CONTENTS ENVELOPE 6991

TENEMENT: P.E.L. 30.

TENEMENT HOLDER: Comalco Aluminium Limited.

000003

PETROLEUM EXPLORATION LICENCE 30

REPORT ON ACTIVITIES FOR QUARTER ENDING

12TH MAY 1985.

COMALCO ALUMINIUM LIMITED

G. WESTE

PREVIOUS COMALCO EXPLORATION

Comalco has held Mineral Exploration Licence 1070, covering PEL 30, since 1980. Under the terms of this licence Comalco conducted diamond drilling and reflection seismic as part of a regional search for sodium carbonate and base metal deposits. During the period prior to granting of the PEL one diamond drill hole was completed (Byilkaoora-2) and 39 kilometres of weight drop seismic (and associated uphole drilling) were recorded as an extension to Comalco's petroleum exploration programme in adjacent PEL 23. During this first quarter a careful reappraisal of this data was carried out to aid planning of the 1984 programme.

SEISMIC

The 1985 exploration programme is primarily seismic. The conditions under which the PEL was granted stipulate a minimum of 60 line kilometres of reflection seismic. A programme to compliment the previously recorded seismic and to tie in Comalco's trona drill hole, Byilkaoora 2, was designed. A plan showing the programme is attached. Total line kilometres will be approximately 76 and 10 upholes will be drilled at all line intersections and along lines to depths of not less than 50 metres. The data will be recorded at 60 fold using a 30 metre group interval. The source will be either Thumper or Vibroseis depending on the outcome of source tests to be conducted in PEL 23 at a location 20 kilometres south east of PEL 30. The experimental survey will be located on the southern 13 kilometre portion of PEL 23 line 83-0200 through Comalco diamond drill hole Manya 6 (TD 1760 metres). 60 fold and 15 fold Vibroseis and Thumper will be recorded to further evaluate the suitability of these sources for reconnaissance and detailed seismic in 1984 and 1986. Experimental source and recording parameters have been determined by Comalco geophysicist G. Cucuzza aided by consultant Dr. H. Espey and Comalco acquisition consultant J.C. Akerman. The 1985 seismic acquisition contractor is Petty Ray Division of Geosource Inc.).

Line clearing commenced on the 17th of March, with lines being cleared to one dozer blade width. Grading commenced on the 20th of March 1985. Lines are 13 feet to 16 feet wide depending on vegetation/dune development.

Uphole drilling, loading, and recording commenced in late April. The contractor, Thompson Drilling, is drilling holes to depths of up to 150 metres using a combination of mud, air and blade, bit techniques. The average uphole spacing will be approximately 5 kilometres.

ABORIGINAL SCOUTING

Scouting of seismic lines was completed in March. A mens team of four elders and a womens team of five, all from Indulkana, were led by Pitjantjatjara Council anthropoligists D.A. Vachon and S. Woenne-Green. No line deviations were requested except for leaving a sand dune behind Mt. Byilkaoora on line 85-0032.

Scouting was conducted using a vehicle-mounted Magnavox 6102 Terrain Navigation System which uses predictive nagivation (speedometer coupled to a flux-gate compass) backed up by a satellite position fixing capability. The instrument allowed fairly accurate and rapid traversing of seismic lines in unsurveyed country.

SEDIMENTOLOGY

Studies of the lithofacies of the playa lake Observatory Hill beds by Comalco and Baas Becking Geobiological Laboratory (BBL) sedimentologists continued with detailed core logging and sampling of Comalco drill hole Byilkaoora-2. BBL sedimentologist Dr. Peter Southgate, spent two weeks in Adelaide as part of this study. Detailed studies of the sedimentology and diagenesis of early Cambrian marine carbonates were commenced during the quarter. Comalco geologist John Dunster has commenced a Master of Science Thesis on the sedimentology of the rocks. Professor Chris Kendall provided consultant advice on the best methods of conducting the sedimentological studies. Studies of porosity and permeability were commenced during the quarter. Consultant Dr. Robert Sneider designed a method of potential reservoir and seal evaluation for our existing mineral drill cores and for slim hole petroleum wells yet to be drilled. The method included evaluation of porosity and permeability from capillary pressure porosity curves and use of comparitor charts.

ORGANIC CHEMISTRY

BBL organic chemist, Dr. Roger Summons visited Adelaide for one week to discuss research methods and to further sample Comalco mineral exploration drill holes. Samples collected will be studied using combined gas chromatography-mass spectrometry to further isolate irreversible maturation pathfinder isomers.

