rectangular shape, that are most likely feldspars. The latter consist mostly of fine illite and minor kaolinite and are thought to be altered plagioclase; those pseudomorphs of fine matted kaolinite are probably altered orthoclase. Therefore the rock was probably an adamellite.

As for QML2, biotite forms are noted ($\sim 0.6 \times 0.4$, 0.6×0.6 mm) and contain illite or fibrous muscovite with limonite secreted along prismatic cleavages. Aggregates (0.8×0.8 , 1.8×1.6 mm) of magnetite (0.1 mm) are associated with muscovite and illite. Alunite as short prisms (0.2×0.1 mm) and aggregated fragments are embedded in clays or are attached to quartz.

Alteration: Plagioclase -> illite > kaolinite; orthoclase -> kaolinite;
biotite -> muscovite + alunite + iron oxides

Metamorphism: Quartz brecciation.

Specimen No.: 40393/MPS 5414.

Cahill Formation
Ranger Mine Site

Field Note: -

Petrographic Summary: A schist of chlorite:pyrite and quartz:pyrite lenticles, are cut across by epigenetic quartz with coarse pyrite (mobilised syngenetic pyrite?), followed by carbonate veins. Syngenetic (?) pyrite is associated with minor graphite.

<u>Mineralogy:</u>	<u>Vol.%</u>
Quartz	26
Chlorite	57
Muscovite	3
Carbonate	5
Graphite	2
Pyrite	7

Veins: Quartz:pyrite, carbonate.

Texture: A mainly chlorite:quartz:pyrite schist with minor kaolinite in bands, muscovite associated with chlorite and minor graphite that envelopes pyrite. Carbonate forms late cross-cutting veins (0.1 to 2.4 mm, that dilate and branch).

Bands of quartz (0.2 to 0.9 mm wide) as lenticles of single grains are joined or form mosaics of complex sutured quartz (0.1 to 1 mm) of irregular size, often augen shaped and otherwise lenticles of healed quartz breccia are cut across by cherty quartz veins (0.1 mm wide). Quartz veins are displaced by later carbonate veins and carbonate with chlorite enters cross-cutting fractures.

Between quartz layers are thin lenticles of laminal chlorite (~ 0.02 mm wide) containing cherty quartz, fine layers of sphene and trapped pyrite clusters (0.014 x 0.007 mm). Between chlorite laminae are variable widths of quartz

laminae (to 1.6 mm wide) with few pyrite grains. Also between quartz lenticles are broad layers (0.6 to 3.2 mm) of mainly fibrous chlorite, parallel to schist direction and containing abundant sheared pyrite laminae (0.015 to 0.08 mm) separated by chlorite. Dense chlorite layers contain minor pyrite (associated with minor graphite).

Coarse pyrite (1.2 x 0.3 mm) is embedded in fracture-fill, dense chlorite and coarse pyrite vein networks cut across quartz layers.

Alteration: Chloritised sediments with 'syngenetic' pyrite. Sheared but show later cross fractures (20 to 80 degrees to preferred shear direction) filled with coarse pyrite:quartz followed by clear carbonate.

Pyrite may be syngenetic pyrite that was mobilised during brecciation and shear.

Metamorphism: Regional with strong shear.

Specimen No.: 40394/MPS 5415

Cahill Formation
Ranger Mine Site

Field Note: -

Petrographic Summary: Chlorite:quartz schist with an indication that chlorite is retrograded biotite. Quartz shows brecciation and later healing.

<u>Mineralogy:</u>	<u>Vol.%</u>
Quartz	33
Chlorite	62
Muscovite	-
Graphite	-
Pyrite	-
Limonite	2
Sphene	3
Baryte	<1
Zircon	<1

Texture: Basically not unlike Specimen 403 but pyrite, quartz:pyrite vein and carbonate are absent.

The chlorite occurs as continuous lenticles (0.4 to 1.6 mm) which in places become brownish and shorter in length, more prismatic ($\sim 0.1 \times 0.06$ mm) with a biotite habit. However, all chlorite including the sheared lenticles contains specks of sphene along cleavages. This suggests that chlorite is retrograded biotite. Limonite tends to stain the contacts of chlorite with quartz. Quartz lenticles (0.1 to 1.2 mm wide) consist of recrystallised quartz breccia; quartz and chlorite of various widths form alternate parallel foliae. Chlorite lenticles contain scattered fine quartz (as 0.04, 0.08 mm). Fine baryte (0.01 mm) and zircon (0.02 mm) are either present along chlorite cleavages or are embedded in quartz, respectively.

Alteration: Biotite $\rightarrow$ chlorite + sphene + iron oxides.

Metamorphism: Retrograde brecciation and shear.

Specimen No.: 40395/MPS 5416

Cahill Formation
Ranger Mine Site

Field Note: -

Petrographic Summary: A chlorite:quartz schist. Brecciation of quartz bands and deformation led to mobilisation of much chlorite into fractures, followed by quartz vein that was eventually itself brecciated and lastly narrow chlorite veins displaced coarse quartz. Earliest vein system was quartz:hematite.

Mineralogy:

Vol.%

Quartz

41

Chlorite

55

Iron oxides

4

Veins: (1) Quartz:hematite. (2) Quartz. (3) Chlorite.

Texture: A brecciated quartz:chlorite schist, that was subsequently quartz veined. The most prominent identifiable quartz vein varies 1 to 0.3 mm wide and fills a 90 degree cross-fracture in the schist.

Otherwise regular bands of healed quartz breccia (0.15 to 0.3 mm) with interleaved chlorite (0.2 to 0.5 mm wide) were further brecciated and fractures filled by mobilised finely fibrous pale green chlorite showing anomalous interference. The chlorite as veins lies parallel to and subsequently followed fractures across quartz veins. Both quartz and chlorite were mobilised from adjoining sheared(?) chlorite:quartz schist to fill fractures formed during brecciation.

Massive quartz lenticles (3 to 5 mm wide) are cross brecciated in several places and fractures filled by chlorite. Similarly the broad quartz lenticles were brecciated and fractures filled by quartz and the entire structure was healed so that cross-cutting quartz is now only just identifiable. Original iron oxides as fine hematite and limonite occupy

fractures in quartz breccia, particularly cementing quartz breccia embedded in chlorite. Hematite occurs as tiny prism clusters. Possible quartz-hematite vein was brecciated and fractures filled by chlorite. Chlorite veins cut across all other structures.

Alteration: Added quartz and chlorite + hematite.

Metamorphism: Original sediment(?) sheared and metamorphosed to quartz:chlorite schist. Then brecciated, and fractures filled by mobilised chlorite and quartz.

Specimen No.: 40396/MPS 5417

Replacement Carbonate "facies"
Cahill Formation
Ranger Mine Site.

Field Note: -

Petrographic Summary: Dolomite laths as replacement of chlorite:quartz schist.

Relict fine corroded quartz and traces of apatite remain as original inclusions in earlier biotite.

<u>Mineralogy:</u>	<u>Vol. %</u>
Dolomite*	83
Chlorite	15
Iron oxides	<1
Apatite	<1
Quartz	2

* Checked by staining procedure.

Texture: Random crystal intergrowths composed of euhedral laths and fragments (vary 0.12 to 3.2 x 1.2 mm, mostly 1.2 x 0.6 mm) form much of the section, otherwise occupied by parallel trails of relict sheared chlorite laths and sheared intergrowths of chlorite (after biotite?). Tiny apatite (0.05 x 0.04 mm) crystals are seen to be embedded in the chlorite laths. Dolomite crystals (0.3 x 0.2 mm) show ovoid structures of authigenic growths. The presence of the carbonate may also be the result of dolomite fill after leaching of chlorite ($\pm$ quartz) of original chlorite:feldspar schist?

Rare ovoid quartz (0.1, 0.08, 0.08 mm) as corroded forms remain embedded in the carbonate laths.

Alteration: Dolomite replacement of chlorite schist ($\pm$ feldspar?).

Metamorphism: -

APPENDIX 3

LISTING OF DRILL HOLE ASSAY RESULTS

Plans and Cross Sections

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21st December 1988

Our Ref : 8DN0815

8AD377SA + 8 files

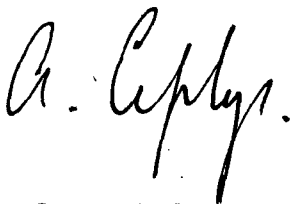
REPORT NUMBER 8DN0815

CLIENT : Surtec Geosurveys Pty. Ltd.

CLIENT REFERENCE : Order Number 5036

REPORT COMPRISING : Cover Page
Pages 1 - 44

DATE RECEIVED : 24th November 1988



Alan Ciplys
Manager
CLASSIC COMLABS LTD. (N.T.)

This report relates specifically to the sample(s) tested in so far as that the sample(s) is truly representative of the sample source as supplied.



Job: 8AD3775

O/N: 8DN0815

ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP1 00-02	2	4	5	8	0.76
LAP1 02-04	<2	10	19	6	4.20
LAP1 04-06	2	12	16	22	3.10
LAP1 06-08	<2	12	42	26	5.55
LAP1 08-10	<2	<4	18	14	1.38
LAP1 10-12	2	<4	12	32	1.77
LAP1 12-14	2	4	30	18	12.6
LAP1 14-16	<2	6	32	32	6.00
LAP1 16-18	2	6	24	46	4.76
LAP1 18-20	2	<4	24	28	4.56
LAP1 20-22	2	12	30	20	3.28
LAP1 22-24	4	8	30	28	5.15
LAP1 24-26	7	4	20	18	3.52
LAP1 26-28	11	<4	28	18	4.34
LAP1 28-30	18	<4	40	18	4.68
LAP1 30-32	32	<4	30	28	5.05
LAP1 32-34	38	6	28	38	5.40
LAP1 34-36	34	8	26	28	5.25
LAP1 36-38	46	32	38	30	5.65
LAP1 38-40	44	16	30	26	5.25
LAP1 40-42	32	12	32	26	5.05
LAP2 00-02	<2	8	<2	10	3.52
LAP2 02-04	<2	10	11	24	2.62
LAP2 04-06	<2	4	12	20	2.32
LAP2 06-08	<2	4	26	24	2.32
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C

525332



Job: 8AD3775

O/N: 8DN0815

ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP2 08-10	<2	20	11	18	1.22
LAP2 10-12	3	<4	11	22	1.73
LAP2 12-14	<2	10	13	26	2.40
LAP2 14-16	3	24	28	34	2.86
LAP2 16-18	<2	<4	20	30	2.54
LAP2 18-20	2	10	34	28	2.24
LAP2 20-22	2	12	78	32	2.92
LAP2 22-24	5	4	30	32	2.48
LAP2 24-26	6	<4	34	34	2.56
LAP2 26-28	10	<4	32	34	5.10
LAP2 28-30	28	<4	22	70	5.80
LAP2 30-32	7	<4	28	24	6.25
LAP2 32-34	50	<4	38	36	6.10
LAP2 34-36	40	<4	20	44	4.32
LAP2 36-38	34	<4	36	84	4.76
LAP2 38-40	48	<4	42	82	3.78
LAP2 40-42	22	<4	26	32	3.00
LAP2 42-44	56	<4	40	24	5.35
LAP2 44-46	34	<4	14	40	5.40
LAP2 46-48	8	<4	19	40	3.58
LAP2 48-50	15	4	46	32	4.78
LAP2 50-52	9	4	52	26	5.50
LAP2 52-54	22	<4	46	24	6.25
LAP2 54-56	17	<4	64	34	4.18
LAP2 56-58	28	<4	46	36	3.96
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



Job: 8AD3775

O/N: 8DN0815

ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP2 58-60	11	<4	30	24	2.18
LAP2 60-62	28	<4	44	32	3.26
LAP2 62-64	30	<4	56	40	4.06
LAP2 64-66	34	<4	54	40	3.50
LAP2 66-68	36	4	42	38	3.30
LAP2 68-70	40	<4	66	48	4.38
LAP2 70-72	18	4	58	38	3.34
LAP2 72-74	12	<4	60	34	2.84
LAP2 74-76	26	<4	60	18	3.56
LAP2 76-78	24	6	36	18	2.04
LAP3 00-02	5	<4	6	14	1.74
LAP3 02-04	3	<4	13	28	2.10
LAP3 04-06	3	<4	24	34	2.90
LAP3 06-08	2	<4	34	36	3.18
LAP3 08-10	4	<4	30	38	3.04
LAP3 10-12	2	4	38	38	2.98
LAP3 12-14	<2	<4	30	38	3.04
LAP3 14-16	<2	6	20	28	2.82
LAP3 16-18	<2	<4	18	24	2.40
LAP3 18-20	3	<4	30	34	3.90
LAP3 20-22	3	<4	22	30	4.12
LAP3 22-24	5	<4	36	44	6.25
LAP3 24-26	6	<4	38	46	6.90
LAP3 26-28	2	4	30	44	5.50
LAP3 28-30	2	<4	22	42	6.05
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP3 30-32	2	<4	30	52	6.95
LAP3 32-34	6	<4	30	50	7.25
LAP3 34-36	<2	<4	26	44	8.15
LAP3 36-38	17	<4	40	70	7.25
LAP3 38-40	22	<4	30	32	3.04
LAP3 40-42	11	<4	28	42	4.34
LAP3 42-44	<2	<4	36	44	7.45
LAP3 44-46	14	<4	48	56	7.60
LAP3 46-48	26	<4	28	70	4.70
LAP3 48-50	22	<4	34	34	6.35
LAP3 50-52	50	<4	18	30	2.96
LAP3 52-54	42	<4	38	32	2.96
LAP4 00-02	<2	<4	<2	8	1.29
LAP4 02-04	2	4	3	12	1.81
LAP4 04-06	5	8	9	12	1.88
LAP4 06-08	4	4	3	10	2.18
LAP4 08-10	4	4	3	10	1.67
LAP4 10-12	4	10	<2	8	1.07
LAP4 12-14	<2	6	<2	12	0.70
LAP4 14-16	3	6	6	34	1.29
LAP4 16-18	19	12	24	36	1.76
LAP5 00-02	20	6	<2	10	0.73
LAP5 02-04	6	<4	<2	14	1.87
LAP5 04-06	7	<4	<2	16	1.99
LAP5 06-08	7	<4	<2	10	1.97
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP5 08-10	6	<4	<2	10	1.33
LAP5 10-12	11	<4	<2	12	0.84
LAP5 12-14	7	<4	18	52	2.30
LAP5 14-16	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
LAP5 16-18	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
LAP5 18-20	7	4	42	86	5.70
LAP5 20-22	6	<4	46	96	7.15
LAP5 22-24	6	<4	52	90	8.25
LAP5 24-26	20	<4	40	40	4.24
LAP5 26-28	7	<4	18	26	2.10
LAP5 28-30	4	<4	32	36	3.08
LAP5 30-32	5	<4	32	32	3.18
LAP5 32-34	7	<4	32	36	3.56
LAP5 34-36	5	<4	26	34	3.44
LAP5 36-38	9	<4	30	36	3.38
LAP5 38-40	8	<4	20	32	3.54
LAP5 40-42	7	<4	24	36	3.46
LAP5 42-44	10	<4	32	38	3.98
LAP5 44-46	11	<4	28	36	6.15
LAP5 46-48	7	<4	30	32	4.32
LAP5 48-50	6	<4	34	36	3.80
LAP5 50-52	4	<4	36	30	3.30
LAP5 52-54	6	<4	42	44	3.98
LAP5 54-56	6	<4	24	32	2.94
LAP5 56-58	7	<4	32	32	3.30
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP5 58-60	5	<4	30	30	3.30
LAP5 60-62	12	<4	44	38	3.70
LAP5 62-64	13	<4	50	36	3.82
LAP5 64-66	54	<4	80	28	4.24
LAP5 66-68	40	12	100	26	5.45
LAP5 68-70	44	12	100	24	7.40
LAP6 00-02	5	<4	<2	10	1.00
LAP6 02-04	6	<4	22	44	2.44
LAP6 04-06	6	<4	20	38	2.96
LAP6 06-08	8	<4	36	48	3.92
LAP6 08-10	7	<4	44	56	4.68
LAP6 10-12	9	<4	44	54	4.24
LAP6 12-14	10	<4	40	52	3.32
LAP6 14-16	11	<4	34	48	3.08
LAP6 16-18	I.S.	I.S.	I.S.	I.S.	I.S.
LAP6 18-20	13	<4	34	44	3.76
LAP6 20-22	13	<4	56	74	4.04
LAP6 22-24	9	<4	56	76	4.16
LAP6 24-26	18	<4	32	42	3.26
LAP6 26-28	11	4	26	38	3.06
LAP6 28-30	12	12	48	44	3.04
LAP6 30-32	19	<4	24	36	2.58
LAP6 32-34	36	<4	34	48	3.74
LAP6 34-36	11	<4	38	38	4.00
LAP6 36-38	10	4	38	42	4.28
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP6 38-40	7	8	64	36	0.58
LAP6 40-42	11	4	36	32	3.14
LAP6 42-44	7	<4	50	38	3.64
LAP6 44-46	8	6	40	38	3.52
LAP6 46-48	24	<4	48	68	4.66
LAP7 00-02	6	16	8	22	10.1
LAP7 02-04	3	30	34	50	10.1
LAP7 04-06	5	54	48	94	7.40
LAP7 06-08	5	46	50	68	5.20
LAP7 08-10	6	40	28	56	4.06
LAP7 10-12	6	10	30	44	3.08
LAP7 12-14	8	12	30	38	2.60
LAP7 14-16	10	12	34	44	2.84
LAP7 16-18	11	6	28	34	2.46
LAP7 18-20	9	6	26	38	3.00
LAP7 20-22	6	6	28	46	3.46
LAP7 22-24	7	12	32	54	5.00
LAP7 24-26	8	14	32	46	5.65
LAP7 26-28	9	4	34	46	5.50
LAP7 28-30	10	<4	32	40	5.85
LAP7 30-32	8	4	30	40	5.60
LAP7 32-34	7	<4	32	40	5.75
LAP7 34-36	7	4	32	36	5.65
LAP7 36-38	7	<4	40	38	6.30
LAP7 38-40	7	4	56	30	8.10
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP7 40-42	9	<4	58	30	8.95
LAP7 42-44	48	12	44	34	6.05
LAP7 44-46	13	4	36	42	4.10
LAP7 46-48	13	<4	30	28	2.78
LAP7 48-50	11	4	44	36	4.64
LAP7 50-52	18	<4	54	26	4.68
LAP7 52-54	26	16	150	8	6.85
LAP7 54-56	18	54	155	18	6.30
LAP7 56-58	20	12	98	22	3.62
LAP7 58-60	36	24	110	14	6.95
LAP7 60-62	14	88	165	16	4.86
LAP7 62-64	17	82	160	16	5.45
LAP7 64-66	19	12	64	32	3.02
LAP7 66-68	12	6	44	40	3.44
LAP7 68-70	26	8	165	16	4.46
LAP7 70-72	42	6	120	28	4.10
LAP7 72-74	60	42	130	32	4.00
LAP7 74-76	36	98	185	24	4.64
LAP7 76-78	26	24	98	20	5.20
LAP7 78-80	40	26	110	14	5.40
LAP7 80-82	28	20	98	6	5.95
LAP7 82-84	24	18	120	6	7.20
LAP7 84-86	14	14	170	8	7.70
LAP7 86-88	12	20	120	14	5.15
LAP7 88-90	28	6	74	30	3.76
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP8 00-02	6	12	14	22	13.1
LAP8 02-04	6	8	22	36	5.50
LAP8 04-06	4	<4	34	48	5.75
LAP8 06-08	4	4	34	42	4.80
LAP8 08-10	4	4	28	42	3.30
LAP8 10-12	5	4	38	46	3.48
LAP8 12-14	6	6	28	42	3.48
LAP8 14-16	4	<4	28	38	2.78
LAP8 16-18	6	4	28	40	3.04
LAP8 18-20	4	4	30	38	3.28
LAP8 20-22	4	6	26	36	4.16
LAP8 22-24	4	6	26	36	4.76
LAP8 24-26	3	10	30	34	5.10
LAP8 26-28	5	<4	24	26	2.98
LAP8 28-30	12	<4	36	38	3.44
LAP8 30-32	7	8	40	34	3.84
LAP8 32-34	16	6	62	40	4.96
LAP8 34-36	58	<4	66	42	8.25
LAP8 36-38	26	<4	38	20	5.25
LAP8 38-40	14	4	42	14	6.35
LAP8 40-42	42	<4	44	18	6.10
LAP8 42-44	16	<4	38	30	4.26
LAP8 44-46	10	<4	36	34	3.30
LAP8 46-48	12	<4	28	36	3.34
LAP8 48-50	10	<4	28	30	3.68
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP8 50-52	9	<4	30	36	3.30
LAP8 52-54	11	8	28	36	3.24
LAP8 54-56	9	4	34	36	3.12
LAP8 56-58	11	4	56	46	3.68
LAP8 58-60	18	6	56	36	3.34
LAP8 60-62	22	<4	48	40	4.06
LAP8 62-64	28	4	40	42	4.10
LAP8 64-66	19	<4	30	48	3.24
LAP8 66-68	8	<4	32	34	3.18
LAP8 68-70	40	<4	38	42	3.58
LAP8 70-72	28	<4	36	40	3.98
LAP8 72-74	19	<4	30	28	2.82
LAP8 74-76	19	4	36	32	3.04
LAP8 76-78	14	6	46	34	3.04
LAP9 00-02	8	4	2	8	4.92
LAP9 02-04	7	12	2	22	3.78
LAP9 04-06	3	<4	8	28	1.70
LAP9 06-08	8	8	15	22	1.56
LAP9 08-10	5	14	115	62	2.64
LAP9 10-12	8	6	72	60	3.18
LAP9 12-14	5	6	34	38	2.06
LAP9 14-16	7	6	15	26	1.85
LAP9 16-18	6	4	24	30	2.02
LAP9 18-20	8	4	22	28	2.54
LAP9 20-22	7	4	16	24	2.22
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP9 22-24	8	<4	14	30	2.08
LAP9 24-26	5	4	20	30	2.30
LAP9 26-28	5	6	16	38	2.16
LAP9 28-30	6	<4	20	36	2.48
LAP9 30-32	4	<4	20	<4	2.72
LAP9 32-34	6	6	30	50	3.48
LAP9 34-36	4	6	28	46	1.30
LAP9 36-38	2	<4	22	40	3.12
LAP9 38-40	<2	<4	17	42	3.14
LAP9 40-42	3	<4	28	40	3.54
LAP9 42-44	2	<4	26	36	3.10
LAP9 44-46	5	<4	28	36	3.06
LAP9 46-48	6	4	22	42	3.22
LAP9 48-50	4	4	26	56	3.00
LAP9 50-52	8	<4	32	48	3.26
LAP9 52-54	15	<4	40	40	3.44
DAP1 00-01	24	16	19	42	7.85
DAP1 01-02	48	44	26	28	8.95
DAP1 02-03	60	30	26	34	3.74
DAP1 03-04	64	24	34	34	3.56
DAP1 04-05	125	6	58	56	3.12
DAP1 05-06	130	4	74	70	3.08
DAP1 06-07	110	<4	68	46	2.90
DAP1 07-08	54	6	90	62	3.56
DAP1 08-09	74	<4	74	52	3.22
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP1 09-10	210	6	44	115	6.65
DAP1 10-11	145	<4	64	220	8.45
DAP1 11-12	150	<4	68	200	7.30
DAP1 12-13	180	10	70	190	6.65
DAP1 13-14	120	64	120	220	6.80
DAP1 14-15	90	12	100	260	7.65
DAP1 15-16	110	10	120	210	8.05
DAP1 16-17	160	8	80	120	6.60
DAP1 17-18	370	<4	62	30	8.75
DAP1 18-19	32	8	115	12	7.15
DAP1 19-20	30	10	94	18	5.55
DAP1 20-21	290	10	88	16	5.00
DAP1 21-22	38	6	64	24	3.06
DAP1 22-23	36	4	40	22	2.28
DAP1 23-24	22	6	62	12	3.62
DAP1 24-25	26	4	76	12	4.54
DAP1 25-26	32	8	72	16	4.44
DAP1 26-27	24	14	80	20	5.20
DAP1 27-28	26	6	76	22	4.72
DAP1 28-29	26	14	90	24	5.95
DAP1 29-30	66	10	100	18	6.35
DAP1 30-31	24	8	110	22	6.80
DAP1 31-32	20	6	115	18	5.75
DAP1 32-33	14	8	110	14	6.00
DAP1 33-34	32	4	78	18	5.80
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP1 34-35	48	8	50	28	3.82
DAP1 35-36	56	4	60	26	4.08
DAP1 36-37	54	<4	64	30	4.86
DAP1 37-38	52	8	56	26	4.12
DAP1 38-39	48	6	66	20	4.70
DAP1 39-40	44	8	70	16	4.80
DAP1 40-41	34	8	90	16	5.50
DAP1 41-42	46	6	66	20	4.84
DAP1 42-43	76	<4	74	58	5.65
DAP1 43-44	10	<4	60	14	1.58
DAP1 44-45	88	<4	82	76	6.05
DAP1 45-46	64	<4	110	80	6.95
DAP1 46-47	38	10	82	36	4.94
DAP1 47-48	62	12	56	22	3.90
DAP1 48-49	50	4	74	32	5.25
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAQ1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP1 00-02	<4	<4	4
LAP1 02-04	4	4	10
LAP1 04-06	4	<4	4
LAP1 06-08	<4	<4	7
LAP1 08-10	<4	<4	2
LAP1 10-12	<4	<4	2
LAP1 12-14	<4	<4	4
LAP1 14-16	<4	<4	3
LAP1 16-18	4	14	4
LAP1 18-20	<4	<4	6
LAP1 20-22	4	<4	3
LAP1 22-24	<4	<4	7
LAP1 24-26	6	<4	2
LAP1 26-28	<4	<4	6
LAP1 28-30	6	<4	4
LAP1 30-32	<4	14	3
LAP1 32-34	<4	<4	<2
LAP1 34-36	<4	<4	2
LAP1 36-38	4	<4	7
LAP1 38-40	<4	<4	5
LAP1 40-42	<4	<4	7
LAP2 00-02	4	<4	5
LAP2 02-04	10	18	4
LAP2 04-06	4	12	3
LAP2 06-08	<4	14	2
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP2 08-10	<4	4	2
LAP2 10-12	<4	12	2
LAP2 12-14	6	12	<2
LAP2 14-16	<4	10	4
LAP2 16-18	<4	14	<2
LAP2 18-20	<4	10	3
LAP2 20-22	<4	18	4
LAP2 22-24	4	8	4
LAP2 24-26	4	12	5
LAP2 26-28	4	<4	3
LAP2 28-30	<4	<4	3
LAP2 30-32	<4	10	<2
LAP2 32-34	<4	6	5
LAP2 34-36	<4	4	3
LAP2 36-38	4	<4	3
LAP2 38-40	<4	<4	7
LAP2 40-42	4	<4	<2
LAP2 42-44	<4	<4	3
LAP2 44-46	<4	12	<2
LAP2 46-48	<4	8	5
LAP2 48-50	<4	<4	4
LAP2 50-52	<4	<4	<2
LAP2 52-54	<4	<4	3
LAP2 54-56	<4	18	2
LAP2 56-58	4	10	8
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP2 58-60	<4	8	<2
LAP2 60-62	<4	16	2
LAP2 62-64	4	14	<2
LAP2 64-66	14	12	3
LAP2 66-68	<4	14	3
LAP2 68-70	<4	12	<2
LAP2 70-72	6	10	<2
LAP2 72-74	<4	8	3
LAP2 74-76	<4	<4	2
LAP2 76-78	<4	<4	4
LAP3 00-02	<4	<4	<2
LAP3 02-04	6	6	3
LAP3 04-06	4	6	7
LAP3 06-08	6	12	<2
LAP3 08-10	4	10	5
LAP3 10-12	<4	12	3
LAP3 12-14	4	20	3
LAP3 14-16	<4	<4	<2
LAP3 16-18	<4	8	5
LAP3 18-20	<4	<4	6
LAP3 20-22	<4	<4	<2
LAP3 22-24	<4	<4	2
LAP3 24-26	<4	<4	4
LAP3 26-28	4	4	5
LAP3 28-30	<4	<4	4
UNITS SCHEME	ppm XRF1	ppm XRF1	ppm XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP3 30-32	<4	6	5
LAP3 32-34	<4	<4	3
LAP3 34-36	<4	<4	4
LAP3 36-38	<4	14	<2
LAP3 38-40	6	14	2
LAP3 40-42	<4	14	3
LAP3 42-44	8	<4	4
LAP3 44-46	4	4	<2
LAP3 46-48	<4	4	4
LAP3 48-50	<4	<4	<2
LAP3 50-52	<4	8	6
LAP3 52-54	<4	10	4
LAP4 00-02	<4	<4	5
LAP4 02-04	4	<4	3
LAP4 04-06	<4	<4	5
LAP4 06-08	4	<4	4
LAP4 08-10	6	8	7
LAP4 10-12	6	18	5
LAP4 12-14	<4	18	3
LAP4 14-16	6	16	4
LAP4 16-18	4	16	5
LAP5 00-02	<4	4	6
LAP5 02-04	<4	4	5
LAP5 04-06	<4	<4	4
LAP5 06-08	<4	6	6

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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SAMPLE	U	Th	As
LAP5 08-10	<4	12	<2
LAP5 10-12	4	14	2
LAP5 12-14	<4	20	3
LAP5 14-16	L.N.R.	L.N.R.	L.N.R.
LAP5 16-18	L.N.R.	L.N.R.	L.N.R.
LAP5 18-20	<4	<4	<2
LAP5 20-22	<4	<4	<2
LAP5 22-24	<4	<4	4
LAP5 24-26	10	<4	3
LAP5 26-28	8	4	3
LAP5 28-30	<4	18	5
LAP5 30-32	<4	10	2
LAP5 32-34	4	8	2
LAP5 34-36	4	4	7
LAP5 36-38	4	10	7
LAP5 38-40	<4	8	6
LAP5 40-42	<4	6	3
LAP5 42-44	<4	4	7
LAP5 44-46	4	<4	2
LAP5 46-48	<4	<4	3
LAP5 48-50	4	12	2
LAP5 50-52	<4	8	4
LAP5 52-54	<4	14	3
LAP5 54-56	<4	14	7
LAP5 56-58	<4	10	3

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP5 58-60	<4	14	4
LAP5 60-62	<4	16	4
LAP5 62-64	4	18	3
LAP5 64-66	<4	4	7
LAP5 66-68	<4	8	<2
LAP5 68-70	8	<4	5
LAP6 00-02	<4	<4	5
LAP6 02-04	<4	10	5
LAP6 04-06	<4	<4	3
LAP6 06-08	<4	<4	3
LAP6 08-10	<4	<4	5
LAP6 10-12	<4	10	5
LAP6 12-14	<4	4	<2
LAP6 14-16	<4	10	3
LAP6 16-18	I.S.	I.S.	I.S.
LAP6 18-20	<4	<4	4
LAP6 20-22	<4	<4	6
LAP6 22-24	4	6	2
LAP6 24-26	4	6	<2
LAP6 26-28	<4	14	5
LAP6 28-30	<4	8	6
LAP6 30-32	<4	14	3
LAP6 32-34	4	8	3
LAP6 34-36	<4	<4	3
LAP6 36-38	<4	4	2
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP6 38-40	<4	10	2
LAP6 40-42	<4	10	<2
LAP6 42-44	<4	8	3
LAP6 44-46	<4	8	3
LAP6 46-48	<4	14	8
LAP7 00-02	40	18	14
LAP7 02-04	110	<4	<2
LAP7 04-06	170	4	<2
LAP7 06-08	180	14	5
LAP7 08-10	125	12	10
LAP7 10-12	76	16	5
LAP7 12-14	58	10	5
LAP7 14-16	64	12	3
LAP7 16-18	48	14	2
LAP7 18-20	36	16	4
LAP7 20-22	40	6	3
LAP7 22-24	80	10	2
LAP7 24-26	64	14	3
LAP7 26-28	66	4	4
LAP7 28-30	34	<4	6
LAP7 30-32	40	8	4
LAP7 32-34	52	<4	3
LAP7 34-36	22	8	4
LAP7 36-38	16	<4	4
LAP7 38-40	14	<4	4

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP7 40-42	48	6	4
LAP7 42-44	86	18	4
LAP7 44-46	40	10	3
LAP7 46-48	16	4	4
LAP7 48-50	16	14	7
LAP7 50-52	16	18	7
LAP7 52-54	8	8	4
LAP7 54-56	14	4	4
LAP7 56-58	10	6	5
LAP7 58-60	6	6	8
LAP7 60-62	10	12	<2
LAP7 62-64	10	6	<2
LAP7 64-66	4	8	6
LAP7 66-68	8	10	7
LAP7 68-70	4	<4	5
LAP7 70-72	12	8	5
LAP7 72-74	8	<4	6
LAP7 74-76	6	4	<2
LAP7 76-78	16	<4	2
LAP7 78-80	14	8	<2
LAP7 80-82	10	4	<2
LAP7 82-84	8	12	5
LAP7 84-86	12	<4	7
LAP7 86-88	8	<4	8
LAP7 88-90	10	18	3

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP8 00-02	34	<4	16
LAP8 02-04	8	18	<2
LAP8 04-06	8	8	4
LAP8 06-08	6	6	<2
LAP8 08-10	4	18	3
LAP8 10-12	14	6	4
LAP8 12-14	6	4	4
LAP8 14-16	8	14	3
LAP8 16-18	14	24	<2
LAP8 18-20	8	<4	4
LAP8 20-22	18	<4	4
LAP8 22-24	24	10	<2
LAP8 24-26	18	6	<2
LAP8 26-28	16	<4	<2
LAP8 28-30	32	8	3
LAP8 30-32	22	8	<2
LAP8 32-34	30	10	11
LAP8 34-36	48	<4	15
LAP8 36-38	16	10	6
LAP8 38-40	4	<4	5
LAP8 40-42	<4	<4	<2
LAP8 42-44	8	12	9
LAP8 44-46	8	12	<2
LAP8 46-48	<4	8	6
LAP8 48-50	12	6	3

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1

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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP8 50-52	8	10	<2
LAP8 52-54	6	8	7
LAP8 54-56	4	6	<2
LAP8 56-58	<4	6	7
LAP8 58-60	4	14	2
LAP8 60-62	6	12	5
LAP8 62-64	<4	16	<2
LAP8 64-66	6	12	2
LAP8 66-68	<4	18	2
LAP8 68-70	<4	8	3
LAP8 70-72	8	14	3
LAP8 72-74	8	6	<2
LAP8 74-76	<4	<4	2
LAP8 76-78	4	12	4
LAP9 00-02	16	<4	9
LAP9 02-04	14	14	9
LAP9 04-06	<4	16	7
LAP9 06-08	<4	12	5
LAP9 08-10	8	10	4
LAP9 10-12	8	8	<2
LAP9 12-14	12	14	3
LAP9 14-16	8	16	6
LAP9 16-18	4	12	4
LAP9 18-20	12	6	<2
LAP9 20-22	10	8	6
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1

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ANALYTICAL REPORT

SAMPLE	U	Th	As
LAP9 22-24	4	20	3
LAP9 24-26	18	10	3
LAP9 26-28	12	12	2
LAP9 28-30	4	10	6
LAP9 30-32	10	12	4
LAP9 32-34	18	10	3
LAP9 34-36	6	6	3
LAP9 36-38	<4	6	5
LAP9 38-40	4	10	4
LAP9 40-42	<4	14	<2
LAP9 42-44	<4	8	3
LAP9 44-46	<4	10	4
LAP9 46-48	6	18	<2
LAP9 48-50	4	4	4
LAP9 50-52	<4	18	6
LAP9 52-54	<4	14	5
DAP1 00-01	44	<4	3
DAP1 01-02	230	24	8
DAP1 02-03	180	10	<2
DAP1 03-04	165	10	5
DAP1 04-05	68	16	7
DAP1 05-06	86	10	<2
DAP1 06-07	44	12	5
DAP1 07-08	72	20	9
DAP1 08-09	48	18	7
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP1 09-10	94	4	8
DAP1 10-11	22	<4	6
DAP1 11-12	18	<4	7
DAP1 12-13	22	<4	4
DAP1 13-14	26	<4	3
DAP1 14-15	18	<4	6
DAP1 15-16	8	<4	6
DAP1 16-17	26	<4	8
DAP1 17-18	26	4	10
DAP1 18-19	8	<4	4
DAP1 19-20	6	<4	8
DAP1 20-21	<4	<4	3
DAP1 21-22	<4	<4	2
DAP1 22-23	<4	<4	5
DAP1 23-24	4	6	5
DAP1 24-25	<4	12	<2
DAP1 25-26	8	10	6
DAP1 26-27	4	<4	2
DAP1 27-28	6	<4	3
DAP1 28-29	6	<4	4
DAP1 29-30	<4	4	5
DAP1 30-31	<4	4	5
DAP1 31-32	<4	4	3
DAP1 32-33	<4	10	5
DAP1 33-34	8	<4	5
UNITS SCHEME	ppm XRF1	ppm XRF1	ppm XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP1 34-35	8	<4	4
DAP1 35-36	<4	<4	<2
DAP1 36-37	4	<4	7
DAP1 37-38	<4	<4	2
DAP1 38-39	<4	<4	7
DAP1 39-40	<4	<4	5
DAP1 40-41	<4	4	<2
DAP1 41-42	4	<4	2
DAP1 42-43	12	4	<2
DAP1 43-44	<4	4	10
DAP1 44-45	4	<4	3
DAP1 45-46	<4	<4	3
DAP1 46-47	<4	<4	9
DAP1 47-48	<4	<4	9
DAP1 48-49	<4	<4	2

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP1 49-50	48	12	60	24	4.32
DAP1 50-51	38	12	54	24	4.22
DAP1 51-52	56	12	52	26	3.94
DAP1 52-53	62	8	56	30	4.54
DAP1 53-54	50	6	52	24	4.00
DAP1 54-55	54	12	54	36	4.32
DAP1 55-56	54	14	60	28	4.42
DAP1 56-57	92	12	72	72	4.58
DAP1 57-58	78	8	52	62	3.94
DAP1 58-59	78	6	50	68	4.04
DAP1 59-60	115	8	74	64	4.22
DAP1 60-61	72	8	44	38	2.52
DAP1 61-62	34	4	32	34	2.12
DAP1 62-63	48	8	30	36	2.08
DAP1 63-64	50	8	32	40	1.93
DAP1 64-65	26	12	36	28	2.20
DAP1 65-66	42	22	80	40	2.88
DAP1 66-67	38	8	54	48	2.64
DAP1 67-68	36	10	58	54	3.68
DAP1 68-69	36	4	46	44	3.32
DAP1 69-70	44	6	44	80	3.04
DAP1 70-71	86	14	52	46	3.28
DAP1 71-72	32	4	48	36	3.14
DAP1 72-73	150	10	52	88	3.76
DAP1 73-74	54	8	44	54	3.64
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP1 74-75	64	10	48	38	3.20
DAP1 75-76	44	12	46	40	3.18
DAP1 76-77	58	12	42	46	2.98
DAP1 77-78	195	12	52	42	3.26
DAP1 78-79	58	8	50	38	3.20
DAP1 79-80	56	8	56	44	4.12
DAP1 80-81	32	8	50	52	3.66
DAP1 81-82	250	8	54	44	4.96
DAP1 82-83	82	<4	32	34	2.86
DAP1 83-84	400	8	30	44	3.56
DAP1 84-85	140	10	36	36	3.02
DAP1 85-86	400	12	32	42	3.46
DAP1 86-87	1480	10	30	30	3.10
DAP1 87-88	300	10	34	42	3.48
DAP1 88-89	94	8	36	34	3.16
DAP1 89-90	135	6	40	44	3.08
DAP2 00-02	6	8	4	6	10.6
DAP2 02-04	<2	6	7	8	7.90
DAP2 04-06	2	<4	6	8	5.35
DAP2 06-08	60	14	4	14	2.94
DAP2 08-10	100	18	6	22	2.70
DAP2 10-12	100	14	6	26	2.42
DAP2 12-14	250	26	40	130	10.9
DAP2 14-16	320	10	120	290	8.10
DAP2 16-18	58	20	96	230	6.65
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP2 18-20	62	16	88	46	9.50
DAP2 20-22	46	18	135	16	7.80
DAP2 22-24	16	12	72	16	5.10
DAP2 24-26	34	12	50	26	4.20
DAP2 26-28	30	10	60	16	3.82
DAP2 28-30	20	12	58	10	4.92
DAP2 30-32	150	18	80	18	6.90
DAP2 32-34	64	12	105	16	7.75
DAP2 34-36	32	16	110	12	6.95
DAP2 36-38	30	12	86	28	5.40
DAP2 38-40	68	8	94	20	4.62
DAP2 40-42	64	4	68	24	7.35
DAP2 42-44	74	10	74	28	6.70
DAP2 44-46	110	12	94	72	7.90
DAP2 46-48	62	12	58	46	4.92
DAP2 48-50	80	14	94	34	4.74
DAP2 50-52	640	10	54	28	4.44
DAP2 52-54	450	16	50	36	4.26
DAP2 54-56	110	12	50	30	4.68
DAP2 56-58	74	10	60	28	4.52
DAP2 58-60	74	14	60	36	5.35
DAP2 60-62	74	12	54	36	5.10
DAP2 62-64	125	10	76	58	5.25
DAP2 64-66	92	14	66	36	4.30
DAP2 66-68	60	14	56	38	3.42
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP2 68-70	54	32	105	42	3.52
DAP2 70-72	46	16	72	40	3.66
DAP2 72-74	76	20	68	64	4.54
DAP2 74-76	82	14	58	68	4.12
DAP2 76-78	70	10	50	58	3.70
DAP2 78-80	94	18	60	70	4.62
DAP2 80-82	64	14	54	52	4.02
DAP2 82-84	68	12	54	50	3.66
DAP2 84-86	82	22	70	58	4.48
DAP2 86-88	66	32	92	50	4.12
DAP2 88-90	64	24	84	52	4.20
DAP2 90-92	78	22	86	62	4.70
DAP2 92-94	84	22	64	60	4.40
DAP2 94-96	78	12	58	60	4.40
DAP3 00-02	16	16	11	12	8.15
DAP3 02-04	17	18	10	12	6.75
DAP3 04-06	32	14	8	10	3.00
DAP3 06-08	42	10	12	8	2.90
DAP3 08-10	58	10	14	16	3.24
DAP3 10-12	200	10	62	155	8.15
DAP3 12-14	125	14	86	180	6.65
DAP3 14-16	94	16	98	190	7.60
DAP3 16-18	58	6	90	115	7.85
DAP3 18-20	54	8	98	28	7.25
DAP3 20-22	16	14	78	14	5.40
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP3 22-24	72	10	44	16	3.58
DAP3 24-26	30	12	46	20	2.26
DAP3 26-28	20	12	64	6	4.04
DAP3 28-30	16	14	64	12	4.22
DAP3 30-32	22	14	80	12	5.45
DAP3 32-34	34	8	70	20	5.05
DAP3 34-36	20	8	86	16	5.25
DAP3 36-38	44	8	56	18	5.20
DAP3 38-40	58	12	74	24	3.96
DAP3 40-42	70	8	56	20	4.10
DAP3 42-44	56	10	46	22	3.96
DAP3 44-46	130	8	40	28	4.12
DAP3 46-48	82	8	38	54	4.08
DAP3 48-50	70	14	88	40	4.08
DAP3 50-52	56	10	42	36	3.34
DAP3 52-54	180	8	84	30	6.35
DAP3 54-56	64	10	46	30	4.28
DAP3 56-58	130	6	42	26	3.96
DAP3 58-60	125	8	42	28	4.20
DAP3 60-62	135	8	58	60	4.84
DAP3 62-64	82	8	84	72	5.35
DAP3 64-66	42	8	50	38	3.56
DAP3 66-68	56	8	44	42	3.14
DAP3 68-70	34	10	48	46	3.92
DAP3 70-72	36	16	60	46	3.70
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP3 72-74	58	8	38	70	3.36
DAP3 74-76	34	8	38	40	2.96
DAP3 76-78	42	6	54	60	3.68
DAP4 00-02	84	10	7	20	5.40
DAP4 02-04	150	4	15	22	2.74
DAP4 04-06	220	4	72	220	9.50
DAP4 06-08	175	14	105	280	14.5
DAP4 08-10	84	16	80	250	6.25
DAP4 10-12	74	12	68	165	5.15
DAP4 12-14	96	12	52	100	6.10
DAP4 14-16	380	18	82	74	4.56
DAP4 16-18	42	10	115	12	5.20
DAP4 18-20	165	10	66	14	8.30
DAP4 20-22	40	12	36	20	3.34
DAP4 22-24	22	10	60	14	4.66
DAP4 24-26	18	16	58	6	3.66
DAP4 26-28	19	18	70	10	4.46
DAP4 28-30	44	16	98	14	5.90
DAP4 30-32	26	16	90	18	6.10
DAP4 32-34	18	8	125	22	5.45
DAP4 34-36	42	20	105	34	6.40
DAP4 36-38	72	26	88	40	4.60
DAP4 38-40	62	10	64	42	4.64
DAP4 40-42	58	12	64	36	4.62
DAP4 42-44	135	8	62	40	4.82
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
DAP4 44-46	120	8	62	58	5.20
DAP4 46-48	120	6	58	68	4.88
DAP4 48-50	72	12	56	58	5.15
DAP4 50-52	86	6	44	46	4.08
DAP4 52-54	46	8	78	38	5.50
DAP4 54-56	82	8	60	36	4.74
DAP4 56-58	96	12	64	40	5.40
DAP4 58-60	60	10	60	48	4.84
DAP4 60-62	270	6	84	86	5.80
DAP4 62-64	170	4	66	72	5.00
DAP4 64-66	92	<4	68	68	4.84
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP1 49-50	6	<4	4
DAP1 50-51	12	<4	4
DAP1 51-52	8	10	5
DAP1 52-53	<4	<4	2
DAP1 53-54	<4	<4	<2
DAP1 54-55	10	8	4
DAP1 55-56	4	4	6
DAP1 56-57	4	4	7
DAP1 57-58	<4	6	4
DAP1 58-59	4	<4	<2
DAP1 59-60	<4	4	11
DAP1 60-61	8	8	8
DAP1 61-62	4	8	6
DAP1 62-63	4	10	<2
DAP1 63-64	<4	8	<2
DAP1 64-65	6	<4	6
DAP1 65-66	<4	12	5
DAP1 66-67	6	22	2
DAP1 67-68	10	12	5
DAP1 68-69	8	<4	3
DAP1 69-70	<4	14	4
DAP1 70-71	4	12	5
DAP1 71-72	<4	8	4
DAP1 72-73	<4	14	14
DAP1 73-74	6	<4	6

UNITS
SCHEME

ppm
XRF1

ppm
XRF1

ppm
XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP1 74-75	<4	6	3
DAP1 75-76	6	10	4
DAP1 76-77	<4	4	10
DAP1 77-78	4	<4	16
DAP1 78-79	4	6	<2
DAP1 79-80	8	<4	9
DAP1 80-81	<4	20	8
DAP1 81-82	<4	8	8
DAP1 82-83	<4	12	8
DAP1 83-84	<4	12	4
DAP1 84-85	<4	6	8
DAP1 85-86	<4	4	12
DAP1 86-87	4	8	3
DAP1 87-88	6	10	4
DAP1 88-89	4	6	4
DAP1 89-90	6	16	7
DAP2 00-02	22	16	4
DAP2 02-04	30	8	2
DAP2 04-06	24	12	5
DAP2 06-08	20	6	<2
DAP2 08-10	46	14	3
DAP2 10-12	76	24	5
DAP2 12-14	190	6	7
DAP2 14-16	48	<4	2
DAP2 16-18	64	6	2
UNITS SCHEME	ppm XRF1	ppm XRF1	ppm XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP2 18-20	74	8	7
DAP2 20-22	32	8	3
DAP2 22-24	14	4	4
DAP2 24-26	42	<4	5
DAP2 26-28	26	4	9
DAP2 28-30	14	12	<2
DAP2 30-32	32	<4	8
DAP2 32-34	16	<4	<2
DAP2 34-36	12	6	9
DAP2 36-38	10	<4	5
DAP2 38-40	4	<4	5
DAP2 40-42	28	4	6
DAP2 42-44	18	<4	10
DAP2 44-46	12	<4	3
DAP2 46-48	10	<4	11
DAP2 48-50	14	<4	5
DAP2 50-52	12	8	9
DAP2 52-54	12	<4	5
DAP2 54-56	16	<4	3
DAP2 56-58	12	<4	5
DAP2 58-60	12	<4	3
DAP2 60-62	12	4	11
DAP2 62-64	8	20	4
DAP2 64-66	12	<4	5
DAP2 66-68	14	4	8

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP2 68-70	4	4	6
DAP2 70-72	16	10	2
DAP2 72-74	12	8	3
DAP2 74-76	12	10	6
DAP2 76-78	14	10	4
DAP2 78-80	10	<4	2
DAP2 80-82	8	<4	5
DAP2 82-84	12	10	<2
DAP2 84-86	18	<4	3
DAP2 86-88	14	6	4
DAP2 88-90	12	8	3
DAP2 90-92	16	<4	<2
DAP2 92-94	18	4	2
DAP2 94-96	18	<4	6
DAP3 00-02	58	20	5
DAP3 02-04	50	14	<2
DAP3 04-06	30	8	2
DAP3 06-08	34	8	<2
DAP3 08-10	68	18	6
DAP3 10-12	160	<4	5
DAP3 12-14	60	<4	6
DAP3 14-16	42	<4	8
DAP3 16-18	62	8	12
DAP3 18-20	64	8	11
DAP3 20-22	<4	4	6

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP3 22-24	<4	4	9
DAP3 24-26	<4	<4	6
DAP3 26-28	16	14	6
DAP3 28-30	4	<4	<2
DAP3 30-32	8	16	2
DAP3 32-34	14	20	6
DAP3 34-36	8	<4	7
DAP3 36-38	10	<4	3
DAP3 38-40	8	<4	3
DAP3 40-42	10	8	<2
DAP3 42-44	<4	16	8
DAP3 44-46	<4	4	3
DAP3 46-48	<4	<4	5
DAP3 48-50	16	4	9
DAP3 50-52	12	<4	13
DAP3 52-54	10	<4	8
DAP3 54-56	14	<4	7
DAP3 56-58	10	10	9
DAP3 58-60	12	<4	<2
DAP3 60-62	4	6	5
DAP3 62-64	16	4	<2
DAP3 64-66	6	<4	4
DAP3 66-68	10	8	8
DAP3 68-70	10	8	9
DAP3 70-72	4	8	3
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP3 72-74	12	4	5
DAP3 74-76	10	<4	7
DAP3 76-78	10	12	7
DAP4 00-02	72	14	8
DAP4 02-04	52	8	6
DAP4 04-06	100	4	8
DAP4 06-08	86	<4	17
DAP4 08-10	4	<4	4
DAP4 10-12	4	<4	9
DAP4 12-14	<4	6	5
DAP4 14-16	28	<4	4
DAP4 16-18	<4	12	3
DAP4 18-20	<4	10	<2
DAP4 20-22	<4	<4	<2
DAP4 22-24	<4	<4	3
DAP4 24-26	<4	6	5
DAP4 26-28	<4	8	5
DAP4 28-30	4	12	<2
DAP4 30-32	<4	6	<2
DAP4 32-34	<4	<4	8
DAP4 34-36	<4	<4	4
DAP4 36-38	10	4	6
DAP4 38-40	6	<4	7
DAP4 40-42	6	4	7
DAP4 42-44	8	<4	2
UNITS SCHEME	ppm XRF1	ppm XRF1	ppm XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
DAP4 44-46	6	<4	6
DAP4 46-48	<4	4	5
DAP4 48-50	14	<4	5
DAP4 50-52	10	6	2
DAP4 52-54	6	<4	7
DAP4 54-56	10	<4	2
DAP4 56-58	8	<4	6
DAP4 58-60	<4	<4	2
DAP4 60-62	6	<4	6
DAP4 62-64	6	<4	2
DAP4 64-66	<4	<4	6

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
LAP5 15-17	8	6	38	52	3.28
LAP5 18	18	<4	48	82	4.78
° UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C

CLASSIC COMLABS LTD

Analytical Laboratories (INC. IN WA.)

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4th January 1989

Our Ref : 8DN0913

REPORT NUMBER 8DN0913

CLIENT : Surtec Geosurveys Pty. Ltd.

CLIENT REFERENCE : Order Number 5037

REPORT COMPRISING : Cover Page
Pages 1 - 30

DATE RECEIVED : 8th December 1988

For Alan Ciplys
Manager
CLASSIC COMLABS LTD. (N.T.)

This report relates specifically to the sample(s) tested in so far as that the sample(s) is truly representative of the sample source as supplied.



