



View of Oceana old workings within low lying
Gordon Limestone and Zeehan Smelter dumps in the background



View of South Oceana

CONTENTS

	PAGE NO.
SUMMARY	1
1. INTRODUCTION	2
2. TENURE	4
3. PREVIOUS INVESTIGATION	6
4. GEOLOGY	7
4.1 Regional Geological Setting	7
4.2 Geology of Oceana	10
4.2.1 Geological Investigation of Oceana	10
4.2.2 Gordon Limestone stratigraphy at Oceana	11
4.3 Proposed Diamond Drilling	14
5. GEOCHEMISTRY	18
6. GEOPHYSICS	22
6.1 Ground Magnetism	22
6.2 Physical Properties	22
6.3 Gravity	24
6.4 Combined Gravity and Magnetic Interpretation	28
6.5 Proposed Work	29
7. ORE RESOURCE AND POTENTIAL	30
7.1 Ore Resource	30
7.2 Ore Potential	31
8. CONCLUSIONS	33
9. EXPENDITURE REPORT	34
10. PROPOSED PROGRAMME AND BUDGET	35
REFERENCES	
KEYWORDS	

FIGURES

1.	Location Map	1:500 000
2.	Tenure	1:25 000
3.	Geology	1:10 000
4.	Simplified Geology	1:5 000
5.	Stratigraphic Column of Gordon Limestone – Regional Context	nominal
6.	DDH Locations Plan View and Long Section	1:2 500
7.	Geology: Section at 3175mN (Oceana grid)	1:1 000
8.	Geology: Section at 3400mN	1:1 000
9.	Geology: Section at 3600mN	1:1 000
10.	Geology: Proposed DDH 2800mN	1:1 000
11.	Geology: Proposed DDH 3300mN	1:1 000
12.	Grid Refurbishment and Extension	1:1 000
13.	Ground Magnetism Colour Drape (sun NE)	nominal
14.	Ground Magnetism Locations and Values	1:2 000
15.	Gravity Colour Drape (sun E/W)	nominal
16.	Gravity Colour Drape (sun N/S)	nominal
17.	Gravity Locations and Values	1:5 000
18.	Location of Current Resource	1:5 000

APPENDICES

1. Schedule RL 8809
2. Oceana DDH collar coordinates and down hole surveys.
3. A Sedimentological Survey of the Ordovician host sediments to the Oceana mineralisation, Tasmania. Dr M.K. Neudert.
4. Physical Properties from Oceana DDH core.
5. Review of Gravity and Magnetic Data Oceana Mine Area, Zeehan. By Leaman Geophysics.
6. Oceana Gravity Gradient Plots. Dr R.G.Richardson.
7. Western Tasmania Area T.M. scene 91 - 89 1:1000000

TABLES

1. Summary Statistics from ZT Series Diamond Drilling
2. Statistics for ZT Series DDH samples

SUMMARY

Exploration at Oceana has two principal objectives: firstly, to confirm and increase the existing resource and secondly, to identify new targets elsewhere within the tenement.

Work has concentrated on the determination of the structural and stratigraphic relationship between the Gordon Limestone and its enclosing sediments, and of the mineralisation to the Gordon Limestone.

The approach has been through investigation of Gravity and Magnetic data, geological field observation and re-examination of old diamond drill core. Examination of air photographs and TM images and discussions with Mines Department mappers currently working in the area has also provided useful information.

Results from the geophysical investigations indicate that combined gravity/magnetic interpretations can be used to target mineralisation and to aid structural mapping.

Results from the geological investigation indicate the following:

- the sequence from within the Mt Zeehan Conglomerate to at the top of the Gordon Limestone is conformable;
- a recognisable stratigraphy exists within the Gordon Limestone which allows correlation;
- the Gordon Limestone continues to the south overthrust by the Moína Sandstone;
- the thrust pattern established at South Oceana may be locally and regionally extensive.

Future work will involve the testing of geophysical targets and geological models by diamond drilling.

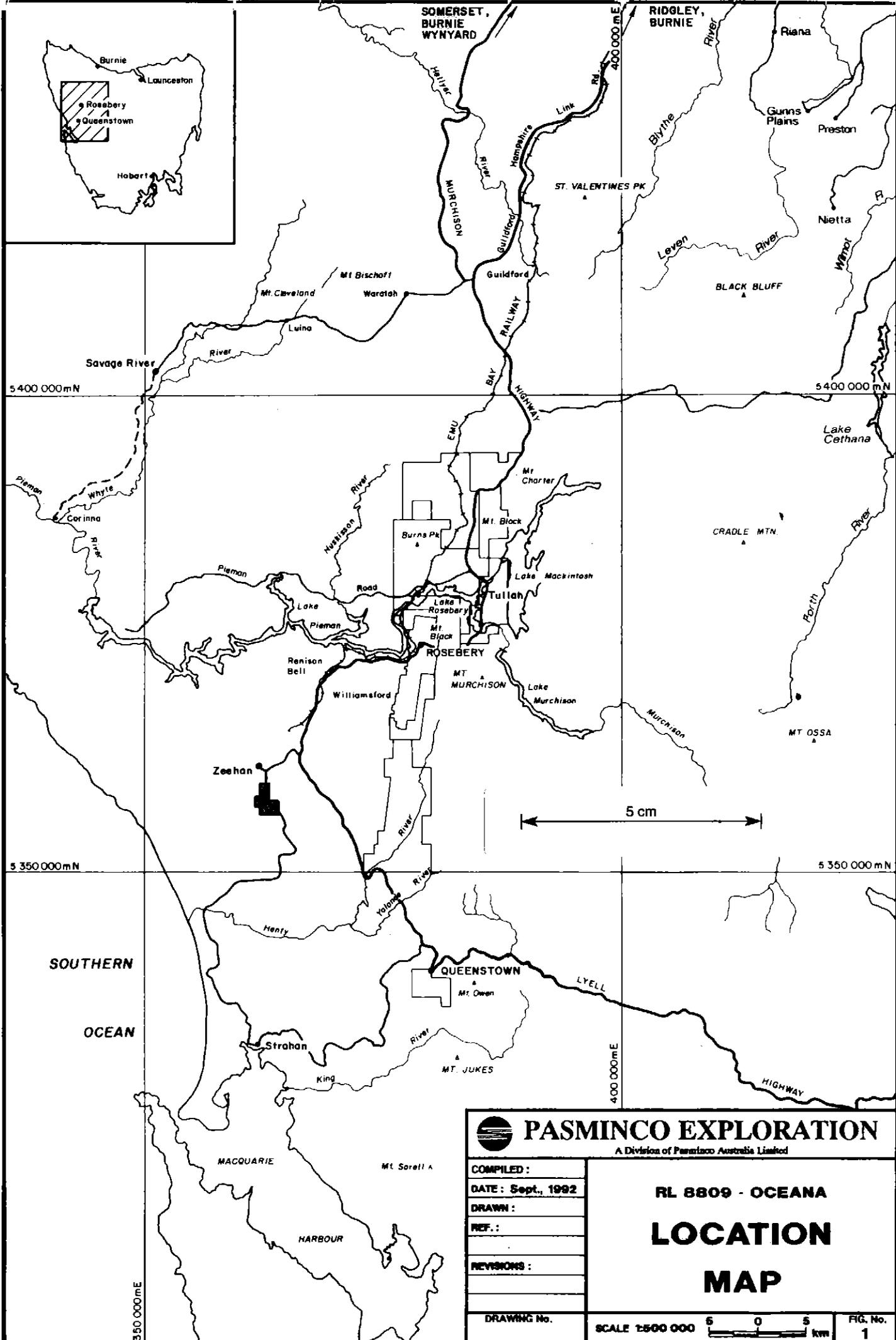
Potential exists to both increase the existing resource and to identify new resources.

1. INTRODUCTION

Retention Licence 8809 (*Oceana*) covering 5kms, is located 1km south of Zeehan in Western Tasmania (see Figure 1). Title to the tenement is held by Arimco Mining Pty Ltd. Pasminco Australia Limited are in Joint Venture agreement with Arimco to evaluate the mineral potential of the licence area.

This report covers the period from October 1991 to September 1992. Work conducted during this period included:

- evaluation of existing data;
- refurbishing and extension of old grid lines;
- a detailed ground-magnetic survey;
- a combined gravity and magnetic interpretation;
- field examination of facies sequences;
- and the initiation of a two diamond drill hole programme.



 PASMINCO EXPLORATION <small>A Division of Pasminco Australia Limited</small>	
COMPILED : DATE : Sept., 1992 DRAWN : REF. : REVISIONS :	RL 8809 - OCEANA LOCATION MAP
DRAWING No.	SCALE 1:500 000 
	FIG. No. 1

2. TENURE

Retention Licence 8809, Oceana was granted to Cyprus Gold Australia Corporation on 14 October 1988 for a period of two years. The licence was retained from part of former Exploration Licence 4/78, which was relinquished on 14 July 1988.

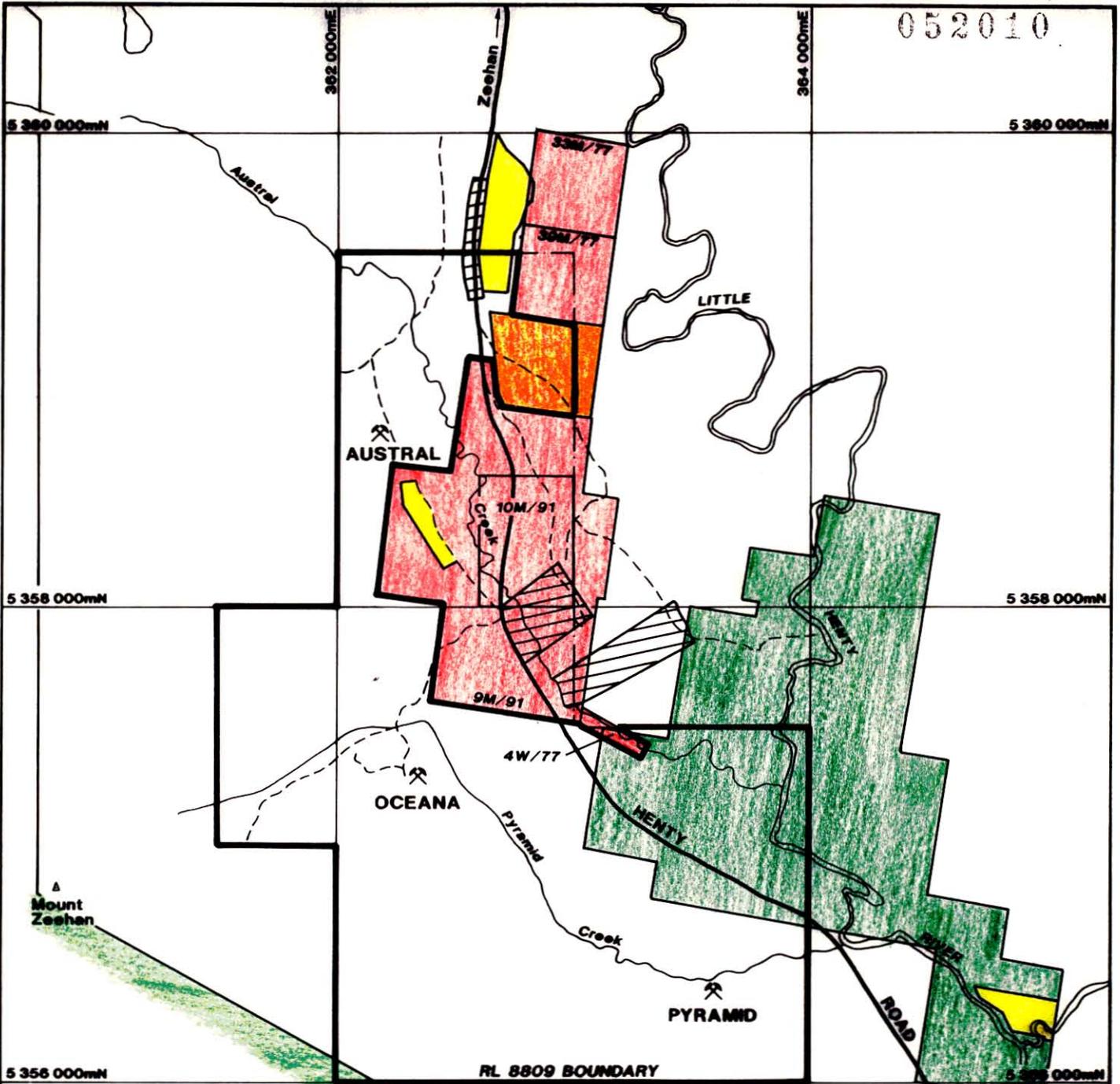
Title to RL 8809 was transferred to Hudspeth and Company Pty Ltd on 23 October 1990. This was subsequently transferred to Arimco Mining Pty Ltd on 24 August 1991 following a certified change of Company name.

Pasminco Australia Limited entered into negotiations with Hudspeth (Arimco) in late 1990 to reach an agreement to evaluate the base metal mineral potential of the licence area. A formal Joint Venture Agreement was signed on 7th April 1992. Under the terms of a Joint Venture Agreement, Pasminco Exploration, a division of Pasminco Australia Limited, would manage and operate the Joint Venture. Pasminco have the right to earn a 65% interest in the tenement by spending \$2 million within 9 years with \$1 million being spent in the first 5 years.

The licence covers an area of 5.5km² (see Schedule in Appendix 1). This area excludes a total of 1.1km² of the following Mine Leases: 9M/91, 10M/91 and 4W/77, held by Pasminco Australia Limited, and 39M/77 held by JNR Enraght - Mooney (see Figure 2). Lease 10M/01 is subject to a joint agreement with Dragon Resources whereby they have the surface rights to retreat the old Zeehan smelter dumps. Also excluded is 0.2km² of Crown Reserves.

The land tenure of RL 8809 comprises: Crown Land; Private Property and Timber Reserve. In addition, part of the area is on the interim list of the Register of the National Estate as part of the Zeehan Smelters Geological monuments (see Figure 2).

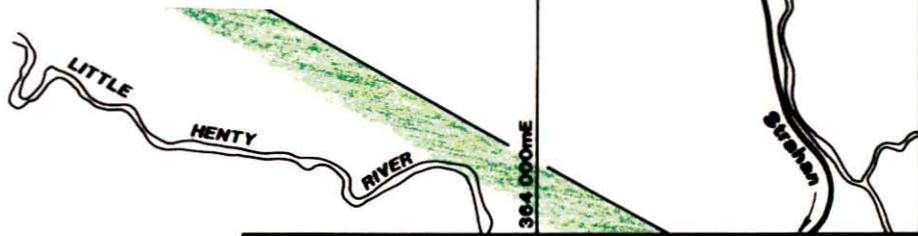
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KEY

-  Mining Lease
-  Crown Reserve
-  Timber Reserve
-  State Forest
-  Private Freehold Land
-  Uncommitted Crown Land (within E.L. Boundary)
-  National Estate Interim Listing

5 cm



PASMINCO EXPLORATION <small>A Division of Pasminco Australia Limited</small>	
COMPILED: G.M.B.	RL 8809 - OCEANA LAND TENURE
DATE: Sept., 1992	
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REF.:	
REVISIONS:	
DRAWING No.	SCALE 1:25,000 
FIG. No. 2	

3. PREVIOUS INVESTIGATIONS

Comprehensive accounts of past prospecting and mining activities in the Zeehan area, including the Oceana RL have been given in Taylor (1983) and Jones (1988). Jones (op cit) also presents a good summary of the more recent exploration undertaken by Amoco (Cyprus) during 1978-88.

The earliest report of mining activity at Oceana dates from 1890 when small-scale trenching was undertaken. During the next 3 years the *Oceana Silver Mining Co* extracted approximately 1000t at 39% Pb and 14.5oz/t Ag. A further 517t of lead ore was mined between 1896-99 by *Oceana Pty Ltd*. No further significant production from the Oceana Mine occurred until 1954 when *Zeehan Mines Pty Ltd* (a joint venture between North Broken Hill and Broken Hill South) reopened the old workings, following a successful exploration drilling program. *Zeehan Mines* extracted a total of 128 177t at 11.6% Pb and 4.79oz/t Ag up to 1960 when the mine closed again.

The Cyprus exploration program focussed on carbonate hosted lead-zinc-silver mineralisation within their EL 4/78. During the 10 years of this licence's tenure Cyprus undertook a major program of geological mapping, geochemistry (bedrock auger and costean sampling) geophysics (IP, EM, gravity and magnetics surveys) and diamond drilling (25 holes for a total of 6690m) within the current area of RL 8809. This work culminated in the delineation of an ore resource of:

	tonnes	Pb%	Zn%	Ag g/t
3550 - 3700mN	2 297 000	7.1	2.5	48
3200 - 3450mN	750 000	12.0	4.0	89
Total	3 047 000	8.3	2.9	58

Significant untested potential for similar mineralisation was also recognised over several other prospects, including *Oceana South*, *Austral* and *Pyramid*.

Since RL 8809 was granted, *Hudspeth (Arimco)* have not undertaken any significant work, due to the prevailing unfavourable mineral economics associated with the ore resource, outlined above.

4. GEOLOGY

4.1 Regional Setting

The regional geological setting of the Oceana area is well described in Blissett (1962), Taylor (1983) and Jones (1988).

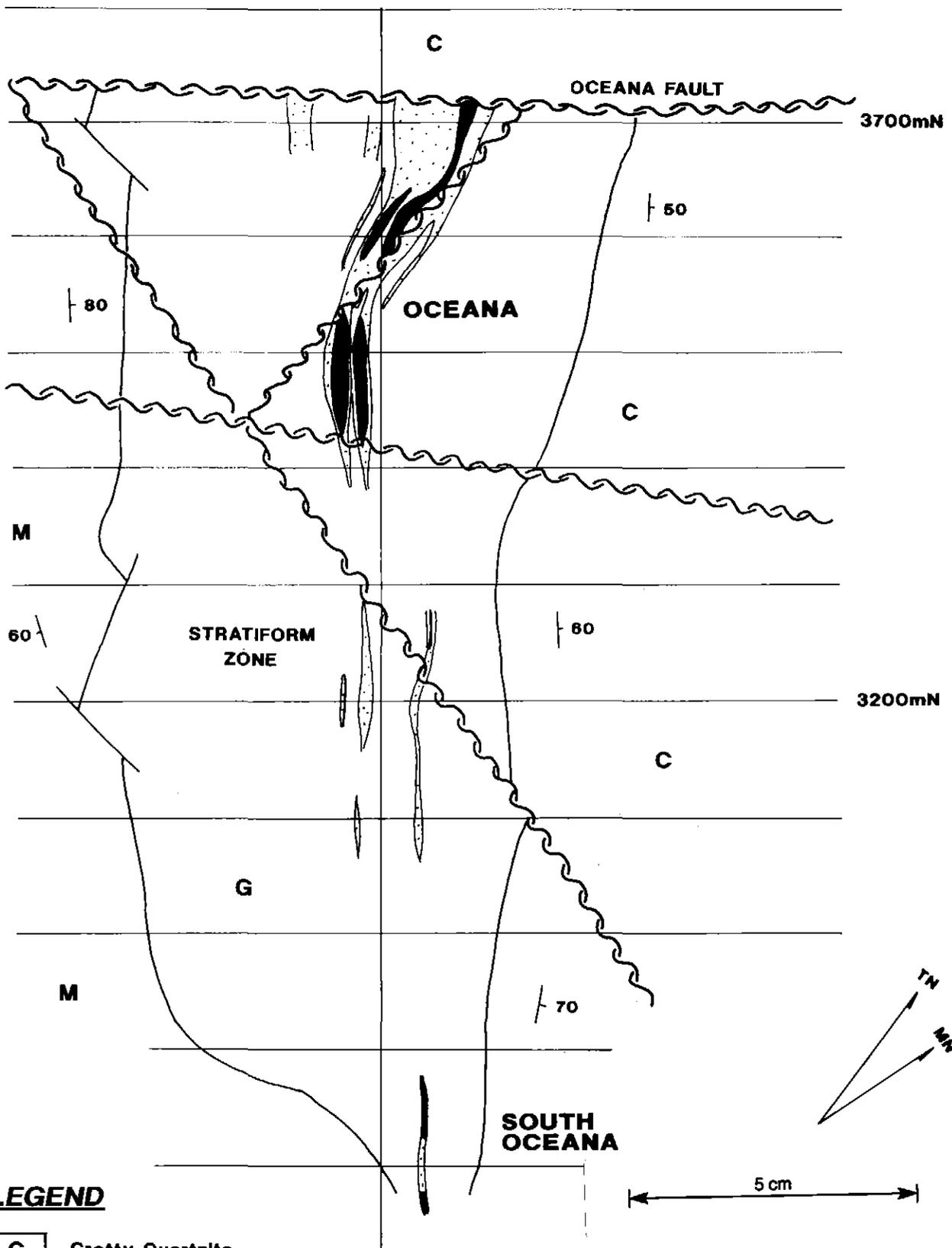
To summarise, the Gordon Limestone lies at the top of the Junee Group of Ordovician sediments (Fig 5) above the Mt Zeehan Conglomerate and Moina Sandstone, and is overlain by the Eldon Group of Silurian to Devonian sediments. Whilst the contact between the Gordon Limestone and the Crotty Quartzite (the base of the Eldon Group) may be locally disconformable there do not appear to be major structural breaks through this sequence. In fact the regular spatial association of the above units as seen on the Zeehan Sheet Map (Blissett and Gulline, 1962) is such that the presence of Gordon Limestone could be extrapolated by association.

The underlying Cambrian Crimson Creek Formation is important as it may provide the metals that form amongst others the Oceana orebody (Lees 1992).

The Proterozoic Oonah Quartzite is important as recent work (Findlay and Brown 1992) interprets the Oonah Formation as a Tabberabberan thrust sheet. This model has profound implications on both the reconstruction of regional geology and for mineral exploration. This thrust sheet could be covering shallow units of mineralised Cambrian volcanics or Ordovician carbonates. The mineral occurrences within and peripheral to the Oonah Formation may reflect more significant mineral occurrences below, within younger rocks.

Marcus McClenaghan (pers. comm.) has mapped several other major thrusts in the South Zeehan area which indicates that the thrusting is of regional importance, and that these features have significant implications for regional mineral exploration.

The use of a combination of TM images (Appendix 7), aerial photographs, and regional gravity and magnetics, will aid regional geological interpretation. Superimposed geological mapping and mineral occurrences will be useful in identifying mineralising structures, and



