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3	LD 51/1008	Outcrop Geology	1: 20,000
4	LD 51/1019	Geophysical Summary Plan	1: 20,000
5	LD 51/1027	Anomaly 5A - Interpreted Geology	1: 2,000
6	D/LD 51/018	Anomaly 5A - Cu Assay Values	1: 2,000
7	D/LD 51/019	Anomaly 5A - Pb Assay Values	1: 2,000
8	D/LD 51/020	Anomaly 5A - Zn Assay Values	1: 2,000
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10	LD 51/1028	Max Min EM Profile Line 5600N	1: 5,000
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1.0 INTRODUCTION

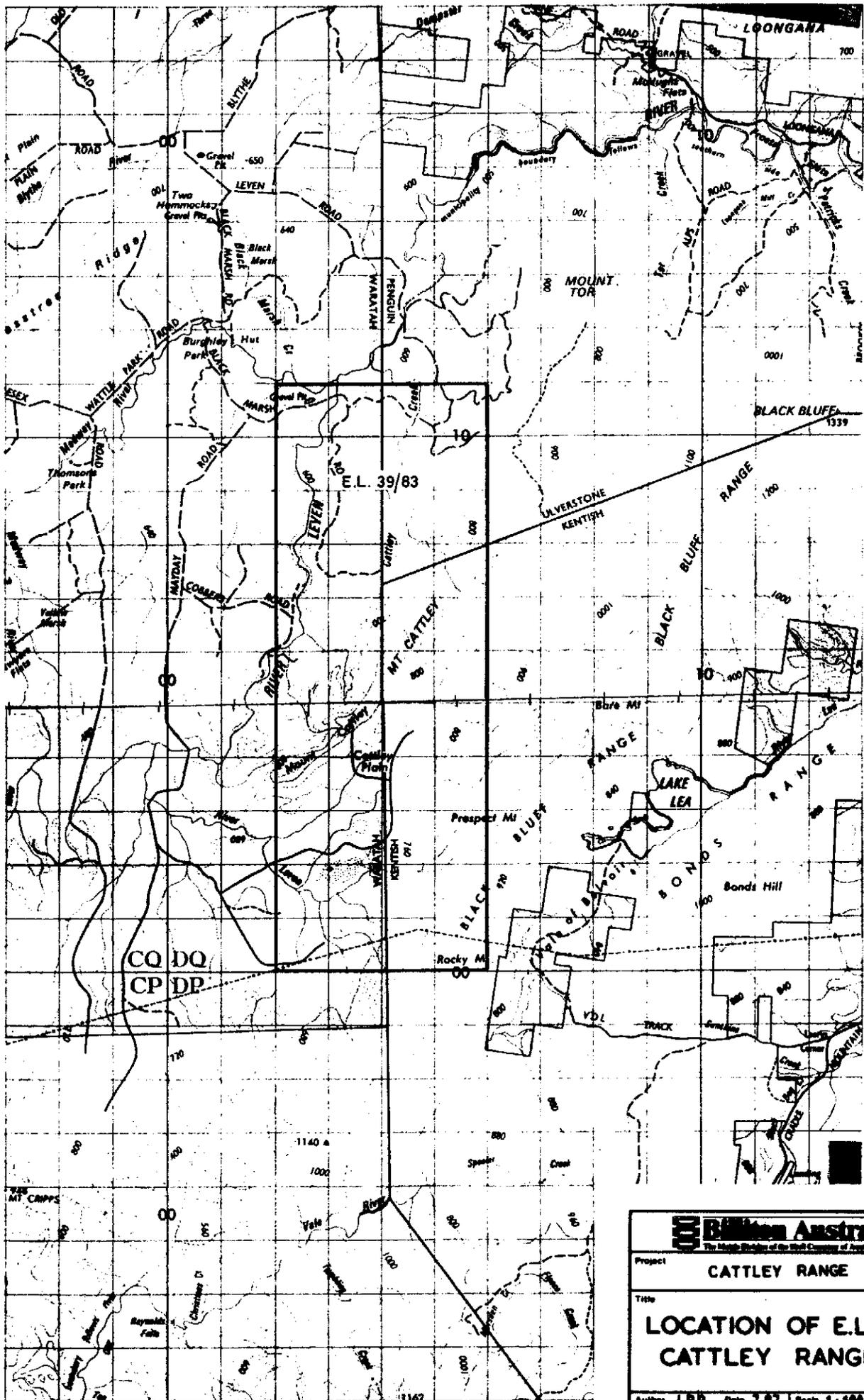
Exploration Licence No. 39/83, covering 44 km², was granted to the Shell Company of Australia Limited on 22nd August, 1983.

The area is located 50 kilometres south of Burnie partially within an A.P.P.M. Concession and encloses the Cattley Range. (Fig. 1).

The principal exploration target within the licence is massive volcanogenic base metal sulphides with type characteristics of Hellyer - Que River. The more distal deposit type (viz Rosebery) is also a valid target and geological evidence to date on EL 39/83 would suggest good prospectivity for both VMS types.

The gross exploration philosophy applicable to this licence relates to the strike/stratigraphic proximity of Hellyer (13 kilometres), the continuity of a major rift margin fault (Henty Fault) north from Hellyer and the presence within the licence and adjacent licences of strongly altered and geochemically anomalous lithologies (Two Hummocks, Cattley North, Basin Road).

This report summarizes exploration carried out over the last four years and including the 1986-87 season. Previous Billiton reports detail the annual activities since the inception of the licence. (Billiton reports 08.2489, 08.2887, 08.3410).



5 cm

Barton Australia <small>The Map Division of the Shell Company of Australia Limited</small>			
Project		CATTLE RANGE	
Title		LOCATION OF E.L.39/83 CATTLE RANGE	
Author	JPR	Date	7 67
Scale	1:100,000		
Drawn	Office	Revised	Date
Drawing No.	D/LD 51/022		Fig. No. 1

2.0 PREVIOUS EXPLORATION

Geopeko held the licence area as part of their EL 10/74. Regional stream sediment and Dighem surveys defined several low order anomalies and one moderately anomalous lead anomaly (<120ppm Pb vs background 20ppm Pb) at AMG co-ordinates 5409560mN 403930mE. In addition one Dighem anomaly at AMG co-ordinates 5410200mN 405000mE was recorded (Mariner II anomaly) (Figure 2). No ground follow up of these anomalies was recorded in Geopeko reports and the ground was relinquished subsequently.

See reports from 1981 & 1983

During 1982, Shell flew an INPUT EM survey over the adjacent Loongana licence EL 36/79 and located the original Dighem anomaly of Geopeko's. Once the Cattley Range licence had been granted, a small grid was cut over the ground located position of the anomaly and the following geophysical methods carried out: viz ground magnetics, VLF EM, Max Min EM, dipole IP. It was concluded from this work that the responses were due to conductive layers at the base of the Tertiary basalt that covers much of the licence.

Work on the Geopeko stream sediment anomaly included gridding, repeat stream sediment sampling, grid based soil sampling and geological mapping. It was concluded that a low order lithologically related geochemical source was present but that sufficient interest could not be maintained to further test the anomaly.

During the 1984-85 season, exploration focussed on geophysical testing of all Cambrian windows within the tenement. (Figures 3-4). Gridding (42 kms), EM 37 surveying (12 line kms) and geological mapping (1:20,000 scale) were carried out, principally in the northern portion of the licence. In addition, one line of dipole-dipole IP was completed on line 9800N and 42 kilometres of ground magnetics was completed. Several low order EM anomalies were recorded in the vicinity of the previously known INPUT, Dighem, IP anomalies but these responses were not considered to be due to a bedrock conductor.

Continued gridding (28 kms), EM 37 surveying (15 kms) and ground magnetics (19 kms) in 1985-86 completed the EM coverage of the southern portion of Cambrian lithologies and resulted in the definition of a three line 600 metre strike length bedrock conductor. (Lines 5600N, 5900N, 6200N). Detailing of this anomaly was carried out using Sirotem (3.25 line kms) and at the time, modelling suggested that the source was most probably conductive clays beneath the Tertiary basalt.

Other work carried out during 1985-86 focussed on additional auger sampling on three lines across the IP anomaly at 9800N and the soil Pb anomaly on line 9400N. This work did not produce anomalous geochemistry associated with the IP anomaly but did define weak sporadic Pb geochemistry coincident with previous soil sampling on and near line 9400N. Slightly elevated lead values (240ppm Pb) are associated with felsic tuffs on line 9600N at 11060 - 11120E.

3.0 EXPLORATION COMPLETED 1986-87

Evaluation of the EM anomaly on lines 5600N-6200N has been the prime focus of exploration during the year. One line of Max Min EM was completed on line 5600N across the EM 37 anomaly position and 129 auger samples were collected on lines 5300N, 5600N, 5700N, 5800N, 5900N, 6000N. Detailed grid mapping and rock chip sampling was carried out along these lines also.

Diamond drill hole CRD 86-1 was completed at 278 metres after having passed through the interpreted position of the EM 37 conductor (Anomaly 5A). Geological logging, petrological examination, sample assaying and down hole EM surveying were also completed on the diamond drill hole.

4.0 EXPLORATION RESULTS

4.1 Grid Mapping (Figure 5)

Limited grid mapping was carried out by graduate geologist I. Gordon in the vicinity of the proposed drill hole. The sequence strikes 040° Mag and dips steeply to the east. Facing evidence was obtained from limited access track exposure and suggests an east facing consistently. From the stratigraphic top at 12800E the sequence is:-

- 1) Feldspar phyric volcanics, weakly sericitized.
- 2) +200m sericitized volcanoclastics, some epiclastics and volcanic sandstones.

- 3) 75-150m quartz phyric volcanics, probably lavas with minor interbedded cherty horizons.
- 4) 50-70m volcanic sandstone, black shale, fine epiclastics.
- 5) 150-200m quartz phyric volcanics, possibly lavas.
- 6) >400m feldspar phyric andesitic lavas.

Facies tend to interfinger and correlation within the volcanoclastic horizons is difficult especially given the very poor outcrop. An island of Tertiary basalt covers the central northern portion of the grid area and also overlies the interpreted position of the EM 37 conductor. Nevertheless, correlation along strike suggests that either the EM 37 anomaly source relates to unit 4 (volcanic sandstone, black shale, fine epiclastic) or to an unidentified source within unit 5.

Selected rock chip sampling (Appendix I) failed to provide any geochemical encouragement to the local area.

4.2 Auger Sampling (Figures 6-9)

C horizon samples were collected using a hand auger from depths of 0.8-1.2 metres and at a sample spacing of 25m. Samples were analysed for Cu Pb Zn Mn and although only a small population (129 samples) a threshold of Cu 55ppm, Pb 100ppm, Zn 135ppm, Mn 3300ppm was calculated ($\bar{x} + 2\sigma$). Several isolated Pb anomalies (105-270ppm Pb) occur on lines 5700N, 5800N, 5900N associated with unit 2 volcan-

iclastics but other elements are not anomalous. High Mn (up to 4650ppm Mn) and moderate Cu, Zn values (60ppm Cu, 155ppm Zn) are recorded within the Tertiary basalt and tend to define this boundary reasonably well.

No anomalies were recorded coincident with the interpreted position of the EM 37 conductor.

4.3 Max Min EM Anomaly 5A

Max Min EM was run along one line 5600N (Figure 10) over existing EM-37 anomaly 5A, (Billiton report 08.3410). Coil separation was 204 metres and four frequencies were used in the horizontal loop mode.

The in-phase readings were uncorrected for topography, and problems with peg spacings on the grid mean that this component is useless. The out-of-phase component however indicates a poor conductor coincident with the EM-37 anomaly at 12275E. The ground magnetics and geology along this line do not indicate the presence of any basalt, so the poor conductor must have some bedrock source (i.e. fault, alteration zone etc). This source could be readily investigated. Geological mapping suggests it could be due to a black shale unit, but similar units in DDH CRD 86-1 do not appear to be conductive.

4.4 Diamond Drilling (Figure 11, Appendices 2,3)

One diamond drill hole, CRD 86-1, has tested the interpreted position of the EM 37 conductor in a position that was considered to show the best response.

A summary log is presented below and is shown on Figure 11.

Collar Co-ordinates : AMG 5405958mN Grid 5890N

403025mE 12490E

Collar Azimuth : 302° Mag

Collar Dip : 55°

Target : EM 37 conductor top at 12360E, 100m
vertical depth, 60° E dip

Log :

0- 15m	Interbedded black shale, siltstone, sandstone with graded beds (up hole facing) and weak disseminations (1% ave.) pyrite, galena, sphalerite.
15- 23m	Fine volcanoclastics, sandstone and minor feldspar phytic lava. Weak disseminated pyrite (2%), rare pyrite, galena veinlets, graded beds.
23- 91m	Well laminated black shale and fine sandstone with minor zones of pyrite-chalcopyrite (up to 10%).
91-192m	Massive dacitic lava/intrusive.
192-205m	Well laminated black shale/siltstone.
205-207m	Silicified and sericitized fine grained volcanoclastic.
207-239m	Massive polymict epiclastic breccia, dominantly felsic volcanic clasts and black shale, volcanic sandstone. Strongly silicified and sericitized, 5% sulphides.
239-253m	Interbedded black shale and epiclastic breccia, soft sediment slumping, up hole facing.

- 253-257m Massive polymict breccia, as above.
- 257-273m Strongly altered (sericitized, carbonated) epiclastic sandstone and polymict breccia.
- 273-276m Black shale with minor interbedded epiclastics.
- 276-278m Altered polymict epiclastic breccia.

E.O.H.

Splitting was carried out on selected sections of core and samples submitted for analysis of Cu Zn Ag (AAS), Pb As Ba Sn W (XRF), Au (FA). Values were generally low and the best intercept recorded was:

191.8-193.8m 2m @ 0.17% Pb, 0.65% Zn, 2ppm Ag, 0.04ppm Au at the contact of the massive dacitic volcanics with the underlying laminated black shales.