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
CAP1 0 -2	5	4	5	8	0.79
CAP1 2 -4	4	<4	<2	8	0.45
CAP1 4 -6	4	4	3	8	0.74
CAP1 6 -8	3	8	3	6	0.46
CAP1 8 -10	4	<4	<2	6	0.44
CAP1 10-12	6	<4	<2	6	0.67
CAP1 12-14	4	<4	<2	8	0.46
CAP1 14-16	5	<4	5	6	0.43
CAP1 16-18	6	<4	8	8	0.47
CAP1 18-20	3	<4	<2	6	0.38
CAP1 20-22	3	<4	4	6	0.38
CAP1 22-24	4	<4	9	6	0.33
CAP1 24-26	3	<4	7	8	0.37
CAP1 26-28	5	<4	8	6	0.37
CAP1 28-30	4	4	<2	6	0.35
CAP1 30-32	3	<4	<2	6	0.32
CAP1 32-34	6	<4	6	10	0.35
CAP1 34-36	6	4	<2	8	0.31
CAP1 36-38	6	<4	<2	8	0.42
CAP1 38-40	7	<4	4	6	0.37
CAP1 40-42	6	<4	2	6	0.49
CAP1 42-44	58	<4	125	44	15.4
CAP1 44-46	10	6	110	66	6.85
CAP1 46-48	24	4	50	48	7.40
CAP1 48-50	78	<4	40	42	6.00
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
CAP1 50-52	52	6	40	32	4.38
JAP1 0 -2	5	6	22	14	0.90
JAP1 2 -4	3	<4	9	18	1.06
JAP1 4 -6	3	4	6	16	1.12
JAP1 6 -8	3	<4	5	28	1.46
JAP1 8 -10	4	4	6	12	0.54
JAP1 10-12	9	6	<2	22	1.12
JAP1 12-14	4	4	5	16	0.98
JAP1 14-16	5	8	11	30	2.00
JAP1 16-18	4	4	9	30	1.66
JAP1 18-20	4	4	11	28	1.53
JAP1 20-22	10	4	13	22	0.95
JAP1 22-24	12	8	6	28	1.69
JAP1 24-26	11	<4	11	32	1.59
JAP1 26-28	12	6	3	34	1.80
JAP1 28-30	6	6	10	32	2.62
JAP1 30-32	5	8	9	28	1.41
JAP1 32-34	4	<4	7	32	1.29
JAP1 34-36	6	<4	11	24	0.92
JAP1 36-38	5	10	6	26	1.30
JAP1 38-40	4	4	7	26	1.49
JAP1 40-42	4	<4	6	26	1.52
JAP1 42-44	34	<4	11	34	1.80
JAP1 44-46	11	<4	19	26	1.21
JAP1 46-48	7	4	15	28	2.00
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
JAP2 0 -2	9	4	4	12	1.00
JAP2 2 -4	6	<4	5	16	0.81
JAP2 4 -6	3	<4	4	14	1.50
JAP2 6 -8	5	4	9	18	1.23
JAP2 8 -10	5	4	6	22	0.98
JAP2 10-12	6	<4	10	14	0.78
JAP2 12-14	6	8	2	14	0.61
JAP2 14-16	3	<4	8	16	0.88
JAP2 16-18	4	<4	12	16	0.91
JAP2 18-20	5	8	16	18	0.63
JAP2 20-22	5	<4	6	14	0.75
JAP2 22-24	5	4	8	14	0.80
JAP2 24-26	4	6	6	20	1.87
JAP2 26-28	4	8	3	14	1.18
JAP2 28-30	9	8	8	6	1.03
JAP2 30-32	<2	<4	7	16	2.18
JAP2 32-34	<2	6	9	14	1.08
JAP2 34-36	4	8	3	8	1.28
JAP2 36-38	<2	10	5	4	1.44
JAP2 38-40	10	8	9	18	2.22
JAP2 40-42	4	8	12	22	2.46
JAP2 42-44	6	10	10	38	2.80
JAP2 44-46	2	10	15	26	2.34
JAP2 46-48	<2	32	11	36	2.78
MAP8 0 -2	8	16	5	20	12.2
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP8 2 -4	6	8	42	36	9.70
MAP8 4 -6	9	6	60	42	8.40
MAP8 6 -8	8	6	66	36	8.55
MAP8 8 -10	8	6	68	36	10.4
MAP8 10-12	<2	<4	80	38	10.7
MAP8 12-14	2	8	68	24	1.36
MAP8 14-16	8	8	74	32	8.20
MAP8 16-18	4	6	70	40	7.90
MAP8 18-20	2	<4	86	52	12.2
MAP8 20-22	5	12	66	30	9.05
MAP8 22-24	7	6	62	30	8.75
MAP8 24-26	7	6	48	22	10.7
MAP8 26-28	4	4	34	14	9.30
MAP8 28-30	10	12	38	14	7.80
MAP8 30-32	<2	6	66	18	8.20
MAP8 32-34	8	<4	88	24	11.9
MAP8 34-36	6	6	58	14	7.00
MAP8 36-38	6	4	62	16	9.15
MAP8 38-40	3	10	60	12	7.80
MAP8 40-42	9	8	50	18	7.45
MAP8 42-44	9	6	58	18	7.75
MAP8 44-46	14	6	64	16	7.85
MAP8 46-48	7	<4	48	18	7.15
MAP8 48-50	10	94	28	18	6.30
MAP8 50-52	12	4	15	18	5.20
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP8 52-54	<2	4	30	18	7.15
MAP8 54-56	26	<4	46	16	9.10
MAP8 56-58	8	4	46	20	7.30
MAP8 59	3	4	40	16	7.80
MAP7 0 -2	9	10	4	14	9.45
MAP7 2 -4	3	4	<2	10	12.0
MAP7 4 -6	7	<4	4	10	10.8
MAP7 6 -8	<2	<4	14	8	11.3
MAP7 8 -10	10	<4	17	4	8.60
MAP7 10-12	12	<4	24	12	7.90
MAP7 12-14	11	4	40	20	8.60
MAP7 14-16	<2	4	42	22	7.55
MAP7 16-18	6	<4	58	24	11.5
MAP7 18-20	6	32	80	30	7.40
MAP7 20-22	<2	6	80	40	6.65
MAP7 22-24	6	4	100	50	10.3
MAP7 24-26	5	8	60	44	7.10
MAP7 26-28	13	<4	34	32	3.54
MAP7 28-30	<2	<4	34	30	3.02
MAP7 30-32	9	4	34	36	3.42
MAP7 32-34	5	6	24	30	3.88
MAP7 34-36	6	4	24	34	3.94
MAP7 36-38	6	4	26	44	3.98
MAP7 38-40	4	4	30	34	3.06
MAP7 40-42	5	<4	38	34	2.76
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP7 42-44	8	6	42	32	3.32
MAP7 44-46	19	<4	40	34	2.48
MAP7 46-48	5	<4	32	18	7.00
MAP7 48-50	2	6	30	16	7.65
MAP7 50-52	<2	4	30	20	5.85
MAP7 52-54	12	8	30	12	7.05
MAP7 54-56	<2	8	32	30	5.30
MAP7 56-58	2	6	34	36	3.72
MAP7 59	2	6	32	30	3.50
MAP9 0 -2	8	10	5	18	7.05
MAP9 2 -4	15	8	3	10	5.55
MAP9 4 -6	13	4	12	16	2.88
MAP9 6 -8	11	4	28	16	6.50
MAP9 8 -10	22	6	42	26	7.85
MAP9 10-12	9	8	40	28	7.15
MAP9 12-14	38	8	32	26	4.22
MAP9 14-16	86	6	54	56	9.10
MAP9 16-18	110	4	58	66	9.75
MAP9 18-20	52	10	72	60	10.7
MAP9 20-22	30	38	80	54	10.6
MAP9 22-24	26	10	88	48	10.7
MAP9 24-26	19	6	115	52	9.25
MAP9 26-28	32	12	120	58	11.9
MAP9 28-30	62	74	80	52	9.90
MAP9 30-32	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP9 32-34	48	8	56	30	6.10
MAP9 34-36	38	8	66	28	5.05
MAP9 36-38	50	12	50	30	6.95
MAP9 38-40	42	10	58	26	6.75
MAP9 40-42	20	10	62	20	7.25
MAP9 42-44	22	14	66	22	6.80
MAP9 44-46	24	12	60	22	7.30
MAP9 46-48	20	12	70	12	6.60
MAP10 0 -2	22	6	3	12	13.2
MAP10 2 -4	11	4	2	12	3.92
MAP10 4 -6	9	4	<2	18	4.02
MAP10 6 -8	30	6	2	14	5.50
MAP10 8 -10	28	28	<2	6	3.32
MAP10 10-12	19	6	<2	8	3.06
MAP10 12-14	34	8	4	6	3.00
MAP10 14-16	86	4	46	30	5.60
MAP10 16-18	76	6	28	32	3.74
MAP10 18-20	32	<4	40	34	4.24
MAP10 20-22	36	<4	16	28	2.26
MAP10 22-24	32	8	24	22	3.38
MAP10 24-26	15	<4	20	14	2.18
MAP10 26-28	9	4	7	10	1.39
MAP10 28-30	13	4	14	16	2.18
MAP10 30-32	22	4	28	44	4.92
MAP10 32-34	24	8	<2	10	2.18
UNITS SCHEME UPPER SCHEME	ppm AAS1	ppm AAS1	ppm AAS1	ppm AAS1	% AAS1 AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP10 34-36	11	6	8	20	1.96
MAP10 36-38	17	4	12	30	2.04
MAP10 38-40	4	4	26	56	2.96
MAP10 40-42	4	<4	8	26	1.63
MAP10 42-44	6	<4	7	26	1.93
MAP10 44-46	10	6	18	30	2.64
MAP10 46-48	14	6	26	34	3.22
MAP1 0 -2	6	<4	<2	8	2.12
MAP1 2 -4	5	<4	<2	4	1.83
MAP1 4 -6	4	4	<2	10	1.35
MAP1 6 -8	8	6	<2	8	1.05
MAP1 8 -10	9	6	<2	<4	0.84
MAP1 10-12	2	<4	<2	<4	0.70
MAP1 12-14	6	6	24	6	0.73
MAP1 14-16	8	12	6	<4	0.61
MAP1 16-17	13	4	<2	6	0.73
MAP2 0 -2	3	<4	<2	10	1.51
MAP2 2 -4	6	<4	5	6	1.47
MAP2 4 -6	5	<4	<2	8	0.97
MAP2 6 -8	4	<4	3	8	0.66
MAP2 8 -10	<2	<4	5	8	0.94
MAP2 10-12	4	<4	4	8	0.79
MAP2 12-14	5	<4	4	6	0.64
MAP2 14-16	2	<4	4	6	0.67
MAP2 16-18	10	<4	<2	14	0.79
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP2 18-20	3	<4	<2	10	0.49
MAP2 20-22	5	<4	<2	4	0.56
MAP2 22-24	8	<4	<2	10	0.44
MAP2 24-26	7	<4	<2	8	0.46
MAP2 26-28	6	<4	<2	8	0.44
MAP2 28-30	6	<4	<2	8	0.56
MAP2 30-32	<2	<4	2	4	0.39
MAP2 32-34	9	<4	2	16	1.16
MAP2 34-36	7	<4	2	6	0.50
MAP2 36-38	4	<4	<2	12	0.67
MAP2 38-40	6	<4	2	8	0.49
MAP2 40-42	8	<4	<2	18	0.94
MAP2 42-44	<2	<4	<2	6	0.63
MAP2 44-46	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
MAP2 46-48	11	4	<2	16	0.96
MAP2 48-50	3	<4	2	6	0.46
MAP2 50-52	16	4	<2	14	1.77
MAP2 52-54	6	6	2	12	3.58
MAP2 54-56	11	4	17	30	6.20
MAP2 56-58	5	<4	26	24	6.20
MAP2 59	3	<4	26	20	6.05
MAP3 0 -2	7	20	6	10	7.10
MAP3 2 -4	15	24	4	20	5.05
MAP3 4 -6	8	30	5	6	6.00
MAP3 6 -8	18	8	14	16	4.36
UNITS SCHEME UPPER SCHEME	ppm AAS1	ppm AAS1	ppm AAS1	ppm AAS1	% AAS1 AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP3 8 -10	19	<4	14	18	3.54
MAP3 10-12	12	6	3	28	6.35
MAP3 12-14	16	4	3	32	6.75
MAP3 14-16	28	4	8	38	6.25
MAP3 16-18	28	<4	13	32	7.05
MAP3 18-20	68	<4	40	76	5.85
MAP3 20-22	28	<4	68	145	5.30
MAP3 22-24	4	<4	22	56	4.06
MAP3 24-26	<2	<4	32	66	3.16
MAP3 26-28	3	<4	18	70	3.16
MAP3 29	<2	<4	20	46	3.82
MAP3 29-31	7	<4	30	56	4.98
MAP3 31-33	3	<4	20	46	4.90
MAP3 33-35	<2	<4	28	44	4.62
MAP3 35-37	3	4	36	50	3.86
MAP3 37-39	4	<4	26	34	3.22
MAP3 39-41	3	4	20	44	3.12
MAP3 41-43	4	<4	24	48	3.94
MAP3 43-45	2	<4	22	48	4.18
MAP3 45-47	2	<4	24	70	4.16
MAP4 0 -2	9	4	10	24	7.45
MAP4 2 -4	14	<4	8	32	6.50
MAP4 4 -6	3	<4	26	32	7.65
MAP4 6 -8	4	<4	34	40	6.85
MAP4 8 -10	<2	<4	42	38	6.10
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



Job: 8AD3909
O/N: 8DN0913

ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP4 10-12	5	<4	52	44	6.75
MAP4 12-14	<2	<4	62	34	7.35
MAP4 14-16	7	<4	26	40	7.40
MAP4 16-18	7	<4	32	28	7.50
MAP4 18-20	5	<4	38	30	8.60
MAP4 20-22	2	<4	44	32	9.20
MAP4 22-24	11	4	30	38	4.92
MAP4 24-26	12	<4	24	30	3.34
MAP4 26-28	5	<4	22	32	2.98
MAP4 28-30	10	<4	30	22	5.15
MAP4 30-32	5	<4	28	20	5.05
MAP4 32-34	9	<4	22	38	4.76
MAP4 34-36	6	<4	17	70	4.44
MAP4 36-38	6	<4	44	14	6.60
MAP4 38-40	3	<4	40	6	6.40
MAP4 40-42	4	<4	36	8	6.30
MAP4 42-44	14	<4	15	22	5.00
MAP4 44-46	6	<4	22	30	3.32
MAP4 46-48	13	<4	11	26	3.42
MAP5 0 -2	7	10	8	<4	13.9
MAP5 2 -4	8	<4	17	24	8.75
MAP5 4 -6	9	<4	30	40	9.05
MAP5 6 -8	3	<4	32	26	7.20
MAP5 8 -10	7	<4	36	40	6.95
MAP5 10-12	6	<4	24	30	7.50
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP5 12-14	9	<4	19	20	6.10
MAP5 14-16	7	<4	22	36	4.80
MAP5 16-18	6	4	30	40	3.82
MAP5 18-20	14	<4	32	38	3.76
MAP5 20-22	7	<4	26	38	3.68
MAP5 22-24	6	<4	19	38	5.15
MAP5 24-26	10	<4	30	60	4.40
MAP5 26-28	5	<4	30	64	4.36
MAP5 28-30	7	<4	32	34	5.70
MAP5 30-32	13	<4	44	16	5.85
MAP5 32-34	7	<4	22	38	3.74
MAP5 34-36	6	<4	3	72	3.18
MAP5 36-38	<2	<4	22	82	3.26
MAP5 38-40	<2	6	24	76	3.26
MAP5 40-42	2	4	72	40	3.78
MAP5 42-44	3	4	40	34	3.32
MAP5 44-46	3	4	44	62	3.12
MAP5 46-48	6	<4	50	26	2.90
MAP5 48-50	15	<4	60	22	3.56
MAP5 50-52	9	<4	46	24	4.08
MAP5 52-54	<2	<4	44	6	6.10
MAP5 54-56	9	<4	28	26	5.40
MAP5 56-58	4	4	40	28	3.82
MAP5 58-60	2	<4	34	26	4.86
MAP6 0 -2	7	4	8	10	11.3
UNITS SCHEME UPPER SCHEME	ppm AAS1	ppm AAS1	ppm AAS1	ppm AAS1	% AAS1 AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP6 2 -4	10	<4	7	<4	5.45
MAP6 4 -6	7	4	17	10	7.00
MAP6 6 -8	12	<4	36	36	6.50
MAP6 8 -10	<2	<4	54	48	7.30
MAP6 10-12	2	<4	50	52	9.95
MAP6 12-14	<2	<4	32	28	6.70
MAP6 14-16	2	<4	24	30	6.05
MAP6 16-18	4	<4	15	32	3.80
MAP6 18-20	8	<4	11	36	3.28
MAP6 20-22	4	4	28	42	3.52
MAP6 22-24	2	<4	30	50	4.44
MAP6 24-26	7	6	24	32	4.00
MAP6 26-28	8	6	32	48	3.14
MAP6 28-30	<2	<4	36	72	3.96
MAP6 30-32	<2	<4	46	28	5.10
MAP6 32-34	<2	<4	34	32	4.82
MAP6 34-36	2	<4	32	30	4.36
MAP6 36-38	6	<4	15	52	3.38
MAP6 38-40	<2	<4	14	78	2.52
MAP6 40-42	5	6	26	84	3.20
MAP6 42-44	3	<4	20	74	2.96
MAP6 44-46	4	<4	56	32	4.70
MAP6 46-48	4	<4	42	40	4.42
MAP6 48-50	2	<4	36	44	3.58
MAP6 50-52	6	<4	28	32	3.20
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C



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ANALYTICAL REPORT

SAMPLE	Cu	Pb	Zn	Ni	Fe
MAP6 52-54	7	<4	38	28	3.54
MAP6 54-56	6	<4	56	14	4.00
MAP6 56-58	12	<4	58	10	4.80
MAP6 58-60	<2	<4	42	56	6.00
MAP6 60-62	5	<4	34	30	4.82
MAP6 62-64	6	<4	28	24	5.25
MAP6 65	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
DAP5 0 -2	28	22	16	26	7.80
DAP5 2 -4	62	32	26	18	4.74
DAP5 4 -6	84	10	26	36	3.20
DAP5 6 -8	88	<4	22	32	2.54
DAP5 8 -10	40	<4	64	140	6.60
DAP5 10-12	86	<4	74	180	7.30
DAP5 12-14	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
DAP5 14-16	88	<4	86	180	8.30
DAP5 16-18	140	<4	88	42	7.75
DAP5 18-20	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
DAP5 20-22	50	4	62	56	4.04
DAP5 22-24	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
DAP5 24-26	28	6	68	38	4.50
DAP5 26-28	38	<4	84	40	5.55
DAP5 28-30	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.
CAP1 52-54	52	<4	52	28	3.88
UNITS	ppm	ppm	ppm	ppm	%
SCHEME	AAS1	AAS1	AAS1	AAS1	AAS1
UPPER SCHEME					AAS1C

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ANALYTICAL REPORT

SAMPLE	U	Th	As
CAP1 0 -2	<4	44	4
CAP1 2 -4	<4	4	2
CAP1 4 -6	<4	18	<2
CAP1 6 -8	<4	30	3
CAP1 8 -10	<4	6	4
CAP1 10-12	4	58	<2
CAP1 12-14	4	8	5
CAP1 14-16	<4	4	2
CAP1 16-18	<4	20	5
CAP1 18-20	<4	16	4
CAP1 20-22	<4	<4	3
CAP1 22-24	<4	<4	<2
CAP1 24-26	<4	<4	<2
CAP1 26-28	4	4	2
CAP1 28-30	<4	<4	<2
CAP1 30-32	<4	4	<2
CAP1 32-34	<4	<4	<2
CAP1 34-36	<4	4	4
CAP1 36-38	<4	4	3
CAP1 38-40	<4	8	3
CAP1 40-42	<4	36	7
CAP1 42-44	6	10	<2
CAP1 44-46	<4	4	3
CAP1 46-48	4	<4	2
CAP1 48-50	<4	<4	5

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
CAP1 50-52	<4	<4	3
JAP1 0 -2	<4	10	5
JAP1 2 -4	<4	12	<2
JAP1 4 -6	<4	10	8
JAP1 6 -8	<4	<4	3
JAP1 8 -10	<4	8	2
JAP1 10-12	<4	10	5
JAP1 12-14	<4	10	<2
JAP1 14-16	4	16	2
JAP1 16-18	<4	10	4
JAP1 18-20	<4	8	4
JAP1 20-22	<4	8	<2
JAP1 22-24	<4	14	<2
JAP1 24-26	6	12	<2
JAP1 26-28	6	8	3
JAP1 28-30	4	14	2
JAP1 30-32	4	10	2
JAP1 32-34	<4	8	4
JAP1 34-36	<4	12	2
JAP1 36-38	<4	12	2
JAP1 38-40	<4	14	4
JAP1 40-42	<4	16	3
JAP1 42-44	4	6	5
JAP1 44-46	<4	14	3
JAP1 46-48	<4	6	5

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
JAP2 0 -2	<4	8	2
JAP2 2 -4	<4	10	3
JAP2 4 -6	<4	8	2
JAP2 6 -8	<4	6	3
JAP2 8 -10	<4	10	5
JAP2 10-12	<4	12	<2
JAP2 12-14	4	<4	<2
JAP2 14-16	<4	6	6
JAP2 16-18	<4	10	7
JAP2 18-20	<4	14	2
JAP2 20-22	<4	10	3
JAP2 22-24	<4	10	5
JAP2 24-26	<4	12	<2
JAP2 26-28	<4	12	6
JAP2 28-30	4	12	<2
JAP2 30-32	<4	14	6
JAP2 32-34	<4	14	3
JAP2 34-36	<4	4	<2
JAP2 36-38	<4	14	6
JAP2 38-40	6	6	2
JAP2 40-42	<4	20	<2
JAP2 42-44	<4	6	2
JAP2 44-46	<4	16	<2
JAP2 46-48	<4	16	3
MAP8 0 -2	6	10	10

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP8 2 -4	8	<4	4
MAP8 4 -6	4	<4	6
MAP8 6 -8	4	<4	5
MAP8 8 -10	12	<4	6
MAP8 10-12	<4	6	4
MAP8 12-14	<4	<4	2
MAP8 14-16	<4	<4	4
MAP8 16-18	<4	<4	3
MAP8 18-20	<4	<4	2
MAP8 20-22	<4	4	4
MAP8 22-24	<4	<4	3
MAP8 24-26	<4	14	4
MAP8 26-28	6	<4	6
MAP8 28-30	<4	4	6
MAP8 30-32	<4	<4	6
MAP8 32-34	<4	<4	4
MAP8 34-36	<4	<4	6
MAP8 36-38	<4	<4	<2
MAP8 38-40	<4	<4	11
MAP8 40-42	<4	6	11
MAP8 42-44	<4	<4	17
MAP8 44-46	<4	<4	11
MAP8 46-48	6	<4	12
MAP8 48-50	<4	<4	14
MAP8 50-52	<4	<4	17

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP8 52-54	<4	<4	10
MAP8 54-56	<4	<4	10
MAP8 56-58	<4	<4	6
MAP8 59	<4	<4	6
MAP7 0 -2	18	4	14
MAP7 2 -4	24	16	15
MAP7 4 -6	8	<4	2
MAP7 6 -8	<4	16	8
MAP7 8 -10	8	14	10
MAP7 10-12	<4	6	<2
MAP7 12-14	8	8	<2
MAP7 14-16	8	8	10
MAP7 16-18	6	<4	<2
MAP7 18-20	10	16	4
MAP7 20-22	16	4	<2
MAP7 22-24	16	8	10
MAP7 24-26	12	6	8
MAP7 26-28	10	12	2
MAP7 28-30	6	20	<2
MAP7 30-32	<4	10	9
MAP7 32-34	4	10	4
MAP7 34-36	8	12	2
MAP7 36-38	4	8	8
MAP7 38-40	14	14	2
MAP7 40-42	<4	12	4
UNITS SCHEME	ppm XRF1	ppm XRF1	ppm XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP7 42-44	10	14	7
MAP7 44-46	6	12	7
MAP7 46-48	6	8	4
MAP7 48-50	4	4	2
MAP7 50-52	8	14	5
MAP7 52-54	<4	10	2
MAP7 54-56	6	12	6
MAP7 56-58	<4	16	8
MAP7 59	6	10	2
MAP9 0 -2	<4	8	16
MAP9 2 -4	4	6	7
MAP9 4 -6	<4	<4	8
MAP9 6 -8	<4	12	7
MAP9 8 -10	<4	8	8
MAP9 10-12	<4	6	7
MAP9 12-14	<4	16	4
MAP9 14-16	<4	<4	4
MAP9 16-18	<4	<4	3
MAP9 18-20	<4	4	5
MAP9 20-22	4	4	10
MAP9 22-24	<4	12	<2
MAP9 24-26	<4	10	9
MAP9 26-28	6	10	4
MAP9 28-30	<4	<4	8
MAP9 30-32	L.N.R.	L.N.R.	L.N.R.

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP9 32-34	<4	6	4
MAP9 34-36	<4	8	3
MAP9 36-38	<4	<4	<2
MAP9 38-40	6	4	6
MAP9 40-42	<4	4	3
MAP9 42-44	<4	<4	<2
MAP9 44-46	<4	6	9
MAP9 46-48	4	6	<2
MAP10 0 -2	4	10	52
MAP10 2 -4	<4	10	8
MAP10 4 -6	<4	10	8
MAP10 6 -8	4	12	8
MAP10 8 -10	<4	6	5
MAP10 10-12	<4	6	7
MAP10 12-14	4	16	4
MAP10 14-16	<4	6	6
MAP10 16-18	<4	10	12
MAP10 18-20	4	<4	16
MAP10 20-22	<4	10	5
MAP10 22-24	<4	8	9
MAP10 24-26	4	10	6
MAP10 26-28	6	8	7
MAP10 28-30	<4	4	24
MAP10 30-32	<4	8	94
MAP10 32-34	<4	8	17

UNITS
SCHEME

ppm
XRF1

ppm
XRF1

ppm
XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP10 34-36	6	20	13
MAP10 36-38	<4	10	6
MAP10 38-40	4	16	9
MAP10 40-42	<4	10	<2
MAP10 42-44	4	8	6
MAP10 44-46	<4	18	14
MAP10 46-48	<4	10	17
MAP1 0 -2	<4	8	8
MAP1 2 -4	<4	12	10
MAP1 4 -6	8	32	7
MAP1 6 -8	6	38	7
MAP1 8 -10	4	40	9
MAP1 10-12	<4	32	8
MAP1 12-14	8	44	10
MAP1 14-16	10	78	14
MAP1 16-17	10	74	12
MAP2 0 -2	4	8	11
MAP2 2 -4	<4	12	5
MAP2 4 -6	<4	<4	7
MAP2 6 -8	<4	10	5
MAP2 8 -10	<4	8	5
MAP2 10-12	12	18	8
MAP2 12-14	18	26	8
MAP2 14-16	14	28	8
MAP2 16-18	6	8	2
UNITS SCHEME	ppm XRF1	ppm XRF1	ppm XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP2 18-20	10	8	6
MAP2 20-22	<4	10	7
MAP2 22-24	4	6	2
MAP2 24-26	10	4	7
MAP2 26-28	<4	4	2
MAP2 28-30	<4	<4	<2
MAP2 30-32	<4	<4	<2
MAP2 32-34	<4	<4	2
MAP2 34-36	<4	<4	4
MAP2 36-38	<4	<4	5
MAP2 38-40	6	4	6
MAP2 40-42	4	<4	3
MAP2 42-44	<4	8	5
MAP2 44-46	L.N.R.	L.N.R.	L.N.R.
MAP2 46-48	6	<4	7
MAP2 48-50	<4	<4	<2
MAP2 50-52	42	4	22
MAP2 52-54	14	<4	84
MAP2 54-56	<4	8	88
MAP2 56-58	<4	<4	54
MAP2 59	6	8	32
MAP3 0 -2	50	20	17
MAP3 2 -4	28	8	12
MAP3 4 -6	24	8	52
MAP3 6 -8	26	8	13
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP3 8 -10	38	16	9
MAP3 10-12	60	6	<2
MAP3 12-14	80	6	7
MAP3 14-16	130	12	8
MAP3 16-18	140	6	6
MAP3 18-20	240	4	3
MAP3 20-22	165	12	2
MAP3 22-24	46	14	3
MAP3 24-26	30	16	7
MAP3 26-28	6	12	6
MAP3 29	14	8	2
MAP3 29-31	26	10	5
MAP3 31-33	24	12	9
MAP3 33-35	34	6	5
MAP3 35-37	22	12	12
MAP3 37-39	18	8	7
MAP3 39-41	26	14	7
MAP3 41-43	34	16	3
MAP3 43-45	14	10	6
MAP3 45-47	18	8	4
MAP4 0 -2	8	16	13
MAP4 2 -4	16	10	2
MAP4 4 -6	18	10	3
MAP4 6 -8	18	16	<2
MAP4 8 -10	22	16	5

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP4 10-12	34	8	14
MAP4 12-14	18	8	12
MAP4 14-16	16	6	12
MAP4 16-18	14	4	8
MAP4 18-20	14	12	5
MAP4 20-22	4	6	7
MAP4 22-24	74	14	5
MAP4 24-26	12	18	5
MAP4 26-28	<4	10	2
MAP4 28-30	<4	4	3
MAP4 30-32	8	8	5
MAP4 32-34	4	4	4
MAP4 34-36	<4	<4	3
MAP4 36-38	<4	<4	4
MAP4 38-40	<4	<4	10
MAP4 40-42	4	10	8
MAP4 42-44	6	<4	7
MAP4 44-46	8	<4	3
MAP4 46-48	<4	6	19
MAP5 0 -2	48	22	14
MAP5 2 -4	40	10	7
MAP5 4 -6	30	10	3
MAP5 6 -8	10	14	2
MAP5 8 -10	6	16	4
MAP5 10-12	8	<4	4

UNITS
SCHEMEppm
XRF1ppm
XRF1ppm
XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP5 12-14	12	6	3
MAP5 14-16	12	16	3
MAP5 16-18	22	24	<2
MAP5 18-20	20	14	<2
MAP5 20-22	4	10	2
MAP5 22-24	10	<4	3
MAP5 24-26	4	8	3
MAP5 26-28	<4	6	<2
MAP5 28-30	8	<4	4
MAP5 30-32	8	6	<2
MAP5 32-34	4	<4	5
MAP5 34-36	12	<4	<2
MAP5 36-38	14	<4	5
MAP5 38-40	14	6	6
MAP5 40-42	<4	4	3
MAP5 42-44	<4	<4	2
MAP5 44-46	<4	4	3
MAP5 46-48	<4	<4	4
MAP5 48-50	<4	4	<2
MAP5 50-52	<4	<4	2
MAP5 52-54	4	<4	5
MAP5 54-56	8	10	<2
MAP5 56-58	<4	4	2
MAP5 58-60	<4	8	5
MAP6 0 -2	52	22	6

UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP6 2 -4	20	10	6
MAP6 4 -6	18	22	<2
MAP6 6 -8	30	20	3
MAP6 8 -10	12	<4	2
MAP6 10-12	8	10	<2
MAP6 12-14	6	6	2
MAP6 14-16	18	8	6
MAP6 16-18	16	6	5
MAP6 18-20	32	14	5
MAP6 20-22	18	14	4
MAP6 22-24	6	6	3
MAP6 24-26	6	4	4
MAP6 26-28	<4	<4	9
MAP6 28-30	4	10	4
MAP6 30-32	8	8	<2
MAP6 32-34	8	18	3
MAP6 34-36	16	6	4
MAP6 36-38	<4	<4	4
MAP6 38-40	4	<4	5
MAP6 40-42	16	6	7
MAP6 42-44	16	4	4
MAP6 44-46	<4	<4	6
MAP6 46-48	<4	12	3
MAP6 48-50	<4	<4	3
MAP6 50-52	<4	<4	<2

UNITS
SCHEMEppm
XRF1ppm
XRF1ppm
XRF1

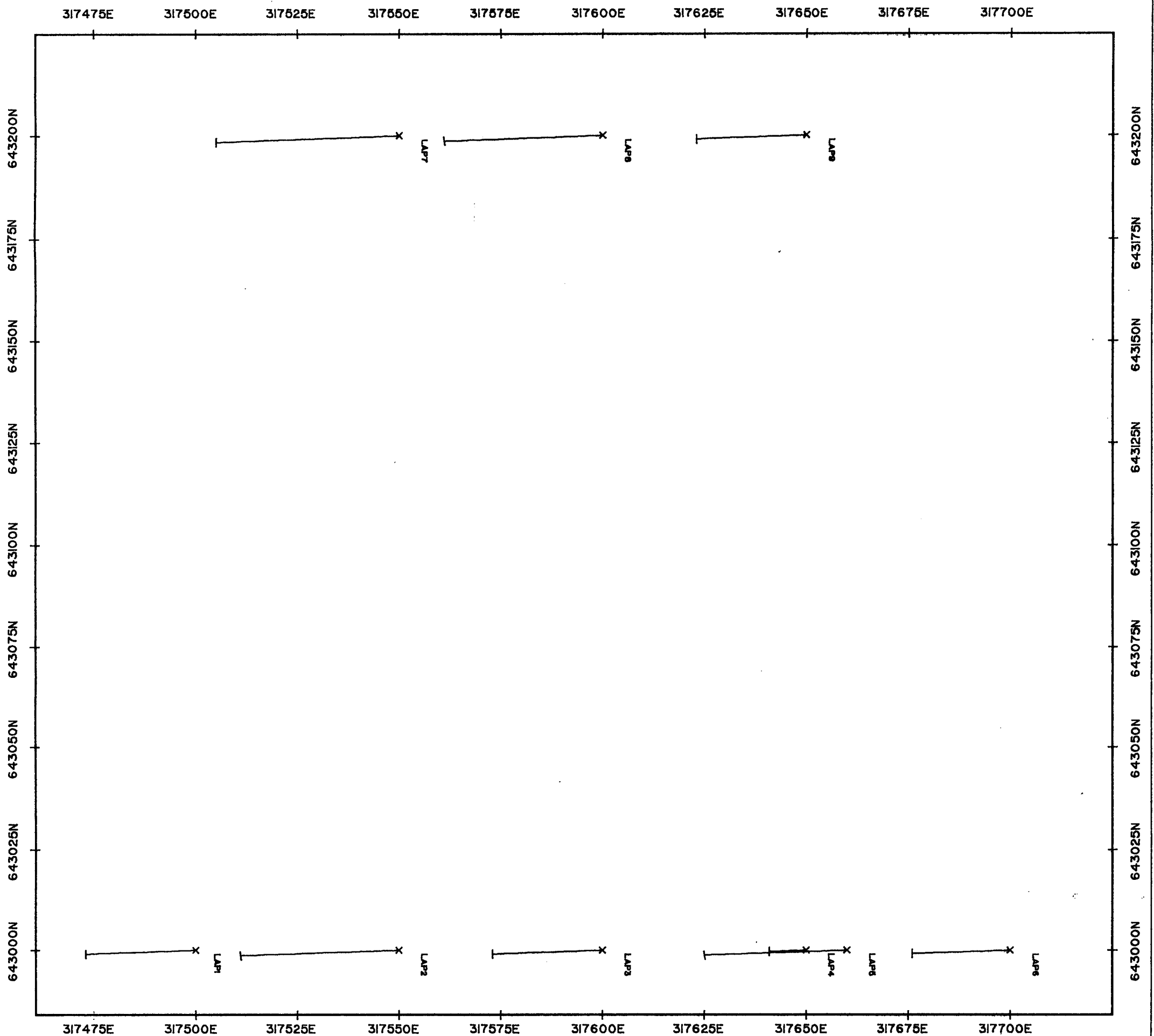


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ANALYTICAL REPORT

SAMPLE	U	Th	As
MAP6 52-54	<4	<4	2
MAP6 54-56	4	<4	3
MAP6 56-58	<4	12	<2
MAP6 58-60	8	10	7
MAP6 60-62	6	8	8
MAP6 62-64	8	16	8
MAP6 65	L.N.R.	L.N.R.	L.N.R.
DAP5 0 -2	180	16	10
DAP5 2 -4	165	12	7
DAP5 4 -6	82	10	2
DAP5 6 -8	92	20	3
DAP5 8 -10	84	10	8
DAP5 10-12	30	<4	11
DAP5 12-14	L.N.R.	L.N.R.	L.N.R.
DAP5 14-16	30	<4	9
DAP5 16-18	18	4	9
DAP5 18-20	L.N.R.	L.N.R.	L.N.R.
DAP5 20-22	4	<4	4
DAP5 22-24	L.N.R.	L.N.R.	L.N.R.
DAP5 24-26	<4	14	4
DAP5 26-28	8	10	6
DAP5 28-30	L.N.R.	L.N.R.	L.N.R.
CAP1 52-54	8	<4	4
UNITS	ppm	ppm	ppm
SCHEME	XRF1	XRF1	XRF1



SURTEC

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DATA ACQUISITION
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SURTEC GEOSURVEYS PTY LTD

0 10 20 30 40 50
m SCALE 1:1000 m

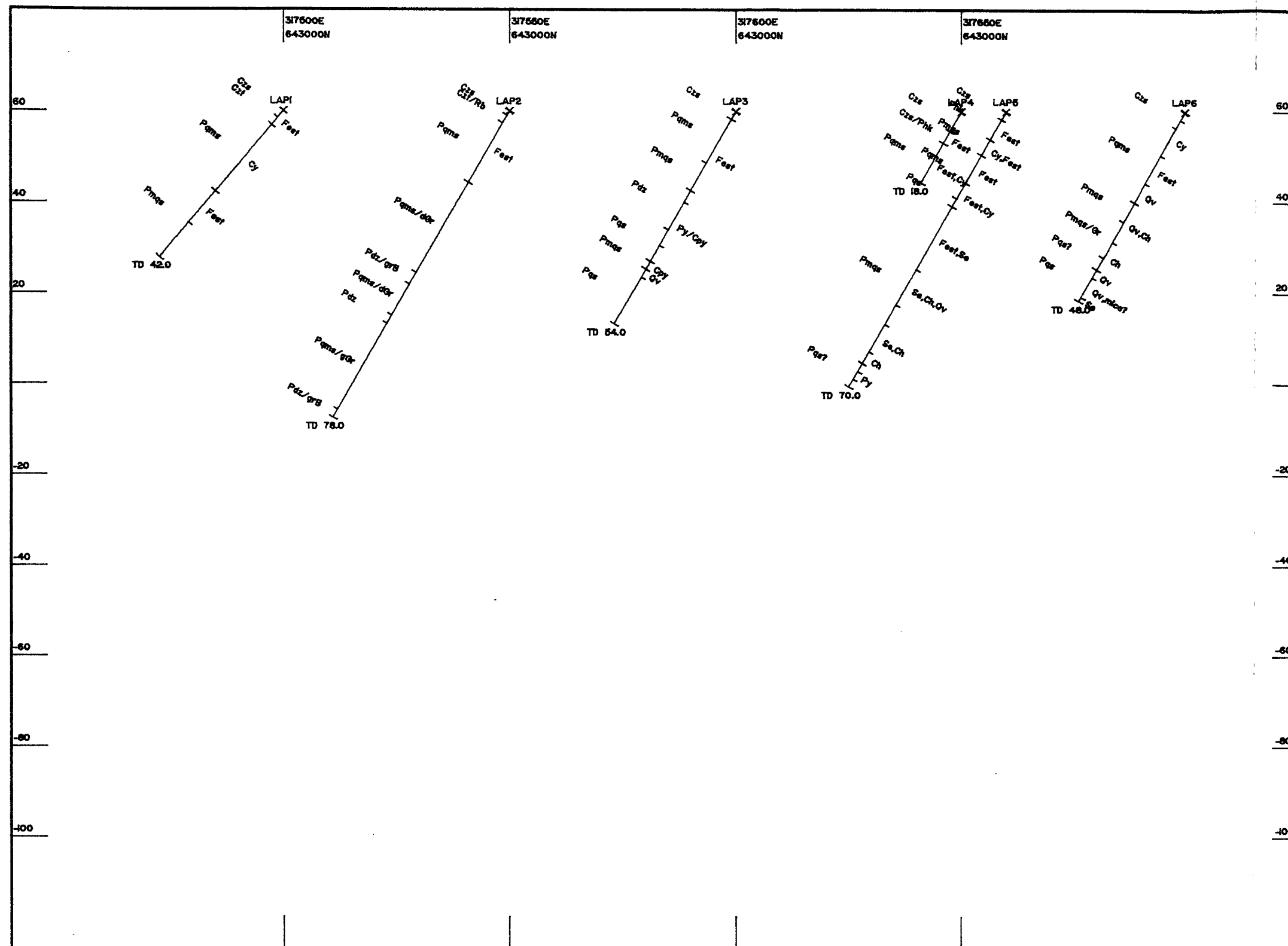
QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (Libby's)

PLAN VIEW DRILLING PROGRAM

Author: DR.N.F.RUTHERFORD	Scale: 1:1000
Drawn: C.J.DEDMAN	Comp. No. Drawing No.
Date: MAR. 89	LIBPLAN Figure 21



REFERENCE	
L.H.S	GEOLOGY/COLOUR
GEOLOGY	
Czs	- Cainozoic sand
Czt	- Talus/scree/sandstone, schist
Czi	- lateritic scree/laterite
Phk	- Kombolgie sandstone
Pds	- Oenpelli Dolerite
Pdz	- Zamu Dolerite
Amp	- Amphibolite
Qzite	- Quartzite
Pox	- undifferentiated schist
Pqs	- quartz schist
Pmq	- mica quartz schist
Pms	- quartz mica schist
Qz Breccia	- quartz breccia
COLOUR	
rb	- red brown
yB	- yellow brown
gb	- grey brown
grG	- green grey
gGr	- grey green
d.gr	- dark green
grB	- green black
yGr	- yellow green
gWh	- grey white
bR	- brown red
gP	- grey pink
R.H.S	ALTERATION/MINERALISATION
ALTERATION	
Ch	- Chlorite Alteration
Cy	- Clay (replacement)
fest	- Iron stained
Se	- sericite
lt	- laterite
Haem	- haematite
MINERALISATION	
Py	- pyrite
Cpy	- chalcopyrite
Qv	- quartz veining
Biot	- Biotite

SURTEC

SURVEY CONTROL
DATA ACQUISITION
MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

0 10 20 30 40 50
m SCALE 1:1000 m

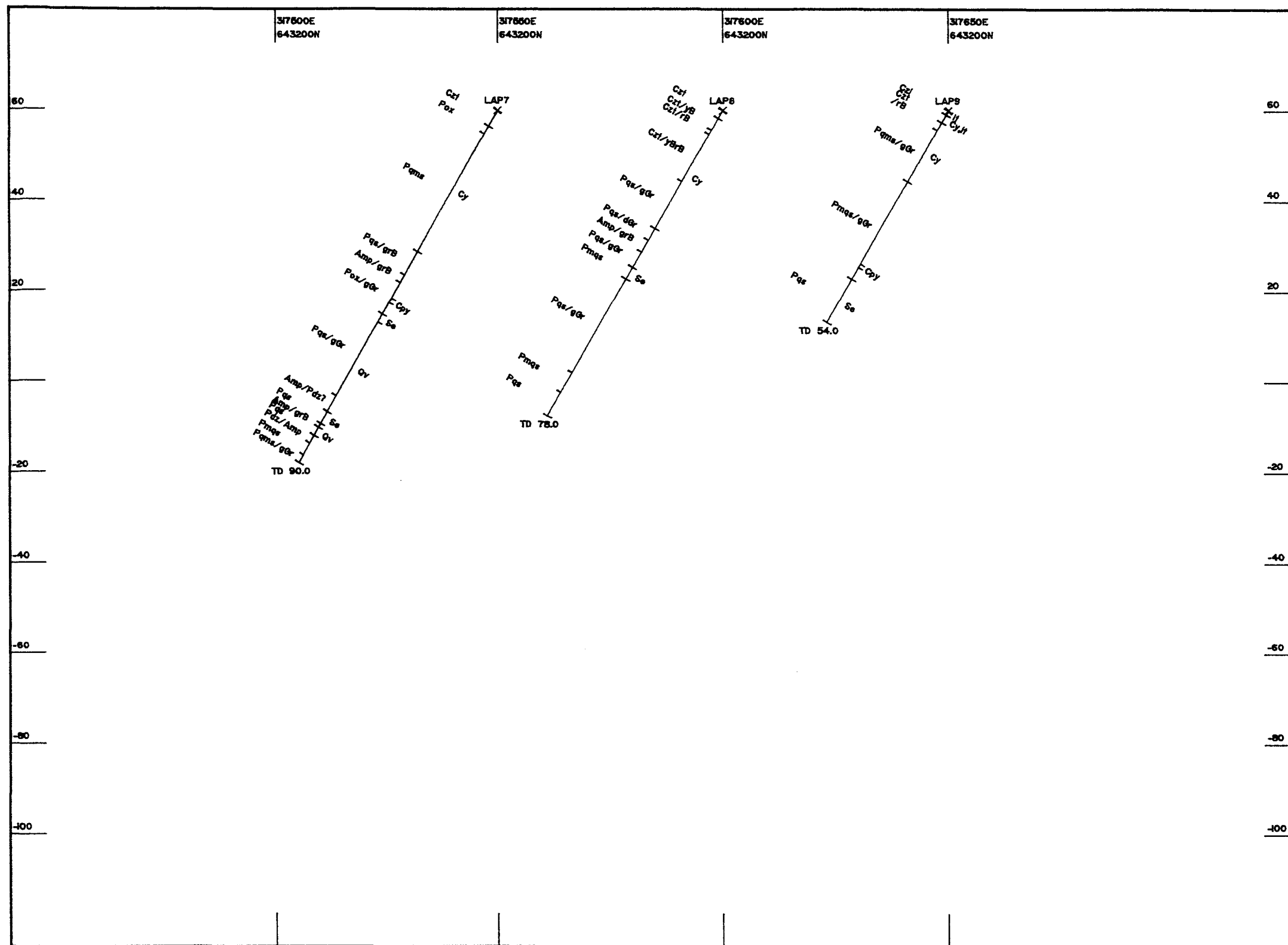
QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (Libby's)

GEOLOGY/COLOUR : ALTERATION/MINERALISATION

Author: DR. N.F.RUTHERFORD	Scale: 1:1000	
Drawn: C.J.DEDMAN	Comp. No.	Drawing No.
Date: MAR.89	L3000G	Figure 22



REFERENCE	
L.H.S	GEOLOGY/COLOUR
GEOLOGY	
Czs	- Cainozoic sand
Czt	- Talus/scree/sandstone, schist
Czl	- lateritic scree/latefite
Phk	- Kombolgie sandstone
Pdo	- Denpall Dolerite
Pdz	- Zamu Dolerite
Amp	- Amphibolite
Qzite	- Quartzite
Pox	- undifferentiated schist
Pqs	- quartz schist
Pmqs	- mica quartz schist
Pqms	- quartz mica schist
Qz Breccia	- quartz breccia
COLOUR	
rb	- red brown
yB	- yellow brown
gb	- grey brown
grG	- green grey
gGr	- grey green
d.gr	- dark green
grB	- green black
yGr	- yellow green
gWh	- grey white
bR	- brown red
gP	- grey pink
R.H.S	ALTERATION/MINERALISATION
ALTERATION	
Ch	- Chlorite Alteration
Cy	- Clay (replacement)
Iest	- Iron stained
Se	- sericite
lt	- laterite
Haem	- haematite
MINERALISATION	
Py	- pyrite
Cpy	- chalcopyrite
Qv	- quartz veining
Biot	- Biotite

SURTEC

SURVEY CONTROL
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MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

0 10 20 30 40 50
m
SCALE 1:1000

QUEENSLAND MINES LTD

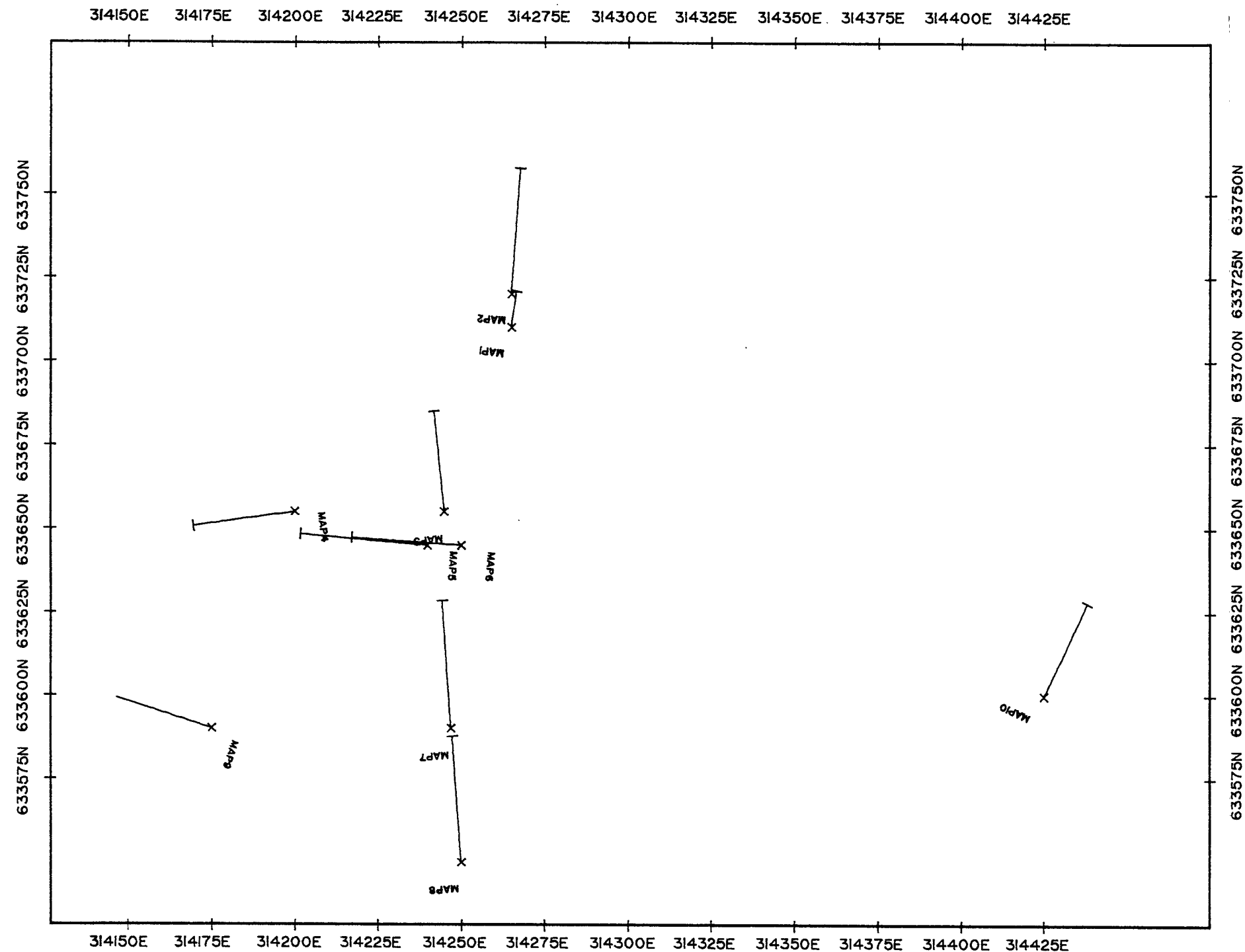
ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (Libby's)

GEOLOGY/COLOUR : ALTERATION/MINERALISATION

Author: DR. N.F.RUTHERFORD	Scale: 1:1000
Drawn: C.J.DEDMAN	Comp. No.
Date: MAR.89	Drawing No.
	L3200G
	Figure 27

REFERENCE



SURTEC

SURVEY CONTROL
DATA ACQUISITION
MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