LEGEND

- C Crotty Quartzite
- G Gordon Limestone
- M Molna Formation
- ~~~~~ Fault
- ▬▬▬ >10% pb
- ▬▬▬ <1% pb

PASMINCO EXPLORATION <small>A Division of Pasminco Australia Limited</small>	
COMPILED: DATE: 0104.92 DRAWN: P.M.G. REF.: REVISIONS: DRAWING No.	RL8809 - OCEANA SIMPLIFIED GEOLOGY
SCALE 1:5000	REC. No. 4

PERMIAN
 SILURIAN/DEVONIAN
 ORDOVICIAN
 CAMBRIAN
 PROTERZOIC

ELDON GROUP

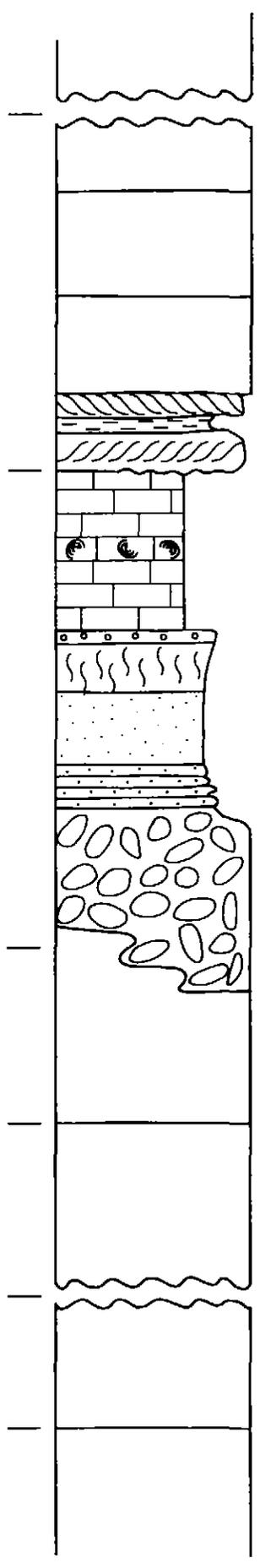
JUNEE GROUP

DUNDAS GROUP

CRIMSON CREEK FORMATION

OONAH QUARTZITE

CONCERT SCHIST



~1500m

~500m

~500m

TABBERABBERAN OROGENY

folding and granite intrusive

BELL SHALE

FLORENCE QUARTZITE

AMBER SLATE

CROTTY QUARTZITE

GORDON LIMESTONE

MOINA SANDSTONE

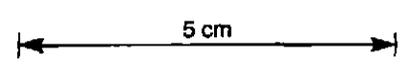
MT. ZEEHAN CONGLOMERATE

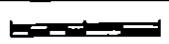
(This contact is a time transgressive response to Tyennanland convergence and may be coeval with Dundas Group)

Mixed sedimentary, epiclastic, volcanic sequence

Deep marine mudstones and turbidites

PENGUIN OROGENY



 PASMINCO EXPLORATION A Division of Pasminco Australia Limited	
COMPILED : P.M.Q. DATE : Sept., 1992 DRAWN : G.M.B. REFERENCE : REVISIONS :	R.L. 8809 - OCEANA STRATIGRAPHIC COLUMN OF GORDON LIMESTONE REGIONAL CONTEXT
DRAWING No.	SCALE  m
	FIG. No. 5

extrapolation of Gordon Limestone beneath thrust cover may identify new mineral potential.

4.2 Geology of Oceana

4.2.1 GEOLOGY OF OCEANA

Geological investigation of Oceana has included a sedimentological survey of the Oceana mineralisation in its geological setting by Dr M.K. Neudert (Appendix 3). This study involved field examination of the facies sequence from and including the Mt Zeehan Conglomerate to within the Crotty Quartzite, and the examination of the Gordon Limestone in core from six diamond drill holes.

The objectives of the study were as follows:

- to establish a regional facies framework;*
 - to identify features enabling correlation within the Gordon Limestone;*
 - to determine the depositional environment;*
 - to identify geological controls on mineralisation;*
- and thus;*
- to develop an approach to the exploration for sulphides within the Oceana RL., and within the Gordon Limestone in its regional context.*

The conclusions of the study are as follows:

- i. the sequence from the Mt Zeehan Conglomerate to the top of the Gordon Limestone (and possibly including the Crotty Quartzite) is conformable and no major structural breaks are indicated. Lithological variation is due to lateral facies variation complicated by changing tectonic conditions.*
- ii. a method of distinguishing facies within the Gordon Limestone was developed thus enabling correlation.*
- iii. the depositional environment was marine, sub-tidal, had high biological activity indicating oxygenated water, was close to terrigenous source, and much of the deposition involved turbulent suspension currents. An off-reef basin is inferred.*

- iv. whilst the scope of this study did not allow in depth examination of mineralization three types of mineralization were observed:
- post lithification vein or fracture fill;
 - fine to coarse disseminated to massive sulphides in mudstone;
 - coarse open space filling and bioclast replacement
- a syndepositional origin for mineralisation was ruled out due to the presence of bioturbation indicating an oxygenated environment.
- v. the thinning of the Gordon Limestone in the vicinity of South Oceana:
- fault displacement is unlikely as the Gordon Limestone Crotty Quartzite contact is not displaced;
 - facies onlapping onto a topographic high unlikely due to steepness of gradient;
 - nondeposition due to growth faulting is unlikely as to deposit 200m of limestone would have left the upthrown block in a different environment for a considerable time which is not evident in enclosing sediments;
 - thrusting of the Moira Sandstone over the Gordon Limestone is the most likely origin to the present geometry of units.

A stratigraphic interpretation can be developed by correlating marker horizons in the existing core. This can be compared with the position of mineralisation to establish the spatial relationship between mineralisation and stratigraphy. The interpretation could then be used to determine the effects of later faulting and possibly the present position of offset mineralisation.

4.2.2 GORDON LIMESTONE STRATIGRAPHY AT OCEANA.

The Gordon Limestone at Oceana can be subdivided into four main facies as follows:

- a *intercalated mudstones and carbonate units;*
- b *laminated carbonate sandstones;*
- c *massive carbonate sandstones and siltstones;*
- d *terrigenous sandstones and conglomerates.*

These facies can be further subdivided using the presence of the following textures;

- 1 tube mottled bioturbation;
- 2 sculpture mottled bioturbation;
- 3 slump shear texture;
- 4 stylolites;
- 5 graded coarse shell beds;
- 6 bioclastic breccia.

a Intercalated mudstones and carbonates are by far the most abundant facies type. This facies can be further subdivided by categorising the mudstone to carbonate ratio, and the bed thickness.

Mudstone refers to dolomitic, carbonaceous siltstones with a fine terrigenous component. These are generally dark grey to black, react slightly to dilute hydrochloric acid and stain with a faint blue hue with solution of mixed Alizarin Red and Potassiumferricyanide.

Carbonate refers to a generally calcite cemented siltstone, sandstone or conglomerate composed of bioclastic debris. Generally pale grey in colour carbonate reacts readily to dilute hydrochloric acid and stains distinct purple with Alizarin Red solution.

The use of the following mudstone to carbonate ratios has proved effective in core logging and correlation:

< 10%

10 – 40%

>40%

The following bed thickness ranges have also been useful:

<5cm

5 – 20cm

>20cm

The carbonate intercalations often show distinct and repeated grading indicating that deposition involved turbulent suspension currents. The mudstone component perhaps reflects background sedimentation.

The mudstone/carbonate intercalations are generally disrupted and mixed and are rarely well bedded. The disrupted and mixed texture may be extreme obliterating sedimentary features. In many places however the disruption increases gradationally and can be identified.

Three types of disruption have been distinguished as follows:

- 1 tube mottled bioturbation consists of accumulations of worm burrows which may be sand filled in mud units or any combination of sand and mud.
- 2 sculpture mottled bioturbation describes the sculptured appearance of mixed sand and mud units interpreted as the result of bioturbation by sediment surface dwellers.
- 3 slump shear describes the asymmetric wispy mixing of sand and mud units interpreted as the result of soft sediment slumping.

One or more disruption textures may be superimposed. It appears however that tube mottling is the dominant texture below the "reefal debris units" and that passing up sequence sculpture mottled texture gives way to well bedded intercalations of mudstone and carbonate. Slump shearing is most abundant in the vicinity of the reefal debris units possibly indicating growth fault activity.

The distinctive bioclastic breccia also occurs in this facies. This breccia is composed of coarse three to fifteen centimetre clasts of coralline, stromatolitic and shell debris within intercalated mudstone and carbonate. The zone may contain tube mottled bioturbation, is frequently associated with slump shearing and is often associated with narrow bands of laminated carbonate sandstones both above and below. This distinctive sedimentary breccia is also notable because of its spatial association with mineralization.

Large isolated and possibly in-situ stromatolites occasionally occur in mudstone units proximal to the bioclastic debris flows.

- b Laminated carbonate sandstones are a rare but distinctive facies and as such provide good marker horizons. They comprise zones approximately one metre thick of thin wispy mudstone laminae in massive carbonate sandstone. These

zones may be disrupted by slump shearing but remain distinctive. A rare but well preserved worm trail passing through and disrupting the laminae indicate that it is a pre-lithification feature.

- c Massive carbonate sandstones and siltstones are distinct due to the lack of grading and mudstone component and possibly reflect deposition close to the carbonate source. These massive carbonates frequently display prominent stylolitic texture.
- d Terrigenous sandstones and conglomerates are a rare but distinctive facies thus providing good marker horizons. These zones contain prominent rounded white quartz grains or pebbles which both indicate a proximal terrigenous source and a link with the Moina Sandstone.

A drillcore logging scheme has been developed using the following criteria:

- mudstone to carbonate ratio;
- grainsize of carbonate component;
- bed thickness;

and the presence of :

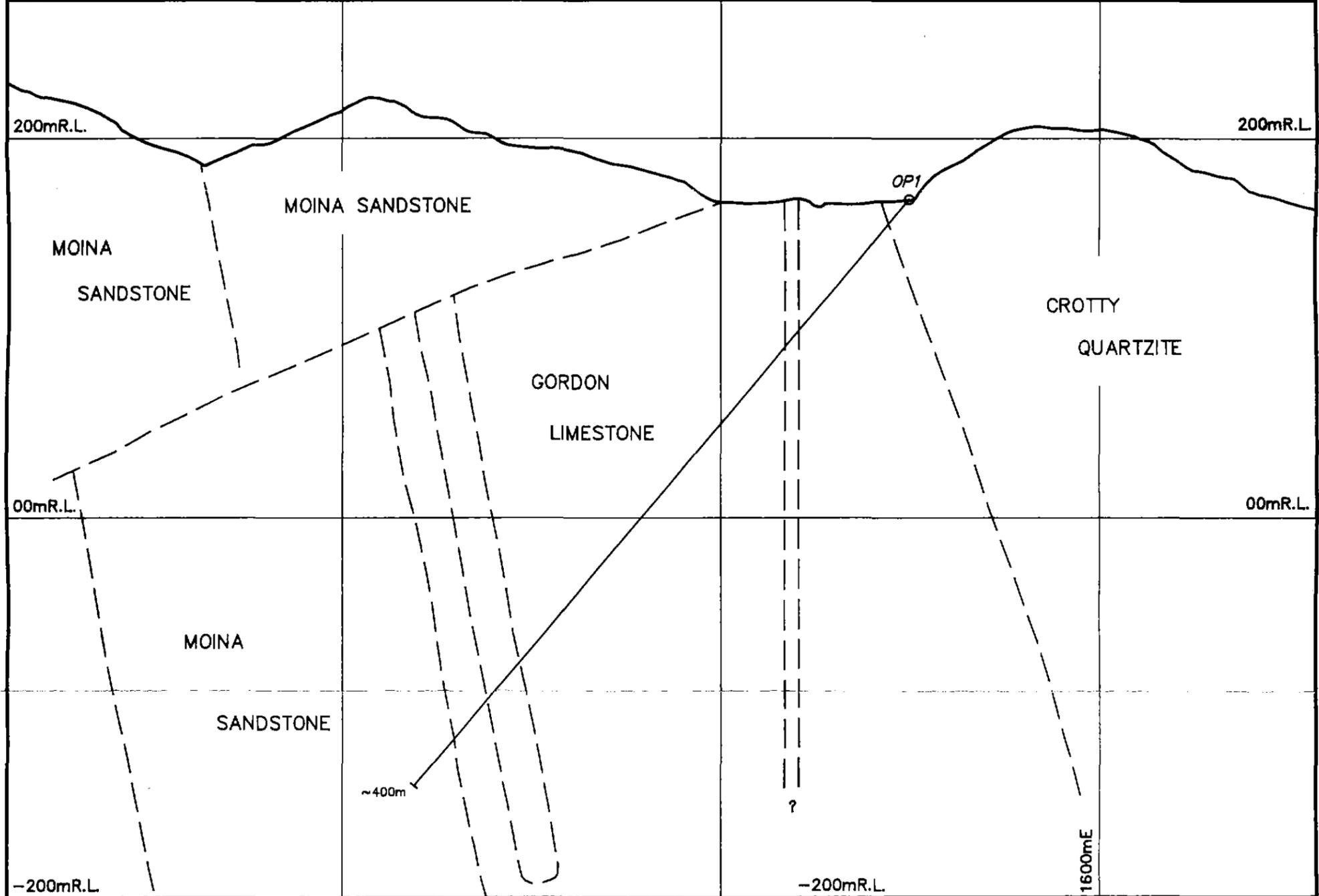
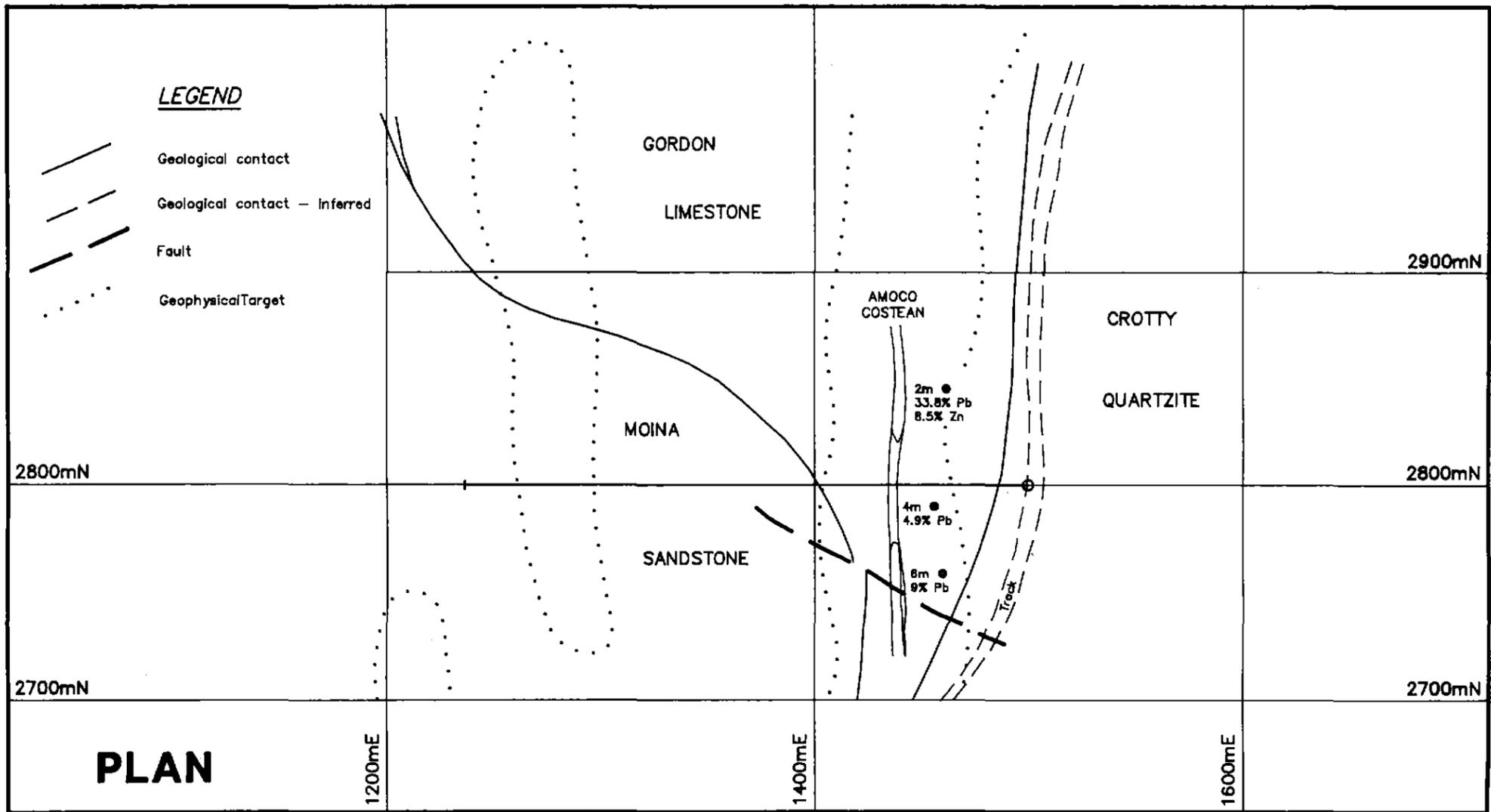
- tube mottled, sculpture mottled or slump sheared texture;
- coarse shell beds (bioclastic turbidites);
- bioclastic breccia (reefal debris flows);
- in-situ corals or stromatolites;
- fine mudstone laminae;
- stylolites;
- terrigenous component.

This system of describing core has to date proved useful in correlating and interpreting the stratigraphy of the Gordon Limestone (Figs 7,8,9.)

4.3 Proposed Diamond Drilling

Two DDH are proposed targeted at combined geological and geophysical targets. One is designed to intersect an along strike continuation of known mineralization, whereas the other is targeted at new potential.

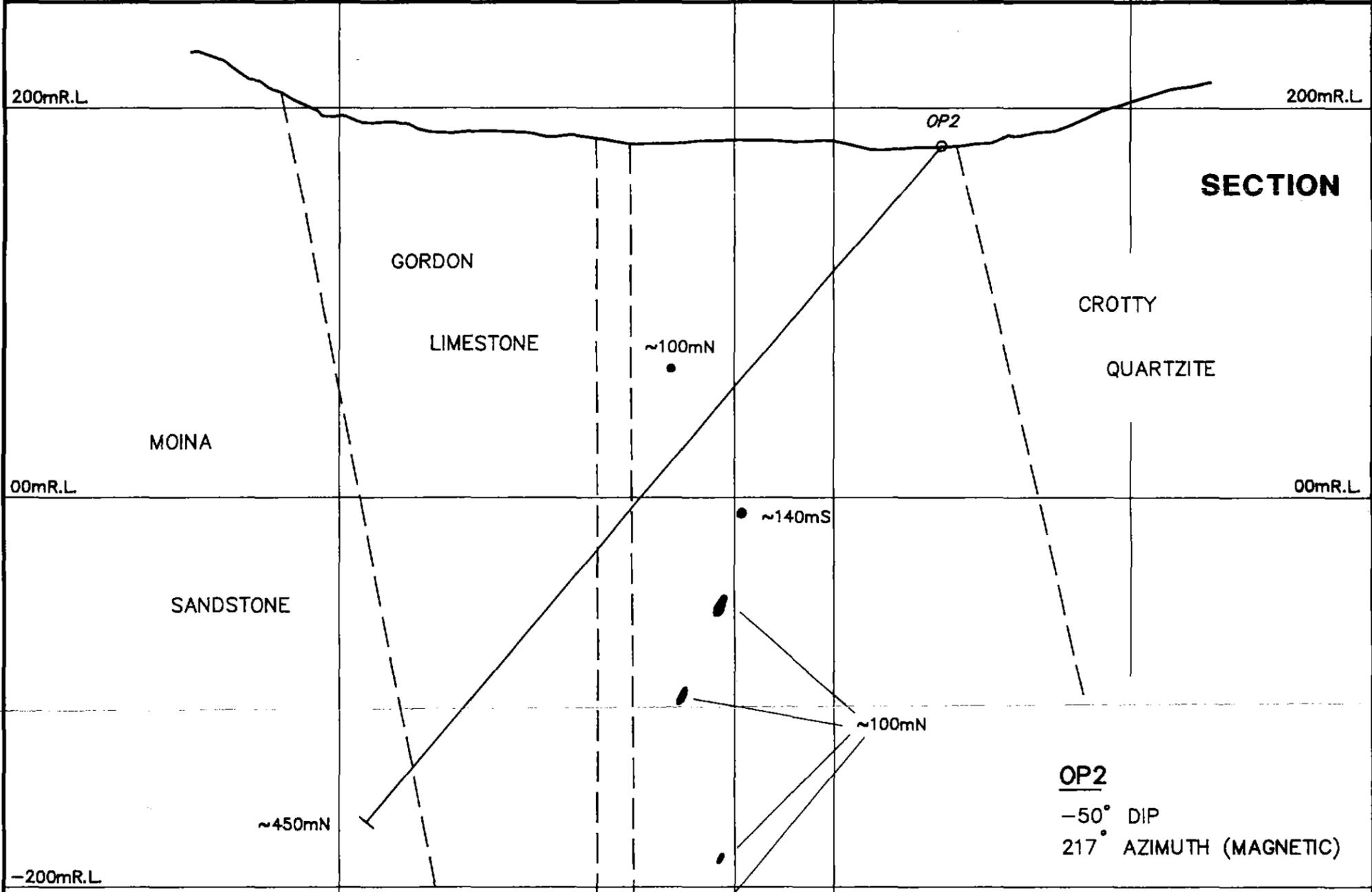
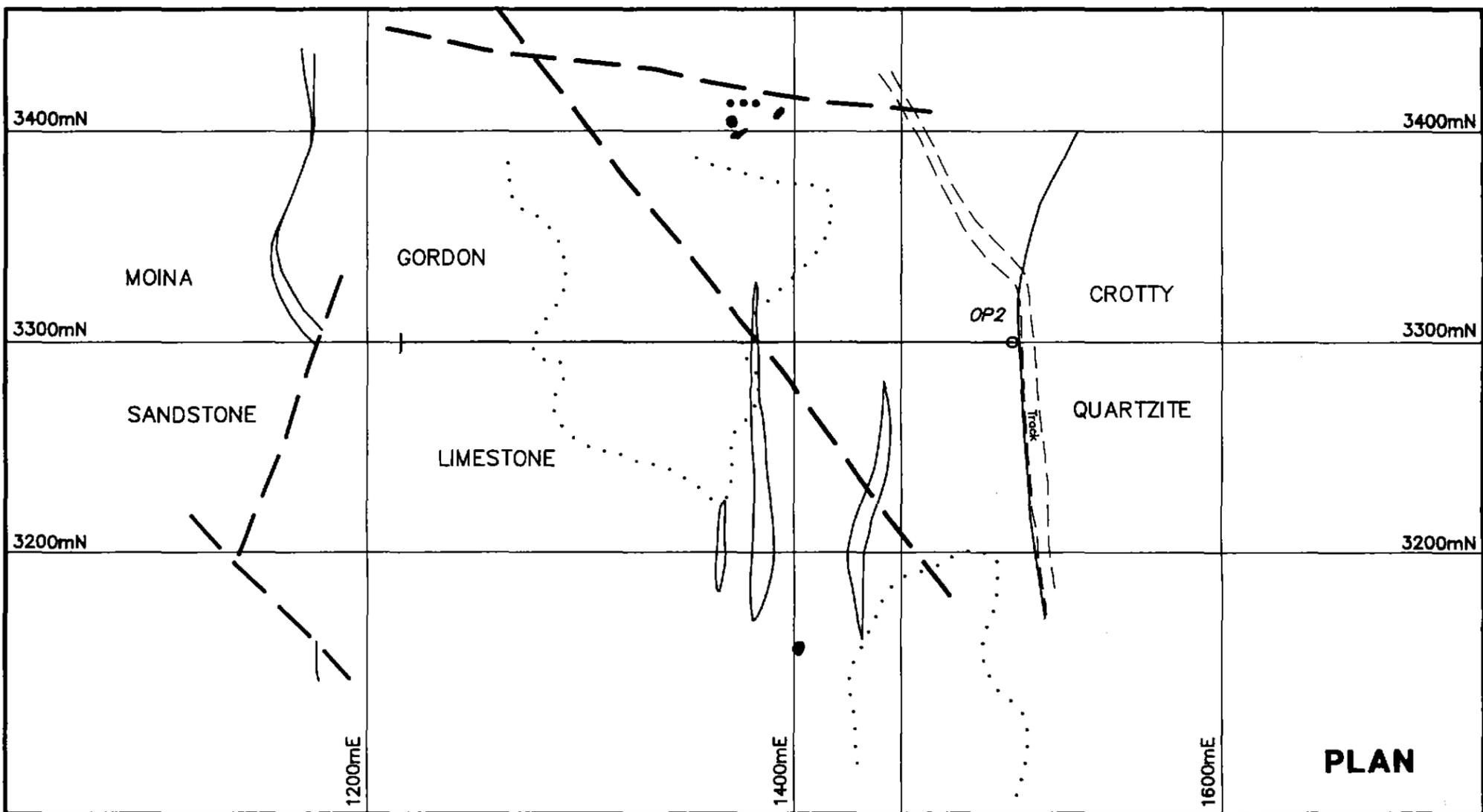
DDH OP1(Fig.10) is designed to traverse the entire Gordon Limestone Sequence from the



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COMPILED : P.M.Q.	RL8809 - OCEANA PROPOSED DRILL HOLE OP1 SECTION 2800N
DATE : Sept., 1992	
DRAWN : G.M.B.	
REFERENCE :	
REVISIONS :	
DRAWING No. 2800NOP1	SCALE 1:2500 0 25 50 m FIG. No. 10

OP1
-50° DIP
217° AZIMUTH (MAGNETIC)



LEGEND

	Geological contact
	Geological contact - Inferred
	Fault
	Geophysical Target
	Intersected Mineralisation

PASMINCO EXPLORATION
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COMPILED : P.M.O.	RL8809 - OCEANA PROPOSED DRILL HOLE OP2 SECTION 3300N
DATE : Sept, 1982	
DRAWN : G.M.B.	
REFERENCE :	
REVISIONS :	
DRAWING No. 2800NOP1	SCALE 1:2500 FIG. No. 11

0120291

Crotty Quartzite contact to the Moina Sandstone contact. It will be the first hole at Oceana to do so. It is targeted to test a gravity/magnetic anomaly and the geological model that the Gordon Limestone continues to the south overthrust by the Moina Sandstone. The target zone is expected at approximately 330m down hole (300m below surface and the hole is planned at 400m length. A secondary target is the down dip continuation of the South Oceana line of mineralisation intersected in consteans.

DDH OP2 (Fig 11) is designed to test for the along strike extension of the Oceana Mineralisation intersected on line 3400mN (Fig 8). The target is coincident with a magnetic negative and an offset gravity positive anomaly from which Leaman (Appendix 5) has inferred a zone of alteration and two structural features, a double offset. The DDH is designed to end the Moina Sandstone at approximately 450 m depth.

Both DDH have sound geological targets and both will test geophysical anomalies. These DDH will also provide information on the angle of dip of the Moina Sandstone and its physical properties at depth, important information in the interpretation of the structural and stratigraphic setting of the host to the Oceana mineralisation.

5. GEOCHEMISTRY

Only minor geochemical sampling has been done during this period.

Two samples were taken from the Oceana Fault, and the South Oceana Fault to the east of the Gordon Limestone to test for anomalous base metal values within the faults along strike from mineralisation.

Two samples were taken from the "worm burrowed" unit of the Monia Sandstone to resolve the anomalous density highlighted by Leamans study of the gravity data. These samples have a measured SG of 2.86 and 2.96.

Results from the above samples are awaited.

All downhole geochemistry from the ZT series DDH has been computerised. Various statistics from these assays are shown in tables 1 & 2.

It is proposed that selected mineralisation be analysed for a range of elements to determine its overall characteristics. Metallurgical reports suggest a very low As and Bi content and possibly a high Sn content, but no comprehensive analyses have been found.

It is also proposed that certain samples of sphalerite be probed to determine their manganese and cadmium content. The results would be compared with results from samples taken from a range of west coast deposit for the purpose of regional correlation.

Pb isotope data analysed by Gulson (in Ellis 1984) will be compared with similar data from other west coast deposits to review the implication of the results.

Table 1 Summary Statistics from ZT series diamond drilling.

	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_no
(for all samples with Pb <1%)						
Number	6178	6778	6782	4448	6777	4448
Mean	0.003	0.135	0.395	3.12	67	27
(for all samples with Pb >1%)						
Number	1153	1163	1163	1162	1163	1162
Mean	0.010	11.0	4.2	94	24	6
Maximum	0.1	58.7	39.9	1219	88	82
(for all samples with Pb >2%) 823 samples						
Mean	0.013	15.0	5.3	129	19	7
Maximum	0.1	58.7	39.9	1219	81	82
(for all samples with Pb >5%) 545 samples						
Mean	0.017	21.1	7.3	161	18	6
Maximum	0.1	58.7	39.9	1040	76	15
(for all samples with Pb >10%) 405 samples						
Mean	0.021	25.9	9.4	203	21	6
Maximum	0.1	58.7	39.9	1040	63	15
(for all samples with Pb >15%) 284 samples						
Mean	0.027	31.6	11.8	268	22	7
Maximum	0.1	58.7	39.9	1040	63	15
(for all samples with Pb >20%) 212 samples						
Mean	0.032	36.5	13.2	316	23	7
Maximum	0.1	58.7	39.9	1040	63	15
(for all samples with Pb >25%) 171 samples						
Mean	0.033	39.7	12.0	340	20	7
Maximum	0.1	58.7	32.1	1040	43	15

$$\text{Zn_no} = 100 \text{ Zn\%} \times \text{Zn\% Pb\%} + /$$

$$\text{Ag_no} = 1000 \text{ Ag(ppm)} \times \text{Ag } 100 \times \text{Pb(ppm)} + /$$

Table 2 Statistics for ZT series DDH samples

Pearson Correlation Coefficients		all data 6778 pairs				
	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.6164	0.5914	0.6665	-0.2102	-0.1158
Pb%	0.6164	1.	0.6326	0.7370	-0.3570	-0.2156
Zn%	0.5914	0.6326	1.	0.4762	-0.0334	-0.1485
Ag	0.6665	0.7370	0.4762	1.	-0.2170	-0.0380
Zn_no	-0.2102	-0.3570	-0.0334	-0.2170	1.	0.5330
Ag_Pb	-0.1158	-0.2156	-0.1485	-0.0380	0.5330	1.

Pearson Correlation Coefficients		for Pb<1% 6177 pairs				
	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.1258	-0.0147	0.3433	-0.1502	-0.0803
Pb%	0.1258	1.	0.4779	0.1352	-0.3764	-0.5773
Zn%	-0.0147	0.4779	1.	-0.0214	0.3156	-0.1824
Ag	0.3433	0.1352	-0.0214	1.	-0.2045	0.1823
Zn_no	-0.1502	-0.3764	0.3156	-0.2045	1.	0.4680
Ag_Pb	-0.0803	-0.5773	-0.1824	0.1823	0.4680	1.

Pearson Correlation Coefficients		for Pb>1% 1153 pairs				
	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.7157	0.7127	0.7329	0.2550	0.3923
Pb%	0.7157	1.	0.5444	0.6743	-0.1079	0.0196
Zn%	0.7127	0.5444	1.	0.3849	0.4923	0.1079
Ag	0.7329	0.6743	0.3849	1.	0.0672	0.6610
Zn_no	0.2550	-0.1079	0.4923	0.0672	1.	0.1706
Ag_Pb	0.3923	0.0196	0.1079	0.6610	0.1706	1.

Pearson Correlation Coefficients		for Pb>2% 823 pairs				
	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.6743	0.7094	0.7057	0.4960	0.3937
Pb%	0.6743	1.	0.5217	0.6330	0.0595	-0.0145
Zn%	0.7094	0.5217	1.	0.3502	0.6914	0.1081
Ag	0.7057	0.6330	0.3502	1.	0.2422	0.6940
Zn_no	0.4960	0.0595	0.6914	0.2422	1.	0.3202
Ag_Pb	0.3937	-0.0145	0.1081	0.6940	0.3202	1.

Pearson Correlation Coefficients		for Pb>5% 545 pairs				
	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.7185	0.6962	0.6101	0.5110	0.3604
Pb%	0.7185	1.	0.4464	0.8443	0.1737	0.4116
Zn%	0.6962	0.4464	1.	0.2872	0.8674	0.1955
Ag	0.6101	0.8443	0.2872	1.	0.0715	0.7201
Zn_no	0.5110	0.1737	0.8674	0.0715	1.	0.0373
Ag_Pb	0.3604	0.4116	0.1955	0.7201	0.0373	1.

Pearson Correlation Coefficients		for Pb>10% 405 pairs				
	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.6407	0.6500	0.5376	0.4892	0.3844
Pb%	0.6407	1.	0.3169	0.8284	0.0227	0.4649
Zn%	0.6500	0.3169	1.	0.1791	0.8830	0.2028
Ag	0.5376	0.8284	0.1791	1.	-0.0220	0.7953
Zn_no	0.4892	0.0227	0.8830	-0.0220	1.	0.1082
Ag_Pb	0.3844	0.4649	0.2028	0.7953	0.1082	1.