Nine samples were selected for petrological examination (see Appendix 3) to determine the type and extent of alteration and possible paleo environmental implications of rock textures. These descriptions together with geological observations in core suggests that the lower units (stratigraphically below the massive dacitic ?lava) are immature reworked volcanoclastics that have been intensely sericitized and carbonated. The units are composed predominantly of sand to cobble size pumiceous acid fragments with lesser black shale. The degree of slumping, scouring and coarse graded bedding would suggest rapid deposition and little transport, perhaps in a fluviotile environment that was frequently flushed with volcanic debris. It is of interest that along strike from the drill hole there is

little indication of this facies either because of the poor outcrop or facies variations along strike.

4.5 Down Hole EM (CRD 86-1)

The drill hole was initially logged using Billiton Australia's Sirotem MkI transmitter/receiver and Sirotem probe. A transmitter loop, 250x200 metres, was used, and situated so as to optimally couple with a massive sulphide conductor off-hole and within the altered volcanoclastic unit (below 190 metres downhole). The DH Sirotem log is shown in Figure 12. The results do not indicate any obvious off-hole conductor within about 50 metres of the hole. Unfortunately the noisy data, probably instrument related, means that any subtle anomalies from more distant sources cannot be recognised.

Because of this the hole was logged again using a Sirotem MkII unit operated by McSkimming Geophysics. The resultant preliminary log is included in Figure 13. The same transmitter loop was used as on the previous log. Although the late time channels (beyond channel 12 = 1.054 ms) are similar to the previous Billiton log indicating a continuous slow decay and no off-hole conductor, the early channels are questionable since they are not repeatable and bear no resemblance to the Billiton log. This is not due to reading within the Sirotem turn-off time which is about 0.04ms in this case. A SATX transmitter unit was employed by McSkimming (but not by Billiton) and synchronisation was checked 3 times during the survey.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Despite the disappointing assay results from diamond drill hole CRD 86-1, the degree of alteration observed in the epiclastic horizons below the massive dacite is of considerable interest. The intensity of alteration (sericitization, carbonatization) together with the weak sulphide development suggests that strong hydrothermal fluid circulation has contaminated the epiclastics and that regionally, the environment is permissive to base metal mineralization.

Further to the north, near lines 9400-9800N, weak geochemical anomalies remain unexplained and require further testing.

It is recommended that future work focus primarily in the region of CRD 86-1 to trace the alteration along strike and to carry out costeaning, auger sampling to better identify the bedrock geology. This work needs to identify alteration types and intensity as well as geochemical anomalism in order to target further diamond drilling. Reinterpretation of previous EM 37 survey results may be required in areas thus generated.

At the northern Pb soil anomaly costeaning is recommended to expose the source of the anomaly and to further expose an IP anomaly source on line 9800N.

APPENDIX 1

Rock Chip Sampling Results

SAMPLE RECORD

Sheet 1 of

METALS DIVISION

SAMPLE TYPE: Rock Chips

LOCATION / PROJECT: Cattley Range - Tas.

SAMPLER: J.R.G.

DATE: MAP / PHOTO REF:

ASSAY LAB: ANALAB

SAMPLE DESPATCH ASSAY REPORT NOS:

ORDER NO:

SAMPLE STORAGE: Devonport

SAMPLE No.	LOCATION *		INTER'L (m)	ANALYSES						DESCRIPTION
	Northng	Eastng		Cu	Pb	Zn	Ag	Bi	Au**	
13501	5600	12765		10	45	80	0.5	< 10	< 0.008	sericitised cleaved fgs of phyric volc
13502	5900	12495		55	50	50	1.0	< 10	< 0.008	well laminated bl. shale/siltstone
13503	5900	12495		15	75	15	< 0.5	< 10	< 0.008	well laminated bl. shale/siltstone
13504	5600	12508		10	45	30	< 0.5	< 10	< 0.008	quartz phyric volcanic
13505	5600	12487		20	45	35	< 0.5	< 10	0.017	quartz phyric volcanic
13506	5600	12458		10	45	30	< 0.5	< 10	< 0.008	silicified + (?) altered qtz phyric ? lava
13507	5600	12458		5	45	35	0.5	< 10	0.032	silicified (?) altered qtz phyric ? lava
13508	5600	12215		10	45	30	0.5	< 10	< 0.008	alterbrecciated by weakly qtz phyric lava
13509	5600	11885		30	15	50	< 0.5	20	< 0.008	pink fgs of phyric ? andalite lava
13510	5800	12800		5	15	65	< 0.5	10	< 0.008	fgs cleaved sericitised volcanic
13511	5800	12519		25	45	25	< 0.5	40	< 0.008	pale green chert
13512	5800	12504		10	45	30	0.5	40	< 0.008	qtz phyric lava
13513	5800	12464		15	20	20	0.5	10	< 0.008	chert
13514	5900	12762		15	50	60	< 0.5	40	< 0.008	polymict Fe stained eq epidlastic
13515	5900	12795		10	15	25	0.5	40	0.017	pale green fg ? tuff
13516	6000	12538		20	10	90	0.5	40	< 0.008	massive cleaved ? tuff
13517	5700	12533		10	5	10	< 0.5	40	< 0.008	altered fg silicified tuff
13518	5700	12441		10	50	15	< 0.5	< 10	< 0.008	massive pale green qtz phyric tuff
13519	5700	12159		5	45	25	< 0.5	< 10	< 0.008	bleached fg qtz phyric tuff
13520	5300	12620		10	40	35	0.5	< 10	< 0.008	massive silicified tuff
13521	6000	12500		20	40	1300	0.5	< 10	< 0.008	ferrous fault pug

906016

REMARKS: * Coordinates are for Cattley Range Grid.
 ** Au by Fire Assay/ABS

APPENDIX 2

Diamond Drill Log CRD 86-1

SILMET SYSTEM
METRIC
DECIMAL POINTS AS REQUIRED

The Shell Company of Australia Limited
METALS DIVISION
DRILL LOG SHEET

PROJECT *CATLEY RANGE* HOLE NAME *LD 86-1*
LOGGED BY *I.F.L.* TOTAL DEPTH *281 m*

CONTINUATION SHEET

DISTANCE FROM COLLAR		Cu	Pb	Zn	Ag	Au	Ba	Mn	S	W	SAMPLE NO	CORE ANGLE	ROCK TYPE	DIAM	DESC CODE	GRAPHIC LOG	DESCRIPTIVE LOG	
TO TOP	TO BOTTOM																	
14.9	15.5	46	700	340													14.9-15.5: Broken core weakly chloritic, quite stringy, siliceous, fragmented volcanoclastic. contains numerous wispy veins of brown carbonate (? siderite) with py (10-15%), sph (5%), and go (5%). Py occurs in veins, and as thin pyritic interbeds (~7-8mm thick).	
15.5	17.1	7	65	230	<1	0.01	340	30	610								15.5-17.15: Buff coloured, bleached(?) ashy tuff(?) contains occasional chunky fragments, and fragments of siltstone up to 3mm. abundant wispy carbonate, py, go, sph veins which have darker (? chloritic) selvages. py in veins varies up to 100%, sometimes forming pods around 4cm in size (eg 16.45m). 17.15m: Several fibrous Qtz (goldschulite) veins up to 8mm wide. Vein core angle = 80°	
17.1	18.2	5	165	155	1	0.01	350	5	410									
18.2	20.0	12	160	600	1	0.01	320	5	810									
20.0	21.9	19	75	175	<1	0.01	340	9	410									
21.9	23.0	26	30	240	<1	0.01	340	18	410									
23.0	25.0	32	60	270	<1	0.01	340	38	610									
																		17.15-18.15: Silicified and weakly chloritic fragmented, similar to 14.9-15.5 above. contains up to 2% disseminated py throughout. several thin (max 7mm) fibrous Qtz, calc, Ksp, Ksp, tourmaline (? py, go) veins, more common towards upper contact.
																		18.15-21.9: weakly foliated phytic 'lenses' 18.15-21.95: Buff coloured, bleached(?) foliated phenes are zoned, shown by alteration (rims now carbonate, centres chloritic phenes ~2%) many thin (<1mm) veinlets of carb, py, go, Qtz. Sometimes pods of massive py (eg 19.8m). Abundant spots (=1mm) of py, py make up 2% of rock. 21.05-21.9: Darker green colour (less bleached?). Gradational into buff colour above. Carbonatised foliated phenes up to 4mm, zoned. several cross cutting Qtz carb, Ksp veins up to 15mm thick. fibrous occur with vein/core angles around 75°
																		21.9-23m: Mainly vfg ashy siltstone with some coarser units. coarser units are up to 5cm thick, composed of angular to sub-rounded Qtz grains and siltstone fragments. Grading is common, indicating uphole facing (right way up). Some thin carbonate veinlets, sometimes with carbonatised selvages, occasionally up to 2mm wide.

ASSAY INFORMATION

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906019

SHEMET SYSTEM
METRIC
DECIMAL POINTS AS REQUIRED

The Shell Company of Australia Limited
METALS DIVISION
DRILL LOG SHEET

PROJECT *LAILEY RANGE* HOLE NAME *CRD 86-1*
LOGGED BY *J.F.G.* TOTAL DEPTH *281 m*

CONTINUATION SHEET

DISTANCE FROM COLLAR		SAMPLE NO	CORE ANGLE	ROCK TYPE	DIAM	DESC CODE	GRAPHIC LOG	DESCRIPTIVE LOG																																																																																																																																																																																																																																																																																
TO TOP	TO BOTTOM																																																																																																																																																																																																																																																																																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281

ASSAY INFORMATION

23.1 → 90.6m: Well laminated black shale and fine sandstone.
 - This unit is strongly fissile, with much broken core and poor core recovery.
 - The unit is similar to the overlying unit (2.0m to 14.9m). Bedding is often disrupted, exhibiting some soft sediment deformation.
 - Individual sandstone units are up to 30cm thick, generally thicker towards the top of the unit. These often show graded bedding, indicating uphole facies, right way up, at 47.75m.
 - Several interformational breccias occur towards the base of the unit (eg 57.7-58.9m) these contain clasts and fragments of black shale and coarse tuffaceous sandstone up to 9cm.
 - Wavy anastomosing quartz/carbonate veins occur, often close to fossils, to cleavage. These contain 1-2% pyrite and trace base metal sulphides.
 - 23.0 → 23.4m: intense quartz/carbonate veining with up to 10% pyrite and trace chalcoppyrite.
 - Sandstone unit contains 1-2% disseminated pyrite, with occasional concentrations up to 5% in bedding planes.
 - 58.0 → 58.4m: healed fault zone, intense chlorite/quartz veining with up to 10% pyrite, and up to 5% secondary pyrite in the matrix of the surrounding sandstone breccia.
 - 76.45 → 78.0m: Strongly bleached unit. Basic lithologies are similar to the rest of this sequence, with all carbonaceous matter removed by alteration, resulting in a buff colored sandy rock. Fine sandstones and shales are represented in this altered unit.

Bedding / Heavy Core Azis Angles:
 47° @ 23m
 18° @ 36m
 32° @ 45m
 10° @ 65.3m

032

906020

SPLMET SYSTEM
METRIC
DECIMAL POINTS AS REQUIRED

The Shell Company of Australia Limited
METALS DIVISION

DRILL LOG SHEET

PROJECT Cattley Range HOLE NAME CRD 96-1
LOGGED BY JFL TOTAL DEPTH 281m

CONTINUATION SHEET

DISTANCE FROM COLLAR		Cu	Pb	Zn	Ag	Au	Ba	SAMPLE NO	CORE ANGLE	ROCK TYPE	DIAM	DESC CODE	GRAPHIC LOG	DESCRIPTIVE LOG
TO TOP	TO BOTTOM													
190.0	191.0	6	4	8	1	0.02	27010							89.2-90.0m Strongly Altered Contact Zone
191.0	191.8	90	6	16	1	0.01	23028							- Intense quartz/pale chlorite veining with 5% pyrite
191.8	193.8	125	170	8450	2.0	0.042	3802550							- small (<1cm) fragments of carbonaceous sediment incorporated into underlying dacite
193.8	195.8	70	460	905	1.0	0.008	4102650							90.6-191.8m Massive Dacite Intrusive
195.8	197.8	130	230	675	2.0	0.008	5202650							- Massive textureless but coloured intrusive dacite weakly quartz phyrin and in places felspar phyrin
197.8	199.8	80	130	415	2.0	0.008	4105025							- widely spaced quartz phenocrysts of 1-3mm size in a very fine matrix
199.8	201.8	135	110	155	2.5	0.008	4307940							- Occasionally veined by up to 2cm wide quartz fibrous quartz veins, many containing trace galena
201.8	203.8	110	90	90	2.0	0.008	5505545							
203.8	204.8	45	75	45	2.0	0.017	4605525							204.8-209.8m well laminated Black Shale Siltstone
204.8	206.8	25	5	15	4.0	0.008	4202210							- well laminated black shale and grey siltstone sequence with generally less than 1% pyrite, becoming more pyritic and silicified towards the base
206.8	208	10	10	10	0.5	0.008	4402215							- Secondary introduced? pyrite replacing darker shale bands forms massive Fe sulphide veins up to 1.5cm thick
208	209	5	10	50	0.5	0.008	4402215							- 198.35-200.0m: Fault broken shale fragments with much qtz/carbonate veining and polished chlorite surfaces
209	211	5	15	25	0.5	0.008	4202215							
211	213	5	15	25	0.5	0.008	4402215							
213	215	5	15	20	0.5	0.008	4502215							
215	217	5	20	40	0.5	0.008	3802210							
217	219	5	10	20	1.0	0.008	3702210							204.8-207.0m Fine to med Grained Volcanic
219	221	5	20	15	0.5	0.008	3702210							- Silicified & Sericified, with some wispy dark chlorite bands overall grey colour due to silicification
221	223	5	15	10	0.5	0.008	3602215							- 5% disseminated sulphides (py + greasph) associated with alteration
223	225	5	20	20	0.5	0.008	4302210							
225	227	5	20	15	0.5	0.008	4202215							
227	229	5	10	15	0.5	0.008	4802220							
229	231	5	10	15	0.5	0.008	4102215							
231	233	5	10	10	0.5	0.008	4602210							207.0-239.0m Massive Polymict Epiclastic Breccia
233	235	5	20	15	0.5	0.033	4602210							- Grain size varies up to 15cm roughly graded from bottom to top
235	237	5	15	15	0.5	0.008	4002210							- Polymict provenance; dominantly fels volcanic clasts with sedimentary fragments (bl. sh. silt, volcanogenic, etc) becoming more abundant towards the base. Also minor massive py clasts. Abundant pyritic fragments, now chloritised and flattened
237	239	5	20	25	0.5	0.008	4002210							- Clasts are generally angular to sub-angular
239	241	20	35	20	0.5	0.008	4802220							- Strongly silicified and sericified with 5% py + base metal sulphides, and <1% greasph
241	243	160	115	205	1.5	0.008	4502520							
243	245	85	115	235	1.5	0.008	4402520							
245	247	65	110	75	1.0	0.008	4802025							
247	249	50	150	205	0.5	0.008	5102520							
249	251	20	80	50	1.0	0.008	7302020							
251	251.7	15	80	65	1.0	0.008	4402620							
251.7	253	15	40	20	1.0	0.017	4702510							