0 15 30 45 60 75
m
SCALE 1:1500
m

QUEENSLAND MINES LTD

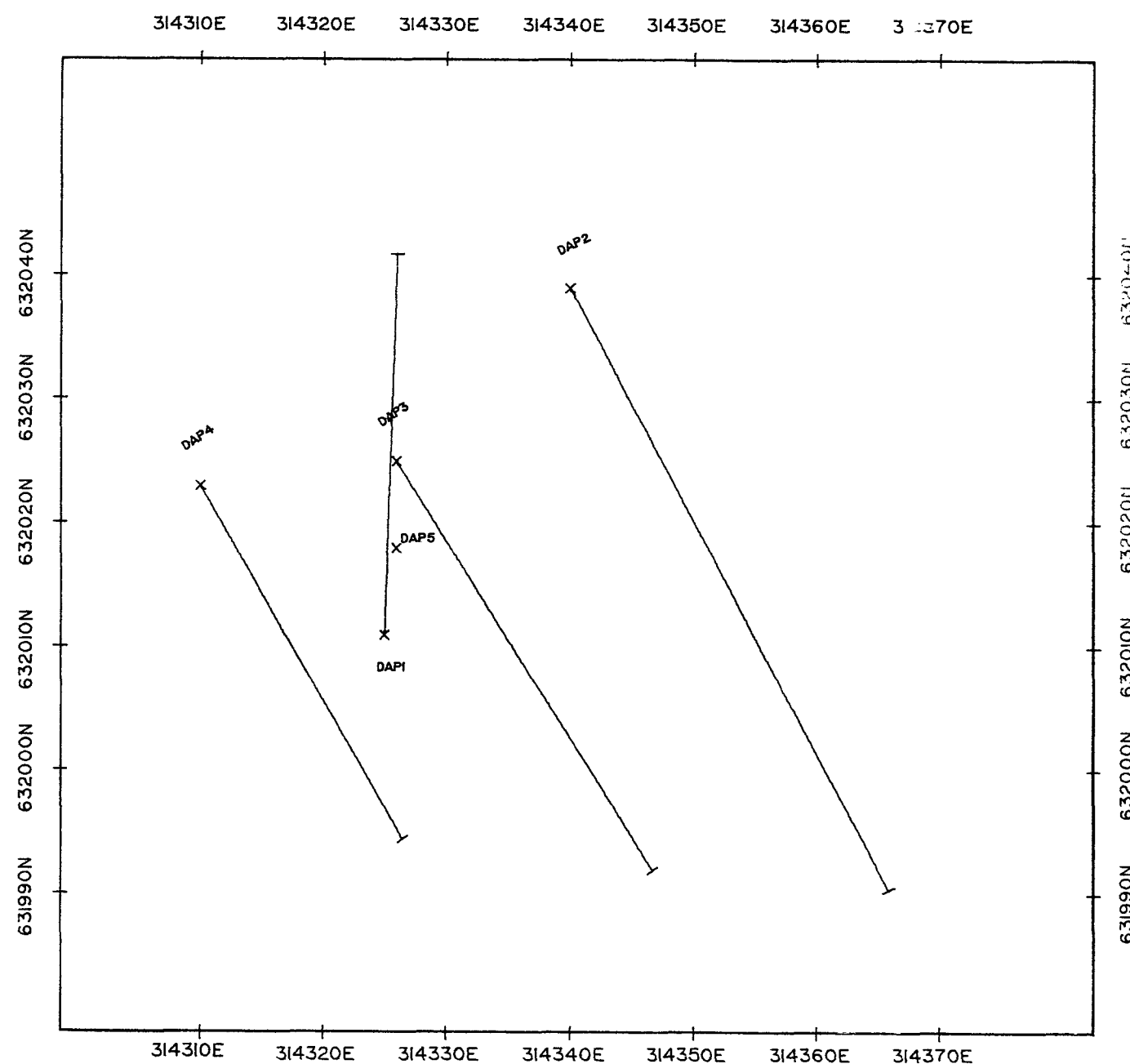
ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (Michael's)

PLAN VIEW DRILLING PROGRAM

Author: DR. N.F.RUTHERFORD	Scale: 1:1500
Drawn: C.J.DEDMAN	Comp. No.
Date: MAR.89	Drawing No.
	MPLAN Figure 74

REFERENCE



SURTEC

SURVEY CONTROL
DATA ACQUISITION
MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

0 5 10 15 20 25
m SCALE 1:500 m

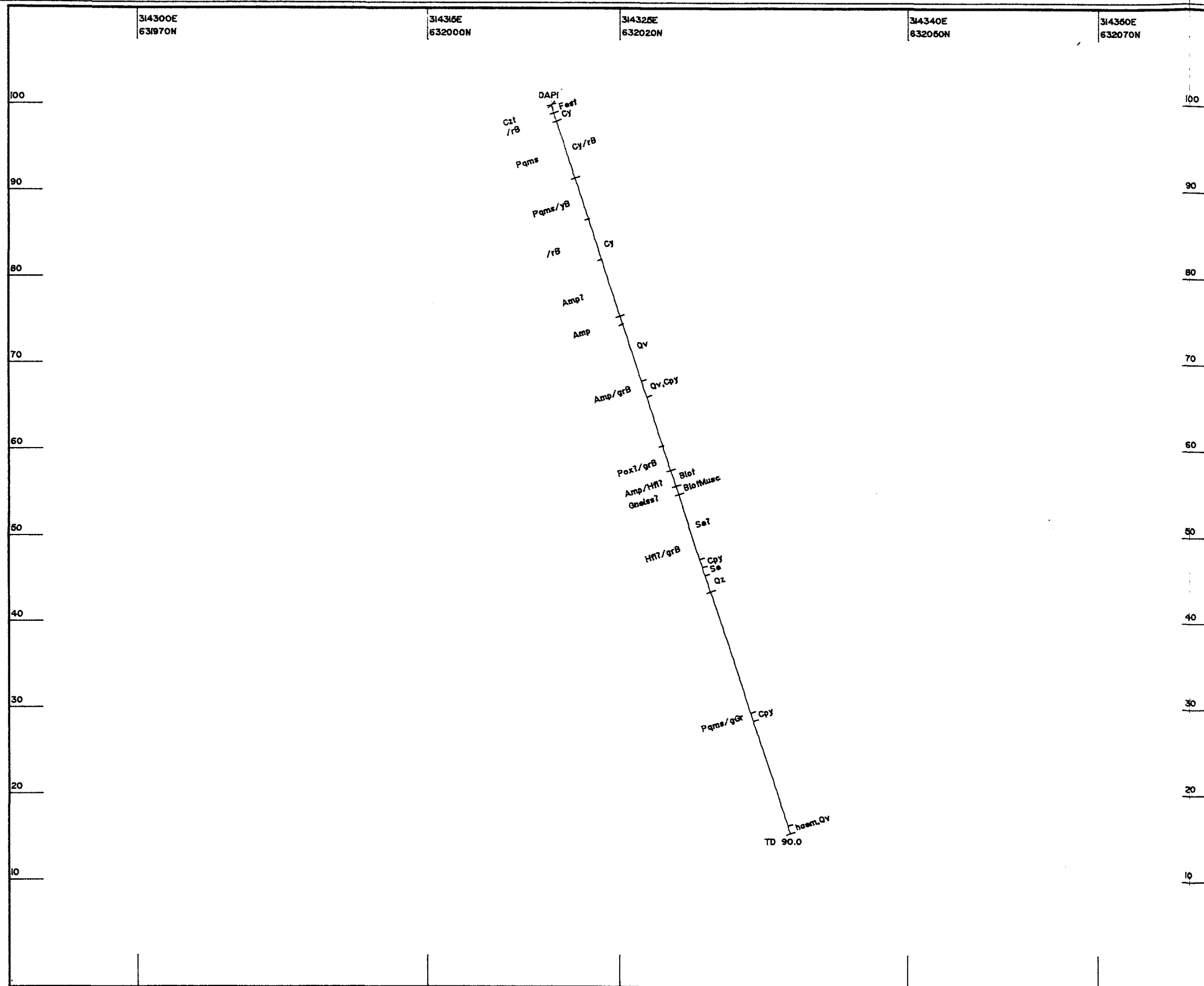
QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41

PLAN VIEW DRILLING PROGRAM

Author: DR. N.F.RUTHERFORD	Scale: 1:500
Drawn: C.J.DEDMAN	Comp. No. Drawing No.
Date: MAR.89	DPLAN Figure 105



REFERENCE	
L.H.S	GEOLOGY/COLOUR
GEOLOGY	
Czs	- Cainozoic sand
Czf	- Talus/scree;sandstone, schist
Czl	- lateritic scree;laterite
Phk	- Kombolgie sandstone
Pda	- Oenpelli Dolerite
Pdz	- Zamu Dolerite
Amp	- Amphibolite
Qzite	- Quartzite
Pox	- undifferentiated schist
Pqs	- quartz schist
Pmqs	- mica quartz schist
Pqms	- quartz mica schist
Qz Breccia	- quartz breccia
COLOUR	
rb	- red brown
yB	- yellow brown
gb	- grey brown
grG	- green grey
gGr	- grey green
d.gr	- dark green
grB	- green black
yGr	- yellow green
gWh	- grey white
BR	- brown red
gP	- grey pink
R.H.S	ALTERATION/MINERALISATION
ALTERATION	
Ch	- Chlorite Alteration
Cy	- Clay (replacement)
fest	- Iron stained
Se	- sericite
lt	- laterite
Haem	- haematite
MINERALISATION	
Py	- pyrite
Cpy	- chalcopyrite
Qv	- quartz veining
Biot	- Biotite

SURTEC

SURVEY CONTROL
DATA ACQUISITION
MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

0 5 10 15 20 25
m SCALE 1:500 m

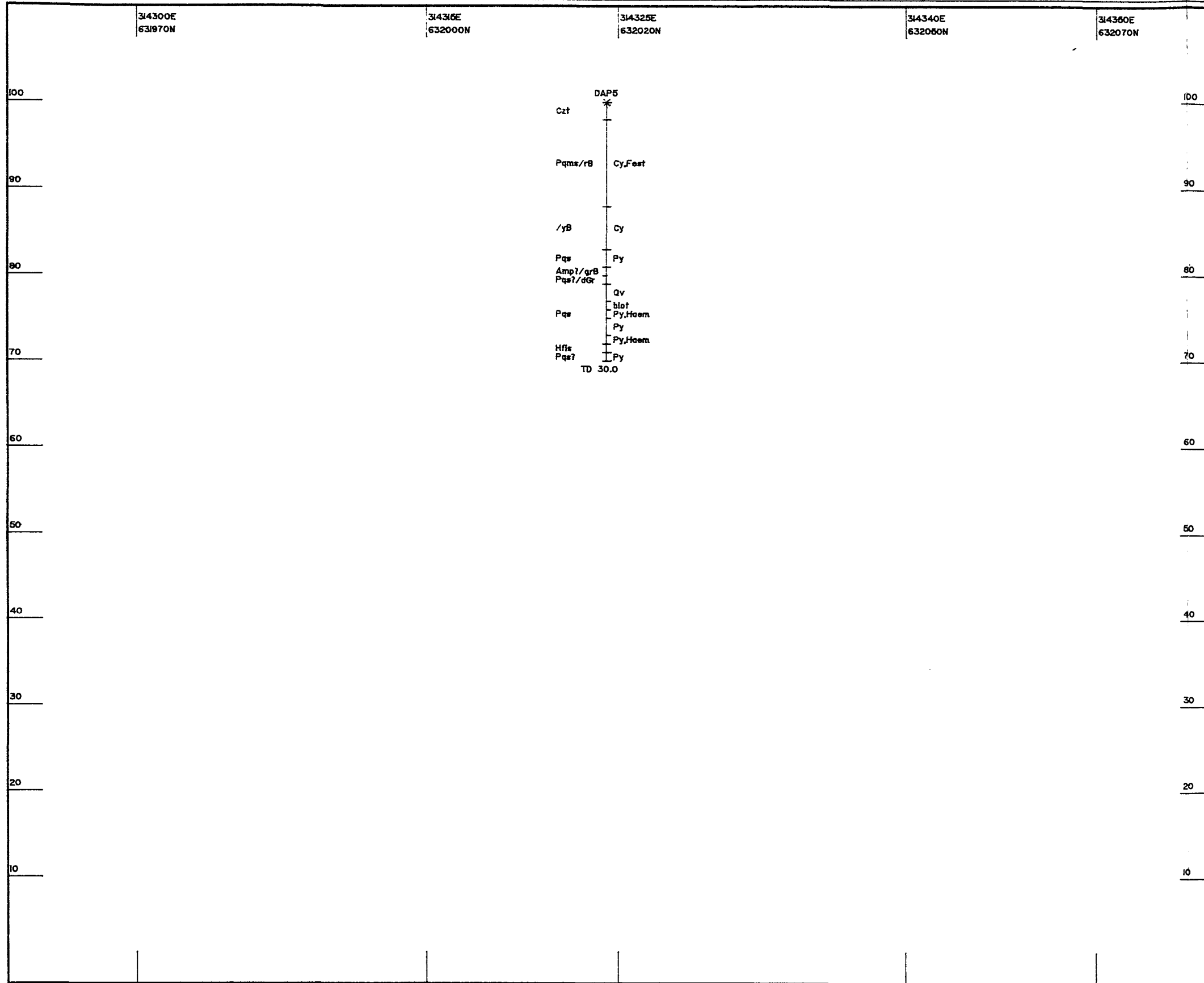
QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41

GEOLOGY/COLOUR : ALTERATION/MINERALISATION

Author: DR. N.F.RUTHERFORD	Scale: 1:500	
Drawn: C.J.DEDMAN	Comp. No.	Drawing No.
Date: MAR.89	D1G	Figure 106



REFERENCE

L.H.S GEOLOGY/COLOUR

GEOLOGY

Czs - Cainozoic sand
Czt - Talus/scree;sandstone, schist
Czl - lateritic scree;laterite
Phk - Kombolgie sandstone
Pdo - Oenpelli Dolerite
Pdz - Zamu Dolerite
Amp - Amphibolite
Qzite - Quartzite
Pox - undifferentiated schist
Pqs - quartz schist
Pmqs - mica quartz schist
Pqms - quartz mica schist
Qz Breccia - quartz breccia

COLOUR

rb - red brown
yB - yellow brown
gb - grey brown
grG - green grey
gGr - grey green
d.gr - dark green
grB - green black
yGr - yellow green
gWh - grey white
BR - brown red
gP - grey pink

R.H.S ALTERATION/MINERALISATION

ALTERATION

Ch - Chlorite Alteration
Cy - Clay (replacement)
fest - Iron stained
Se - sericite
lt - laterite
Haem - haematite

MINERALISATION

Py - pyrite
Cpy - chalcopyrite
Qv - quartz veining
Biot - Biotite

SURTEC

SURVEY CONTROL
DATA ACQUISITION
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SURTEC GEOSURVEYS PTY LTD

0 5 10 15 20 25
m SCALE 1:500 m

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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41

GEOLOGY/COLOUR : ALTERATION/MINERALISATION

Author: DR. N.F.RUTHERFORD

Scale: 1:500

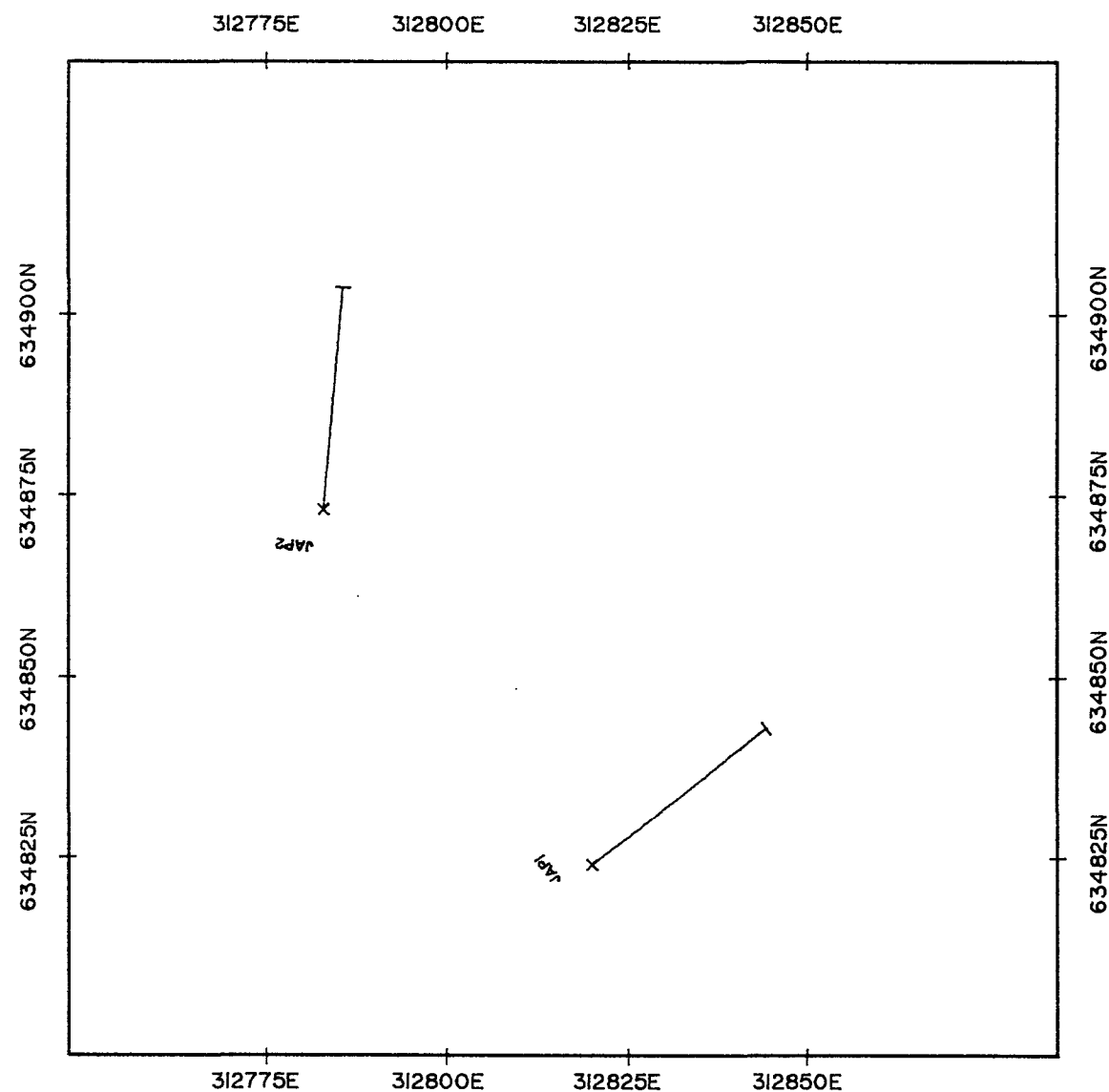
Drawn: C.J.DEDMAN

Comp. No. Drawing No.

Date: MAR.89

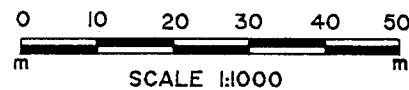
D5G Figure 116

REFERENCE



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SURTEC GEOSURVEYS PTY LTD



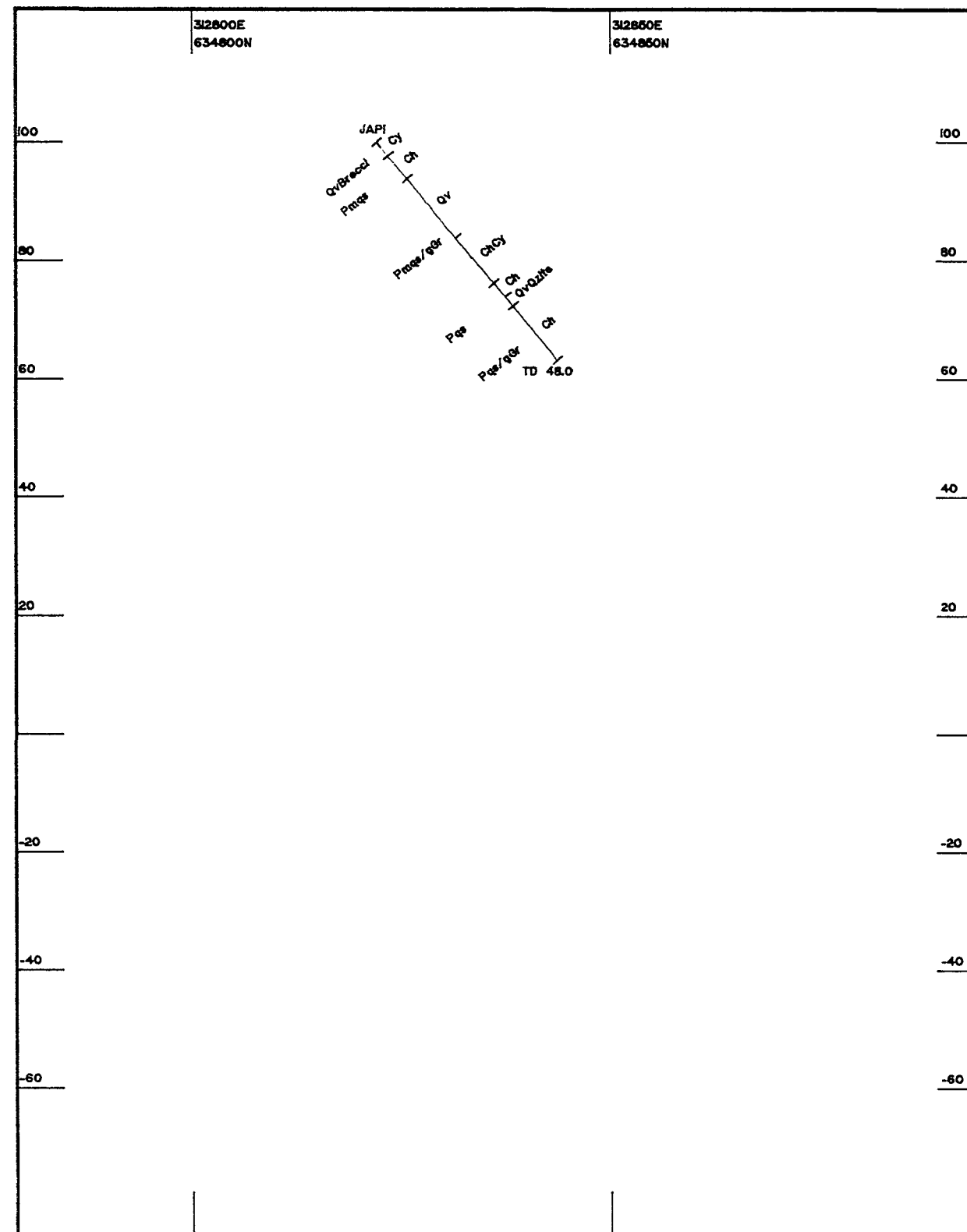
QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 91 (Jo-ann's)

PLAN VIEW DRILLING PROGRAM

Author: DR. N.F.RUTHERFORD	Scale: 1:1000
Drawn: C.J.DEDMAN	Comp. No. Drawing No.
Date: MAR.89	JPLAN Figure 126



REFERENCE

L.H.S GEOLOGY/COLOUR

GEOLOGY

- Czs - Cainozoic sand
- Czt - Talus/scree/sandstone, schist
- Czl - lateritic scree/laterite
- Phk - Kombolgie sandstone
- Pdo - Oenpelli Dolerite
- Pdz - Zamu Dolerite
- Amp - Amphibolite
- Qzite - Quartzite
- Pox - undifferentiated schist
- Pqs - quartz schist
- Pnqs - mica quartz schist
- Pqms - quartz mica schist
- Qz Breccia - quartz breccia

COLOUR

- rb - red brown
- yB - yellow brown
- gb - grey brown
- grG - green grey
- gGr - grey green
- d.gr - dark green
- grB - green black
- yGr - yellow green
- gWh - grey white
- bR - brown red
- gP - grey pink

R.H.S ALTERATION/MINERALISATION

ALTERATION

- Ch - Chlorite Alteration
- Cy - Clay (replacement)
- fest - Iron stained
- Se - sericite
- lt - laterite
- Haem - haematite

MINERALISATION

- Py - pyrite
- Cpy - chalcopyrite
- Qv - quartz veining
- Biot - Biotite

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0 10 20 30 40 50
m SCALE 1:1000 m

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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 91 (Jo-ann's)

GEOLOGY/COLOUR : ALTERATION/MINERALISATION

Author: DR. N.F.RUTHERFORD

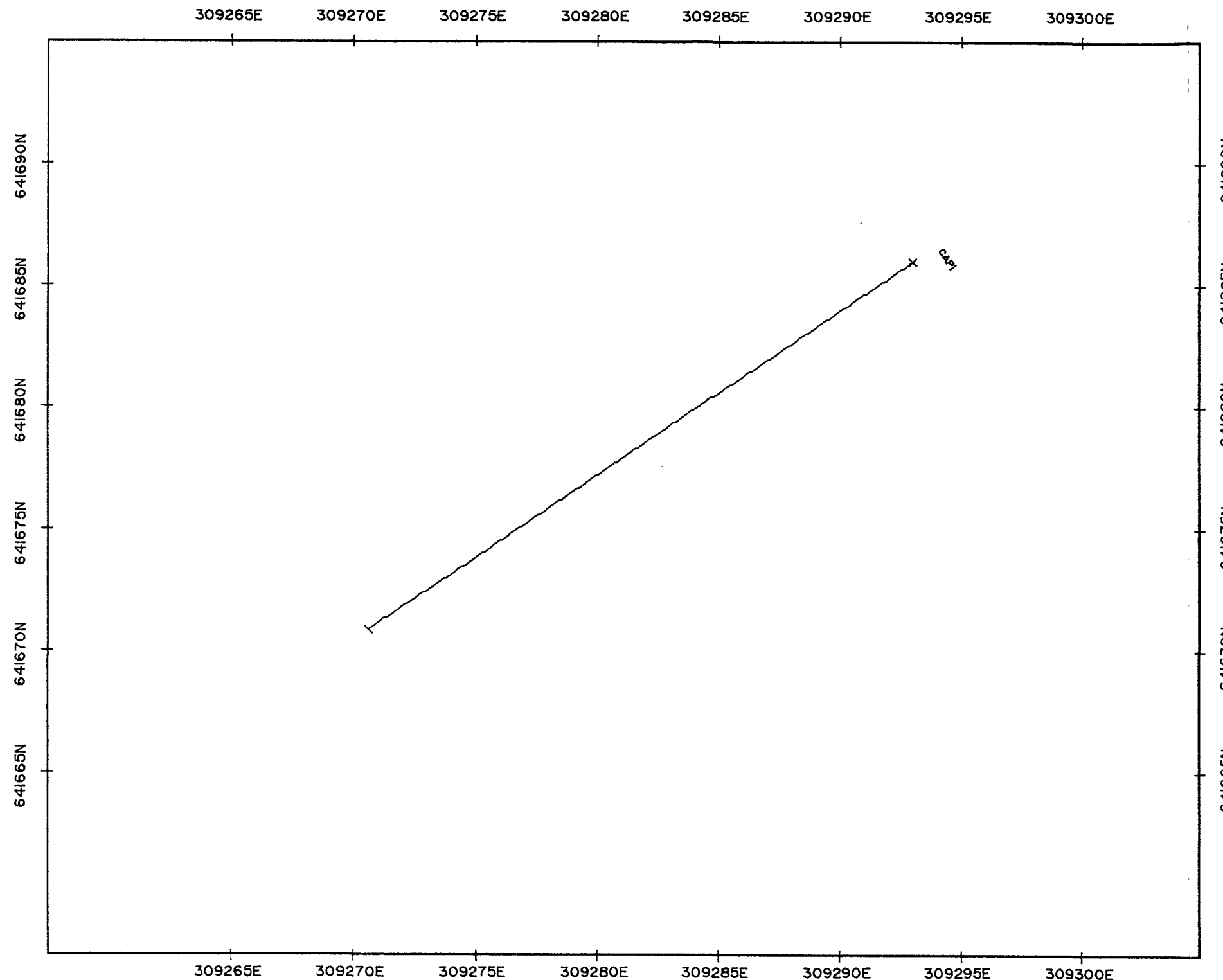
Scale: 1:1000

Drawn: C.J.DEDMAN

Comp. No. Drawing No.

Date: MAR.89

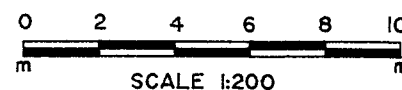
J01G Figure 127



REFERENCE

SURTEC

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COMPUTER DRAFTING BY
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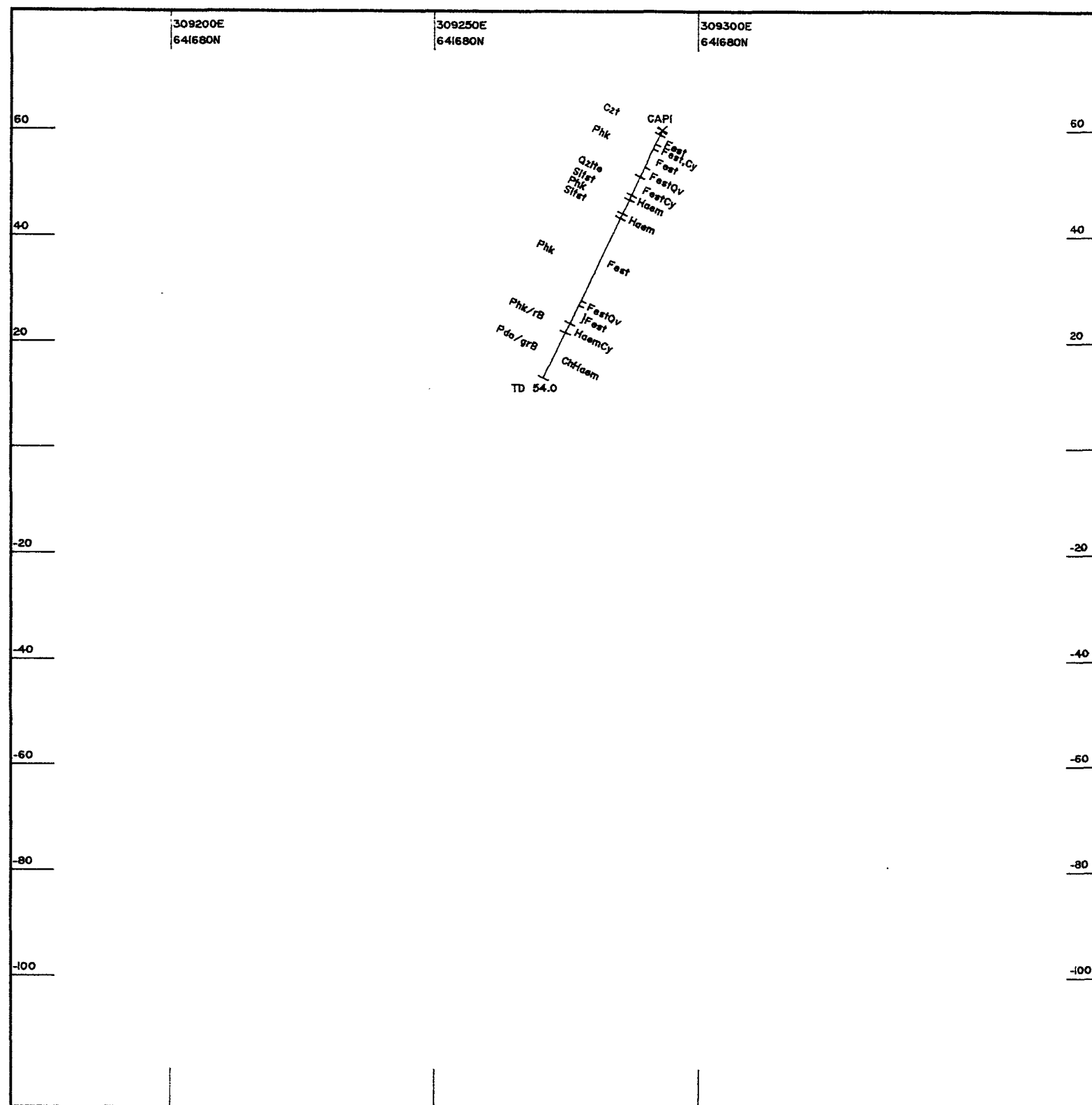
QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S2 (Chris)

PLAN VIEW DRILL PROGRAM

Author: DR. N.F.RUTHERFORD	Scale: 1:200
Drawn: C.J.DEDMAN	Comp. No. Drawing No.
Date: MAR.89	CPLAN Figure 140



REFERENCE

L.H.S	GEOLOGY/COLOUR
	GEOLOGY
Czs	- Cainozoic sand
Czt	- Talus/scree; sandstone, schist
Czl	- lateritic scree; laterite
Phk	- Kombolgie sandstone
Pdo	- Oenpelli Dolerite
Pdz	- Zamu Dolerite
Amp	- Amphibolite
Qzite	- Quartzite
Pox	- undifferentiated schist
Pqs	- quartz schist
Pmq	- mica quartz schist
Pqm	- quartz mica schist
Qz	- Breccia - quartz breccia
	COLOUR
rb	- red brown
yB	- yellow brown
gb	- grey brown
grG	- green grey
gGr	- grey green
d.gr	- dark green
grB	- green black
yGr	- yellow green
gWh	- grey white
bR	- brown red
gP	- grey pink

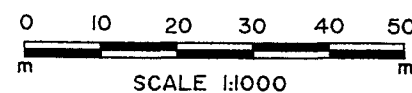
R.H.S ALTERATION/MINERALISATION

	ALTERATION
Ch	- Chlorite Alteration
Cy	- Clay (replacement)
fest	- Iron stained
Se	- sericite
lt	- laterite
Haem	- haematite

	MINERALISATION
Py	- pyrite
Cpy	- chalcopyrite
Qv	- quartz veining
Biot	- Biotite

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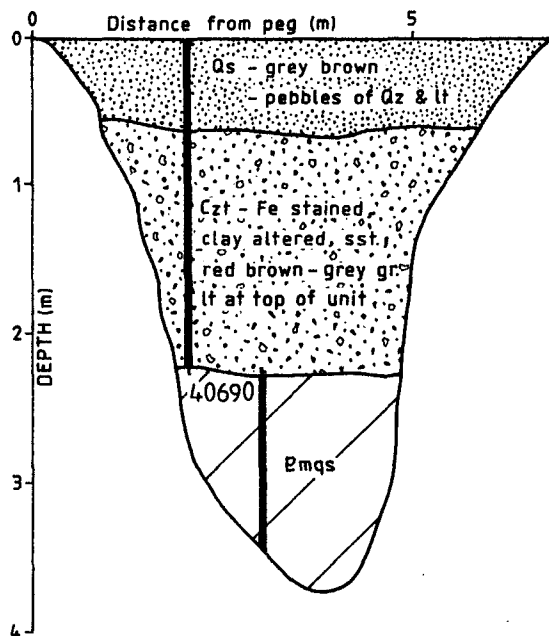
ANOMALY S2 (Chris)

GEOLOGY/COLOUR : ALTERATION/MINERALISATION

Author: DR. N.F.RUTHERFORD	Scale: 1:1000
Drawn: C.J.DEDMAN	Comp. No. Drawing No.
Date: MAR.89	c1680g Figure 141

APPENDIX 4

TRENCH GEOLOGY AND ASSAYS



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
40691	4	12	13	4	4	12	16	4.06
40692	10	4	16	2	12	5	20	7.65
40693	<4	20	15	5	14	6	28	10.3
42151	8	32	4	10	10	2	6	4.18
42152	6	<4	<2	2	8	5	6	3.96
42153	<4	10	<2	4	8	9	12	2.74

ppm %

RADIOMETRICS	TC	281	1079	1463	1183	1224	840	562
	K	34	171	203	175	160	96	74
	U	23	94	153	100	122	79	46
	Th	14	60	97	61	64	48	25

Counts / 20 secs

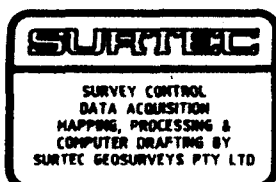
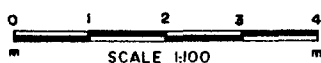
SAMPLE No 42154 40690

U	<4	12
Th	<4	32
As	6	<2
Cu	3	<4
Pb	6	10
Zn	3	420
Ni	8	94
Fe	2.22	7.00

ppm %

	Qs	Uconsolidated sand, outwash, colluvium
	Czt	Sst / qtzite & schist rubble, sand: talus & scree
	Emqs	Quartz mica schist
		Lithological boundary
		Profile location

COMPOSITE WALL PROFILE
317600 E 643300 N Bearing 90°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (LIBBYS)

TRENCH LT 2

Author: DR. N.F. RUTHERFORD

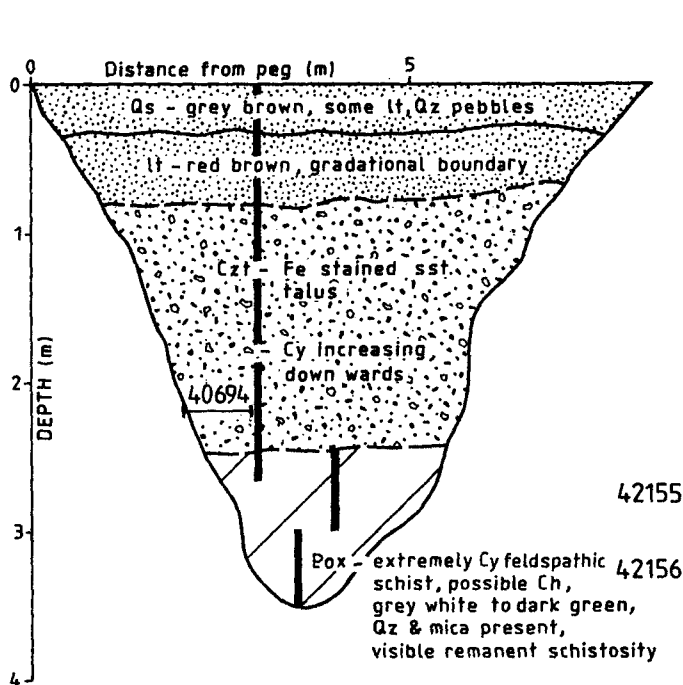
Scale: Hor. 1:100 Vert. 1:50

Drawn: A.B.

Drawing No.

Date: JAN. 1989

Figure 16



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
40695	8	10	13	5	12	3	18	4.50
40696	10	8	32	4	22	7	18	15.7
40697	10	28	20	3	4	3	18	10.9
40698	8	24	22	6	22	8	22	10.0
40699	6	16	<2	4	4	24	16	6.05
40700	<4	14	9	3	<4	8	16	3.26
42155	4	14	7	5	4	<2	6	2.76
42156	<4	16	5	2	6	<2	6	2.76

ppm %

473	1370	1498	1275	1103	989	TC
68	236	304	199	166	166	K
40	131	92	94	91	74	U
24	80	85	89	55	49	Th

RADIOMETRICS
Counts / 20 secs

SAMPLE N°	40694	42157
U	6	<4
Th	18	28
As	7	2
Cu	3	2
Pb	6	8
Zn	2	<2
Ni	16	4
Fe	2.42	2.28

ppm %

KEY	
	Unconsolidated sand, outwash, colluvium
	Outcropping nodular concretion, pisolitic laterite
	Sst / qtzite & schist rubble, Sand: talus & scree
	Undifferentiated, inferred Nouriangie schist
	Lithological boundary
	Gradational boundary
	Profile location

COMPOSITE WALL PROFILE
317600 E 643500 N Bearing 90°

0 1 2 3 4
m SCALE 1:100 m

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SURTEC GEOSURVEYS PTY LTD

QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (LIBBYS)

TRENCH LT3

Author: DR N.E. RUTHERFORD

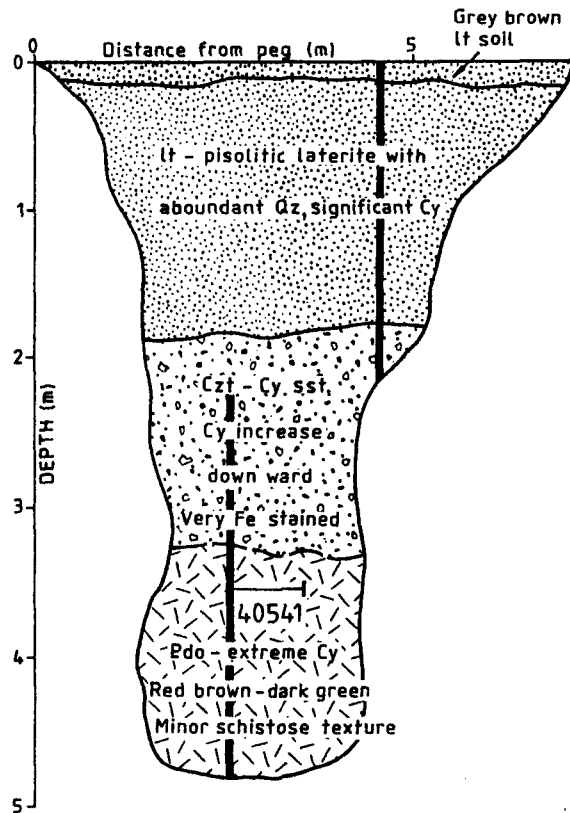
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 17



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
40546								
40545								
40544								
40543								
40542								
42158	<4	36	3	<2	12	64	230	8.95
42159	<4	34	8	5	10	48	175	7.05
42160	4	94	<2	4	12	44	145	8.70
	ppm							%

RADIOMETRICS	TC	576	861	1079	653	891	886	666
	K	64	112	204	96	132	119	86
	As	54	77	84	52	77	82	69
	Th	32	30	42	30	42	36	31

Counts / 20 secs

SAMPLE N°	42161	40541
U	4	
Th	70	
As	4	
Cu	<2	
Pb	8	
Zn	50	
Ni	175	
Fe	10.9	

KEY



Outcropping nodular concretion, pisolitic laterite



Sst / qtzite & schist rubble, sand: talus & scree



Oenpelli Dolerite



Lithological boundary

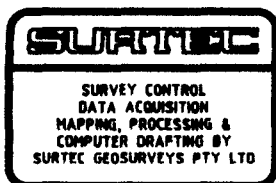


Gradational boundary



Profile location

COMPOSITE WALL PROFILE
317600 E 643700 N Bearing 90°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2608

ANOMALY S1 (LIBBYS)

TRENCH LT4

Author: DR N. F. RUTHERFORD

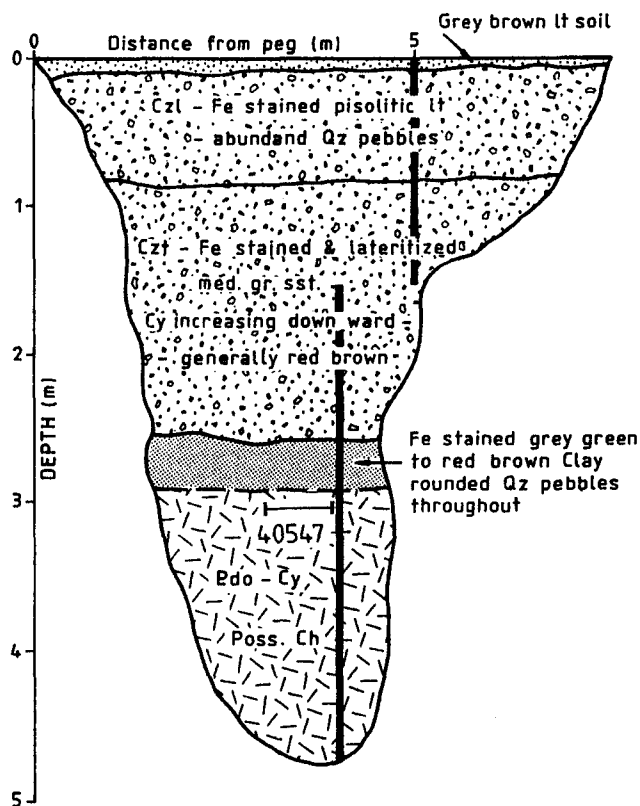
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 18



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
40548	<4	14	10	36	6	22	74	10.0
40549	<4	4	13	42	8	20	70	11.2
40550	<4	16	18	58	10	30	82	13.5
38851	<4	10	14	86	14	30	90	17.0
38852	<4	6	14	105	18	42	74	16.0
38853	10	4	13	105	20	40	64	16.0
38854	<4	6	12	52	12	32	46	9.30
42162	<4	4	<2	44	12	34	34	9.00
42163	<4	<4	7	52	14	68	58	9.55
42164	<4	<4	<2	62	14	80	76	9.30

ppm %

RADIOMETRICS	TC	280	541	385	372	532	548	522
	K	31	61	42	34	54	61	43
	As	21	53	38	41	50	35	49
	Th	19	31	27	30	37	39	41

Counts / 20 secs

SAMPLE No.	42165	40547
U	<4	4
Th	4	12
As	2	5
Cu	58	60
Pb	16	<4
Zn	50	34
Ni	56	52
Fe	10.1	9.95

ppm %

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Sst / qtzite & schist rubble, sand: talus & scree



Denpelli Dolerite



Lithological boundary

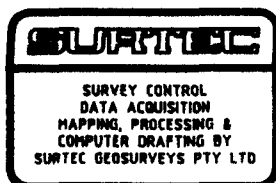
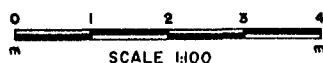


Gradational boundary



Profile location

COMPOSITE WALL PROFILE
317600 E 643900 N Bearing 90°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (LIBBYS)
TRENCH LT5

Author: DR N. F. RUTHERFORD

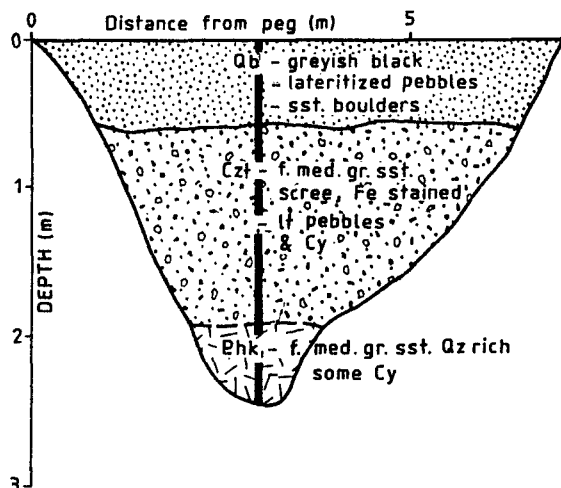
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 19



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
38856	6	18	17	58	<4	12	24	15.8
38857	4	8	5	30	<4	6	34	6.75
38858	6	10	17	44	14	8	22	16.5
38859	4	14	16	42	8	38	46	18.4

ppm %

RADIOMETRICS	TC	K	U	Th	1	1	1	1
	359	487	509	544	464	512	454	428
	35	44	65	46	60	55	52	49
	33	52	66	58	45	62	37	44
	25	24	23	32	30	22	24	28

Counts 20 / secs

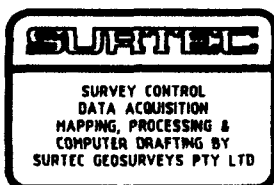
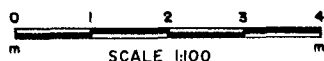
SAMPLE No.	38855
U	<4
Th	6
As	8
Cu	36
Pb	12
Zn	8
Ni	30
Fe	8.95 %

ppm

KEY

-  Black soil & clay predominantly in drainage minor silt / sand
-  Sst / qtzite & schist rubble, sand: talus & scree
-  Kombolgie formation
-  Lithological boundary
-  Gradational boundary
-  Profile location

COMPOSITE WALL PROFILE
317600 E 644100 N Bearing 90°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY S1 (LIBBYS)
TRENCH LT 6

Author: DR N.E. RUTHERFORD

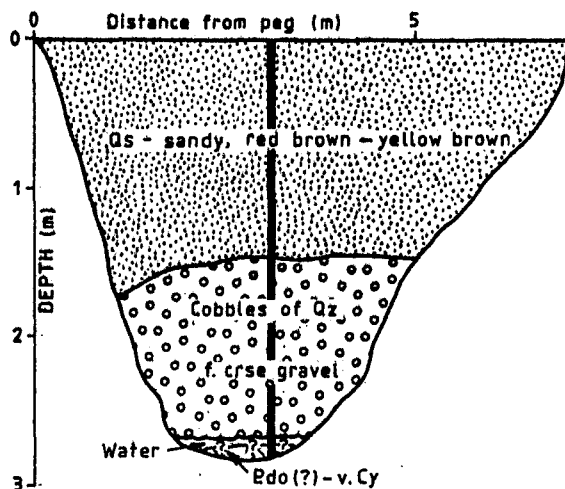
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 20



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42166	4	<4	5	12	<4	2	6	0.68
42167	<4	<4	<2	7	<4	<2	4	0.62
42168	<4	<4	<2	12	<4	<2	18	0.64
42169	<4	<4	7	12	<4	4	12	3.12
42170	<4	<4	3	10	<4	2	10	1.79

ppm %

RADIOMETRICS	TC	437	Counts / 20 secs
	K	50	
	U	46	
	Th	18	

SAMPLE N°	42171	
U	<4	ppm
Th	6	
As	3	
Cu	13	
Pb	6	
Zn	3	
Ni	16	
Fe	2.26	%

KEY

-  Qs Unconsolidated sand, outwash, colluvium
-  Edo- Oenpelli Dolerite
-  Lithological boundary
-  Gradational boundary
-  Profile location

COMPOSITE WALL PROFILE
318800 E 638000 N Bearing 180°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T1

Author: DR N.E. RUTHERFORD

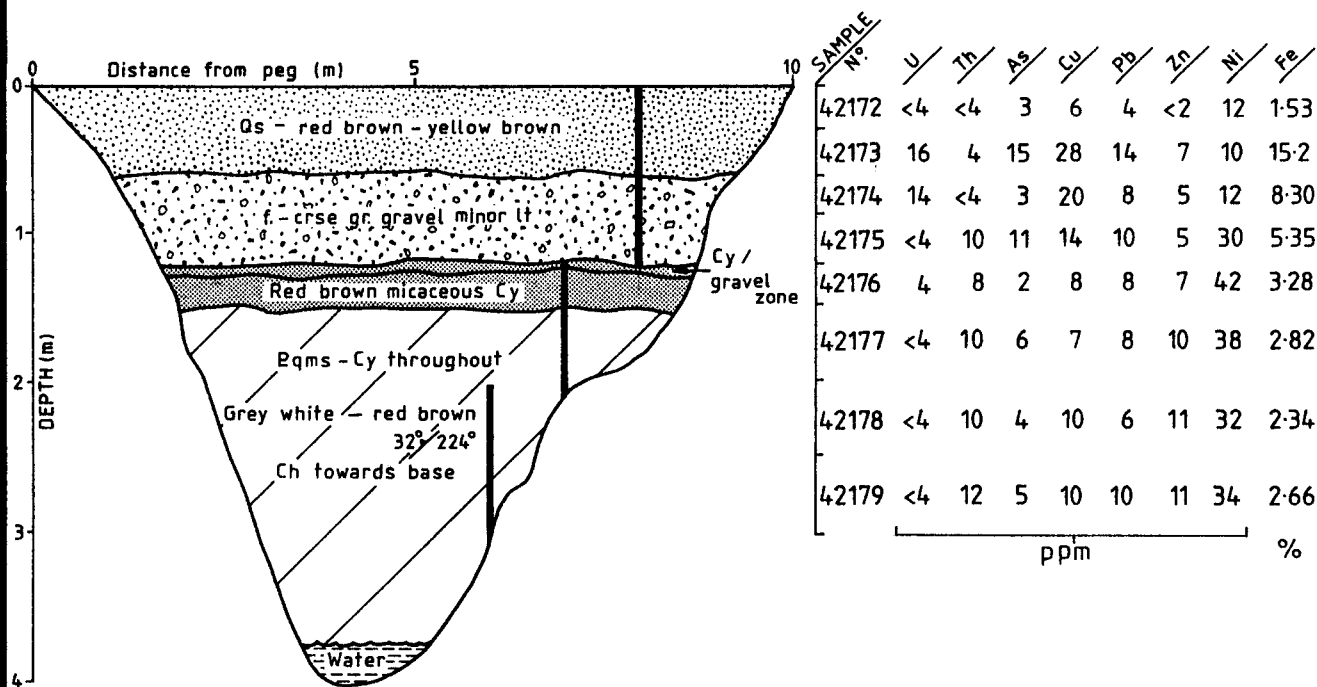
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 32



RADIOMETRICS	TC	1319	2267
	K	202	496
	U	112	105
	Th	68	79

Counts / 20 secs

SAMPLE No.	42801
U	6
Th	10
As	2
Cu	14
Pb	14
Zn	9
Ni	36
Fe	6.55

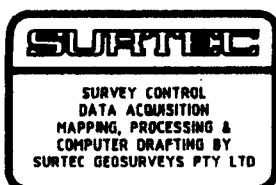
ppm %

KEY

- Qs Unconsolidated sand, outwash, colluvium
- Eqlms Quartz mica schist
- Strike and dip of foliation
- Lithological boundary
- Profile location