Pearson Correlation Coefficients for Pb>15% 284 pairs

	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.5330	0.5798	0.4029	0.4827	0.1901
Pb%	0.5330	1.	0.1591	0.7717	-0.0484	0.3038
Zn%	0.5798	0.1591	1.	0.0093	0.9313	0.0170
Ag	0.4029	0.7717	0.0093	1.	-0.1175	0.7851
Zn_no	0.4827	-0.0484	0.9313	-0.1175	1.	-0.0331
Ag_Pb	0.1901	0.3038	0.0170	0.7851	-0.0331	1.

Pearson Correlation Coefficients for Pb>20% 212 pairs

	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.3263	0.5153	0.2734	0.5045	0.2058
Pb%	0.3263	1.	0.0384	0.7422	-0.1023	0.3586
Zn%	0.5153	0.0384	1.	-0.0756	0.9728	0.0374
Ag	0.2734	0.7422	-0.0756	1.	-0.1460	0.8416
Zn_no	0.5045	-0.1023	0.9728	-0.1460	1.	0.0350
Ag_Pb	0.2058	0.3586	0.0374	0.8416	0.0350	1.

Pearson Correlation Coefficients for Pb>25% 171 pairs

	Cu%	Pb%	Zn%	Ag	Zn_no	Ag_Pb
Cu%	1.	0.3294	0.3628	0.2008	0.3408	0.0768
Pb%	0.3294	1.	0.2301	0.7949	0.0358	0.5917
Zn%	0.3628	0.2301	1.	-0.1650	0.9587	-0.2440
Ag	0.2008	0.7949	-0.1650	1.	-0.2973	0.9171
Zn_no	0.3408	0.0358	0.9587	-0.2973	1.	-0.3332
Ag_Pb	0.0768	0.5917	-0.2440	0.9171	-0.3332	1.

6. GEOPHYSICS

Geophysical work has focused on magnetics and gravity for the following reasons:

Previous work has identified gravity as a potentially useful tool (Langron 1966);

Siderite gangue produces a low but measurable magnetic response (Jones 1982b);

Pasminco Exploration in Tasmania has found combined gravity and magnetics to be a powerful tool in resolving structural relationships;

And comprehensive gravity data were available and ground magnetic data readily obtained.

6.1 Ground Magnetics

A ground magnetic survey was carried out on a refurbished and extended Oceana Grid (Fig. 12). The survey was conducted using a Geo-instruments G-856 magnetometer and base station leased from the Tasmanian Department of Mines.

Readings were taken with 5m station spacing and 100m line spacing from 2400 to 3700mN and 1000 to 1600 or 1800mE Oceana Grid.

The objectives of the survey were as follows:

- a. to identify a magnetic signature over known ore occurrence;
- b. to test for along strike continuation of mineralization;
- c. to identify magnetic signature of lithological units and structures, to aid a structural interpretation of the area hosting mineralization;
- d. to test for continuation of Gordon Limestone and mineralization below Moina Sandstone to the south.

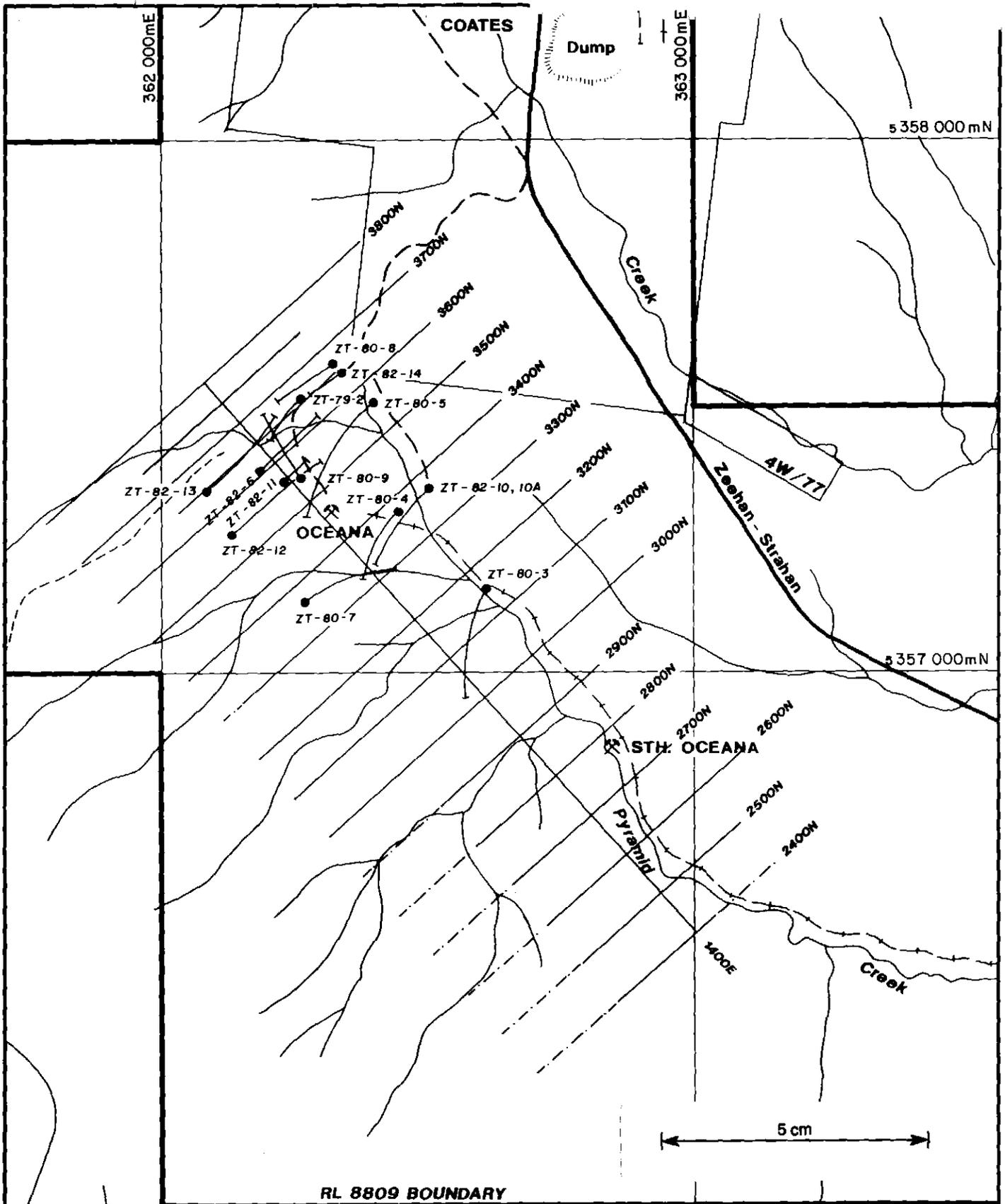
Corrected ground magnetic values are shown in plan (Fig 14).

Images of data modelled by ER Mapper are shown in fig 13

Results have been modelled in conjunction with gravity data by Leaman Geophysics and are discussed in section 6.4

6.2 Physical Properties

Physical property tests carried out by AMOCO (Jones 1982b) identified magnetic character associated with siderite gangue which although of low tenor contrasted with a bland background response. This was followed up by a test ground magnetic survey over the



KEY

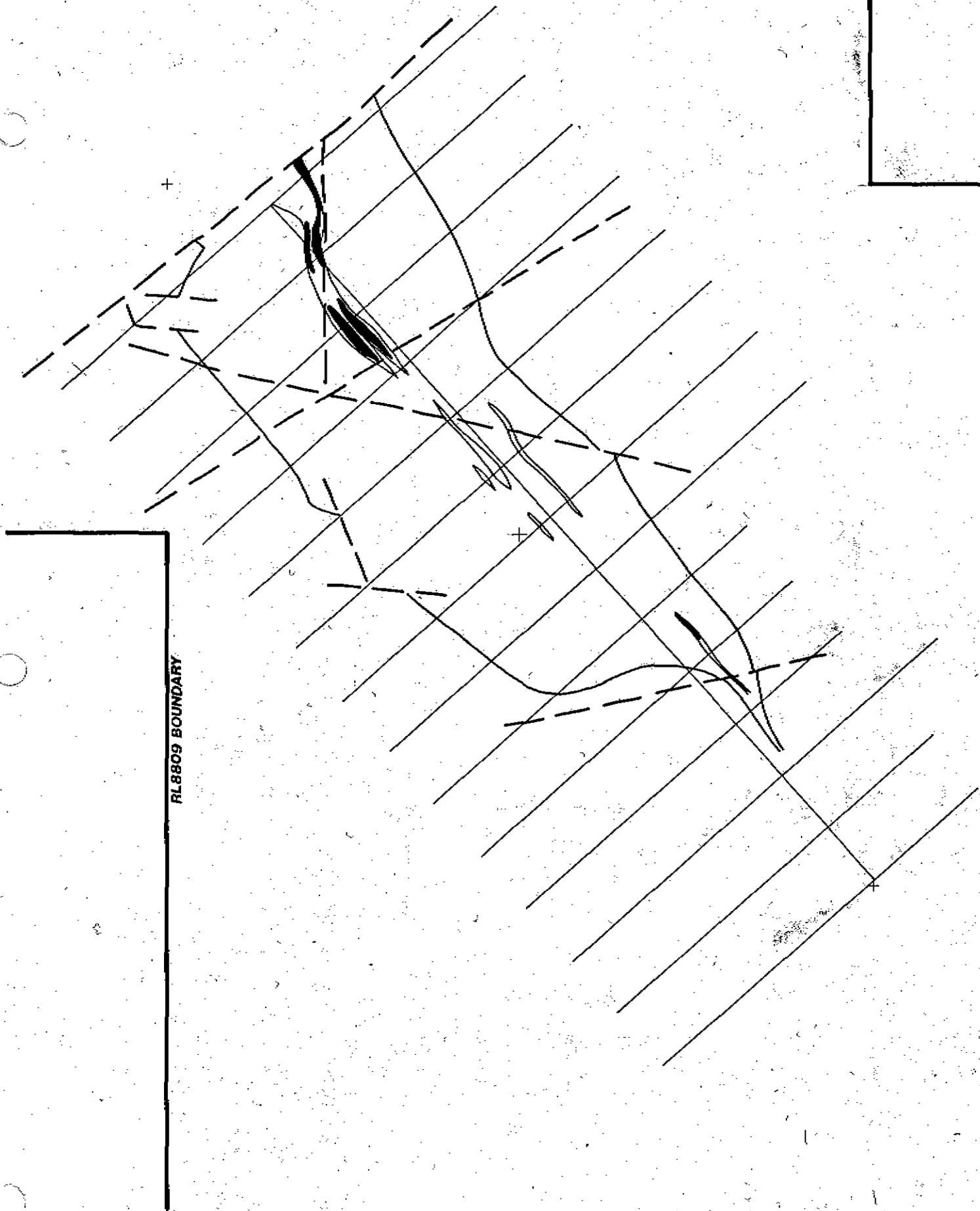
- Old grid
- - - - New grid

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COMPILED: P. M. Q. DATE: July, 1992 DRAWN: G. M. B. REF.: REVISIONS:	RL8809 - OCEANA GRID REFURBISHMENT AND EXTENSION
DRAWING No.	SCALE 1:10,000
	
FIG. No 12	

052028

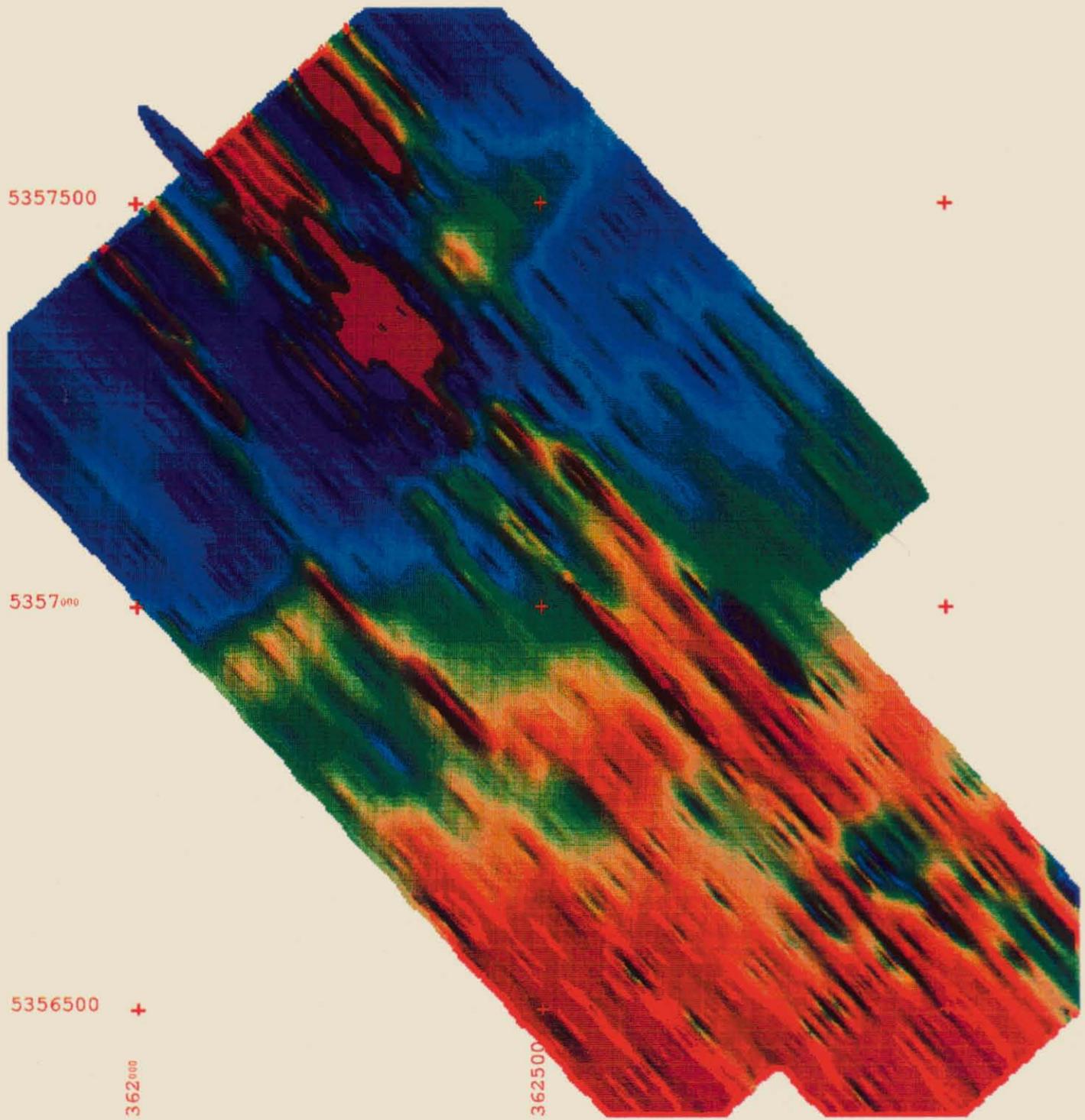
362 000 mE

052029



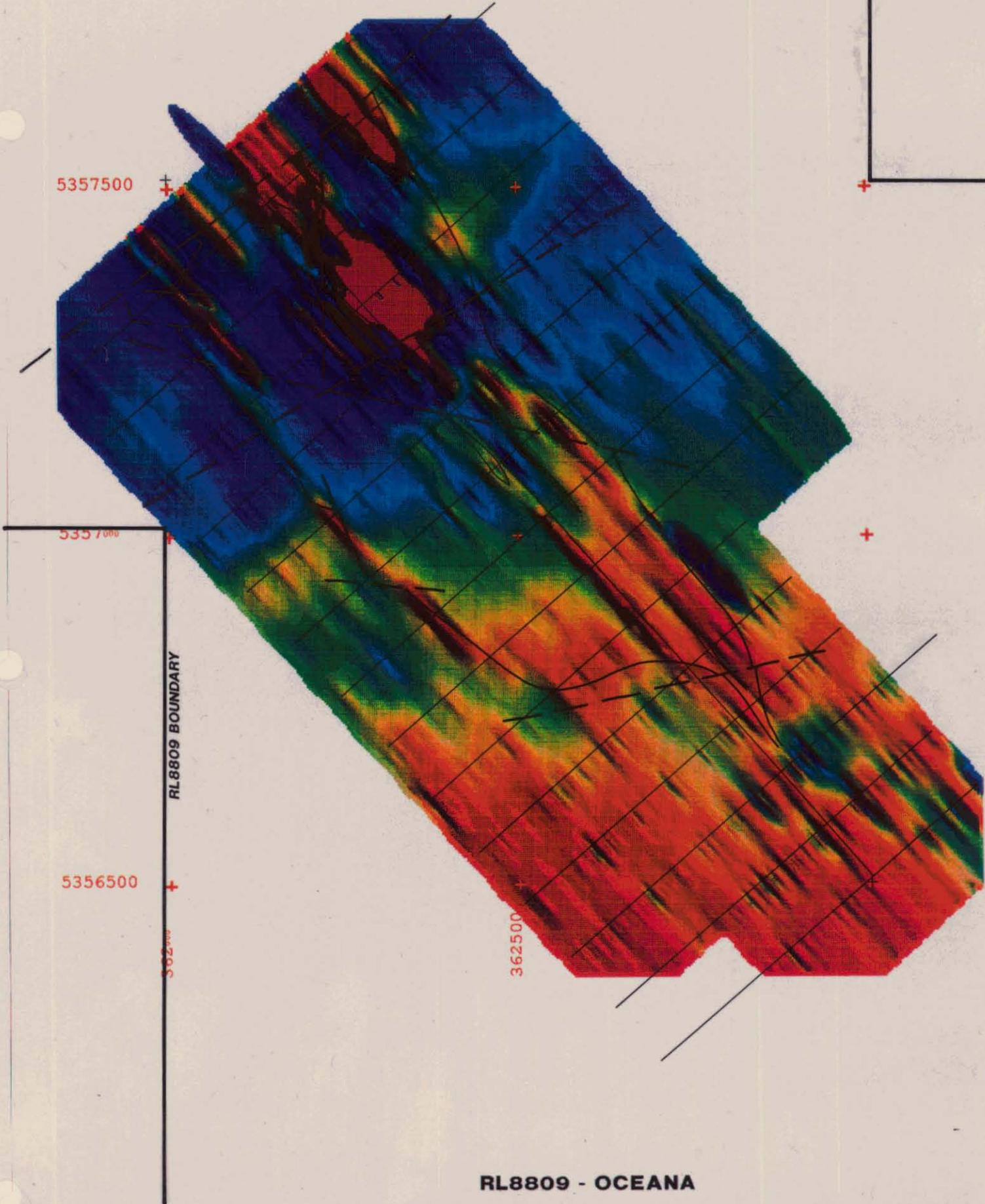
RL8809 BOUNDARY

SIMPLIFIED GEOLOGY



RL8809 - OCEANA
GROUND MAGNETICS
COLOUR DRAPE (Sun N/E)

052029
052030



RL8809 - OCEANA
GROUND MAGNETICS
COLOUR DRAPE (Sun N/E)
SIMPLIFIED GEOLOGY

north part of the Oceana mine area with encouraging results, and subsequent surveys over the Austral, North Austral, Pyramid and Nubeena grids.

Physical property tests have recently been carried out on a number of diamond drill holes from Oceana (appendix 4).

These indicate that mineralized/sideritic zones have a magnetic susceptibility of approximately 25 times background.

Specific Gravity:

Previous work (Jones 1982a) produced an average density for various rock types as follows:

calcite-rich carbonates	2.72 - 2.74
dolomite-rich carbonates	2.83
siderite	2.98
quartzose limestones	2.69

Magnetic susceptibility and specific gravity determination will be carried out on all remaining "ZT" series AMOCO diamond drill holes and on all new drilling. Petrology will be conducted on anomalous zones to identify the source of the anomalous magnetic response and its relationship to mineralization.

6.3 Gravity.

Existing gravity data have been acquired from the Tasmanian Department of Mines. This includes data from Amoco 1981 surveys (Jones 1981) which were subsequently tied into the state datum and corrected by Leaman Geophysics. The data location and values are shown in fig 17. ER Mapper images of modelled data appear in figs 15 and 16.

Plots of gravity gradient for the Oceana area (appendix 6) were received from the Tasmanian Department of Mines in order to assess the applicability of gravity gradient methods to the Oceana area. Whilst these plots are of interest the method will not be further investigated at this time.

052032

RL8809 - OCEANA

GRAVITY

COLOUR DRAPE (Sun E/W)

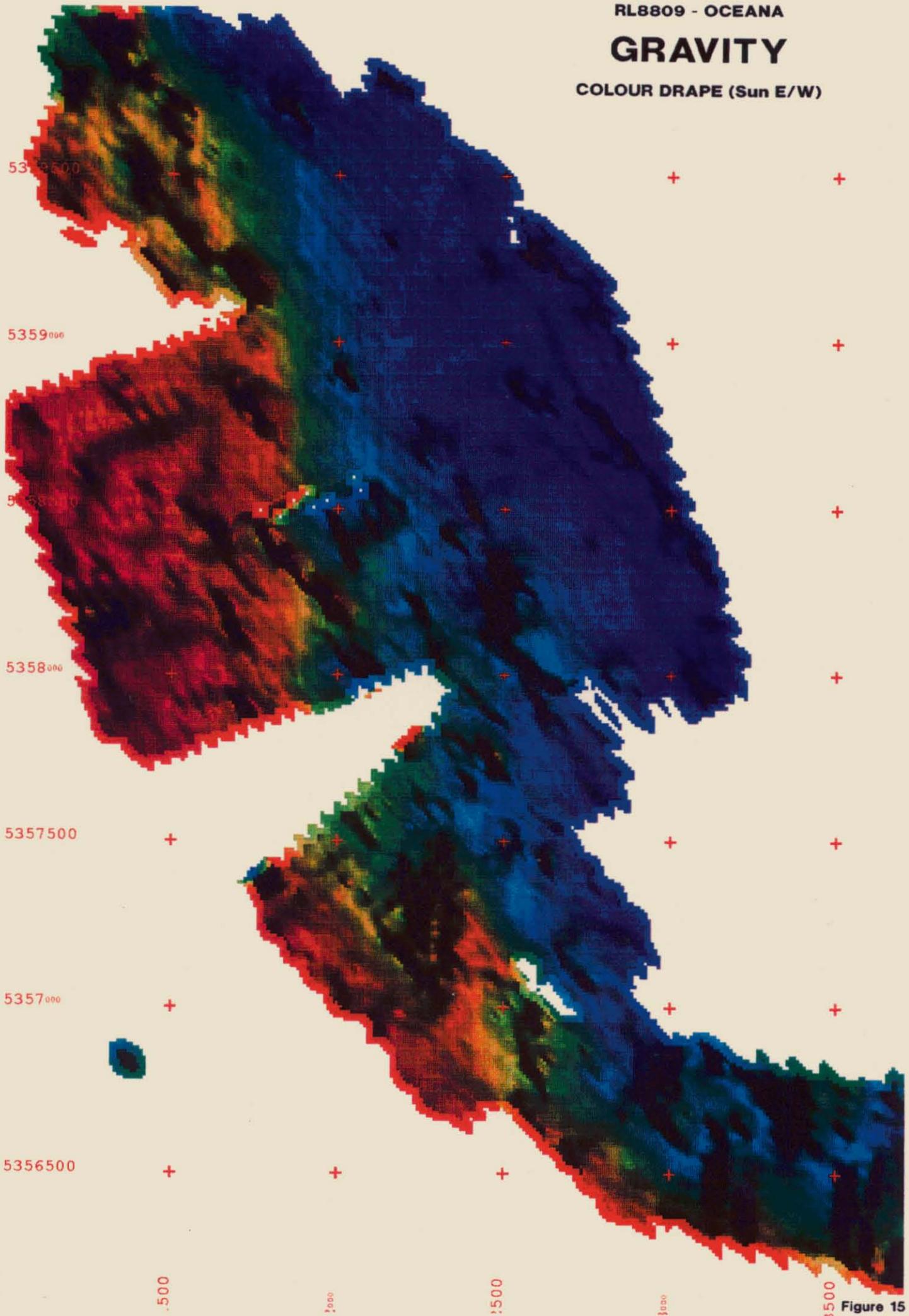
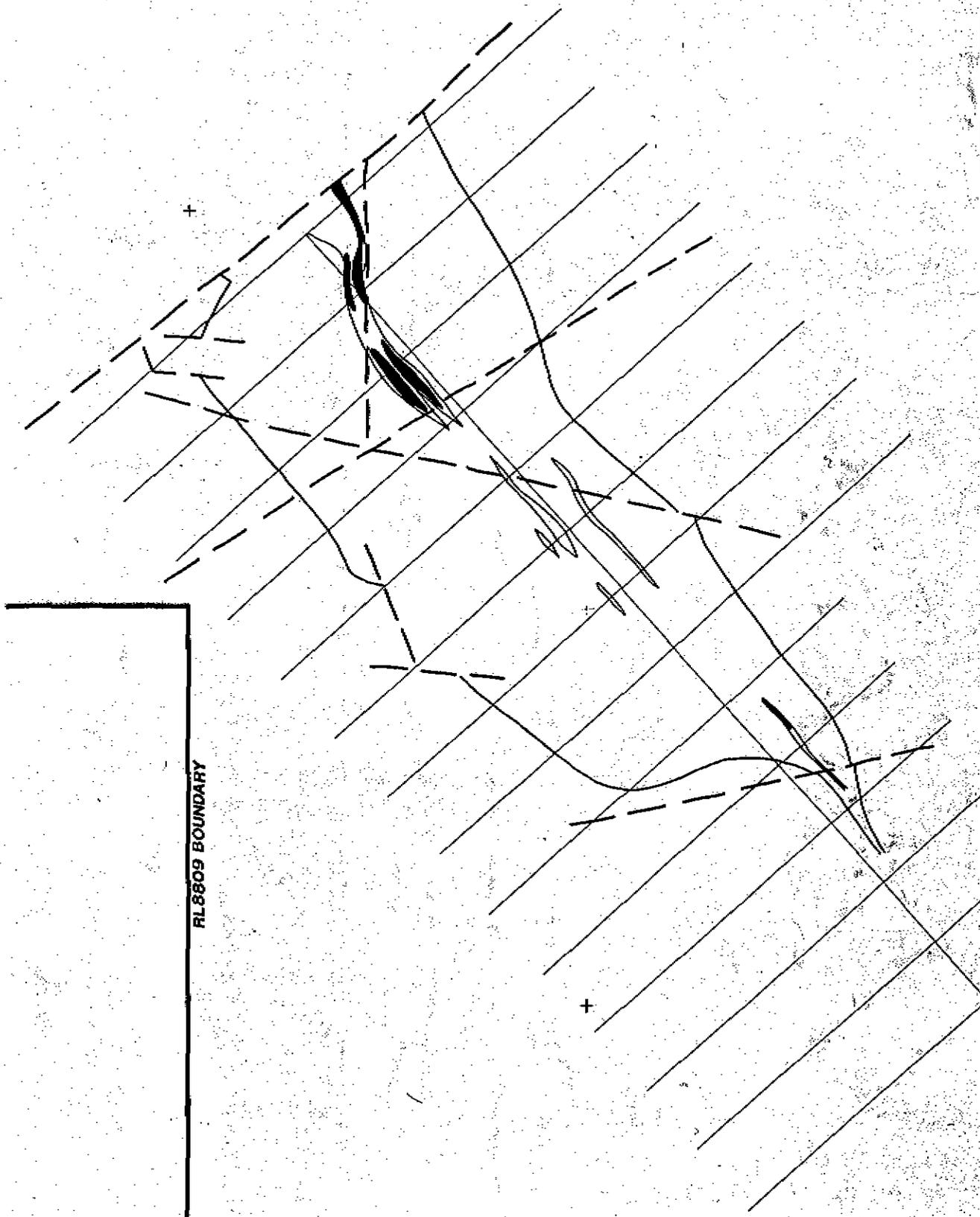


Figure 15

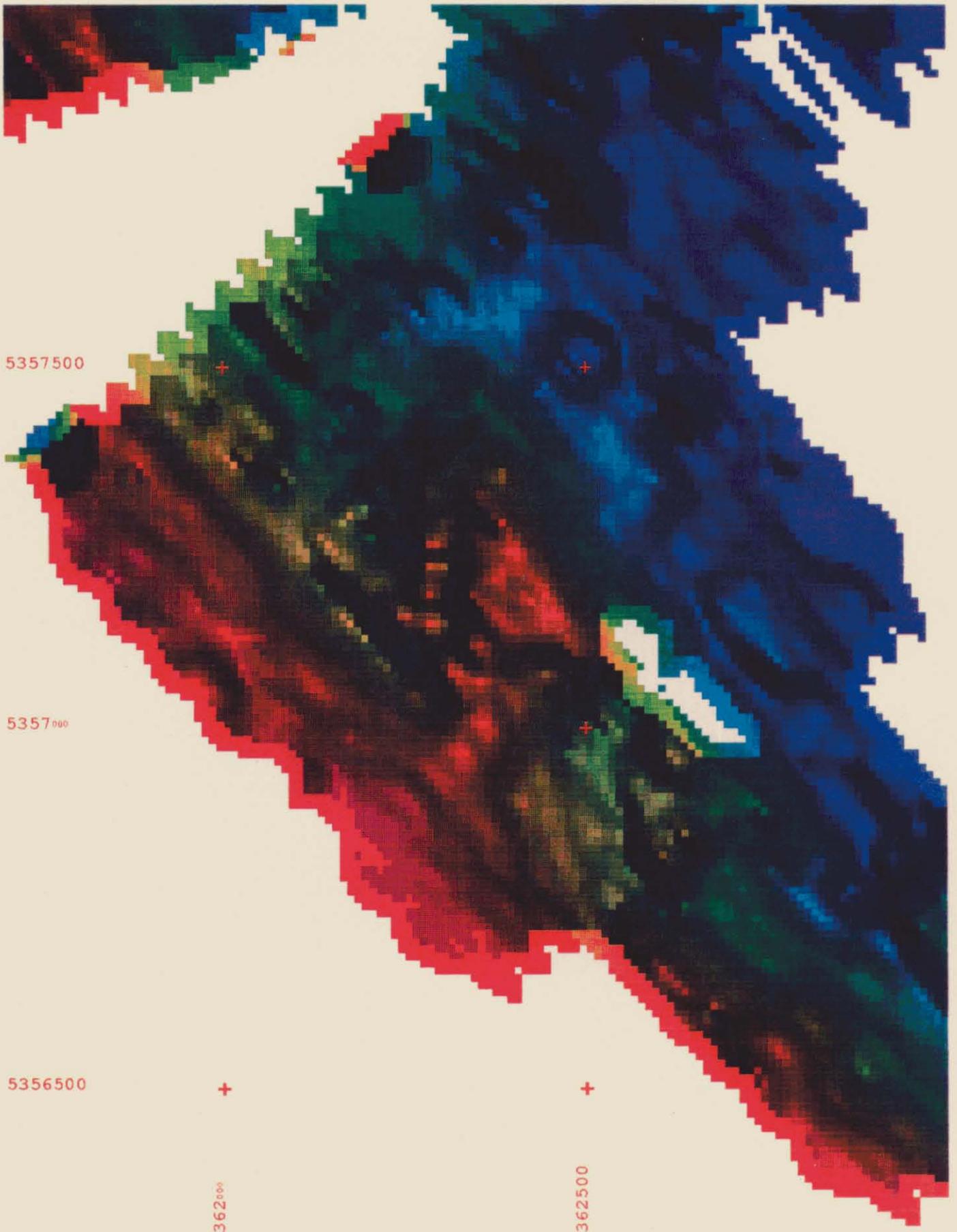
052033



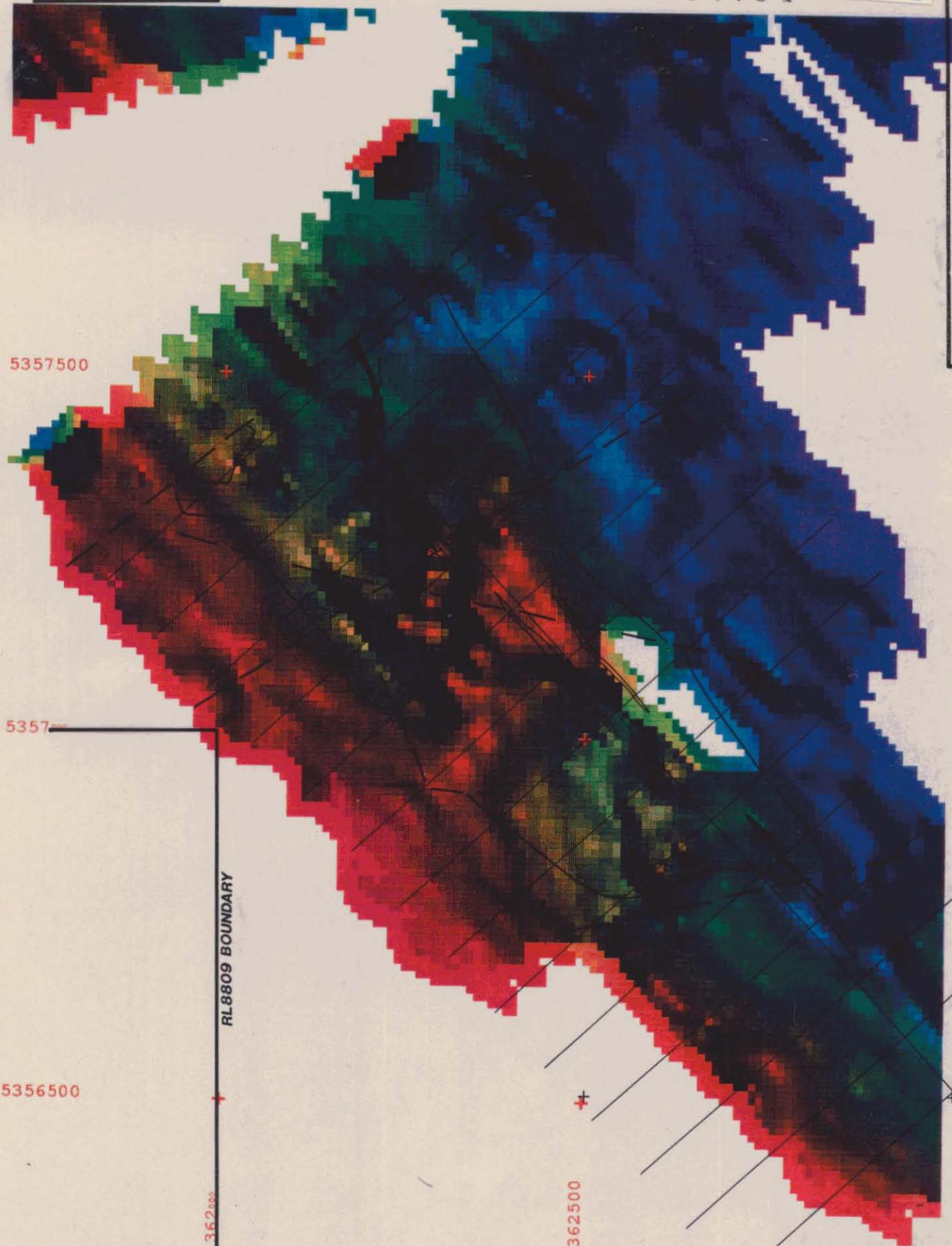
RL8809 BOUNDARY

SIMPLIFIED GEOLOGY

052034



RL8809 - OCEANA
GRAVITY
COLOUR DRAPE (Sun N/S)



RL8809 - OCEANA
GRAVITY
COLOUR DRAPE (Sun N/S)
SIMPLIFIED GEOLOGY

6.4 Combined Gravity and Magnetism Interpretations.

Leaman Geophysics was commissioned to model the existing gravity and magnetic data discussed above and to review further data acquisition.

Leaman stresses the importance of viewing the local gravity within the regional context in order to filter out regional trends and to enhance local *critical features*.

The critical features Leaman identified as follows:

1. A magnetic response corresponds exactly to known mineralisation.
2. The Gordon Limestone contacts with the overlying Crotty Quartzite and with the Moina Sandstone across the Oceana Fault respond magnetically probably reflecting alteration/oxidation on the contacts.
3. There is a major change at 3350 – 3400mN Oceana Grid (OG). This change is approximately E/W (OG) and corresponds imperfectly with the South Oceana Fault. The change can be seen as a magnetic negative and an offset gravity positive. A zone of alteration and the presence of two structural features is inferred.
4. A similar feature to the "known mineralisation response" continues to the south of 3200mN (offset? to 1450mE) towards the South Oceana mineralisation.
5. A further feature similar to but more diffuse than the "known mineralisation response" strikes across the Gordon Limestone / Moina Sandstone contact where the Gordon Limestone thins at approximately 2800mN. This is consistent with mineralisation at depth within the Gordon Limestone overthrust by Moina Sandstone.
6. The gravity and magnetic response at 3400mN is consistent with the overthrust pattern established at 2800mN possibly indicating Gordon Limestone at depth to the west beneath the Moina Sandstone.
7. All contacts appear to dip steeply to the east.
8. Abnormally high density was observed within the "worm burrowed" unit of the Moina Sandstone.
9. Limited data across the Oceana Fault queries its depth of influence.

Leaman identified three target zones as follows:

- a. 3350mN 1330 – 1350mE, a continuation of the Oceana Mine mineralised line doubly offset;
- b. 2800mN 1300mE continuing southwards beneath overthrust Moina Sandstone;
- c. 3200mN 1450mE continuing southwards to become the South Oceana line of mineralisation.

Leaman recommended that the following work be undertaken:

The collection of gravity data from north of the Oceana Fault, and from traverses to the west, south and east of the grid. This coverage should extend for approximately 1km with 250m station spacings in order to clarify the regional setting;

The collection of magnetic data to be continued on two lines to the north of the Oceana Fault.

And to increase the local physical properties database.

6.5 Proposed work

A programme to collect some 55 gravity readings, and the continuation of the ground magnetic survey as discussed in section 6.4 is planned for late October. Existing ground magnetic data from the Austral, North Austral, Pyramid and Nubeena grids are currently being digitised.

Physical properties will be collected from all remaining available drill core, all current drill core and any appropriate field samples. Several samples of Moina Sandstone from the "worm burrowed" were collected. These samples were taken from the zone with anomalous density discussed in section 6.4. Two of these samples which had a measured S.G. of 2.85 and 2.96 are currently being analysed.

Leamans targets (b) and (c) are currently being drilled, a further drill hole to intersect target (a) is planned.

This data will be incorporated into further studies by Leaman Geophysics.

7. ORE RESOURCE AND POTENTIAL

7.1 Ore Resource

The following figures are taken from Joyce (1988) (Fig.18)

	tonnes	Pb%	Zn%	Ag g/t
1988 Cyprus Gold 3550 – 3700mN	2 297 000	7.1	2.5	48
1983 EZ 3200 – 3450mN	750 000	12	4	89
Total	3 047 000	8.3	2.9	58

A specific gravity and a cutoff of 5% Pb +Zn were used.

lens
A second lease approximately 20 m west of resource stated above (1983 EZ) and 2 to 3m wide which must be viable if that resource is exploited could contain a further 240 000 tonnes at approximately 17.5% Pb, 6% Zn and 211 g/t Ag.

Advantages:

proximity to infrastructure:

good recoveries – 96 – 98% Pb and 95 – 98 % Ag recoveries obtained by simple flotation processes (from Manager's Reports, Zeehan Mines Pty. Ltd., Sept 1950);

good quality concentrate – virtually no arsenic or bismuth and only minor antimony;

morphology of lenses – narrow, vertical and consistent?

Disadvantages

water influx – the closure of the Oceana Mine in 1960 was partly due to influx of 11.4 megalitres of water per day.

ground conditions – the bulk of the current resource is between the Oceana Fault and the Mine Fault and very poor ground conditions are expected.

Others

commodity – is dependent on expected market.

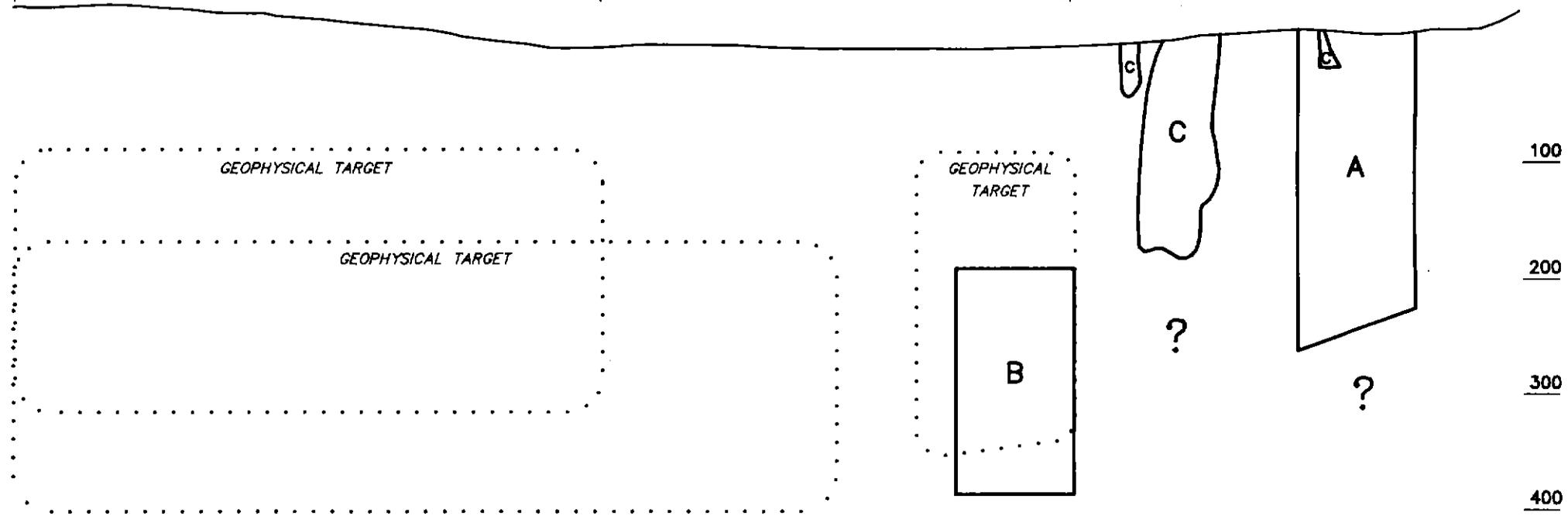
water – could become a resource if the old Zeehan Smelter dumps are to be retreated.

7.2 Ore Potential

Potential for increasing the resource is as follows:

- 1 Leaman's gravity/magnetic target (a) to the south and west of Resource B (Fig 18)
- 2 Leaman's gravity/magnetic target (b) on along strike continuation of the Oceana mineralized position in the Gordon Limestone below overthrust Moina Sandstone.
- 3 Leaman's gravity/magnetic target (c) the South Oceana line of mineralisation, possibly an eastern lens or an eastern off-set of the Oceana mineralisation.
- 4 Below the Oceana Mine: mining was stopped due to falling metal prices and water influx, not lack of ore.
- 5 Resource A (Fig. 18) is cutoff at depth by a shallow fault, there is no drilling information below this flat fault, but minor faulting in a similar orientation was mapped in the Oceana Mine (Jack 1961) displacing mineralization rather than terminating it.
- 6 If the Oceana Fault or the South Oceana Fault is a feeder structure then the trace of the fault is prospective and not tested.
- 7 A continuation of the Oceana line of mineralisation to the north of the Oceana Fault off-set to the east.
- 8 If the Gordon Limestone is over thrust by the Moina Sandstone then the Pyramid mineralization becomes more interesting.
- 9 If the Oceana is a transform fault then mineralised Gordon Limestone could exist to the north overthrust by Moina Sandstone.

2500mN 3000mN 3400mN



052039

RESOURCE

Using SG = 4 Cut off = 5% Pb + Zn

		tonnes	Pb %	Zn %	Ag g/t
A	CYPRUS 1988	2,297,000	7.1	2.5	48
B	EZ 1983	750,000	12	4	89
	TOTAL	3,047,000	8.3	2.9	58

PRODUCTION

C		130,000	11.8	~4	152
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COMPILED : P.M.Q.	RL8809 - OCEANA LOCATION OF CURRENT RESOURCE, HISTORICAL PRODUCTION AND POTENTIAL		
DATE : Oct., 1982			
DRAWN : G.M.B.			
REFERENCE :			
REVISIONS :			
DRAWING No. OCCRHPP	SCALE 1:5000		FIG. No. 18

8. CONCLUSIONS

Investigations of combined Gravity and Magnetic data indicate that:

- mineralisation has a gravity/magnetic signature;
- lithological units can be distinguished;
- the Gordon Limestone continues to the south overthrust by the Moina Sandstone;
- a similar feature to the "known magnetic response" occurs in the Gordon Limestone beneath the Moina Sandstone;
- the overthrust pattern is repeated further to the north;

and thus gravity and magnetic interpretation is a useful tool in targeting mineralisation and in resolving structural relationships.

Geological investigation has indicated that:

- a recognisable stratigraphy exists within the Gordon Limestone at Oceana and thus detailed work on existing and new core should elucidate the structural and stratigraphic relationships of the mineralization

thrusting on a small and large scale has acted upon the Oceana mineralization and its regional setting and this has profound implications on the local and regional exploration for sulphide mineralization.

Much largely untested potential exists within the Oceana RL.

9. EXPENDITURE REPORT

The following is a breakdown of expenditure for the period from October 1991 to September 1992.

Salaries, Wages, On-costs: staff	29897
Geological Consultants	575
Geophysical Consultants	1897
Other Consultants and Contractors	1964
Gridding	6000
Geophysical Survey	3000
Drilling: including access, acquisition of Amoco core, and materials	10735
Computing	1567
Vehicles and Equipment	4294
Stores and Supplies	2241
Tenement Costs	1183
Travel and Accommodation	2648
Office Running Costs	11790
Administration	7779
TOTAL	85570

10. PROPOSED WORK PROGRAMME AND BUDGET

Exploration activities proposed for the period from October 1992 to September 1993 include:

1. Diamond Drilling: two DDH each of approximately 500m will be drilled as proposed in Section 4.3 on combined geological, geophysical and geochemical targets. One of the DDH is designed to increase the existing resource whilst the other is designed to identify new potential.
2. Geology: detailed logging of existing core from Oceana and other prospects together with selected field mapping is proposed in order to place mineralisation, structure and stratigraphy in both a detailed and a regional geological context. This study will incorporate petrographic examination.
3. Geophysics as follows:
 - extension of gravity survey;*
 - increase physical properties database;*
 - existing ground magnetic data from other grids to be digitised;*
 - aeromagnetic survey to be flown over 120 line kms;*
 - ongoing gravity/magnetic study of above results;*
 - DHEM will be conducted on current DDH.*
4. Geochemistry as follows:
 - relevant analyses for current DDH;*
 - analyses of a comprehensive range of elements from selected minerals to determine overall characteristics;*
 - probing of selected sphalerite for regional correlation.*

The total cost of the proposed programme is expected to be as follows:

Salaries: wages and on-costs: staff	38000
Diamond Drilling	89000
Geophysics:	
DHEM	2500
Aeromagnetics collection and consultants	8500
Gravity; collection and consultants	6000
Geochemistry	2500
Computing	3000
Vehicles and Equipment	4000
Stores and Supplies	3000
Tenement Costs	1000
Office Running Costs	9500
Administration	13000
TOTAL:	180000

REFERENCES

- Blissett, A.H. 1962. One mile geological map series. K/55-5-50. Zeehan. Explanatory Rep. Geol. Surv. Tas.
- Blissett, A.H. and Gulline, A.B., 1962 One mile geological map series. K/55-5-50. Zeehan Department of Mines, Tasmania.
- Ellis, A.P., 1984. Mineralization and Palaeoenvironments in Gordon Group Sediments, South of Zeehan, Western Tasmania. Unpublished Hons Thesis, University of Tasmania.
- Findlay, R.H., and Brown, A.V., 1992. The 10th Legion Thrust, Zeehan District: Distribution, interpretation and regional and economic significance. Division of Mines and Mineral Resources - Report 1992/02.
- Jack, R., 1961 Report on the Oceana Mine - Zeehan. Tech. Report Dept. Mines Tasmania. 5:77-88.
- Jones, P.A., 1981, Progress Report June 1980 to June 1981: Amoco Minerals Australia Company.
- Jones, P.A., 1982a, Progress Report July 1981 to January 1982: Amoco Minerals Australia Company.
- Jones, P.A., 1982b, Progress Report January to July 1982: Amoco Minerals Australia Company.