ASSAY INFORMATION

023

906021

DISTANCE FROM COLLAR		ASSAY INFORMATION										SAMPLE NO	CORE ANGLE	ROCK TYPE	DIAM	DESC CODE	GRAPHIC LOG	DESCRIPTIVE LOG
		TO TOP		TO BOTTOM		Cu	Pb	Zn	Ag	Au	Ba							
253.1	254.4		5	15	30	0	5	0	0.33	480	610	13559						253.0-254.4m Interbedded Black Shale and Epitlastic Breccia
254.4	255.7		5	25	40	0	5	0	0.33	570	610	13560						- Dominated by black shale with 5-10% pyrite.
255.7	256.4		5	35	50	1	0	0	0.08	580	610	13561						Intervals of volcanogenic epitlastic breccia are generally 4cm thick, and are of volcanogenic sandstones to poorly sorted polymict breccia with clasts up to 4cm in size.
256.4	257.0	80	15	40	50	1	0	0	0.08	590	610	13562						- Individual coarse grained units are graded, indicating uphole facings.
257.0	257.6	110	15	45	60	0	5	0	0.08	420	210	13563						- soft sediment slumping and deformation is locally intense in finer grained shales
257.6	258.3		5	55	70	0	5	0	0.08	460	210	13564						- Caprock sandstones and breccias are moderately silicified
258.3	259.0		5	65	80	0	5	0	0.17	500	215	13565						
259.0	260.4		5	75	90	0	5	0	0.17	490	215	13566						
260.4	261.4	10	20	40	0	5	0	0.08	620	210	13567							
261.4	262.4	20	15	40	0	5	0	0.08	660	210	13568							
262.4	263.4	10	15	40	0	5	0	0.08	570	210	13569							
263.4	264.4		5	10	10	0	5	0	0.83	580	210	13570						
264.4	265.4		5	25	60	0	5	0	0.17	620	210	13571						
265.4	266.4		5	20	30	0	5	0	0.08	550	310	13572						
266.4	267.4		5	10	10	0	5	0	0.08	600	210	13573						
267.4	268.5	10	20	20	0	5	0	0.08	800	115	13574							
268.5	269.5		5	25	30	0	5	0	0.08	690	410	13575						
269.5	270.5	10	30	25	0	5	0	0.08	830	415	13576							
251.9-253.1m Fine - Med. Grained Epitlastic - Bedded volcanogenic epitlastic - Macrophy altered, silicified sericitized and chloritized. Chlorite is characteristically pale apple green coloured.																		
253.1-255.7m Massive Polymict Breccia - Fragments are dominantly felsic volcanic derived, with sedimentary and massive pyrite fragments also - Breccia is poorly sorted, with grain size varying up to 10cm - Silicified, and weakly chloritized, exhibits pale apple green (Fe-poor) chlorite																		
255.7-256.4m Fine - Med Grained Epitlastic - as for 251.9-253.1m above																		
256.4-257.0m Massive Polymict Breccia - as for 253.1-255.7m above																		
257.0-265.4m Strongly Altered Epitlastic - med. grained volcanic derived epitlastic sandstone, with occasional fragments up to 8cm in size - Caprock fragments are flattened and strongly bleached - Alteration is dominated by silicification and chloritization, with wispy amethystine quartz veinlets.																		
265.4-272.85m Strongly Altered Polymict Breccia - mainly felsic volcanic fragments - intense silicification and chloritization with																		

SILMET SYSTEM
METRIC
DECIMAL POINTS AS REQUIRED

The Shell Company of Australia Limited
METALS DIVISION
DRILL LOG SHEET

PROJECT CATLEY RANGE	HOLE NAME CRD 86-1
LOGGED BY IFG	TOTAL DEPTH 281m

CONTINUATION SHEET

DISTANCE FROM COLLAR	DISTANCE FROM COLLAR		SAMPLE NO	CORE ANGLE	ROCK TYPE	DIAM	DESC CODE	GRAPHIC LOG	DESCRIPTIVE LOG
	TO TOP	TO BOTTOM							
1.5	0.00	0.00							some "pink" alteration which is probably a combination of albisation and potassic alteration.
272.85	272.85	275.75							272.85 → 275.75m Black Shale with Minor Interbedded Epiclastics - Black shale has been chloritised and silicified - Occasional epiclastic units show alteration similar to above units.
275.75	275.75	278.5							275.75 → 278.5m Intensely Altered Polymict Breccia - Polymict breccia is dominated by felsic volcanic fragments - Alteration is intense silicification and albification, with some chlorite alteration. - Clasts are flattened and the matrix sponged due to intense hydrothermal alteration.
278.5	278.5	281.0							278.5 → 281.0m Altered Polymict Breccia - as for 253.1 - 255.7m above.
281.0	281.0	281.0							281.0 END OF HOLE

ASSAY INFORMATION

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906023

APPENDIX 3

CRD 86-1 Petrological Descriptions



Billiton Australia

The Metals Division of The Shell Company of Australia Limited

Your Reference

Our Reference

Date 12th January, 1987.

Tasmanian Office:
30 Mersey Main Road,
Spreyton, Tasmania 7310
P.O. Box 860
Devonport, Tasmania 7310
Telex: AA 59069 SHELL
Telephone: (004) 27 2296

Geochempet Services,
200 Chapel Hill Road,
CHAPEL HILL. qLDS.

Dear Stan,

These samples are from a recent drillhole in NW Tasmania. The hole was drilled into Mt. Read Volcanics about 14 kms north-north-east of Hellyer ore body. It is the first hole to be drilled in the area as far as we know.

Briefly rock distributions are as follows:

- 0 - 90m Black shale and graded Volcanogenic sandstones.
- 90 - 192 Massive dacite ?lava.
- 192 - 205 Black shale/siltstone.
- 205 - 207 Fine-med grained bedded epiclastic.
- 207 - 239 Massive polymict epiclastic breccia.
- 239 - 252 Black shale with minor med grained polymict breccia.
- 252 - 253 Fine-med grained bedded epiclastic
- 253 - 255.7 Massive polymict breccia.
- 255.7-256.4 Fine-med grained bedded epiclastic.
- 256.4-257 Massive polymict breccia.
- 257 - 265 Strongly altered epiclastic
- 265 - 273 Strongly altered breccia.
- 273 - 276 Black shale with minor fg epiclastics.
- 276 - 279 Strongly altered volcanic dominated breccia.
- 279 - 281 Altered polymict breccia.

All units beneath the massive dacite are altered to some degree, and it is this alteration in which we are interested.

A set of nine samples from the lower parts of the drill hole are enclosed for petrographic descriptions.

#13577 (192.8m): Different layers within the black shale/siltstone sequence are variably replaced by ?pyrite. Of particular interest are any compositional and/or textural differences between layers which may control preferential replacement and the mineralogy and textures of the sulphide replacement.

It would be appreciated if a polished thin section could be prepared with minimum damage to the good replacement textures in the remainder of the sample.

#13578 (189.8m): Dacite lava. Describe from thin section.

#13579 (206.25m): Altered f-med. grained bedded epiclastic. Of particular interest are details of the alteration assemblage. If fine grained opaque minerals are present in the matrix a polished section may be required.

#13580 (218.2m) These samples are of varying types and
#13581 (238.36m) intensity of alteration. Thin section
#13582 (256.65m) descriptions of alteration details and
#13583 (264.2m) clast type if possible would be appreciated.
#13584 (271.85m)
#13585 (278.8m)

It is envisaged that 1 polished thin section and 8 thin sections will be required. A polished section may be required to identify fine grained sulphides in the alteration matrix of sample #13579.

Yours faithfully,
for The Shell Company of Australia Ltd.

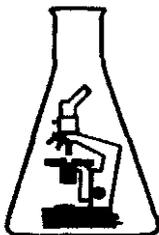
O. Hedditch

for Ian Gordon,
Geologist.

029

Geochempet Services

906027



PETROLOGICAL and GEOCHEMICAL CONSULTANTS

REGISTERED IN QUEENSLAND

Principal : A.S. Joyce B.Sc. (Hons), Ph.D.
200 Chapel Hill Road
Chapel Hill, Qld. 4069

Telephone: (07) 375 5258
AM 378 6467

PETROLOGICAL REPORT
ON NINE SAMPLES OF DRILL CORE
FROM THE MOUNT READ VOLCANICS

prepared for

BILLITON AUSTRALIA

Ref : I. Gordon

Stan Joyce

A. S. Joyce, B.Sc.(Hons), Ph.D.

2nd February, 1987.

SUMMARY COMMENTS

1. The sample 13577 is a laminated calcareous, carbonaceous shale with a mineralized reverse microfault and adjacent lobes of disseminated and semi-massive replacement by pyrite. Carbonaceous matter in the dark layers probably triggered initial deposition of pyrite, but it has proceeded into adjacent silty layers by replacement of carbonate.

The microfault carries a fissure filling of calcite-chlorite-pyrite-sphalerite-galena-chalcopyrite.

2. The sample 13578 is considered to be consistent with dacite lava, although no features were observed which would preclude the possibility of a subvolcanic intrusion. It has been heavily sericitized and carbonated and carries traces of disseminated pyrite. Several tight fracture veins are chloritic.

3. Six of the remaining seven samples show intense alteration to sericite and carbonate (calcite or slightly dolomitic carbonate) with accompanying rare to trace pyrite. No feldspar survives.

The other sample (13582) has also been intensely sericitized and carbonated, but in addition it carries chlorite in altered pumiceous clasts and in tight fractures. It has more pyrite than the other samples and some of it is associated with the chloritic veinlets.

4. In terms of source material the seven samples 13579 to 13585 appear to have been derived mainly from acid tuffaceous and pumiceous material, along with minor carbonaceous shale and a few fragments of acid lava.

The samples 13579, 13580 and 13581 have the most obviously epiclastic textures and are rich in phenoclasts of quartz. There is poor to moderate sorting, but textures are not far removed from those of unwelded tuff. They have been described as cobbly and pebbly volcanoclastic arenite.

The deeper samples 13582, 13583 and 13585 carry few phenoclasts of quartz and have textures quite similar to unwelded tuff : they have been described as pumiceous vitroclastic arenite. The sample 13584 has no phenoclasts or phenocrysts, but was some form of breccia prior to alteration : it may have consisted of fragments of pumice or glass.

Sample Number : 13577 (192.8m)

Identification : Laminated calcareous carbonaceous shale with a mineralized reverse microfault and adjacent lobes of pyritization

Description :

The sample is a 200mm slab of drill core which displays alternating layers of dark grey carbonaceous pelite and medium grey silty rock, about 1 to 15mm thick and orientated at about 80 degrees to the core axis. Running along the axis of the core there is a microfault which carries a thin vein. The microfault has a reverse displacement of about 1 or 2mm. At intermittent locations along the fault fine replacement pyrite has spread for distances of about 5 to 20mm into the adjacent rock. Preferential replacement has occurred along some, but not most carbonaceous layers. Where there are packets of fine laminations dominated by carbonaceous rock there are smooth lobes of major replacement embracing both carbonaceous and silty layers.

In polished thin section the sample is seen to consist of laminated, richly calcareous shale with alternating silty and finely carbonaceous layers. The silt grains are angular quartz, about 0.01 to 0.05mm in size. The carbonate is anhedral and about 0.03mm in grain size. Sericite is abundant, but difficult to distinguish quantitatively from the carbonate. Carbonaceous specks and wisps are less than about 0.01mm in size.

An approximate mode of typical silty layers is :

40-50%	sericite
35-45%	carbonate
5-10%	quartz
0.1%	carbonaceous matter

An approximate mode of typical carbonaceous layers is :

60-70%	sericite
20-30%	carbonate
5-7%	carbonaceous matter
3-4%	quartz

The vein which occupies the reverse microfault is about 0.5 to 1mm wide. It contains anhedral carbonate and plates of chlorite, about 0.1 to 0.2mm in grain size, and a discontinuous core of sulphides. The sulphides include subhedral pyrite (about 0.02 to 0.1mm), anhedral translucent grey to yellowish sphalerite (about 0.05 to 0.1mm), minor anhedral galena (about 0.1mm) and a few grains of chalcopyrite (0.03 to 0.1mm). The sulphide grains occur variously alone or interlocked, but show no obvious replacement or exsolution intergrowths.