COMPOSITE WALL PROFILE
318800 E 637900 N Bearing 180°

0 1 2 3 4
m SCALE 1:100 m



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T 2

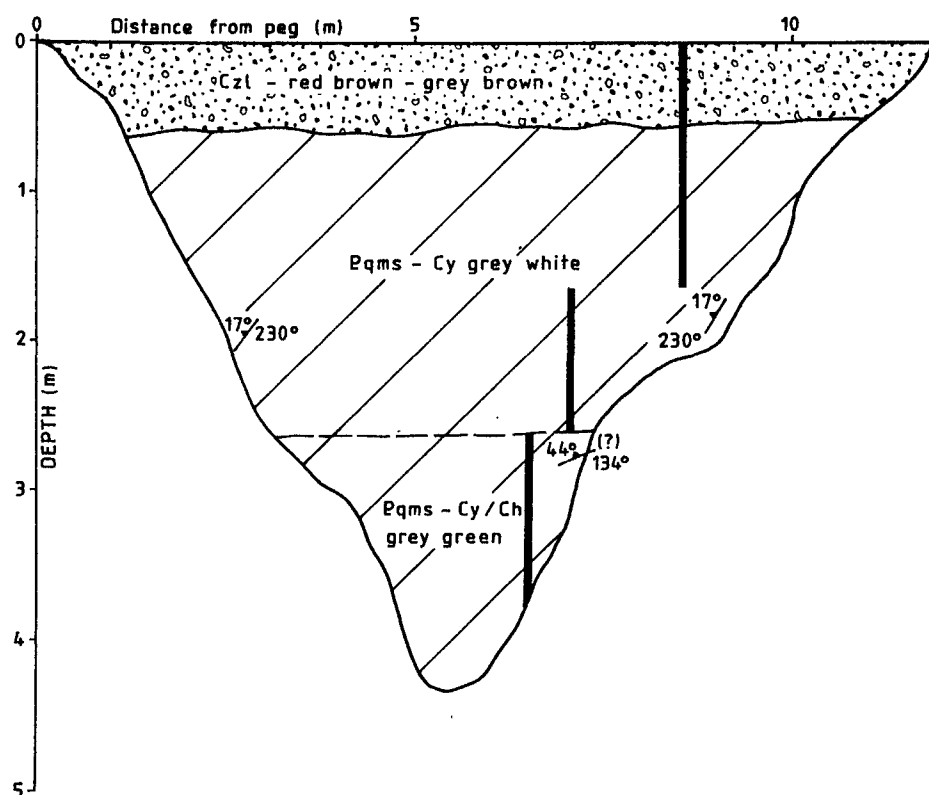
Author: DR N.E. RUTHERFORD

Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No
Figure 33



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42181	6	10	2	14	14	9	36	6.55
42182	<4	12	2	6	16	14	42	3.88
42183	6	8	3	9	12	10	28	2.66
42184	8	8	5	4	10	10	20	2.54
42185	<4	16	5	5	14	14	28	2.44
42186	<4	10	2	3	10	22	42	3.02
42187	<4	18	5	9	8	20	36	2.82
ppm								%

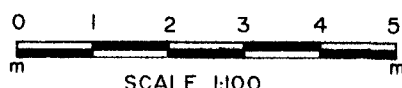
RADIONETRICS	1	1	1
TC	1213	1463	1905
K	159	286	367
U	93	86	101
Th	37	62	81
Counts / 20 secs			

SAMPLE No.	42188	42189	42190
U	<4	<4	4
Th	16	14	4
As	2	5	3
Cu	10	3	4
Pb	8	20	16
Zn	10	32	17
Ni	24	44	28
Fe	3.56	3.56	2.76
%			

KEY

	Nodular, concretionary, pisolitic laterite, within silt sandy, loams
	Quartz mica schist
	Lithological boundary
	Gradational boundary
	Strike and dip of foliation
	Profile location

COMPOSITE WALL PROFILE 318800 E 637790 N Bearing 180°



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**ANOMALY 147
TRENCH T3**

Author: DR N.E. RUTHERFORD

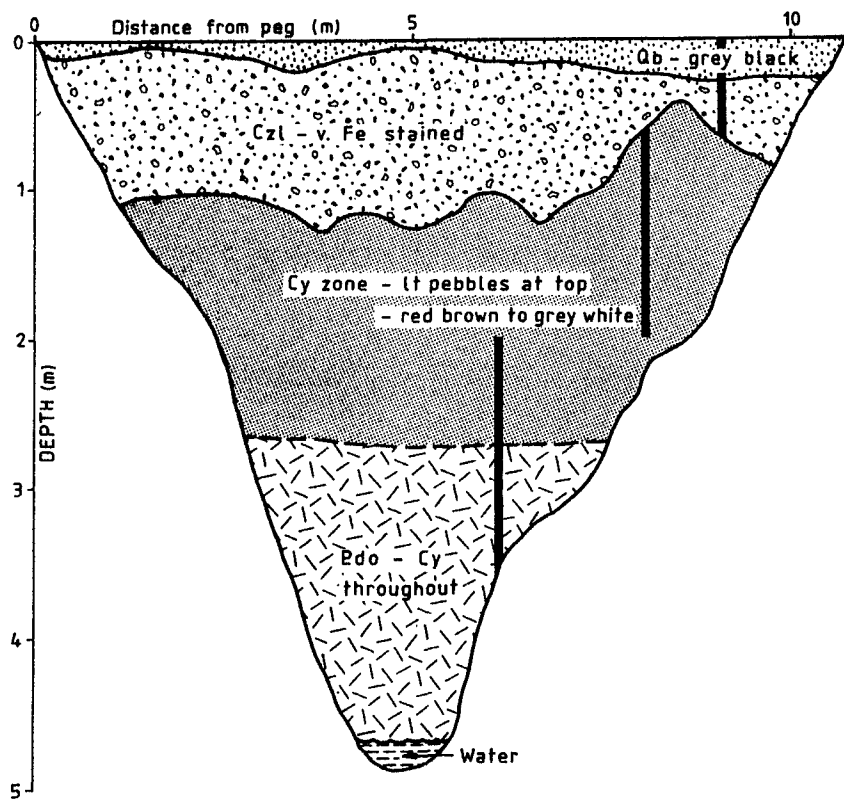
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 34



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
42191	<4	<4	18	66	20	14	28	16.0
42192	6	<4	20	88	20	12	32	33.7
42193	8	6	28	76	16	16	22	33.0
42194	<4	<4	7	125	6	62	30	8.30
42195	<4	<4	5	130	6	74	24	7.85
42196	4	<4	5	140	16	84	22	8.90
42197	<4	<4	7	125	14	70	16	9.20
42198	4	<4	5	90	12	68	18	6.15
42199	<4	<4	5	78	10	64	18	3.84
	ppm							%

RADIOMETRICS	TC	399	273
	K	47	42
	U	49	33
	Th	14	11

Counts / 20 secs

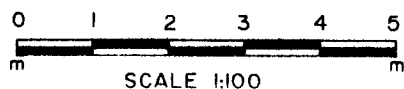
SAMPLE No	42200
U	<4
Th	<4
As	<2
Cu	74
Pb	4
Zn	64
Ni	20
Fe	4.44

ppm %

KEY

- Qb Black soil & clay predominantly in drainage minor silt / sand
- Czl Nodular, concretionary, pisolitic laterite, within silt sandy, loams
- lt Outcropping nodular concretion, pisolitic laterite
- Edo Oenpelli Dolerite
- Lithological boundary
- Gradational boundary
- Profile location

COMPOSITE WALL PROFILE 318800 E 637700 N Bearing 180°



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ANOMALY 147
TRENCH T4

Author: DR. N. F. RUTHERFORD

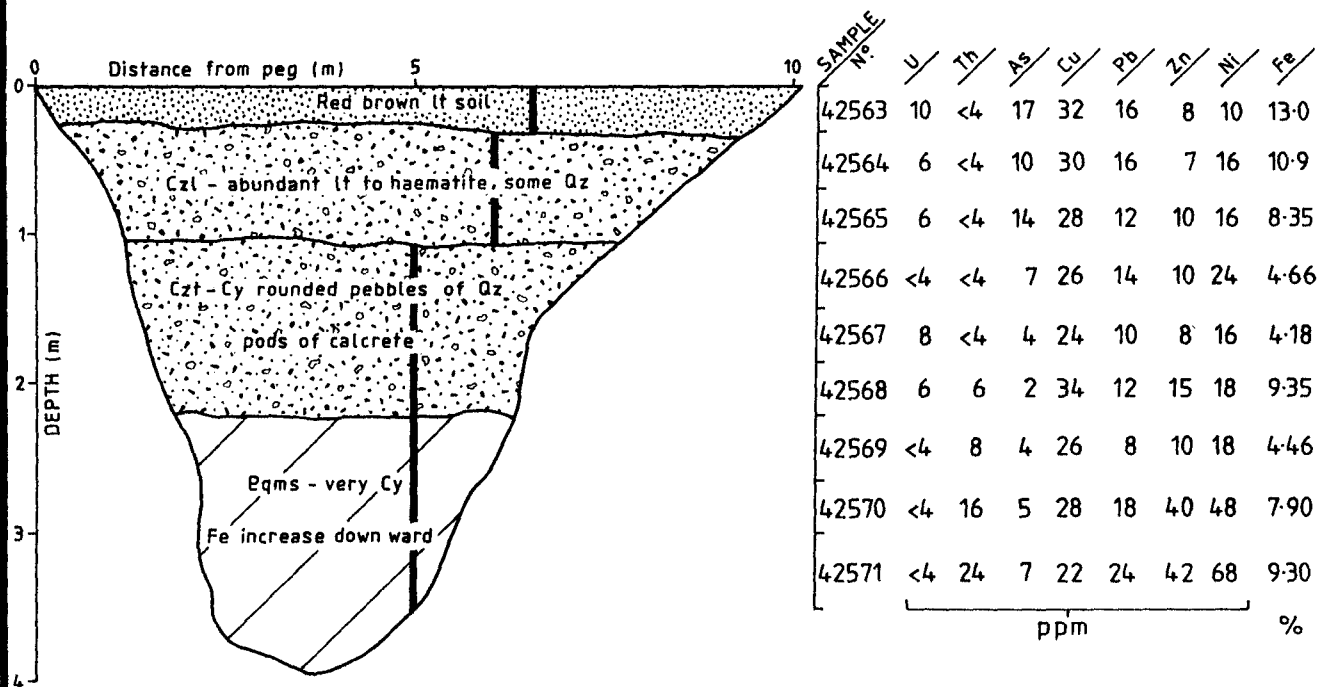
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 35



RADIOMETRICS	TC	959	635	1358
	K	123	81	306
	U	98	57	19
	Th	22	19	51

Counts / 20 secs

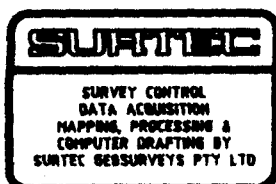
SAMPLE N°	42572	42573
U	8	<4
Th	8	8
As	9	7
Cu	22	19
Pb	20	20
Zn	38	36
Ni	56	56
Fe	8.90	8.45

ppm %

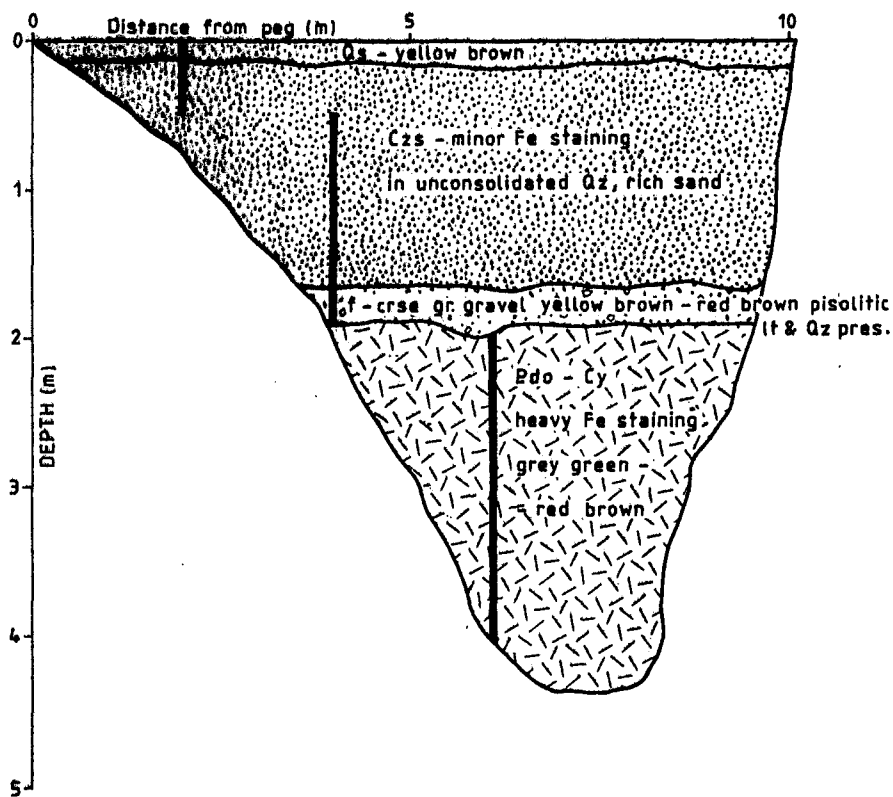
	Outcropping nodular concretion, pisolitic laterite
	Nodular, concretionary, pisolitic laterite, within silt sandy, loams
	Sst / qtzite & schist rubble, sand: talus & scree
	Quartz mica schist
	Lithological boundary
	Profile location

COMPOSITE WALL PROFILE
318600 E 637780 N Bearing 180°

0 1 2 3 4
m SCALE 1:100 m



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ANOMALY 147	
TRENCH T5	
Author: DR N.F. RUTHERFORD	Scale: Hor. 1:100 Vert. 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 36



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42551	<4	<4	4	6	<4	2	12	0.87
42552	<4	<4	4	12	4	3	12	0.88
42553	<4	<4	2	9	4	2	8	0.61
42554	<4	<4	2	11	6	4	10	0.73
42555	<4	<4	5	15	6	3	8	1.58
42556	4	<4	4	36	16	5	12	6.75
42557	<4	8	4	40	20	9	12	8.00
42558	<4	4	7	62	22	15	10	9.90
42559	4	8	8	84	26	20	8	12.2
42560	14	<4	6	78	24	22	10	10.9
42561	8	<4	<2	66	20	20	8	8.75
	ppm							%

RADIOMETRICS	1	1	1
TC	378	585	676
K	42	60	78
U	35	66	76
Th	10	16	9

Counts / 20 secs

SAMPLE No.	42562
U	8
Th	<4
As	4
Cu	76
Pb	18
Zn	20
Ni	6
Fe	10.5

ppm

%

KEY

Qs	Unconsolidated sand, outwash, colluvium
Czs	Unconsolidated sand, ferruginous & clayey sand
Edo	Oenpelli Dolerite
—	Lithological boundary
	Profile location

COMPOSITE WALL PROFILE 318800 E 637600 N Bearing 180°

0 1 2 3 4 5
m SCALE 1:100 m

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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T6

Author: DR N.E. RUTHERFORD

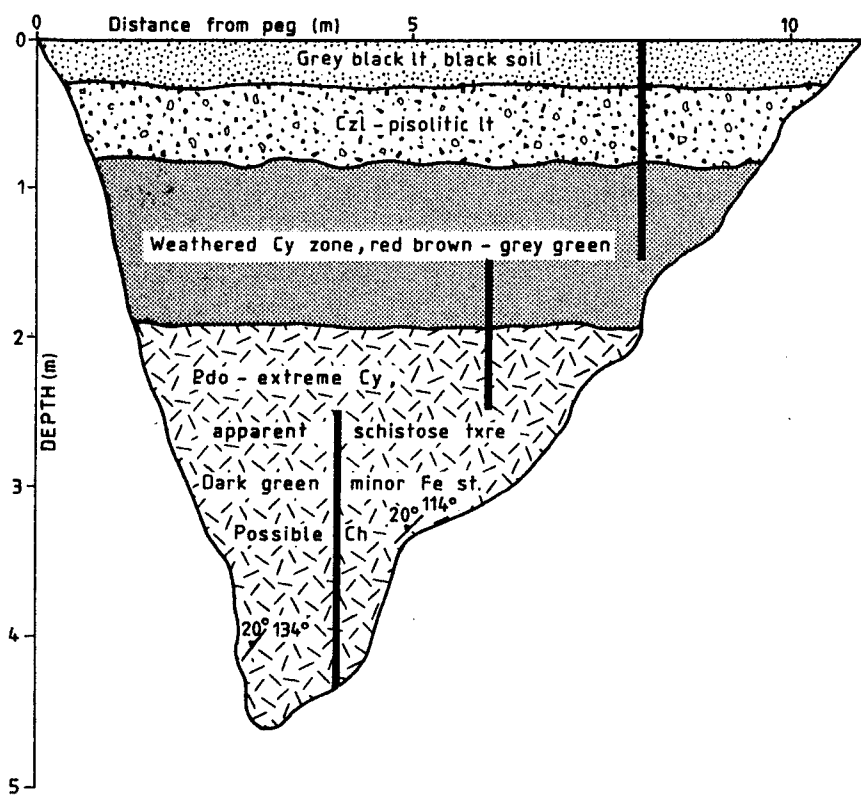
Scale: Hor: 1:100 Vert: 1:50

Drawn: A.B.

Drawing No.

Date: JAN. 1989

Figure 37



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
42574	6	20	5	30	20	40	66	8.95
42575	6	<4	14	30	12	8	18	9.55
42576	16	<4	20	58	24	11	22	19.9
42577	16	6	22	90	26	13	26	25.2
42578	10	10	4	30	22	38	50	7.50
42579	4	10	5	26	18	32	34	4.32
42580	8	18	<2	17	22	50	42	6.80
42581	<4	12	5	18	18	52	52	4.48
42582	8	18	7	22	22	60	46	4.42
42583	4	14	6	19	18	40	36	2.68
42584	4	26	<2	17	20	58	42	3.86
	ppm							%

RADIOMETRICS	TC	I	I	I
	1604	2322	2055	
	K	294	425	416
	U	119	146	118
	Th	70	95	47
Counts / 20 secs				

SAMPLE N°	42585	
U	6	ppm
Th	16	
As	4	
Cu	15	
Pb	16	
Zn	70	
Ni	32	
Fe	3.68	%

KEY

- Outcropping nodular concretion, pisolitic laterite
- Nodular, concretionary, pisolitic laterite, within silt sandy, loams
- Oenpelli Dolerite
- Lithological boundary
- Strike and dip of foliation
- Profile location

COMPOSITE WALL PROFILE 318600 E 637700 N Bearing 190°

0 1 2 3 4 5
m SCALE 1:100 m

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ANOMALY 147
TRENCH T7

Author: DR N.E. RUTHERFORD

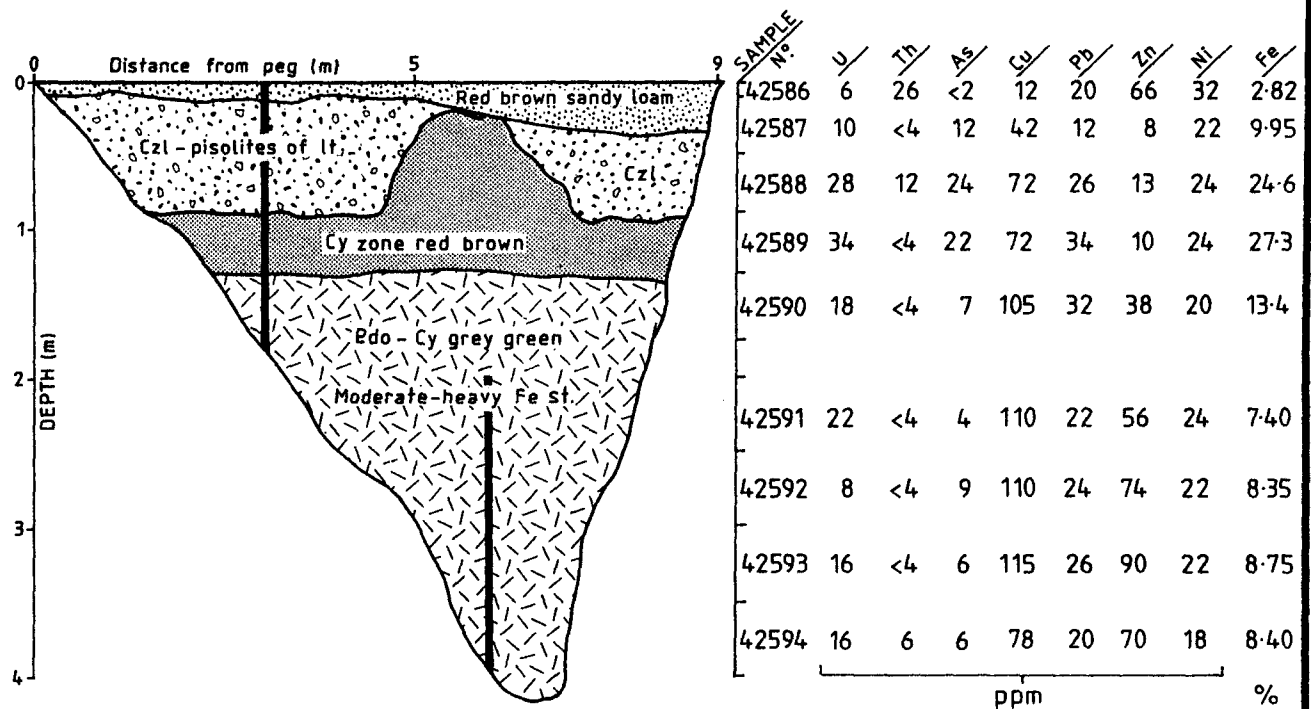
Drawn: A. B.

Date: JAN. 1989

Scale: Hor 1:100 Vert 1:50

Drawing No.

Figure 38



RADIOMETRICS	TC	1056	804	866
	K	108	90	107
	U	132	105	108
	Th	13	11	7

Counts / 20 secs

SAMPLE N°	42595
U	18
Th	<4
As	5
Cu	54
Pb	18
Zn	60
Ni	18
Fe	6.85 %

ppm

KEY



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Oenpelli Dolerite

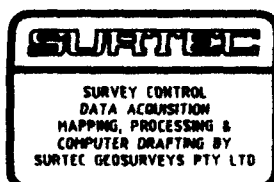
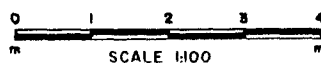


Lithological boundary

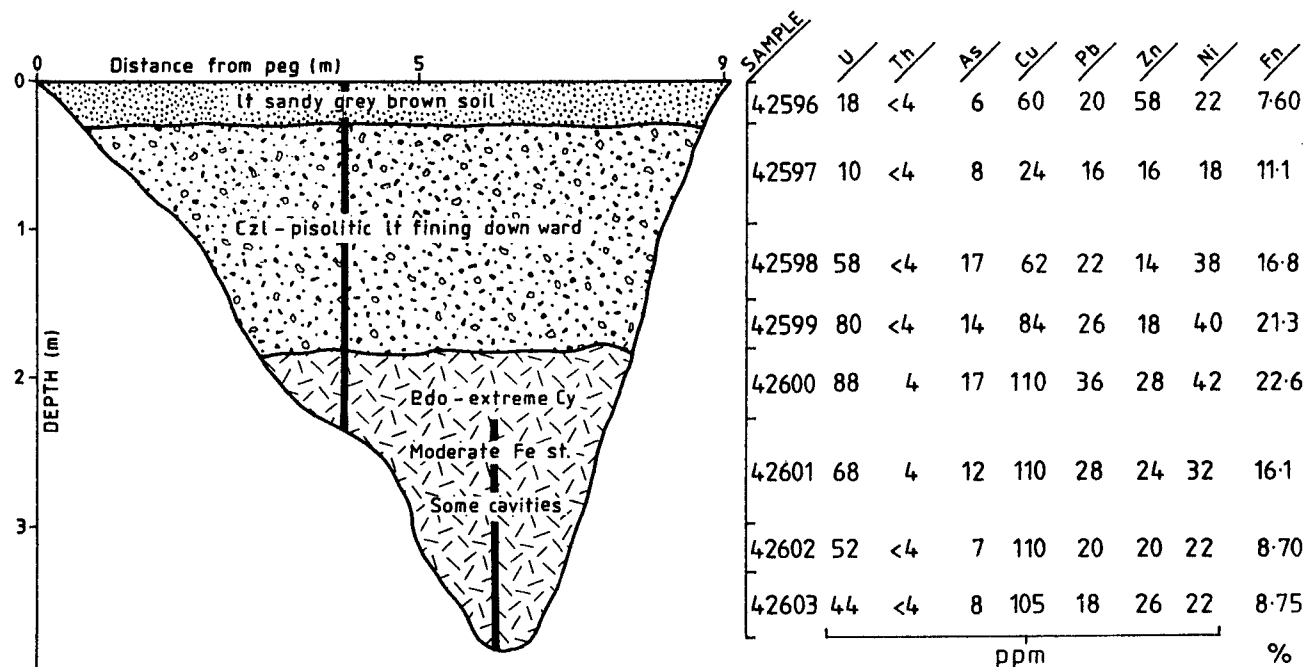


Profile location

COMPOSITE WALL PROFILE
318600 E 637600 N Bearing 240°



QUEENSLAND MINES LTD	
ARNHEM LAND EXPLORATION PROJECT, EL 2508	
ANOMALY 147	
TRENCH T 8	
Author: DR N. F. RUTHERFORD	Scale: Hor 1:100 Vert 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 39

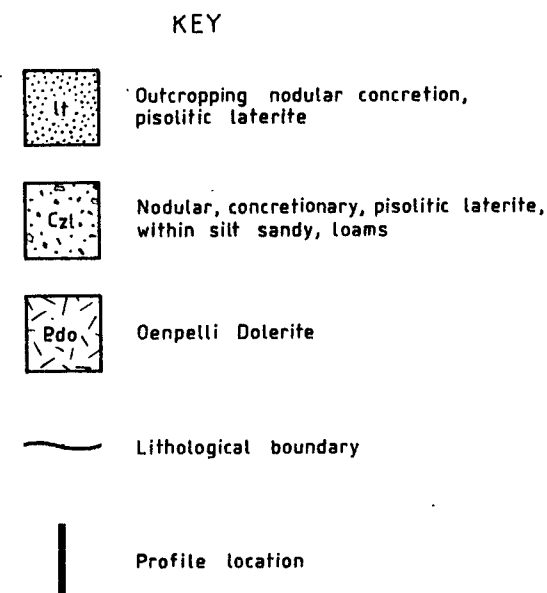


RADIONETRICS	TC	4925	4146	3048
	U	575	513	349
	K	644	522	351
	Th	29	30	25

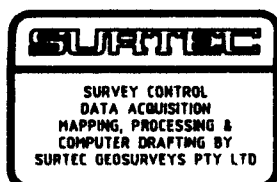
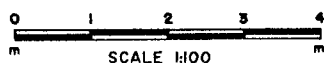
Counts / 20 secs

SAMPLE N°	42604
U	28
Th	6
As	2
Cu	96
Pb	14
Zn	22
Ni	20
Fe	8.80

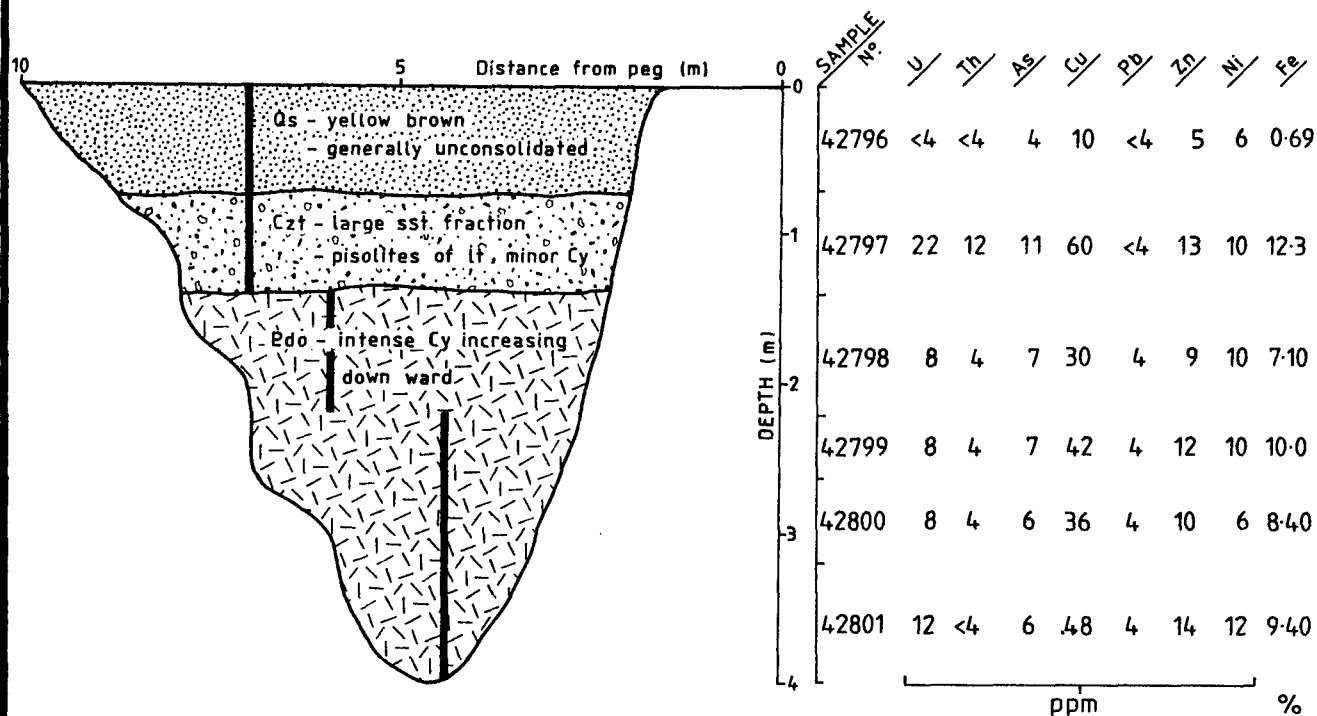
ppm %



COMPOSITE WALL PROFILE
318600 E 637500 N Bearing 260°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508	
ANOMALY 147	
TRENCH T 9	
Author: DR N.F. RUTHERFORD	Scale: Hor:1:100 Vert:1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 40



RADIOMETRICS	TC	450	645	586
	K	49	74	69
	U	44	68	53
	Th	11	13	19
	Counts / 20 secs			

SAMPLE N°	42802
U	8
Th	12
As	5
Cu	38
Pb	<4
Zn	10
Ni	8
Fe	7.25 %

ppm

	Unconsolidated sand, outwash, colluvium
	Sst / qtzite & schist rubble, sand: talus & scree
	Oenpelli Dolerite
	Lithological boundary
	Profile location

COMPOSITE WALL PROFILE
318900 E 637600 N Bearing 358°

0 1 2 3 4
m SCALE 1:100 m

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ANOMALY 147
TRENCH T 10

Author: DR N.E. RUTHERFORD

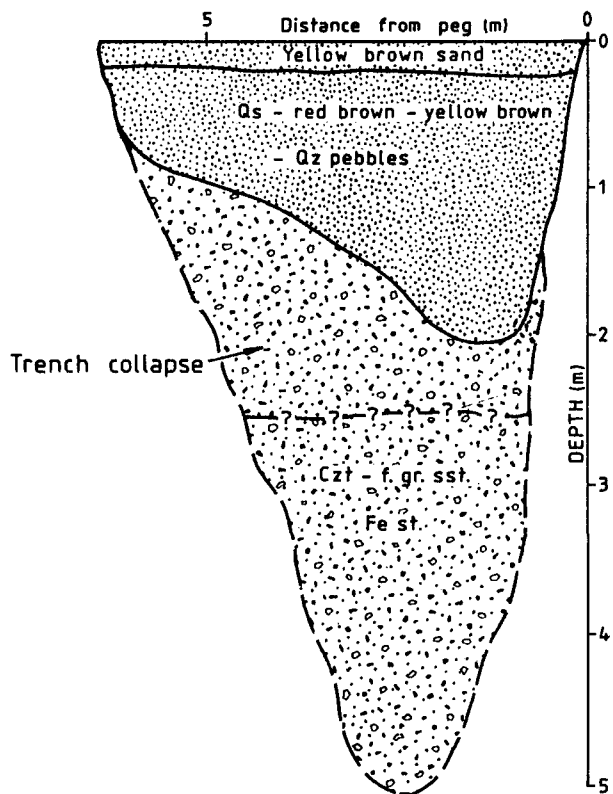
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 41



RADIOMETRICS	TC	232	Counts / 20 secs
	U	23	
	K	21	
	TC	17	

SAMPLE	Nº	42803	
U	6	ppm	
Th	6		
As	5		
Cu	6		
Pb	<4		
Zn	5		
Ni	10		
Fe	0.80	%	

KEY



Unconsolidated sand, outwash, colluvium



Sst / qtzite & schist rubble, sand: talus & scree



Lithological boundary

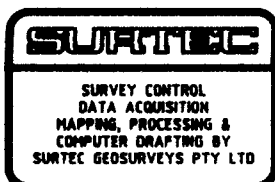
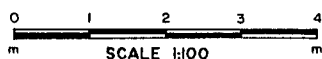


Gradational boundary



Profile location

COMPOSITE WALL PROFILE
318200 E 637400 N Bearing 8°



QUEENSLAND MINES LTD

ARMHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T11

Author: DR. N. F. RUTHERFORD

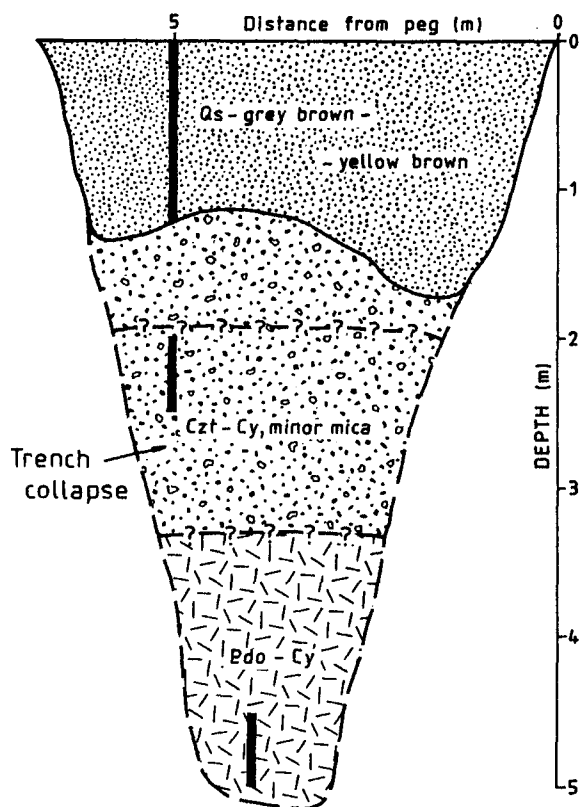
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 42



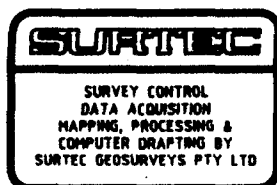
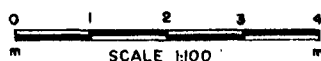
SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42804	4	4	3	6	<4	4	8	0.46
42805	16	4	7	42	4	22	16	8.65
42806	12	4	2	72	4	110	34	4.96

ppm %

RADIOMETRICS	TC	224	Counts / 20 secs
	K	29	
	U	30	
	Th	7	

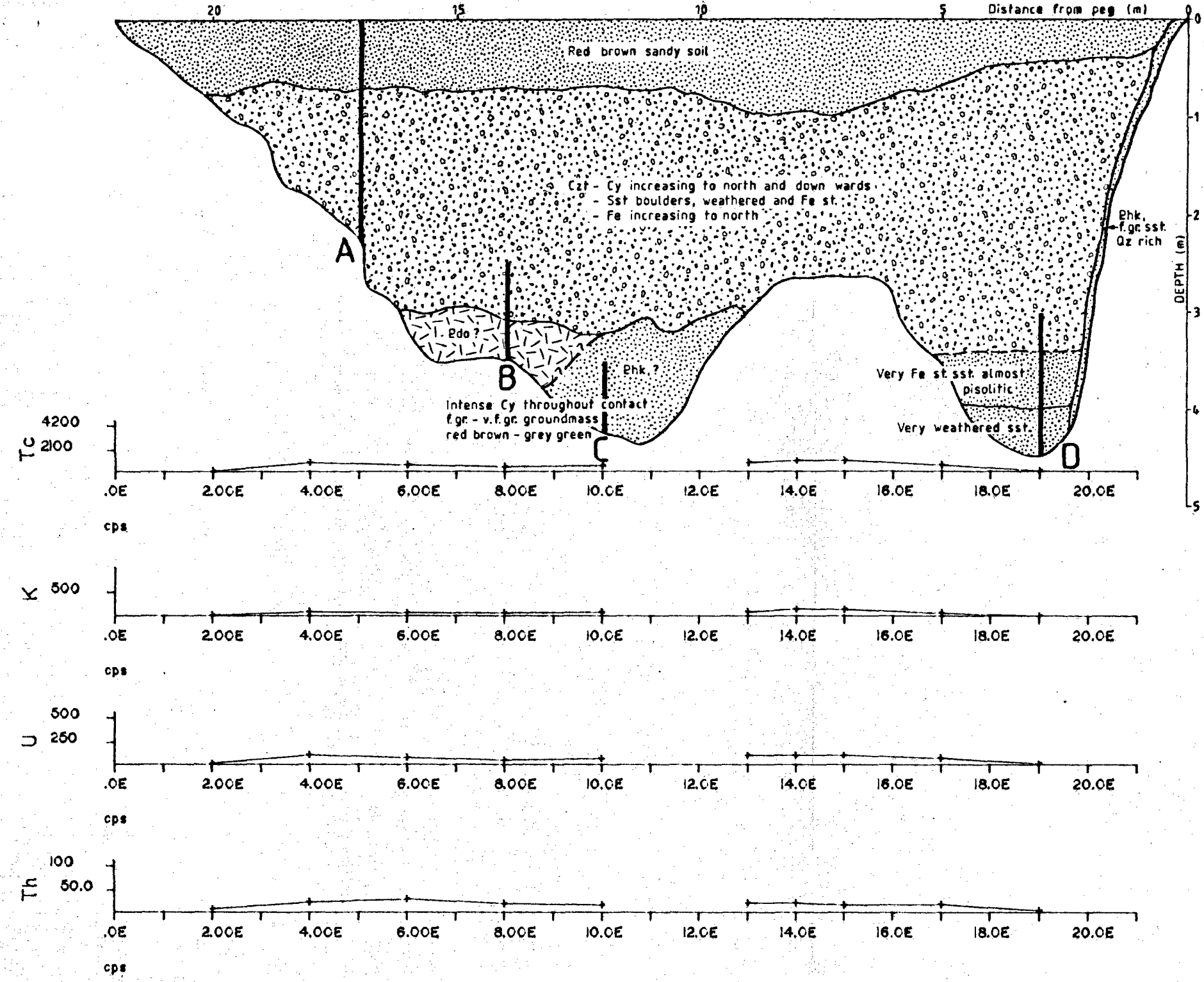
KEY	
	Qs
	Czt
	Bdo
	Lithological boundary
	Gradational boundary
	Profile location

COMPOSITE WALL PROFILE
318200 E 637500 N Bearing 8°



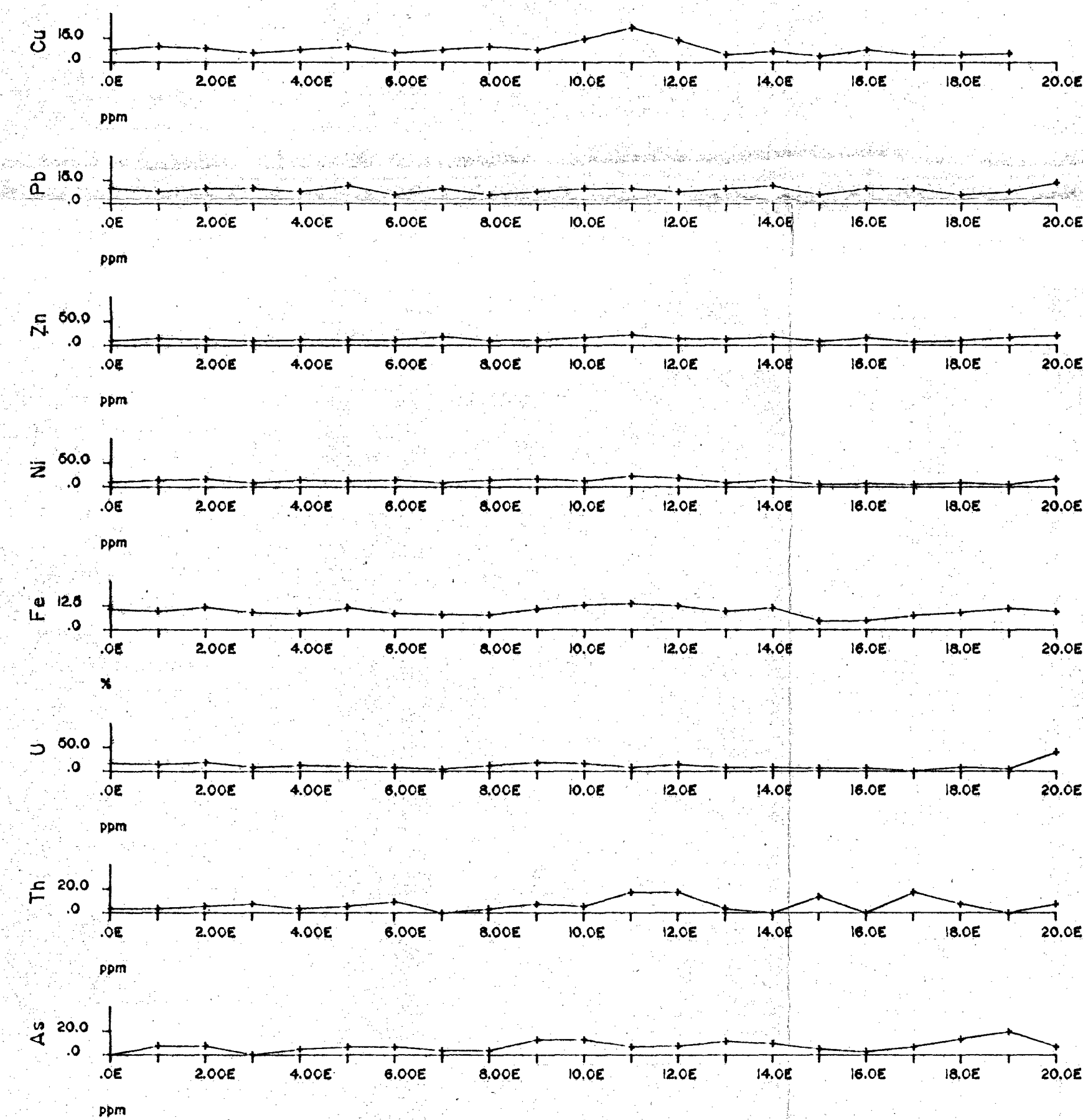
QUEENSLAND MINES LTD	
ARNHEM LAND EXPLORATION PROJECT, EL 2508	
ANOMALY 147	
TRENCH T 12	
Author: DR N. E. RUTHERFORD	Scale: Hor: 1:100 Vert: 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 43

RADIOMETRICS

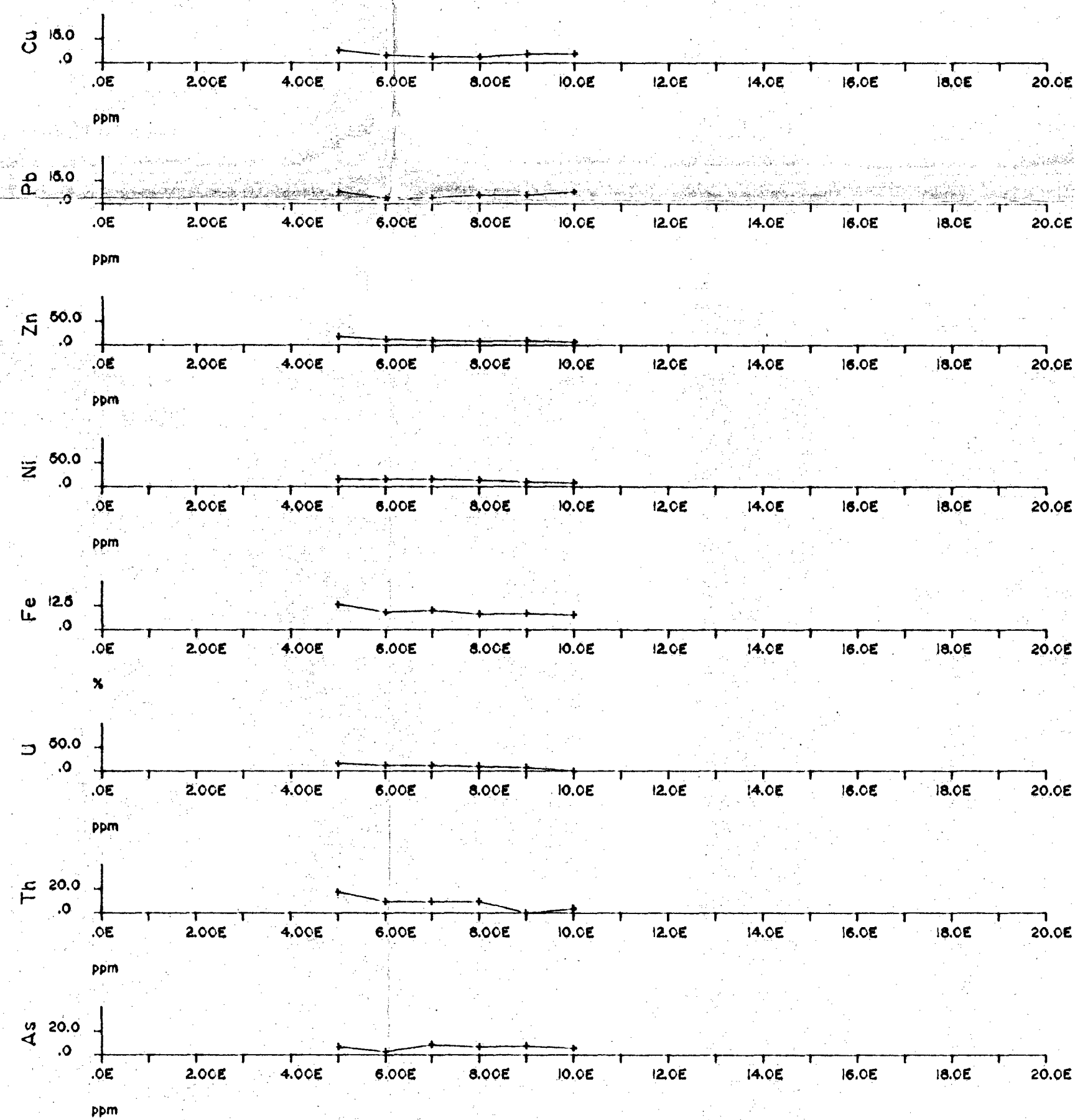


SAMPLE NO.	U	Th	K	Fe	Co	Mo	As
42626	8	8	4	7	10	10	12.0
42627	10	12	3	9	10	9	14.0
42628	16	10	18	30	14	26	20.1
42629	6	8	9	6	4	6	1.75
42630	4	26	26	28	16	28	19.8
42631	16	12	11	14	12	14	16.1
42632	18	12	13	8	12	12	13.0
42633	14	10	11	11	10	10	9.35
42634	16	12	8	9	8	13	11.2
42635	12	6	4	8	10	10	10.7
42636	14	12	10	7	16	12	15.7
42637	6	12	11	6	10	8	10.2
42638	<4	10	13	5	8	8	8.15
42639	<4	8	12	3	4	9	7.10

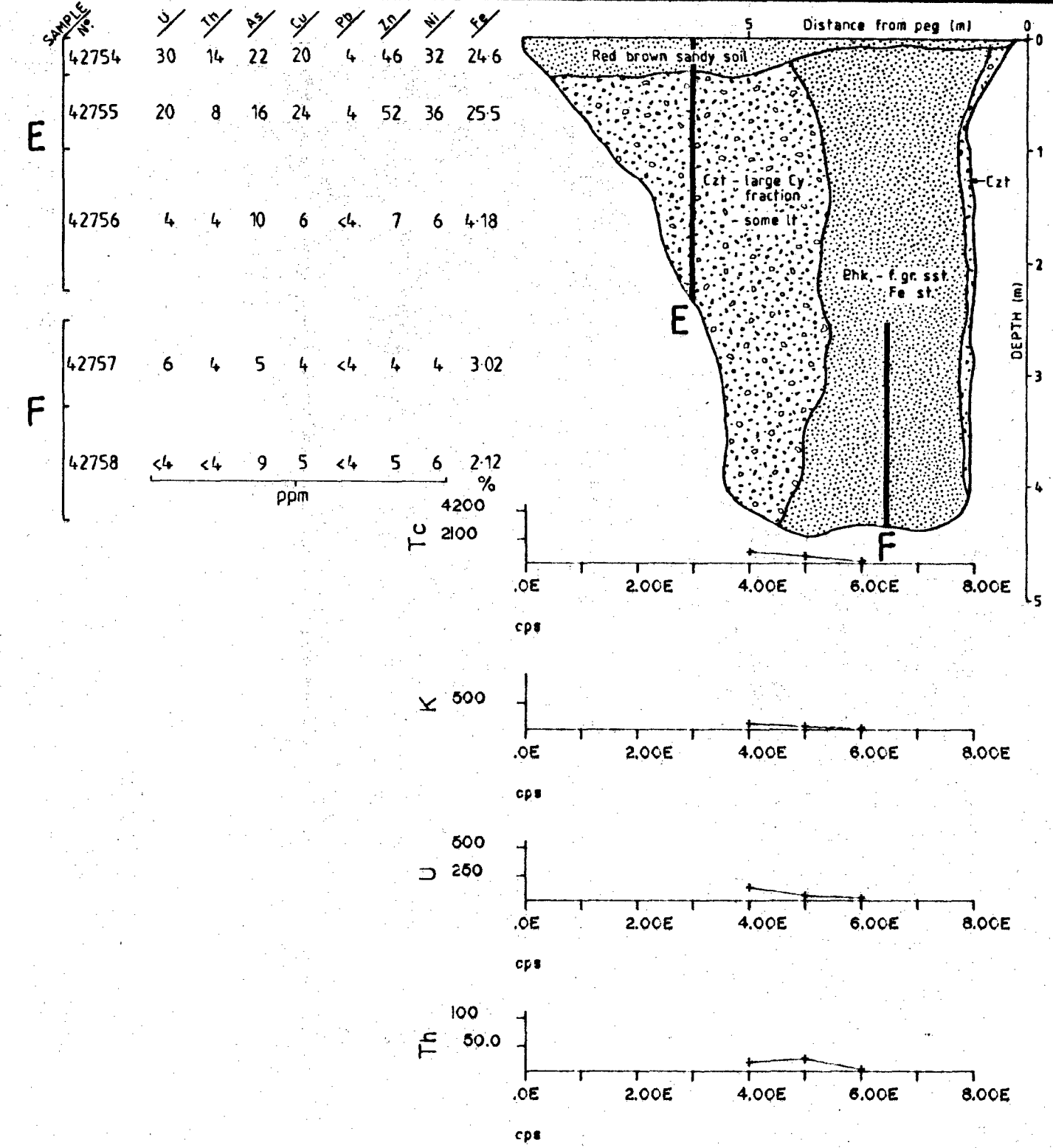
GEOCHEMISTRY



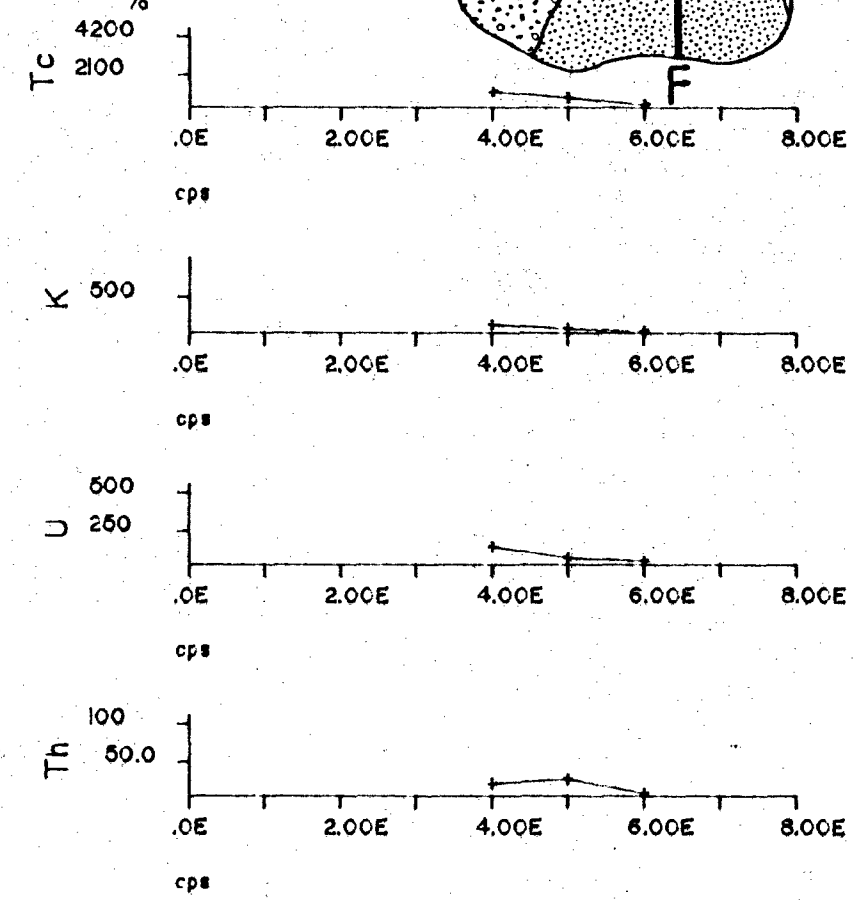
TRENCH No.13 EASTERN WALL 318600E 637405N Bearing 346°



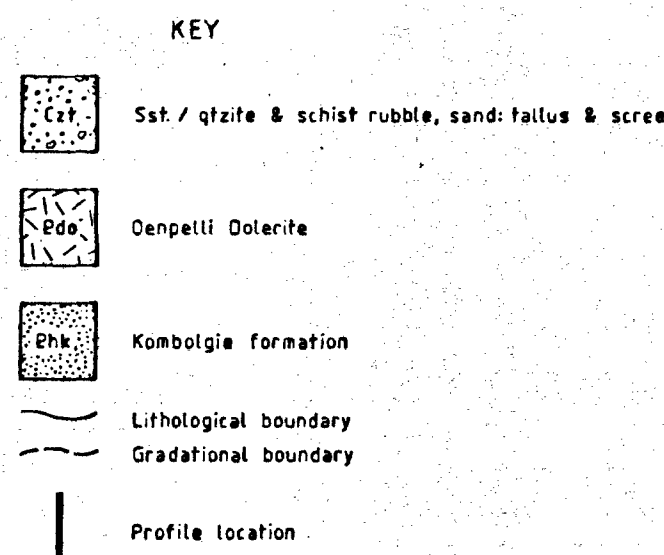
TRENCH No.13 WESTERN WALL 318600E 637405N Bearing 346°



SAMPLE NO.	U	Th	K	Fe	Co	Mo	As
42754	30	16	22	20	4	46	24.6
42755	20	8	16	24	4	52	36
42756	4	4	10	6	<4	7	6
42757	6	4	5	4	<4	4	4
42758	<4	<4	9	5	<4	5	6



TRENCH No.14 318600E 637405N Bearing 258°



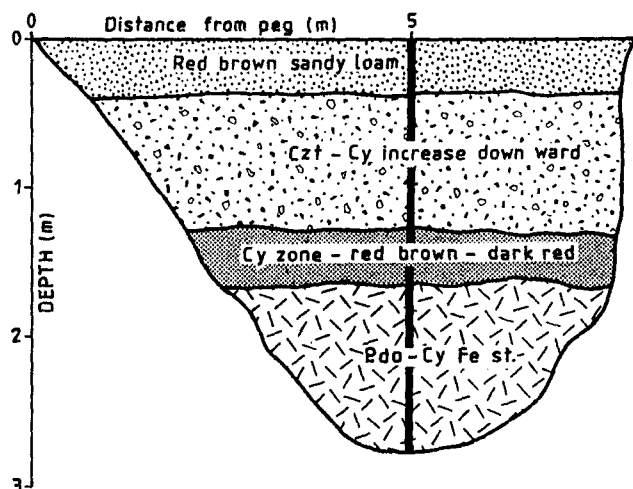
SURTEC
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SURTEC GEOSURVEYS PTY LTD

QUEENSLAND MINES LTD
ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH 13 & 14 PROFILES

Author: DR. N. F. RUTHERFORD	Scale: H. 1:100, V. VARIES
Drawn: G. COURT	Computer File No. 10351N147
Date: FEB. 89	Drawing No. Figure 44

CR 89-423 B



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42764	6	14	9	14	4	11	8	9.90
42765	16	18	17	30	14	17	12	23.0
42766	14	10	16	20	18	10	10	18.7
42767	10	8	6	15	4	8	10	8.00
42768	10	14	9	11	4	8	10	7.05
42769	8	4	5	13	6	8	8	8.30
ppm								%

RADIOMETRICS	1	1	1	1
TC	1207	1016	960	1162
K	153	142	159	206
U	120	99	68	82
Th	21	38	39	39

Counts / 20 secs

SAMPLE N° 42770

U	8
Th	<4
As	5
Cu	12
Pb	10
Zn	8
Ni	12
Fe	7.85 %

ppm

KEY



Sst / qtzite & schist rubble,
sand: talus & scree



Denpelli Dolerite

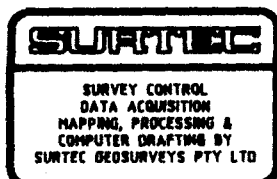


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
318400 E 637395 N Bearing 160°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T 15

Author: DR. N. E. RUTHERFORD

Drawn: A. B.