- Jones, P.A., 1988, Geological Report Retention Licence Application Oceana - Austral Zeehan Tasmania. Unpublished Cyprus Report No.574, May 1988.
- Joyce, P., 1 1988 Oceana. Internal Report to Cyprus Gold Australia Corporation.
- Langron, W.J., 1966, Zeehan Geophysical Surveys, Tasmania 1947-1948. Record of Bureau Mineral Resources, Australia, 1966/163.
- Lees, T.C., 1992 Second Regrad Study of West Tasmania. Pasminco Exploration Internal Report HW96
- Taylor, S., 1983. Review of Amoco Exploration of Gordon Limestone in EL4/78 and Assessment of Pb-Zn Potential of Gordon Limestone in West-Central Tasmania. Unpublished EZ Report, March 1983.

KEYWORDS

LEAD, ZINC, SILVER, LIMESTONE, CARBONATE HOSTED, FAULT, THRUST, ORDOVICIAN, DATA REVIEW; GEOPHYS, GEOPHYS GROUND MAGNETICS, GEOPHYS GRAVITY, GEOPHYS PHYSICAL PROPERTIES, ORE RESOUCE .

LOCATION

1:25 000 Sheet Oceana

Tenement: RL 8809 OCEANA JV

District West Coast Tasmania

Gordon Limestone

APPENDICES

APPENDIX 1.

Schedule RL 8809

SCHEDULE RL8809

Commencing at a south west corner of the area whose grid co-ordinates are 362 000 metres E. 5 356 000 metres N. thence grid north to 5 357 000 metres N. grid west to 361 500 metres E. again grid north to 5 358 000 metres N. grid east to 362 000 metres E. aforesaid again grid north to 5 359 500 metres N. again grid east to 363 000 metres E. grid south to 5 357 500 metres N. again grid east to 364 000 metres E. again grid south to 5 356 000 metres N. thence again grid west to the point of commencement.

APPENDIX 2.**Oceana DDH collar coordinates and down hole surveys.**

Oceana DDH collars

HOLE_ID	OMG E	OMG N	AMG E	AMG N	RL	EOH
ZT_79_2	1500.0	3700.0	362214.31	5357539.95	193.5	235.9
ZT_80_3	1515.0	3200.0	362560.03	5357178.42	198.5	399.7
ZT_80_4	1490.0	3420.0	362394.24	5357325.18	178.0	360.3
ZT_80_5	1590.0	3600.0	362348.11	5357525.86	186.0	475.3
ZT_80_6	1350.0	3650.0	362136.30	5357402.42	200.5	330.0
ZT_80_7	1250.0	3420.0	362215.88	5357164.59	188.0	250.0
ZT_80_8	1575.0	3700.0	362270.05	5357590.14	195.0	228.6
ZT_80_9	1400.0	3600.0	362206.91	5357398.72	196.5	228.6
ZT_82_10	1560.0	3415.0	362449.60	5357368.30	181.0	190.7
ZT_82_10A	1562.0	3415.0	362451.09	5357369.64	181.0	574.6
ZT_82_11	1374.0	3602.0	362186.25	5357382.81	196.0	87.9
ZT_82_12	1230.0	3605.0	362077.23	5357288.69	208.0	481.6
ZT_82_13	1250.0	3685.0	362038.56	5357361.52	210.0	346.0
ZT_83_14	1575.0	3670.0	362290.12	5357567.84	191.0	173.0
ZT_W2	1415.0	3600.0	362218.06	5357408.76	193.0	15.0
o1	1483.0	3651.5	362234.13	5357492.53	189.0	96.3
o2	1420.0	3472.5	362307.09	5357317.36	183.5	295.0
o3	1418.5	3421.0	362340.44	5357278.08	182.5	152.0
o4	1552.5	3523.0	362371.77	5357443.54	185.0	78.0
o5	1504.5	3573.0	362302.64	5357448.58	185.5	229.8
o25	1405.0	3502.5	362275.87	5357329.61	186.0	136.5
o26	1405.0	3502.5	362275.87	5357329.61	186.0	241.7
o27	1391.0	3485.5	362276.84	5357307.61	186.5	55.0
o28	1392.0	3454.5	362298.33	5357285.24	186.0	55.0
o29	1399.0	3424.5	362323.60	5357267.63	183.0	74.0
o32	1415.0	3485.0	362295.01	5357323.30	185.0	121.0
o34	1443.0	3544.0	362276.34	5357385.88	188.5	112.5
o35	145.3	3551.0	361307.28	5356522.75	188.0	158.2
o41	1435.0	3456.0	362329.28	5357315.13	181.5	149.0
o44	1417.0	3415.5	362343.00	5357272.99	181.0	77.0
o45	1394.0	3408.5	362330.59	5357252.40	186.0	73.0
o46	1349.0	3430.5	362282.43	5357238.64	183.0	48.0
o47	1349.0	3430.5	362282.43	5357238.64	183.0	70.0
o48	1389.0	3668.0	362153.24	5357441.90	197.5	39.0
o50	1363.0	3652.0	362144.62	5357412.61	200.0	85.0
o53	1441.0	3691.0	362176.49	5357493.78	195.5	56.0
o60	1352.0	3445.0	362274.96	5357251.42	183.5	55.0
o61	1440.5	3460.0	362330.69	5357321.78	182.5	177.0
o62	1339.0				182.5	51.0
o64	1565.5	3485.0	362406.85	5357424.00	180.5	276.0
o65	1461.0	3630.5	362231.84	5357462.21	191.5	63.0
o66	1461.0	3606.0	362248.23	5357444.00	196.0	66.0
o68	1303.0	3453.0	362233.19	5357224.58	190.0	119.0
OP1	1500.0	2795.0	362819.88	5356867.41	168.0	

HOLE_ID	DEPTH	DIP	AMG AZIMUTH
OP1	0.0	-50.00	229.50
OP1	30.0	-51.00	232.50
OP1	60.0	-52.00	232.00
OP1	90.0	-52.50	231.50
OP1	120.0	-52.50	230.50
OP1	150.0	-52.00	229.50
ZT_79_2	0.0	-60.00	227.50
ZT_79_2	50.0	-65.00	227.50
ZT_79_2	100.0	-63.00	227.50
ZT_79_2	150.0	-57.00	227.50
ZT_79_2	200.0	-73.00	227.50
ZT_79_2	235.9	-71.00	227.50
ZT_80_3	0.0	-60.00	228.50
ZT_80_3	50.0	-62.00	218.50
ZT_80_3	100.0	-61.00	209.50
ZT_80_3	150.0	-59.50	200.50
ZT_80_3	200.0	-56.00	194.50
ZT_80_3	250.0	-55.00	191.50
ZT_80_3	300.0	-52.00	189.00
ZT_80_3	350.0	-47.00	186.50
ZT_80_3	399.7	-41.00	184.50
ZT_80_4	0.0	-66.00	227.50
ZT_80_4	50.0	-66.00	228.50
ZT_80_4	100.0	-67.00	226.50
ZT_80_4	150.0	-67.50	227.50
ZT_80_4	200.0	-67.00	213.50
ZT_80_4	250.0	-65.00	202.50
ZT_80_4	300.0	-64.00	199.50
ZT_80_4	350.0	-59.50	191.50
ZT_80_4	360.3	-59.50	191.50
ZT_80_5	0.0	-65.00	227.50
ZT_80_5	50.0	-66.50	229.50
ZT_80_5	100.0	-67.00	226.50
ZT_80_5	150.0	-65.00	224.50
ZT_80_5	200.0	-61.00	221.50
ZT_80_5	250.0	-61.00	216.50
ZT_80_5	300.0	-57.00	213.50
ZT_80_5	350.0	-55.00	206.50
ZT_80_5	400.0	-55.00	198.50
ZT_80_5	450.0	-54.00	198.50
ZT_80_5	475.3	-54.00	198.50
ZT_80_6	0.0	-60.00	48.50
ZT_80_6	50.0	-65.00	48.50
ZT_80_6	100.0	-64.00	46.50
ZT_80_6	150.0	-64.00	45.50
ZT_80_6	200.0	-63.50	46.50
ZT_80_6	266.0	-61.00	44.50
ZT_80_6	300.0	-59.00	45.50
ZT_80_6	330.0	-60.50	43.50
ZT_80_7	0.0	-50.00	48.50
ZT_80_7	50.0	-48.00	51.50
ZT_80_7	75.0	-46.00	54.50
ZT_80_7	100.0	-44.00	56.50
ZT_80_7	125.0	-41.50	59.50
ZT_80_7	200.0	-41.50	63.50
ZT_80_7	250.0	-40.50	62.50
ZT_80_8	0.0	-55.00	228.50
ZT_80_8	50.0	-61.50	229.00
ZT_80_8	100.0	-61.50	233.50
ZT_80_8	150.0	-62.50	233.50
ZT_80_8	200.0	-64.50	233.50
ZT_80_8	228.6	-65.00	233.50

HOLE_ID	DEPTH	DIP	AMG AZIMUTH
ZT_80_9	0.0	-50.00	324.50
ZT_80_9	50.0	-50.50	328.50
ZT_80_9	100.0	-52.00	328.50
ZT_80_9	150.0	-53.00	327.50
ZT_80_9	200.2	-54.00	330.50
ZT_82_10	0.0	-67.50	227.50
ZT_82_10	29.0	-69.00	227.50
ZT_82_10	53.0	-70.00	226.00
ZT_82_10	79.0	-71.00	227.50
ZT_82_10	100.0	-70.00	226.50
ZT_82_10	132.0	-70.00	223.00
ZT_82_10	144.0	-70.00	222.50
ZT_82_10	179.0	-70.00	221.00
ZT_82_10	190.7	-70.00	221.00
ZT_82_10A	0.0	-65.00	227.50
ZT_82_10A	95.0	-68.00	226.50
ZT_82_10A	126.0	-68.00	227.00
ZT_82_10A	151.0	-68.50	226.00
ZT_82_10A	200.0	-68.00	223.50
ZT_82_10A	251.0	-68.00	221.50
ZT_82_10A	300.0	-68.00	217.00
ZT_82_10A	325.0	-68.00	213.50
ZT_82_10A	350.0	-67.00	213.50
ZT_82_10A	400.0	-67.00	209.50
ZT_82_10A	458.0	-67.00	207.50
ZT_82_10A	500.0	-66.50	206.00
ZT_82_10A	574.6	-64.50	200.50
ZT_82_11	0.0	-45.00	47.50
ZT_82_12	0.0	-64.00	47.50
ZT_82_12	60.0	-65.00	45.50
ZT_82_12	106.0	-63.00	50.50
ZT_82_12	146.0	-62.50	51.50
ZT_82_12	229.0	-63.50	51.50
ZT_82_12	292.0	-63.50	50.50
ZT_82_12	334.0	-62.00	54.00
ZT_82_12	349.0	-62.00	54.00
ZT_82_12	398.0	-63.00	53.00
ZT_82_12	443.0	-65.00	54.50
ZT_82_12	480.0	-65.00	56.00
ZT_82_12	481.6	-65.00	56.00
ZT_82_13	0.0	-60.00	47.50
ZT_82_13	122.0	-58.00	45.50
ZT_82_13	218.0	-60.00	41.50
ZT_82_13	250.0	-60.00	40.50
ZT_82_13	282.0	-60.00	38.95
ZT_82_13	290.0	-59.00	37.50
ZT_82_13	317.0	-59.00	37.50
ZT_82_13	346.0	-59.00	37.50
ZT_83_14	0.0	-61.00	227.50
ZT_83_14	97.0	-61.00	225.50
ZT_83_14	156.0	-61.50	225.50
ZT_83_14	172.2	-61.50	225.50
ZT_W2	0.0	-45.00	185.50

HOLE_ID	DEPTH	DIP	AMG AZIMUTH
o1	0.0	-42.00	236.50
o2	0.0	-65.00	266.50
o25	0.0	-66.00	231.50
o26	0.0	-47.00	231.50
o27	0.0	-53.00	229.50
o28	0.0	-53.00	229.50
o29	0.0	-53.00	229.50
o3	0.0	-45.00	233.00
o32	0.0	-57.50	229.50
o34	0.0	-45.00	238.50
o4	0.0	-45.00	256.00
o41	0.0	-58.00	228.50
o44	0.0	-51.00	49.00
o45	0.0	-50.00	49.00
o46	0.0	-54.00	49.00
o47	0.0	-74.00	49.00
o48	0.0	-48.50	19.50
o5	0.0	-55.00	245.00
o50	0.0	-48.00	19.50
o53	0.0	-50.00	202.50
o61	0.0	-61.00	265.50
o64	0.0	-44.00	230.50
o65	0.0	-44.00	224.50
o66	0.0	-46.00	36.00
o68	0.0	-47.00	49.00

APPENDIX 3.

**A Sedimentological Survey of the Ordovician host
sediments to the Oceana mineralisation, Tasmania.**

Dr M.K. Neudert.

A sedimentological survey of the Ordovician
host sediments to Oceana mineralisation,
Tasmania.

Martin K. Neudert
Sedcon
Brisbane
September 1992

A sedimentological survey of the Ordovician host sediments to Oceana mineralisation, Tasmania.

Activities at Oceana Prospect:

1) Field examination of the facies sequence from near the base of the Mount Zeehan Conglomerate to near the top of the Moina Sandstone including the Quartz Pebble Conglomerate (QPC).

Purpose: examination of the nature of contacts between (i) the Moina Sandstone and the QPC, and (ii) the QPC and the Gordon Limestone.

2) Core examination of the Gordon Limestone in drillholes ZT 80-3, ZT 80-4, ZT 80-5, ZT 80-7, ZT 82-10A and ZT 82-12.

Purpose:

- (i) establishing a regional facies framework in which to place Oceana mineralisation,
- (ii) generating a method for facies correlation through the Gordon Limestone,
- (iii) searching for coarse terrigenous clastics at the lower boundary (with the Moina Sandstone) and the upper boundary (with the the Crotty Quartzite) as indications for stratigraphic continuity,
- (iv) determining the depositional environment(s) of Gordon Limestone facies as an indicator for depositional conditions during sediment accumulation,
- (v) searching for indications of the likely geological controls over sulphide mineralisation.

3) Teaching the preparation and use of a staining solution for carbonate minerals.

Purpose: Field identification of the carbonate minerals calcite, dolomite, ankerite and siderite.

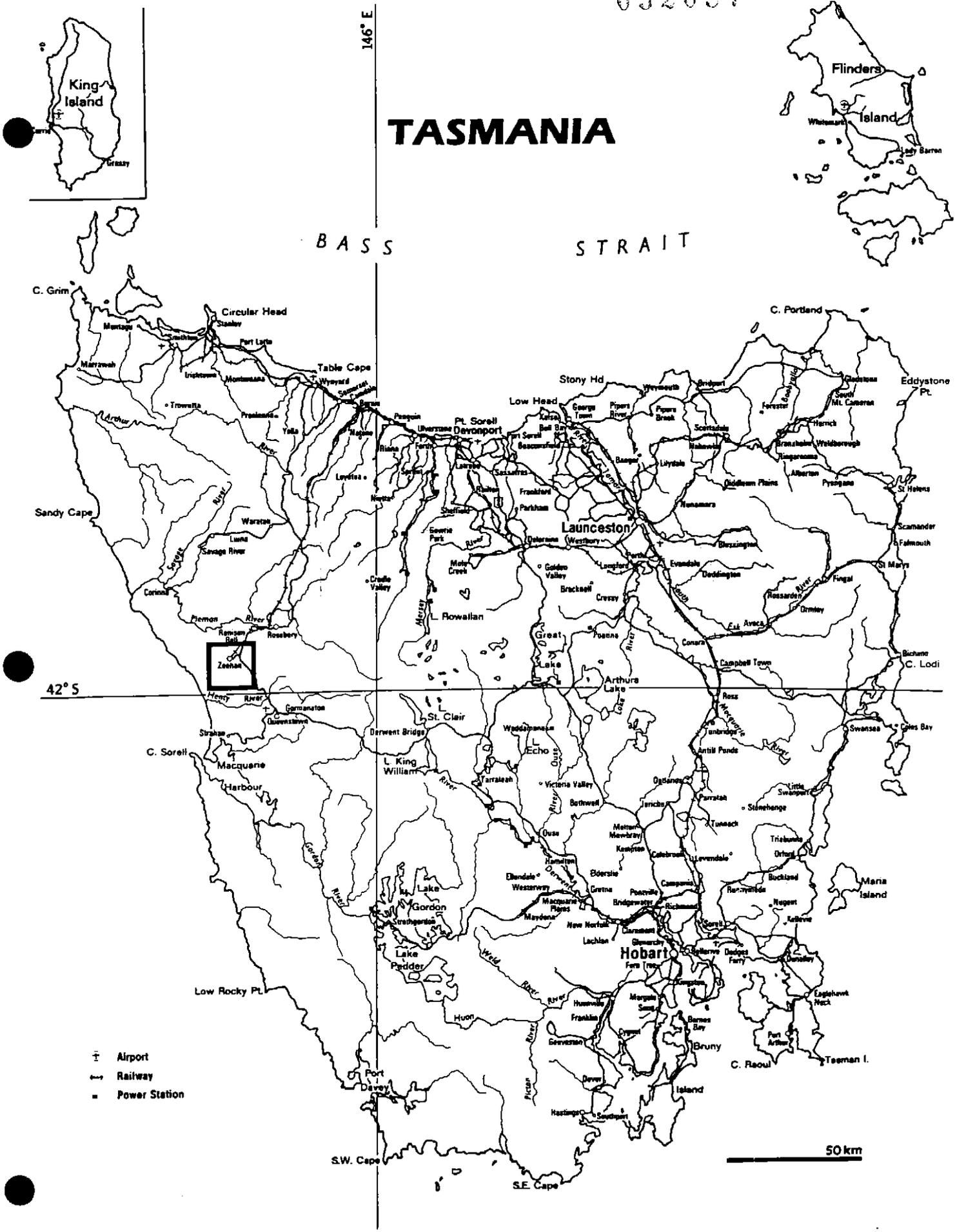


Figure 1 : Location Map

5 cm

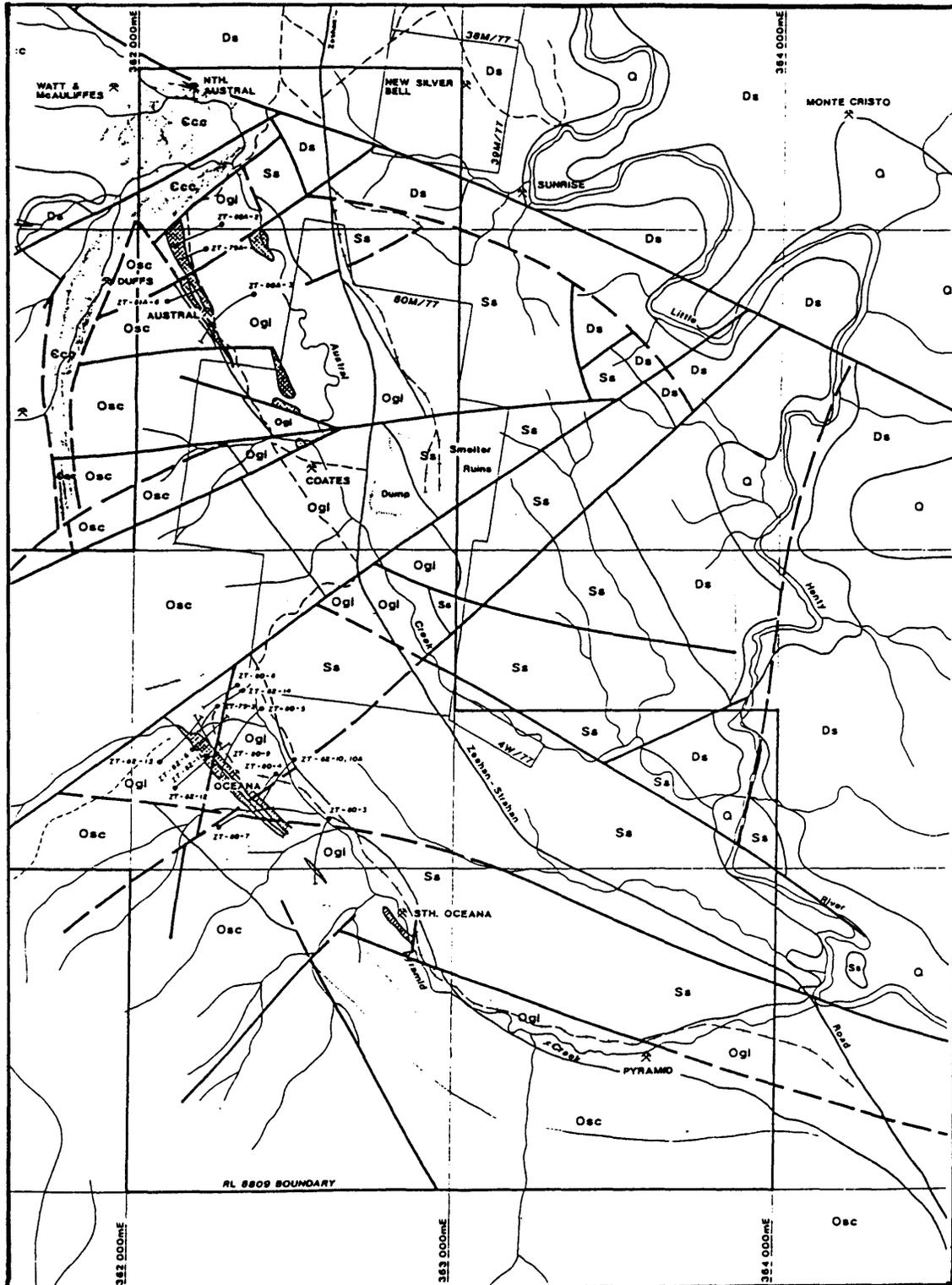


Figure 2 : Geological Map of Oceana Prospect Area

Summary and Conclusions

Regional facies sequence at Oceana

- 1) Oceana Pb-Zn mineralisation occurs in the Ordovician Gordon Limestone which is part of a continuous facies sequence including the underlying Ordovician Moina Sandstone and Mount Zeehan Conglomerate, and possibly also the overlying Silurian Crotty Quartzite (Plate 1).
- 2) The Mount Zeehan Conglomerate is a terrigenous fining-upward sequence consisting mainly of conglomerate facies (Plate 2) but also containing pebbly sandstone (Plates 3-5), cross-laminated sandstone (Plate 6), and worm-burrowed sandstone (Plates 4 and 5). Both the *maximum size of clasts* and the *number of conglomerate layers* decreases upsequence.
- 3) The lower part of the Moina Sandstone represents the upward continuation of the terrigenous fining-upward facies sequence (Mount Zeehan Conglomerate to middle Moina Sandstone). Sediments are mainly sandstone with and without worm burrows (Plates 7 and 8) and minor conglomerate. Towards the top of the Moina Sandstone worm-burrowed sandstone and siltstone (or very fine sandstone) make up most of the sequence. Amalgamated layers of burrowed sediment may reach several tens of centimetres in thickness (Plate 9). Locally, the very top of the Moina Sandstone is a coarsening upward sequence from sandstone with burrows (Plate 9) to pebbly sandstone (Plates 12 and 11) into quartz pebble conglomerate (QPC, Plate 10).
- 4) The precise contact of the Gordon Limestones with the Moina Sandstone has not been located in this field survey. In areas where the QPC is absent the contact may be either sharp or transitional. The lowermost exposure of Gordon Limestone is a thickly laminated to very thinly bedded sequence of alternating beds of dark grey mudstone and light grey (somewhat coarser) siltstone (Plate 14).

Most of the Gordon Limestone sequence encountered in core consists of a similar rhythmic intercalation of units of two types of sedimentary rock, (i) a dark grey (carbonate-poor) dolomitic mudstone and (ii) a light grey carbonate-rich rock.

The organic-rich mudstones are relatively fine grained and probably contain a significant proportion of fine terrigenous sediments. Most mudstone

units appear to have escaped early carbonate cementation, but many contain some bioclast debris of sand to gravel size.

The carbonate-rich units range in grain size from silt to gravel; most carbonate units are silts. Some of the coarser carbonate units are well sorted grain-supported bioclastic sands or gravels but many others are mud-supported (micritic carbonate matrix). Generally, the very coarse sediment particles in the carbonate rocks are bioclasts (coral, bivalve shells, stromatolite fragments, ect.).

In addition to mudstone and carbonate units the Gordon Limestone also contains distinct, if minor, occurrences of coarse terrigenous sediments ranging in grain size from sand to gravel. In terrigenous gravel layers both vein quartz and rock fragments have been recognised (e.g ZT 82-12, 133.8-136.0m). Some sand-rich carbonate units also appear to contain a terrigenous sand component (e.g. ZT 80-3 around 334m, Plate 19).

5) The contact of the Gordon Limestone with the overlying Crotty Quartzite has not been investigated in this field survey. The Crotty Quartzite appears to be a purely terrigenous facies sequence of mainly sandstone (with large scale crossbeds, Plate 28), minor current-rippled sandstone (Plate 30), and minor siltstone (Plate 29). A vertical grain size trend has not been recognised in the exposures viewed. The sequence shows characteristics of fluvial deposition in the combination of (i) channel bar deposits, and (ii) floodplain or overbank fines. If fluvial, the very small amount of fines would indicate a braided rather than a meandering system. Further study is required to delineate its depositional environments more precisely.

6) The facies from the base of the Mount Zeehan Conglomerate to the top of the Gordon Limestone appear to be part of one continuous depositional sequence, because terrigenous facies or facies elements, e.g. quartz pebble conglomerates, sandstones and worm-burrowed strata occur throughout the sequence (e.g. in the Mount Zeehan Conglomerate, Plates 4, in the Moina Sandstone, Plates 7 -9 and 10 - 12) and in the Gordon Limestone, ZT 82-12, 133.8 - 136.0m).

The Mount Zeehan Conglomerate to Gordon Limestone sequence can thus be interpreted to be a fining upward sequence from boulder conglomerate (mainly in Mount Zeehan Conglomerate over sandstone (mainly in the Moina sandstone) to siltstone and carbonate (Gordon Limestone). If the contact with the Crotty Quartzite can be shown to be gradational, then this formation may be included in the facies sequence (probably representing a coarsening upward subsequence).

A depositional model for the Ordovician strata at Oceana

7) The construction of a depositional model for the Mount Zeehan Conglomerate to Gordon Limestone facies sequence relies on the established continuity of this part of the stratigraphic column. In a continuous sequence vertical facies transitions are interpreted to represent the record of laterally shifting subenvironments. Based on this principle a depositional system is envisaged that contains alluvial conglomerates at the basin margin (base of the Mount Zeehan Conglomerate) which grade basinward into fluvial sands and gravels (transition zone between Mount Zeehan Conglomerate and Moina Sandstone) and further into subtidal shallow marine sediments with associated reef life (Gordon Limestone). The Crotty Quartzite (if part of the same sequence) may represent the return to a fluvial subenvironment similar to that interpreted for the transition zone between the Mount Zeehan Conglomerate and the Moina Sandstone. The change upsequence from coarse clastic non-marine to fine clastic marine depositional conditions is interpreted to reflect the sedimentary response to a gradually receding hinterland and associated transgression of the sea. The underlying causes for this may have been (i) a sea-level rise or (ii) accelerated tectonic subsidence or (iii) a combination of (i) and (ii) (see *Tectonic Setting*, below).

Gordon Limestone Facies

8) Facies in the Gordon Limestone have been distinguished on the basis of combinations of (i) stratification structures, (ii) mudstone contents (dark grey sediment), (iii) grain size of clasts and matrix of carbonate units, and (iv) bioactivity.

Based on these criteria, four main facies types are currently distinguished:

- (1) **Massive carbonate** (silt, sand or gravel) with less than 10% intercalated mudstone (e.g. Plate 48, lower row). This facies commonly displays stylolites.
- (2) **Parallel-laminated carbonate** with less than 10% intercalated mudstone (e.g. Plate 21). Lamination is due to very fine parallel partings of mudstone in carbonate. Carbonate grain size is usually silt. This facies is comparatively rare and thus forms good markers. Distinct burrows are recognised locally (e.g. Plate 22).