The lobes of sulphide replacement projecting from the veined fault are seen to consist of abundantly disseminated subhedral cubes of pyrite, generally about 0.05 to 0.1mm in grain size within the affected least carbonaceous layers and about 0.02 to 0.03mm in size within the obviously carbonaceous layers. The pyrite is not only finer, but more abundant in the carbonaceous layers : semimassive abundances of about 60% are attained in some carbonaceous layers and about 40% in adjacent silty layers. Carbonate is depleted in the mineralized layers.

Comments and Interpretations :

This specimen is interpreted to consist of laminated calcareous carbonaceous shale cut by a reverse microfault with adjacent lobes of replacement pyrite. The fault is occupied by a thin fissure vein of calcite and chlorite with a central core of pyrite, sphalerite and minor galena and chalcopyrite. The lobes of replacement by pyrite appear to have initiated along some of the carbonaceous layers, but the replacement has also spread into adjacent layers of more silty, much less carbonaceous shale. Carbonate has been replaced but it seems that the presence of carbonaceous matter has triggered initial reaction. The carbonaceous layers have yielded the most pyrite rich, but finest replacements : pyrite is coarser, but more disseminated in the silty layers.

Sample Number : 13578
Identification : Heavily sericitized and carbonated
 porphyritic dacite

Description :

The sample is a drill core specimen of abundantly, finely porphyritic, light olive grey, altered volcanic rock. It is cut by several thin dark veins.

A cobaltinitrite staining test revealed no K-feldspar.

In thin section the sample is seen to be heavily altered, but its primary textures are of abundantly porphyritic volcanic style. Numerous subhedral, altered phenocrysts, about 0.3 to 1.5mm in size, are set in an allotriomorphic, altered groundmass with primary grainsizes of about 0.1mm.

The main phenocrysts have tabular and prismatic shapes, now pseudomorphed by fine sericite and carbonate. There are also several possible amygdales, up to 1.5mm in size, composed of sericite and carbonate with a few stumpy, drusy crystals of quartz. Small phenocrysts of inferred titaniferous magnetite or ilmenite have been converted to barely translucent leucoxene. The groundmass consists of clear equant grains of quartz, heavily sericitized grains of untwinned plagioclase, some anhedral carbonate and a few specks of leucoxene.

Small, multifaceted grains of pyrite (less than 0.06mm) are disseminated sparsely through the rock.

The dark vein is a very narrow (0.02 to 0.2mm) fracture vein carrying chlorite, leucoxene, calcite and sericite.

An approximate mode is :

25-35%	remnant plagioclase
20-30%	sericite
20-30%	quartz
15-20%	carbonate (probably calcite)
0.2-0.3%	leucoxene
0.1%	pyrite
0.1%	vein chlorite-leucoxene-calcite-sericite

Comments and Interpretations :

This rock is interpreted to have originated as abundantly porphyritic dacite, probably lava. There are several small, possible amygdales.

Heavy hydrothermal alteration has completely altered inferred feldspathic and mafic silicate phenocrysts to sericite and carbonate and opaque oxides to leucoxene. The groundmass feldspar has been heavily, but incompletely altered. There are traces of fine, disseminated pyrite. Several tight fractures have generated thin veins with chlorite-leucoxene-calcite-sericite.

Sample Number : 13579 (206.25m)

Identification : Intensely sericitized and carbonated
moderately sorted, volcanoclastic arenite

Description :

The sample is a drill core specimen of moderately sorted, sandy textured, speckled light and medium grey rock.

A staining test revealed no K-feldspar.

In thin section the sample is seen to be intensely sericitized and carbonated, but its primary textures involve densely packed, moderately sorted clasts, about 0.2 to 2mm in size.

There are many unaltered clasts of quartz, with smoothly corroded but broken shapes. Some other clasts have broken, tabular shapes, suggestive of feldspar, but they have been completely altered to sericite and carbonate. Other clasts are of angular or cusped shape, with textures suggestive of lithic clasts and possibly unwelded vitric shards, now altered to sericite, carbonate, leucoxene, sphene and fine quartz. There are a few small clasts of sericitic and carbonaceous black shale.

Pyrite occurs sparsely as nodular aggregates (about 0.4 to 1.5mm in size) of subhedral crystals (about 0.02 to 0.07mm grains).

An approximate mode is :

30-35%	clasts of quartz
0.5-1%	clasts of black shale
35-40%	sericite
15-20%	carbonate
10-15%	fine quartz
0.2-0.3%	sphene and leucoxene
0.1%	pyrite

Comments and Interpretations :

This sample has moderately sorted textures of immature epiclastic style. It may be described as volcanoclastic arenite, having originated as an assemblage of phenoclasts, lithic clasts of acid volcanic and tuffaceous rock and black shale, and some possible vitric shards.

Intense alteration has converted all labile components to sericite, carbonate and minor leucoxene and sphene. Most of the carbonate appears to be calcite, but some grains have a higher relief, suggesting a dolomitic or ankeritic component. Traces of pyrite are present as tiny nodules.

Sample Number : 13580 (218.2m)

Identification : Intensely sericitized and carbonate, cobbly
volcaniclastic arenite

Description :

The sample is a drill core specimen of poorly sorted, volcaniclastic rock with many ragged clasts of pumiceous or vitric style and part of an 80mm clast of rock with similar internal textures. Colours are light and medium grey with conspicuous patches and wisps of a moderate yellow green, sericitic mineral and less obvious very light grey patches of carbonate.

In thin section the large clast is seen to be intensely carbonated tuff, displaying broken phenocrasts of quartz, and completely sericitized clasts scattered through an allotriomorphic mosaic of carbonate (0.1 to 0.2mm grainsize).

The host to the large clast displays poorly sorted, volcaniclastic textures and intense alteration to sericite-carbonate. Clasts are mainly 0.1 to 5mm and include angular mineral clasts and ragged clasts of formerly tuffaceous or pumiceous style. The only unaltered clasts are smoothly corroded and broken grains of quartz. All others have been intensely altered to sericite, subordinate carbonate, fine quartz and traces of sphene.

There are rare grains (less than 0.1mm) and small aggregates of subhedral pyrite.

An approximate mode is :

20-30%	clasts of quartz
30-35%	sericite
25-30%	carbonate
10-15%	fine quartz
0.1-0.2%	sphene
rare	pyrite

Comments and Interpretations :

This rock is interpreted to have originated as a poorly sorted, epiclastic accumulation of angular phenocrasts, acid tuffaceous or pumiceous fragments and lithic clasts up to at least cobble size. Since the specimen is dominated by sand sized clasts, description as cobbly volcaniclastic arenite seems more correct than the exaggerated field term "breccia" which implies a dominance of clasts coarser than sand size.

The rock has experienced intense alteration to sericite and carbonate along with some sphene and rare grains of pyrite. Only quartz phenocrasts and possibly some fine matrix quartz survive as primary components.

Sample Number : 13581 (238.36m)

Identification : Intensely sericitized and carbonated, pebbly volcaniclastic arenite

Description :

The sample is a drill core specimen which displays subangular pebbles (about 3 to 30mm) of pale olive volcanic rock, greenish yellow altered pumice and black shale scattered through a pale olive and light grey, sandy matrix.

A staining test revealed no K-feldspar.

In thin section the sample is seen to be intensely altered, but primary textures involve densely packed, poorly sorted angular clasts of sand and pebble size (about 0.2 to 30mm). Smoothly corroded and broken phenoclasts of quartz range up to about 4mm in size. Stringy, richly sericitic clasts of pumiceous and tuffaceous style variously carry a few phenocrysts and phenoclasts of quartz, sericitized and carbonated inferred feldspar, and sphene aggregates after inferred titaniferous magnetite or ilmenite. Less ragged clasts resemble sericitized and carbonated dacite with phenocrysts and altered phenocrysts set in a groundmass of sericite and fine quartz. There are several small clasts of sericitic black shale.

A few grains of euhedral pyrite (less than 0.03mm) occur mainly within a fragment of tuff which has small sericitized clasts set in a finely siliceous matrix.

An approximate mode is :

20-25%	phenoclasts and phenocrysts of quartz
0.3-0.6%	clasts of black shale
35-45%	sericite
20-25%	carbonate
10-20%	fine quartz
0.1-0.2%	sphene
rare	pyrite

Comments and Interpretations :

This rock is interpreted to have originated as a poorly sorted, epiclastic accumulation of angular phenoclasts, acid pumiceous and tuffaceous clasts, dacitic clasts and black shale clasts. Pebbly volcaniclastic arenite seems an appropriate description.

The rock has experienced intense alteration to sericite and carbonate, along with traces of sphene and rare grains of pyrite. Only quartz phenoclasts and phenocrysts and fine groundmass quartz survive as primary components.

Sample Number : 13582 (256.65m)

Identification : Intensely sericitized and carbonated, pumiceous vitroclastic arenite with traces of disseminated pyrite and veinlets of chlorite-pyrite

Description :

The sample is a drill core specimen of poorly sorted tuffaceous detritus. Many dark greenish grey, altered pumiceous or vitric wisps, about 1 to 15mm long, are scattered through a pale olive matrix.

A staining test revealed no K-feldspar.

In thin section the sample is seen to be intensely altered, but there are obvious remnant textures which appear consistent with clasts of former pumice scattered through a vitroclastic matrix of unwelded, large, formerly vitric shards (about 0.3 to 0.7mm in size). A 4mm clast of sericitic black shale, several quartz phenoclasts (up to 0.3mm) and some leucoxenized crystals of former titaniferous magnetite or ilmenite (0.3mm) are visible.

The largest, pumiceous clasts consist of sericite and minor chlorite. The inferred vitric clasts have cusped shapes and are composed of fine sericite and variable amounts of carbonate : they are set in a very finely siliceous matrix (less than 0.01mm grainsize).

The rock is cut by a subtle pattern of fracture-controlled replacement veins (up to about 0.2mm wide) carrying chlorite and pyrite. Additional pyrite occurs as disseminated subhedral grains, about 0.02 to 0.2mm in size.

An approximate mode is :

0.1%	clasts of quartz
0.1%	clasts of black shale
35-45%	sericite
30-35%	fine quartz
20-25%	carbonate
4-6%	chlorite
0.2-0.3%	pyrite
0.1-0.2%	leucoxene

Comments and Interpretations :

Textures indicate that this rock originated as an unwelded assemblage of coarse vitric shards, pumice and a few phenoclasts and lithic clasts of black shale. Unwelded pumiceous vitric tuff or pumiceous vitroclastic arenite would be adequate terms to describe the thin section characteristics.

The rock has been intensely altered to sericite, carbonate, very fine quartz, chlorite and leucoxene. It has also been fractured in a subtle fashion and veined by chlorite with pyrite. Additional pyrite occurs as disseminated grains.

Sample Number : 13583 (264.2m)

Identification : Intensely sericitized and carbonated,
pumiceous vitroclastic arenite

Description :

The sample is a drill core specimen of foliated, dominantly pale olive, sericitic rock with finely pebbly, tuffaceous textures. Several clasts of black shale are recognisable and there are some patches of very light grey carbonate alteration.

A staining test revealed no K-feldspar.

In thin section the sample is seen to consist of a few clasts of sericitic black shale, some sericitized pumiceous clasts and phenoclasts of quartz (up to 1mm) set in a sericitized and finely siliceous, vitroclastic matrix composed originally of unwelded but aligned, cusped vitric shards, about 0.2mm in size. Anhedral carbonate occurs as irregular replacement patches. There are a few leucoxene and sphene replacements of former opaque oxides and a few grains (0.02 to 0.1mm) and aggregates (up to 1mm) of pyrite.

An approximate mode is :

4-5%	clasts of quartz
0.4-0.6%	clasts of black shale
50-60%	sericite
25-30%	fine quartz
10-15%	carbonate
0.1%	leucoxene and sphene
tr	pyrite

Comments and Interpretations :

This sample has textures consistent with pumiceous unwelded vitric tuff but there are some pebbles of black shale which support the concept that deposition involved epiclastic rather than purely pyroclastic processes. The specimen carries more phenoclasts than that sample 13582, but its matrix is more finely vitroclastic and the aligned small shards impart a foliated appearance.

Intense alteration has generated sericite, carbonate, very fine quartz, sphene and leucoxene, but no chlorite. Pyrite is present in very low abundance.

Sample Number : 13584 (271.85m)

Identification : Carbonate veined, intensely sericitized
breccia with faint hematitic pigmentation

Description :

The sample is a drill core specimen of light olive grey, intensely altered rock with irregular pale reddish brown patches and other patches and veins of very light grey carbonate.

A staining test revealed no K-feldspar.

In thin section the sample displays ghosted textures suggestive of former angular to irregular clasts of at least pebble size. Details have been blurred by intense alteration to fine sericite, fine quartz (0.01 to 0.03mm), some faint hematitic pigment (in the quartz) and replacement patches and veins of anhedral carbonate (0.1 to 1mm grainsize). Several grains (less than 0.2mm) of pyrite occur in a carbonate vein.

An approximate mode is :

55-65%	sericite
30-35%	quartz
5-8%	carbonate
tr	hematite pigment
rare	pyrite

Comments and Interpretations :

This sample has vague, angular pebbly textures but no phenoclasts or phenocrysts. It is possible that it was composed solely of large fragments of pumice or glass. Primary textures have been obscured by intense alteration to sericite and quartz (some faintly hematite pigmented). Carbonate is less abundant than it is in the other samples. There are only rare grains of pyrite, occurring in carbonate veins.