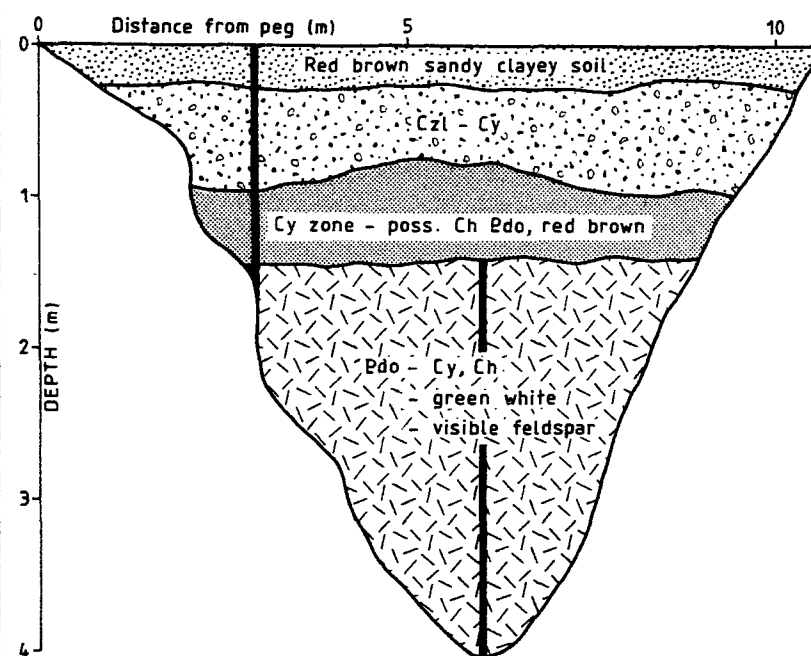
Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 46

COMPOSITE WALL PROFILE 318400E 637500N Bearing 128°



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42771	24	12	7	28	10	13	16	16.4
42772	50	<4	18	38	16	16	22	27.4
42773	26	6	5	10	4	24	44	10.1
42774	22	4	<2	11	<4	22	40	7.70
42775	18	<4	3	5	<4	24	32	7.45
42776	14	<4	3	5	<4	22	32	6.65

ppm %

RADIOMETRICS	1	1	1
TC	2962	1133	924
K	358	135	124
U	378	132	96
Th	20	11	7

Counts / 20 secs

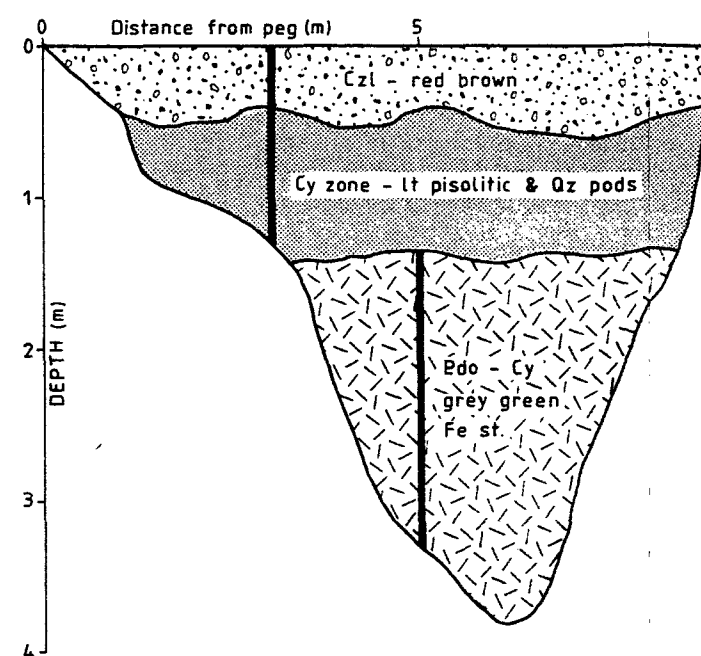
SAMPLE No.	42777
U	10
Th	<4
As	2
Cu	5
Pb	<4
Zn	24
Ni	36
Fe	6.90 %

ppm

KEY

- Nodular, concretionary, pisolitic laterite, within silt sandy, loams
- Oenpelli Dolerite
- Lithological boundary
- Profile location

COMPOSITE WALL PROFILE 318400E 637600N Bearing 128°



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42778	50	<4	11	30	10	13	28	17.8
42779	26	12	5	20	4	13	44	5.30
42780	22	12	7	120	4	8	38	3.26
42781	<4	8	5	7	<4	10	34	2.90
42782	<4	16	3	7	<4	8	30	3.32
42783	10	14	4	2	<4	9	26	3.38

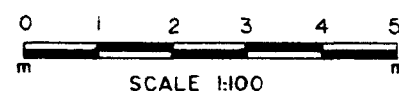
ppm %

RADIOMETRICS	1	1	1	1
TC	1207	1016	960	1162
K	153	142	159	206
U	120	99	68	52
Th	21	38	39	39

Counts / 20 secs

SAMPLE No.	42784
U	4
Th	12
As	4
Cu	4
Pb	<4
Zn	8
Ni	30
Fe	2.66 %

ppm



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T16, T17

Author: DR N.F. RUTHERFORD

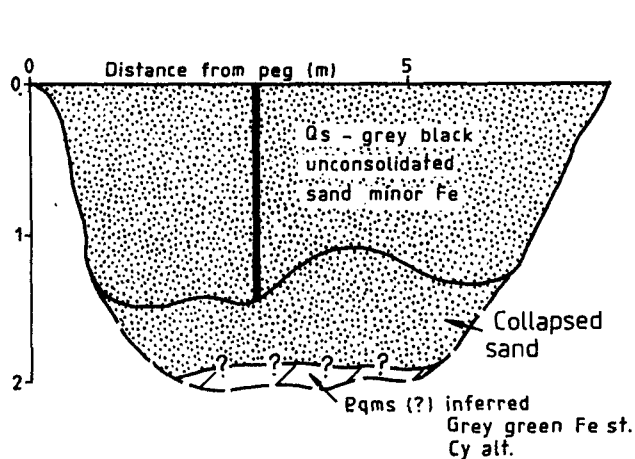
Scale: Hor: 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 47



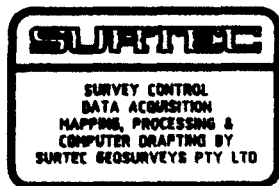
SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42785	6	<4	2	3	<4	6	8	0.43
42786	4	4	4	6	<4	3	8	0.70
	ppm							%

RADIOMETRICS	TC	25	Counts / 20 secs
	K	27	
	U	13	
	Th	20	

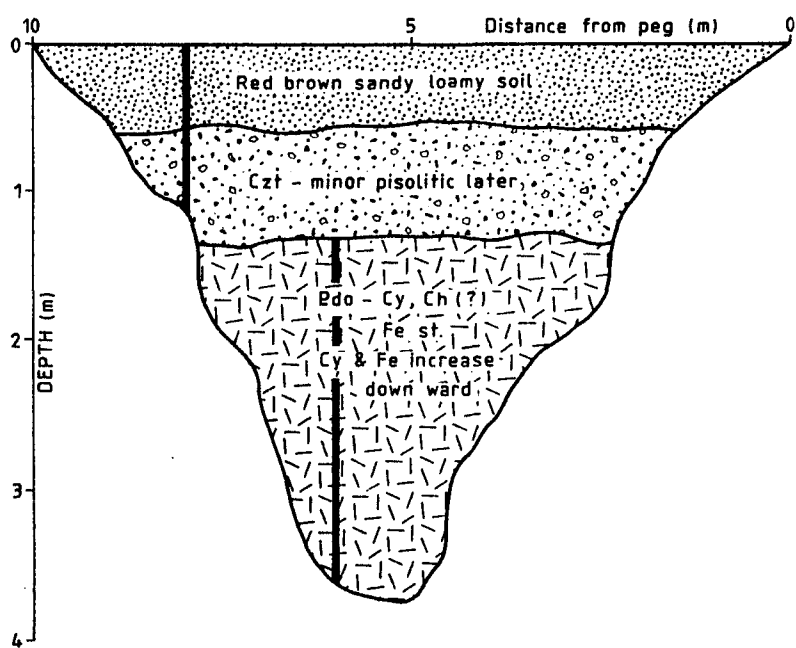
42787	42788	SAMPLE No
6	8	U
10	16	Th
6	3	As
3	17	Cu
<4	<4	Pb
3	72	Zn
4	12	Ni
0.45	8.05	Fe %

KEY	
	Unconsolidated sand, outwash, collovium
	Quartz mica schist
	Lithological boundary
	Gradational boundary
	Profile location

COMPOSITE WALL PROFILE
318400 E 637700 N Bearing 180°



QUEENSLAND MINES LTD	
ARNHEM LAND EXPLORATION PROJECT, EL 2508	
ANOMALY 147	
TRENCH T 18	
Author: DR N.E. RUTHERFORD	Scale: Hor. 1:100 Vert. 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 48



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
42789	<4	4	2	24	<4	9	14	2.86
42790	18	18	20	82	12	17	32	22.7
42791	10	8	5	72	<4	42	14	7.35
42792	<4	8	2	68	<4	52	12	4.60
42793	<4	6	4	64	<4	66	10	7.00
42794	<4	<4	4	80	4	72	12	6.75
	ppm							%

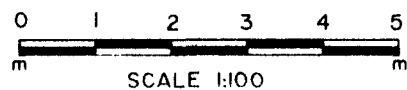
RADIOMETRICS		I	I
	TC	336	809
	K	32	74
	U	42	95
	Th	10	19
Counts / 20 secs			

SAMPLE	Nº	42795
U	4	ppm
Th	<4	
As	5	
Cu	76	
Pb	4	
Zn	70	
Ni	12	
Fe	6.30	%

KEY

-  Sst / qtzite & schist rubble, sand: fallus & scree
-  Oenpelli Dolerite
-  Lithological boundary
-  Profile location

COMPOSITE WALL PROFILE 318900 E 637700 N Bearing 360°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T 19

Author: DR N. F. RUTHERFORD

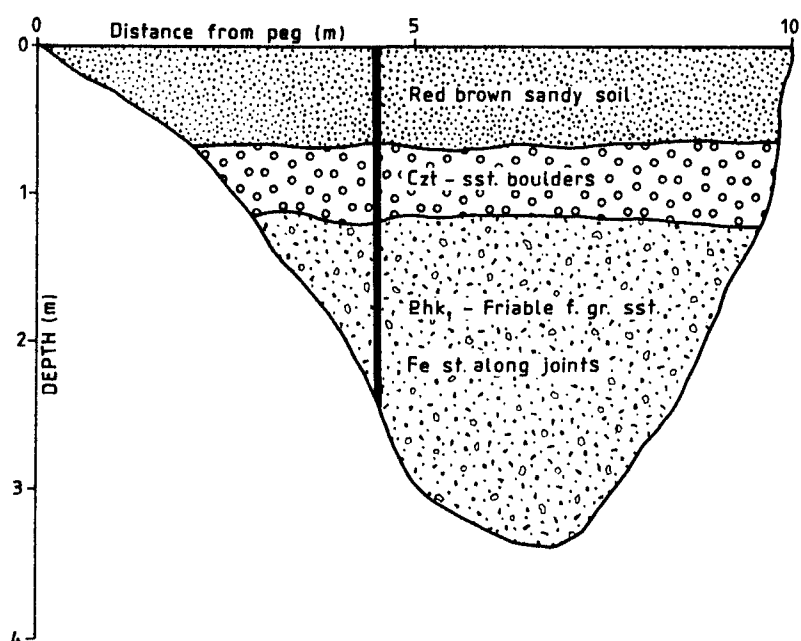
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 49



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
42759	<4	<4	4	3	<4	4	4	0.83
42760	<4	4	18	9	<4	8	6	6.25
42761	8	<4	4	3	<4	3	<4	1.37
42762	<4	<4	9	6	<4	5	6	2.54
	ppm							%

RADIOMETRICS	TC	251	231	Counts / 20 secs
	K	16	19	
	U	23	25	
	Th	19	14	

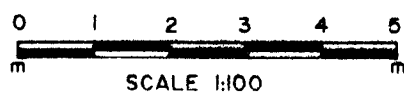
SAMPLE N° 42763

U	6	ppm
Th	<4	
As	4	
Cu	5	
Pb	<4	
Zn	3	
Ni	4	%
Fe	1.16	

KEY

-  Sst / qtzite & schist rubble, sand: talus & scree
-  Kombolgie formation
-  Lithological boundary
-  Profile location

COMPOSITE WALL PROFILE 318600 E 637400 N Bearing 172°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 147
TRENCH T 14A

Author: DR N. F. RUTHERFORD

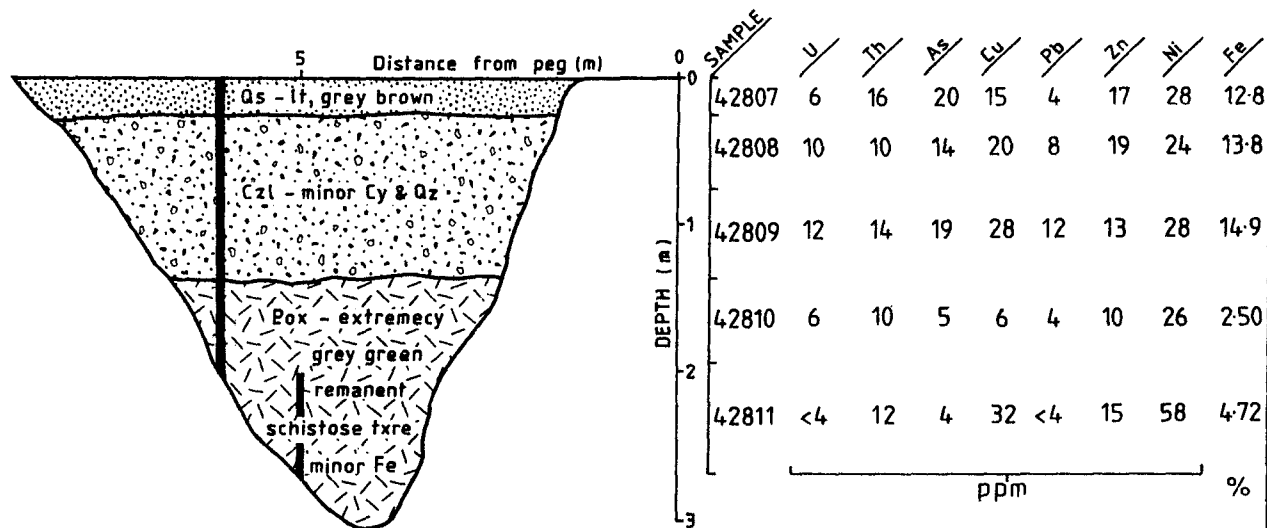
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 45



RADIOMETRICS	TC	1077	840	Counts / 20 secs
	K	132	126	
	U	90	59	
	Th	30	34	

SAMPLE N° 42812

U	<4	ppm
Th	14	
As	8	
Cu	15	
Pb	4	
Zn	30	
Ni	38	%
Fe	4.18	

KEY



Unconsolidated sand, outwash, colluvium



Nodular, concretionary, pisolitic laterite,



Undifferentiated, inferred Nouriangie



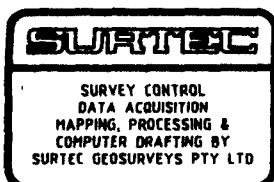
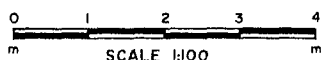
Lithological boundary



Profile location

COMPOSITE WALL PROFILE

314250 E 633475 N Bearing 334°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT 1

Author: DR N. F. RUTHERFORD

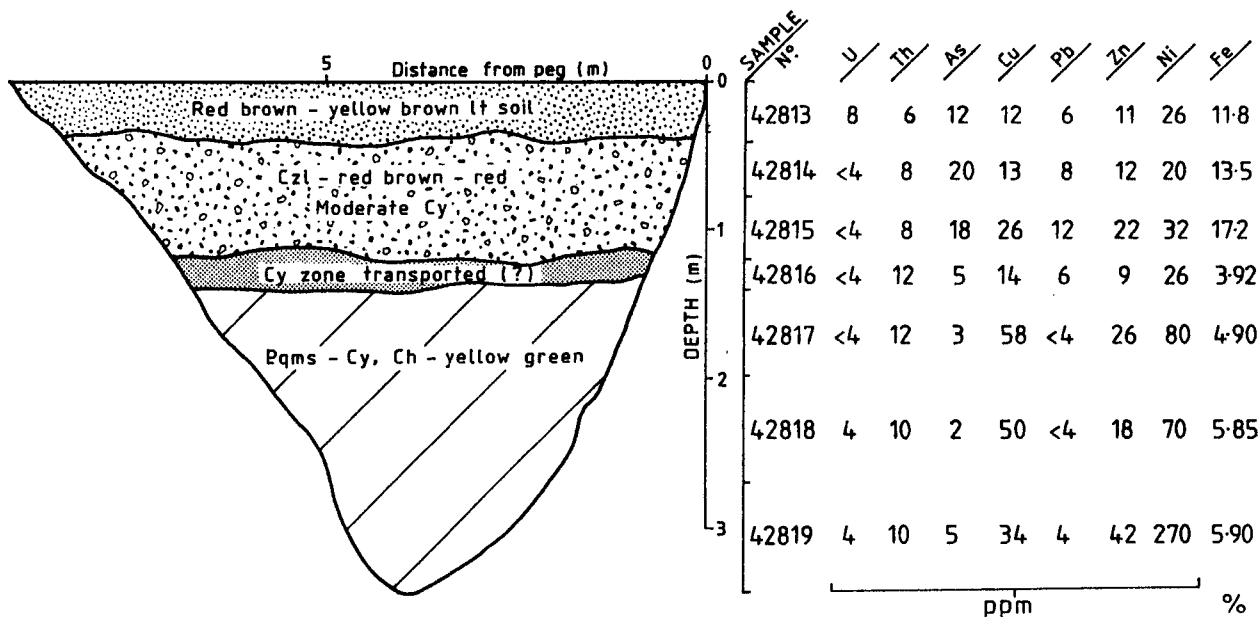
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No

Date: JAN. 1989

Figure 50



RADIOMETRICS	TC	804	717
	K	107	141
	U	49	49
	Th	28	28

Counts / 20 secs

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Quartz mica schist

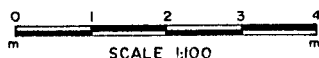


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314250 E 633500 N Bearing 18°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 2

Author: DR N. F. RUTHERFORD

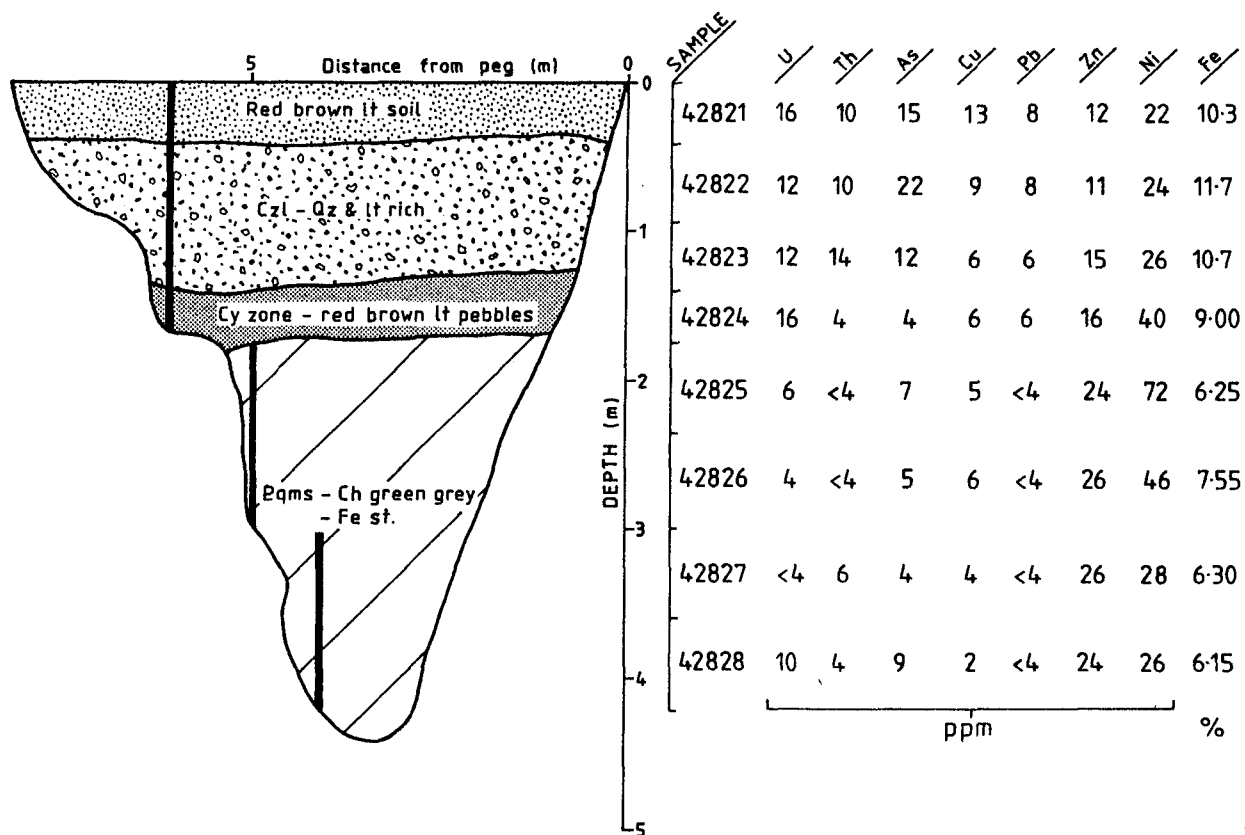
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 51



RADIOMETRICS	TC	1031	691	814
	K	153	151	184
	U	84	34	40
	Th	18	13	12

Counts / 20 secs

SAMPLE N°	42829
U	<4
Th	6
As	3
Cu	4
Pb	<4
Zn	26
Ni	34
Fe	7.55 %

ppm

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Quartz mica schist

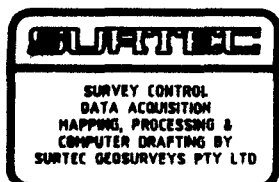
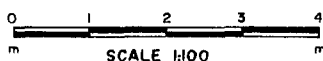


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314250 E 633550 N Bearing 350°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 3

Author: DR N. E. RUTHERFORD

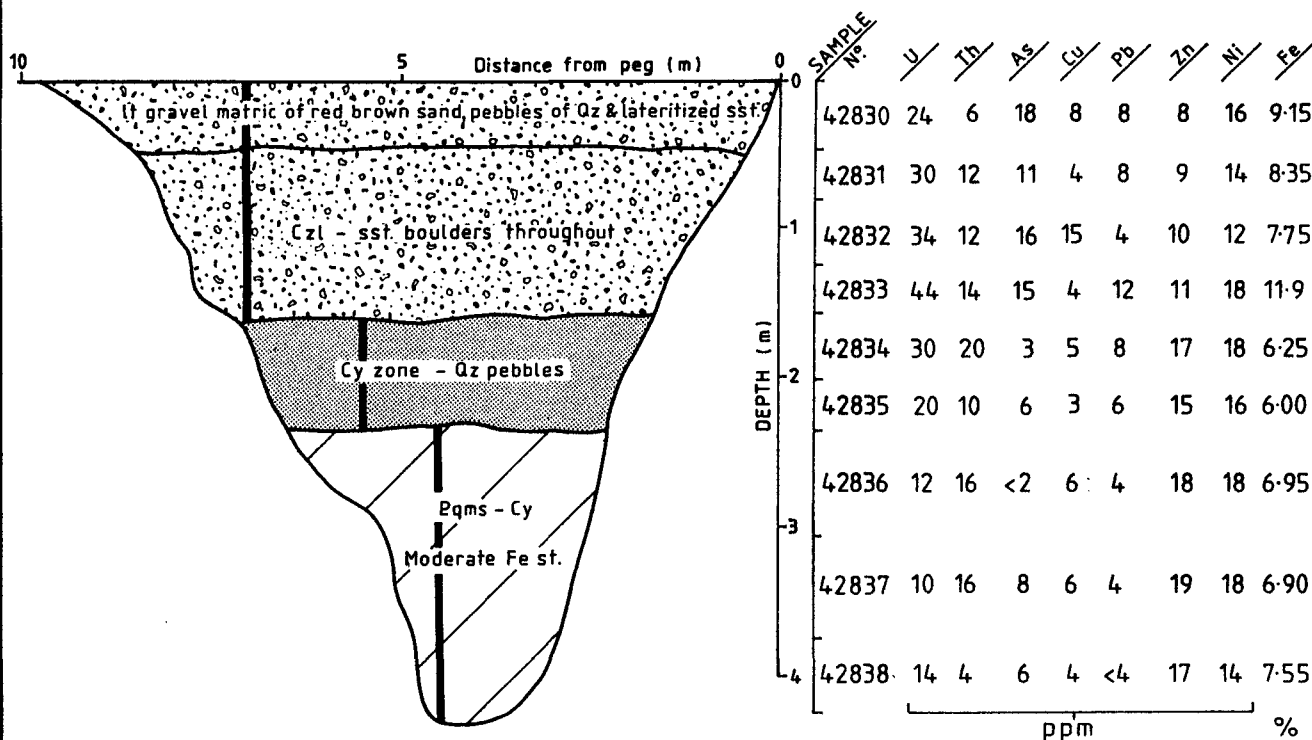
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 52

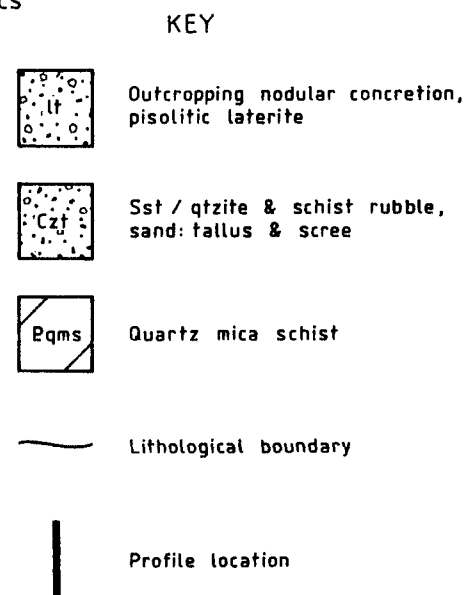


RADIOMETRICS	TC	2965	1617	1965
	K	328	202	227
	U	349	143	198
	Th	53	39	50

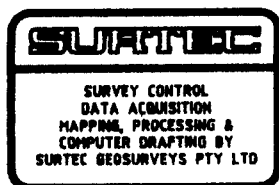
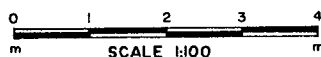
Counts / 20 secs

SAMPLE No.	42839
U	10
Th	16
As	<2
Cu	2
Pb	<4
Zn	24
Ni	18
Fe	9.80

ppm %



COMPOSITE WALL PROFILE
314250 E 633600 N Bearing 338°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2808

ANOMALY 31 (MICHAELS)
TRENCH MT 4

Author: DR N. E. RUTHERFORD

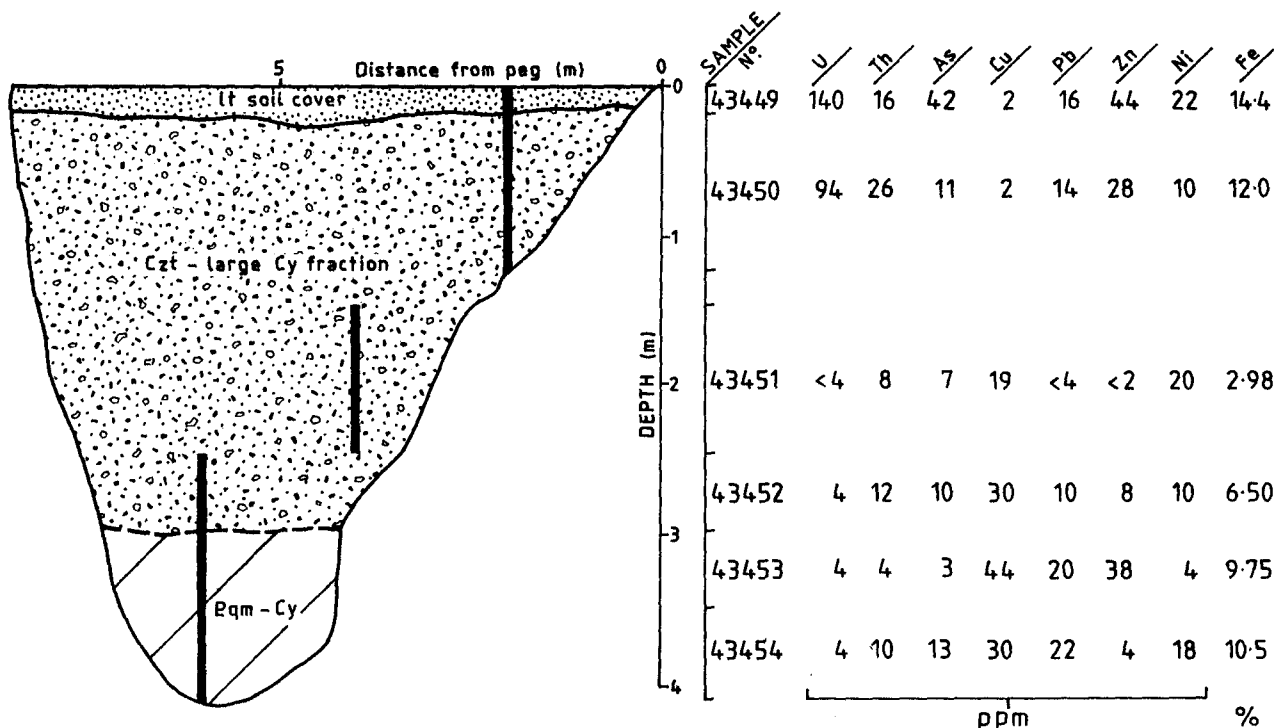
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 53



RADIOMETRICS	TC	3312	3024	4592
	K	479	442	568
	U	349	331	521
	Th	58	65	76

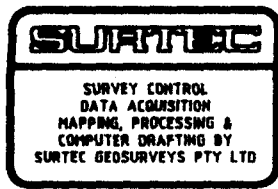
Counts / 20 secs

SAMPLE No.	43255
U	18
Th	10
As	5
Cu	18
Pb	6
Zn	8
Ni	16
Fe	6.05 %

ppm

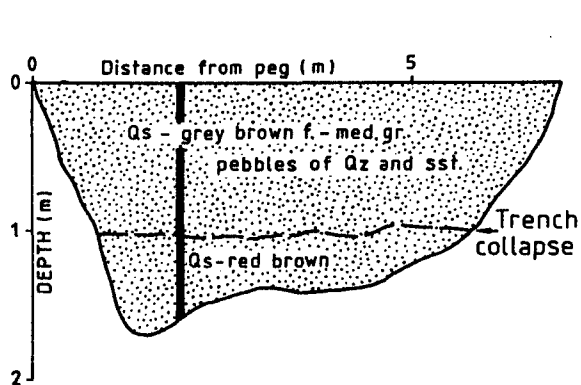
- KEY
- lt Outcropping nodular concretion, pisolitic laterite
 - Czt Sst / qtzite & schist rubble, sand: talus & scree
 - Eqms Quartz mica schist
 - Lithological boundary
 - Gradational boundary
 - Profile location

COMPOSITE WALL PROFILE
314250 E 633650 N Bearing 4°



QUEENSLAND MINES LTD
 ARNHAM LAND EXPLORATION PROJECT, EL 2508
 ANOMALY 31 (MICHAELS)
 TRENCH MT5

Author: DR N.E. RUTHERFORD	Scale: Hor. 1:100 Vert. 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 54



SAMPLE N°	U	Th	As	Cu	Pb	Zn	Ni	Fe
42840	4	12	3	3	<4	5	6	0.78
42841	4	6	6	4	<4	5	6	0.81
	ppm							%

RADIOMETRICS	Counts / 20 secs
476	
48	
35	
38	

SAMPLE N° 42842

U	<4	ppm
Th	12	
As	8	
Cu	5	
Pb	<4	
Zn	5	
Ni	10	
Fe	0.85	%

KEY



Unconsolidated sand,
outwash, colluvium

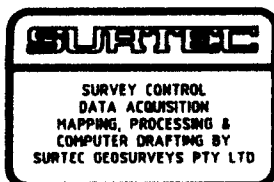


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314300 E 633700 N Bearing 187°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 6

Author: DR N. F. RUTHERFORD

Drawn: A. B.

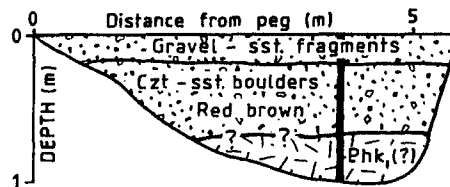
Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

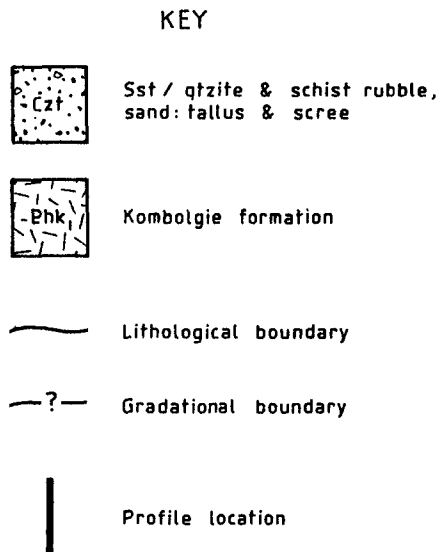
Figure 55

Fe	Ni	Zn	Pb	Cu	As	Th	U	SAMPLE
8.30	10	7	8	8	46	26	18	42843
4.40	8	7	4	9	28	8	16	42844
2.78	10	6	4	5	10	4	14	42845
								%
								ppm



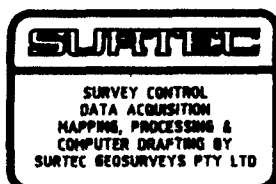
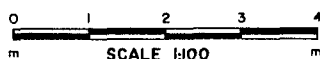
RADIOMETRICS	TC	1521	Counts / 20 secs
	K	157	
	U	160	
	Th	42	

SAMPLE N° 42846



U	8	ppm
Th	<4	
As	11	
Cu	3	
Pb	<4	
Zn	2	
Ni	10	
Fe	2.12	
		%

COMPOSITE WALL PROFILE
314300 E 633645 N Bearing 58°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT 7

Author: DR N. F. RUTHERFORD

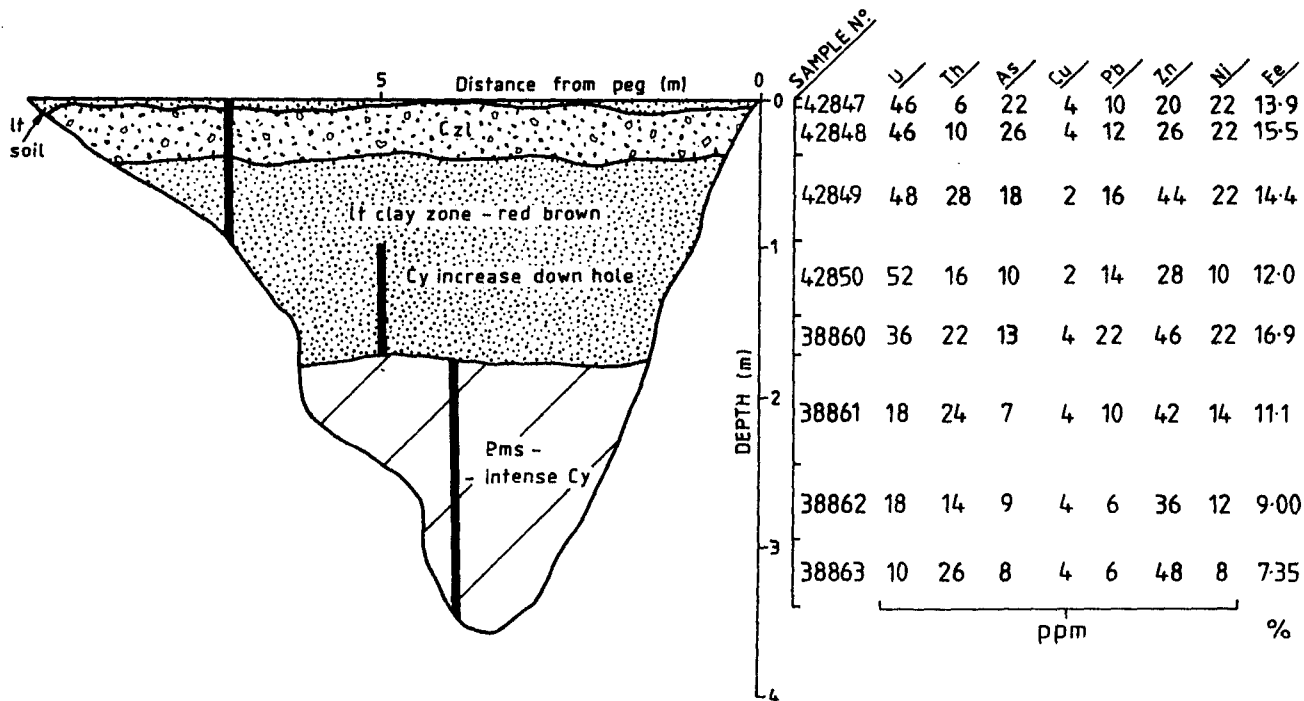
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 56



RADIOMETRICS	TC	4005	1719	1732
	K	455	191	179
	U	457	180	158
	Th	87	53	71

Counts / 20 secs

SAMPLE N°	38864
U	4
Th	22
As	4
Cu	4
Pb	6
Zn	44
Ni	8
Fe	7.80

ppm %

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Mica schist

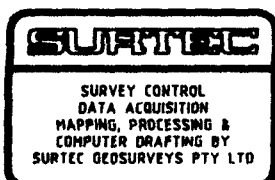
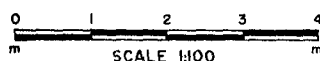


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314300 E 633600 N Bearing 12°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT 8

Author: DR N. F. RUTHERFORD

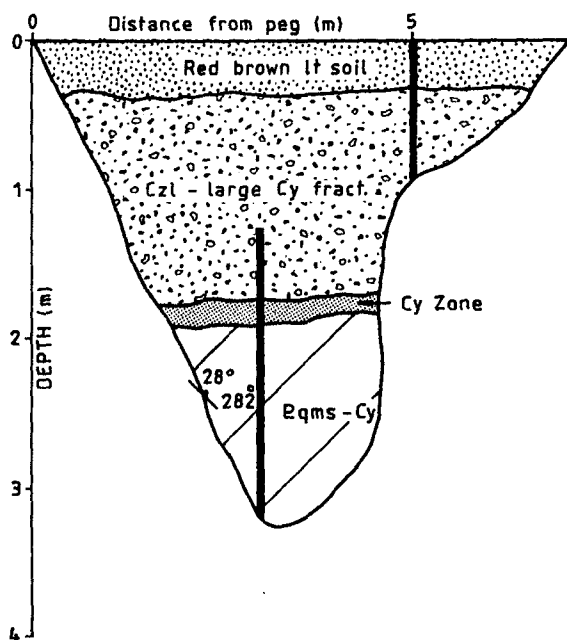
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 57



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
38865	12	16	20	5	8	16	18	9.50
38866	12	16	17	6	12	12	18	11.7
38867	22	12	14	7	8	17	14	7.15
38868	38	<4	8	3	14	185	32	9.20
38869	24	6	3	5	14	360	86	9.75
38870	16	8	7	4	8	310	68	9.10
38871	20	14	11	6	6	330	56	13.0
	ppm							%

RADIOMETRICS	TC	1496	1843
	K	166	198
	U	158	202
	Th	27	47
	Counts / 20 secs		

SAMPLE N°	38872
U	18
Th	<4
As	5
Cu	6
Pb	4
Zn	330
Ni	62
Fe	11.8
	%

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite,



Quartz mica schist



Strike and dip of foliation

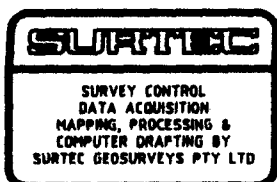
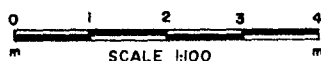


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314300 E 633550 N Bearing 160°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 9

Author: DR N. F. RUTHERFORD

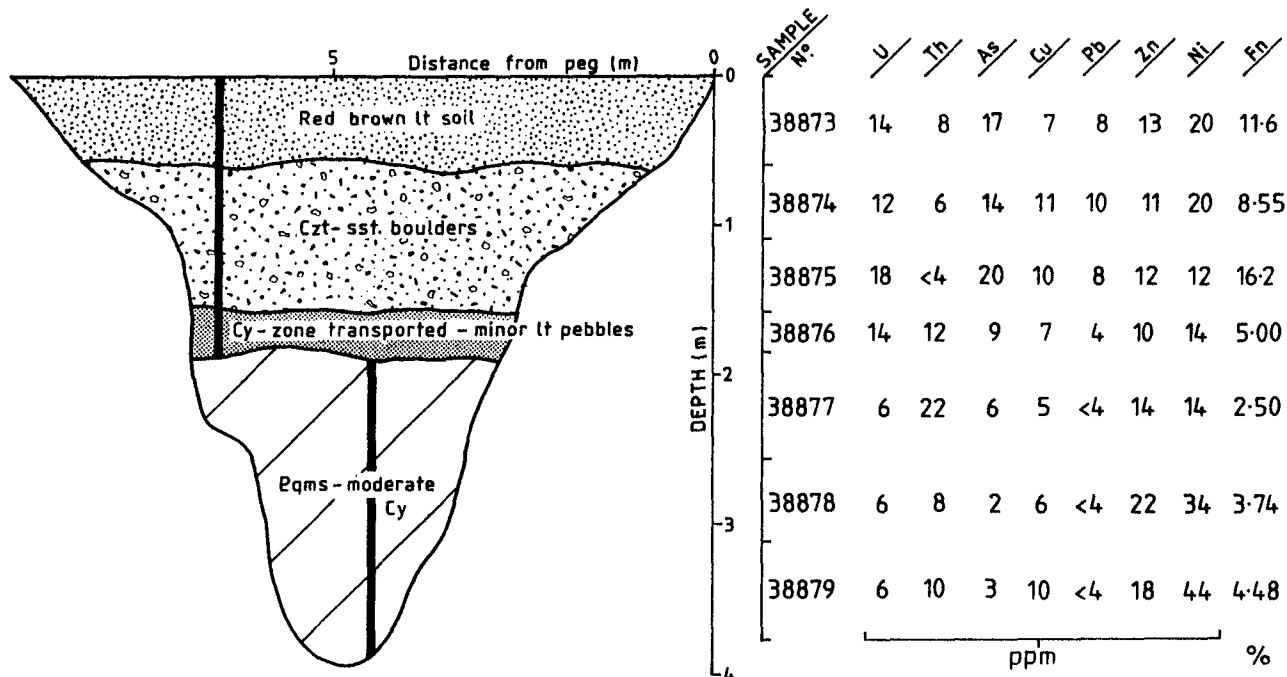
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 58



RADIOMETRICS	TC	1218	1482	Counts / 20 secs
	K	177	314	
	U	119	95	
	Th	36	61	

SAMPLE No.	38880
U	4
Th	4
As	5
Cu	8
Pb	<4
Zn	19
Ni	42
Fe	5.00 %

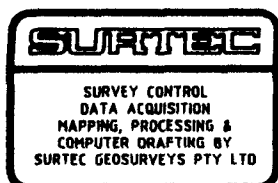
ppm

KEY

- lt Outcropping nodular concretion, pisolitic laterite
- Czt Sst / qtzite & schist rubble, Sand: talus & scree
- Pqms Quartz mica schist
- Lithological boundary
- Profile location

COMPOSITE WALL PROFILE
314300 E 633500 N Bearing 352°

0 1 2 3 4
m
SCALE 1:100



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT10

Author: DR N.F. RUTHERFORD

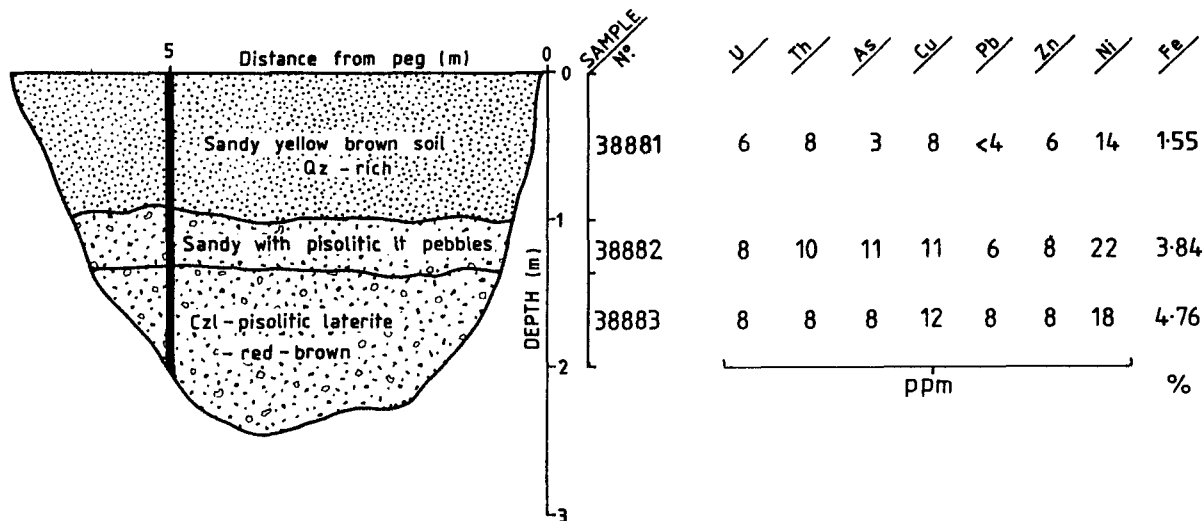
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No

Date: JAN. 1989

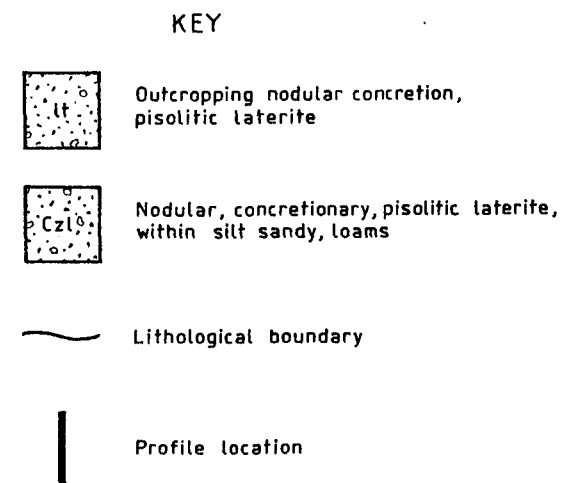
Figure 59



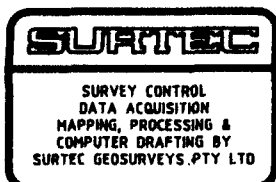
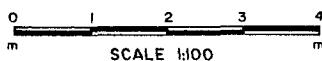
RADIOMETRICS	TC	815	1262	1338
	K	88	171	170
	U	76	123	130
	Th	32	36	35