(3) **Intercalated bands of mudstone and carbonate**, M/C ratio ranging from > 10% to > 40 up to 90%. Mudstone appears to be a weakly dolomitic, carbonaceous siltstone with a fine terrigenous component. In the carbonate units the (carbonate) grain size is mainly silt, but may also be sand or gravel (bioclastic shell and coral debris).

Non-bioturbated sections of this facies are well banded (Plates 16, 51, 58). Bed thickness is of the order of centimetres to tens of centimetres. However, such undisturbed sediment sequences are comparatively rare. Usually, the sediments of this facies are strongly bioturbated.

Two types of bioturbation are distinguished: tubular mottling and sculptured mottling. The first appears in drill core as circular and elongate sections (tubes) predominantly in the mudstone units (e.g. Plates 17, 19, 26), but is also present in some silty carbonate bands (Plate 27). This type of mottling may have been generated by worms or other small bottom dwellers. The second appears to be a more pervasive type of mottling (e.g. Plates 18, 62). Carbonate and mudstone are often intimately mixed such that the original banding is largely obscured. This type of mottling may have been generated by larger bottom-dwelling organisms.

(4) **Terrigenous sand and gravel**. The gravel facies in ZT 82-12 closely resembles the quartz pebble conglomerate (QPC) of the Moina Sandstone in composition as it appears to contain a similar mix of vein quartz and rock fragments (see ZT 82-12, 133.8 - 136.0m).

Most of the sand facies appear to contain admixed bioclasts.

Environments of Deposition of Gordon Limestone Facies

The overall impression of the intercalated mudstone and carbonate facies (facies 3, the most common facies in the Gordon Limestone) is that of a predominantly marine subtidal environment (off-reef basin) laterally adjacent to a source of reefal and other bioclasts and within reach of terrigenous sand and gravel-depositing currents. Biological activity was generally high, even during times of dominance of mud deposition. Therefore, the bottom waters appear to have been oxygenated, generally, during deposition of this facies. Deposition of sediment in facies 3 was probably by turbulent suspension currents, judged by the presence of graded shell debris in the carbonate-rich basal parts of beds. Carbonate appears to be partially a detrital product (shell, coral and other bioclast debris and probably micrite) and partially cement. Cementation effects are seen in (i) filling of vughs and shells by carbonate and (ii) in (rare) carbonate

concretions surrounded by mudstone. The source for the carbonate cement was most probably metastable biogenic carbonate debris which during diagenesis transformed into stable carbonate species (largely low-Mg Calcite).

The environment of the carbonate rich facies 1 and 2 may have been shallower and closer to the source of carbonate than that of facies 3. Some of the very well sorted bioclastic carbonate gravels may have formed in a platform or reef setting. Some coral structures recognised in core are very large, measuring tens of centimetres in section (e.g. ZT 80-4, around 186.5m) and apparently are in growth position (in situ growth). Facies 2 contains non-compacted burrows indicating comparatively early induration of sediment. The carbonate-rich facies 1 and 2 may have been subject to meteoric diagenesis.

The presence of quartz pebble conglomerate facies in the Gordon Limestone indicates a nearby source of terrigenous coarse clastics. The gravels were probably transported in tidal channels during a period of gravel progradation (probably tectonically induced). Their main importance lies in providing the stratigraphic link of the Gordon Limestone with the underlying and overlying terrigenous sequences.

Facies sequences in the Gordon Limestone

Two preliminary graphic logs of sections of the stratigraphy have been plotted during this field survey (see below). The sequences in ZT 80-3 and ZT 80-4 show both fining and coarsening upward subsequences. The grain size variation appears to occur largely in the carbonate fraction of the sediments, but locally, terrigenous grains also appear to vary in size. Coarsening upward sequences from silts into sand or gravel probably indicate shoaling. Conversely, fining upward from carbonate gravel or sand into carbonate mud probably indicates deepening. The likely cause may have been either tectonic (accelerated subsidence) or climatic (sea level rise), or a combination of both.

Tectonic setting

Although a comprehensive tectonic analysis is beyond the scope of this field examination, the sequence surveyed is compatible with deposition in a graben or half-graben setting. The presence of large boulders in the conglomerates at the base of the Mount Zeehan Conglomerate are indications of a nearby active fault scarp separating the depositional site from a rising hinterland. Deposition of conglomerates occurred at the intersection between a series of creek beds issuing from the hinterland and the pediment-bounding fault. At this

'knickpoint' the stream energy was dissipated and boulders were dumped out of the weakening stream currents.

The fining upward trend that followed is interpreted as sediment response to a receding sediment source area. The cause of the changing conditions may have been due to continued tectonic extension with the generation of new sets of basin marginal faults which effectively moved the hinterland and with it its apron of coarse clastic sediments away from the depositional site. As a consequence only finer sediments reached the depositional site. However, at times coarse clastic deposition (e.g. the quartz pebble conglomerates in the Moina Sandstone and the Gordon Limestone) occurred in the distal setting suggesting that marginal coarse clastics prograded basinward just prior to and during Gordon Limestone deposition.

A sea-level rise would also have generated a change from continental to marine sedimentary conditions. However in order to generate several hundreds of metres of shallow marine sediments in the Gordon Limestone, it is necessary that substantial tectonic subsidence occurred at the site of deposition. The presently preferred model is that of a graben or half graben, as it provides the necessary tectonic conditions for thick shallow-water sediment accumulations. However this is no more than an educated guess at present - a more comprehensive basin study is required before a serious tectonic model can be erected.

Mineralisation

Sulphide mineralisation has only briefly been examined. The following may therefore not be a representative account of Oceana mineralisation. Sulphide mineralisation appears to be of three types: (i) coarse sulphides as vein fill in fractures, (ii) fine and coarse sulphide disseminated in mudstone and (iii) coarse sulphides as open space fill and as a replacement of bioclasts. Examples of the first type are found in DDH ZT 80-3 at about 238 m, where sulphides, mainly sphalerite are hosted by a fracture network. This type of mineralisation appears to have a post-lithification timing, as all rock types intersected by the fractures (including mudstone units) apparently were lithified during fracturing.

The disseminated and bioclast-mineralising types of mineralisation are found in fossiliferous carbonate/mudstone facies (facies 3), commonly at stratigraphic levels which are characterised by abundant coarse bioclasts including coral fragments. The sulphides appear to be hosted by both bioclasts and mudstone matrix. Examples can be found in DDH 80-4 at about 248 - 258 m and at about 302 -307 m.

Timing options include (i) early diagenetic emplacement of sulphides in carbonaceous mud (a pore space cementing process) accompanied by open space cement and replacement of carbonate shells, (ii) late diagenetic replacement of carbonaceous semi-consolidated mudstone accompanied by replacement of earlier open space cement and carbonate shells, and (iii) post-diagenetic replacement of carbonaceous mudstone and associated bioclasts. A symsedimentary option (iv) can be excluded because extensive mottling in sediments associated with mineralisation would indicate an oxygenated water column at the sediment-water interface. Present data are insufficient for determining which of options (i), (ii) and (iii) would be the most probable.

Comparison with other sediment-hosted mineral deposits

In the following Oceana sulphide mineralisation is compared with some of the Lower Carboniferous carbonate-hosted base metal deposits of Ireland and the Proterozoic deposits of North Australia (Mount Isa, McArthur River). Comparisons are made between tectonic settings and environments of deposition of the immediate host sediments.

Tectonic setting and general stratigraphic sequence at Oceana are similar to both the Irish and the North Australian deposits. All apparently accumulated in fault bounded basins as fining upward sequences from coarse (conglomerates, sands) to fine terrigenous clastics (silts) and then into carbonates or carbonate-bearing siltstones. Mineralisation is hosted in the upper fine grained, carbonate-bearing and carbonaceous part of the sequence.

Differences exist in the thickness of the underlying terrigenous and carbonate-bearing strata. At Mount Isa the sequence below the footwall to mineralisation is about 3000m thick, at Navan only about 150m.

Oceana host sediments are similar to certain host sediments of the Irish deposits Tynagh and Navan (and probably others). The Navan Boulder Conglomerate contains poorly sorted "reef" clasts supported by carbonaceous mudstones. Mottling similar to the sculptured type at Oceana exists in the Pale Beds. At Tynagh the main mineralisation is hosted by gravity induced flow deposits such as debris flows and turbidites. "Reef" clasts are absent in the Proterozoic deposits of North Australia, but breccias composed of carbonate platform debris (often stromatolitic) is known as intercalations in the H.Y.C. deposit at McArthur River. The Mount Isa deposits lack coarse debris flows in the sequence.

Fine grained pyrite is the dominant sulphide mineral in the sediment-hosted Pb-Zn deposits of North Australia. At Mount Isa iron sulphides constitute

more than 75% of all sulphide mineralisation. A similar dominance of pyrite over galena and sphalerite also characterises Hilton, McArthur River, and Lady Loretta. At Navan fine grained pyrite forms a significant part of the Boulder Conglomerate sequence and locally is the dominant sulphide mineral in the Pale Beds. At Oceana fine grained pyrite is present in some sections of the stratigraphy, but pyrite grade and tonnage is minute compared with the North Australian Proterozoic deposits or with Navan.

Comment on southeastern thinning of Gordon Limestone

Towards the southeast the Gordon Limestone thins across a set of two faults and then thickens again further to the southeast. There are several possibilities to account for the present configuration including:

- (i) non-deposition of Gordon Limestone due to growth faulting on a horst between two downthrown blocks.
- (ii) uplift and erosion of previously deposited Gordon Limestone strata due to block faulting, prior to deposition of the Crotty Quartzite.
- (iii) overthrusting of Moina Sandstone over Gordon Limestone

Present data are insufficient to confidently evaluate these options. It is however evident that thinning cannot have been generated by differences in local sedimentation rates without associated differences in tectonic subsidence rates (across an active fault). The fault contact between the Crotty Quartzite and the Gordon Limestone and the sense of movement of faults seems to point to overthrusting (iii) as the most probable option.

Recommendations

- 1) In order to be able to determine whether Oceana mineralisation is stratabound or cross-cutting it will be necessary to spatially relate the mineralised zones to a three-dimensional facies framework. This can be achieved by facies logging of the currently available cores through Gordon Limestone.
- 2) On present (limited) data it appears that at least some of Oceana mineralisation is controlled by a fracture network. Logging of fracture patterns will reveal the extent of this type of mineralisation.
- 3) Oceana mineralisation should be documented with recourse to the established facies types. This should allow assessments to be made about the

extent and nature of any facies control over mineralisation. Documentation should include handspecimen descriptions and descriptions of petrographic sections (transmitted and reflected light).

4) The upper and lower contacts of the Gordon Limestone should be investigated in all accessible locations for reconstruction of the tectonic history of the mineralised basin.

5) A comprehensive basin study of the Ordovician-Silurian of the Zeehan region will greatly enhance the present understanding of the interplay of regional and local structure, sedimentary facies, diagenesis, alteration and sulphide mineralisation.

Martin Neudert
Sedcon
September 1992

Appendix

Solution recipe for carbonate stain

Solution recipe:

Ingredients: (i) 5% HCl,
(ii) Potassiumferricyanide (PFC),
(iii) Alizarin Red S (ARS):

Solution 1: Dissolve 10g of PFC in 500ml acid.

Solution 2: Dissolve 1g of ARS in 500ml acid.

Mix the two solutions as Solution 1 : Solution 2 = 3:2.

Apply to core and let react for a minute or so. Experiment with strength of acid to suit characteristics of Gordon Limestone carbonate assemblage. Calcite stain is purple, dolomite blue, ankerite turquoise. Siderite is unaffected by stain.

Note: Solutions deteriorate after a few days, especially when exposed to the sun. For best results prepare small amounts of solutions fresh and mix immediately before use.

Graphic Sedimentology Log

DDH ZT 80-3

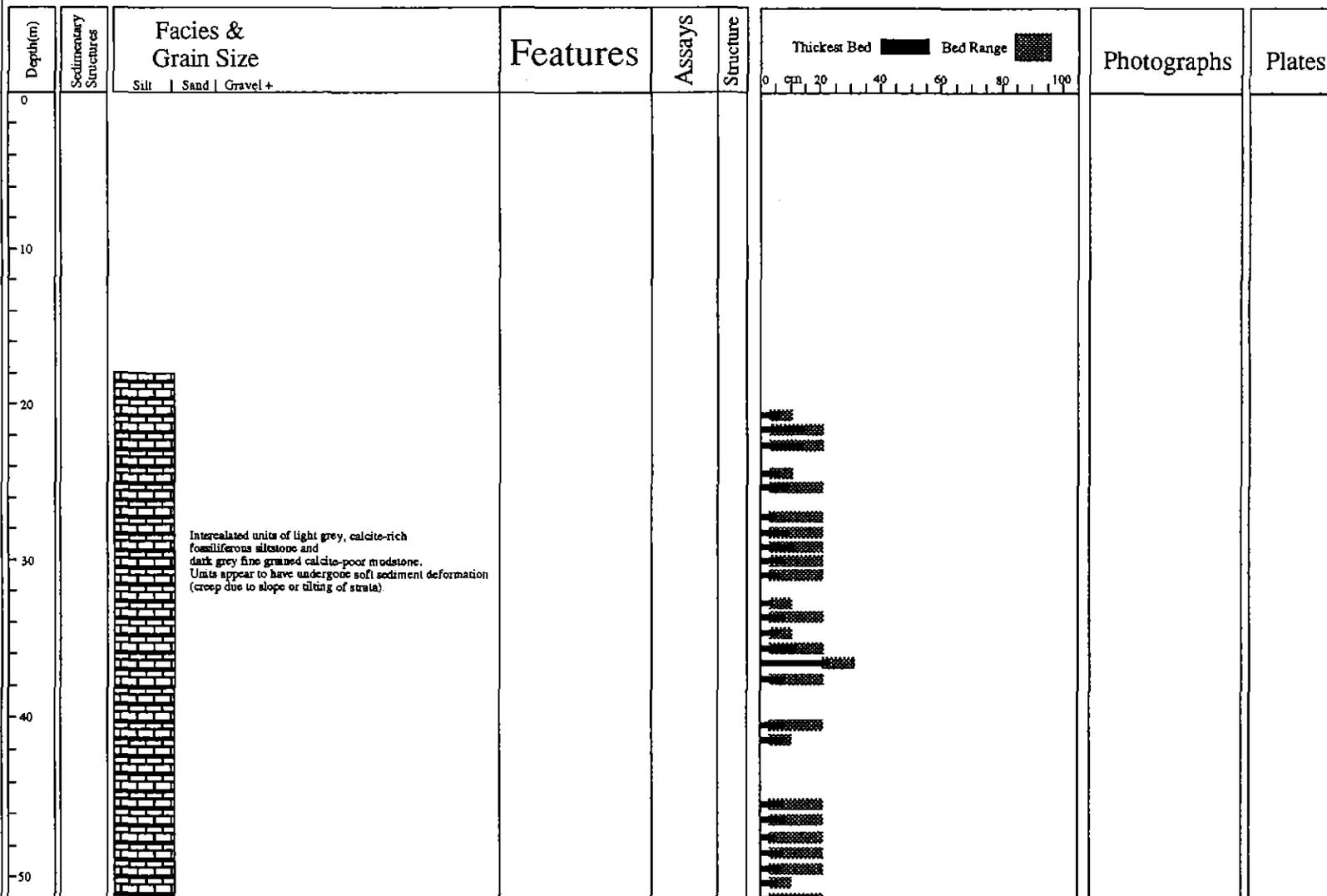
Graphic sedimentology log of Gordon Limestone, Oceana Prospect

Sedcon

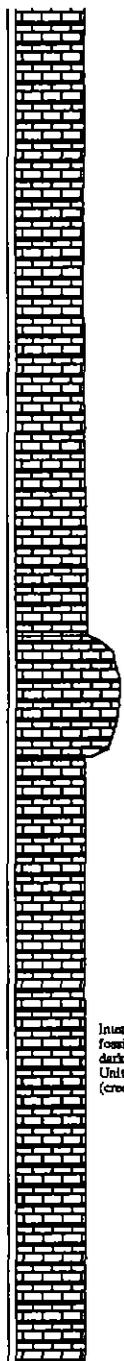
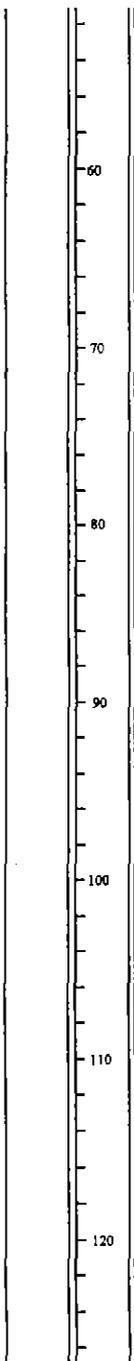
Interpretation by P. M. Quayle and M. K. Neudert, September 1992

DDH: ZT 80-3

Stratigraphy



052069



Intercalated sandy units of light grey, calcite-rich fossiliferous siltstone and dark grey fine grained calcite-poor mudstone. Units appear to be undisturbed.

Intercalated units of light grey, calcite-rich fossiliferous siltstone and dark grey fine grained calcite-poor mudstone. Units appear to have undergone soft sediment deformation (creep due to slope or tilting of strata).

Zone of irregular fractures of vein calcite

Coarse bivalves (brachiopods?)

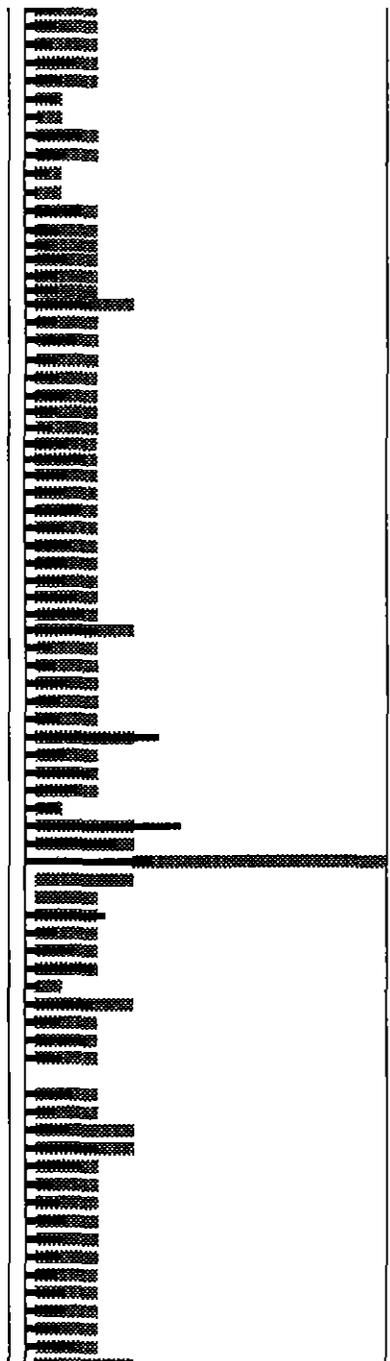
Coarse bivalves (brachiopods?)

Massive calcite vein

Trace pyrite

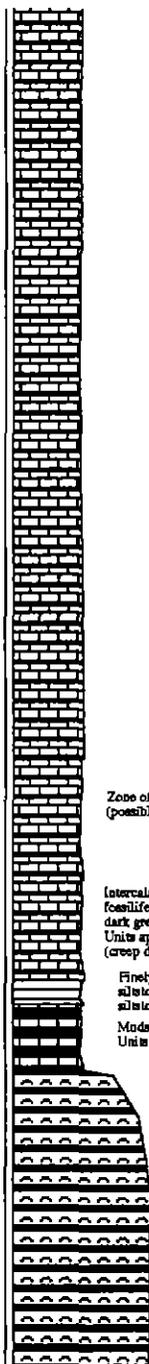
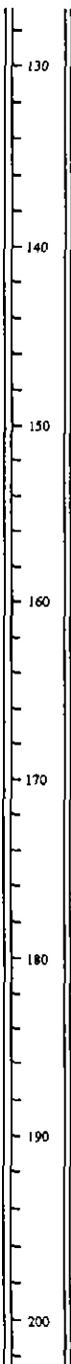
Zn 0.35 %

Zn 0.15 %



052070

Gordon Limestone



Zone of disturbance
(possible slump shear, intrastratal slumping)

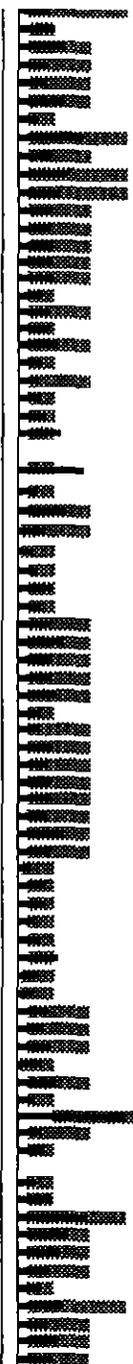
Intercalated units of light grey, calcite-rich fossiliferous siltstone and dark grey fine grained calcite-poor mudstone. Units appear to have undergone soft sediment deformation (creep due to slope or tilting of strata).

Finely parallel-laminated unit. Light grey siltstone is interlaminated with dark grey siltstone. Lamina thickness is greater in light units. Mudstone dominated interval. Units appear to be undisturbed.

Zone of coarse (gravel size) bioclasts in units of light grey, calcite-rich fossiliferous siltstone and dark grey fine grained calcite-poor mudstone. Units appear to have undergone soft sediment deformation (sculptured mottling and possibly also intrastratal creep due to slope or tilting of strata).

Worm burrow

0.07 Zn %



Tas 2 F19

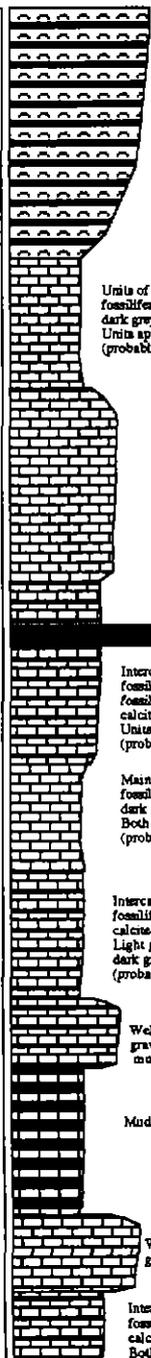
Plate 22

Tas 2 F28

Plate 23

052071

210
220
230
240
250
260
270



Units of light grey, calcite-rich fossiliferous siltstone with very minor dark grey, fine grained calcite-poor mudstone. Units appear mottled (probably as a result of bioturbation).

Units of light grey, calcite-rich arenaceous to rudaceous fossiliferous carbonate with very minor dark grey, fine grained calcite-poor mudstone. Units appear mottled (probably as a result of bioturbation).

Intercalated units of light grey, calcite-rich fossiliferous siltstone with arenaceous and rudaceous fossil components and dark grey fine grained calcite-poor mudstone. Units appear mottled, locally (probably as a result of bioturbation).