Sample Number : 13585 (278.8m)
Identification : Intensely sericitized and carbonated,
 pumiceous vitroclastic arenite
Description :

The sample is a foliated sample of poorly sorted, wispy, pale olive and minor medium grey, volcanoclastic detritus.

A staining test revealed no K-feldspar.

In thin section the sample is seen to be intensely altered and has an incipient sericitic foliation, but remnant primary textures involve densely packed, poorly sorted, angular and irregular clasts of vitroclastic, pumiceous and lithic style, about 0.2 to at least 4mm in size.

The pumiceous clasts are intensely sericitized and some have been streaked. The lithic clasts include obvious sericitized and carbonated tuff, sericitic carbonaceous shale and possible acid lava with intense sericitization and carbonate development. Much of the matrix has a crudely vitroclastic appearance and consists of sericite, fine quartz and patches of carbonate. Leucoxene is common as patches and streaks. There are only a very few, generally small clasts of quartz (less than 0.5mm).

Fine (0.01 to 0.02mm), subhedral pyrite is disseminated throughout the rock.

An approximate mode is :

0.1-0.2%	clasts of carbonaceous slate
tr	clasts of quartz
50-60%	sericite
25-35%	fine quartz
10-15%	carbonate
0.2-0.3%	leucoxene
0.1-0.2%	pyrite

Comments and Interpretations :

This sample is regarded as a poorly sorted sediment composed mainly of acid vitroclastic and pumiceous debris.

Intense alteration has produced an assemblage of sericite, carbonate, very fine quartz, and traces of leucoxene and disseminated pyrite.

Like sample 13582 this specimen carries very few phenoclasts.

006

E.L. 36/79

LOONGANA

906039

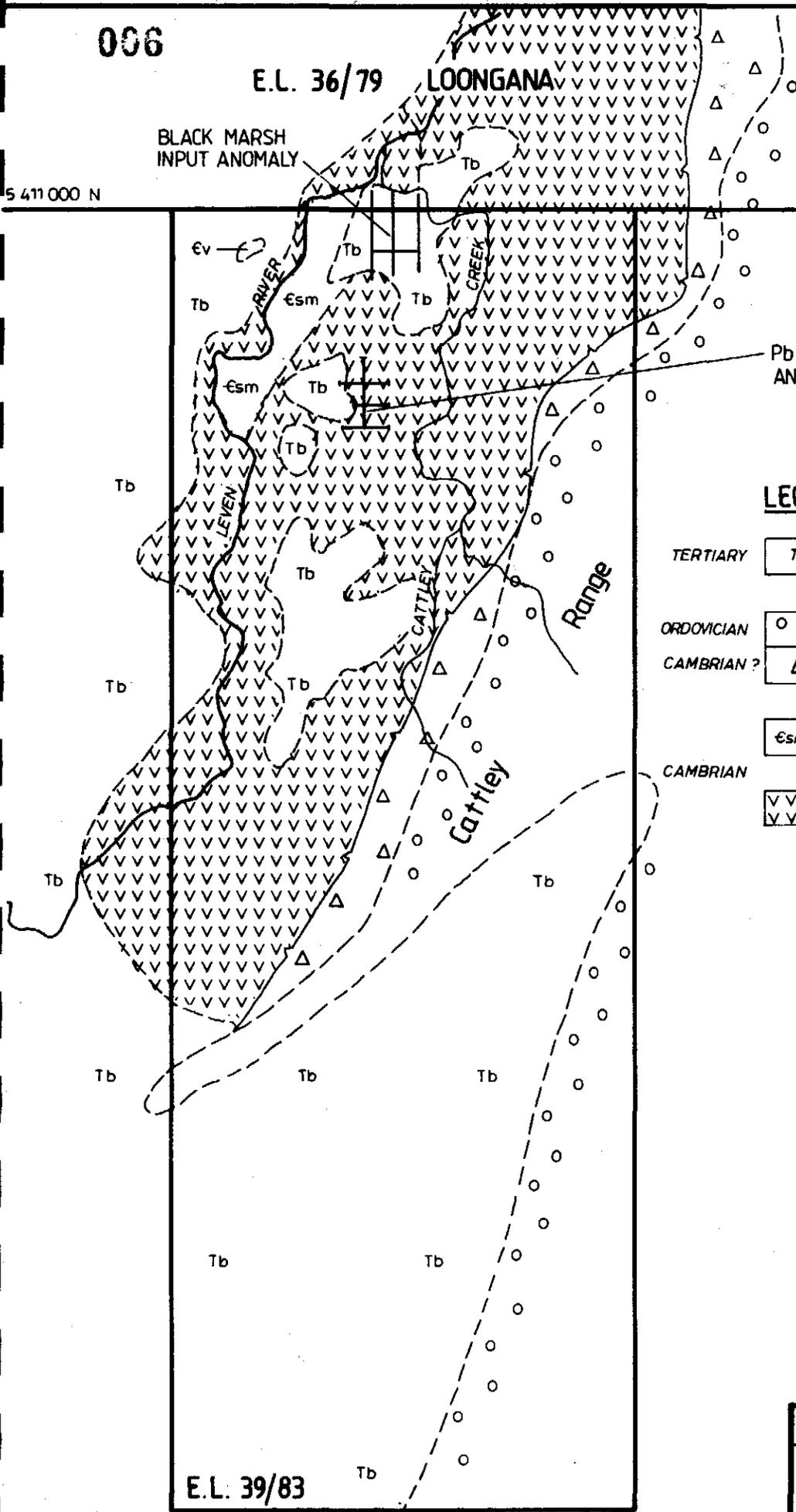
5 411 000 N

BLACK MARSH
INPUT ANOMALY

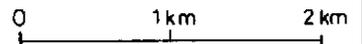
Pb, Zn STREAM SEDIMENT
ANOMALY

LEGEND

- TERTIARY Tb BASALT
- ORDOVICIAN ○ ○ OWEN CONGLOMERATE
- CAMBRIAN? △ JUKES BRECCIA EQ.
- εsm ? QUE RIVER BEDS
- CAMBRIAN ▽▽▽▽ VOLCANICS.



E.L. 39/83

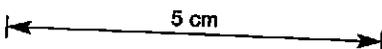


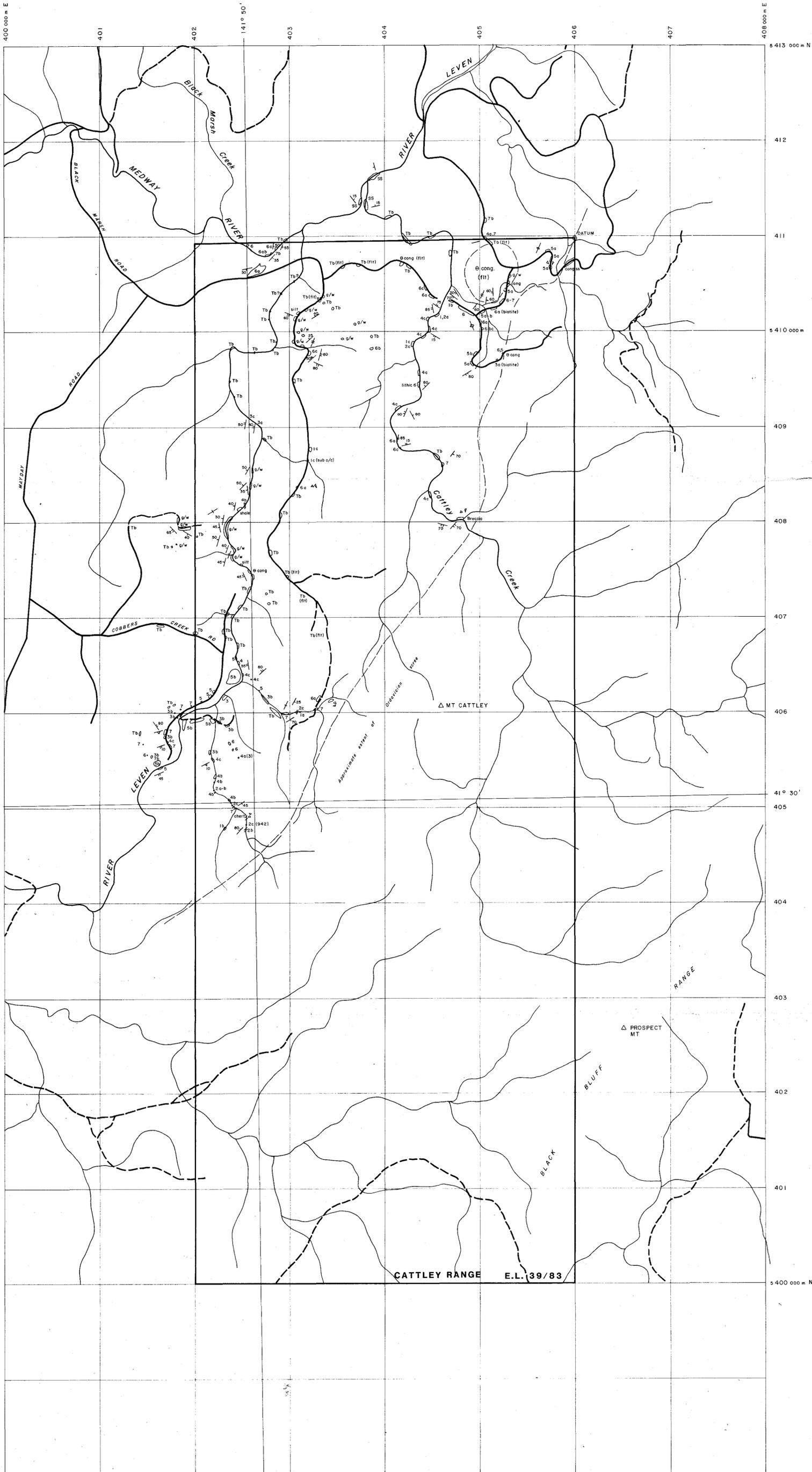
The Shell Company of Australia Limited
METALS DIVISION

E.L. 39/83 CATTLEY RANGE
GEOLOGY

SCALE 1:50000	DATE 23-12-83
AUTHOR WDS.	DRAWN J.L.L.
OFFICE D'PORT	REP.No.
DRG.No. 0/L051/012	FIG.No. 2

402 000 E





LITHOLOGIES

Tertiary

Tb Basalt

Ordovician (O)

cong Conglomerate

ss Sandstone

silt Siltstone

g/w Greywacke

Cambrian

- 1 Quartz phytic lava
- 2 Quartz phytic tuff
- 3 Quartz feldspar phytic lava
- 4 Quartz feldspar phytic tuff
- 5 Feldspar phytic lava
- 6 Feldspar phytic tuff
- 7 Fine grained tuff - sediment

/ss Bedding

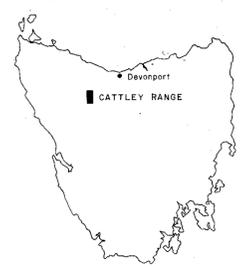
/so Schistosity

/ Jointing

flr Float

Grain Size

- a > 3 mm
 - b 1 - 3 mm
 - c < 1 mm
 - 4y Coarse lapilli
- 925 Rock sample, number



5 cm

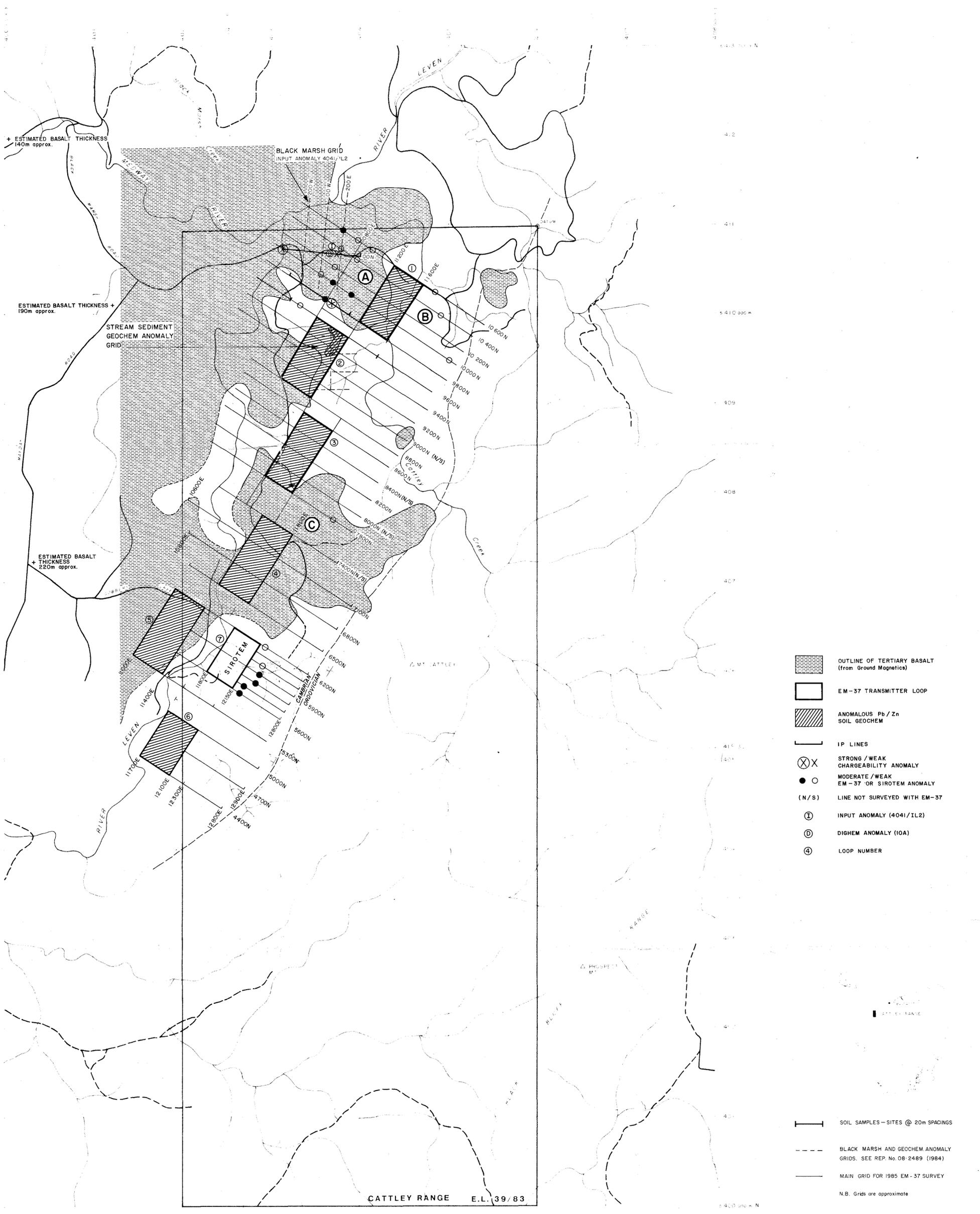
0 1 2 Km

906040

Billiton Australia			
Project CATTLEY RANGE			
N.W. TASMANIA			
Title OUTCROP GEOLOGY			
Author NH, DC	Dept.	Scale 1:20,000	
Drawn AS	Date 3/85	Revised	Date
Checked	Date	S'ced	Date
Sheet No.	FIG. 3	Drawing No.	LD 51 / 1008