Counts / 20 secs

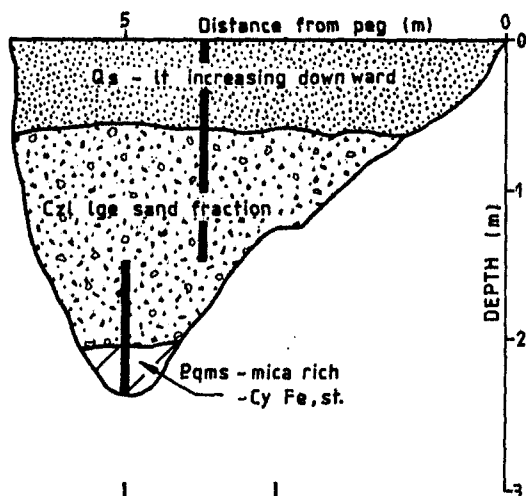
SAMPLE N° 38884		
U	14	ppm
Th	8	
As	16	
Cu	11	
Pb	10	
Zn	7	
Ni	10	
Fe	9.55	%



COMPOSITE WALL PROFILE
314350 E 633400 N Bearing 24°



QUEENSLAND MINES LTD	
ARNHEM LAND EXPLORATION PROJECT, EL 2508	
ANOMALY 31 (MICHAELS)	
TRENCH MT 11	
Author: DR N.F. RUTHERFORD	Scale: Hor: 1:100 Vert: 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 60



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
38885	12	12	13	7	4	6	12	4.62
38886	14	6	34	8	8	7	10	11.0
38887	22	10	18	7	6	7	8	8.75
38888	14	<4	18	7	8	7	12	8.90
38889	10	14	8	9	4	8	14	4.50
	ppm							%

RADIOMETRICS	1	1
TC	1481	1737
K	199	206
U	122	216
Th	50	39

Counts / 20 secs

SAMPLE No	38890
U	10
Th	18
As	10
Cu	14
Pb	<4
Zn	7
Ni	14
Fe	3.34

ppm %

KEY



Unconsolidated sand, outwash, colluvium



Nodular, concretionary, pisolitic laterite, within silt sandy, loams

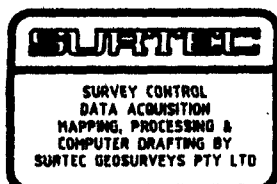
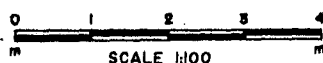


Quartz mica schist

— Lithological boundary

— Profile location

COMPOSITE WALL PROFILE
314350 E 633500 N Bearing 12°



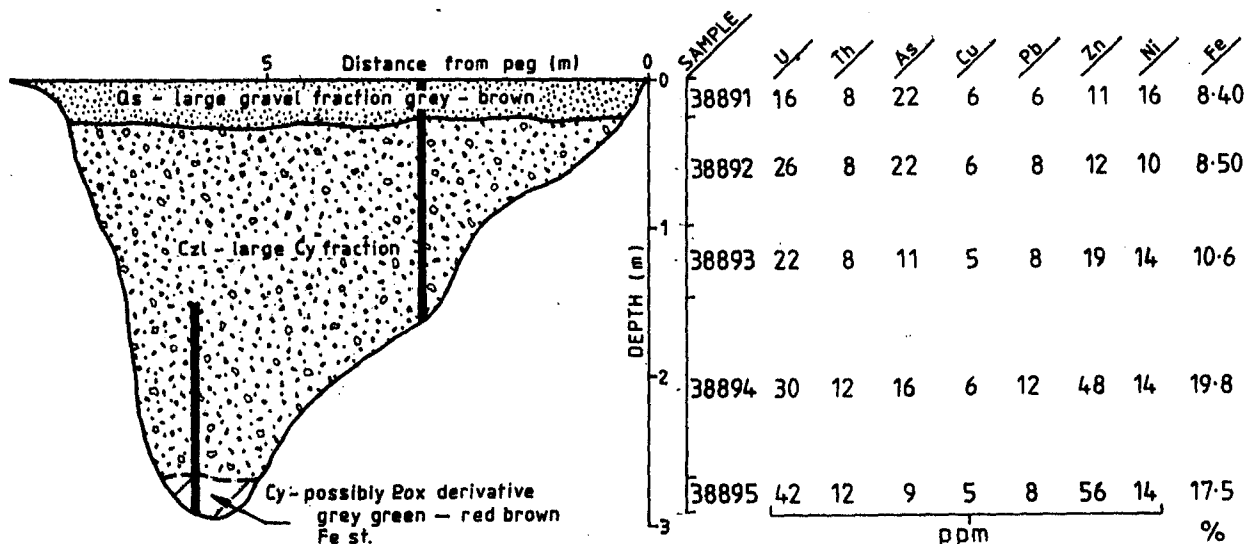
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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT12

Author: DR N.F. RUTHERFORD
Drawn: A. B.
Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50
Drawing No.
Figure 61



RADIOMETRICS	TC	2410	2319
	K	199	206
	U	122	216
	Th	50	39

Counts / 20 secs

SAMPLE N°	38896
U	36
Th	12
As	<2
Cu	5
Pb	12
Zn	46
Ni	14
Fe	17.3 %

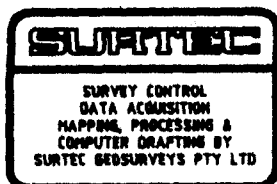
ppm

KEY

-  Box
Undifferentiated, inferred Nourlangie schist
-  Qs
Unconsolidated sand, outwash, colluvium
-  Czl
Nodular, concretionary, pisolitic laterite, within silt sandy, loams
-  Lithological boundary
-  Gradational boundary
-  Profile location

COMPOSITE WALL PROFILE
314350 E 633547 N Bearing 340°

0 1 2 3 4
m SCALE 1:100 m



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT13

Author: DR N.E. RUTHERFORD

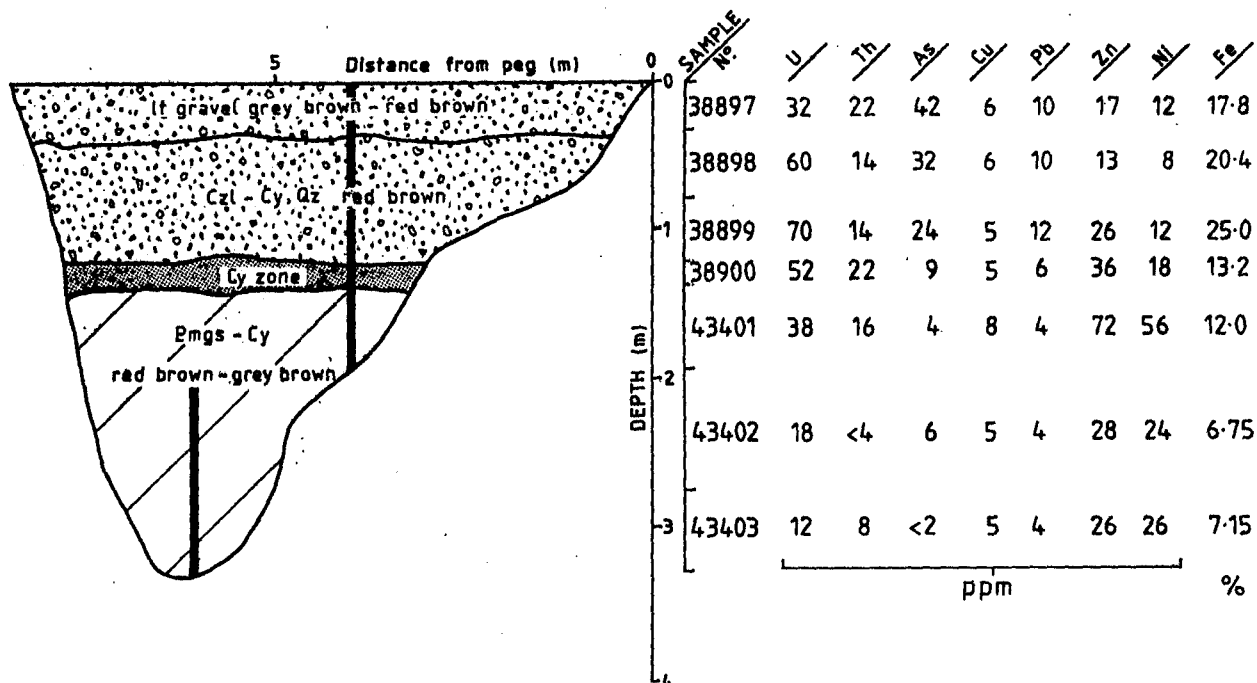
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 62



RADIOMETRICS	TC	1721	3264	Counts / 20 secs
	K	296	442	
	U	139	341	
	Th	33	48	

SAMPLE No 43404

U	12	ppm
Th	<4	
As	4	
Cu	5	
Pb	<4	
Zn	26	
Ni	14	
Fe	810	%

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Mica quartz schist



Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314350 E 633595 N Bearing 4°

0 1 2 3 4
m SCALE 1:100

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QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2808

ANOMALY 31 (MICHAELS)

TRENCH MT 14

Author: DR N. E. RUTHERFORD

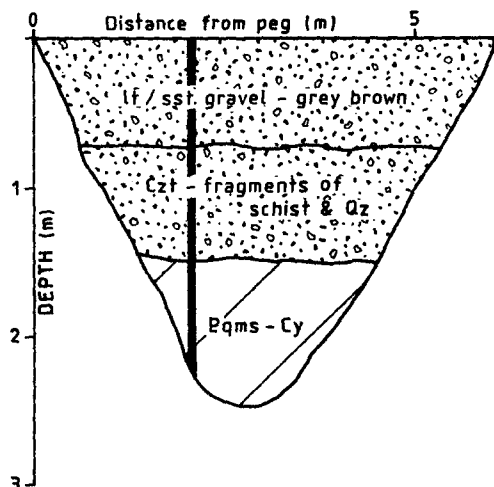
Scale: Hor: 1:100, Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 63



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43416	10	18	28	20	16	8	22	12.2
43417	28	32	22	19	18	8	22	12.3
43418	16	26	13	18	10	13	24	8.20
43419	10	34	17	15	10	11	24	7.45
ppm								
								%

RADIOMETRICS		I	I
	TC	2155	2250
	K	325	318
	U	180	182
	Th	68	108
Counts / 20 secs			

SAMPLE No.	I	I
43420		
U	6	
Th	22	
As	5	
Cu	15	ppm
Pb	4	
Zn	10	
Ni	22	
Fe	4.96	%

KEY



Outcropping nodular concretion, pisolitic laterite



Sst / qtzite & schist rubble, sand: talus & scree



Quartz mica schist

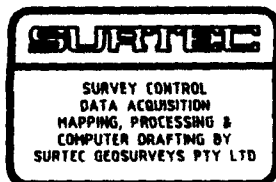


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314400 E 633500 N Bearing 150°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 15

Author: DR N.E. RUTHERFORD

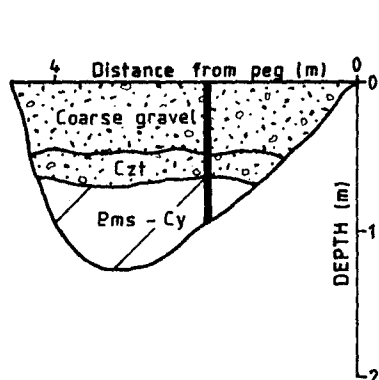
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 64



SAMPLE
Nº

U	Th	As	Cu	Pb	Zn	Ni	Fe
16	4	24	10	16	11	22	12.00
30	30	26	64	18	15	32	18.10
10	14	4	30	6	7	20	7.55
							%

RADIOMETRICS	TC	1829	Counts / 20 secs
	K	287	
	U	150	
	Th	74	

SAMPLE N°	43415	
U	10	] ppm
Th	20	
As	3	
Cu	18	
Pb	38	
Zn	9	
Ni	20	
Fe	3.64	%

KEY



Sst / quartzite & schist rubble,
sand: talus & scree



Mica schist

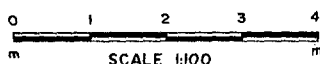


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314400 E 633550 N Bearing 354°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT16

Author: DR N. F. RUTHERFORD

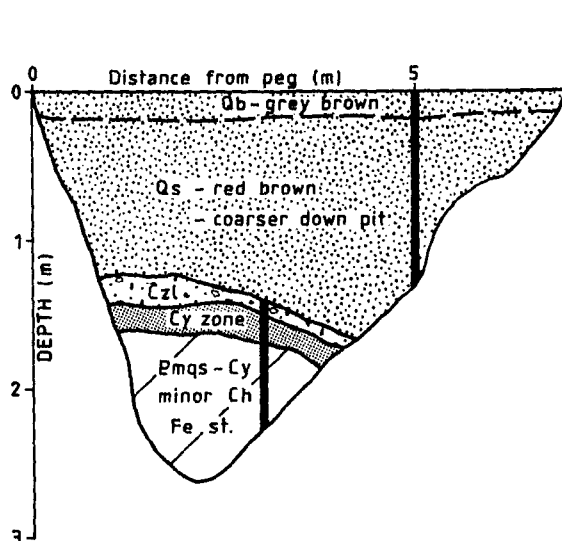
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 65



SAMPLE	U	Tb	As	Cu	Pb	Zn	Ni	Fe
43405	6	6	10	3	<4	4	14	1.42
43406	8	12	13	3	4	7	12	1.36
43407	22	10	90	4	6	7	6	11.1
43408	8	<4	48	<2	<4	4	4	8.50
43409	4	8	30	2	4	7	<4	9.00
43410	<4	8	11	3	6	7	4	5.75
	ppm							%

RADIOMETRICS	1	1	1
TC	1167	1620	993
K	238	214	130
U	81	149	96
Th	41	36	25

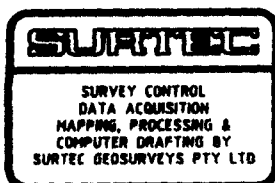
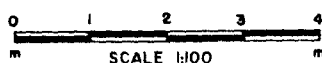
Counts / 20 secs

SAMPLE N°	43411
U	8
Th	<4
As	19
Cu	2
Pb	<4
Zn	9
Ni	6
Fe	6.15 %

ppm

Qb	Black soil & clay predominantly in drainage minor silt / sand
Qs	Unconsolidated sand, outwash, colluvium
Czl	Nodular, concretionary, pisolitic laterite, within silt sandy, loams
Pmq	Mica quartz schist
—	Lithological boundary
- - -	Gradational boundary
	Profile location

COMPOSITE WALL PROFILE
314400 E 633600 N Bearing 174°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT17

Author: DR N. F. RUTHERFORD

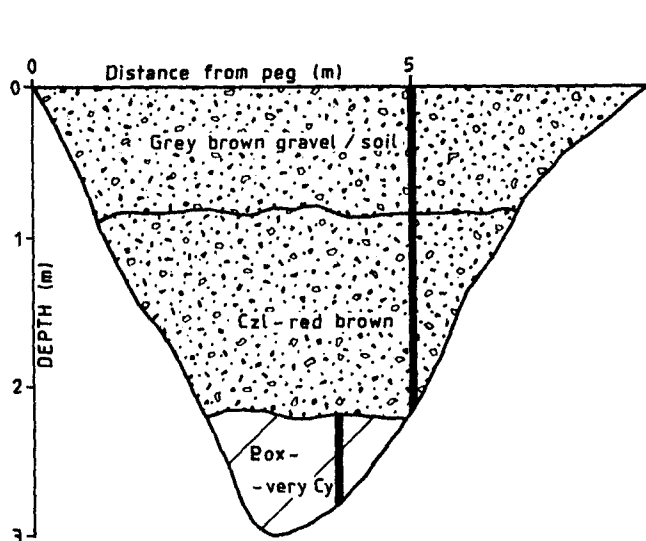
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 66



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
43421	6	12	9	12	6	5	20	2.52
43422	18	10	46	17	26	12	18	12.6
43423	8	20	24	16	22	11	24	8.85
43424	6	24	11	14	10	10	32	5.50

ppm %

RADIOMETRICS	TC	1811	1368
	K	269	172
	U	115	141
	Th	77	48

Counts / 20 secs

SAMPLE No	43425
U	8
Th	18
As	11
Cu	10
Pb	10
Zn	10
Ni	24
Fe	6.40

ppm %

KEY



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Undifferentiated, inferred Nouriangie schist

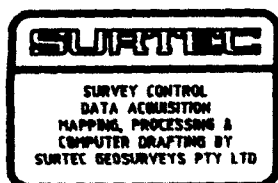


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314400 E 633450 N Bearing 177°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 18

Author: DR N.F. RUTHERFORD

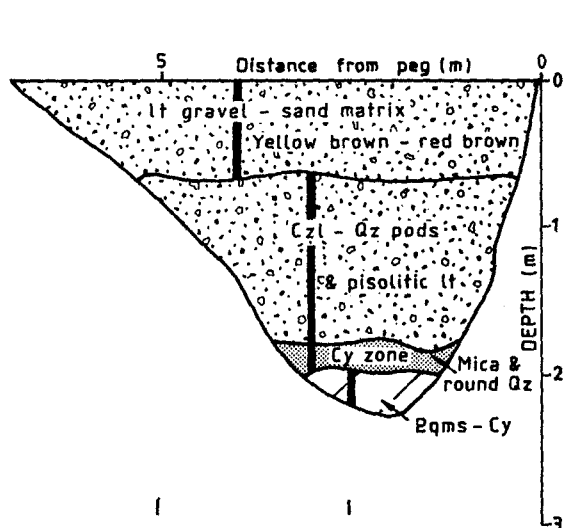
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 67



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43426	10	8	34	19	10	10	30	8.40
43427	8	26	26	28	14	12	36	9.30
43428	<4	14	16	34	26	44	24	8.75
43429	<4	12	14	48	20	58	30	7.05

ppm %

RADIOMETRICS	TC	1453	1524
	K	173	221
	U	133	113
	Th	43	63

Counts / 20 secs

SAMPLE NO	43430
U	8
Th	14
As	13
Cu	48
Pb	22
Zn	58
Ni	32
Fe	6.75 %

ppm

KEY



Outcropping nodular concretion, pisolitic laterite



Nodular, concretionary, pisolitic laterite, within silt sandy, loams



Quartz mica schist

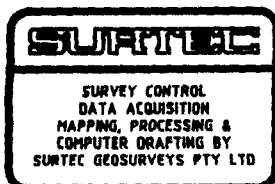
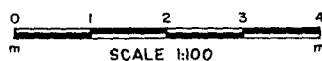


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314500 E 633450 N Bearing 226°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT19

Author: DR N. F. RUTHERFORD

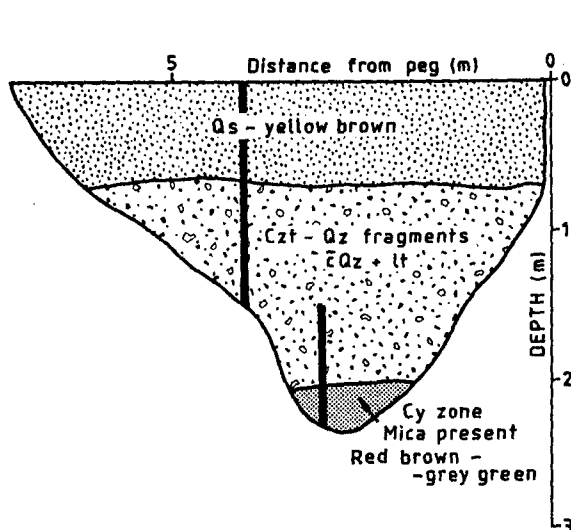
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 68



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43431	4	14	9	14	4	8	16	2.80
43432	6	18	28	19	22	7	20	11.3
43433	8	12	19	16	12	11	24	6.95
43434	12	24	4	16	16	11	28	5.05
ppm								%

RADIOMETRICS	TC	1453	1524	Counts / 20 secs
	K	173	221	
	U	133	113	
	Th	43	63	

SAMPLE N° 43435

U	<4	ppm
Th	18	
As	7	
Cu	16	
Pb	10	
Zn	6	
Ni	24	
Fe	4.74	%

KEY



Unconsolidated sand, outwash, colluvium



Sst / quartzite & schist rubble, sand: talus & scree



Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314500 E 633400 N Bearing 358°

0 1 2 3 4
m SCALE 1:100 m

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ANOMALY 31 (MICHAELS)

TRENCH MT 20

Author: DR N.F. RUTHERFORD

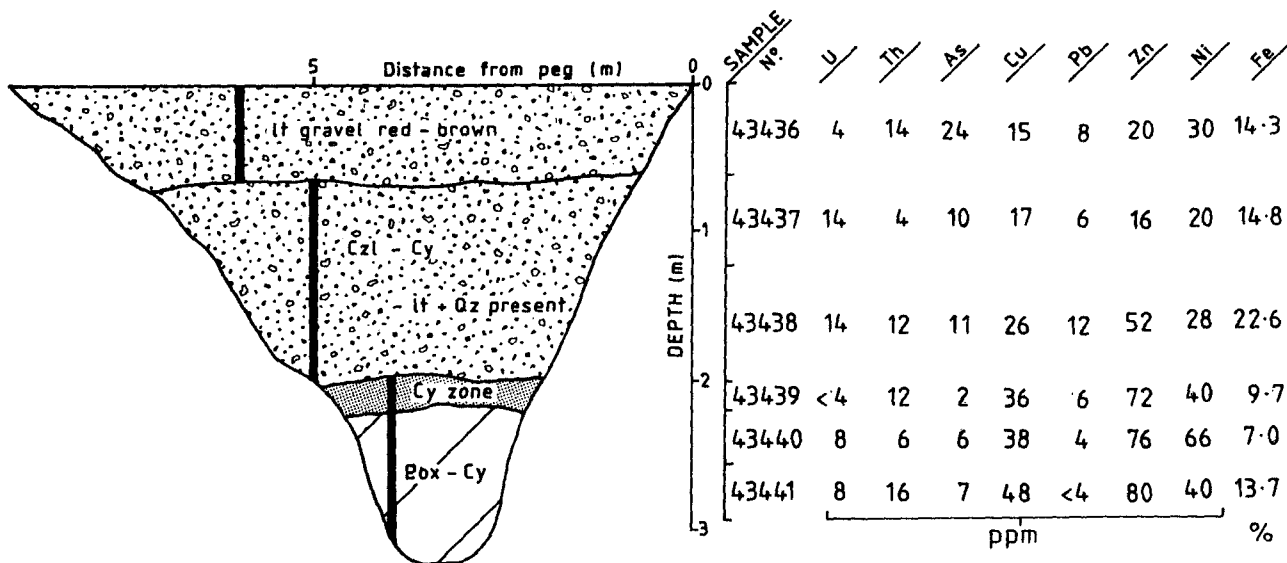
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 69



RADIONETRICS	TC	876	791	542
	K	108	110	92
	U	77	69	39
	Th	36	29	24
	Counts / 20 secs			

SAMPLE N° 43442	
U	<4
Th	12
As	7
Cu	42
Pb	<4
Zn	68
Ni	34
Fe	9.05 %

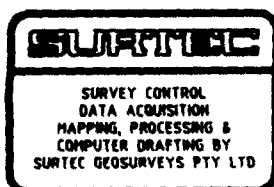
ppm

KEY

- Outcropping nodular concretion, pisolitic laterite
- Nodular, concretionary, pisolitic laterite, within silt sandy, loams
- Undifferentiated, inferred Nouriangie schist
- Lithological boundary
- Profile location

COMPOSITE WALL PROFILE
314200 E 633545 N Bearing 348°

0 1 2 3 4
m SCALE 1:100



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT 21

Author: DR N. F. RUTHERFORD

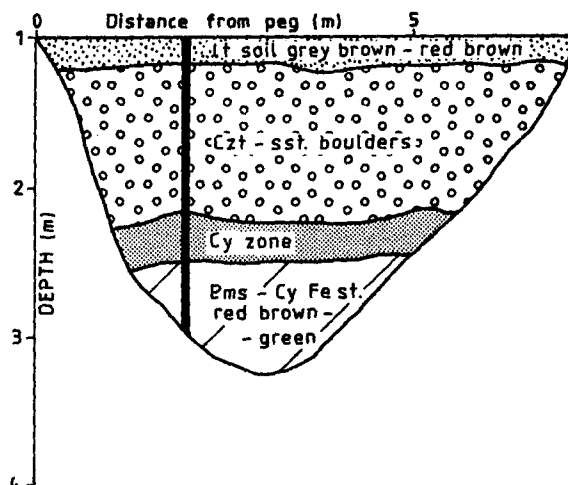
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.
Figure 70

	Fe	Ni	Zn	Pb	Cu	As	Th	U	SAMPLE
7-15	20	9	<4	11	15	6	12	43443	
9-00	16	9	<4	6	16	16	6	43444	
12-8	16	9	6	5	26	6	32	43445	
7-80	16	11	<4	5	9	6	12	43446	
5-30	28	15	<4	9	4	4	12	43447	
%	ppm								



Counts / 20 secs

RADIOMETRICS	TC	2034	1895
	K	306	251
	U	184	212
	Th	21	37

KEY



Outcropping nodular concretion, pisolitic laterite



Sst / qtzite & schist rubble, sand: talus & scree



Mica schist



Lithological boundary

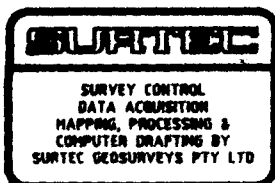
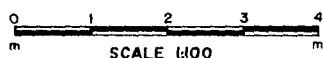


Profile location

SAMPLE N° 43448

U	36	ppm
Th	8	
As	3	
Cu	12	
Pb	4	
Zn	20	
Ni	42	
Fe	11.4	%

COMPOSITE WALL PROFILE
314200 E 633600 N Bearing 186°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)

TRENCH MT22

Author: DR. N. E. RUTHERFORD

Scale: Hor. 1:100 Vert. 1:50

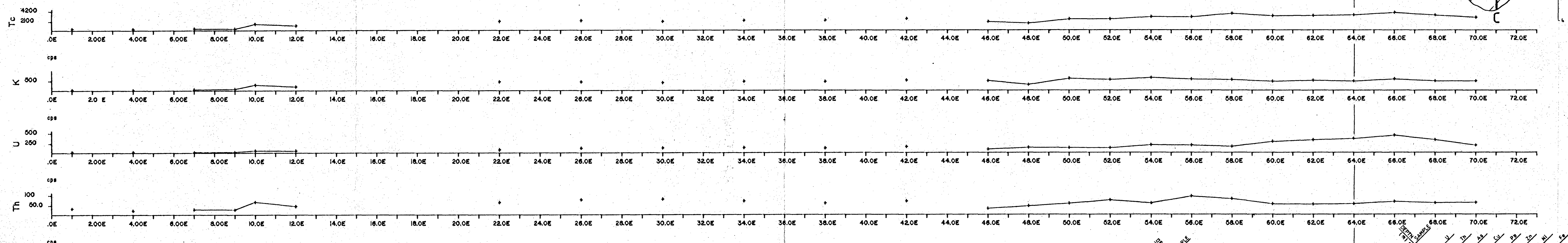
Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 71

RADIOMETRICS



A

DEPTH (m)	Sample No.	U	Th	K	Tc
1.0	43229	4	15	8	4.46
1.5	43230	6	9	7	4.54
2.0	43231	4	11	4	1.78
2.5	43232	10	22	5	3
3.0	43233	6	22	2	3

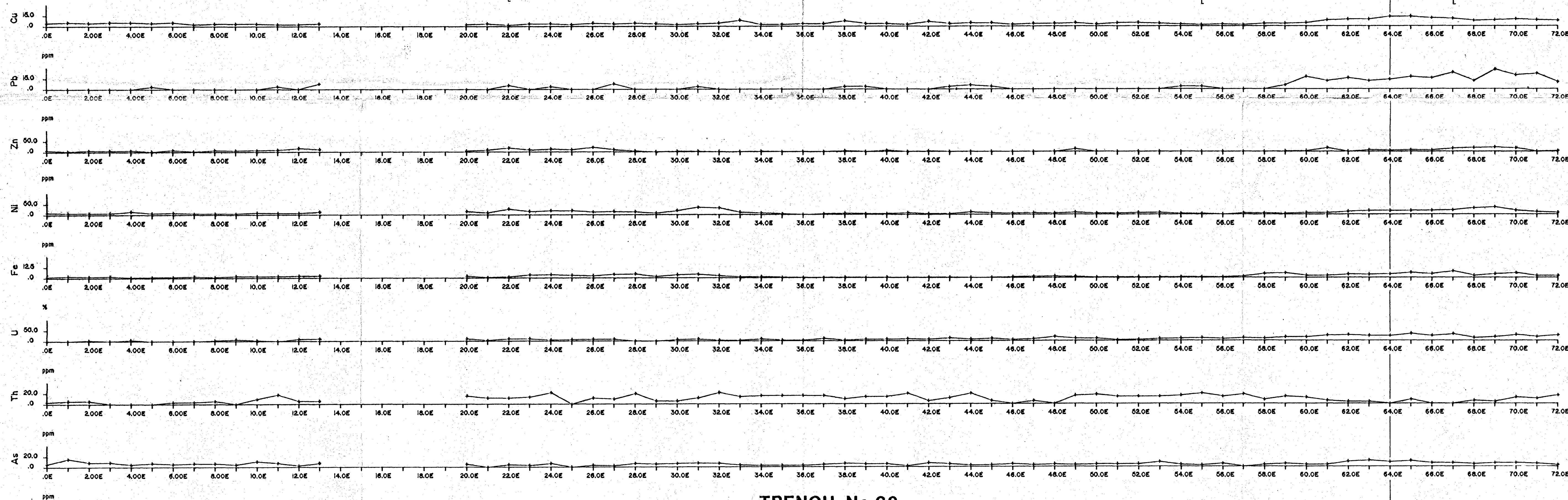
B

DEPTH (m)	Sample No.	U	Th	K	Tc
1.0	43226	40	20	9	6
1.5	43227	10	4	4	2
2.0	43228	6	10	3	4

C

DEPTH (m)	Sample No.	U	Th	K	Tc
1.0	43223	54	22	4	10
1.5	43224	22	20	4	11
2.0	43225	20	10	6	11

GEOCHEMISTRY



TRENCH No.23 314250E 633665N

KEY

- Cst Sst / qtzite & schist rubble, sand / talus & scree
- Kmbolgie formation
- Mica schist
- Quartz mica schist
- Lithological boundary
- Gradational boundary
- Strike and dip of foliation
- Profile location

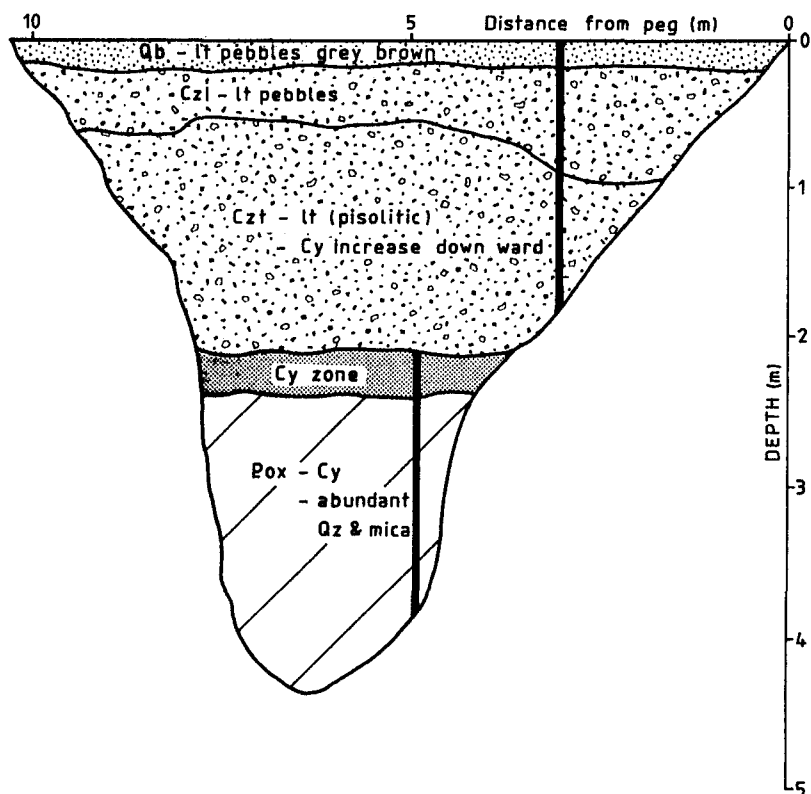
SURTEC

SURVEY CONTROL
DATA ACQUISITION
MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

QUEENSLAND MINES LTD
ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (Michael's)
TRENCH 23 PROFILE

Author: DR. N. F. RUTHERFORD
Scale: H. 1:100, V. VARIES
Drawn: G. COURT
Computer File No. 1028TN31
Date: FEB. 89
Drawing No. Figure 72



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43970	<4	<4	18	16	6	30	22	11.3
43971	6	6	11	20	10	24	14	14.3
43972	8	<4	9	19	8	13	10	9.55
42973	<4	<4	11	40	12	66	18	17.5
43974	4	<4	5	22	10	32	14	10.4
43975	<4	<4	9	38	12	80	20	12.4

ppm %

RADIONETRICS	1	1
TC	406	891
K	62	135
U	27	68
Th	23	38

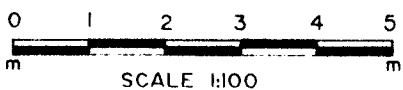
Counts / 20 secs

SAMPLE No	43976
U	6
Th	<4
As	6
Cu	36
Pb	8
Zn	98
Ni	24
Fe	7.90

ppm %

KEY	
	Black soil & clay predominantly in drainage minor silt / sand
	Nodular, concretionary, pisolitic laterite, within silt sandy, loams
	Sst / qtzite & schist rubble, sand: talus & scree
	Undifferentiated, inferred Nouriang schist
	Lithological boundary
	Profile location

COMPOSITE WALL PROFILE 314150 E 633550 N Bearing 8°



SURTEC

SURVEY CONTROL
DATA ACQUISITION
MAPPING, PROCESSING &
COMPUTER DRAFTING BY
SURTEC GEOSURVEYS PTY LTD

QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 31 (MICHAELS)
TRENCH MT 24

Author: DR N.E. RUTHERFORD

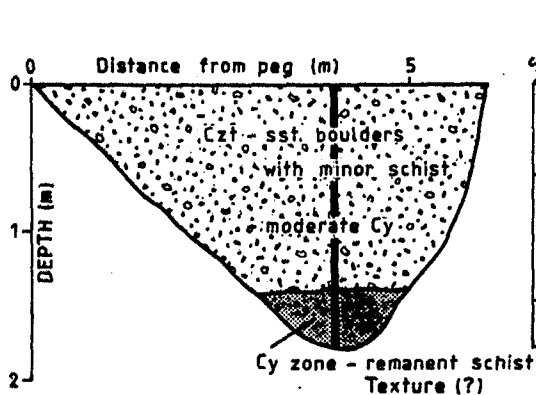
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 73



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43234	40	10	6	48	14	46	64	8.10
43235	58	8	9	48	16	74	70	10.6
43236	56	<4	7	42	12	175	88	16.8

ppm %

RADIOMETRICS	TC	-	-	-	Counts / 20 secs
	K	180	221	358	
	U	197	197	346	
	Th	57	88	112	

SAMPLE N° 43237

U	32	ppm
Th	10	
As	<2	
Cu	38	
Pb	6	
Zn	135	
Ni	86	
Fe	10.7	%

KEY



Sst / qtzite & schist rubble, sand: talus & scree

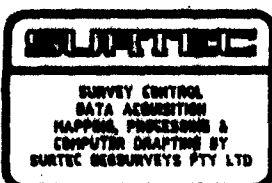


Lithological boundary

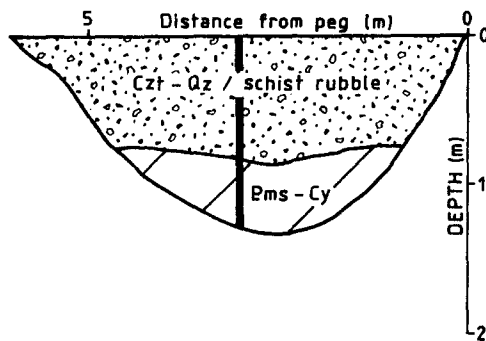


Profile location

COMPOSITE WALL PROFILE
314300 E 632075 N Bearing 150°



QUEENSLAND MINES LTD	
ARNHEM LAND EXPLORATION PROJECT, EL 2508	
ANOMALY 41	
TRENCH DT 1	
Author: DR N.F. RUTHERFORD	Scale: Hor: 1:100 Vert: 1:50
Drawn: A. B.	Drawing No.
Date: JAN. 1989	Figure 95



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43238	270	12	22	86	48	13	26	13.6
43239	210	6	10	78	24	24	20	10.8
	ppm							%

RADIOMETRICS	TC	—	—	—	Counts / 20 secs
	K	978	1220	1104	
	U	805	991	908	
	Th	318	414	315	

SAMPLE N° 43240

U	70	ppm
Th	22	
As	<2	
Cu	42	
Pb	8	
Zn	12	
Ni	24	%
Fe	5.20	

KEY



Sst / qtzite & schist rubble,
sand: talus & scree



Mica schist

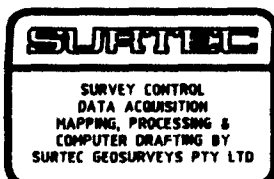
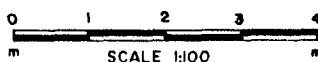


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314315 E 632025 N Bearing 310°



QUEENSLAND MINES LTD

ARMHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT2

Author: DR N.F. RUTHERFORD

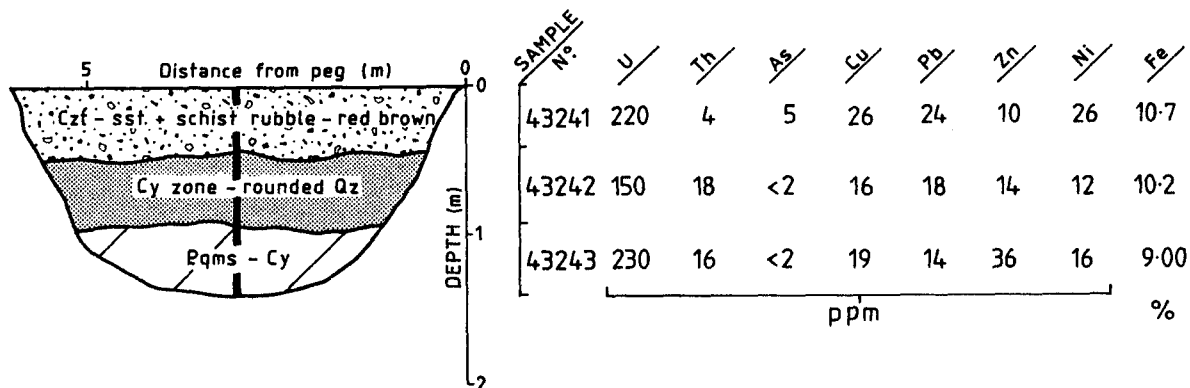
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 96



RADIOMETRICS	TC	—	—	Counts / 20 secs
	K	1896	1061	
	U	1408	797	
	Th	596	354	

SAMPLE No.	43244	
U	210	ppm
Th	6	
As	9	
Cu	20	
Pb	14	
Zn	40	
Ni	22	%
Fe	8.20	

KEY



Sst / qtzite & schist rubble, sand: talus & scree



Quartz mica schist

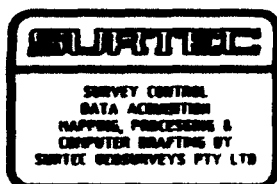


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314220 E 632020 N Bearing 360°



QUEENSLAND MINES LTD

ARMHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT 3

Author: DR N. F. RUTHERFORD

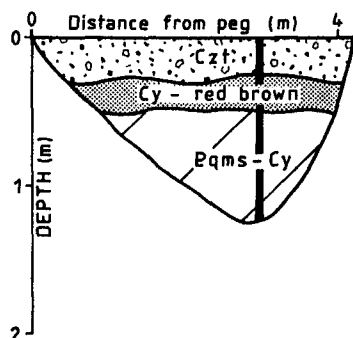
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 97



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43245	105	12	5	24	24	20	28	10.0
43246	110	6	6	18	20	5	18	8.70
43247	210	<4	4	30	54	8	10	7.30

ppm

%

RADIOMETRICS		I	I	Counts / 20 secs
	TC	—	—	
	K	1125	1293	
	U	919	998	
	Th	398	414	

SAMPLE No.	43248
U	230
Th	4
As	9
Cu	26
Pb	52
Zn	32
Ni	16
Fe	7.95

ppm

%

KEY



Sst / qtzite & schist rubble,
sand: talus & scree



Quartz mica schist

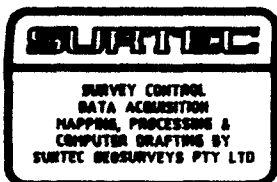


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314338 E 632020 N Bearing 204°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT4

Author: DR N. F. RUTHERFORD

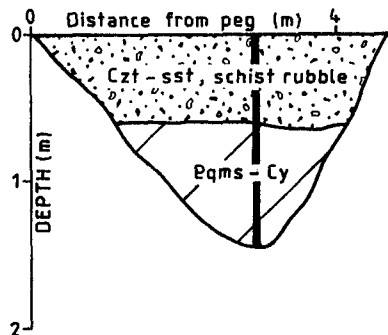
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 98



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43249	6	12	7	90	8	7	62	7.53
43250	36	14	4	125	8	4	38	5.00

ppm %

RADIOMETRICS	TC	—	—	Counts / 20 secs
	K	135	289	
	U	136	231	
	Th	56	99	

SAMPLE N°	43951	
U	16	ppm
Th	14	
As	6	
Cu	125	
Pb	6	
Zn	5	
Ni	30	%
Fe	2.92	

KEY



Sst / qtzite & schist rubble,
sand : fallus & scree



Quartz mica schist

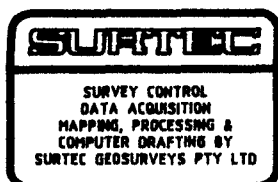
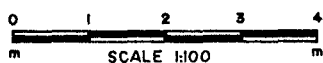


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314300 E 631985 N Bearing 60°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41

TRENCH DT5

Author: DR. N. F. RUTHERFORD

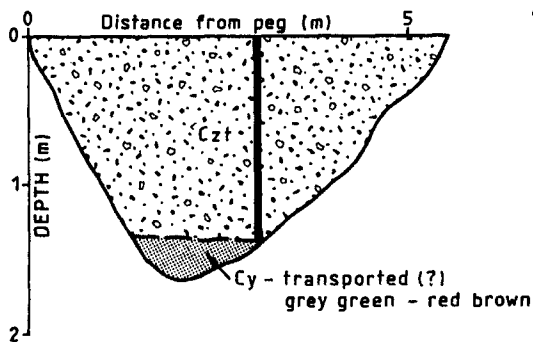
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 99



SAMPLE N°	U	Th	As	Cu	Pb	Zn	Ni	Fe
43952	<4	<4	7	36	10	19	32	7.70
43953	6	<4	5	54	16	40	84	9.70
	ppm							%

RADIOMETRICS	TC	—	—	Counts / 20 secs
	K	46	58	
	U	32	54	
	Th	20	26	

SAMPLE N° 43954

U	4	ppm
Th	6	
As	9	
Cu	60	
Pb	12	
Zn	32	
Ni	94	
Fe	8.50	%

KEY



Sst / qtzite & schist rubble,
sand : fallus & scree

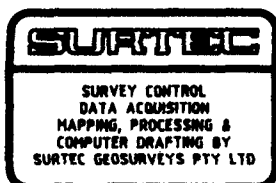
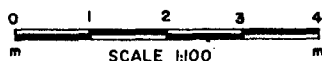


Gradational boundary



Sample location

COMPOSITE WALL PROFILE
314300 E 631950 N Bearing 190°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT6

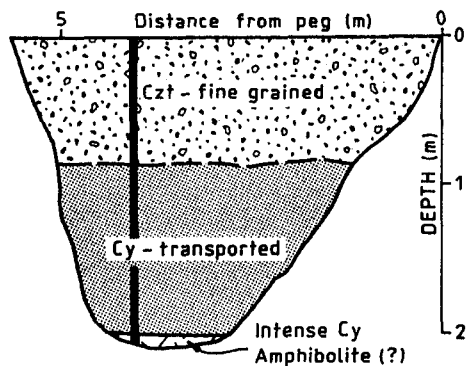
Author: DR. N.F. RUTHERFORD

Drawn: A. B.

Date: JAN. 1989

Scale: Hor:1:100 Vert:1:50

Drawing No. Figure 100



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43955	4	<4	10	36	10	56	56	6.25
43956	6	<4	8	64	10	30	115	7.15

ppm

%

RADIOMETRICS	TC	—	Counts 20 secs
	K	52	
	U	34	
	Th	21	

43957	SAMPLE N°
<4	U
<4	Th
2	As
84	Cu
<4	Pb
50	Zn
140	Ni
7.15	Fe

ppm

%

KEY



Sst / qtzite & schist rubble,
sand: talus & scree



Lithological boundary

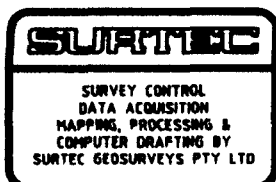
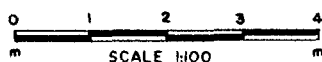


Gradational boundary



Profile location

COMPOSITE WALL PROFILE
314350 E 631950 N Bearing 14°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT7

Author: DR. N. E. RUTHERFORD

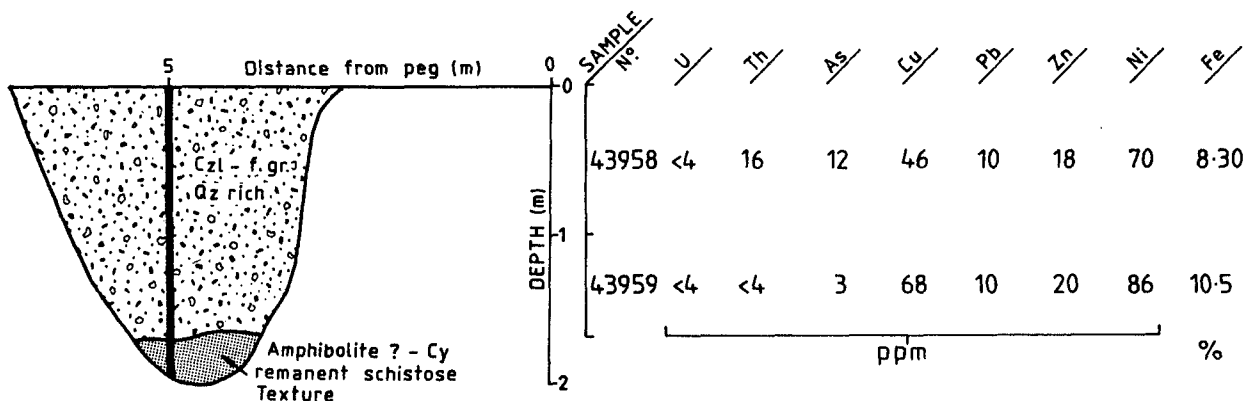
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 101



RADIOMETRICS	TC	—	Counts / 20 secs
	K	45	
	U	28	
	Th	11	

SAMPLE N° 43960

U	4	ppm
Th	<4	
As	8	
Cu	82	
Pb	<4	
Zn	40	
Ni	155	
Fe	7.60	%

KEY



Nodular, concretionary, pisolitic laterite, within silt sandy, loams

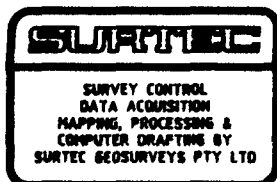
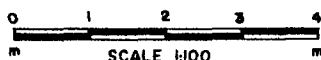


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314350 E 631925 N Bearing 324°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT 8

Author: DR. N. F. RUTHERFORD

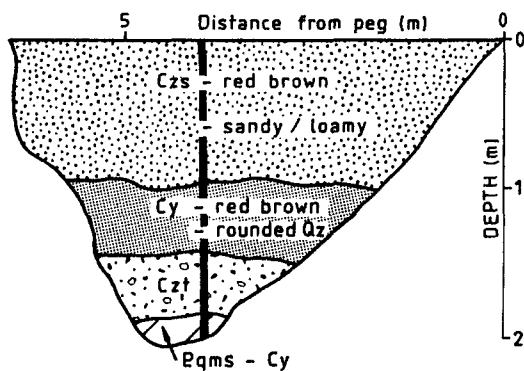
Scale: Hor 1:100 Vert 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 102



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43961	<4	4	3	24	<4	6	36	3.48
43962	<4	6	10	32	4	13	44	4.74
43963	<4	<4	8	30	10	22	20	8.45
43964	ppm							%

RADIOMETRICS	I	I
TC	—	—
K	67	64
U	62	61
Th	44	50

Counts / 20 secs

SAMPLE N° 43965

U	4
Th	8
As	7
Cu	58
Pb	6
Zn	18
Ni	34
Fe	3.62

ppm

%

KEY



Czs Unconsolidated sand, ferruginous & clayey sand



Czt Sst / qtzite & schist rubble, sand: fallus & scree



Eqms Quartz mica schist

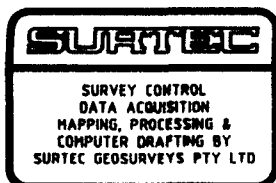
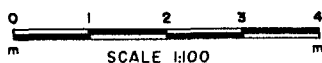


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
314250 E 613900 N Bearing 8°



QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 41
TRENCH DT9

Author: DR N.E. RUTHERFORD

Scale: Hor. 1:100 Vert. 1:50

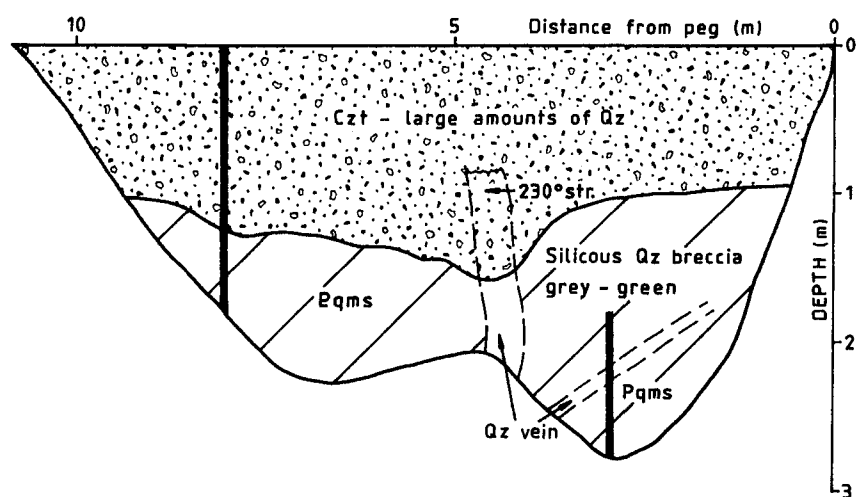
Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 103

Figure 104



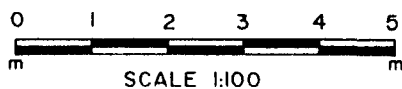
SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43998	18	10	8	12	4	5	16	2.74
43999	20	14	6	11	6	6	14	3.18
44000	10	18	8	8	4	4	18	2.44
33651	10	8	5	7	<4	5	4	1.89
33652	14	8	9	9	<4	7	10	3.08
	ppm							%

RADIOMETRICS	TC	2500	2747	3093
	K	440	564	614
	U	188	224	272
	Th	83	76	82
	Counts / 20 secs			

SAMPLE No.	33653	33654
U	18	8
Th	10	14
As	4	8
Cu	22	10
Pb	12	8
Zn	4	5
Ni	24	16
Fe	1.78	1.62
	%	

KEY	
	Sst / qtzite & schist rubble, sand: talus & scree
	Quartz mica schist
	Lithological boundary
	Profile location

COMPOSITE WALL PROFILE 312700 E 634950 N Bearing 312°



SCALE 1:100

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QUEENSLAND MINES LTD

ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 91 (JO-ANN'S)
TRENCH JAT 1

Author: DR. N.F. RUTHERFORD

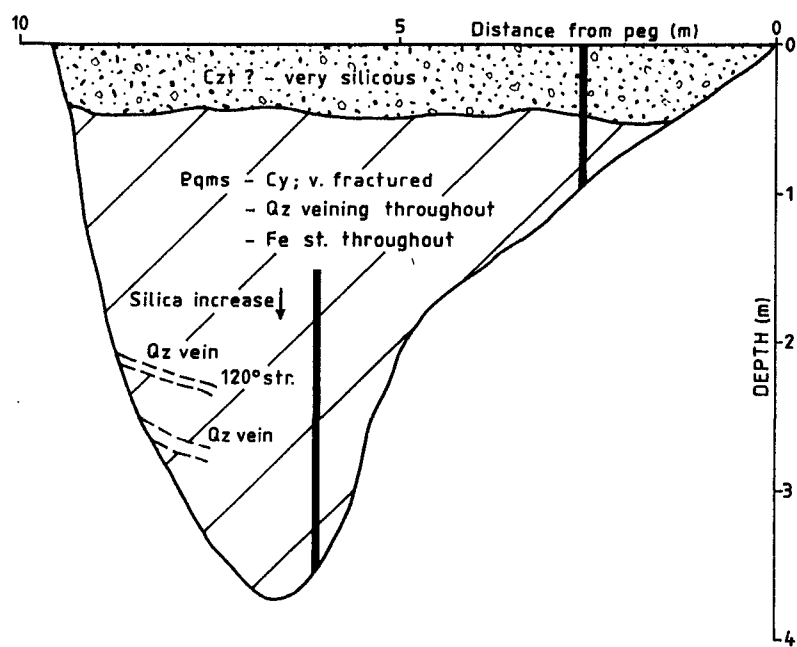
Drawn: A. B.