Mainly light grey, calcite-rich fossiliferous siltstone with little dark grey fine grained calcite-poor mudstone. Both light and dark grey units are extensively mottled (probably as a result of bioturbation).

Intercalated units of light grey, calcite-rich fossiliferous siltstone and dark grey fine grained calcite-poor mudstone. Light grey units are extensively mottled, whereas dark grey units show little disturbance (probably as a result of bioturbation).

Well sorted carbonate-rich sandstone with occasional gravel-size fossil clasts intercalated with dark grey mudstone.

Mudstone dominated interval.

Well sorted carbonate-rich sandstone with many gravel-size bioclasts.

Intercalated units of light grey, calcite-rich fossiliferous siltstone and dark grey fine grained calcite-poor mudstone. Both light and dark grey units are mottled.

Strongly fractured

Circular and tubular sections of probable worm burrows.

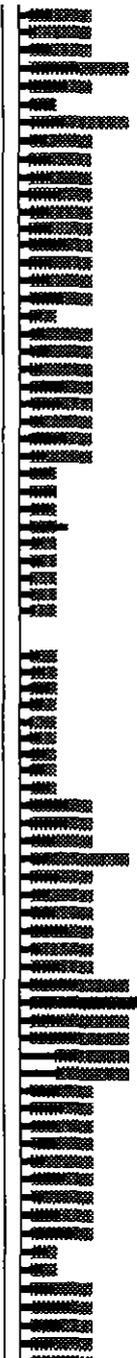
Some circular and tubular sections of probable worm burrows.

Mudstone units contain circular and tubular sections of probable worm burrows.

Calcite-rich units contain circular and tubular sections of probable worm burrows.

Circular and tubular sections of probable worm burrows.

Pb 8.3%
Zn 0.4%
Ag 74 ppm



Tas 2 F23

Plate 17

Tas 2 F22

Plate 18

Tas 2 F16

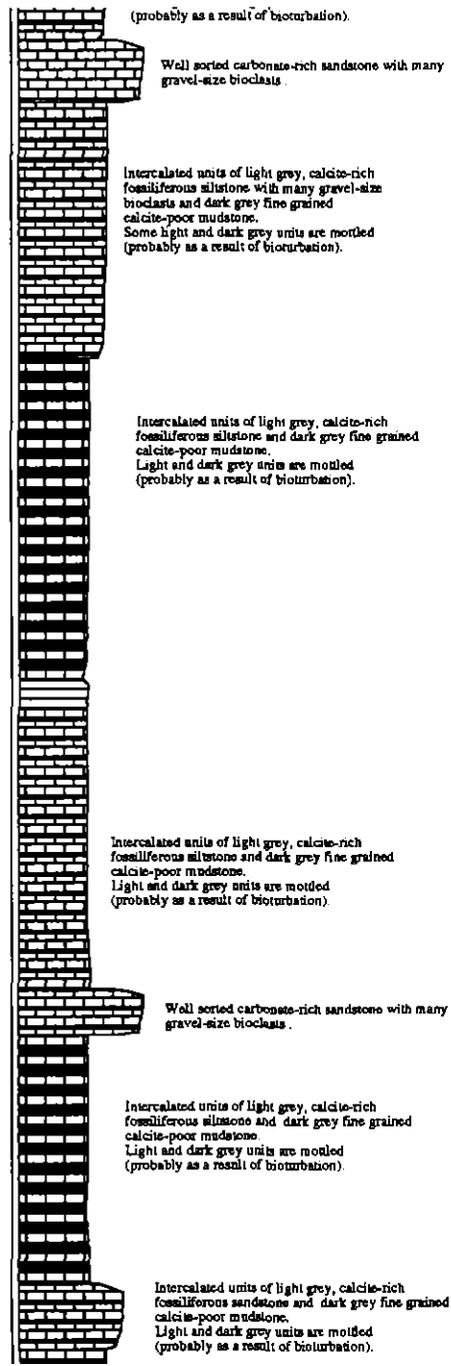
Plate 26

Tas 2 F15

Plate 16

052052

280
290
300
310
320
330
340
350



Stump shearing in places

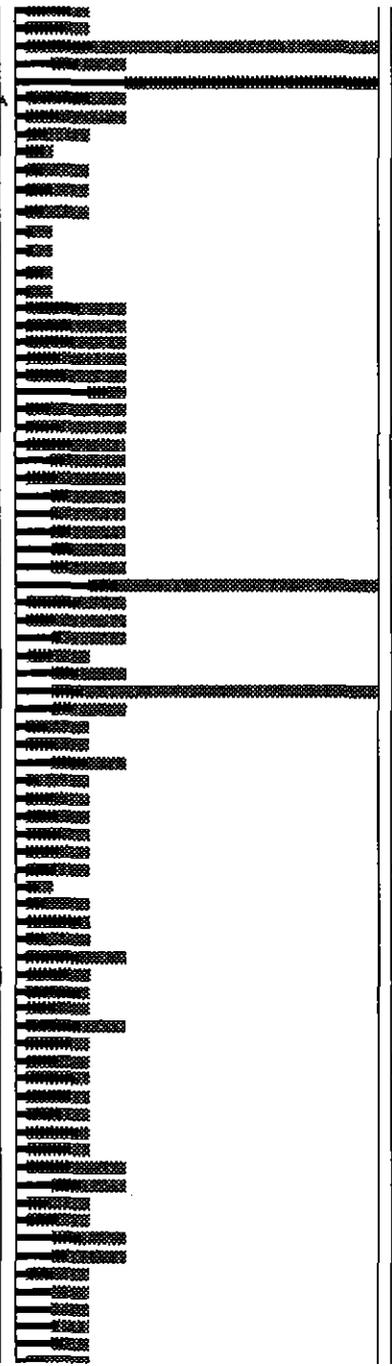
Calcite-rich units contain circular and tubular sections of probable worm burrows. Stump shearing in places

Circular and tubular sections of probable worm burrows.

Circular and tubular sections of probable worm burrows. Burrows are sand-filled

Some gravel size bioclasts
Circular and tubular sections of probable worm burrows. Burrows are fill-filled, mainly by calcitic sediment

Shear zone 40°/NCA



Tas 2 F10 Plate 24

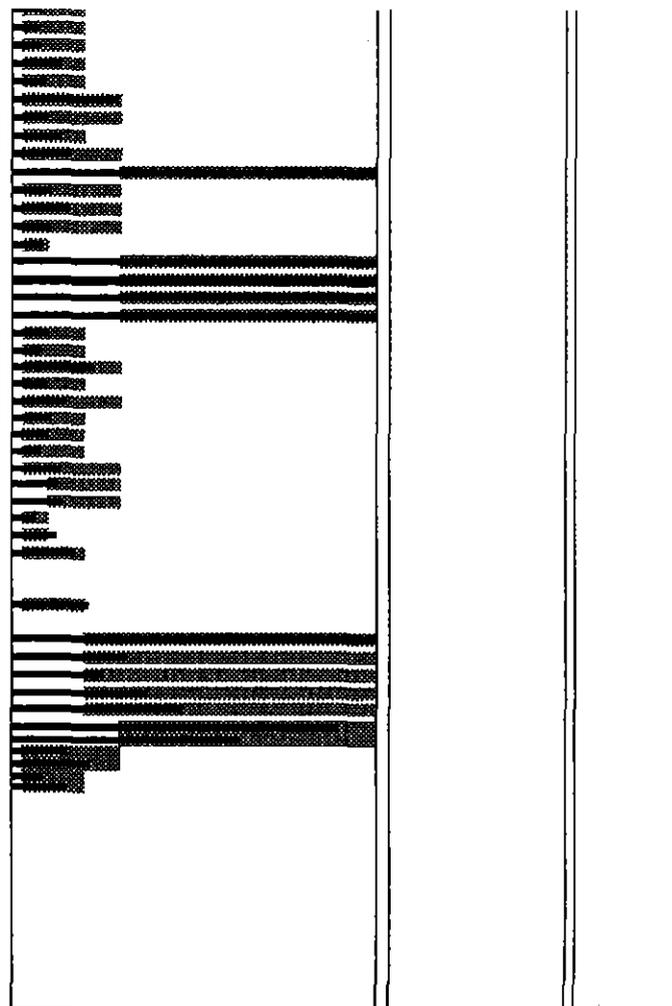
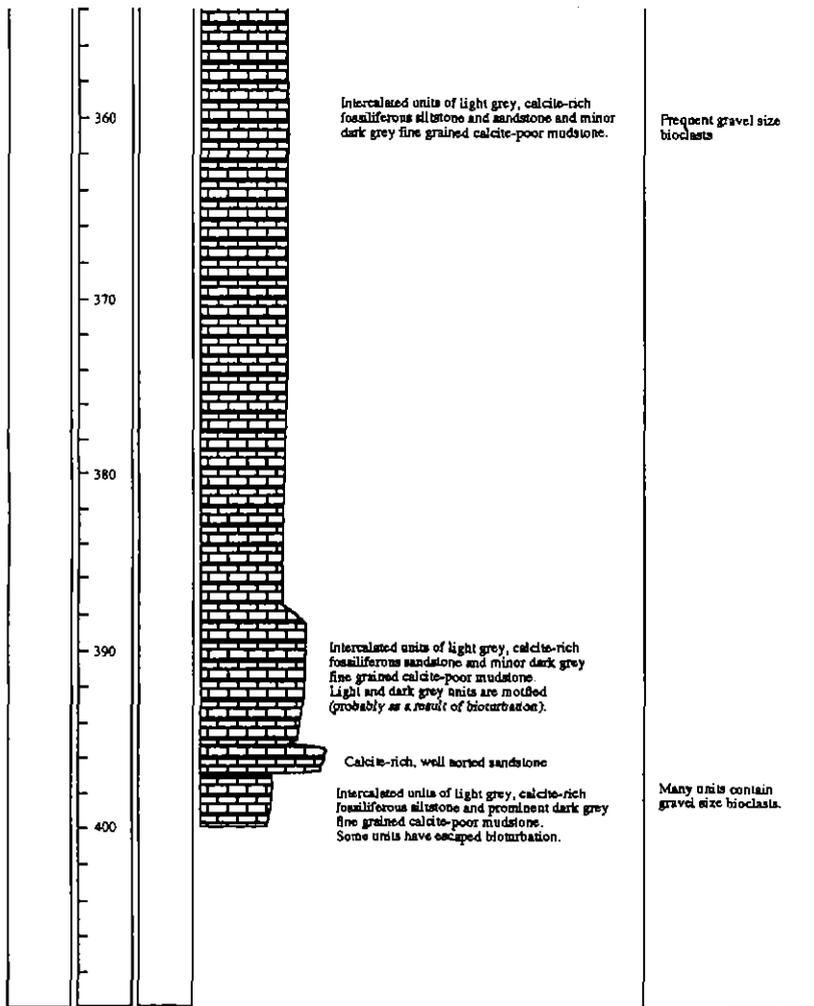
Tas 2 F14 Plate 21

Tas 2 F2 Plate 20

Tas 1 F37 Plate 19

Tas 1 F35 Plate 25

052073



Graphic Sedimentology Log

DDH ZT 80-4

Stratigraphy

Graphic sedimentology log of Gordon Limestone, Oceana Prospect

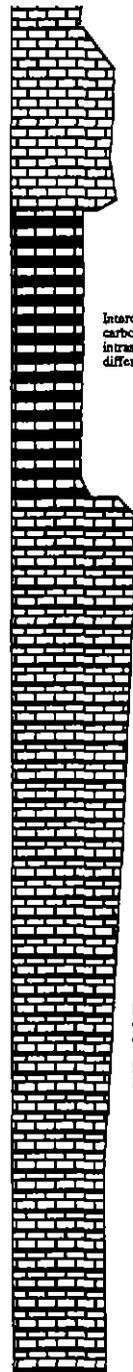
Sedoon

Interpretation by P. M. Quayle and M.K. Neudert, September 1992

DDH: ZT 80-4

Depth(m)	Sedimentary Structures	Facies & Grain Size <small>Silt Sand Gravel +</small>	Features	Assays	Structure	Photographs	Plates
0							
10	<div style="font-size: x-small;"> ← Sculptured mottling ← Tubular mottling </div>	<p style="text-align: center;">no core</p>					
20		<p>Intercalated carbonate and mudstone (M/C: >40%), carbonate grain size: silt, sculptured mottling, minor coarse grained bioclasts, minor shell breccia beds.</p>					
30		<p>Intercalated carbonate and mudstone (M/C: <40%), carbonate grain size: silt, stromatolites and coral fragments</p>					
40		<p>Intercalated carbonate and mudstone (M/C: >40%), carbonate grain size: sand fining upward to silt</p>					
50		<p>Carbonate (M/C: <10%), fine sand or stromatolite structure (in situ), stylolites.</p> <p>Parallel-laminated carbonate (poorly developed).</p> <p>Carbonate (M/C: <10%), grain size: silt, large coral fragment at 49.0m.</p>					

052076



Carbonate (M/C: <10%), grain size: sand fining upward into silt.

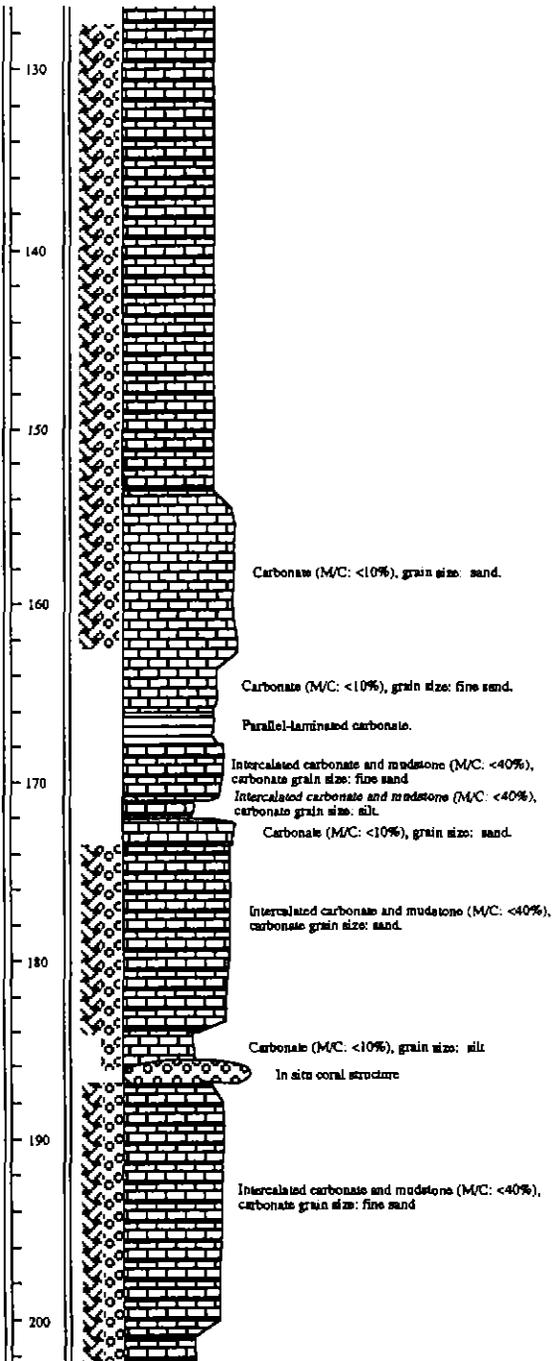
Intercalated carbonate and mudstone (M/C: >40%), carbonate grain size: silt, undisturbed banding, intrasediment cementation visible (compactional difference).

Intercalated carbonate and mudstone (M/C: <40%), carbonate grain size: sand coarsening upward to coarse sand.

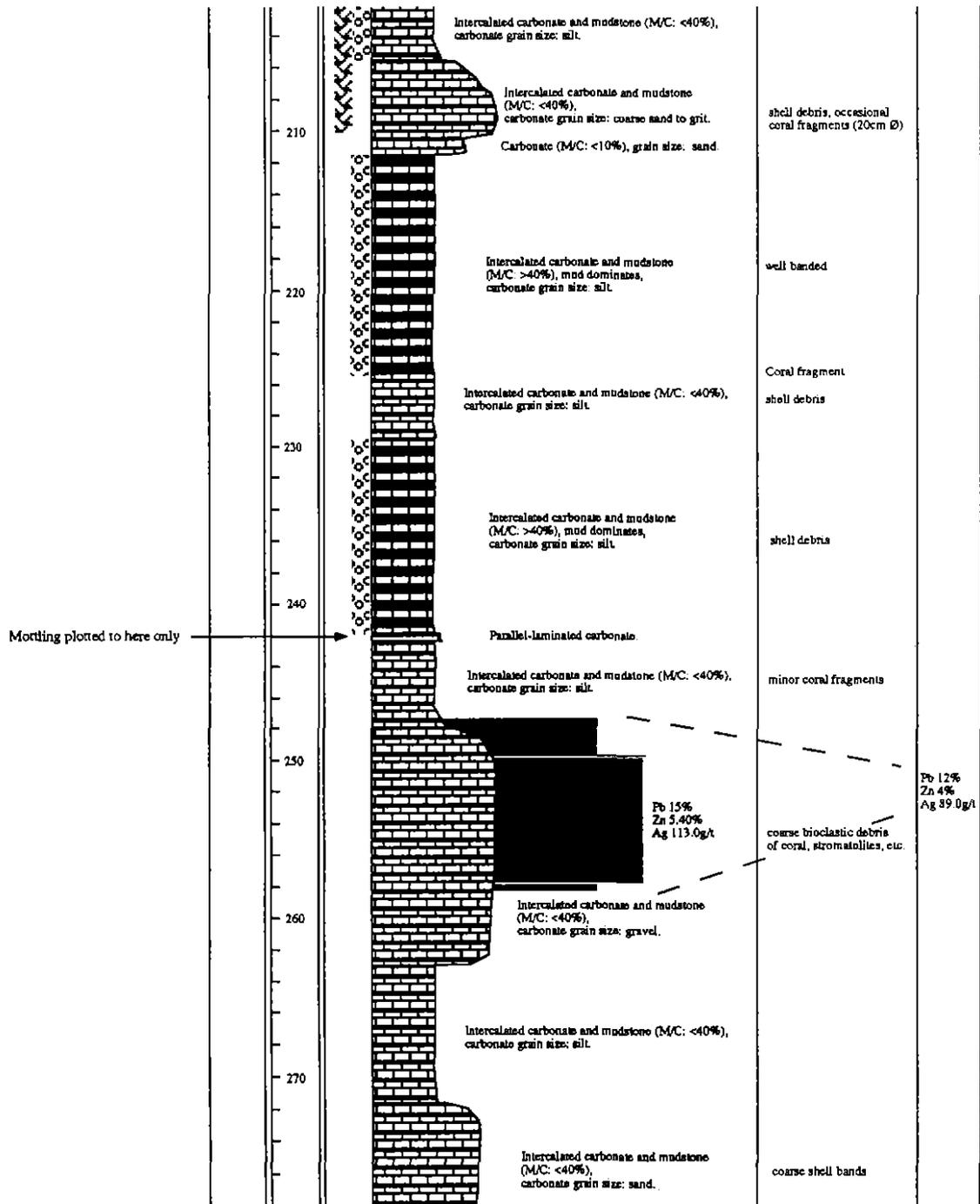
Large bioclasts, corals and stromatolites, Motting: tubular and sculptured

052077

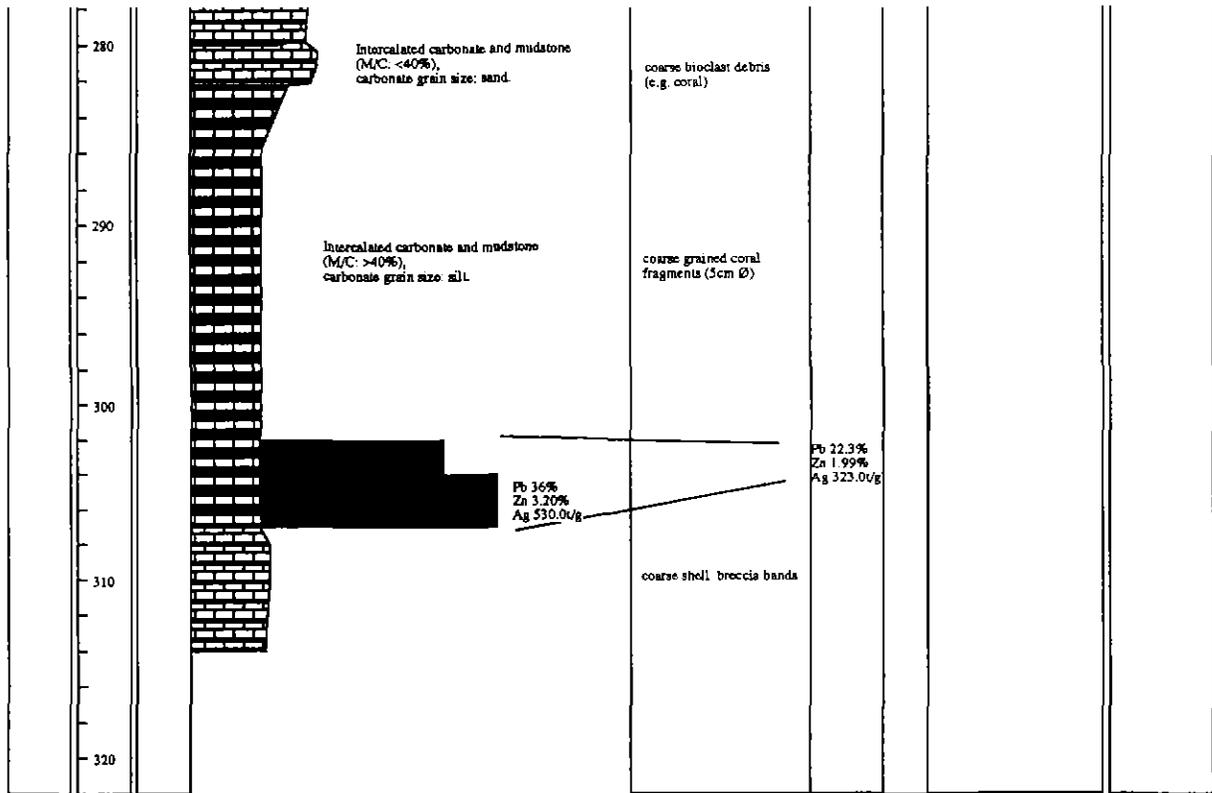
Gordon Limestone



052078



052079



052081

Photographic Plates
Oceana Prospect



052082

Plate 1

Project : Oceana*Location* : Oceana Mine*DDH ID*:*Depth (m)*:*Formation(s)*: Moina Sandstone, Gordon Limestone, Crotty Quartzite*Film Nr*: Tas1*Frame Nr*: 18*Description*:

Oceana mine site (abandoned workings in the foreground) and processing site (tailings in the background). View from the Moina Sandstone to the northeast. Hills in the foreground are the upper part of the terrigenous Mount Zeehan Conglomerate to Moina Sandstone sequence (Ordovician). Valley with mine site is in Gordon Limestone (Ordovician). Low green hills to the northeast of the valley are in Crotty Quartzite (Silurian).

Plate 2

Project : Oceana*Location* : Southwest Of Oceana Mine*DDH ID*:*Depth (m)*:*Formation(s)*: Mount Zeehan Conglomerate*Film Nr*: Tas1*Frame Nr*: 17*Description*:

Bedded clast and matrix-supported conglomerate layers of the Mount Zeehan Conglomerate. Stratigraphic-up to the right.

Plate 3

Project : Oceana*Location* : Southwest Of Oceana Mine*DDH ID*:*Depth (m)*:*Formation(s)*: Mount Zeehan Conglomerate*Film Nr*: Tas1*Frame Nr*: 15*Description*:

Pebbly sandstone facies in the Mount Zeehan Conglomerate. White angular clasts are vein quartz fragments. Some other clasts and the matrix have a pink tinge, probably due to hematite dust.

052084

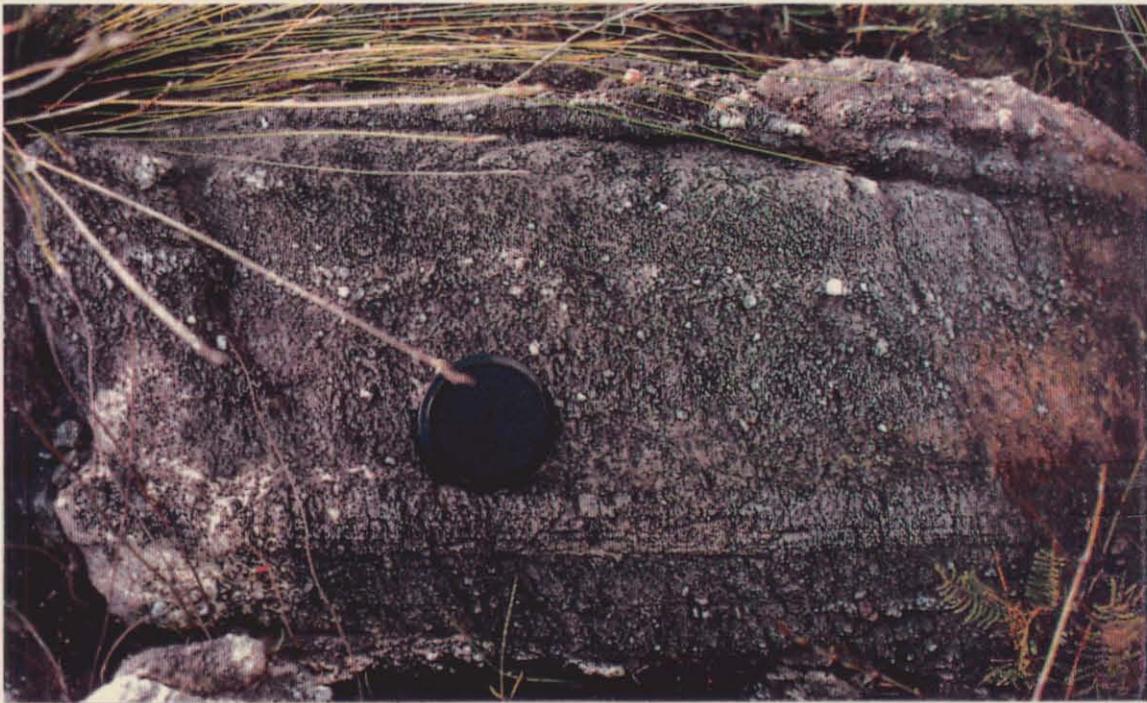


Plate 4

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 16

Project : Oceana

Formation(s): Mount Zeehan Conglomerate

Location : Southwest Of Oceana Mine

Description:

Pebbly sandstone facies (top down to base of lens cap) overlying sandstone with worm burrows (layer below lens cap) in the Mount Zeehan Conglomerate.

Plate 5

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 14

Project : Oceana

Formation(s): Mount Zeehan Conglomerate, Moina Sandstone

Location : Southwest Of Oceana Mine

Description:

Pebbly sandstone with many white quartz pebbles (vein quartz fragments) overlying worm-burrowed coarse sandstone layer. Contact between Mount Zeehan Conglomerate and Moina Sandstone.

Plate 6

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 13

Project : Oceana

Formation(s): Mount Zeehan Conglomerate, Moina Sandstone

Location : Southwest Of Oceana Mine

Description:

Current-produced cross-lamination with erosional base in coarse sandstone at the contact between Mount Zeehan Conglomerate and Moina Sandstone.

052086



Plate 7*DDH ID:**Film Nr:* Tas1*Depth (m):**Frame Nr:* 12*Project :* Oceana*Formation(s):* Moina Sandstone*Location :* Southwest Of Oceana Mine*Description:*

Cone shaped worm burrows in Moina Sandstone.

Plate 8*DDH ID:**Film Nr:* Tas1*Depth (m):**Frame Nr:* 11*Project :* Oceana*Formation(s):* Moina Sandstone*Location :* Southwest Of Oceana Mine*Description:*

U-shaped burrows in Moina Sandstone.

Plate 9*DDH ID:**Film Nr:* Tas1*Depth (m):**Frame Nr:* 3*Project :* Oceana*Formation(s):* Moina Sandstone*Location :* Southwest Of Oceana Mine*Description:*

Massive unit consisting of vertically amalgamated burrowed layers.



052088

052089

Plate 10

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 10

Project : Oceana

Formation(s): Moina Sandstone

Location : Southwest Of Oceana Mine

Description:

Top of coarsening upward sequence (Plates 12, 11, 10) from sandstone with worm burrows to quartz pebble conglomerate, contact zone between Moina Sandstone and Gordon Limestone. This part of the sequence is dominated by pebbles, matrix is subordinate.

Plate 11

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 8

Project : Oceana

Formation(s): Moina Sandstone

Location : Southwest Of Oceana Mine

Description:

Middle of coarsening upward sequence (Plates 12, 11, 10) from sandstone with worm burrows to quartz pebble conglomerate, contact zone between Moina Sandstone and Gordon Limestone. Note the increase in size and number of coarse pebbles compared with Plate 12.

Plate 12

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 7

Project : Oceana

Formation(s): Moina Sandstone

Location : Southwest Of Oceana Mine

Description:

Base of coarsening upward sequence (Plates 12, 11, 10) from sandstone with worm burrows to quartz pebble conglomerate, contact zone between Moina Sandstone and Gordon Limestone. This part of the sequence is matrix dominated, there are comparatively few and only small quartz pebbles.



052090

052091

Plate 13

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 1

Project: Oceana

Formation(s): Moina Sandstone

Location: North Of Oceana Mine

Description:

Contact between worm burrowed facies (right) and quartz pebble conglomerate facies (left) of the Moina Sandstone near the contact with the Gordon Limestone (further to the left, not shown).

Plate 14

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 30

Project: Oceana

Formation(s): Moina Sandstone, Gordon Limestone

Location: North Of Oceana Mine

Description:

Fine parallel lamination (roughly parallel to pen) and thin dark grey beds at the contact between Moina Sandstone and Gordon Limestone. The dark grey beds may be mudstone units of the type which comprises a considerable portion of the Gordon Limestone.

Plate 15

DDH ID:

Film Nr: Tas1

Depth (m):

Frame Nr: 21

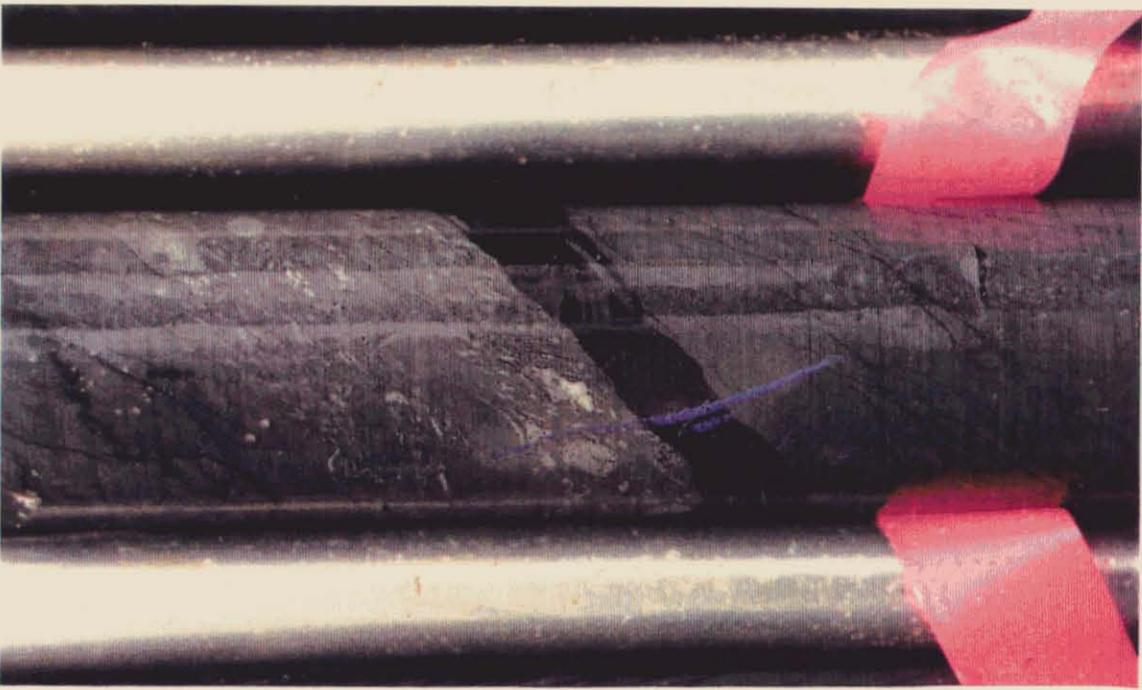
Project: Oceana

Formation(s): Gordon Limestone

Location: Oceana Mine

Description:

Close up of carbonate slab (derived from Oceana Mine) with bands of light brownish grey and light bluish grey. The brown layers are composed of terrigenous muddy sediment, the bluish grey layers of silty carbonate (calcite).



052092

↑

052093

Plate 16

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 276.90

Frame Nr: 15

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Intercalated carbonate-poor mudstone (dark grey) and calcite-rich siltstone (light grey). Coarse shell debris (bioclasts) in carbonate bed. Stratigraphic-up to the left.

Plate 17

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 249.00

Frame Nr: 23

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Tubular mottling - interpreted as due to burrowing activity. Tubes formed in mudstone and filled by silt-size calcite. Note stylolitic contact between carbonate and mudstone (left).

Plate 18

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 259.90

Frame Nr: 22

Project : Oceana

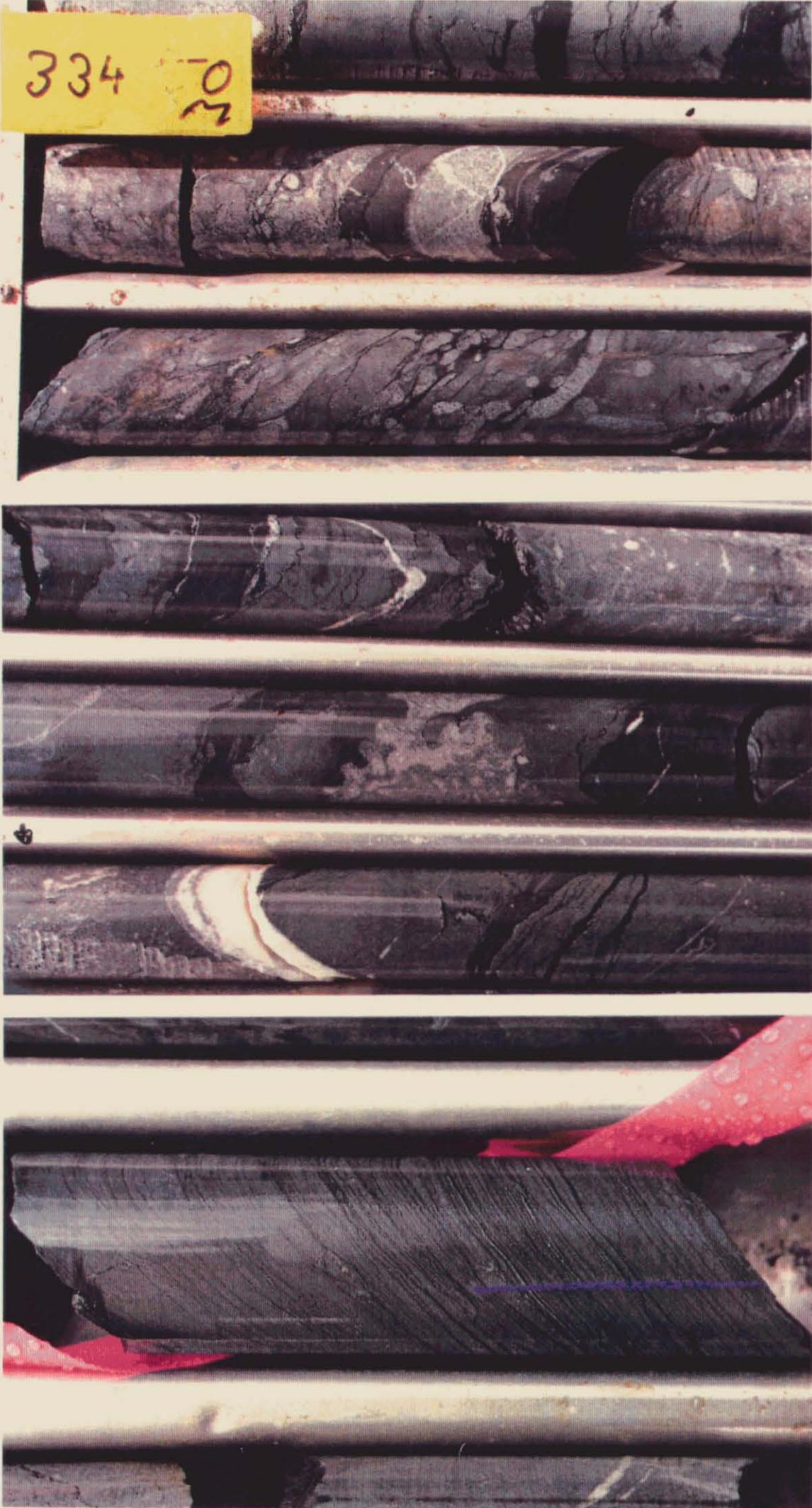
Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Sculptured mottling - near complete disintegration of individual layers. Vugh filled by coarse carbonate in centre.

052094



334 70
3

052035

Plate 19

DDH ID: ZT 80-3

Film Nr: Tas1

Depth (m): 334.50

Frame Nr: 37

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Lower row: Tubular mottling, tubes containing sand-size sediment fill probably made up of a mix of terrigenous and carbonate sediment. Centre row: Fossiliferous carbonate-rich sandstone layers intercalated with little-disturbed mudstone layers. Upper row: Silty to sandy carbonate separated by mudstone bands.

Plate 20

DDH ID: ZT-80-3

Film Nr: Tas2

Depth (m): 326.20

Frame Nr: 2

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Centre row: Large bioclast (coral fragment ?) in silty carbonate layer. Upper row, right: Carbonate layer composed of coarse sand-size fossil debris.

Plate 21

DDH ID: ZT-80-3

Film Nr: Tas2

Depth (m): 316.60

Frame Nr: 14

Project : Oceana

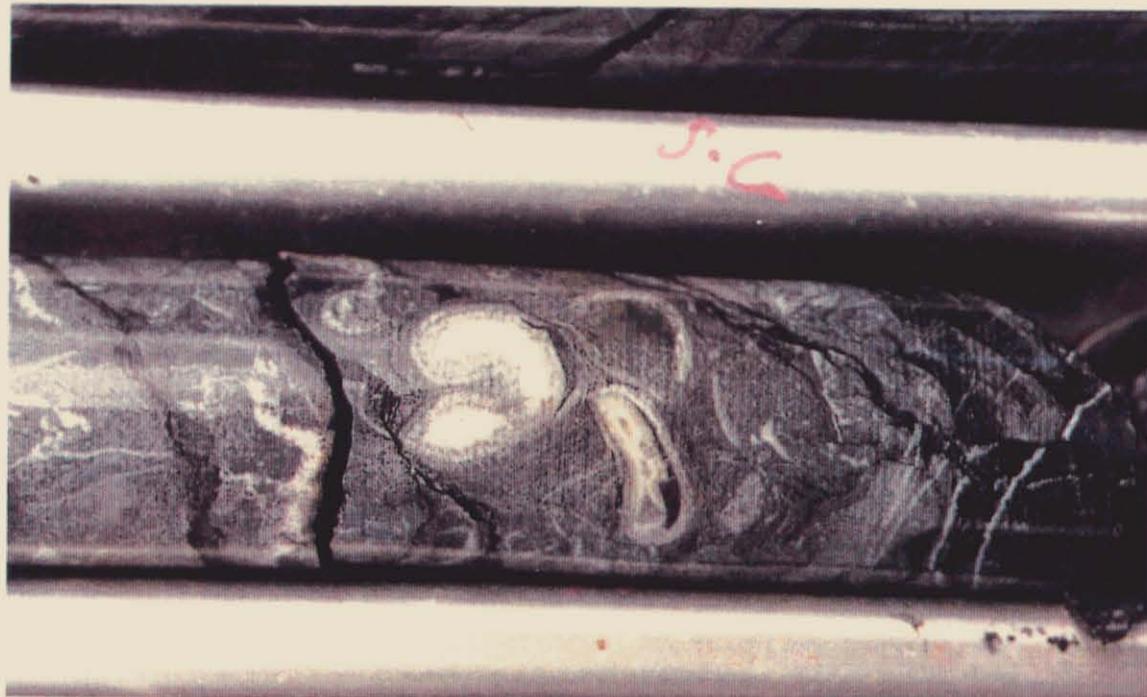
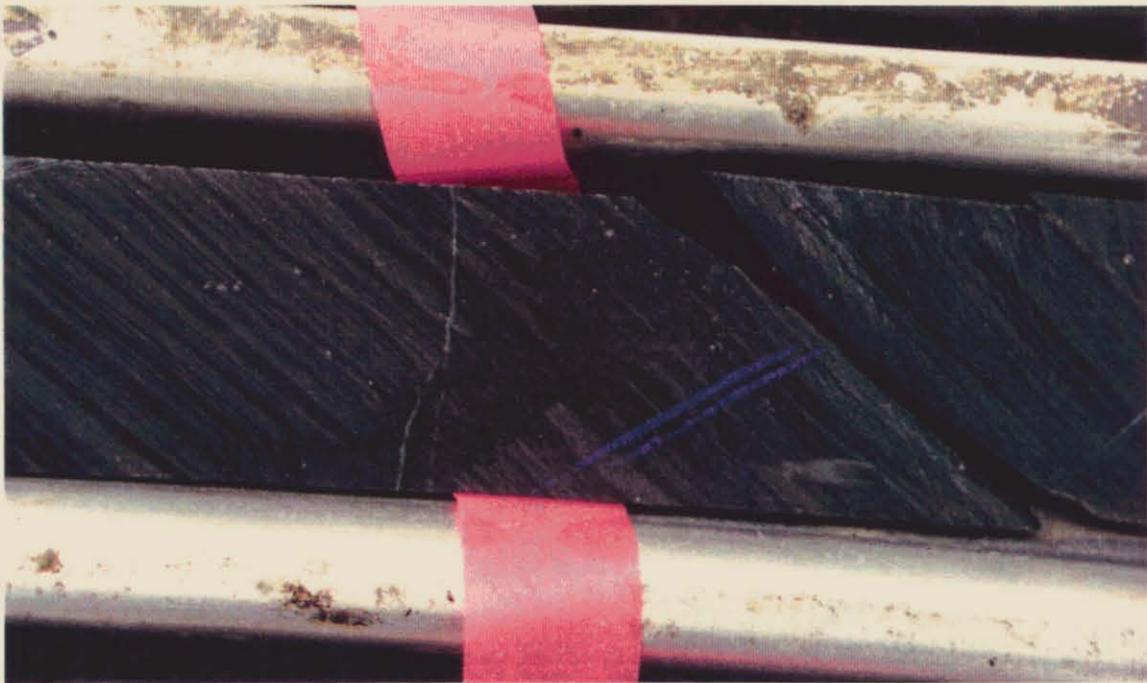
Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Parallel-laminated carbonate characteristic of the laminated facies.

052096



052097

Plate 22

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 182.05

Frame Nr: 19

Project: Oceana

Formation(s): Gordon Limestone

Location: Oceana Mine

Description:

Parallel-laminated carbonate with burrow. Association of structures identifies dark laminae as early diagenetic rather than tectonic cleavage structures.

Plate 23

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 187.30

Frame Nr: 28

Project: Oceana

Formation(s): Gordon Limestone

Location: Oceana Mine

Description:

Fossil debris in mudstone layer.

Plate 24

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 280.15

Frame Nr: 10

Project: Oceana

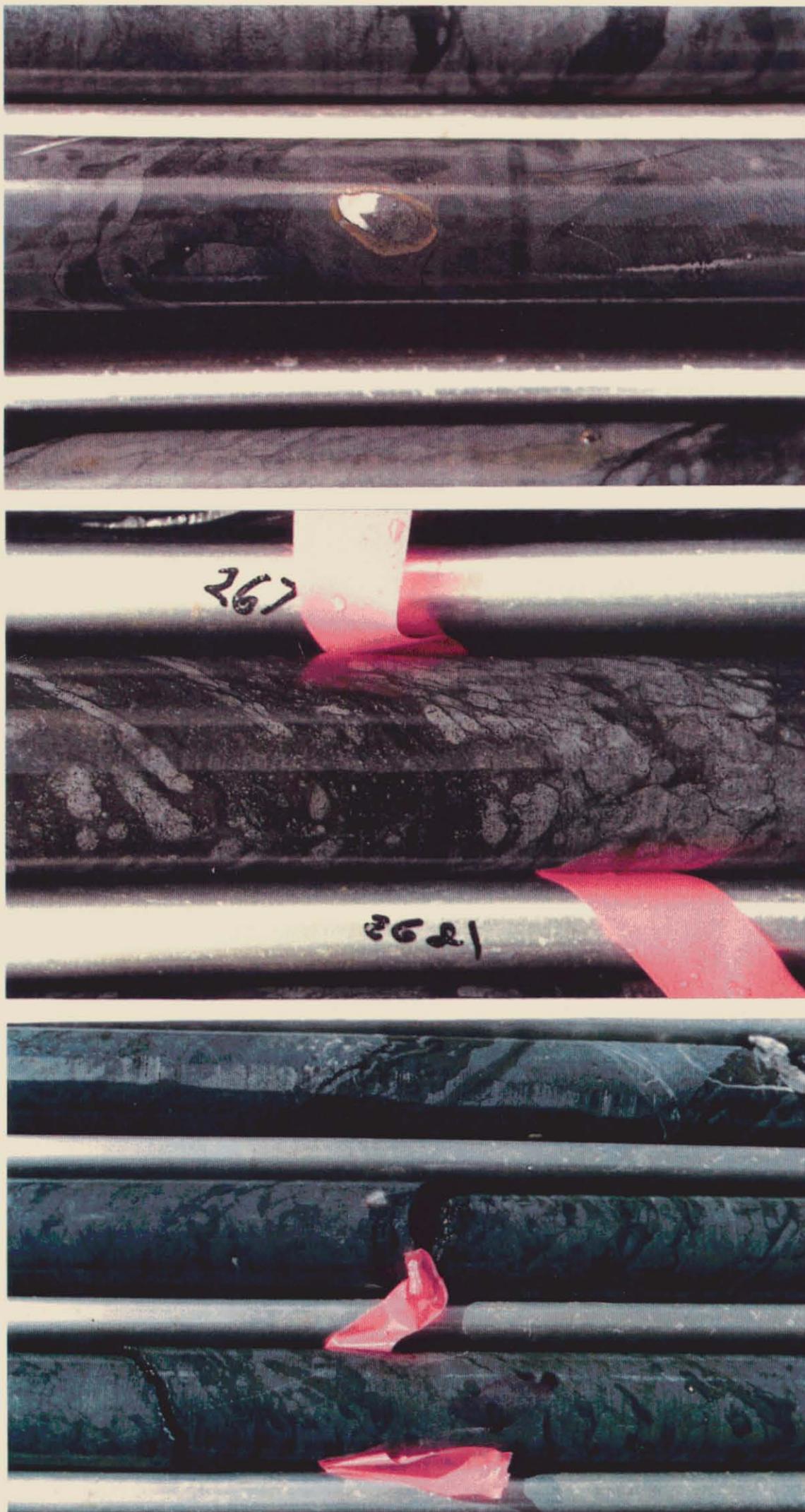
Formation(s): Gordon Limestone

Location: Oceana Mine

Description:

Coarse bioclasts in sandy carbonate.

052098



052099

Plate 25

DDHID: ZT 80-3

Film Nr: Tas1

Depth (m): 342.90

Frame Nr: 35

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Centre row: Tubular mottling with bioclast (centre). Shell is rimmed by fine pyrite (yellow) and filled by both carbonate-rich sediment and void-filling cement (white).

Plate 26

DDHID: ZT-80-3

Film Nr: Tas2

Depth (m): 267.00

Frame Nr: 16

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Tubular mottling in mudstone. Mudstone contains sand-size shell debris (small white spots). Mottle tubes show stylolitic contacts with mudstone.

Plate 27

DDHID: ZT-80-3

Film Nr: Tas5

Depth (m):

Frame Nr: 17

Project : Oceana

Formation(s): Gordon Limestone

Location : Oceana Mine

Description:

Tubular burrows, extensive mixing of carbonate and mudstone. Tubes in carbonate appear dark grey, in mudstone light grey.



052100

Plate 28

DDHID:

Film Nr: Tas1

Depth (m):

Frame Nr: 26

Project : Oceana

Formation(s): Crotty Quartzite

Location : Northeast Of Oceana Mine

Description:

Large scale cross beds extending for tens of metres along strike. Probable lateral accretion deposit (bar).

Plate 29

DDHID:

Film Nr: Tas1

Depth (m):

Frame Nr: 27

Project : Oceana

Formation(s): Crotty Quartzite

Location : Northeast Of Oceana Mine

Description:

Thin siltstone layer, Crotty Quartzite.

Plate 30

DDHID:

Film Nr: Tas1

Depth (m):

Frame Nr: 28

Project : Oceana

Formation(s): Crotty Quartzite

Location : Northeast Of Oceana Mine

Description:

Small scale ripples, probably levee or floodplain deposits, Crotty Quartzite.

APPENDIX 4.

Physical Properties from Oceana DDH core.

HOLE_ID	depth	mag-sus	S.G.
ZT_80_3	40.0		3.27
ZT_80_3	40.5		2.81
ZT_80_3	78.0		2.75
ZT_80_3	78.8		4.03
ZT_80_3	120.2	0.01	2.79
ZT_80_3	160.5		2.87
ZT_80_3	199.4	0.01	2.78
ZT_80_3	240.0		2.77
ZT_80_3	280.2		2.72
ZT_80_3	280.5		2.35
ZT_80_3	319.5	0.02	2.77
ZT_80_3	319.8		2.19
ZT_80_3	360.0		2.50
ZT_80_3	360.0	0.01	2.76
ZT_80_3	400.0	0.01	2.79
ZT_80_4	40.0		2.73
ZT_80_4	80.0		2.65
ZT_80_4	120.0		2.73
ZT_80_4	160.0		2.75
ZT_80_4	200.0		2.71
ZT_80_4	240.0		2.75
ZT_80_4	280.0		2.77
ZT_80_5	21.5	0.03	2.73
ZT_80_5	57.5	0.01	2.68
ZT_80_5	99.5	0.02	2.59
ZT_80_5	136.4		2.57
ZT_80_5	182.0		2.55
ZT_80_5	227.0	0.01	2.61
ZT_80_5	265.4	0.01	2.54
ZT_80_5	299.9		2.36
ZT_80_5	341.0		2.27
ZT_80_5	380.0	0.01	2.08
ZT_80_5	419.6	0.01	2.44
ZT_80_5	460.8	0.01	2.41
ZT_80_5	474.1		2.59
ZT_80_7	21.0	0.01	2.06
ZT_80_7	124.5	0.00	2.61
ZT_80_7	141.0	0.01	2.69
ZT_80_7	168.0	0.02	3.75
ZT_80_7	171.0		2.62
ZT_80_7	208.0	0.01	2.68
ZT_80_7	244.5	0.00	2.70
ZT_80_8	81.5	0.10	3.22
ZT_80_8	181.1		2.52
ZT_80_8	214.0		2.49
ZT_80_8	227.5		3.87
ZT_82_10A	40.6	0.29	2.61
ZT_82_10A	80.0		2.76
ZT_82_10A	120.0		2.72
ZT_82_10A	160.0		2.72
ZT_82_10A	200.2		2.71
ZT_82_10A	240.0		2.72
ZT_82_10A	280.0		2.73
ZT_82_10A	320.0		2.71
ZT_82_10A	360.1		2.72
ZT_82_10A	399.0	0.49	2.71

052104

HOLE_ID	depth	mag-sus	S.G.
ZT_80_3	21.0	0.01	
ZT_80_3	24.0	0.04	
ZT_80_3	27.0	0.01	
ZT_80_3	30.0	0.01	
ZT_80_3	33.0	0.02	
ZT_80_3	36.0	0.01	
ZT_80_3	39.0	0.01	
ZT_80_3	40.0		3.27
ZT_80_3	40.5		2.81
ZT_80_3	42.0	0.01	
ZT_80_3	51.0	0.01	
ZT_80_3	54.0	0.02	
ZT_80_3	57.0	0.02	
ZT_80_3	60.0	0.01	
ZT_80_3	63.0	0.01	
ZT_80_3	66.0	0.02	
ZT_80_3	69.0	0.01	
ZT_80_3	72.0	0.01	
ZT_80_3	75.0	0.01	
ZT_80_3	78.0		2.75
ZT_80_3	78.8		4.03
ZT_80_3	95.9	0.01	
ZT_80_3	99.0	0.01	
ZT_80_3	105.0	0.01	
ZT_80_3	108.0	0.01	
ZT_80_3	111.0	0.01	
ZT_80_3	114.0	0.02	
ZT_80_3	120.0		1.83
ZT_80_3	120.2	0.01	2.79
ZT_80_3	129.0	0.01	
ZT_80_3	132.0	0.01	
ZT_80_3	135.0	0.01	
ZT_80_3	141.0	0.01	
ZT_80_3	145.0	0.01	
ZT_80_3	151.5	0.01	
ZT_80_3	154.5	0.01	
ZT_80_3	160.0		1.76
ZT_80_3	160.5		2.87
ZT_80_3	163.5	0.01	
ZT_80_3	166.5	0.01	
ZT_80_3	168.8	0.01	
ZT_80_3	169.9	0.01	
ZT_80_3	172.5	0.01	
ZT_80_3	175.5	0.01	
ZT_80_3	178.5	0.01	
ZT_80_3	181.5	0.01	
ZT_80_3	187.5	0.01	
ZT_80_3	190.5	0.01	
ZT_80_3	199.4	0.01	2.78
ZT_80_3	200.0		1.74
ZT_80_3	202.5	0.01	
ZT_80_3	211.5	0.01	
ZT_80_3	222.7	0.01	
ZT_80_3	232.0	0.01	
ZT_80_3	235.1	0.01	
ZT_80_3	238.2	0.01	
ZT_80_3	238.5	0.04	
ZT_80_3	240.0		2.77

Physical Properties for Oceana DDH core

052105

HOLE_ID	depth	mag-sus	S.G.
ZT_80_3	240.0		1.82
ZT_80_3	247.5	0.02	
ZT_80_3	262.5	0.01	
ZT_80_3	265.5	0.01	
ZT_80_3	271.5	0.01	
ZT_80_3	280.2		2.72
ZT_80_3	280.5		2.35