4688

87-2682



-  OUTLINE OF TERTIARY BASALT (from Ground Magnetica)
-  ANOMALOUS Pb / Zn SOIL GEOCHEM
-  STREAM SEDIMENT GEOCHEM ANOMALY
-  IP LINES
-  STRONG / WEAK CHARGEABILITY ANOMALY
-  MODERATE / WEAK EM - 37 OR SIROTEM ANOMALY
-  (N/S) LINE NOT SURVEYED WITH EM-37
-  INPUT ANOMALY (4041/IL2)
-  DIGHEM ANOMALY (10A)
-  LOOP NUMBER

-  SOIL SAMPLES - SITES @ 20m SPACINGS
-  BLACK MARSH AND GEOCHEM ANOMALY GRIDS. SEE REP. No. 08-2489 (1984)
-  MAIN GRID FOR 1985 EM - 37 SURVEY
- N.B. Grids are approximate

CATTLEY RANGE E.L. 39/83

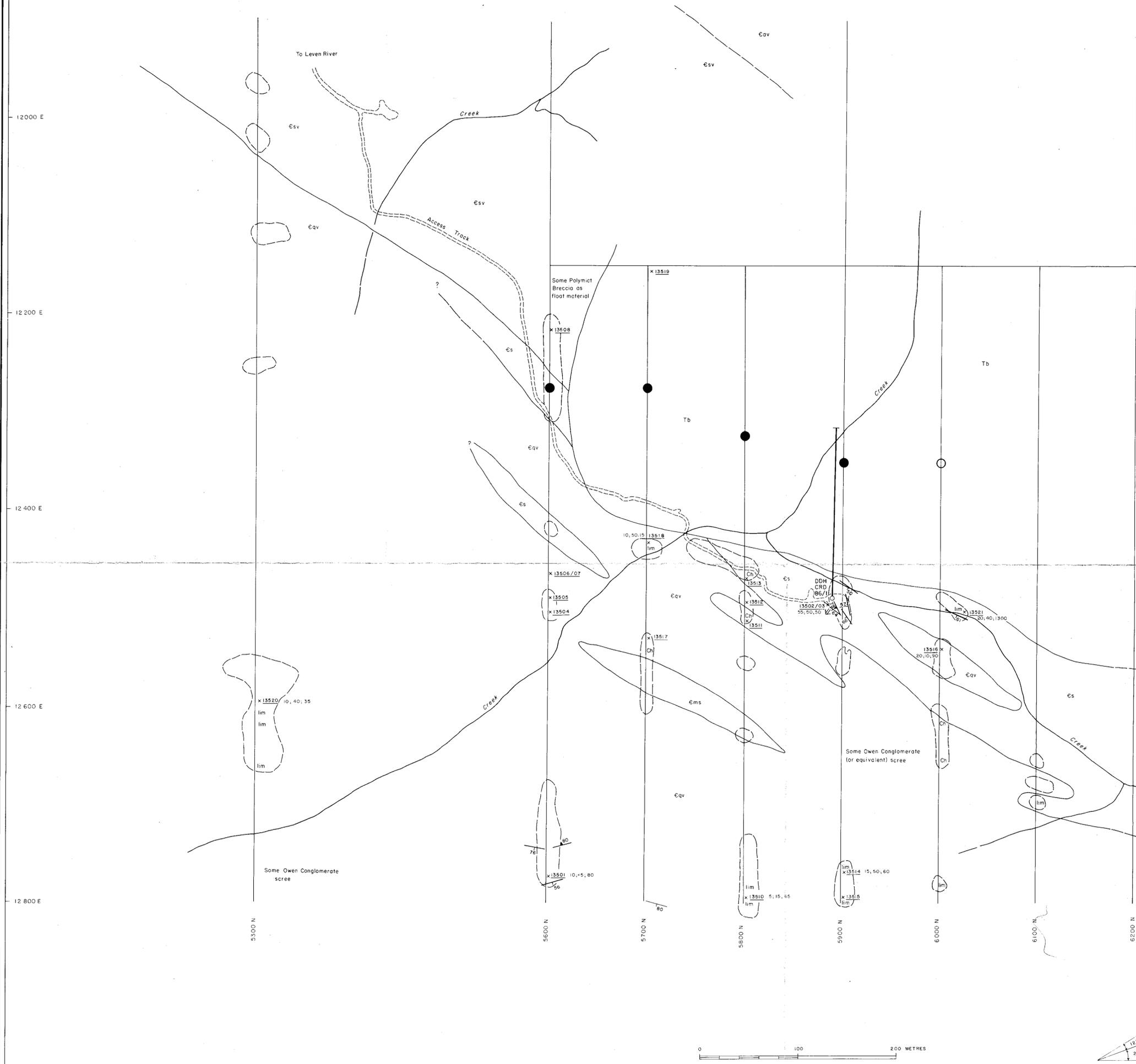
906041

**CATTLEY RANGE
N.W. TASMANIA
GEOPHYSICAL
SUMMARY PLAN**

N.H.	A.H.O.	Scale	1:20,000
H.M.R.	1/86	Drawn	Date
		Checked	Date
FIG. 4		Drawing No.	LDSI/1019

4689

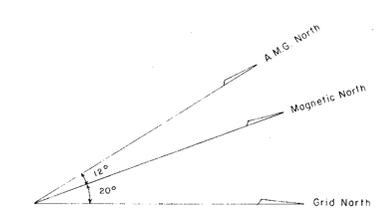
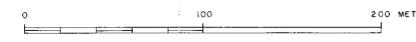
87-2682



- LEGEND**
- TERTIARY**
- Tb Basalt
- CAMBRIAN**
- Eqv Quartz phytic volcanics
 - Ems Quartz rich sandstone
 - Es Ashy siltstones, black shales (pyritic) and volcaniclastic sandstones
 - Esv Silicified fine grained felsic lava
 - Ecv Feldspar (quartz) phytic volcanic
- Bedding
 Cleavage
 Limonite staining
 Chert
 Outcrop
 Geological contact - position approximate
 Geological contact - position inferred
 Younging direction: based on primary sedimentary structures
 Rock chip sample locality
 Rock chip analysis (Cu, Pb, Zn - in ppm)
 EM 37 Anomaly (strong/weak) from 1985 survey

906042

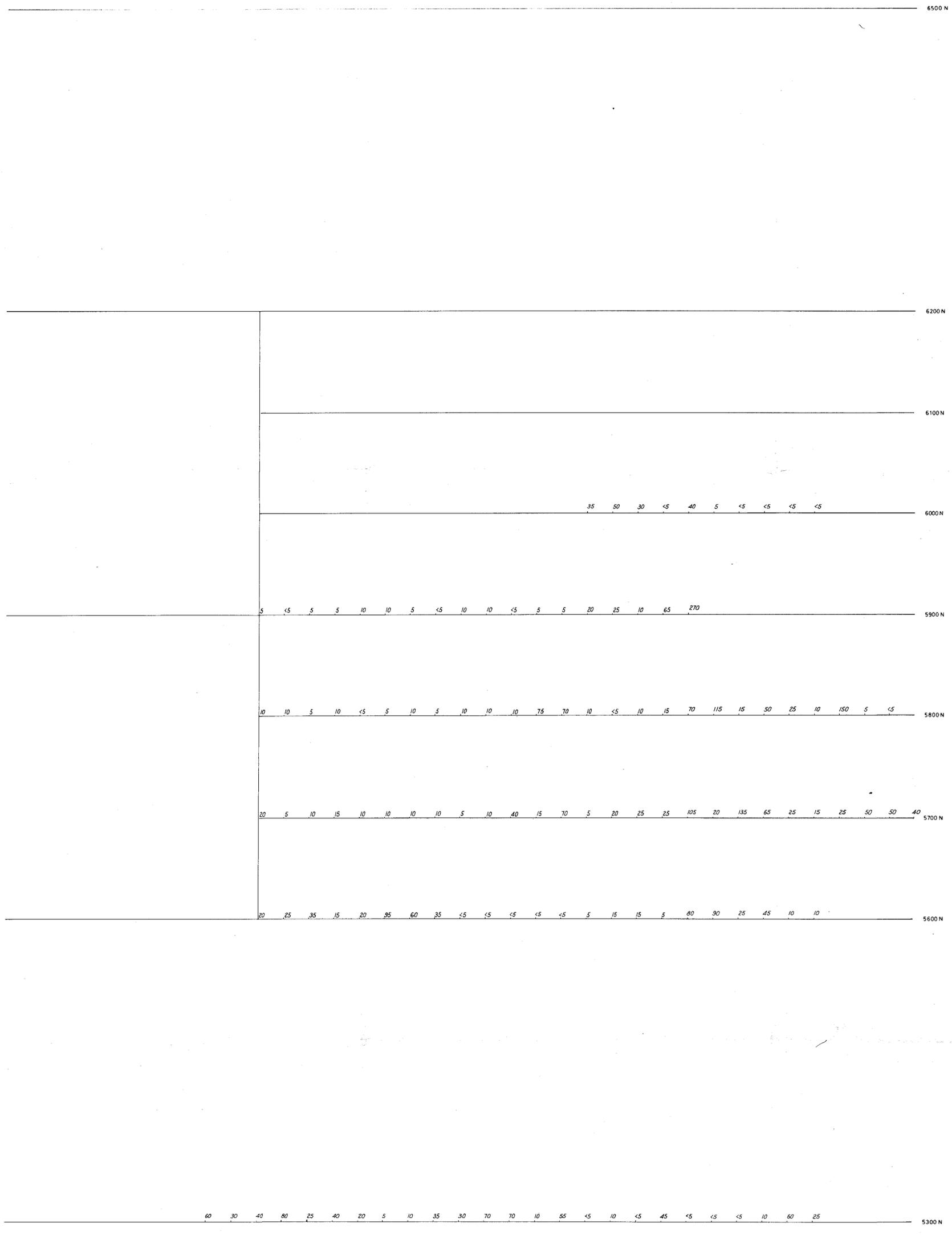
5 cm



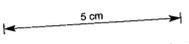
87-2682

Billiton Australia			
Project N.W. TASMANIA CATTLEY RANGE			
Title ANOMALY 5A INTERPRETED GEOLOGY			
Author IFG	Dept. TAS	Scale 1:2000	
Drawn AS	Date 1/87	Revised	Date
Checked	Date	S'ceded	Date
Sheet No.	FIG. No. 5	Drawing No.	LD 51 / 1027

4690



906044



87-2682

 The Metals Division of the Shell Company of Australia Limited			
Project CATTLEY RANGE			
Title ANOMALY 5A Pb ASSAY VALUES			
Author	D B H	Dept.	Scale 1:2000
Drawn	O.H.	Date 1/87	Revised Date
Checked	Date	S'ceded	Date
Sheet No.	FIG. No. 7	Drawing No. D/LD51/019	