Date: JAN. 1989

Scale: Hor. 1:100 Vert. 1:50

Drawing No.

Figure 121



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
33655	8	8	4	4	4	<2	12	1.78
33656	14	18	8	3	<4	2	8	1.23
33657	12	8	4	4	<4	6	4	2.96
33658	<4	14	2	4	<4	<2	4	1.89
33659	<4	16	4	5	8	5	<4	2.46
	ppm							%

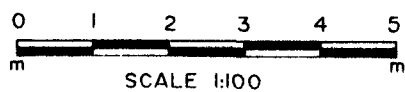
RADIOMETRICS	TC	2323	1925
	K	516	441
	U	142	132
	Th	76	70
Counts / 20 secs			

SAMPLE No.	33660
U	8
Th	10
As	5
Cu	4
Pb	4
Zn	2
Ni	4
Fe	2.36
	%

KEY

-  Czt Sst / quartzite & schist rubble, sand: talus & scree
-  Eqms Quartz mica schist
-  Lithological boundary
-  Profile location

COMPOSITE WALL PROFILE 312700 E 634935 N Bearing 290°



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ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 91 (JO-ANN'S)

TRENCH JAT 2

Author: DR N. F. RUTHERFORD

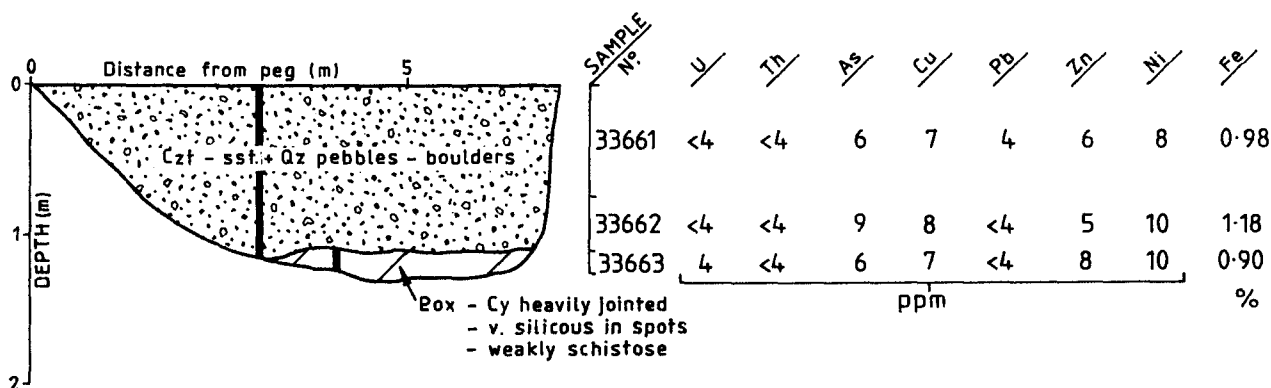
Scale: Hor: 1:100 Vert: 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 122



925	1059	TC	RADIOMETRICS Counts / 20 secs
227	237	K	
50	55	U	
38	46	Th	

SAMPLE No	33664
U	4
Th	<4
As	7
Cu	18
Pb	<4
Zn	4
Ni	6
Fe	1.12
	%

ppm

KEY



Sst / qtzite & schist rubble,
Sand : talus & scree



Undifferentiated,
inferred Nouriangie schist

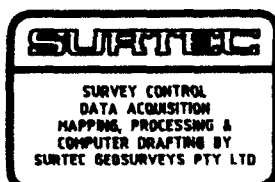


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
312800 E 634850 N Bearing 72°



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ANOMALY 91 (JO-ANN'S)
TRENCH JAT 3

Author: DR N.E. RUTHERFORD

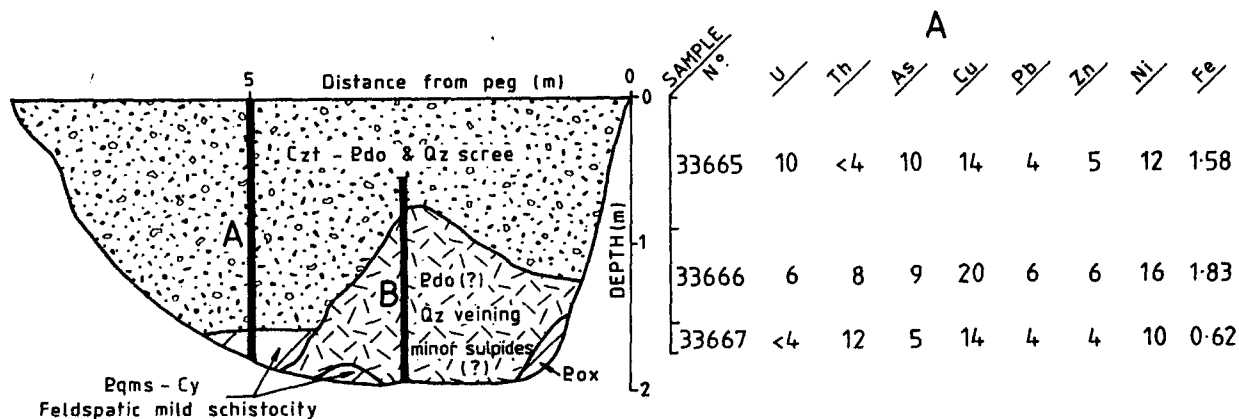
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 123



RADIOMETRICS	I		I	
	TC	1825	3071	Counts / 20 secs
	K	390	667	
	U	96	245	
	Th	54	75	

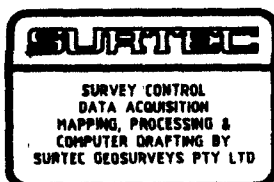
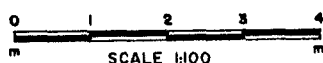
B								
33668	22	22	5	12	4	7	16	1.95
33669	12	8	2	20	6	2	12	1.50
ppm								%

SAMPLE N°	33671	33670	
U	<4	12	ppm
Th	8	10	
As	<2	2	
Cu	22	18	
Pb	4	<4	
Zn	2	4	
Ni	18	8	
Fe	0.71	1.69	%

KEY

-  Czt Sst / qtzite & schist rubble, sand: talus & scree
-  Pdo Oenpelli Dolorite
-  Eqms Quartz mica schist
-  Box Undifferentiated, inferred Nouriangie schist
-  Lithological boundary
-  Profile location

COMPOSITE WALL PROFILE
312800 E 634890 N Bearing 288°



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ANOMALY 91 (JO-ANN'S)

TRENCH JAT 4

Author: DR N.E. RUTHERFORD

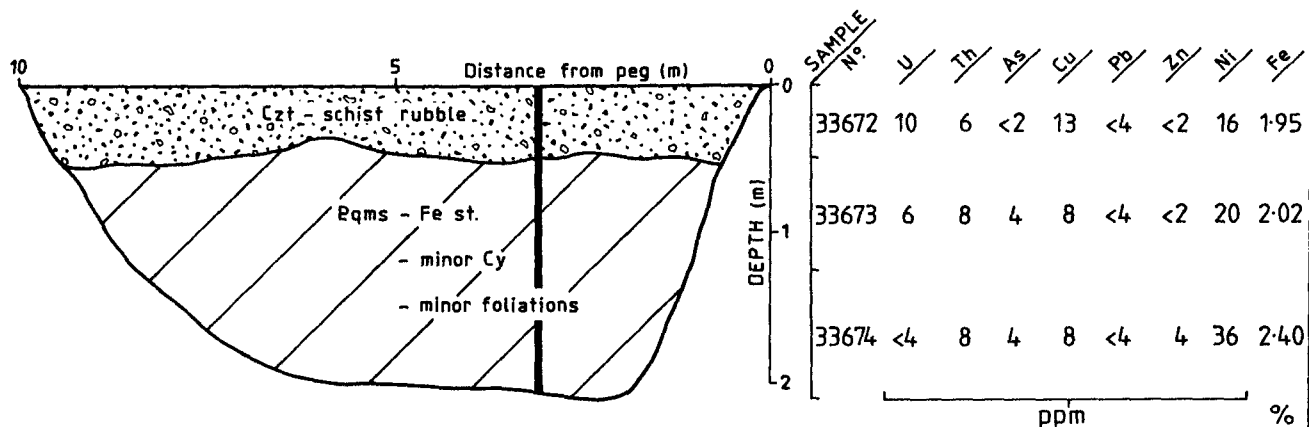
Scale: Hor:1:100 Vert:1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 124



1292	1814	TC	RADIOMETRICS Counts / 20 secs
221	399	K	
96	123	U	
48	80	Th	

SAMPLE N° 33675

U	8	ppm
Th	8	
As	5	
Cu	8	
Pb	<4	
Zn	4	
Ni	32	
Fe	2.14	%

KEY



Sst / qtzite & schist rubble,
sand: talus & scree



Quartz mica schist



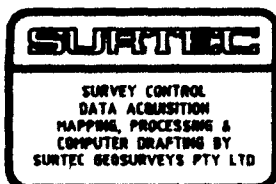
Lithological boundary



Profile location

COMPOSITE WALL PROFILE
312800 E 634950 N Bearing 252°

0 1 2 3 4
m SCALE 1:100



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ANOMALY 91 (JO-ANN'S)

TRENCH JAT 5

Author: DR N.F. RUTHERFORD

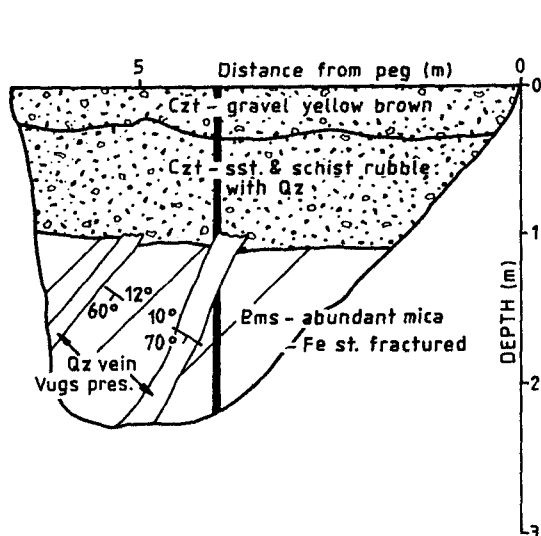
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 125



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43977	<4	22	20	5	8	7	10	5.60
43978	<4	14	20	4	6	8	10	4.58
43979	<4	18	40	6	6	11	6	7.95
43980	<4	4	15	5	<4	5	8	2.28
43981	6	12	18	4	6	2	6	2.10

ppm %

RADIOMETRICS	TC	1756	1596
	K	405	300
	U	76	100
	Th	81	83

Counts / 20 secs

SAMPLE N° 43982

U	<4
Th	8
As	17
Cu	3
Pb	<4
Zn	4
Ni	4
Fe	3.24 %

ppm

KEY



Sst / qtzite & schist rubble, sand: talus & scree



Mica schist



Strike and dip of bedding

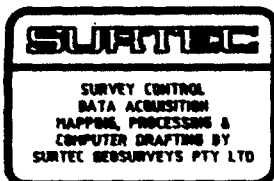


Lithological boundary



Profile location

COMPOSITE WALL PROFILE
315200 E 633850 N Bearing 74°



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JEFFS ANOMALY
TRENCH JT 1

Author: DR N. F. RUTHERFORD

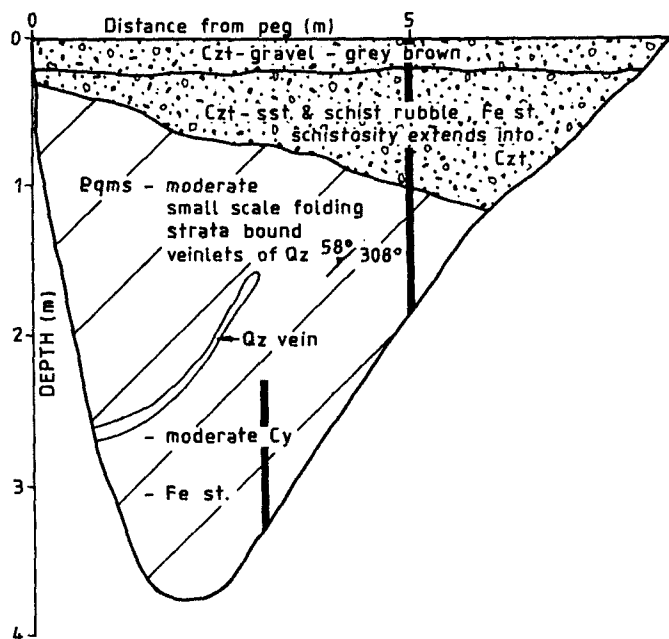
Drawn: A. B.

Date: JAN. 1989

Scale: Hor: 1:100 Vert: 1:50

Drawing No.

Figure 137



SAMPLE No	U	Th	As	Cu	Pb	Zn	Ni	Fe
43983	<4	34	26	4	8	10	14	7.95
43984	<4	14	15	6	6	13	6	5.40
43985	6	8	26	5	8	20	4	12.5
43986	<4	10	13	5	6	12	4	4.64
43987	<4	22	20	2	<4	10	8	4.24
43988	<4	18	15	3	4	11	10	3.22
43989	4	6	19	5	4	10	8	2.18
ppm								%

RADIOMETRICS	TC	1678	1419	Counts / 20 secs
	K	385	287	
	U	95	71	
	Th	75	70	

SAMPLE N° 43990

U	8	ppm
Th	12	
As	11	
Cu	4	
Pb	6	
Zn	9	
Ni	6	%
Fe	2.26	

KEY



Sst / qtzite & schist rubble, sand: fallus & scree



Quartz mica schist



Lithological boundary

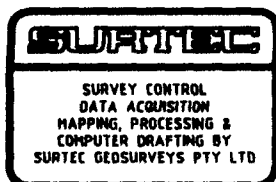
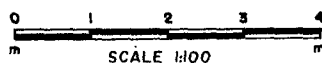


Strike and dip of foliation



Profile location

COMPOSITE WALL PROFILE
315200 E 633800 N Bearing 202°



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JEFFS ANOMALY
TRENCH JT2

Author: DR N.F. RUTHERFORD

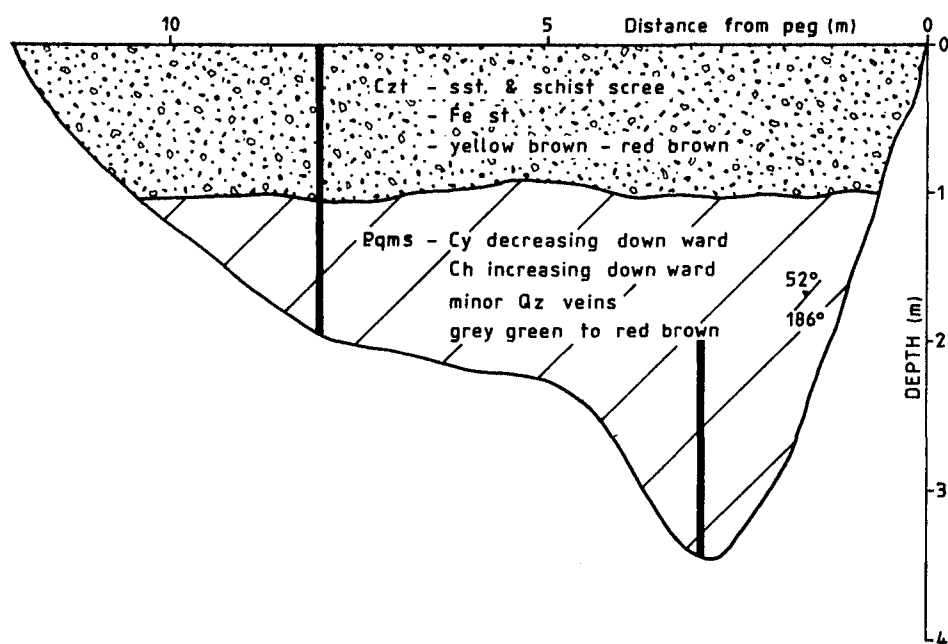
Scale: Hor. 1:100 Vert. 1:50

Drawn: A. B.

Drawing No.

Date: JAN. 1989

Figure 138



SAMPLE No.	U	Th	As	Cu	Pb	Zn	Ni	Fe
43991	78	8	24	5	6	17	14	18.9
43992	22	22	15	6	6	11	16	10.6
43993	4	16	8	5	6	8	4	5.10
43994	4	16	3	4	4	5	4	3.20
43995	<4	24	4	<2	6	2	6	3.66
43996	<4	16	6	6	6	9	6	2.30
	ppm							%

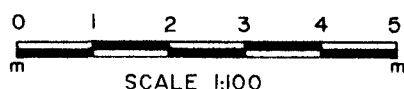
RADIOMETRICS	TC	2355	1981	2485
	K	391	378	531
	U	204	132	141
	Th	116	70	102
	Counts / 20 secs			

SAMPLE No.	43997
U	<4
Th	18
As	5
Cu	5
Pb	4
Zn	4
Ni	4
Fe	1.65 %
	ppm

KEY

- Sst / qtzite & schist rubble, sand:fallus & scree
- Quartz mica schist
- Lithological boundary
- Strike and dip of foliation
- Profile location

COMPOSITE WALL PROFILE 314900 E 633050 N Bearing 90°



SCALE 1:100

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KARELS ANOMALY
TRENCH JT 3

Author: DR N. F. RUTHERFORD

Scale: Hor: 1:100 Vert: 1:50

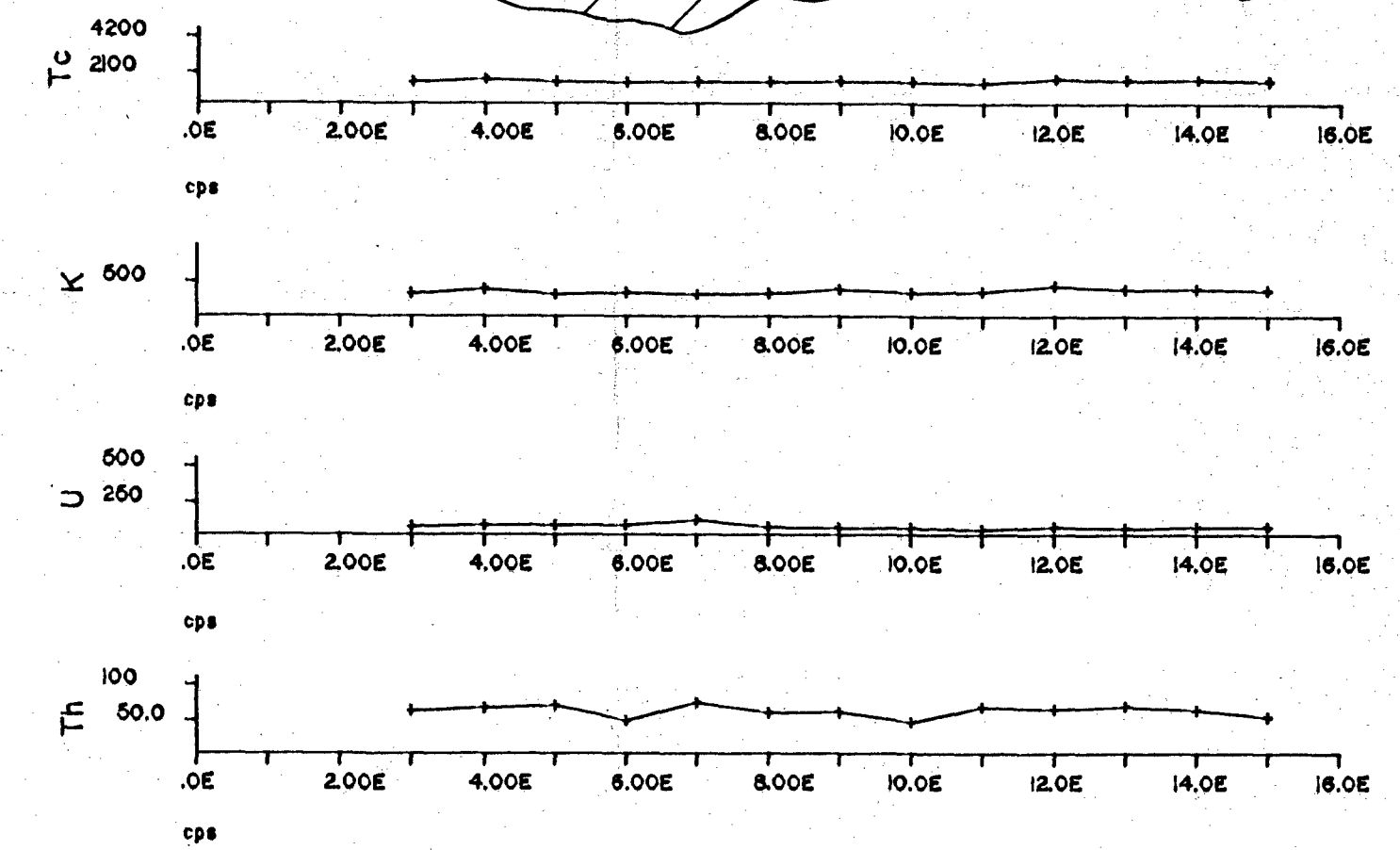
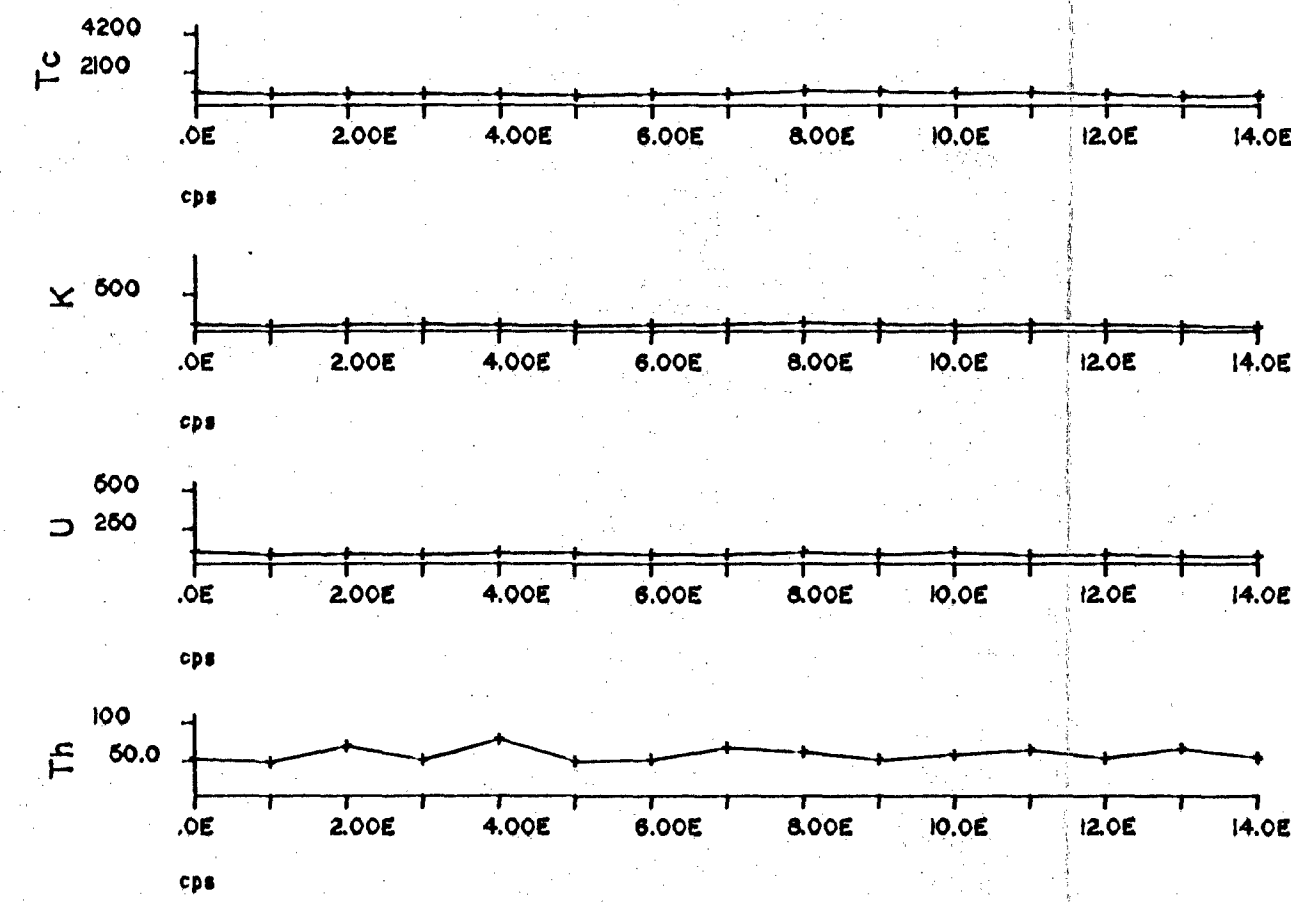
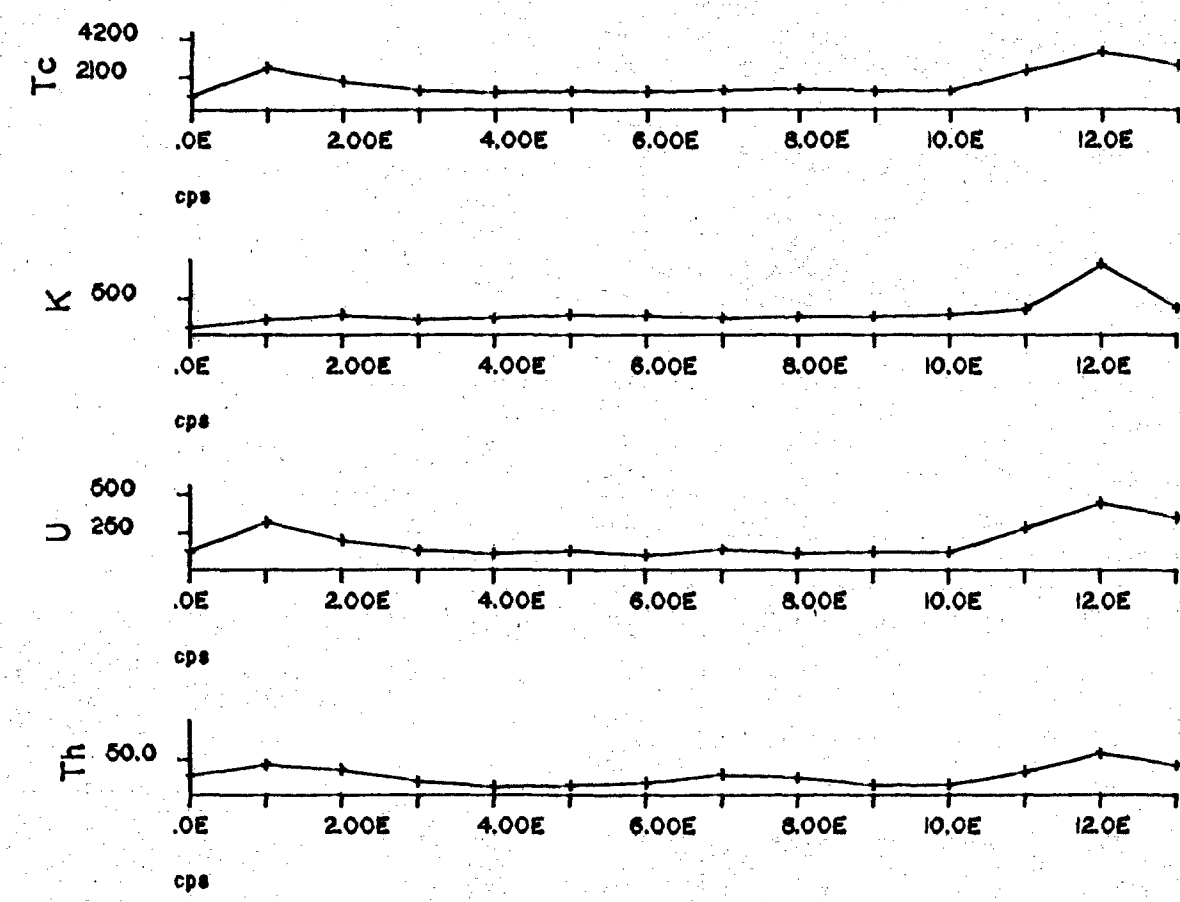
Drawn: A. B.

Drawing No.

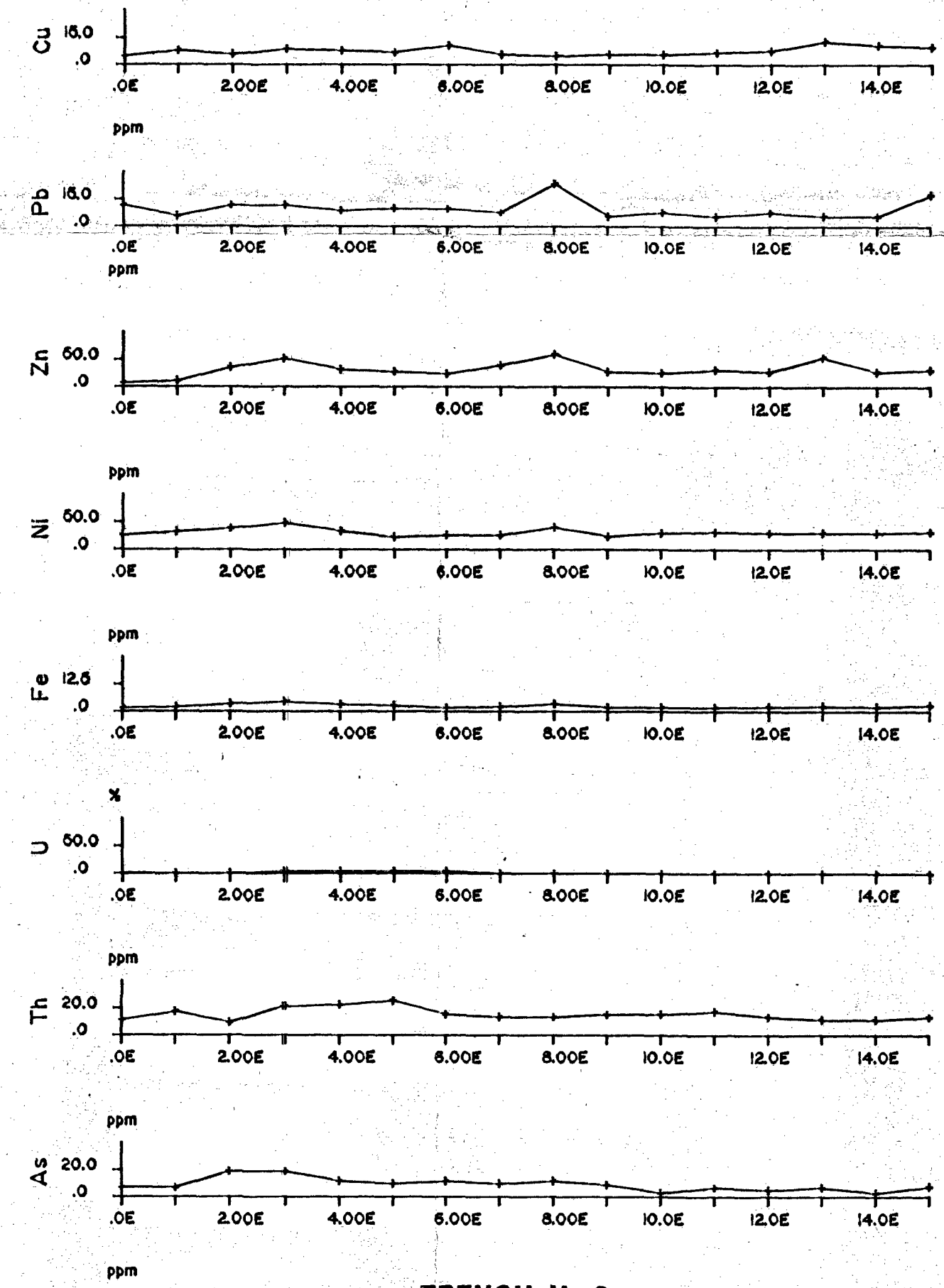
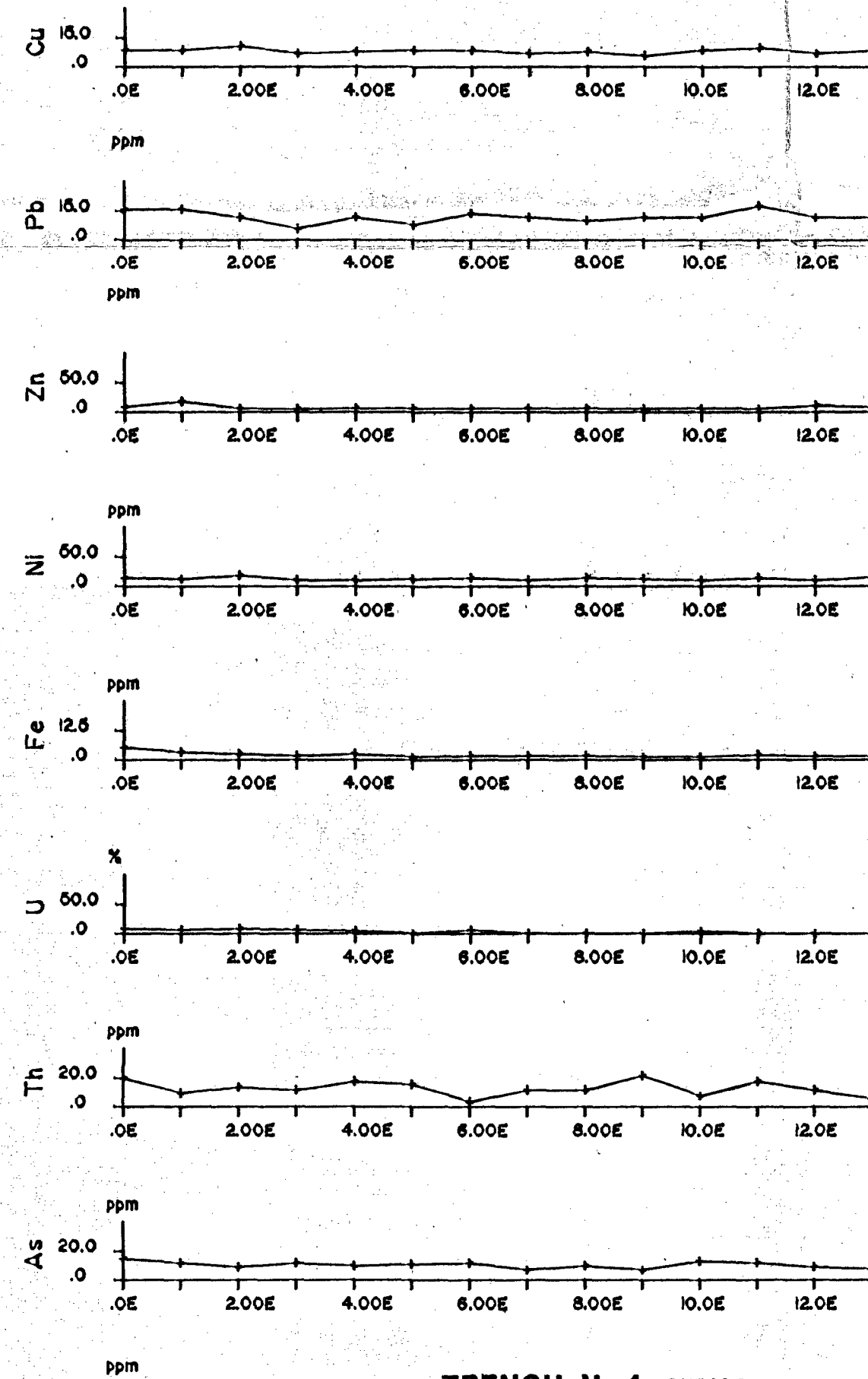
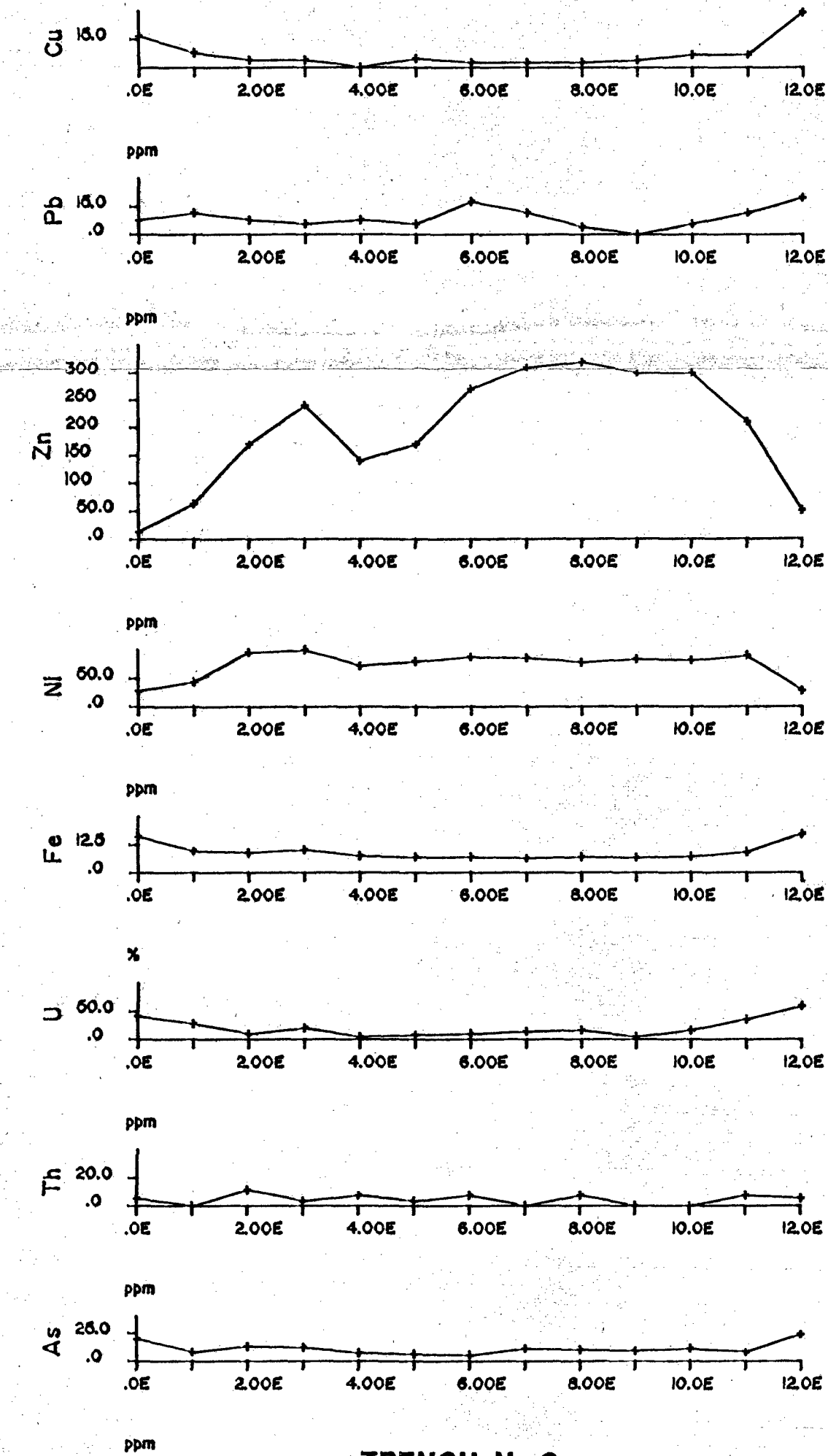
Date: JAN. 1989

Figure 139

RADIOMETRICS



GEOCHEMISTRY

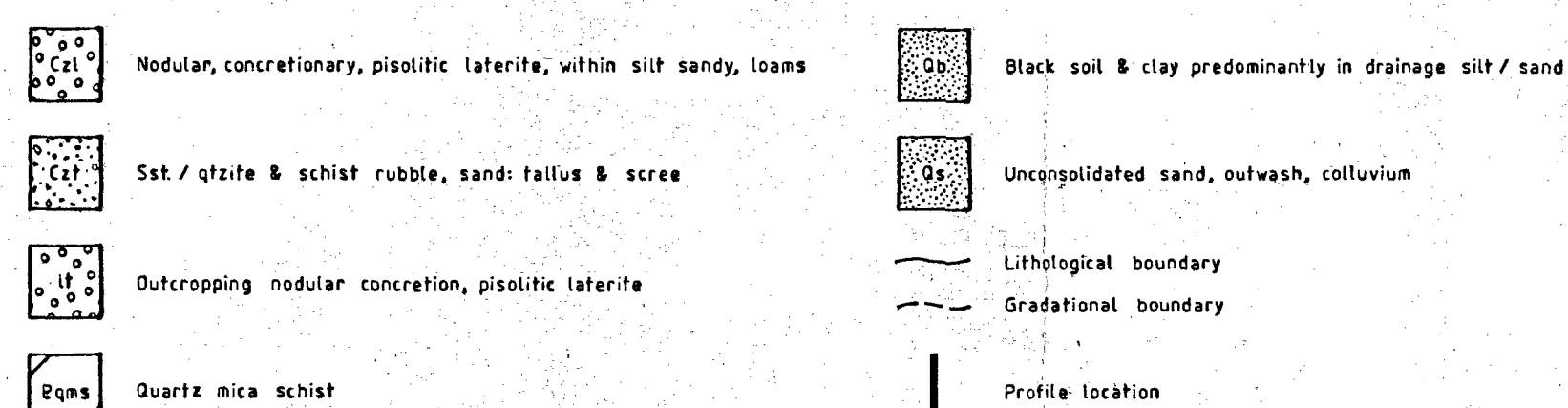


TRENCH No.9 319400 E 641525 N Bearing 135°

TRENCH No.1 319300 E 641510 N Bearing 135°

TRENCH No.2 319200 E 641795 N Bearing 315°

KEY



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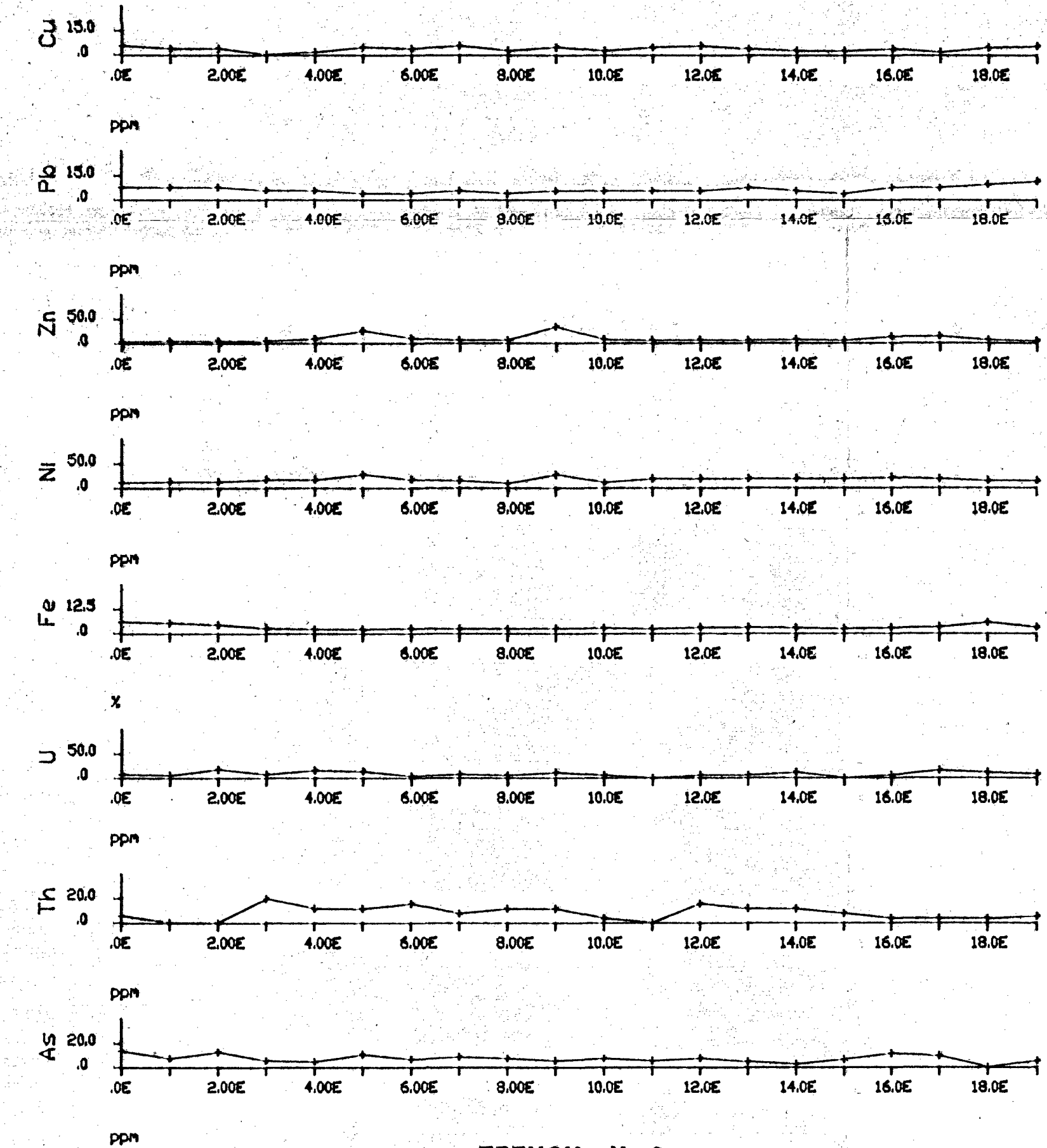
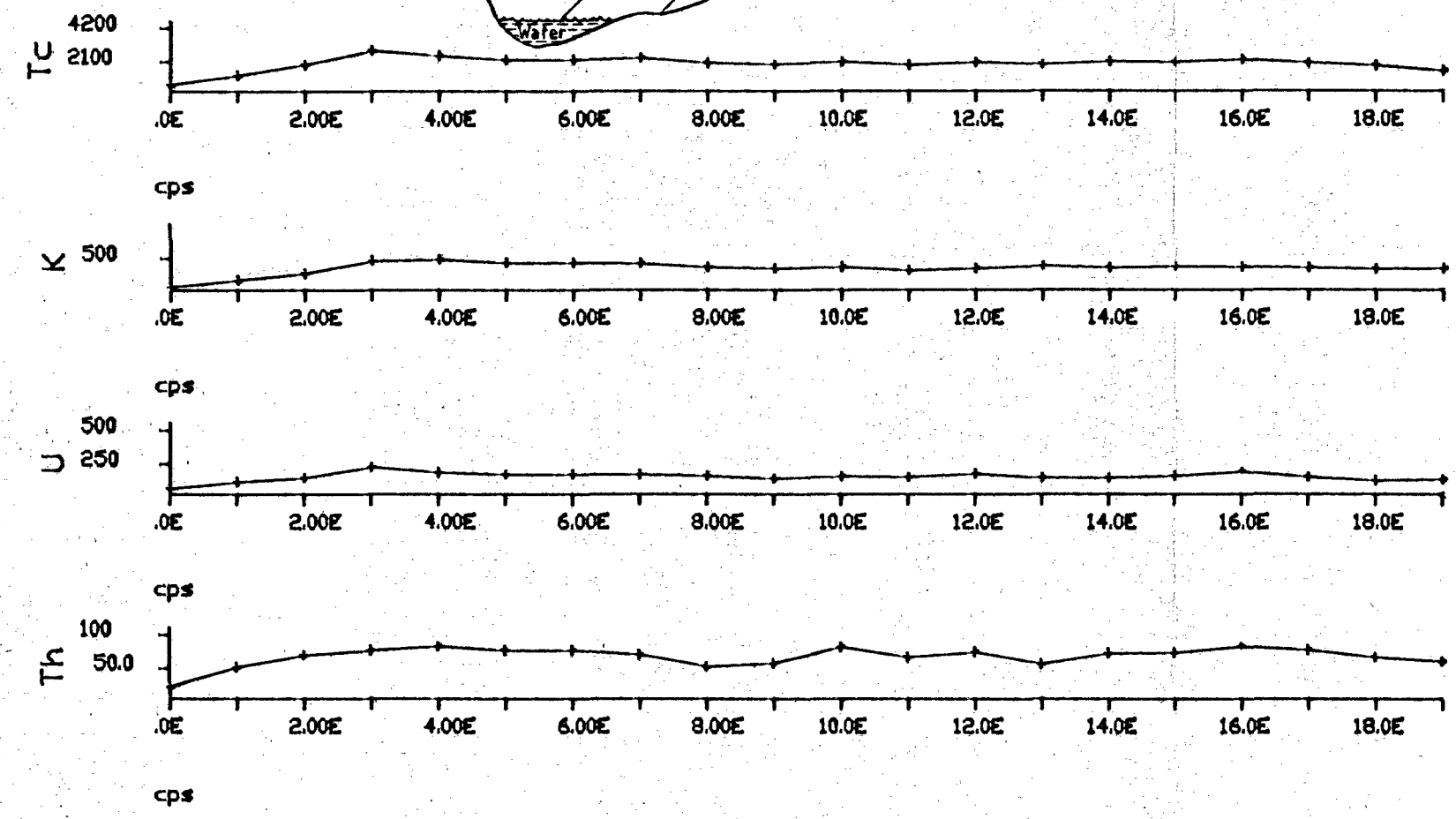
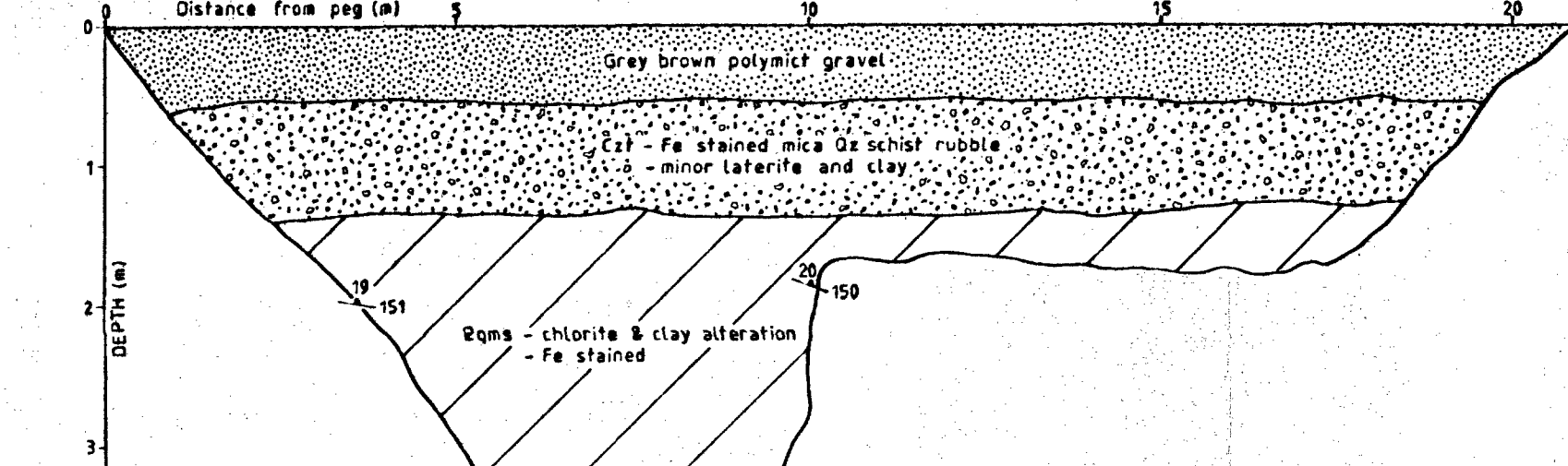
ANOMALY 24