ZT_80_3	283.5	0.01	
ZT_80_3	292.5	0.01	
ZT_80_3	295.1	0.02	
ZT_80_3	298.2	0.01	
ZT_80_3	301.3	0.01	
ZT_80_3	304.1	0.01	
ZT_80_3	307.2	0.02	
ZT_80_3	310.3	0.01	
ZT_80_3	316.3	0.01	
ZT_80_3	319.5	0.02	2.77
ZT_80_3	319.8		2.19
ZT_80_3	325.5	0.01	
ZT_80_3	328.5	0.01	
ZT_80_3	329.5	0.01	
ZT_80_3	340.5	0.02	
ZT_80_3	343.5	0.02	
ZT_80_3	346.5	0.02	
ZT_80_3	349.5	0.01	
ZT_80_3	352.0	0.01	
ZT_80_3	355.0	0.01	
ZT_80_3	358.5	0.02	
ZT_80_3	360.0		2.50
ZT_80_3	360.0	0.01	2.76
ZT_80_3	364.5	0.01	
ZT_80_3	367.5	0.01	
ZT_80_3	368.9	0.01	
ZT_80_3	372.0	0.01	
ZT_80_3	375.1	0.01	
ZT_80_3	378.2	0.01	
ZT_80_3	379.5	0.01	
ZT_80_3	381.7	0.01	
ZT_80_3	384.2	0.01	
ZT_80_3	387.3	0.02	
ZT_80_3	390.4	0.01	
ZT_80_3	393.5	0.01	
ZT_80_3	396.6	0.01	
ZT_80_3	400.0		1.18
ZT_80_3	400.0	0.01	2.79
ZT_80_4	9.6	0.20	
ZT_80_4	18.6	0.20	
ZT_80_4	21.6	0.08	
ZT_80_4	40.0		2.73
ZT_80_4	45.6	0.08	
ZT_80_4	48.6	0.05	
ZT_80_4	63.6	0.05	
ZT_80_4	69.4	0.08	
ZT_80_4	80.0		2.65
ZT_80_4	81.6	0.08	
ZT_80_4	93.2	0.06	
ZT_80_4	120.0		2.73
ZT_80_4	145.5	0.06	
ZT_80_4	146.0	0.04	

HOLE_ID	depth	mag-sus	S.G.
ZT_80_4	160.0		2.75
ZT_80_4	191.0	0.04	
ZT_80_4	194.0	0.08	
ZT_80_4	200.0		2.71
ZT_80_4	240.0		2.75
ZT_80_4	244.9	0.08	
ZT_80_4	248.0	0.25	
ZT_80_4	249.0	2.22	
ZT_80_4	250.0	2.27	
ZT_80_4	251.0	1.77	
ZT_80_4	252.0	0.32	
ZT_80_4	253.0	1.13	
ZT_80_4	254.0	1.77	
ZT_80_4	255.0	1.50	
ZT_80_4	256.8	1.54	
ZT_80_4	258.0	1.79	
ZT_80_4	258.6	1.56	
ZT_80_4	259.0	0.23	
ZT_80_4	259.9	0.23	
ZT_80_4	260.0	0.09	
ZT_80_4	261.0	0.12	
ZT_80_4	280.0		2.77
ZT_80_4	287.0	0.12	
ZT_80_4	288.0	0.23	
ZT_80_4	289.0	1.46	
ZT_80_4	290.0	2.54	
ZT_80_4	291.0	0.88	
ZT_80_4	292.0	0.26	
ZT_80_4	293.0	0.63	
ZT_80_4	294.0	1.88	
ZT_80_4	295.0	1.80	
ZT_80_4	296.0	2.55	
ZT_80_5	18.5	0.03	
ZT_80_5	21.5	0.03	2.73
ZT_80_5	24.5	0.02	
ZT_80_5	57.5	0.01	2.68
ZT_80_5	60.5	0.01	
ZT_80_5	63.5	0.02	
ZT_80_5	66.5	0.01	
ZT_80_5	69.5	0.01	
ZT_80_5	72.5	0.01	
ZT_80_5	75.5	0.01	
ZT_80_5	90.2	0.01	
ZT_80_5	93.2	0.01	
ZT_80_5	96.5	0.02	
ZT_80_5	99.5	0.02	2.59
ZT_80_5	102.5	0.02	
ZT_80_5	104.6	0.01	
ZT_80_5	107.7	0.03	
ZT_80_5	108.5	0.01	
ZT_80_5	117.5	0.01	
ZT_80_5	119.4	0.01	
ZT_80_5	128.0	0.01	
ZT_80_5	130.1	0.01	
ZT_80_5	136.4		2.57
ZT_80_5	147.8	0.01	
ZT_80_5	154.0	0.01	

HOLE_ID	depth	mag-sus	S.G.
ZT_80_5	156.0	0.01	
ZT_80_5	158.9	0.01	
ZT_80_5	170.0	0.01	
ZT_80_5	182.0		2.55
ZT_80_5	185.0	0.01	
ZT_80_5	188.3	0.01	
ZT_80_5	190.1	0.01	
ZT_80_5	193.2	0.01	
ZT_80_5	197.2	0.01	
ZT_80_5	200.0	0.01	
ZT_80_5	205.0	0.02	
ZT_80_5	206.2	0.01	
ZT_80_5	209.0	0.01	
ZT_80_5	212.0	0.01	
ZT_80_5	215.0	0.01	
ZT_80_5	218.0	0.01	
ZT_80_5	221.0	0.01	
ZT_80_5	224.0	0.01	
ZT_80_5	227.0	0.01	2.61
ZT_80_5	230.0	0.02	
ZT_80_5	233.0	0.01	
ZT_80_5	239.0	0.01	
ZT_80_5	242.0	0.01	
ZT_80_5	248.0	0.01	
ZT_80_5	251.0	0.01	
ZT_80_5	254.0	0.01	
ZT_80_5	257.0	0.02	
ZT_80_5	260.0	0.01	
ZT_80_5	263.0	0.01	
ZT_80_5	265.4	0.01	2.54
ZT_80_5	269.0	0.01	
ZT_80_5	278.0	0.01	
ZT_80_5	281.0	0.01	
ZT_80_5	284.0	0.01	
ZT_80_5	292.2	0.02	
ZT_80_5	295.2	0.01	
ZT_80_5	296.9	0.01	
ZT_80_5	299.9		2.36
ZT_80_5	322.6	0.01	
ZT_80_5	324.7	0.01	
ZT_80_5	331.5	0.02	
ZT_80_5	334.6	0.01	
ZT_80_5	341.0		2.27
ZT_80_5	347.0	0.01	
ZT_80_5	362.0	0.08	
ZT_80_5	365.0	0.01	
ZT_80_5	371.8	0.01	
ZT_80_5	380.0	0.01	2.08
ZT_80_5	385.0	0.01	
ZT_80_5	397.6	0.01	
ZT_80_5	400.3	0.01	
ZT_80_5	401.5	0.02	
ZT_80_5	403.1	0.01	
ZT_80_5	414.7	0.01	
ZT_80_5	416.0	0.01	
ZT_80_5	419.6	0.01	2.44
ZT_80_5	420.6	0.01	
ZT_80_5	424.0	0.02	

HOLE_ID	depth	mag-sus	S.G.
ZT_80_5	425.0	0.01	
ZT_80_5	430.6	0.01	
ZT_80_5	438.8	0.01	
ZT_80_5	440.0	0.01	
ZT_80_5	441.5	0.06	
ZT_80_5	443.6	0.02	
ZT_80_5	445.9	0.02	
ZT_80_5	455.0	0.01	
ZT_80_5	460.8	0.01	2.41
ZT_80_5	465.2	0.02	
ZT_80_5	466.9	0.01	
ZT_80_5	470.5	0.01	
ZT_80_5	471.2	0.01	
ZT_80_5	472.1	0.01	
ZT_80_5	474.1		2.59
ZT_80_7	16.0	0.01	
ZT_80_7	18.0	0.01	
ZT_80_7	19.5	0.01	
ZT_80_7	21.0	0.01	2.06
ZT_80_7	25.5	0.01	
ZT_80_7	27.0	0.01	
ZT_80_7	27.7	0.01	
ZT_80_7	34.5	0.01	
ZT_80_7	35.8	0.01	
ZT_80_7	37.3	0.01	
ZT_80_7	38.7	0.01	
ZT_80_7	40.2	0.01	
ZT_80_7	41.7	0.01	
ZT_80_7	42.3	0.01	
ZT_80_7	43.9	0.01	
ZT_80_7	45.0	0.01	
ZT_80_7	48.0	0.01	
ZT_80_7	49.5	0.01	
ZT_80_7	51.0	0.01	
ZT_80_7	53.8	0.02	
ZT_80_7	55.4	0.02	
ZT_80_7	56.9	0.01	
ZT_80_7	58.4	0.01	
ZT_80_7	60.0	0.01	1.74
ZT_80_7	63.0	0.01	
ZT_80_7	64.5	0.01	
ZT_80_7	67.5	0.01	
ZT_80_7	69.0	0.01	
ZT_80_7	70.5	0.01	
ZT_80_7	72.0	0.01	
ZT_80_7	73.5	0.01	
ZT_80_7	74.8	0.01	
ZT_80_7	76.4	0.01	
ZT_80_7	79.4	0.01	
ZT_80_7	81.0	0.01	
ZT_80_7	82.5	0.01	
ZT_80_7	83.8	0.01	
ZT_80_7	85.3	0.01	
ZT_80_7	86.8	0.01	
ZT_80_7	88.3	0.01	
ZT_80_7	90.0	0.02	
ZT_80_7	91.5	0.01	
ZT_80_7	97.5	0.01	

HOLE_ID	depth	mag-sus	S.G.
ZT_80_7	99.0	0.02	
ZT_80_7	100.5	0.01	1.76
ZT_80_7	102.0	0.02	
ZT_80_7	105.0	0.01	
ZT_80_7	106.5	0.01	
ZT_80_7	108.0	0.01	
ZT_80_7	109.5	0.01	
ZT_80_7	111.0	0.01	
ZT_80_7	112.5	0.01	
ZT_80_7	114.0	0.01	
ZT_80_7	117.0	0.01	
ZT_80_7	118.5	0.01	
ZT_80_7	120.0	0.01	
ZT_80_7	121.5	0.01	
ZT_80_7	124.5	0.00	2.61
ZT_80_7	126.0	0.01	
ZT_80_7	130.5	0.01	
ZT_80_7	132.0	0.01	
ZT_80_7	133.5	0.01	
ZT_80_7	135.0	0.01	
ZT_80_7	136.5	0.01	
ZT_80_7	138.0	0.01	
ZT_80_7	139.5	0.01	
ZT_80_7	141.0	0.01	2.69
ZT_80_7	142.5	0.01	
ZT_80_7	154.5	0.01	
ZT_80_7	156.0	0.01	
ZT_80_7	163.5	0.01	
ZT_80_7	165.0	0.01	
ZT_80_7	166.5	0.01	
ZT_80_7	168.0	0.02	3.75
ZT_80_7	169.5	0.01	
ZT_80_7	171.0		2.62
ZT_80_7	175.5	0.01	
ZT_80_7	177.0	0.01	
ZT_80_7	181.3	0.02	
ZT_80_7	182.8	0.01	
ZT_80_7	190.5	0.01	
ZT_80_7	195.0	0.08	
ZT_80_7	196.5	0.01	
ZT_80_7	199.1	0.01	
ZT_80_7	208.0	0.01	2.68
ZT_80_7	217.4	0.01	
ZT_80_7	229.5	0.01	
ZT_80_7	232.5	0.01	
ZT_80_7	235.5	0.02	
ZT_80_7	238.5	0.01	
ZT_80_7	244.5	0.00	2.70
ZT_80_8	32.9	0.03	
ZT_80_8	37.8	0.33	
ZT_80_8	42.3	0.27	
ZT_80_8	45.4	0.07	
ZT_80_8	48.6	0.20	
ZT_80_8	56.6	0.32	
ZT_80_8	64.5	0.02	
ZT_80_8	70.0	0.10	
ZT_80_8	76.0	0.06	

HOLE_ID	depth	mag-sus	S.G.
ZT_80_8	78.0	0.24	
ZT_80_8	80.7	0.02	
ZT_80_8	81.5	0.10	3.22
ZT_80_8	85.7	0.03	
ZT_80_8	99.0	0.00	
ZT_80_8	103.0	0.01	
ZT_80_8	107.6	0.01	
ZT_80_8	110.8	0.06	
ZT_80_8	116.2		
ZT_80_8	122.0	0.12	
ZT_80_8	127.2	0.13	
ZT_80_8	131.9	0.13	
ZT_80_8	133.0		
ZT_80_8	135.0	0.01	
ZT_80_8	139.5	0.03	
ZT_80_8	143.5	0.10	
ZT_80_8	148.5	0.02	
ZT_80_8	171.0		
ZT_80_8	172.5		
ZT_80_8	178.2		
ZT_80_8	181.1		2.52
ZT_80_8	181.5		
ZT_80_8	183.5	0.01	
ZT_80_8	187.1	0.01	
ZT_80_8	187.7		1.88
ZT_80_8	189.2	0.01	
ZT_80_8	192.0	0.01	
ZT_80_8	193.5	0.01	
ZT_80_8	196.2	0.01	
ZT_80_8	197.7	0.01	
ZT_80_8	199.0	0.02	
ZT_80_8	200.5	0.01	
ZT_80_8	203.3	0.01	
ZT_80_8	206.3	0.01	
ZT_80_8	208.0	0.01	
ZT_80_8	209.5	0.01	
ZT_80_8	212.0	0.04	
ZT_80_8	213.5	0.01	
ZT_80_8	214.0		2.49
ZT_80_8	215.2	0.05	
ZT_80_8	216.5	0.01	
ZT_80_8	218.5	0.01	
ZT_80_8	220.0	0.02	
ZT_80_8	223.5	0.02	
ZT_80_8	225.0	0.03	
ZT_80_8	226.0	0.01	
ZT_80_8	227.5		3.87
ZT_80_8	228.0	0.02	
ZT_82_10A	40.6	0.29	2.61
ZT_82_10A	80.0		2.76
ZT_82_10A	91.6	0.29	
ZT_82_10A	94.6	0.77	
ZT_82_10A	100.6	0.22	
ZT_82_10A	118.6	0.22	
ZT_82_10A	120.0		2.72
ZT_82_10A	121.6	0.08	
ZT_82_10A	160.0		2.72
ZT_82_10A	184.6	0.08	
ZT_82_10A	200.2		2.71

Physical Properties for Oceana DDH core

052111

HOLE_ID	depth	mag-sus	S.G.
ZT_82_10A	240.0		2.72
ZT_82_10A	280.0		2.73
ZT_82_10A	320.0		2.71
ZT_82_10A	331.6	0.08	
ZT_82_10A	334.6	0.10	
ZT_82_10A	360.1		2.72
ZT_82_10A	394.6	0.10	
ZT_82_10A	398.2	0.66	
ZT_82_10A	398.6	2.14	
ZT_82_10A	398.8	1.84	
ZT_82_10A	399.0	0.49	2.71
ZT_82_10A	403.6	0.11	

APPENDIX 5.

**Review of Gravity and Magnetic Data Oceana Mine Area,
Zeehan.**

By Leaman Geophysics.

LEAMAN GEOPHYSICS

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

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REVIEW OF GRAVITY AND MAGNETIC DATA
OCEANA MINE AREA, ZEEHAN

for
PASMINCO EXPLORATION
by
D. E. LEAMAN

August 1992

OCEANA1

INTRODUCTION

This review of gravity and magnetic data was undertaken to determine whether further data acquisition was justified in the region of the Oceana Mine workings near Zeehan. This has meant some consideration of the likely value or needed treatment of available data and just what specifications might be advisable for any new surveys.

Gravity data has been acquired by and for previous licence holders but this could never have provided any reliable interpretation due to limited coverage and incomplete correction (principally terrain corrections due to Mt Zeehan which swamp most anomalies). The most recent survey, for Amoco in 1981, forms the basis for the existing data base but this data was only properly tied to state datum by the Mines Department, and fully corrected by Leaman Geophysics for the Mines Department, when the data set entered the public domain. Such processing transformed the data set although some elements are only modestly affected. It clarified, and established, the continuity of many gradients in particular. Figure 1 presents the data base in the Oceana area after extraction of residuals using the MANTLE91 separation process. This presentation excludes crustal effects. Figure 2 provides a more regional view of the entire local data base when processed in the same way. This compilation stresses some of the patchiness and uneven detail of all surveys. Station density is very low in some areas, especially adjacent to the southern half of the Oceana grid (Figure 3).

Previous magnetic surveys have suggested that some responses may be related to mineralisation or host portions of the Gordon Limestone. Figure 4 presents a compilation of a new coverage by Pasminco Exploration.

Gravity and magnetic data sets were supplied in digital and image formats. Images were grainy reflecting local noise in the data and gridding problems. The two contour maps effectively filter much of this noise while retaining a valid representation of the observations.

QUESTIONS POSED

A number of issues were raised by the new compilations or presentations of the data sets and the relationships between many observed features and either lithologies or mineralisation were queried.

1. What is the significance of the magnetic anomalies labelled in Figure 5?
2. Where is the mother lode, if any?
3. Can the dips of the Moina/Gordon/Crotty contacts be estimated?
4. Is the Gordon Limestone underthrust?
5. What is the origin of the anomalous gravity response near 1400E/3300N mine grid?
6. Is the data coverage adequate for the resolution of such queries?

7. Are the methods employed applicable to targetting in this environment?

DISCUSSION

Some elements of Figure 5 must first be clarified. Features 1, 2 and 9 were poorly reproduced in the available image formats; partly due to inadequate filtering or selection in regions with cultural noise and high amplitude high frequency effects. These features present differently in Figure 4. Feature 1 is shown to be much more localised as a positive effect and really a more substantial quasi-regional low anomaly. This is an important observation, as shown below.

Similarly, nothing in the local gravity coverage can be appreciated without viewing it in regional context. Figure 2 shows that the Oceana region is a rather disrupted element in a complex structure. A major NNW-SSE gradient which is strongly developed near Zeehan splits into at least three main zones at the northing of Oceana Mine. Two of the subsidiary gradients border the Oceana mineralised zone and are evident in Figure 1 at about 1100 and 1500E at 3400N. These gradients merge near 2600N. The mine grid is shown on a reproduction of the local geological base in Figure 6. There are several distinctive trend changes from N-S to NW-SE in the western gradient near the NW corner of the Oceana grid. These changes are clearly real and supported by grid coverage but there are several other apparent cross trends a little north of east which may be artifacts of gridding and plotting. Inspection of Figure 3 shows that some large gaps in coverage occur in the critical locations.

Although some cross trends are suspect in terms of orientation, continuity or precise location there is evidence for such features. A major structure is indicated near 3800N but it is not described reliably by the coverage. The Oceana Fault occurs in this region. Although some ENE trends are indicated some other trends to WNW or NW are also suggested but many of these have subtler responses.

No adequate magnetic data exist which might appraise or assist definition of the first order features inferred from the limited gravity compilation.

The anomalous positive gravity feature observed near 1350E/3300N, and which is more pronounced in image formats, extends SW across the western gradient. This orientation is represented in the contour plans but is less obvious.

If the best available geological base (Figure 6) is compared with the magnetic field a number of queried features can be clarified or explained.

Labelled features (1, 2)(Figure 5) correspond exactly to the Oceana Mine mineralised zone and are no wider than the mapped host rocks. This judgment was not possible using the unadjusted images. Features 3 and 4 fall on the upper contacts of the Gordon Limestone or the contact between Gordon Limestone and Moina Sandstone across the

Oceana Fault. There is every indication of a local alteration-oxidation response at such boundaries. The greater alteration may lie on the limestone side but more detailed outcrop observations must be linked with the magnetic survey in order to determine this.

The axis of mineralised host anomaly is truncated near 3500N. The large magnetic low surrounds this cut off. It is not related to mapped(?) faulting.

The available images do not stress this major change which trends NE at about 3350-3400N. It is clearly seen in the gradient in Figure 4. The South Oceana Fault occupies this position but with a slightly different orientation. This character change is not reproduced in the gravity data but the relative positive gravity effect in the area directly overlaps both the implied fault position and the negative magnetic response. Alteration is indicated. The magnetic negative is north of the gravity positive and this suggests the presence of two features; i.e., the break in host zone seen magnetically occurs north of the main mass change.

There is no obvious southerly extension of this anomaly pattern south of the South Oceana Fault in the presumed location of extensions of the ore lenses at 1300 to 1400E. A similar effect, however, occurs displaced to the east near 1400-1500E south of 3200N. This trends slightly west toward the central southern portion of the grid as features 7, 8 and 9. The S. Oceana workings lie on this axis but these have not been drilled extensively. The Gordon Limestone west of 1400E is quite different in geophysical response character. The positive grain east of 1400E and the negative associated from 1300-1350E extends across the mapped fault near the South Oceana workings. There is little evidence in the magnetic data for this fault which produces an apparent thinning of the Gordon Limestone. There is some suggestion of this structure in the gravity data.

It should also be noted that part of the effect corresponds (or underlies) the Crotty Sandstone at 1450E/2700N. This lack of correlation with actual limestone or contact positions must reflect a concealed but continuous source within the limestone.

Other relatively positive magnetic field elements correspond with the Moina Sandstone (especially the southern extension of feature 6) while feature 5 is a contact effect where fault displacement and alteration have occurred.

Most of the queried or labelled features are not truly anomalous. The gradients between features 1, 4 and 5, 8 and the low intensity field about it is certainly anomalous.

The zone 5-9 which relates to part of the Gordon Limestone, but then largely ignores surface lithologies and contacts is also anomalous. It is, however, more diffuse than 1-2 which is definitely associated with mineralisation but this may reflect either diffusion or depth of source.

The gravity field shows more consistent lithological correlation; the gradients observed in Figure 2 can all be linked to major formation boundaries including one within the Silurian sequence (to Florence

Sandstone). The shelf-like character corresponding to the Gordon Limestone varies along strike. Substantial negative disruption of this trend occurs near 3650N and it is also narrowed south of S. Oceana.