4892

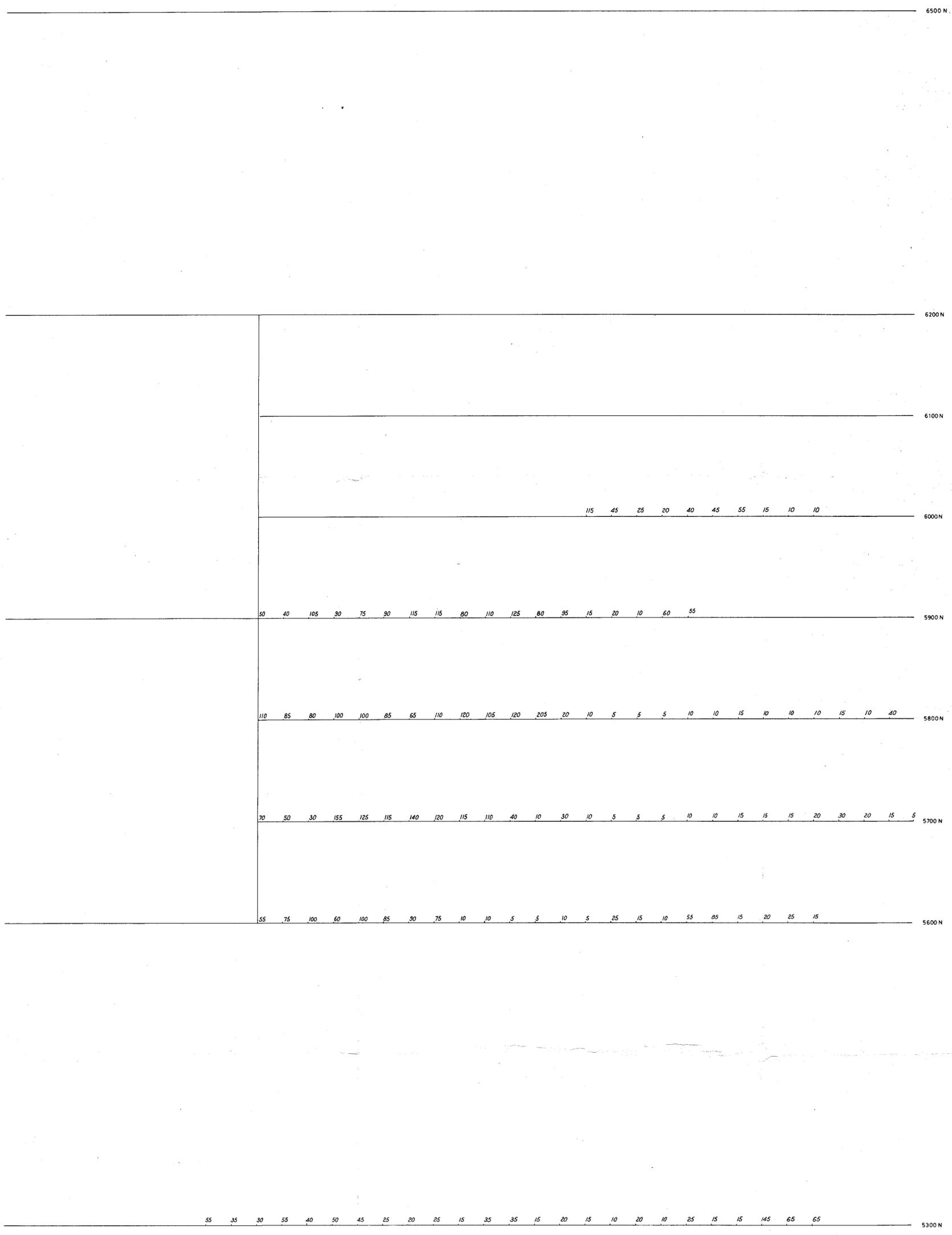
12000 E

12200 E

12400 E

12600 E

12800 E



906045

87-2682

 The Metals Division of the Shell Company of Australia Limited			
Project CATTLEY RANGE			
Title ANOMALY 5A Zn ASSAY VALUES			
Author	D. B. H.	Dept.	Scale 1:2000
Drawn	O. H.	Date 1/87	Revised Date
Checked	Date	S'ceded	Date
Sheet No.	FIG. No. 8	Drawing No.	0/LD 51/020

4693

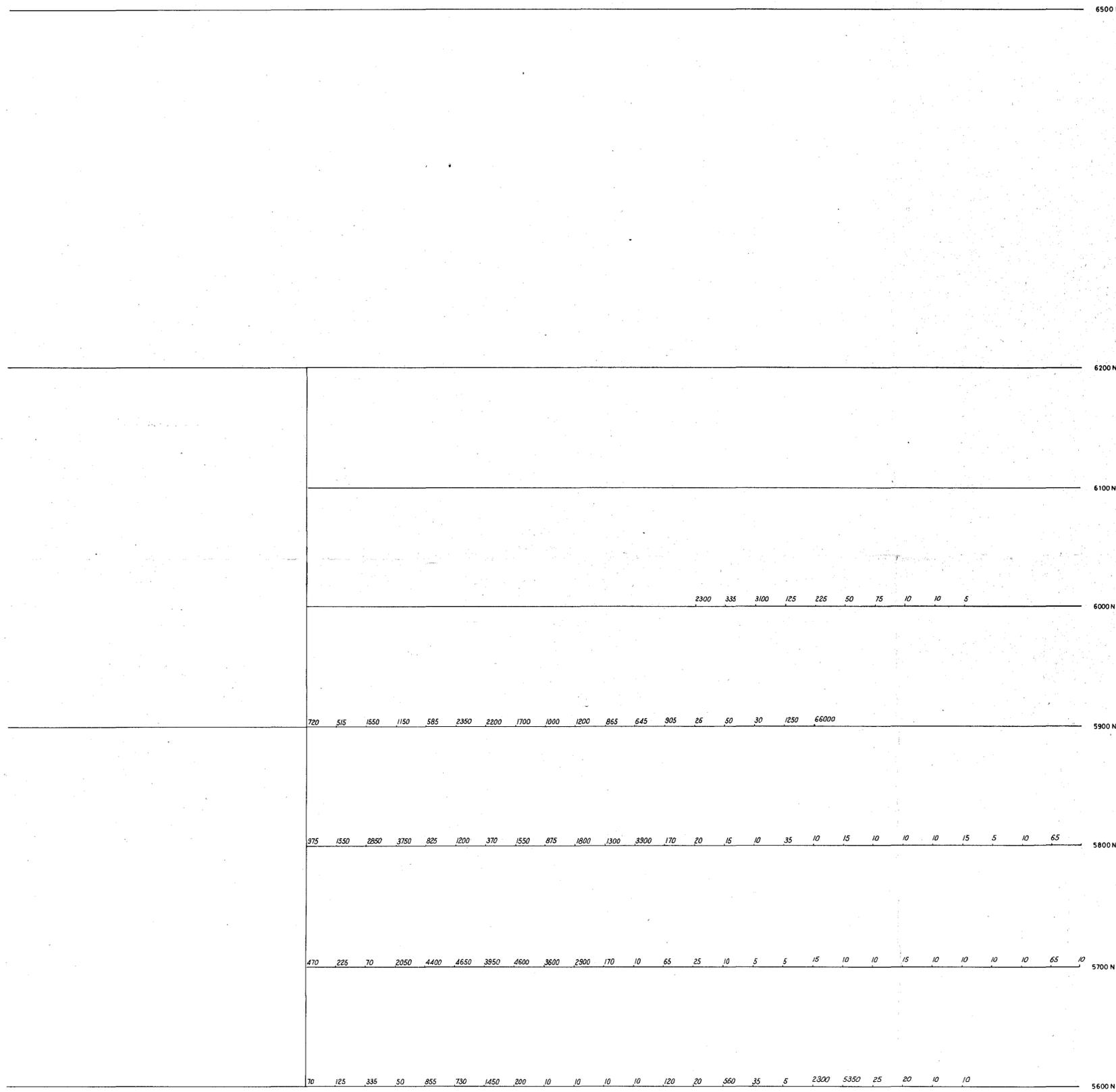
12000 E

12200 E

12400 E

12600 E

12800 E



50 35 30 220 60 60 30 20 25 45 25 220 125 20 20 20 10 20 15 10 15 10 1500 100 85

2300 335 3100 125 225 50 75 10 10 5

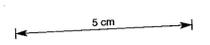
720 515 1550 1150 585 2350 2200 1700 1000 1200 865 645 905 25 50 30 1250 66000

975 1550 2850 3750 825 1200 370 1550 875 1800 1300 3900 170 20 15 10 35 10 15 10 10 10 15 5 10 65

470 225 70 2050 4400 4650 3850 4600 3600 2900 170 10 65 25 10 5 5 15 10 10 15 10 10 10 65 10

70 125 335 50 855 730 1450 200 10 10 10 10 120 20 560 35 5 2300 5350 25 20 10 10

906046



87-2682

 Billiton Australia <small>The Metals Division of the Shell Company of Australia Limited</small>	
Project	CATTLEY RANGE
Title	ANOMALY 5A Mn ASSAY VALUES
Author	D. B. H. Dept.
Scale	1:2000
Drawn	O. H. Date
Revised	Date
Checked	Date
S'ceded	Date
Sheet No.	FIG No. 9
Drawing No.	D / LD 51/021

4694

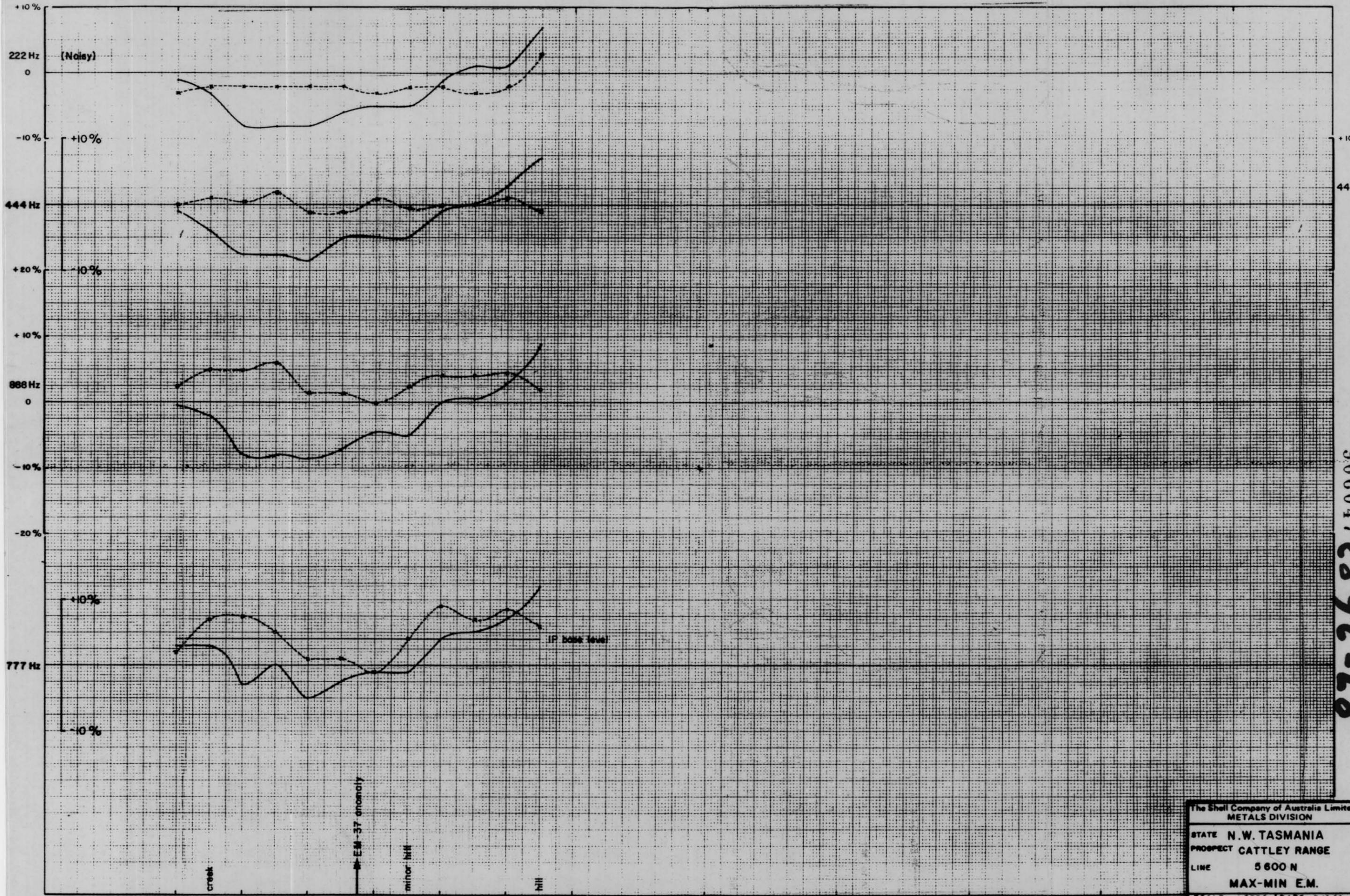
12000 E

12200 E

12400 E

12600 E

12800 E



5 cm

200 metres

Coil Separation = 204m

—●— In Phase Rx to west
 - - - - - Out of Phase

4695

The Shell Company of Australia Limited METALS DIVISION	
STATE N.W. TASMANIA	
PROSPECT CATTLEY RANGE	
LINE 5600 N	
MAX-MIN E.M.	
SCALE 1:5000	DATE 3-10-66
AUTHOR N.H.	DRAWN
OFFICE AMO	REP.No.
DRG.No. 08/1028	FIG.No. 10