TRENCH 9,1,2 PROFILES

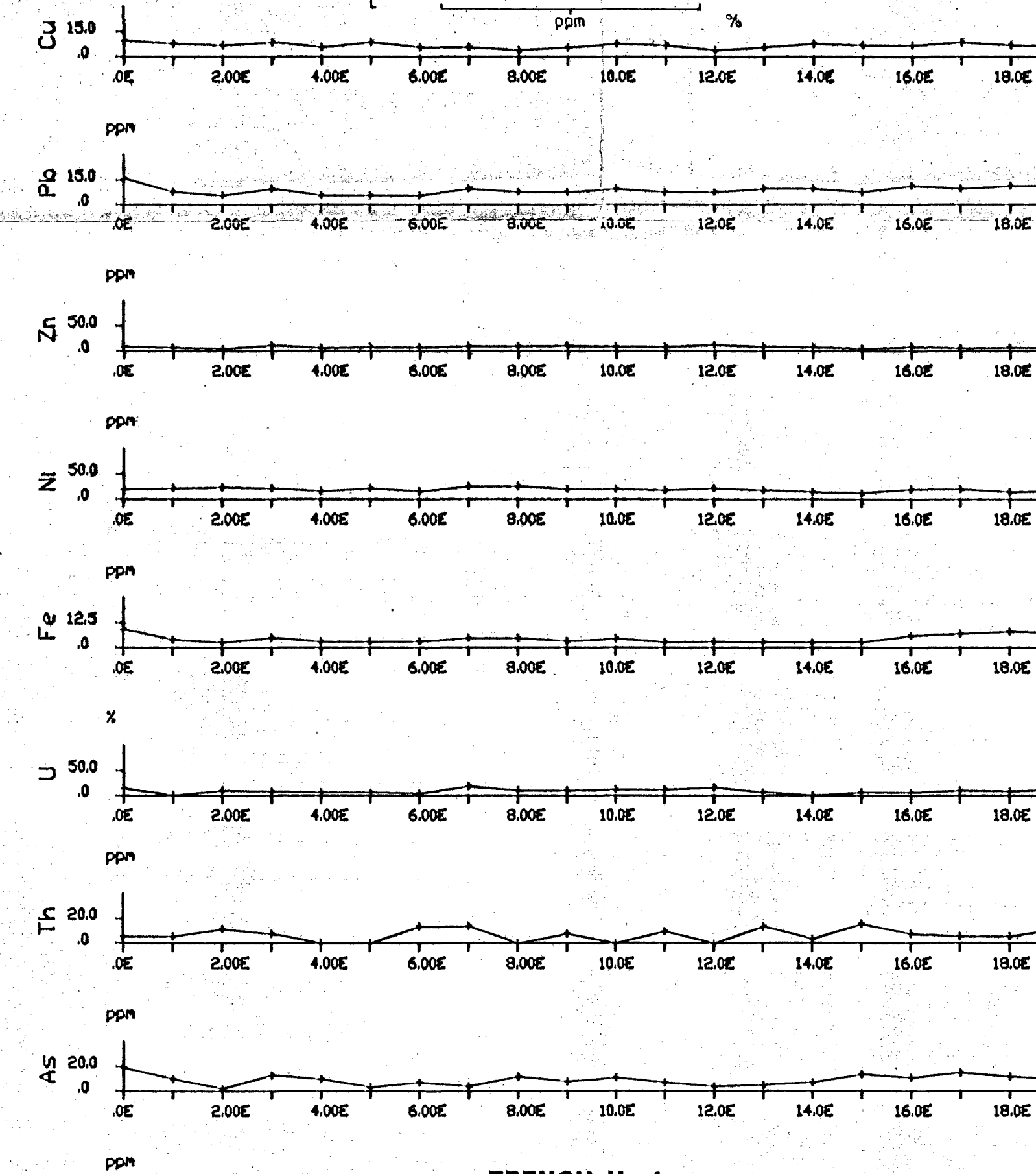
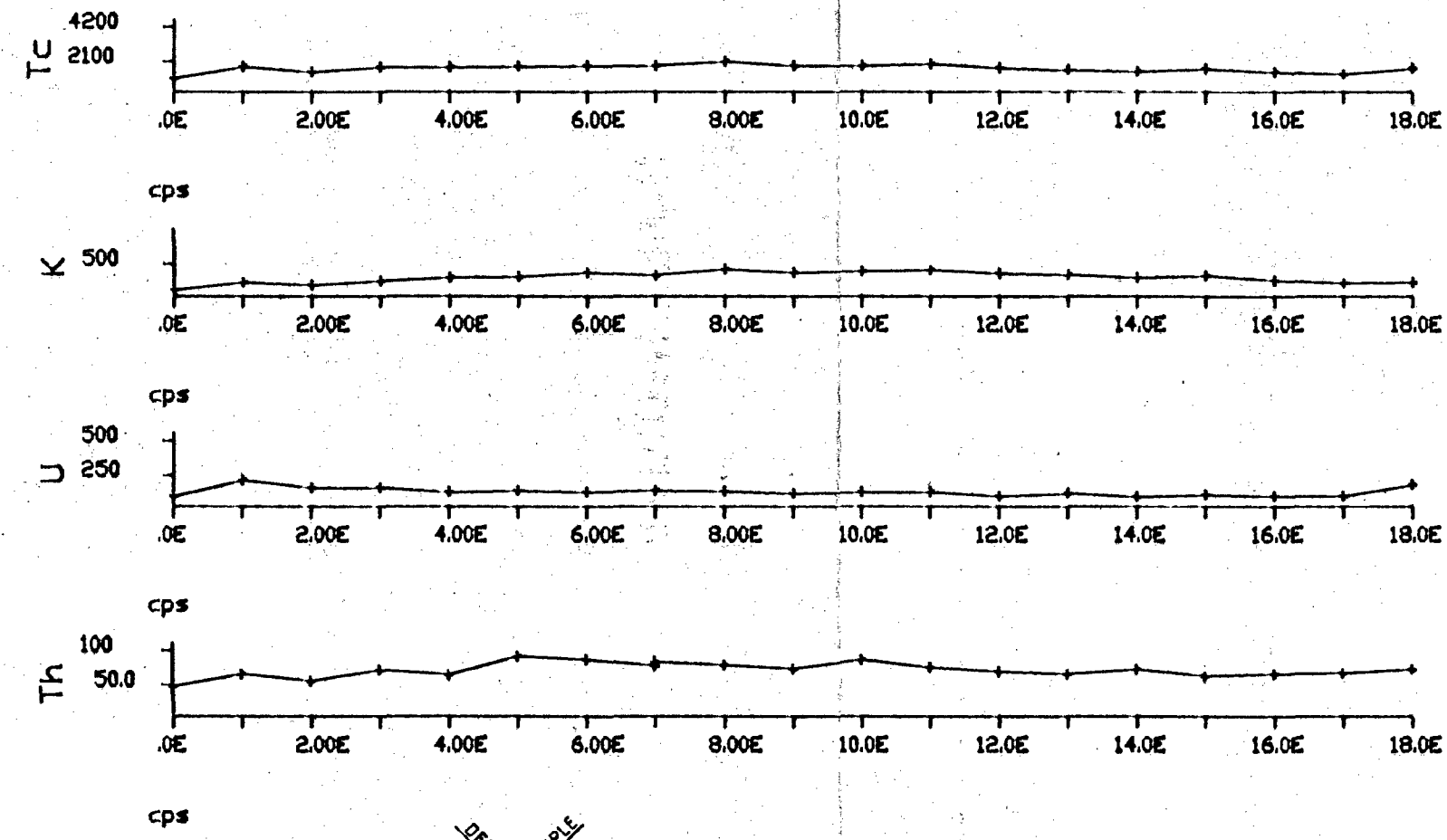
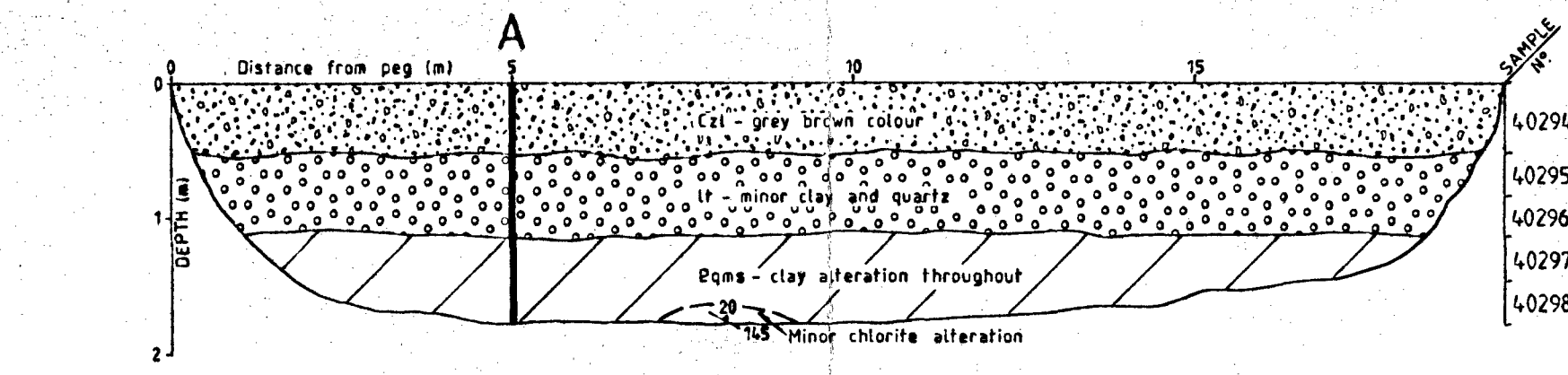
Author: DR. N. F. RUTHERFORD
Drawn: G. COURT
Date: FEB. 89

Scale: H. 1:100, V. VARIES
Computer File No. 1042TN24-3
Figure 146

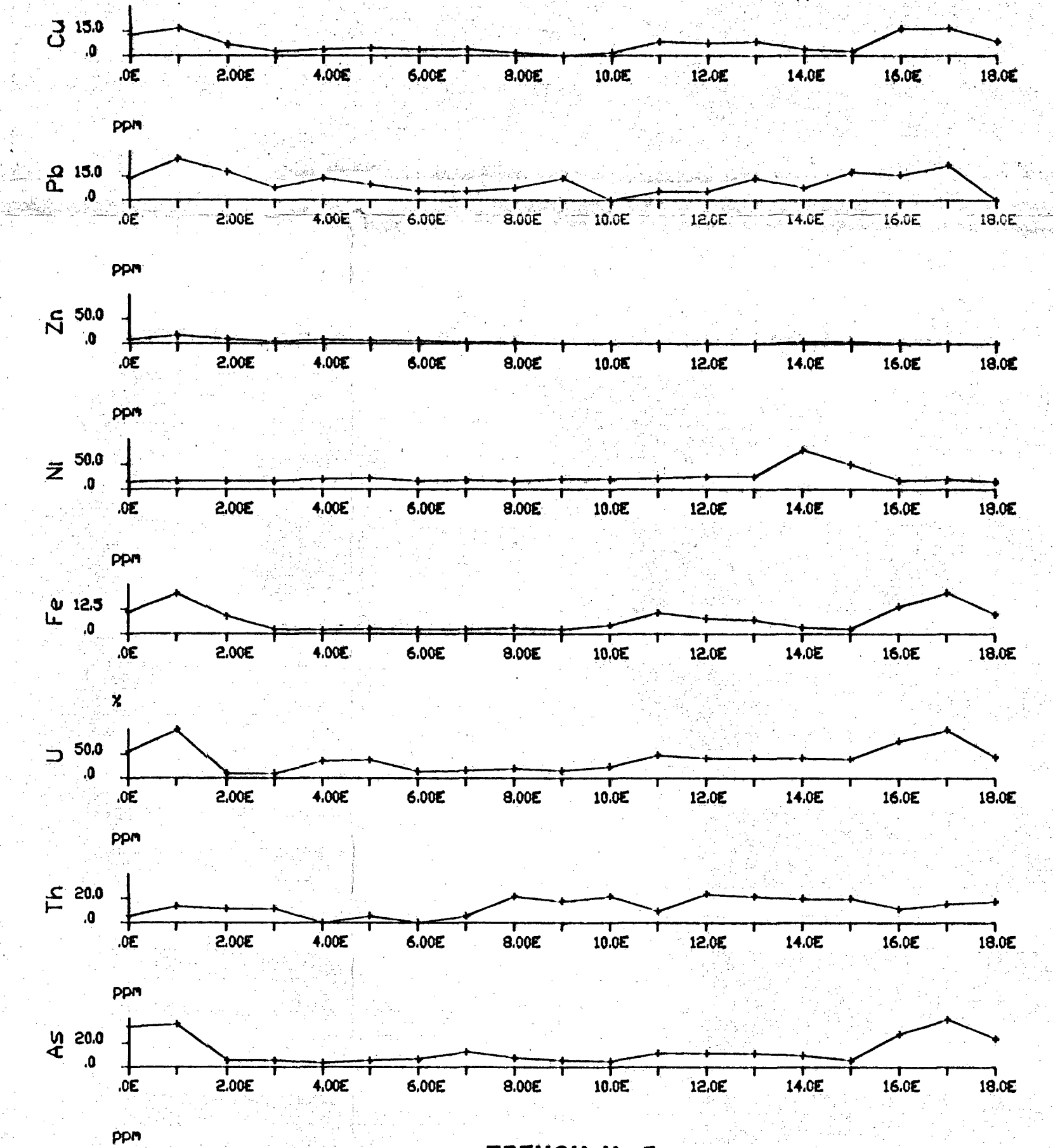
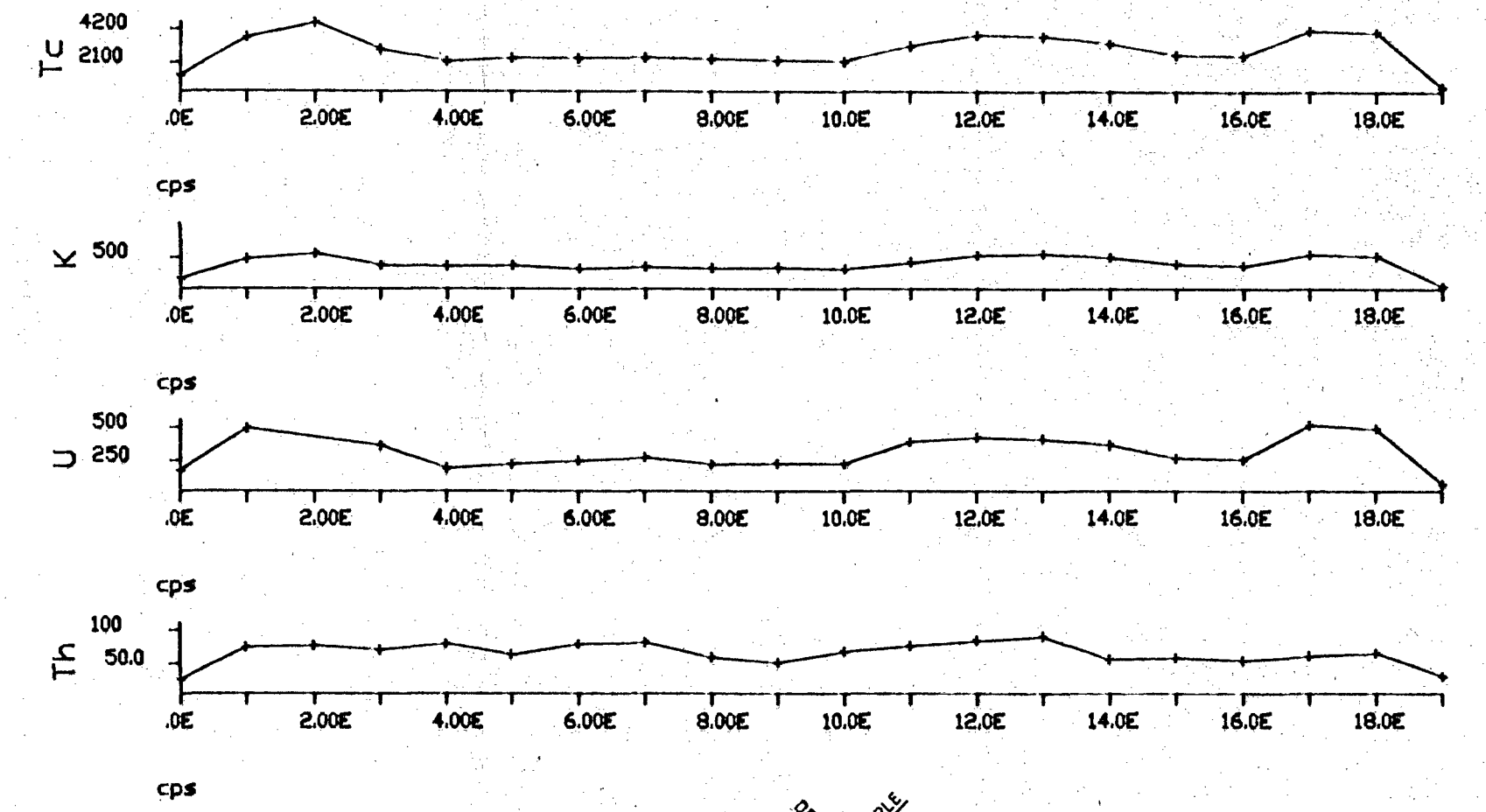
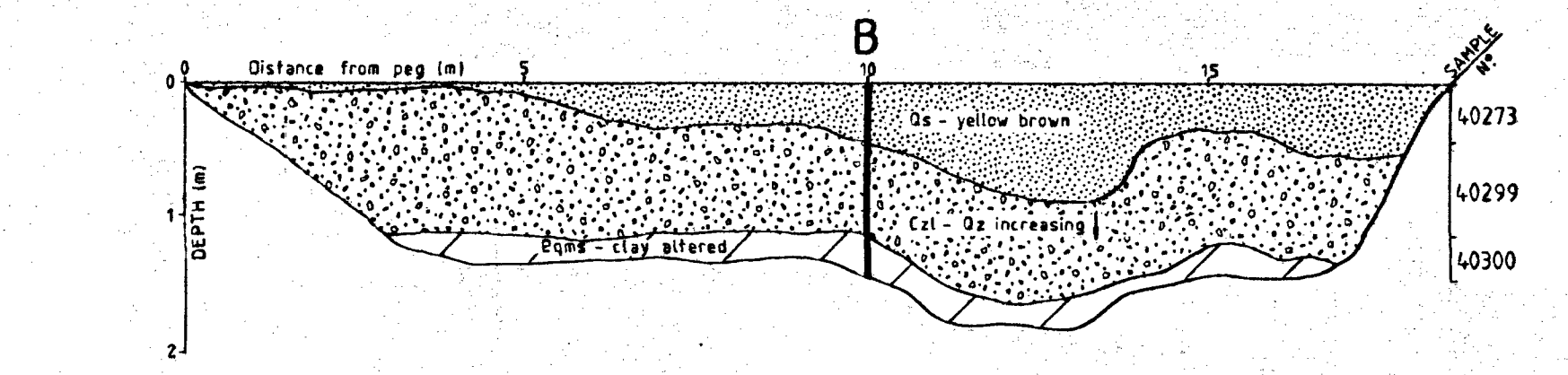
RADIOMETRICS



TRENCH No.3 319000 E 641840 N Bearing 135°



TRENCH No.4 318900 E 641760 N Bearing 135°



TRENCH No.5 318800 E 641760 N Bearing 135°

A

Sample No.	1	2	3	4	5	6	7	8	9	10
40294	18	<4	24	11	12	7	14	10.1		
40295	8	24	17	6	18	8	18	10.9		
40296	8	6	6	8	10	4	20	7.05		
40297	10	10	10	4	6	3	18	3.42		
40298	4	<4	8	5	4	6	20	2.78		

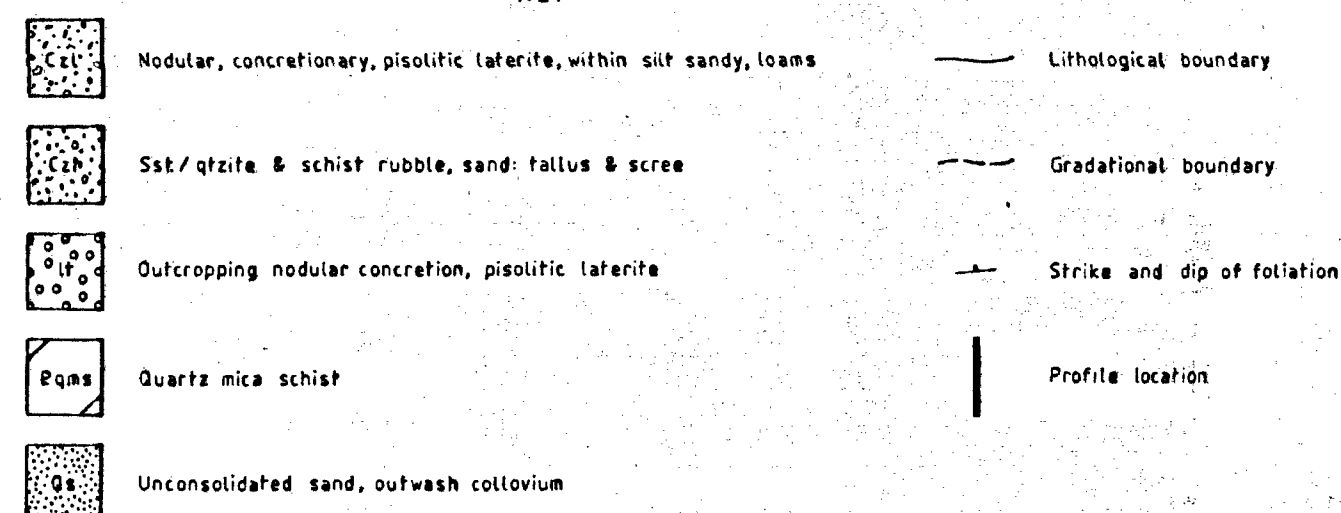
ppm %

B

Sample No.	1	2	3	4	5	6	7	8	9	10
40273	4	<4	11	7	4	3	14	1.87		
40299	4.8	8	20	11	14	10	20	9.45		
40300	14	<4	6	6	6	4	18	1.81		

ppm %

GEOCHEMISTRY



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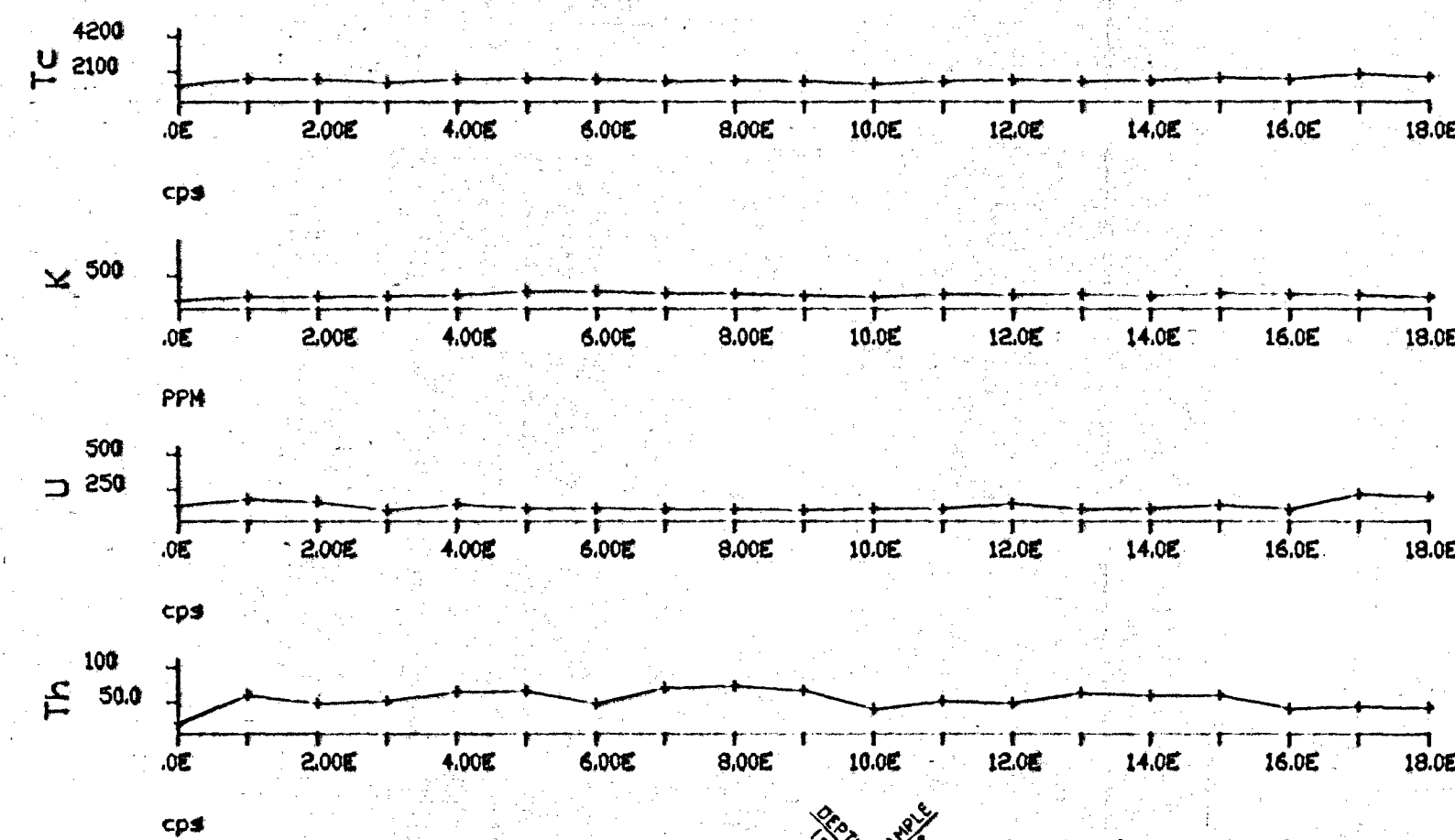
ARNHEM LAND EXPLORATION PROJECT, EL 2508

ANOMALY 24

TRENCH 3, 4, 5 PROFILES

Author: DR. N. F. RUTHERFORD	Scale: H. 1:100, V. VARIES
Drawn: G. COURT	Computer File No. 1042M24-1
Date: FEB. 89	Figure 147

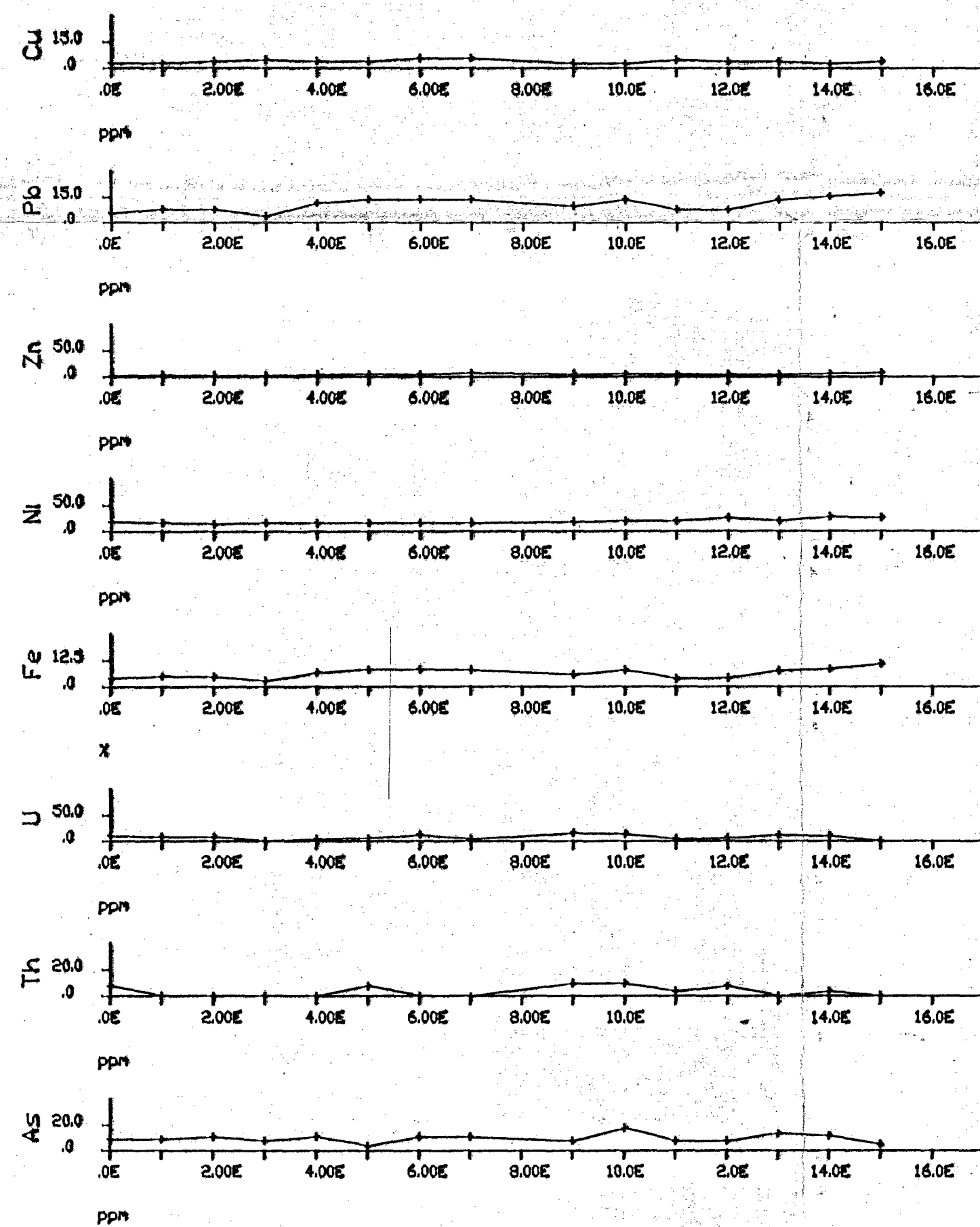
RADIOMETRICS



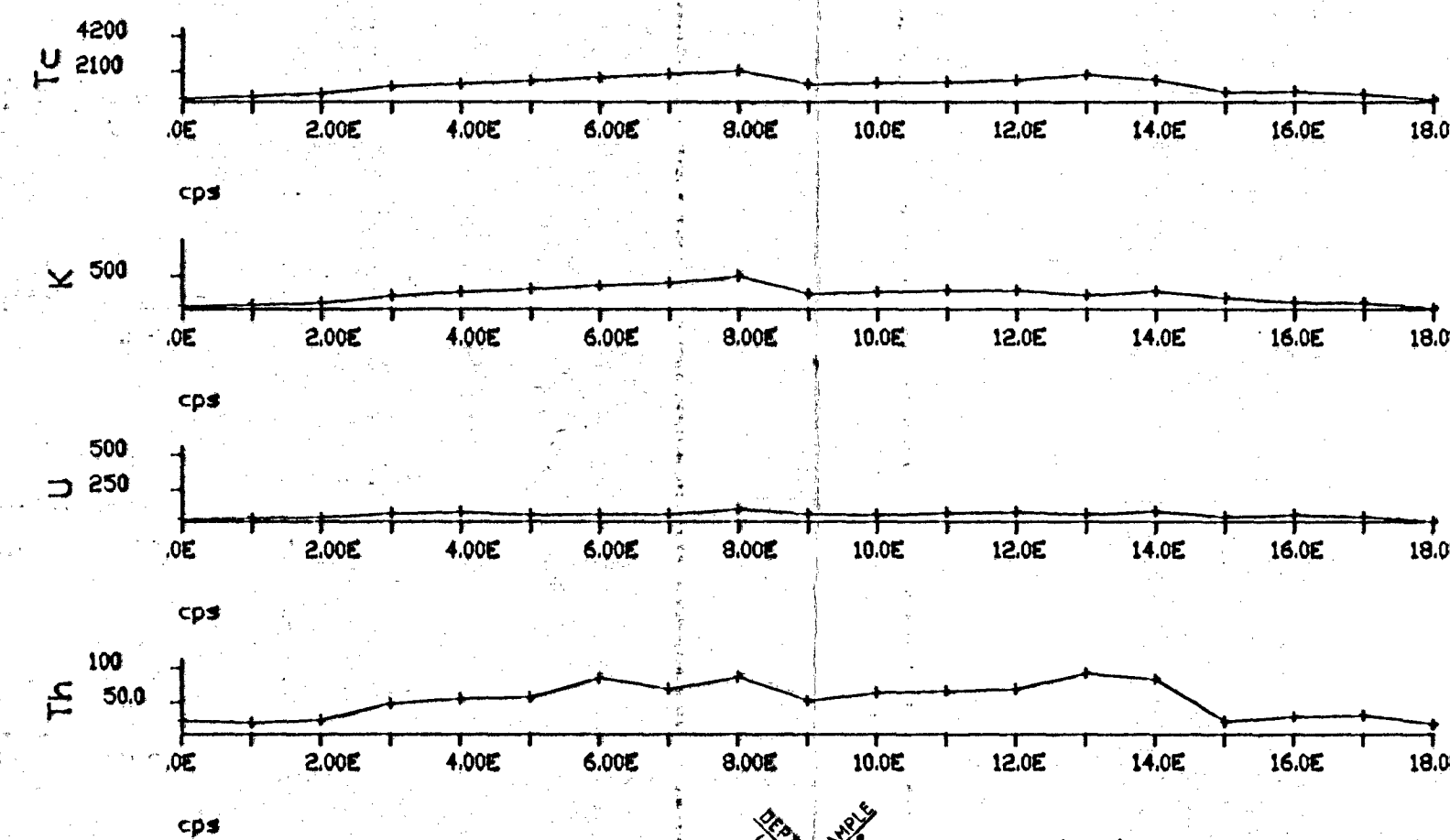
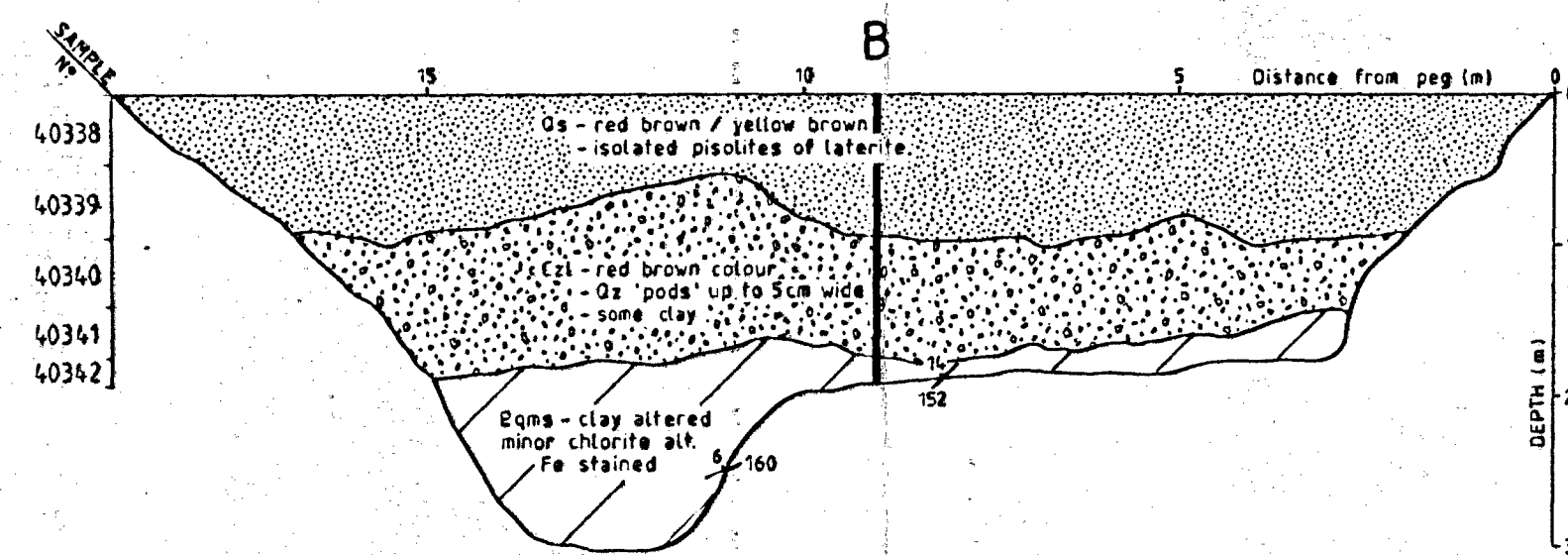
DEPTH (m) SAMPLE NO.

DEPTH (m)	SAMPLE NO.	U	Th	U	Th	U	Th	U	Th
0	40316	16	8	24	7	<4	6	16	10.4
1	40317	6	4	19	5	12	9	20	7.45
2	40318	8	14	13	4	10	6	20	7.15
3	40319	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.	L.N.R.

ppm %



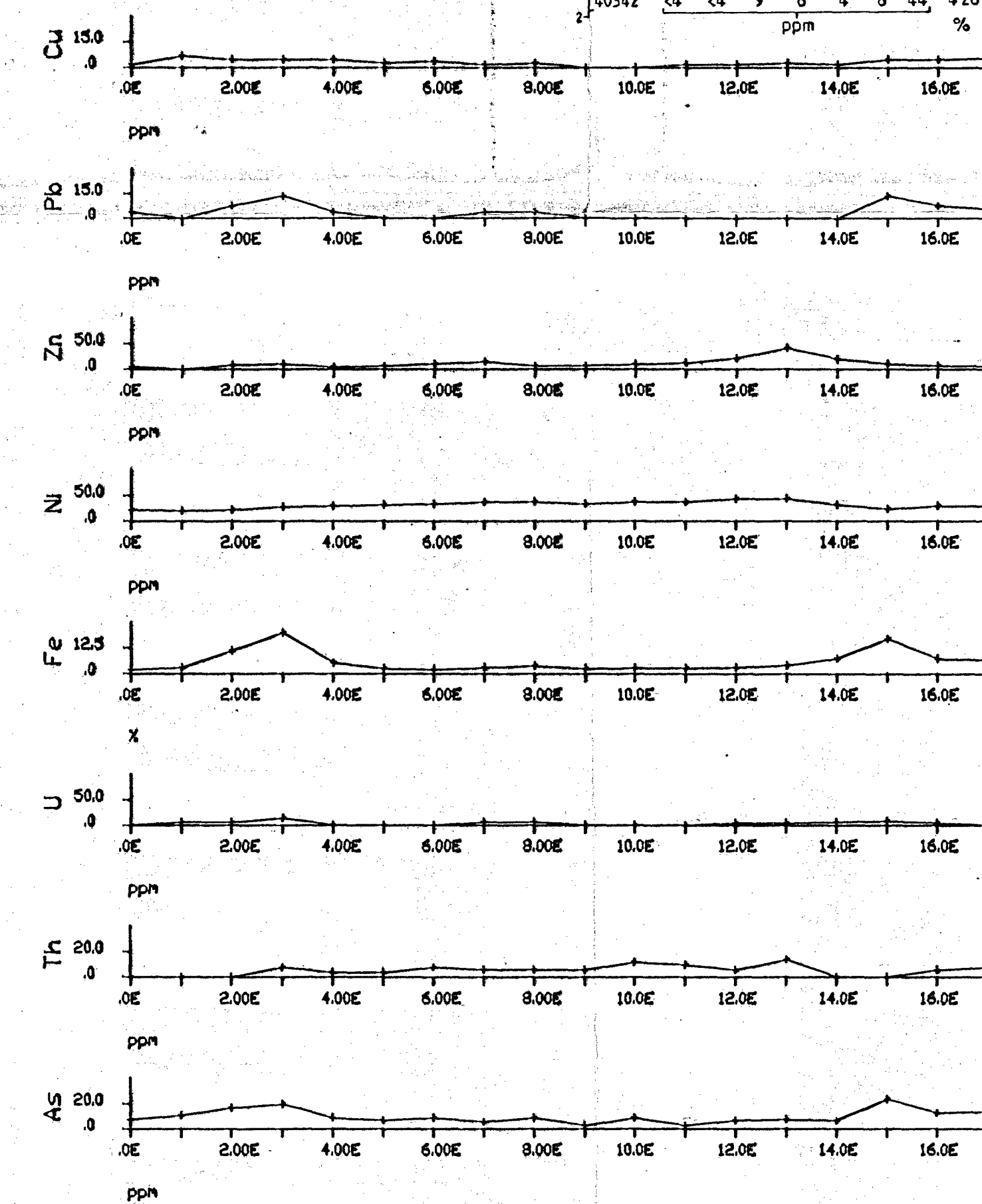
TRENCH No.6 318700 E 641735 N Bearing 135°



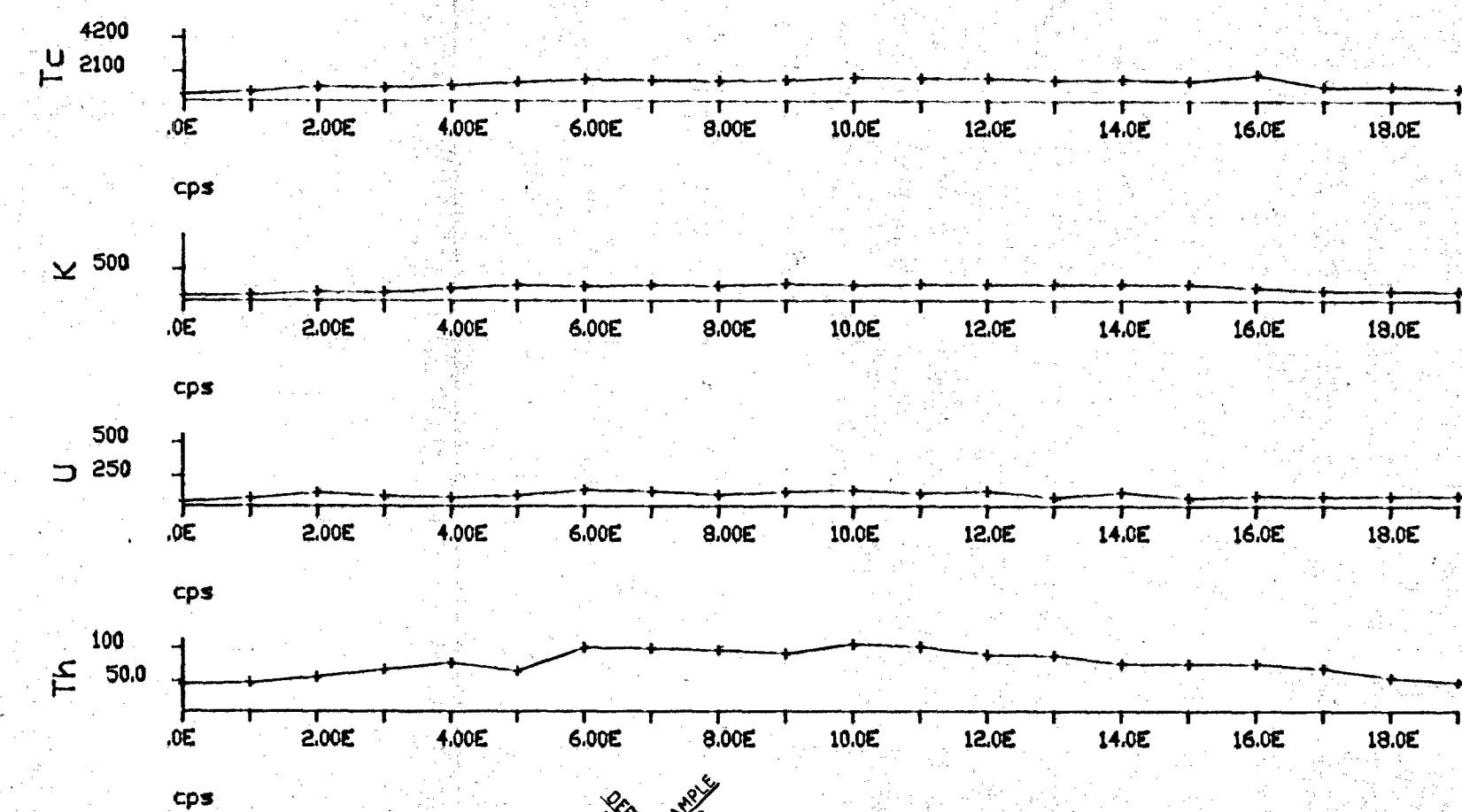
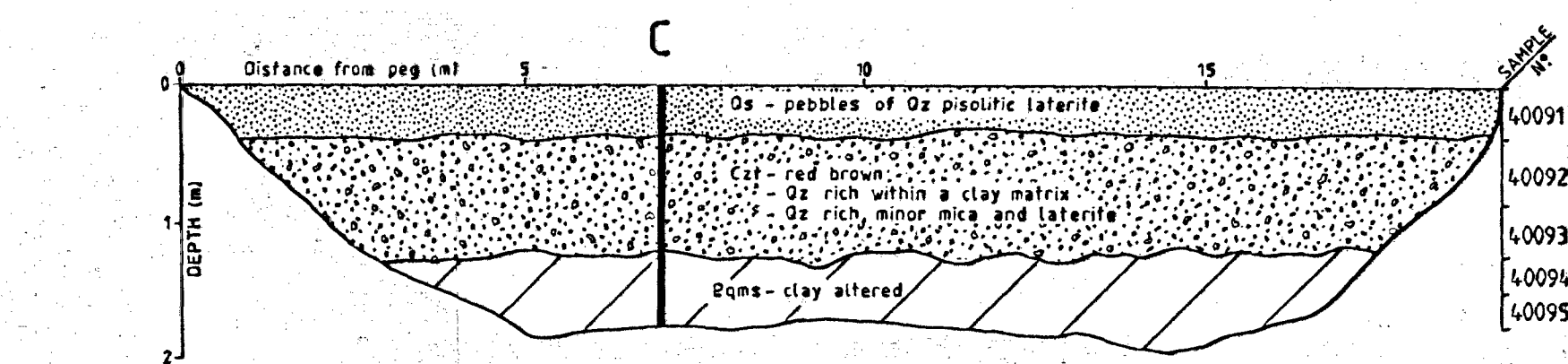
DEPTH (m) SAMPLE NO.

DEPTH (m)	SAMPLE NO.	U	Th	U	Th	U	Th	U	Th
0	40338	4	<4	10	5	4	3	24	234
1	40339	<4	<4	9	5	<4	9	28	3.62
2	40340	10	<4	22	5	12	11	22	16.9
3	40341	6	<4	26	3	12	11	24	17.8
4	40342	<4	<4	9	6	4	8	44	4.26

ppm %



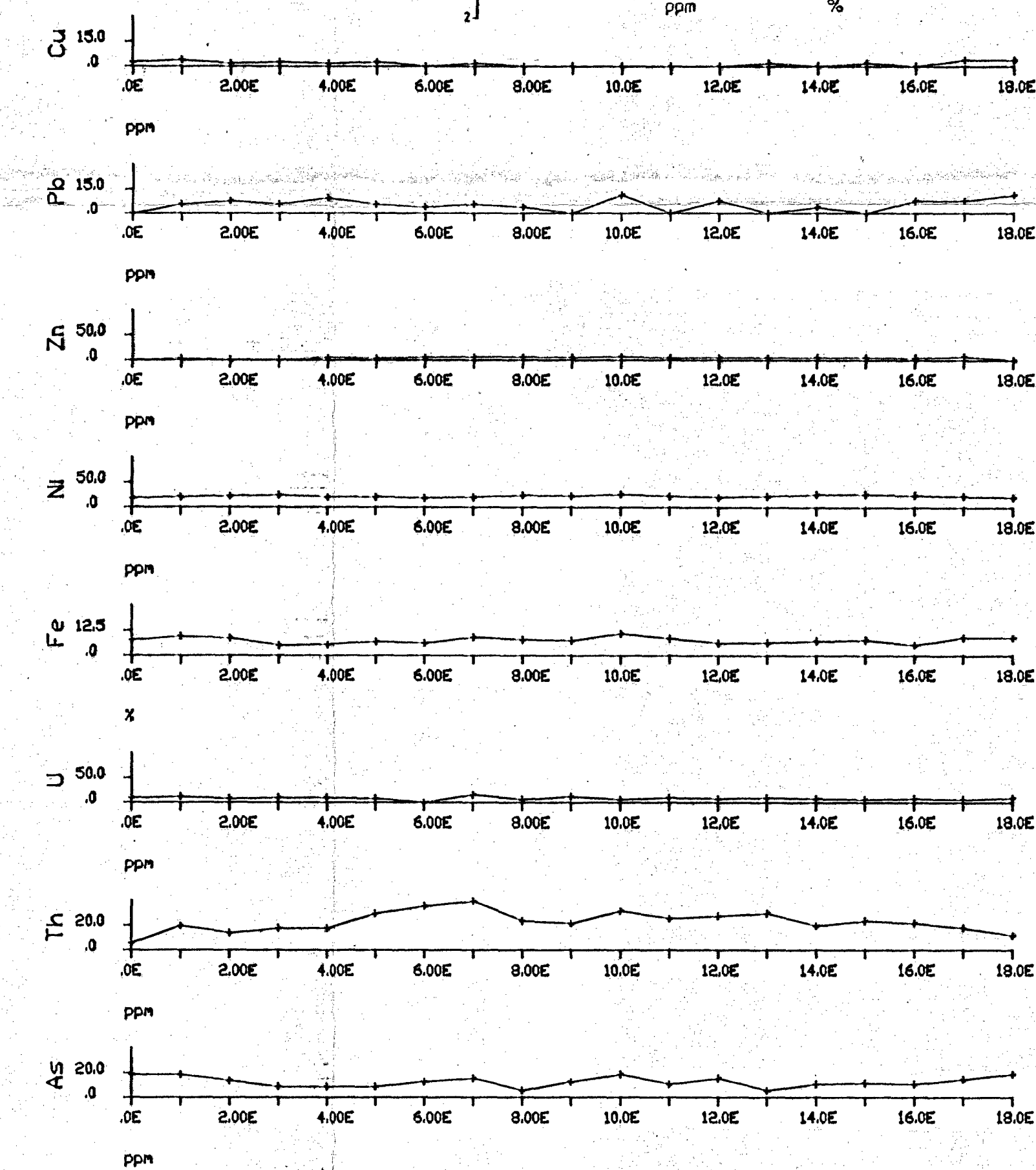
TRENCH No.7 318500 E 642200 N Bearing 135°



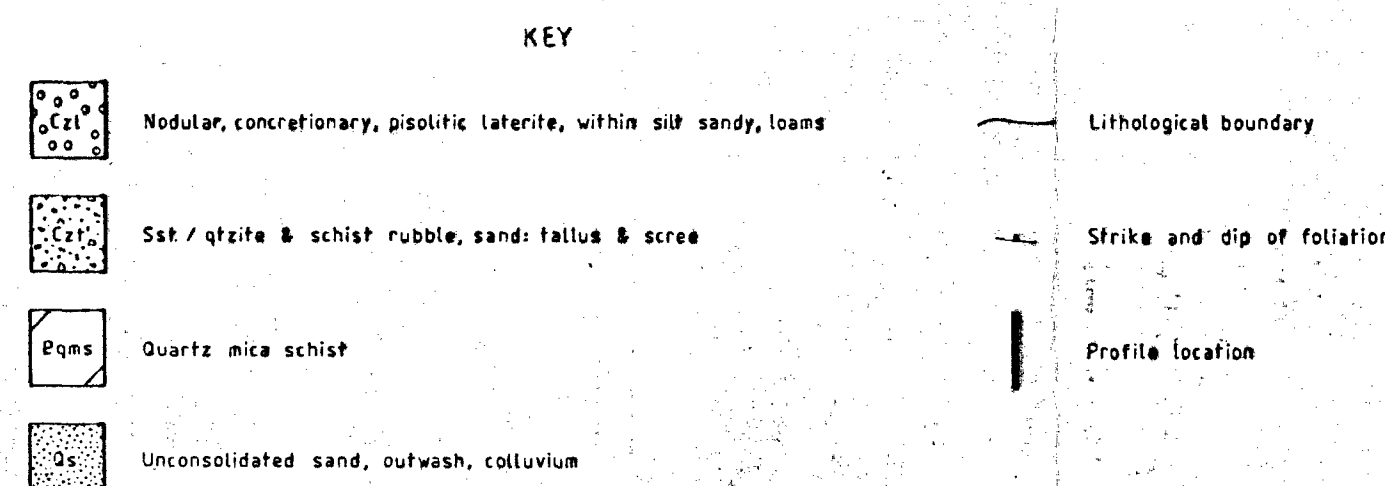
DEPTH (m) SAMPLE NO.

DEPTH (m)	SAMPLE NO.	U	Th	U	Th	U	Th	U	Th
0	40091	8	16	14	5	10	3	18	9.30
1	40092	6	8	17	5	6	3	22	7.65
2	40093	8	22	14	4	8	5	24	5.65
3	40094	10	34	11	4	6	4	26	8.85
4	40095	<4	28	13	5	8	5	24	7.45

ppm %



TRENCH No.8 318400 E 641995 N Bearing 135°



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ANOMALY 24

TRENCH 6,7,8 PROFILES

Author: DR. N. F. RUTHERFORD	Scale: H. 1:100, V. VARIES
Drawn: G. COURT	Computer File No. 10421N2
Date: FEB. 89	Drawing No. Figure 148

CR89-423 B