Limited drilling near S. Oceana was superimposed on a section for 2800N as supplied by M. Quayle. This concept explains the apparent thinning of the limestone by overthrust Moina Sandstone. Features 6-7 and 9 are indicated and shown in proportion at this northing. Figure 7 (2800N) presents a possible solution for the magnetic field. The model shows that all parts of the sequence are slightly magnetised but that elements of the Moina Sandstone are quite strongly magnetised. There seems to be a direct correlation between units described as worm burrowed and magnetic response and this is clearly seen in the west. There is much to support the implication of shallow truncation of this unit. All dips are steeply east. The large positive magnetic feature (9) corresponds to a tabular body dipping either vertically or very steeply to the east. The implied dip of this feature is steeper than those of the formations. Feature (6-7) is of comparable origin since the response cannot be generated by the broad lithological forms. No meaningful gravity test is possible at this northing due to limited coverage.

At 3400N (Figure 8) the magnetic responses show spines from feature (8) and the south side of the major low intensity anomaly. These responses indicate the thickness of the sources unambiguously and demonstrate a very steep dip. The gravity field is less definitive in these terms but not less informative. This profile was modelled using all the implications of Figure 2 (including use of interpolations from the regional data). Few solutions were found which can satisfy the gravity field (Figure 9). It was assumed that the profile length was sufficiently short and far distant from the Heemskirk Granite as to be free of gross interference from this source along the profile. That no fit was possible - on any profile - without a shift offset of +4 mgal on observed data is consistent with this being the local effect of the granite overall in the Oceana area. This is a credible "regional offset".

The rock properties were also largely assumed based on limited drill control and actual field responses. These assumptions provide the greatest source of risk in the interpretation. While densities for the limestone, off section conglomerate, and Silurian rocks appear reasonable those used for the Moina Sandstone test credibility and must be checked when fresh core becomes available. Especially the worm-burrowed member. However one regards these assumptions the actual profile forces use of what appears to be an abnormally high density for this unit.

No shallow mineralisation effect or deeper basin effect can achieve the profile form observed. Further, the faults implied in the section must cut out some of these units since such dense rocks cannot extend east of 1400E. This much is beyond doubt. The structural pattern thus becomes very like that at 2800E.

A dense mineralised zone produces the local effect at 1400E and this is clearly a 1 mgal aberration which may be seen as either positive or negative overall depending on how the entire profile is viewed. Some explanation of this comment is essential.

First the local effects are certainly anomalous and not explainable by sub-regional effects or unit scale sources. But it is unclear whether this zone is composed of positive effects within a negative halo or negative effects within a positive halo. There is a definite positive component. The perspective depends on the precise nature of density changes within the limestone and how one fits the overall profile, either from above the observations or from below, as here. This issue is evident on other profiles (below). The proper sense of fitting and its direct implication for understanding the very local responses depends on review of all profiles (not done for this review) and more reliable property estimates.

Figure 10 presents a magnetics solution for 3500N (Oceana Mine section). The origin of image problems and the nature of cultural noise is apparent.

The critical parts of this section lie to both east and west of this disturbed zone. The magnetic field appears subtle but the sensitive anomaly shoulders betray contact anomalies with both Crotty Sandstone and Moina Sandstone as well as some significant relative changes in contrast. Most lithological contrasts are very small apart from the mineralised zone which is only partly represented at this northing. All contact effects are consistent with steep easterly dips and could be used to give valid dip estimates in many cases.

Figures 11 and 12 review 3700N. This profile could have been expected to display asymmetric forms due to the nearness of the sub parallel Oceana Fault but evidence of this is generally limited or absent subject to further infill to the north. This may imply much about this fault and its depth of influence.

The magnetic profile is more irregular than seen in any previous profiles but this character can be explained by numerous contact anomalies, faulted or steeply dipping ore zones, or variations in the limestone. All unit dips are eastward.

The gravity profile stresses the problem of the Moina Sandstone. Something very dense is implied. It should be noted that a profile shift of about 1.5 mgal (at the western end since the eastern end is not critical for various reasons) could be coupled with up to 50 m of deep alteration within the limestone to yield an equivalent result and remove the illusion of an apparently very dense Moina Sandstone. This is a possible but not preferred solution and the problem remains pending some extension of the data base, checking of edge of survey data, or some property determinations.

Figure 13 summarises some of the inferences about fault locations based on trends within the data sets and anomaly terminations. Some of these features correspond to mapped or inferred positions while other derive solely from the geophysical data. As noted above not all features are continuously reflected in both data sets indicating some mixed and varied responses within the limestone and hosts.

CONCLUSIONS

Review of extant magnetic and gravity data around the Oceana Mine area shows that many queried elements are not anomalous but are contact anomalies between limestone or dolomite and other lithologies.

Mineralised rock is quite strongly magnetic in local terms by at least an order of magnitude.

Real anomalies, yet to be explained relate to termination of negative magnetic responses near 3400N and the magnetic eastern portion of the limestone south of 3100N. This appears to be mineralised - as at S. Oceana, yet it does not stratigraphically correspond to the formation boundaries. This relationship also implies that the "basal" limestone Moina Sandstone contact in the region from 2300-2900N is overthrust and that this anomalous belt is concealed. A second feature of this type - perhaps the same zone repeated by faulting - also underlies the thrust about 200 m further west.

Dips can be estimated and the inference is that all unit dips are very steep to the east. Further work could improve present estimates.

The locus of mineralisation, however, is an open question. The mined northern zone, with its magnetic response, is cut out north of the S. Oceana Fault at about 3400N. The gravity field in the mined area is depressed but the effect is too broad to be related to mineralisation alone and is more properly linked to the Oceana Fault and deep weathering or alteration.

There is limited apparent direct correlation of gravity response and mineralisation until profiles are examined in detail but Figure 13 suggests that the critical zone might be doubly offset by a sinistral-dextral ENE couple crossing the host zone near 3250N. The lesser - sinistral component shifts the ore west beneath the main gravity anomaly and the larger fault moves the entire zone to the east. Due to overthrusting and other possible low angle components which might be associated with these faults - in order to explain the different weightings assigned by the two data sets in every case - and probably multiple generation faulting a second magnetic zone extends from the western position at the first offset. There are thus at least three target zones given this assessment.

1. 1330-1350E/3350N approx.
2. 1300/2800N to south
3. 1450E/3200N - 1410E/2400N

The methods and data reviewed can clearly provide much structural information but are less certain concerning mineralisation or targetting until much better control can be provided about the nature of the materials and responses. In these terms the magnetic methods are most useful with the gravity data somewhat more ambiguous but probably ultimately crucial.

Neither data set is adequately endowed in terms of coverage. Critical gaps occur in the gravity information north and west of 3700N and east and west of the region south of 3000N. Although the magnetic applications are not really affected by limited line length some information about regional setting would be helpful in providing perspective and assisting full utilisation of the gravity data.

The review indicates the the design of the magnetic survey is generally adequate with 5 m sampling and 50 to 100 m line spacings although some flexibility is essential wherever cultural noise is an issue.

The general gravity station density within the gridded areas is also satisfactory overall but a spacing of 25 m is recommended with 200 m of the zone of interest within the limestone and 50 to 100 m spacings beyond this axis. Some infill at 250 m for at least a kilometre in all directions is essential and its absence in important areas about the Oceana grid limit the usefulness of the grid survey.

Apart from some regional magnetic overview, perhaps provided by high resolution aeromagnetics, and some limited extension of the gravity coverage the real need is for some rock property information and perhaps control near 3150N. Other profiles should then be analysed.

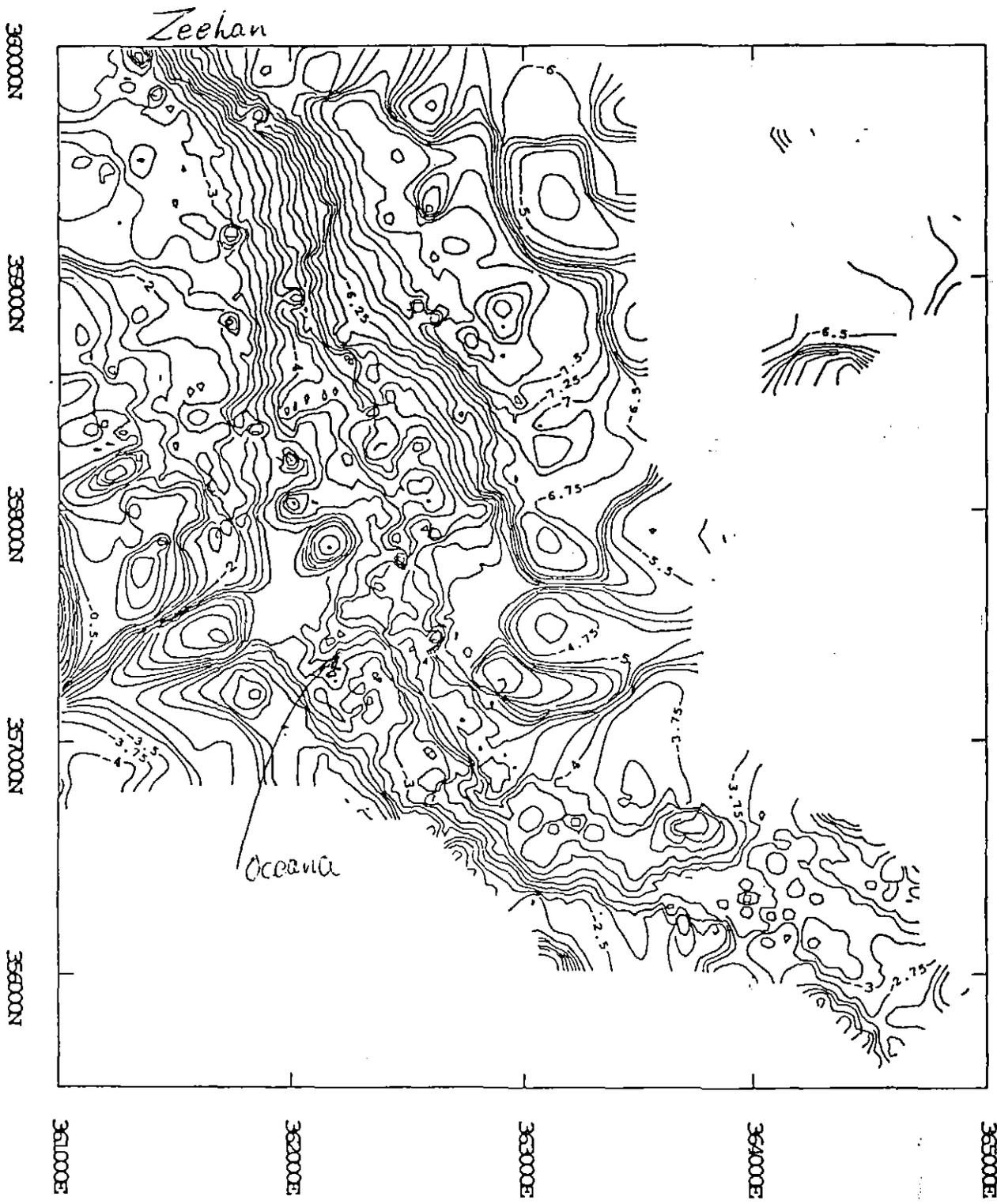
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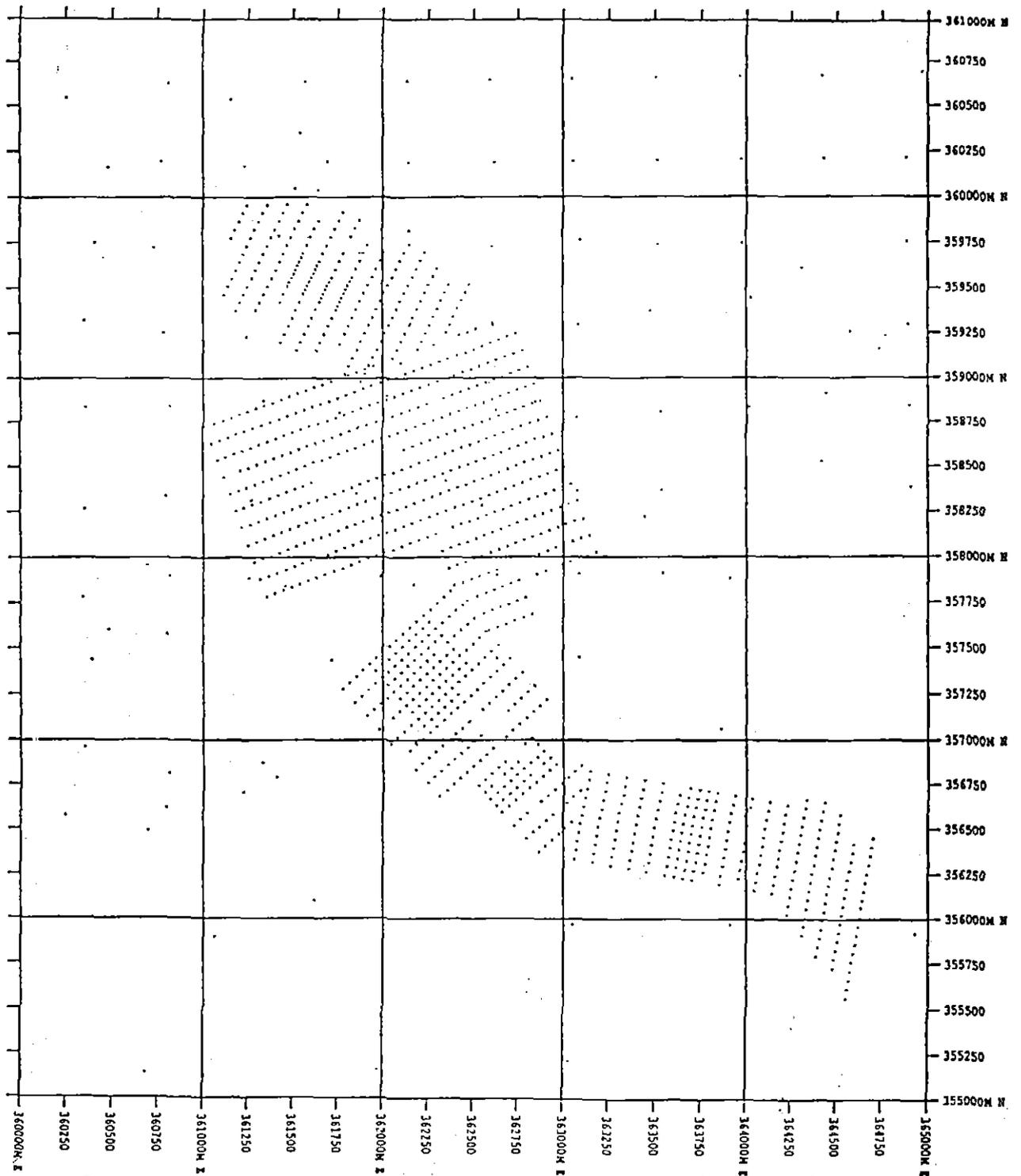
- Leaman, D.E., & Richardson, R.G., 1989. Production of a residual gravity field map for Tasmania and some implications. Exploration Geophysics, 20, 181-184
- Richardson, R.G., 1992. Gravity gradients at several Tasmanian sites. Unpub. Rep. Dep. Mines Tasm., 1992/25.

Residual Bouguer anomalies in the Zeehan area processed using the method of Leaman & Richardson (1989). Map reproduced from Richardson (1992).

FIGURE 2

052122

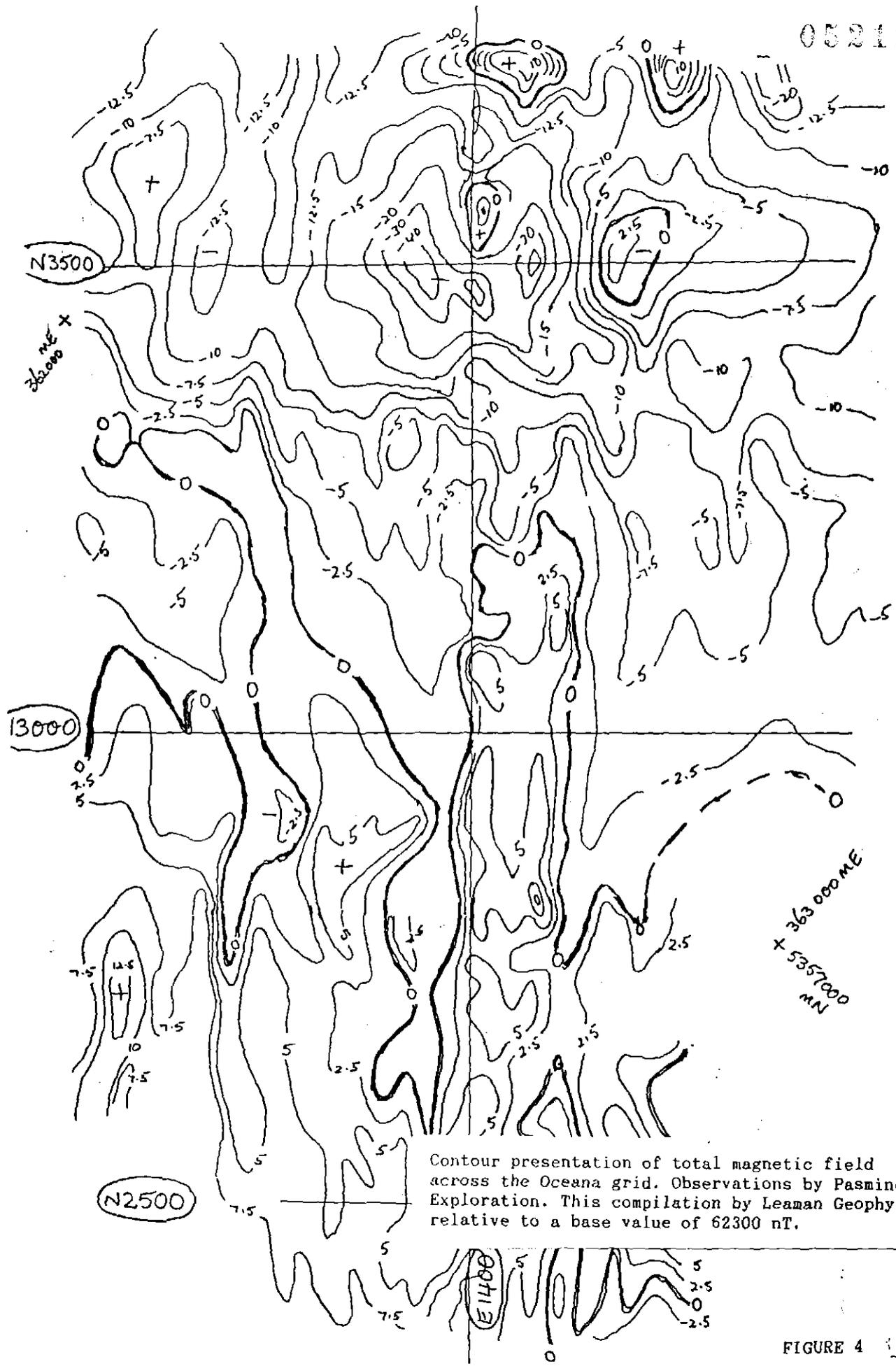




OCEANA PUBLIC DATA 23/JUL/92

Distribution of gravity stations in the Zeehan
area (from Richardson, 1992)

FIGURE 3



Contour presentation of total magnetic field across the Oceana grid. Observations by Pasmenco Exploration. This compilation by Leaman Geophysics relative to a base value of 62300 nT.

FIGURE 4

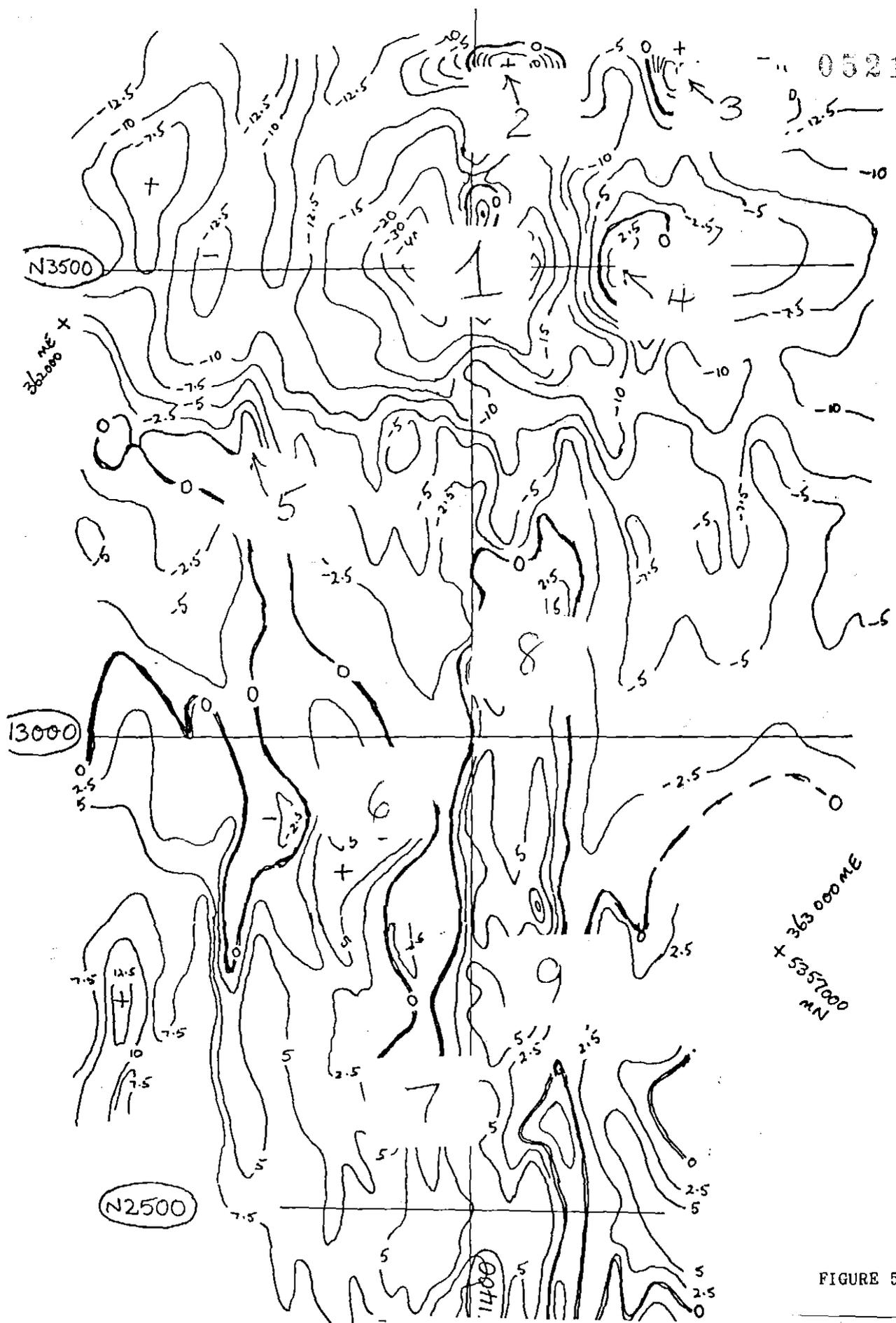


FIGURE 5

Total magnetic field and location of labelled and queried features shown in images of the same data.

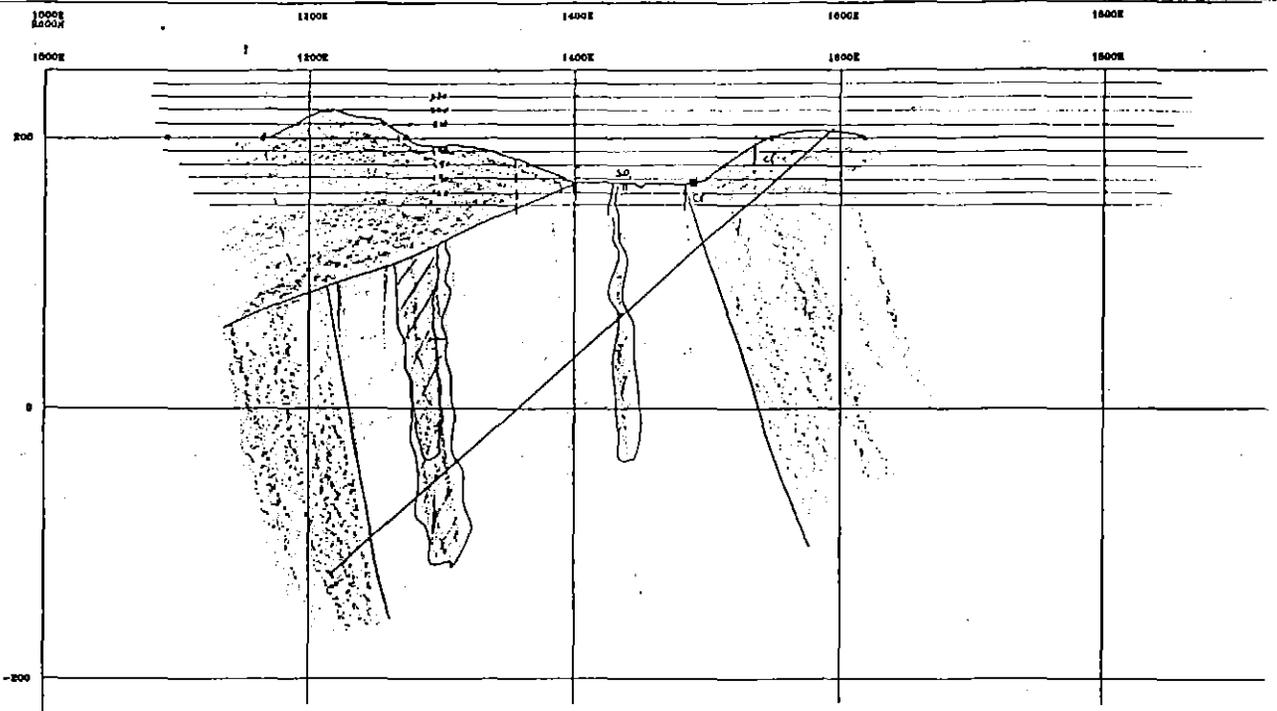
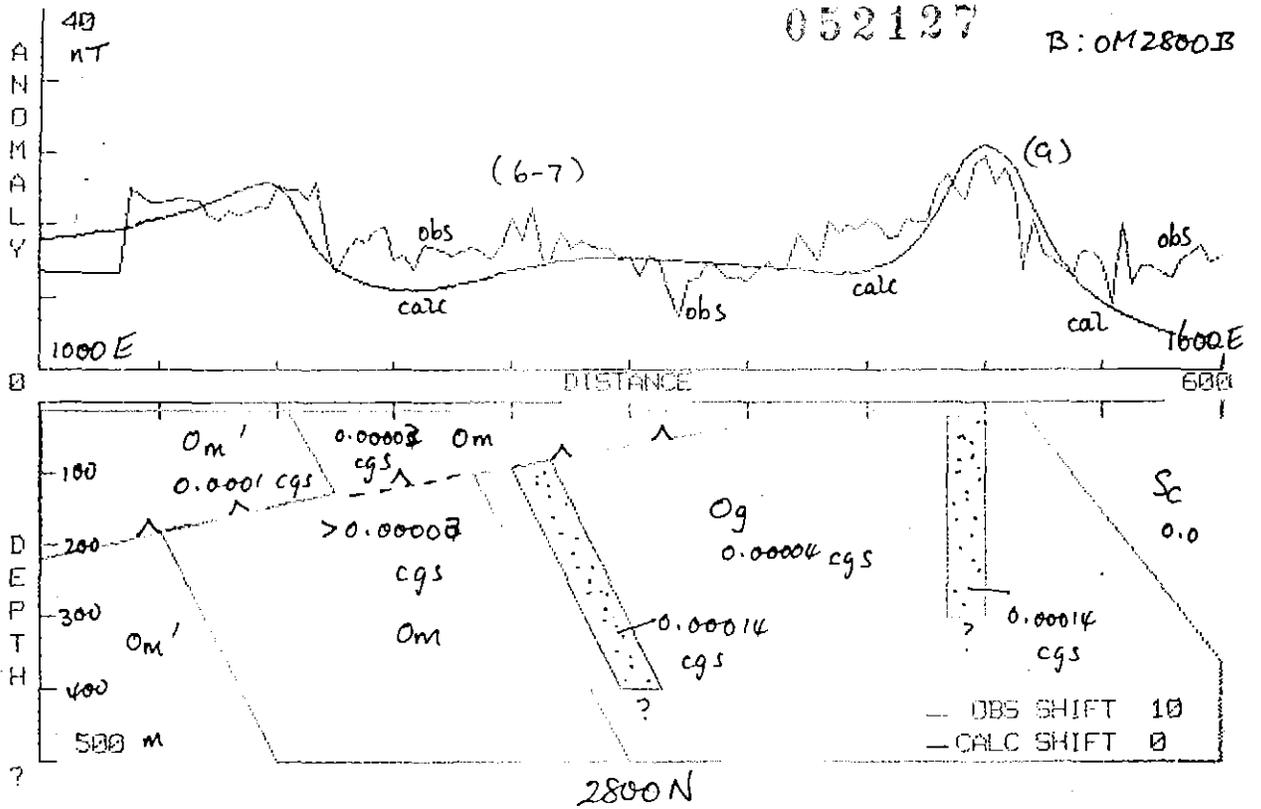


Extract of geological base map of the Oceana grid as supplied by Pasminco Exploration.

FIGURE 6

052127

B: 0M2800B

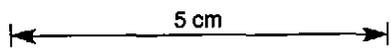


Magnetics model of profile 2800N and proposed geological section submitted for test.

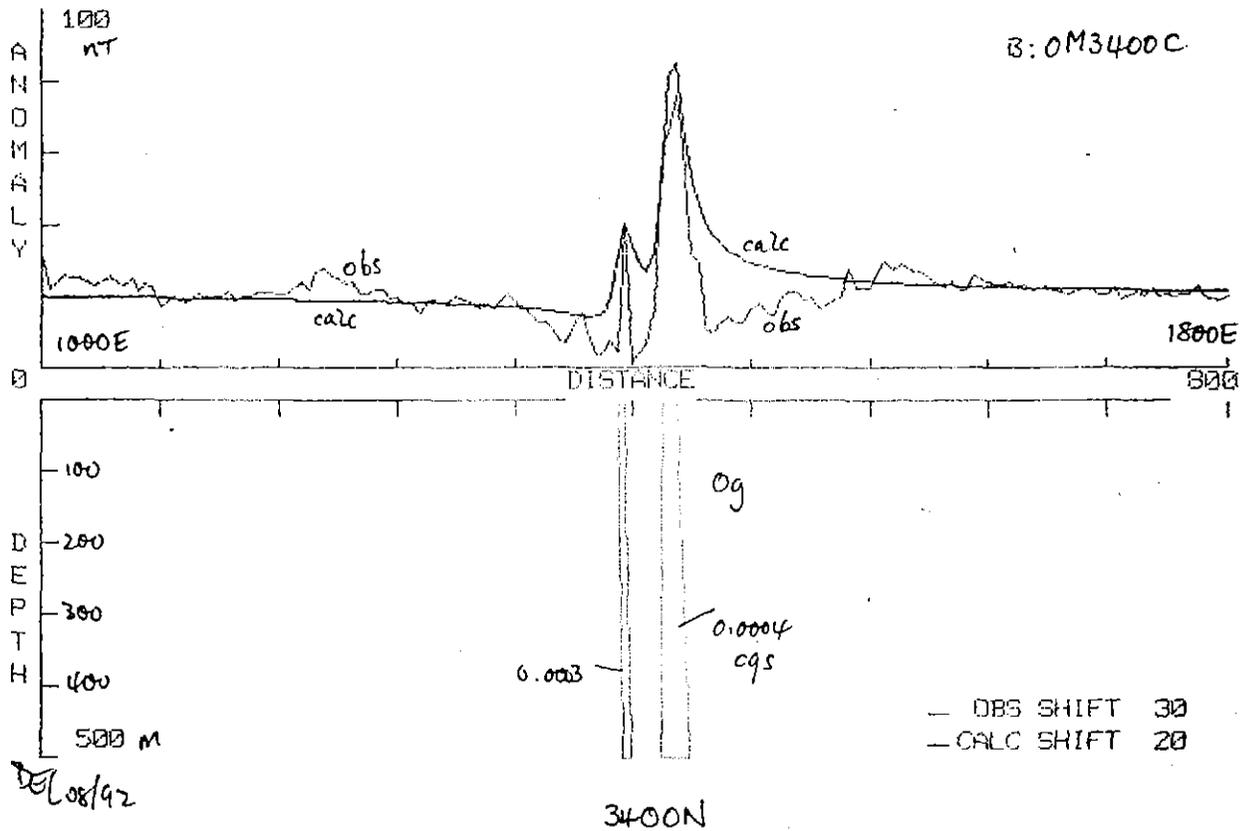
FIGURE 7

PASMINCO EXPLORATION	
A Division of Petroleum Australia Limited	
COMPASS FILE	DECLINE
DATE REVISION	Pb > 12
NAME FILE	2800-N
REFERENCE	

1:5000

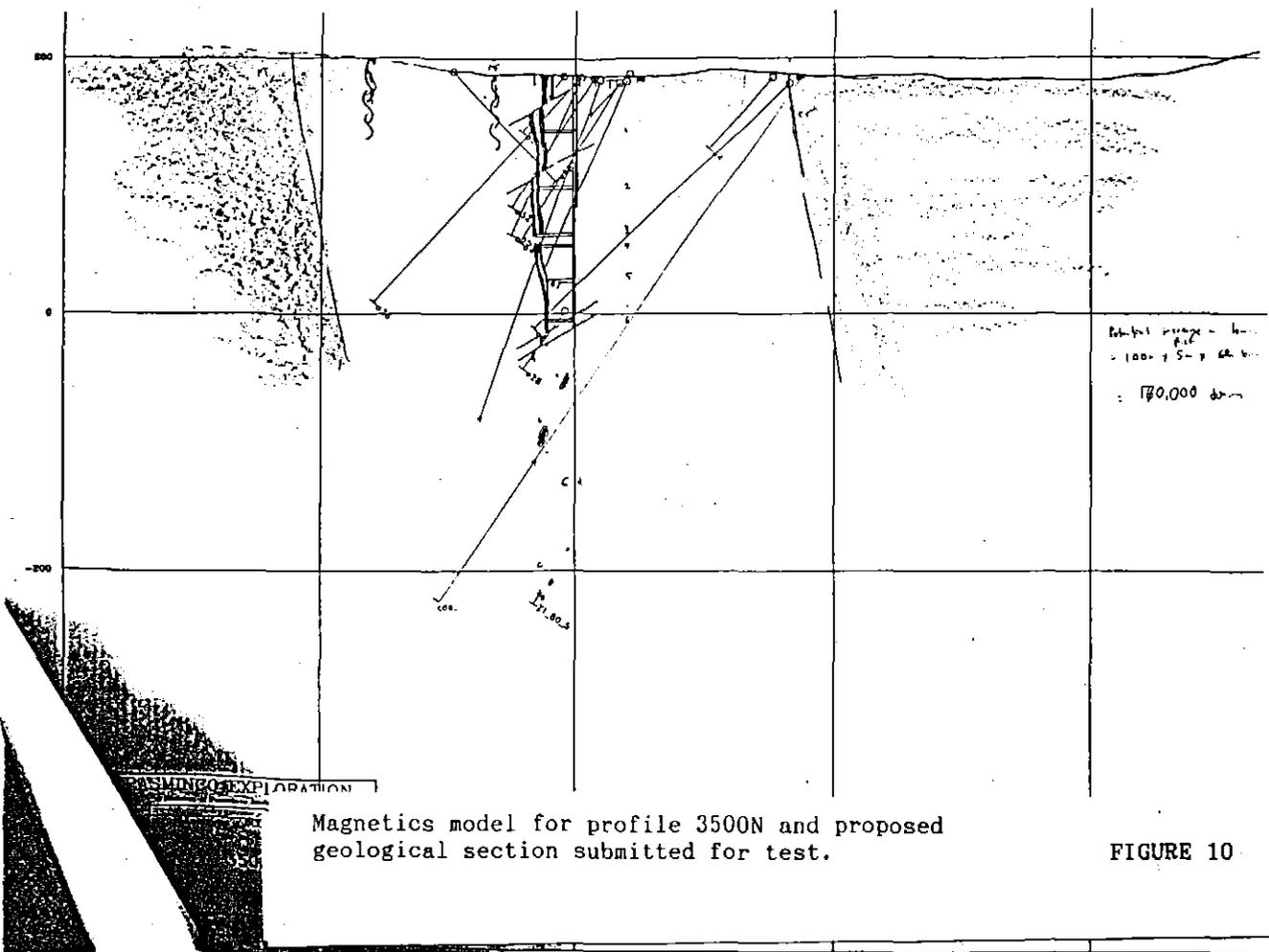
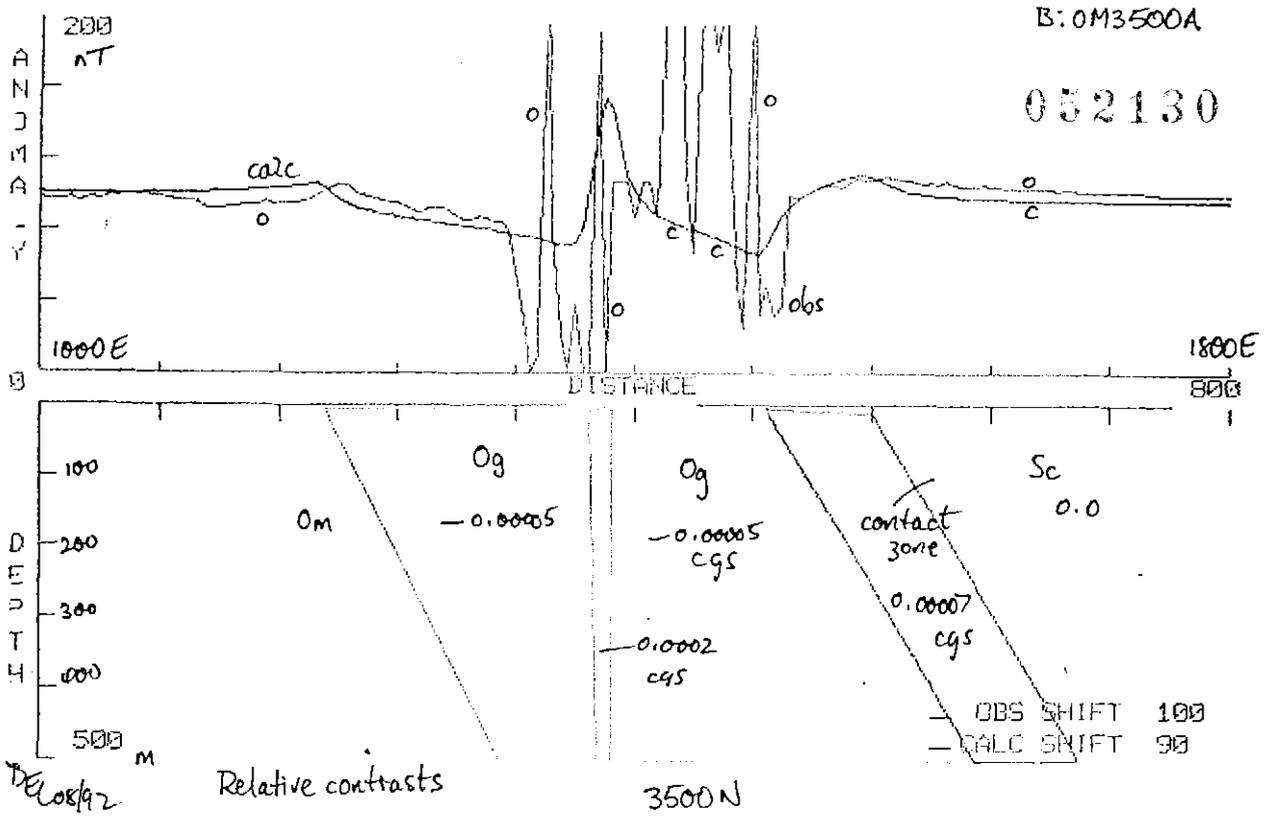


052128



Magnetics model of profile 3400N.

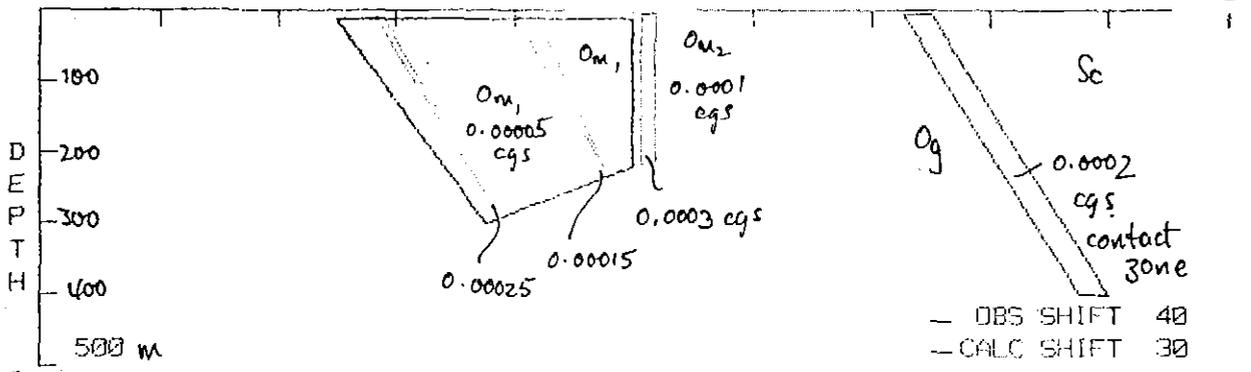
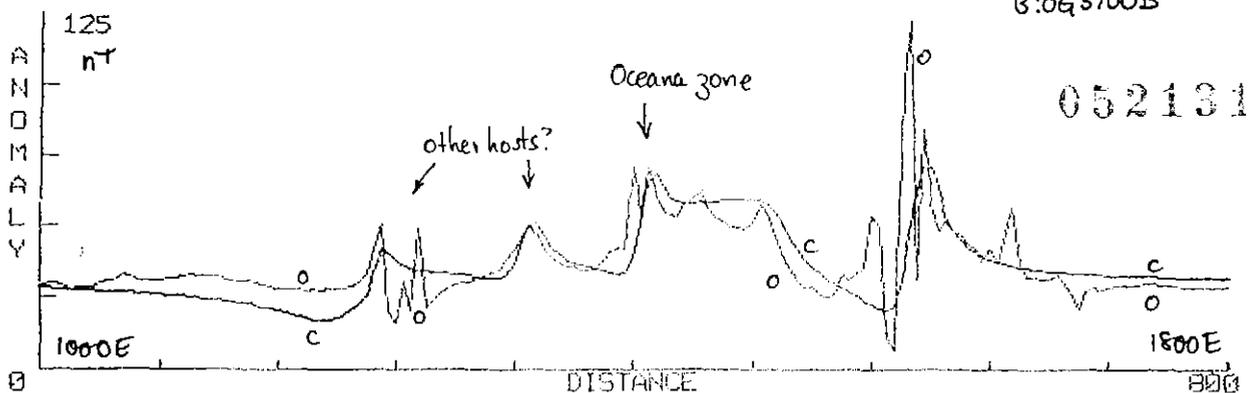
FIGURE 8



Magnetics model for profile 3500N and proposed geological section submitted for test.

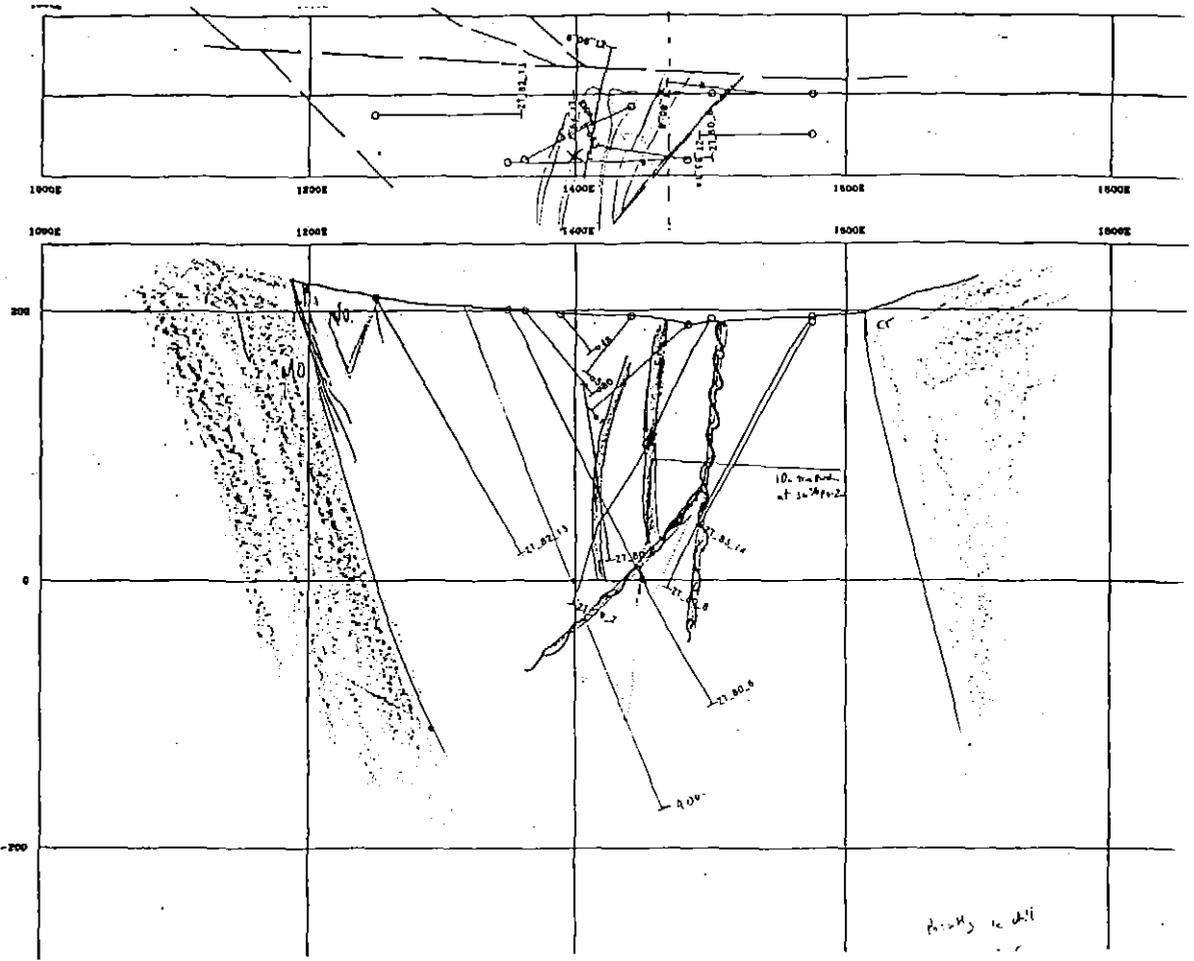
FIGURE 10

052131



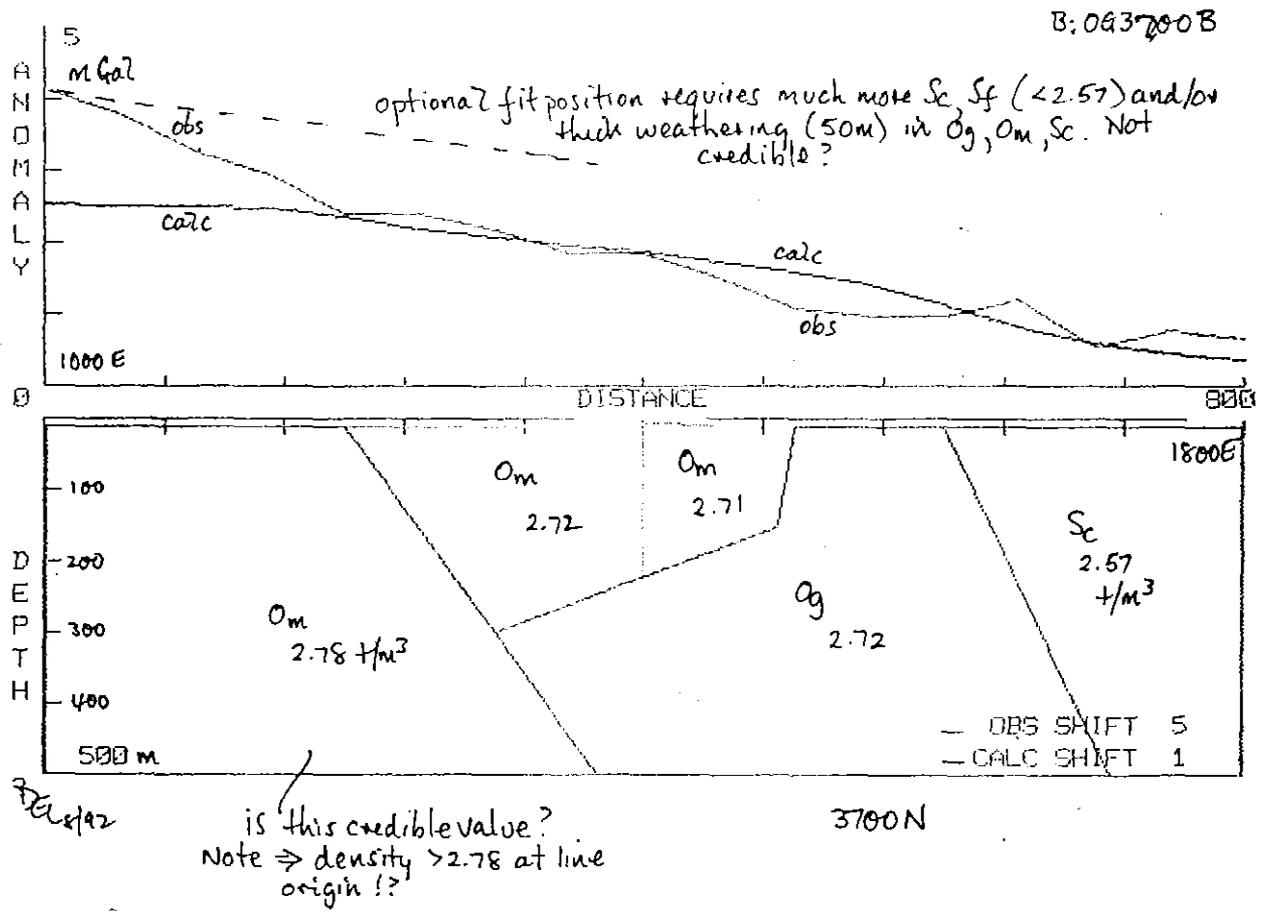
Dec 8/92

3700N



Magnetics model for profile 3700N and proposed geological section submitted for test.

FIGURE 11



Gravity model for profile 3700N.

FIGURE 12

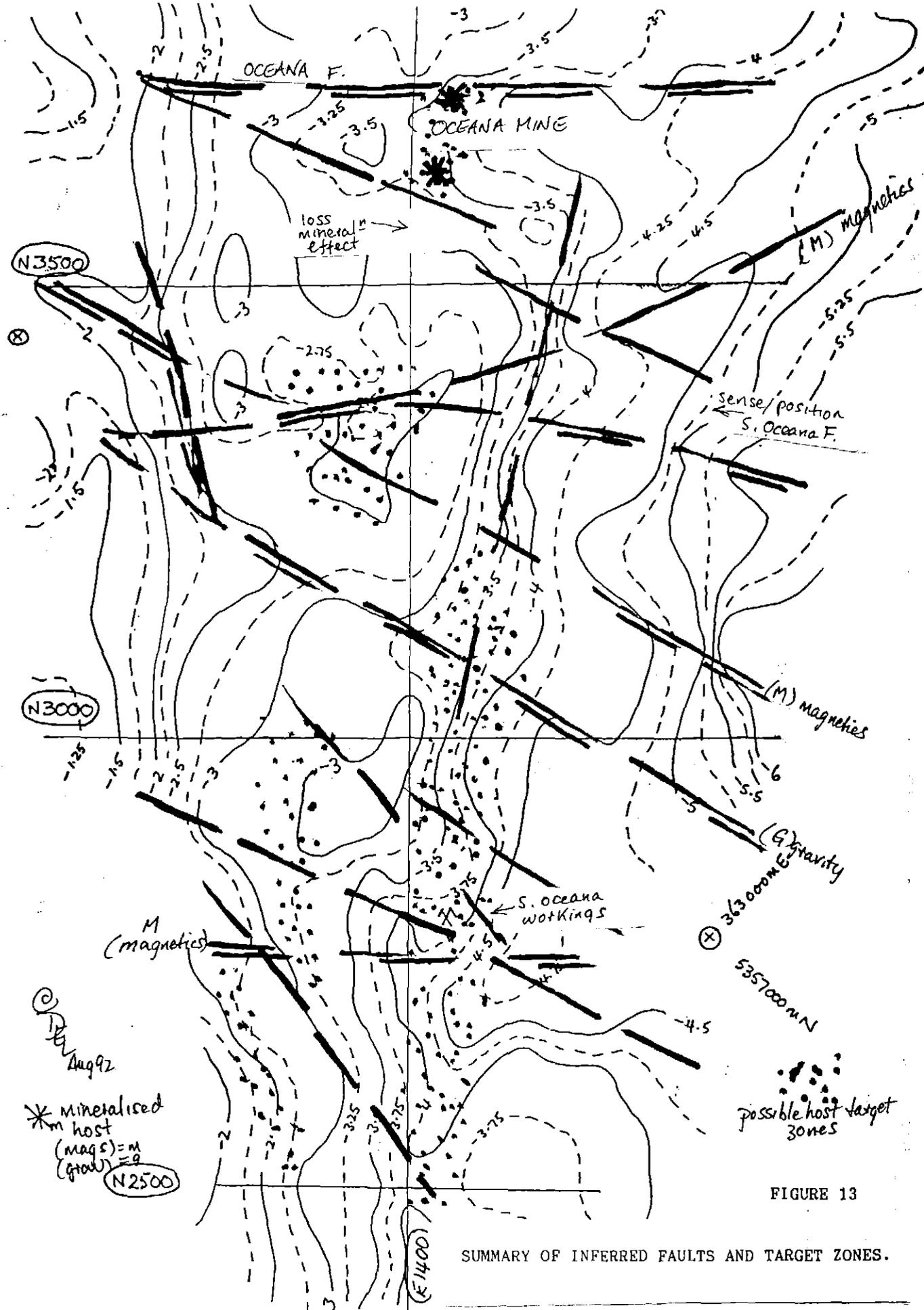


FIGURE 13

SUMMARY OF INFERRED FAULTS AND TARGET ZONES.

Report submitted on behalf of Leaman Geophysics

by



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

Date: 31/8/92

APPENDIX 6.
Oceana Gravity Gradient Plots.
Dr R.G.Richardson.

Date: 29 JULY 1992

TO:

Name: FERGUS FITZGERALD

Company: PASMINCO EXPLORATION

Phone: _____

Fax: 004 318949

FROM:

Name: BOB RICHARDSON

Section: GEOPHYSICS

Phone: (002) 33 8324

Fax: (002) 44 2117

Total number of pages including cover: 10

MESSAGE / SUBJECT:

FERGUS,

RE: GRAVITY GRADIENTS

HEREWITH SOME PLOTS FOR THE OCEANA AREA FROM THE UNPUBLISHED REPORT.

OCEANA GENERAL

BOUGUER ANOMALY	C.I.	1 mgal
DERIVATIVES	C.I.	2 mgal/km

OCEANA DETAIL

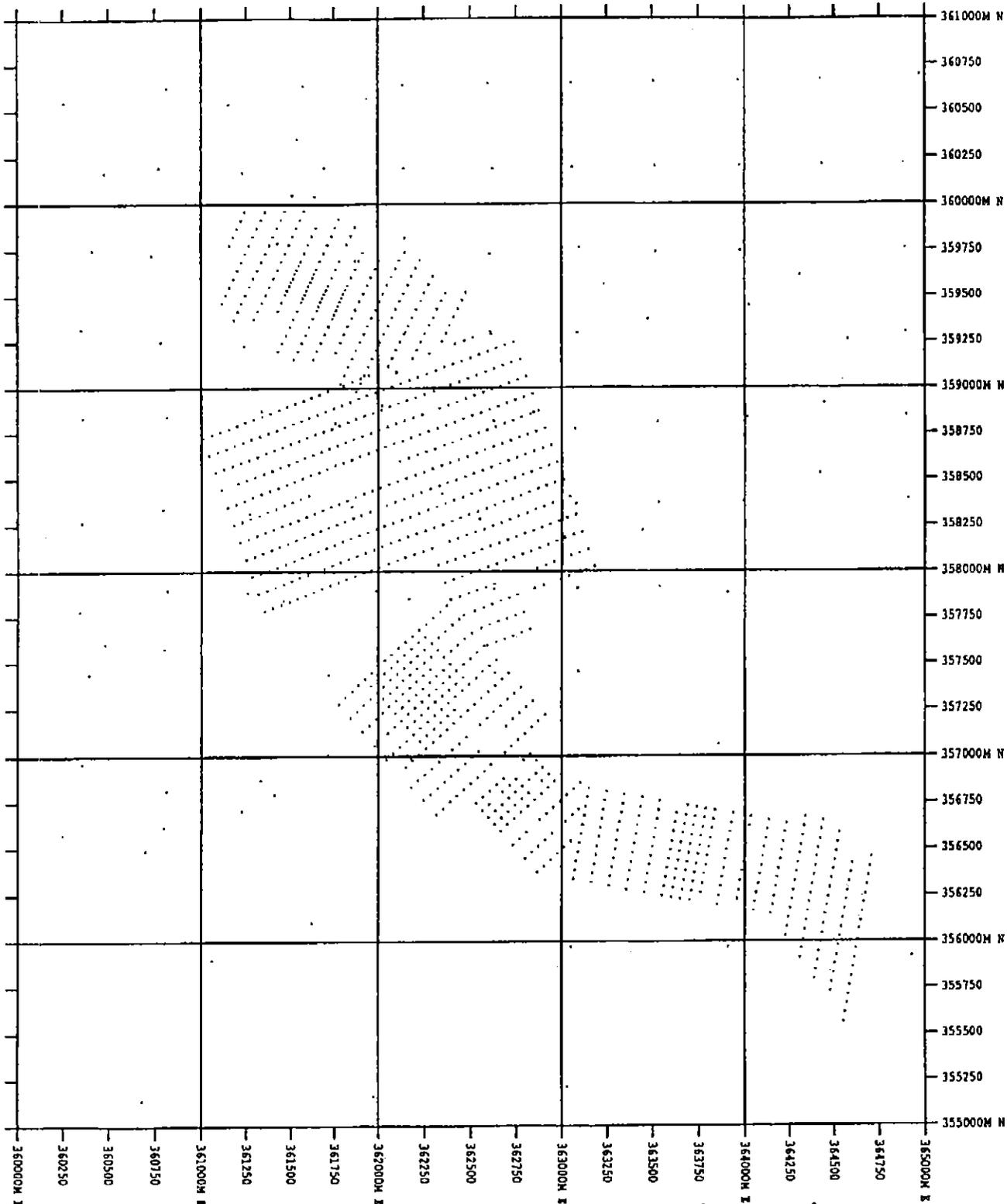
BOUGUER ANOMALY	C.I.	0.25 mgal
DERIVATIVES	C.I.	5 mgal/km

I WILL GIVE DAVID LEAMAN A COPY.

REGARDS,

Bob

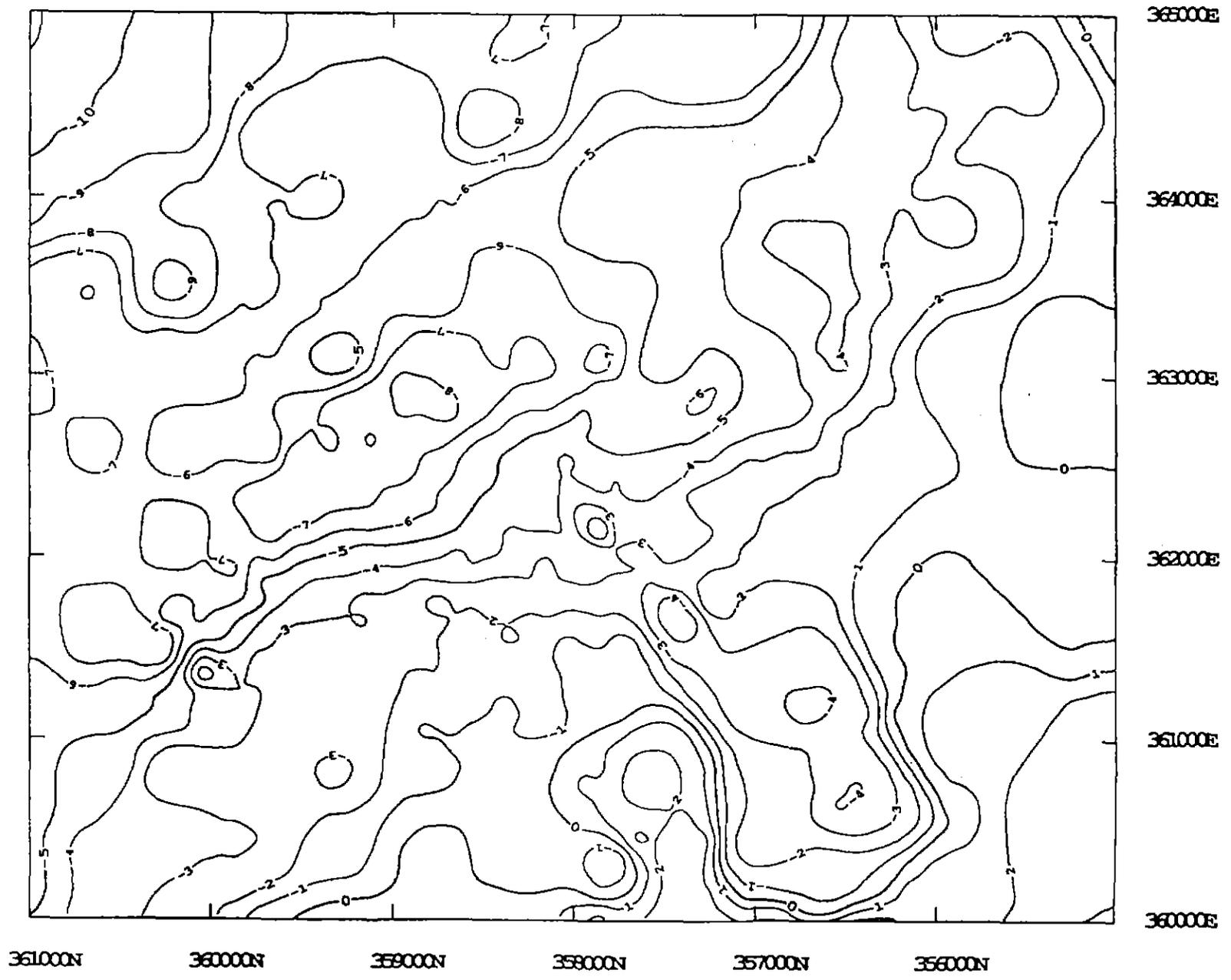




OCEANA PUBLIC DATA 23/JUL/92

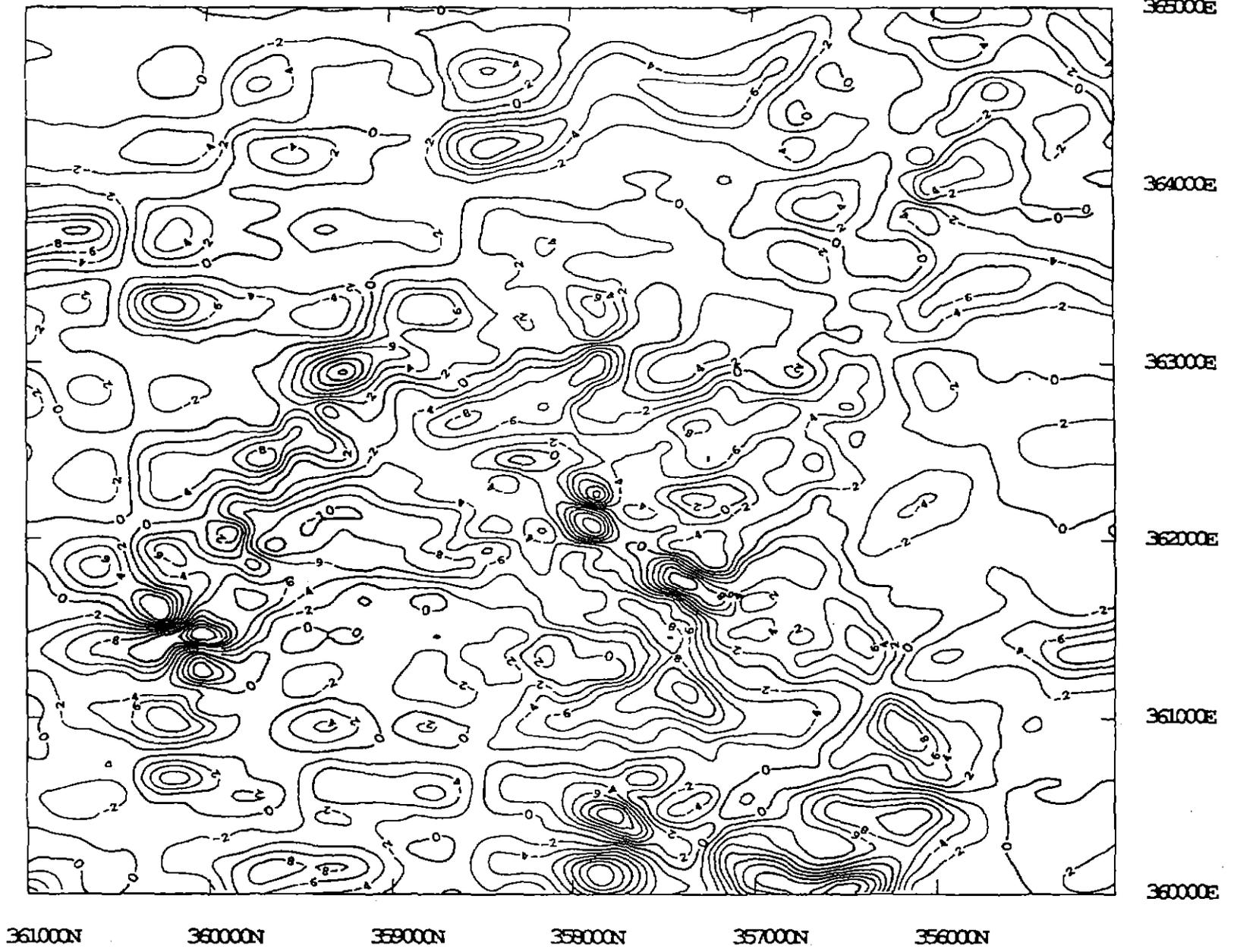
Ocean Region Bay Area Anomaly

561250



+

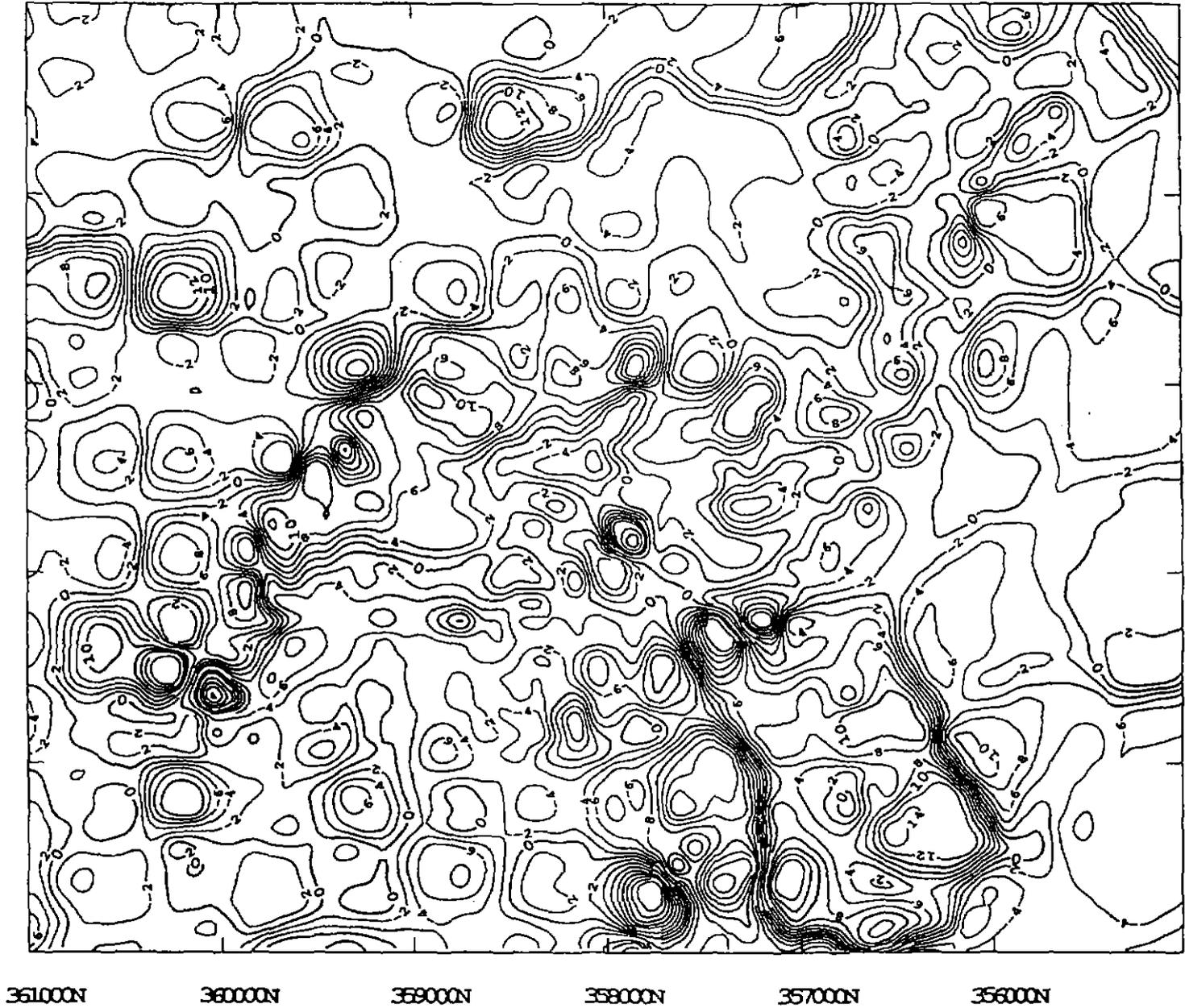
Oceans Region $\frac{16}{dx}$ 052130



+

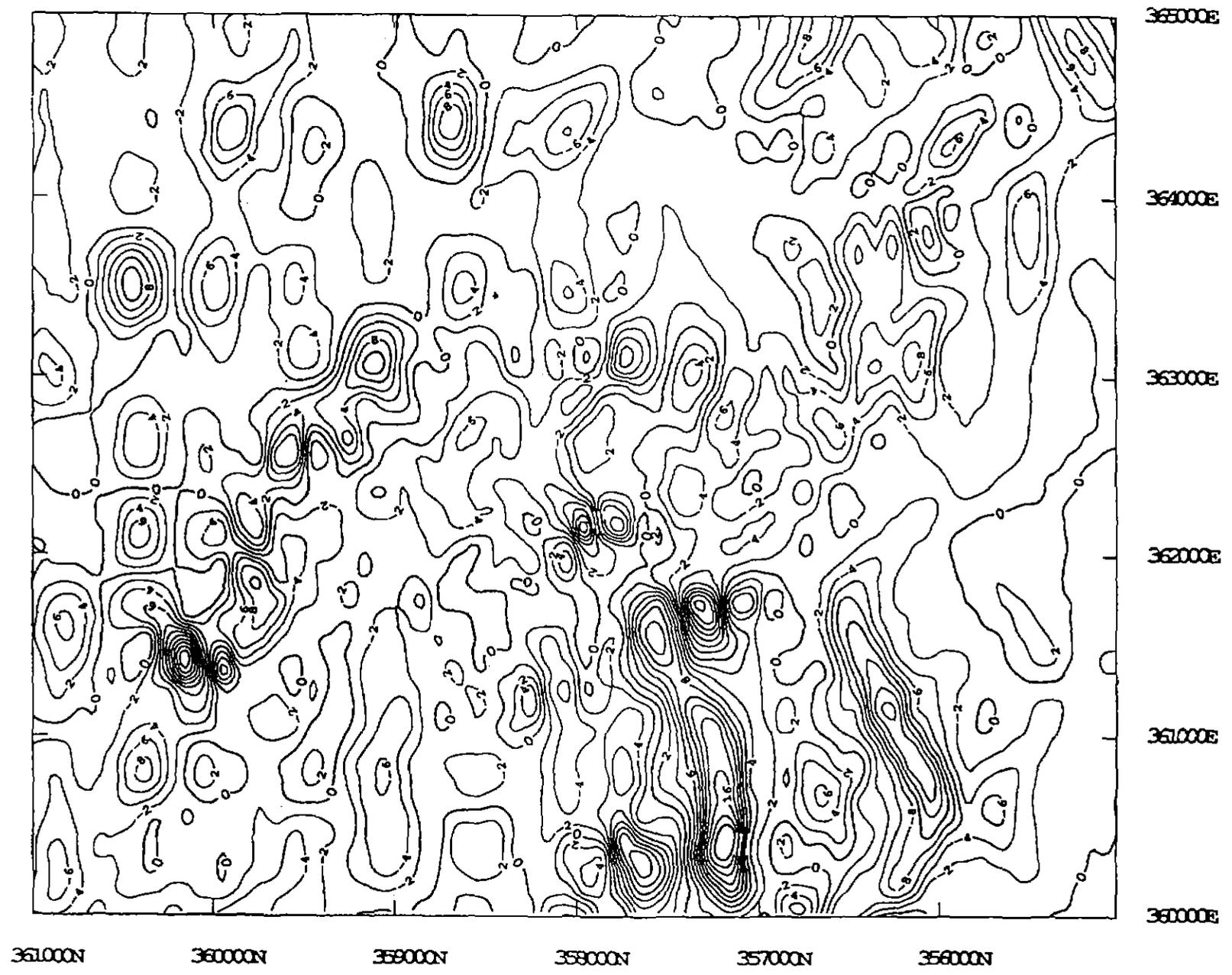
052140

Mean Regional $\frac{dZ}{dt}$



052141

Ocean Regional $\frac{dg}{dy}$

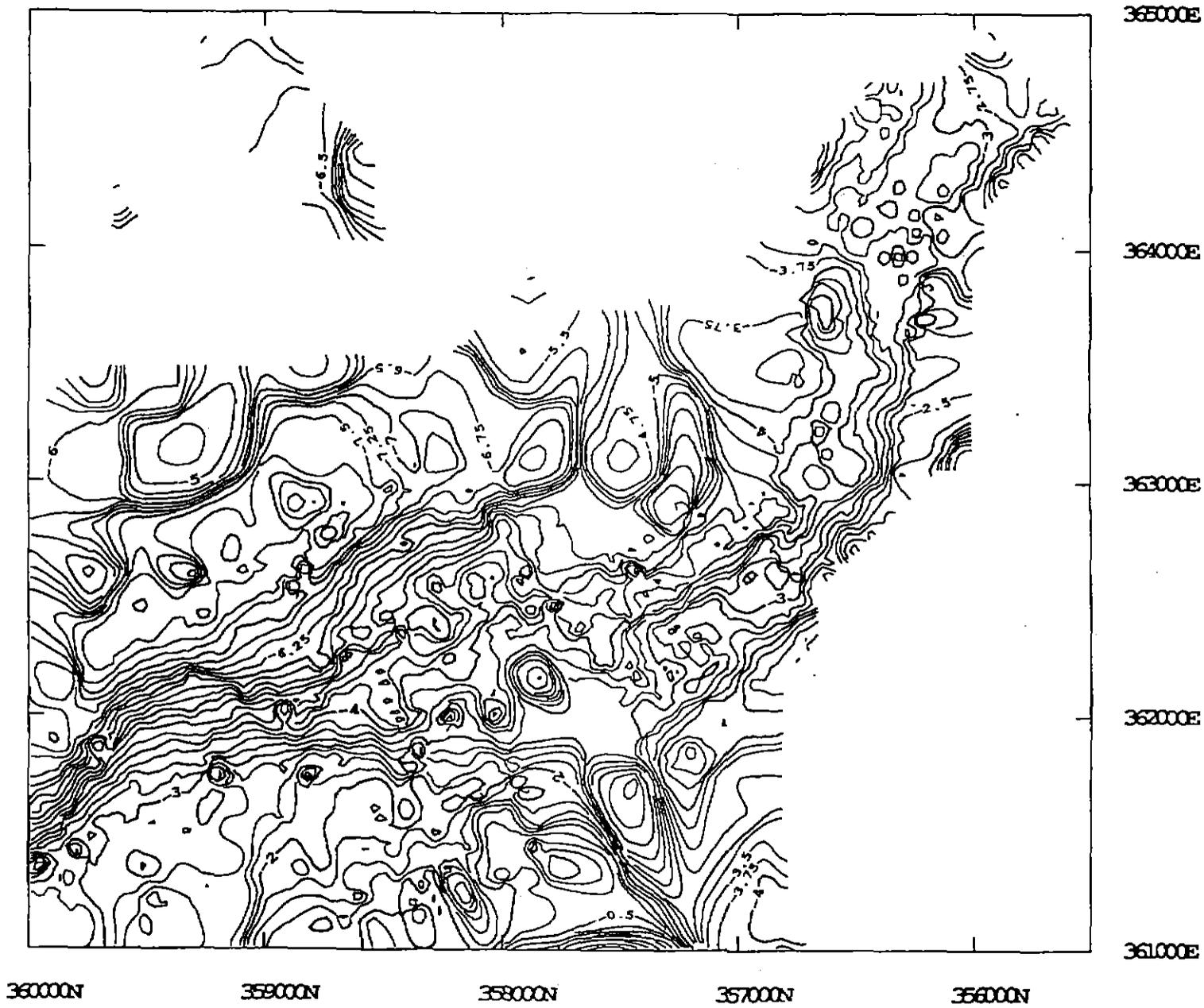


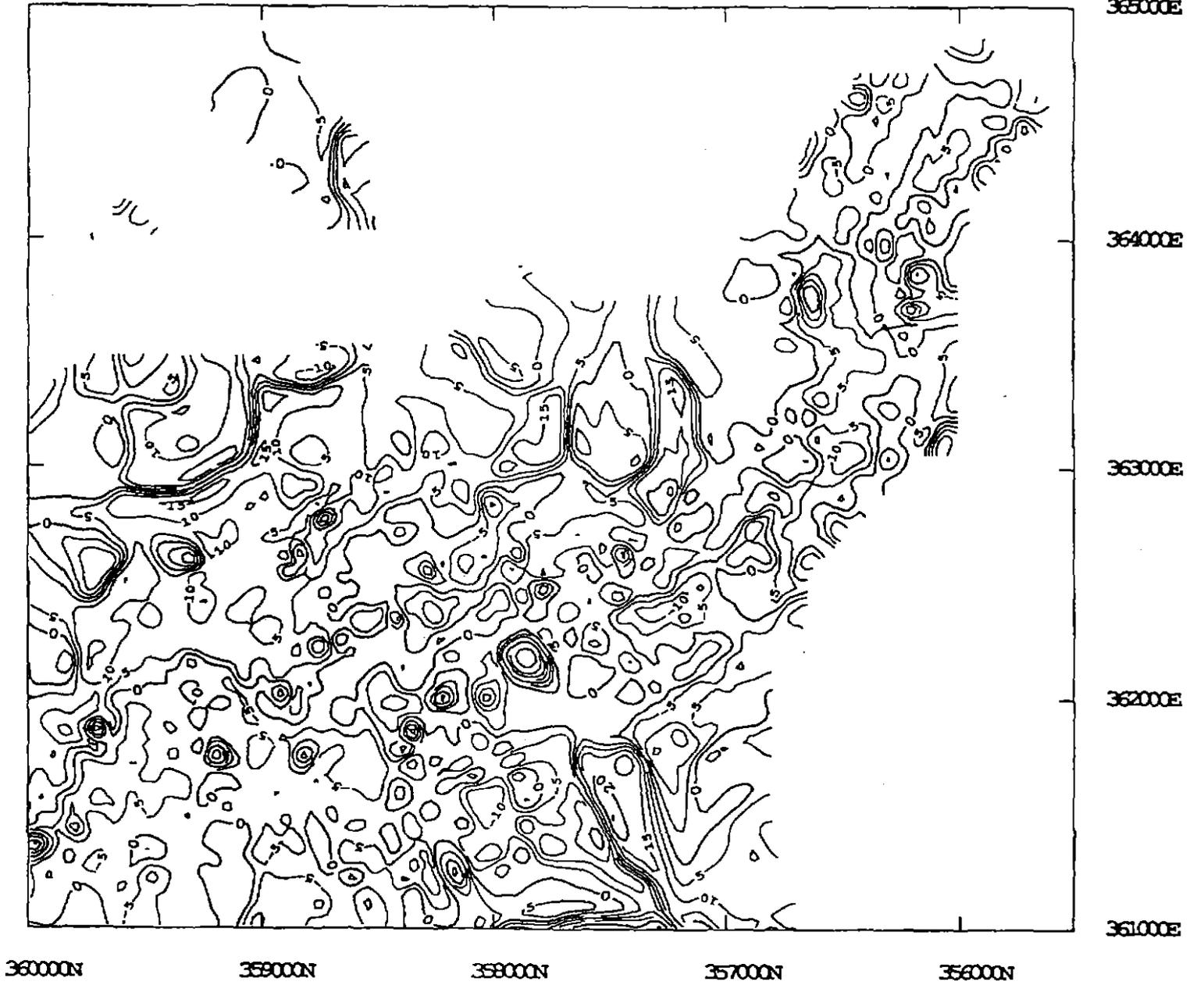
+



611220

Ocean Detail Baygor Anomaly





*Oceanic Atlas 1 dg
72*

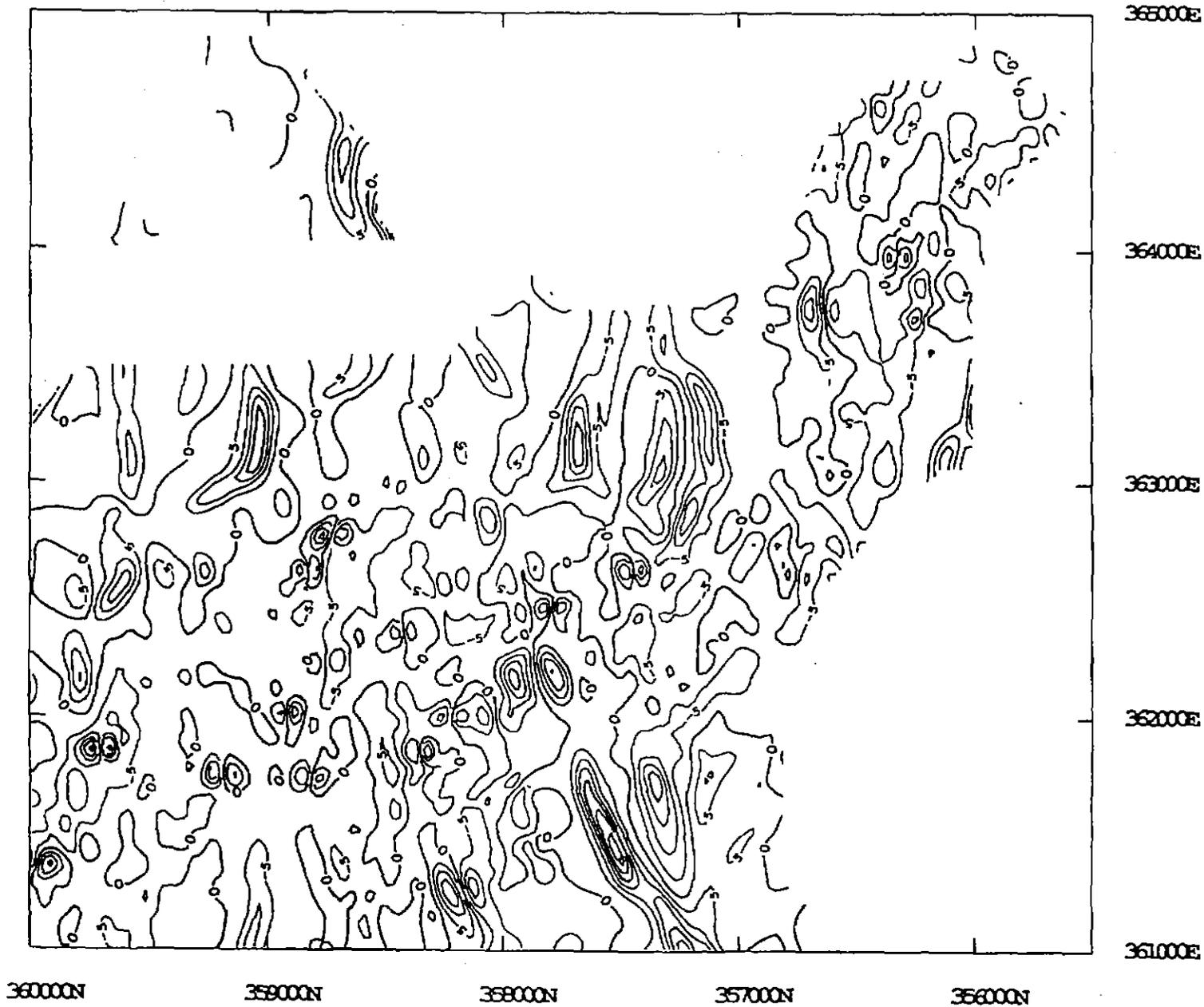
811690





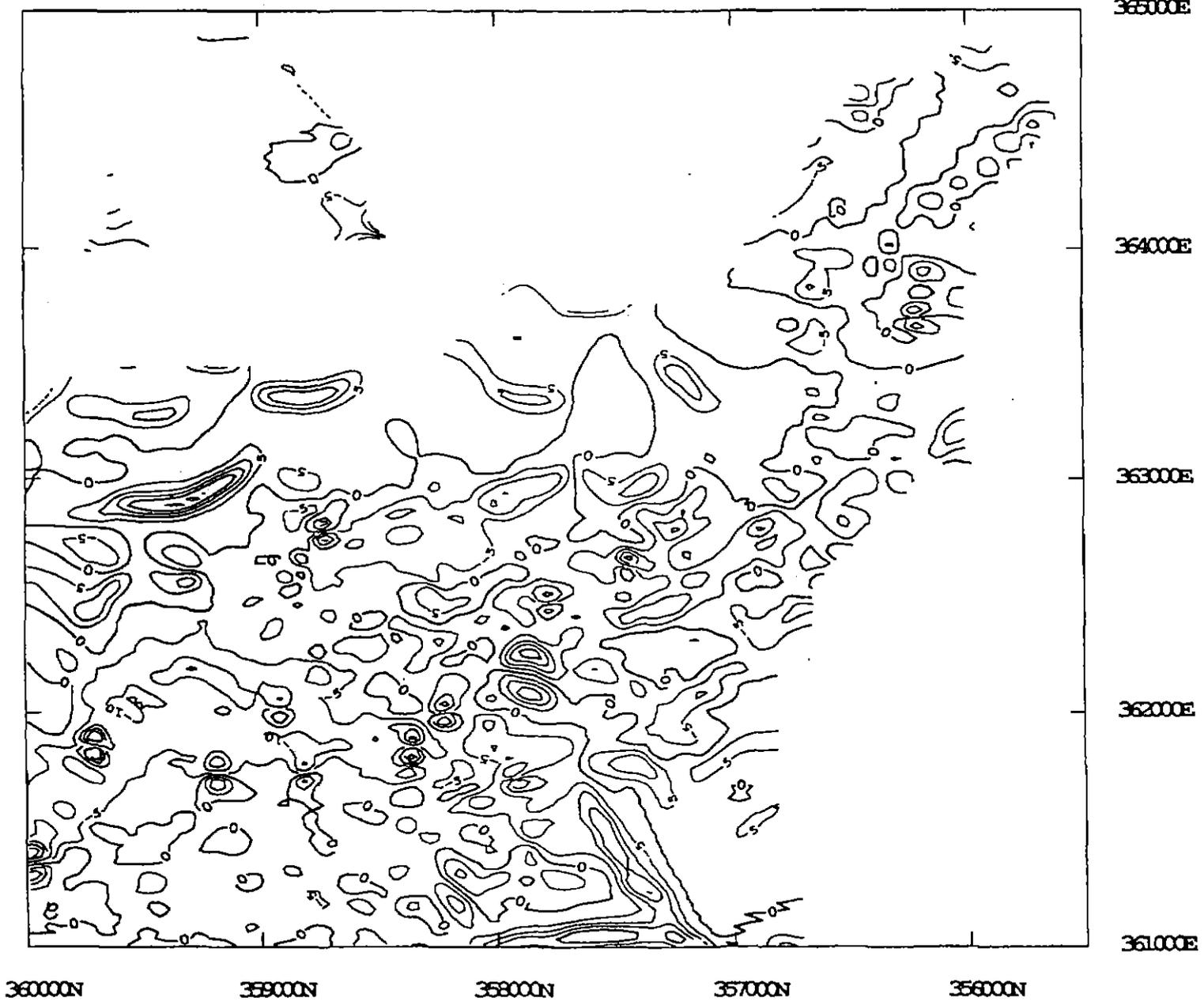
052144

Ocean Detail $\frac{dG}{dY}$



052145

Ocean Detn: $\frac{db}{dx}$



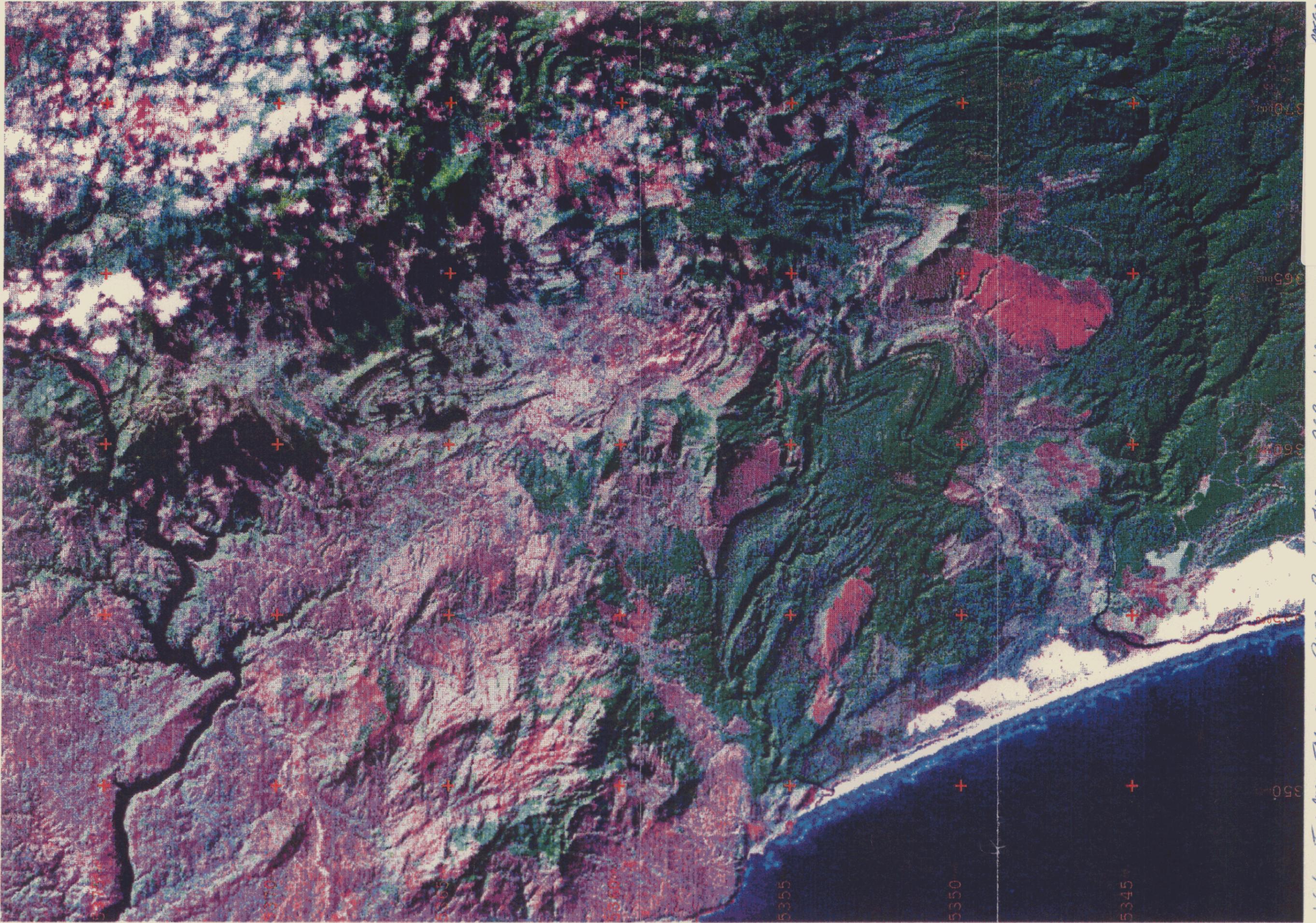
APPENDIX 7.

WESTERN TASMANIA AREA

T.M. SCENE 91 - 89

Scale 1 : 100000

052147



20

MSX
20.0 cm

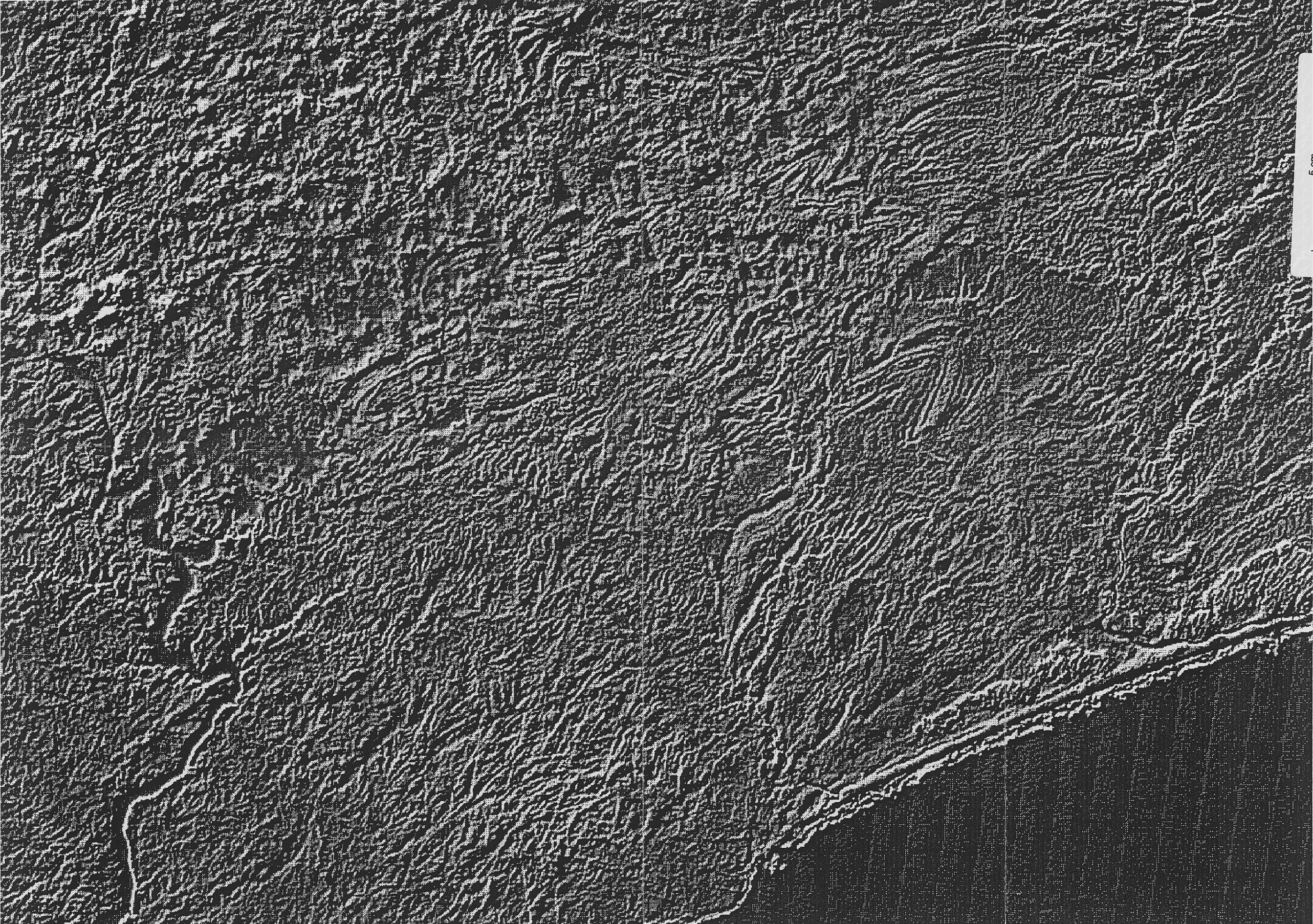
5 cm

Western Tas Area TM scene 91.89. Bands 742 as RGB 1:100000

3

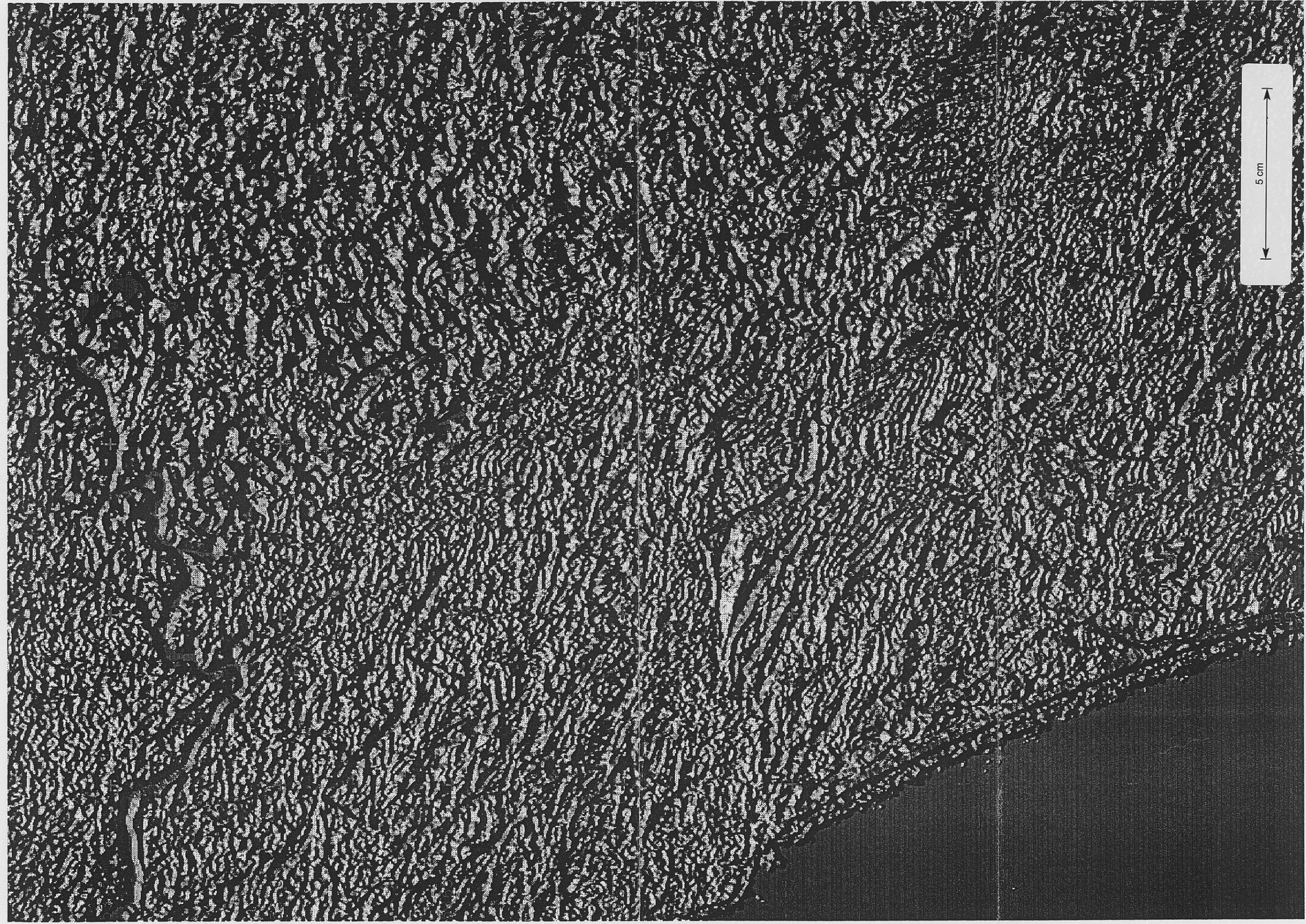
052148

P15EX
24-8-92



5 cm

Western Tas TM, scene 91-89, Band 4 no Sun Filter NE 1:100000

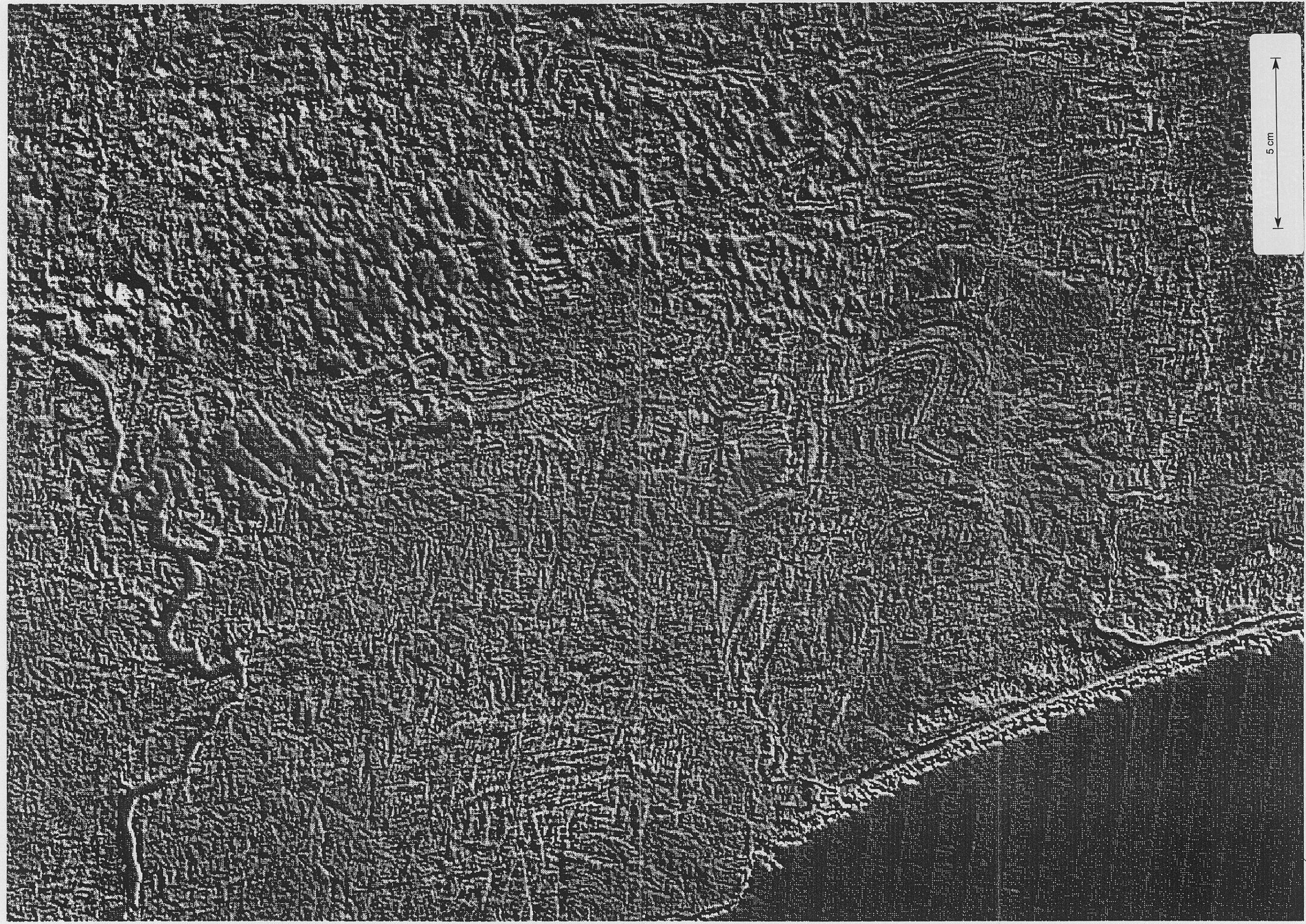
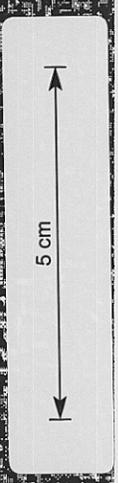


5 cm

RTS 115 0:33 Western Tars Area TM; Band 4 at Scan Angle (RTS) NS 0° 30' 1:100000
 MS EX 24-8-92
 Scan 9/1/89

3

052150

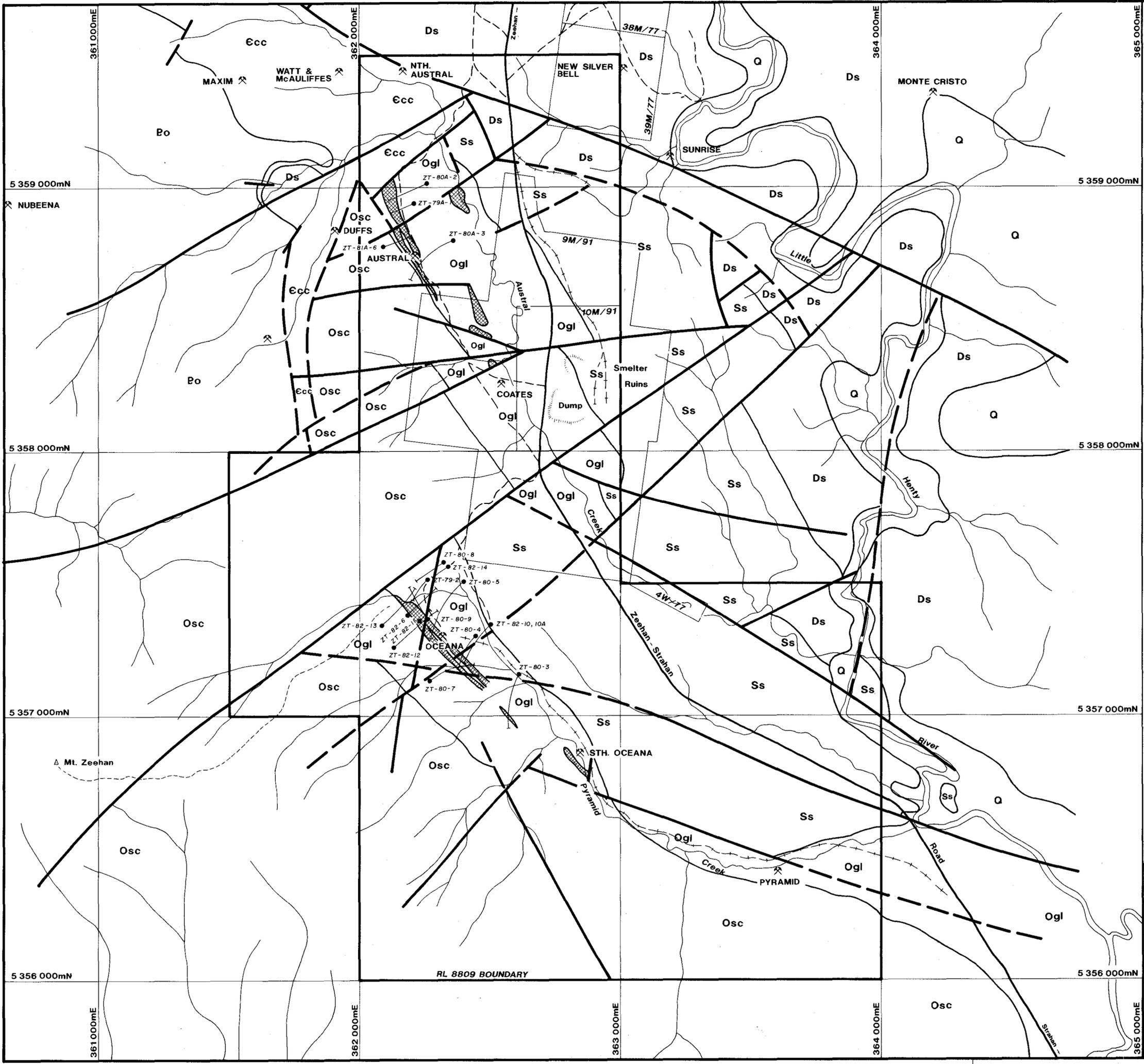


Las Westermotas Area TM scene 91-89. Band 4 as seen Filter-NW 1:100000

PAEX 24-8-92

4

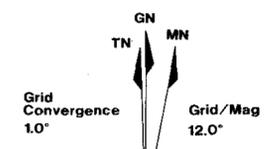
FIGURES



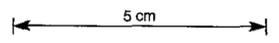
LEGEND

- QUATERNARY**
Q Alluvium, talus
- DEVONIAN**
Ds Bell Shale, Florence Quartzite
- SILURIAN**
Ss Austral Creek Siltstone, Keel Quartzite, Amber Slate, Crotty Quartzite
- ORDOVICIAN**
Ogl Gordon-Limestone Ironstone
Osc Moira Sandstone Mt. Zeehan Conglomerate
- CAMBRIAN**
Ccc Crimson Creek Formation
- PROTEROZOIC**
Bo Oonah Quartzite, Slate Minor Volcanics

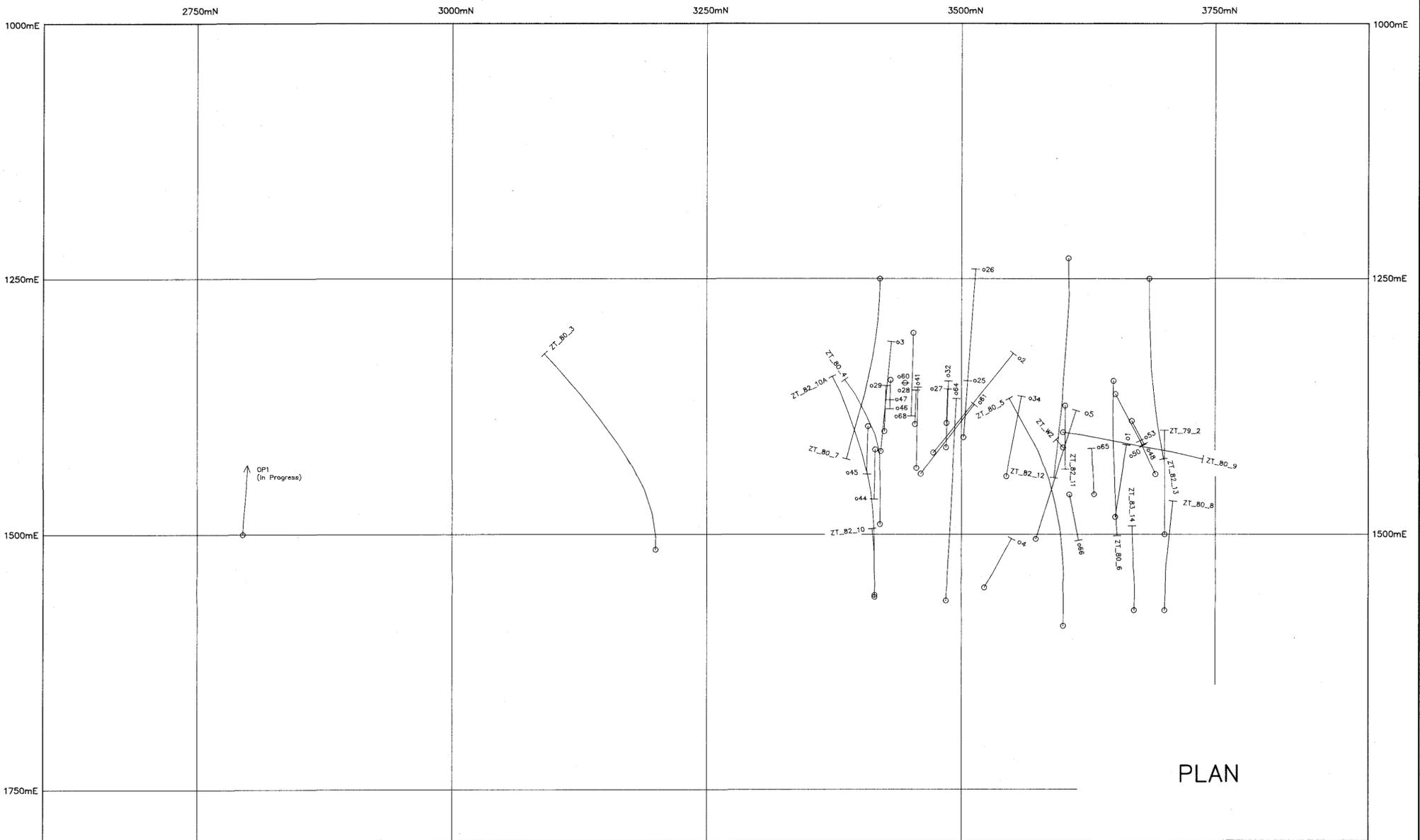
Geology after Cyprus 1980



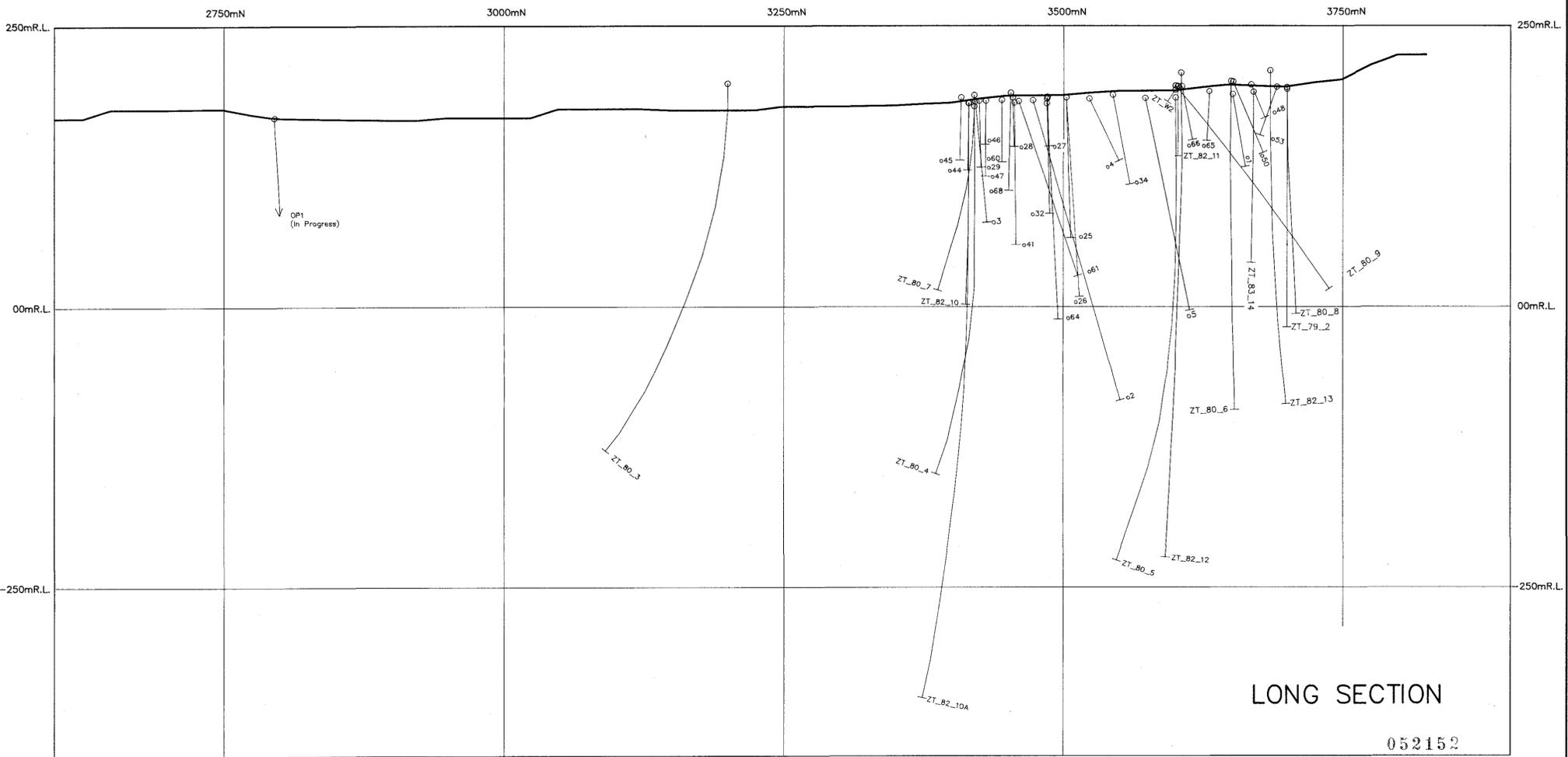
052153



PASMINCO EXPLORATION <small>A Division of Pasminco Australia Limited</small>	
COMPILED : DATE : Oct, 1991 DRAWN : G.M.B. REF : REVISIONS :	RL 8809 - OCEANA <h1 style="margin: 0;">GEOLOGY</h1> <h1 style="margin: 0;">92-3393.</h1>
DRAWING No.	SCALE 1:10,000
	FIG. No. 3



PLAN

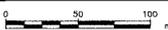


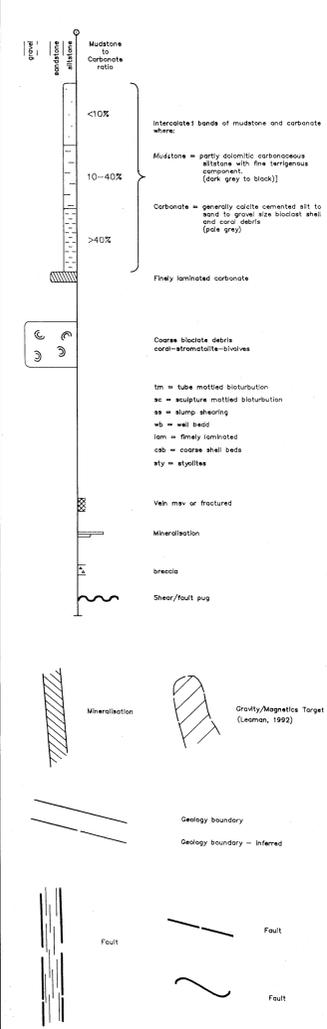
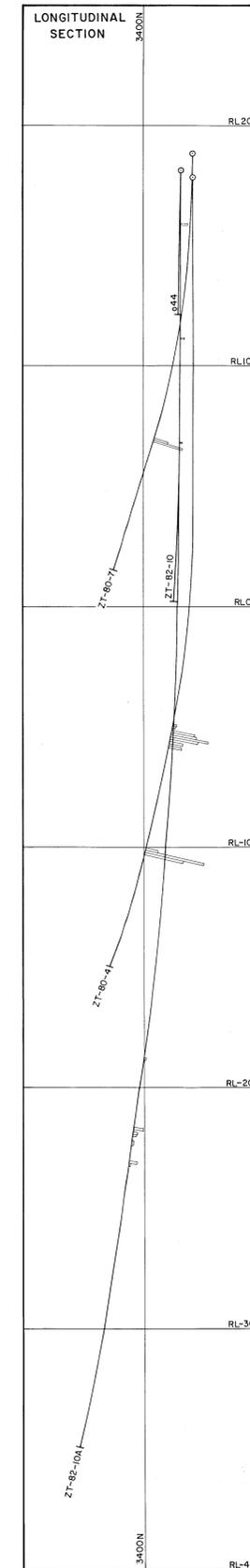
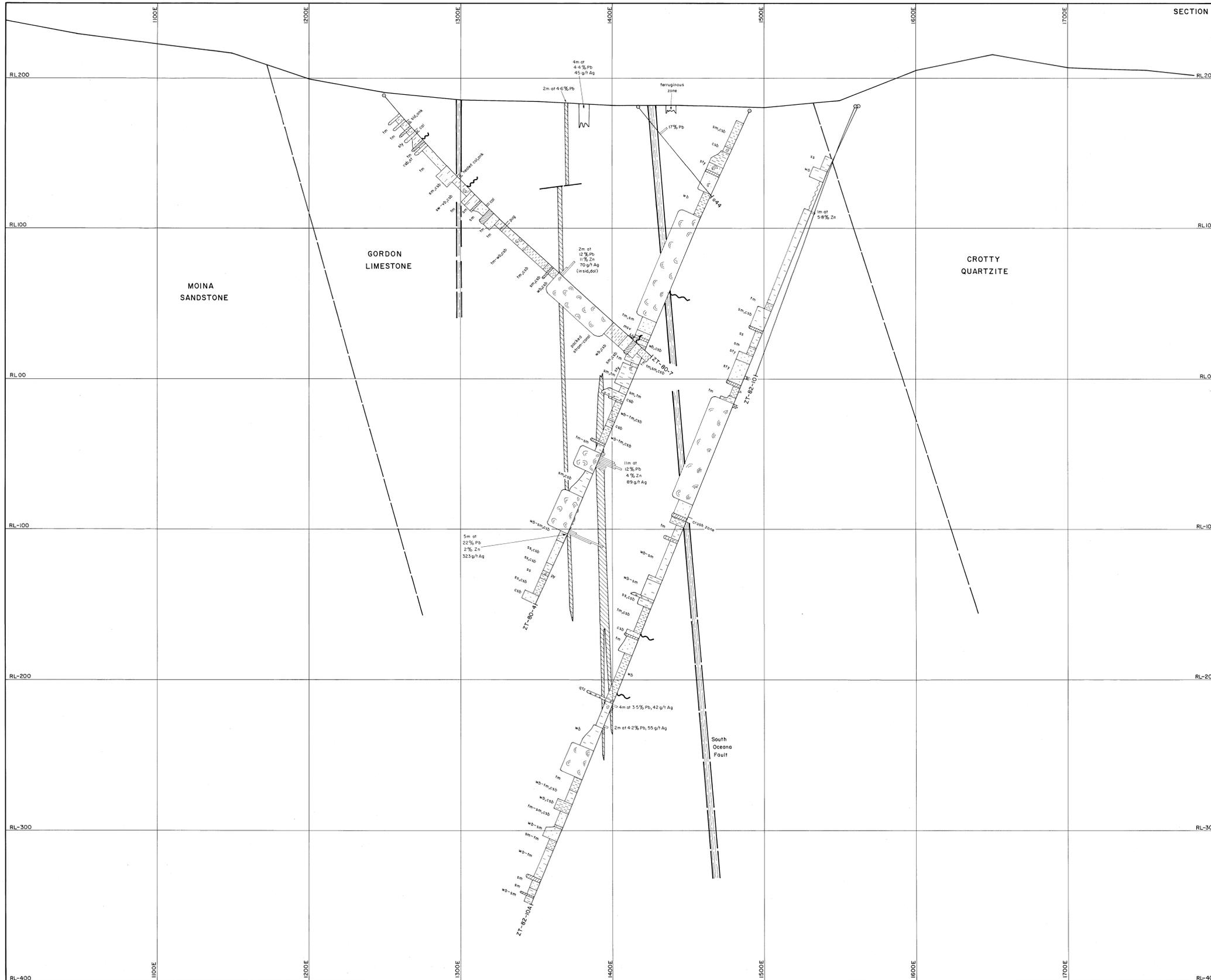
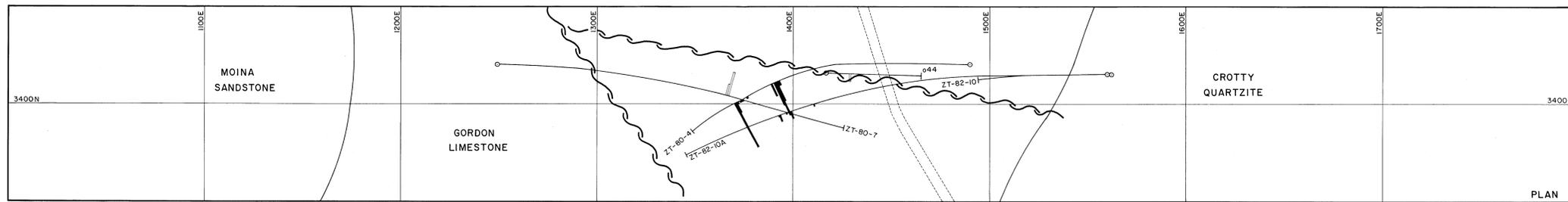
LONG SECTION

052152

5 cm

92-3393.

 PASMINCO EXPLORATION <small>A Division of Pasminco Australia Limited</small>		RL8809 - OCEANA OCEANA GRID DDH LOCATIONS PLAN VIEW AND LONG SECTION	FIG. No. 6
COMPILED : P.M.Q.			
DATE : Oct, 1992			
DRAWN : G.M.B.			
REFERENCE :			
REVISIONS :			
DRAWING No. GGDHPLS	SCALE 1:2500		



052155
92-3393.

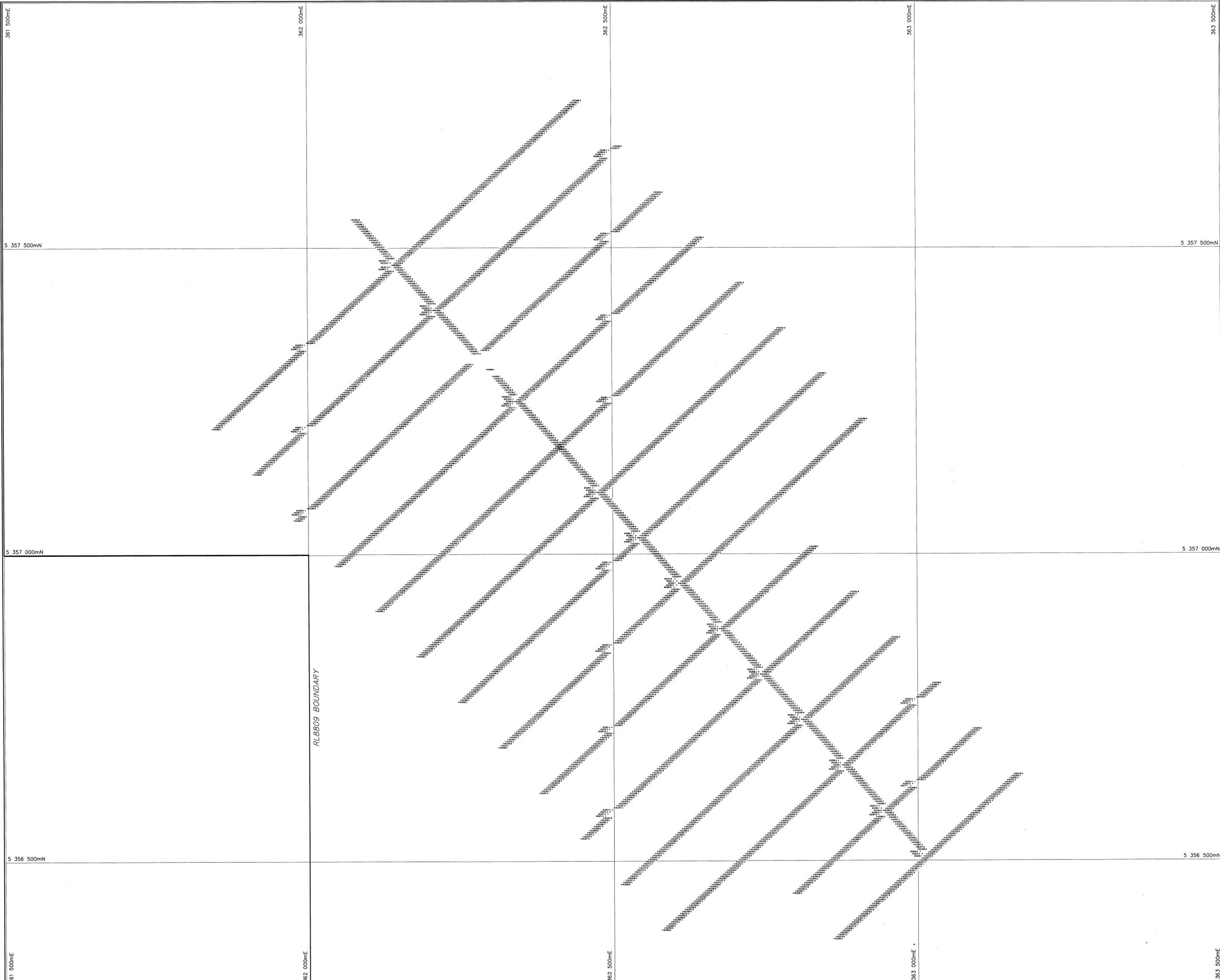
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GEOLOGY
SECTION AT 3400N

DRAWING NO.	SCALE 1:1000
COMPILED: M.G.	DATE: 10-10-92
DRAWN: N.W.D.S.	REF:
REVISIONS:	

FIG. NO. 8



5 357 500mN

5 357 000mN

5 356 500mN

361 500mE
362 000mE
362 500mE
363 000mE
363 500mE

RL8809 BOUNDARY

052157
KEY
Corrected ground magnetic values
5 cm

92-3393.

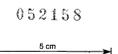
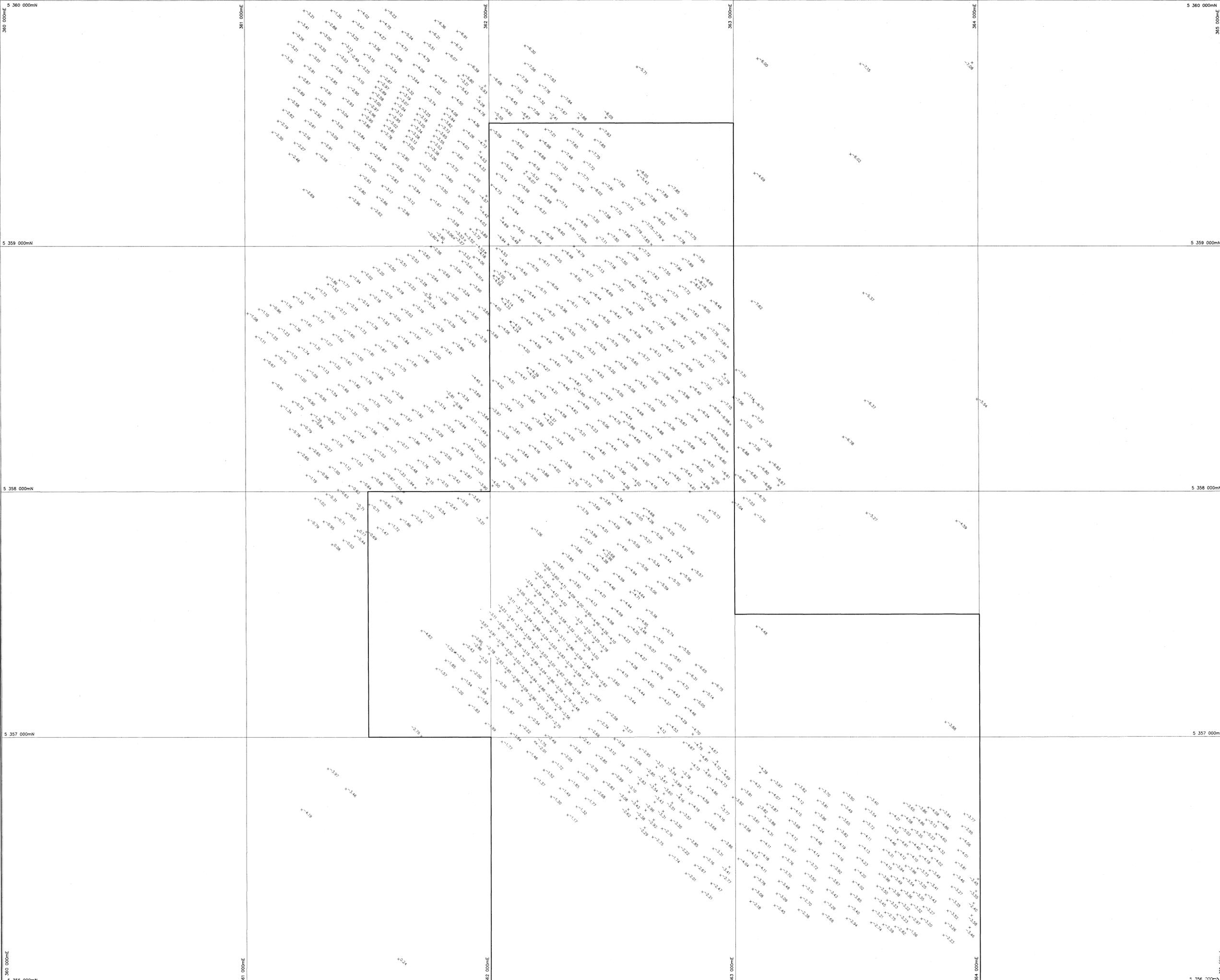
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RL8809 - OCEANA
GROUND MAGNETICS
LOCATIONS AND VALUES

REVISIONS:

DRAWING No. OCGMAG SCALE 1:2000 FIG. No. 14



KEY
Corrected bouguer values

92-3393.

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REFERENCE	
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DRAWING No.	OCGRAN
SCALE	1:5000
FIG. No.	17

RL8809 - OCEANA

GRAVITY
LOCATIONS AND VALUES