9060472892.48

12300E

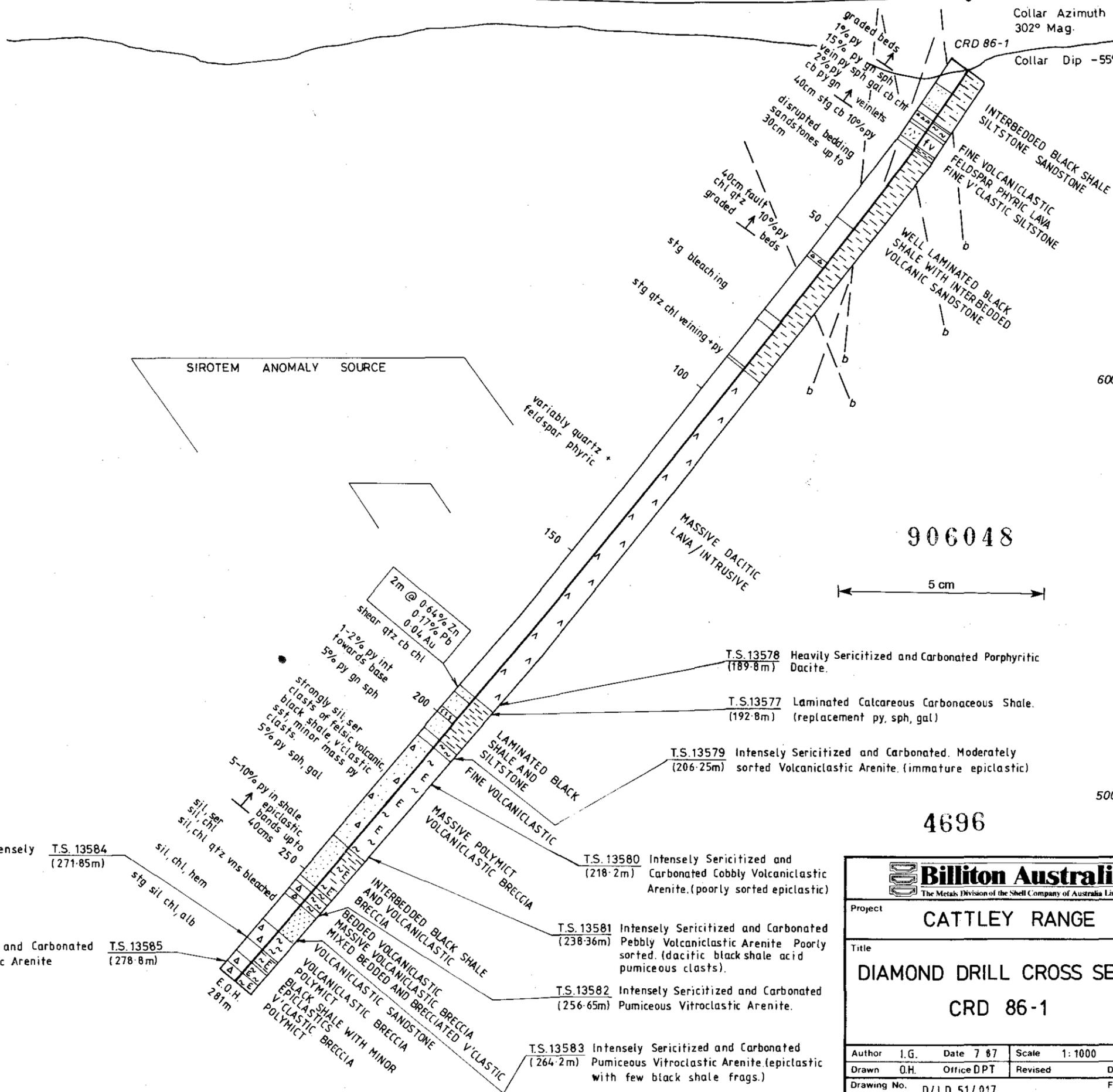
12400E

12500E

Collar Coordinates
405958N 403025E

Collar Azimuth
302° Mag.

Collar Dip -55°



906048

4696

600m RL

500m RL

Carbonated veined intensely Sericitized Breccia T.S. 13584 (271-85m)

Intensely Sericitized and Carbonated Pumiceous Vitroclastic Arenite T.S. 13585 (278-8m)

T.S. 13578 Heavily Sericitized and Carbonated Porphyritic Dacite. (189-8m)

T.S. 13577 Laminated Calcareous Carbonaceous Shale. (192-8m) (replacement py, sph, gal)

T.S. 13579 Intensely Sericitized and Carbonated. Moderately sorted Volcaniclastic Arenite. (immature epiclastic) (206-25m)

T.S. 13580 Intensely Sericitized and Carbonated Cobbly Volcaniclastic Arenite. (poorly sorted epiclastic) (218-2m)

T.S. 13581 Intensely Sericitized and Carbonated Pebbly Volcaniclastic Arenite Poorly sorted. (dacitic black shale acid pumiceous clasts). (238-36m)

T.S. 13582 Intensely Sericitized and Carbonated Pumiceous Vitroclastic Arenite. (256-65m)

T.S. 13583 Intensely Sericitized and Carbonated Pumiceous Vitroclastic Arenite. (epiclastic with few black shale frags.) (264-2m)

87-2682

Billiton Australia <small>The Metals Division of the Shell Company of Australia Limited</small>			
Project		CATTLEY RANGE	
Title		DIAMOND DRILL CROSS SECTION CRD 86-1	
Author	I.G.	Date	7 87
Scale	1:1000		
Drawn	O.H.	Office	DPT
Revised	Date		
Drawing No.	D/LD 511/017		Fig. No. 11

906049

Billiton Australia
The Metals Division of the Shell Company of Australia Limited

SIROTEM SURVEY

AREA CATTLEY RANGE

LINE NO 1

DH No ^{OR} DH CRD-1

COLLAR: 5900N, 12490E

LOOP CONFIG No.5

LOOP DIMENSION-200 x 250m

EARLY TIMES

STATION INTERVAL 5m

STACKS 2° below, 2° above 200m

SPHERICS

INST. SERIAL NO SIROTEM MK I

OPERATOR RD/NH

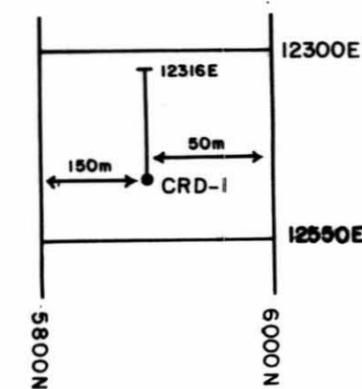
DATE 18/3/87

2.5 amps into Tx loop

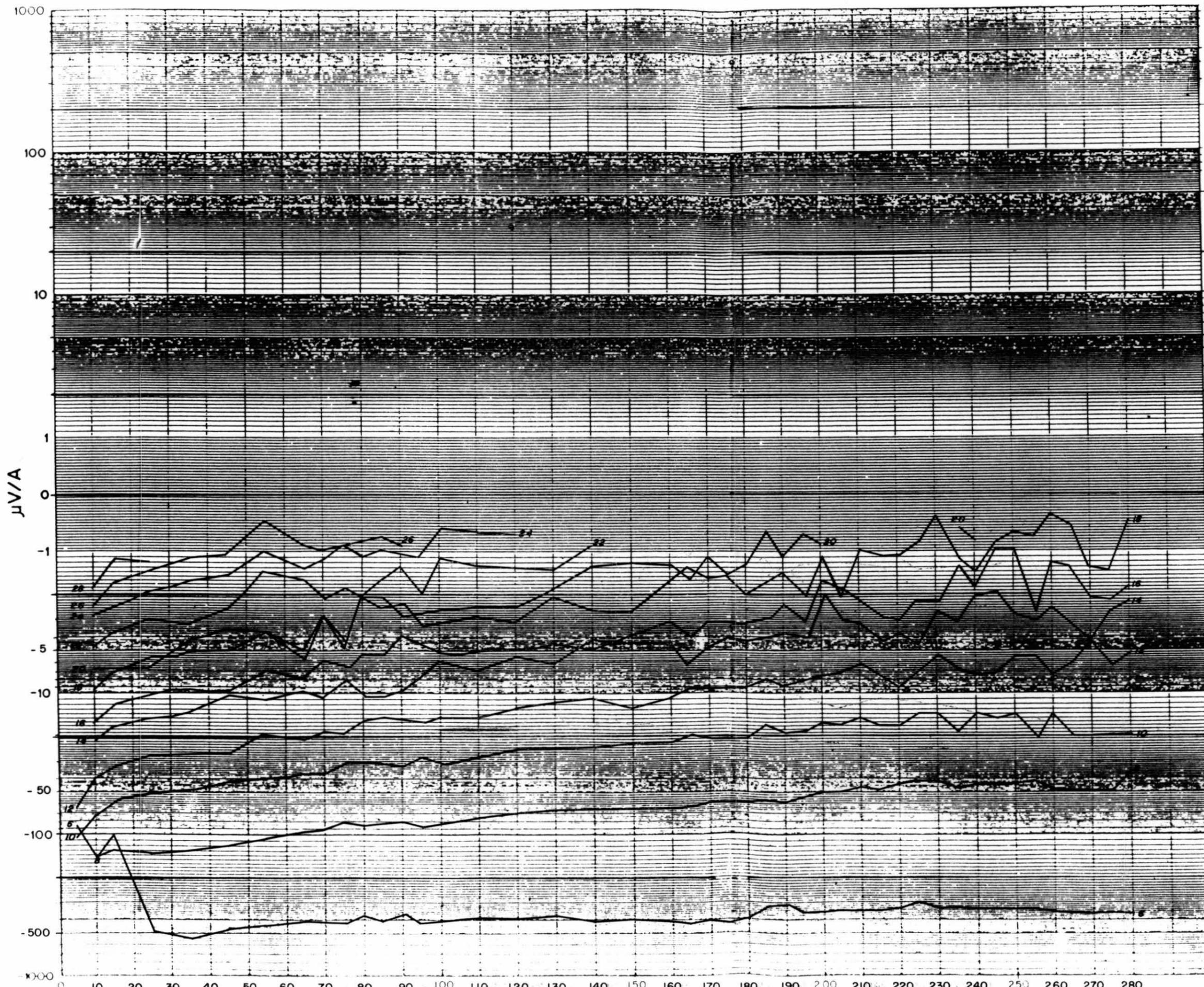
* noise levels 0.5 to 10 μ v/amp

LOOP DIAGRAMS ETC.

Polarity: -ve down at hole collar



4697



Sh, sst Volcaniclastics Massive dacite Sh, Volcs Epiclastic breccia Sh Epiclastic Breccia

87-2682 LD51/1030 FIG. No.12

EOH

SIROTEM SURVEY

906050

CLIENT

AREA .. MT. CATTLEY RANGE

LINE NO. HOUSE CRD 86-1

LOOP CONFIG. DOWNHOLE

LOOP DIMENSION 200 x 250m

E.T.

STATION INTERVAL 10m

STACKS 1024 + 512

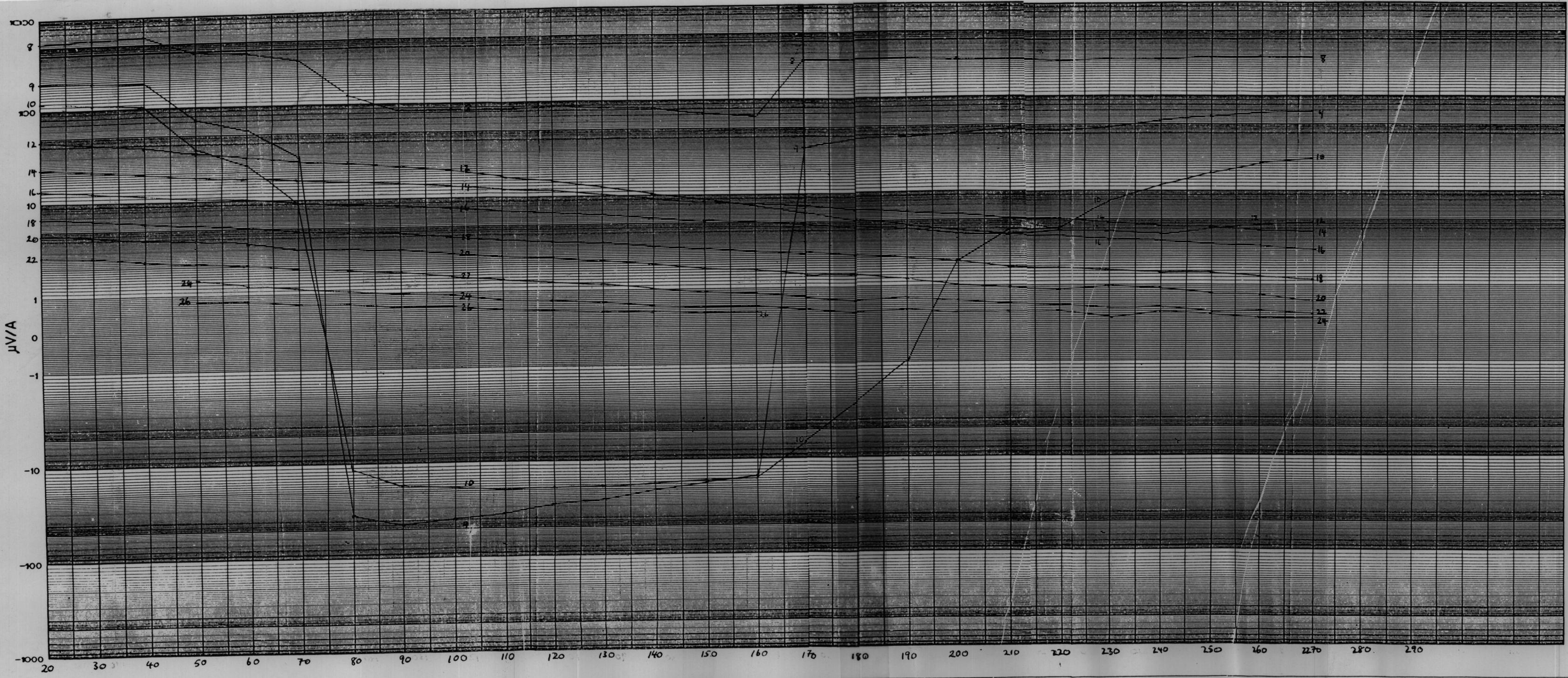
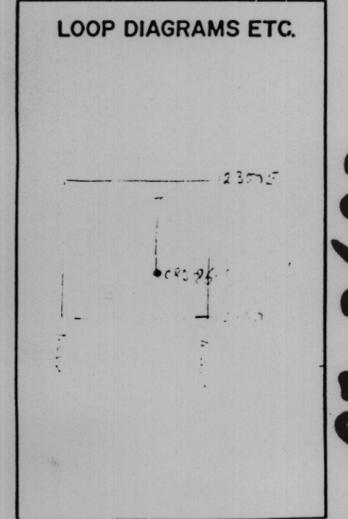
SFERICS 2/6

INST. SERIAL NO. 1237
SIROTEM Mk II

OPERATOR P. McSKIMMING

DATE 3-7-57

* PRELIMINARY PLOT *



87-2682

4698