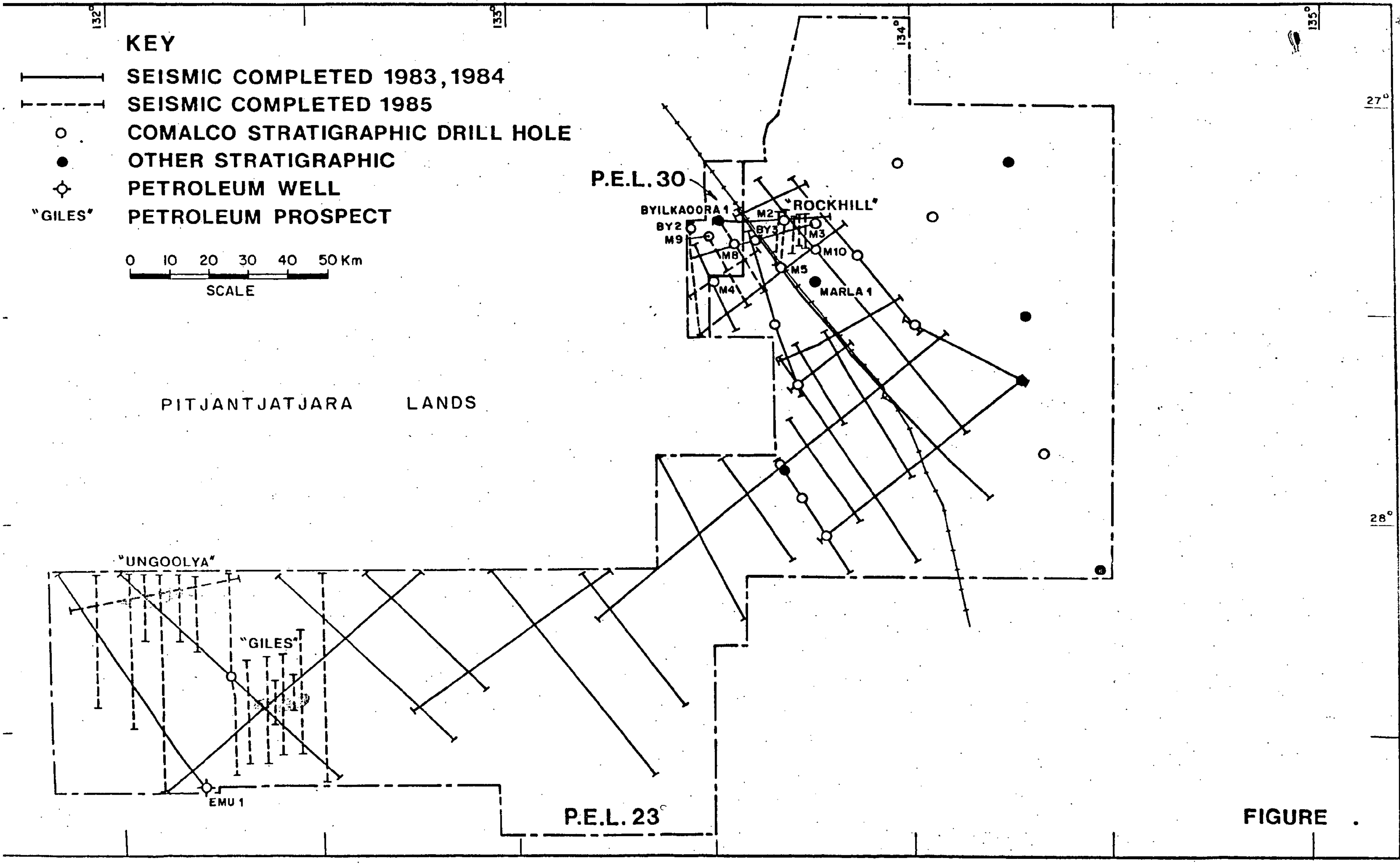

KEY
SEISMIC COMPLETED 1983, 1984
SEISMIC COMPLETED 1985
COMALCO STRATIGRAPHIC DRILL HOLE
OTHER STRATIGRAPHIC
PETROLEUM WELL
"GILES" PETROLEUM PROSPECT
0 10 20 30 40 50 Km
SCALE
132°
134°
27°
28°
P.E.L. 30
BYILKAOORA 1
BY2
M9
M8
M4
M2
BY3
M3
M10
M5
MARLA 1
"ROCKHILL"
PITJANTJATJARA LANDS
"UNGOOLYA"
"GILES"
EMU 1
P.E.L. 23

FIGURE .

000007

2

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING
12TH AUGUST 1985

G. Weste
Comalco Aluminium Limited.

SEISMIC

Prior to the recording of seismic in PEL 30, an experimental Vibroseis - Thumper source comparison was carried out close by in PEL 23. Optimum Vibroseis parameters were selected during the experimental survey and these were applied in PEL 30. A total of 76 km of 60 fold Vibroseis data were recorded using a 30 metre group interval on lines shown on the attached 1:500,000 scale plan. Recording commenced on the 22nd May on line 85-0096 and was completed on the 6th of June.

A total of 10 upholes were drilled and shot. All were geologically logged during drilling to aid stratigraphic correlation and to ensure that the upholes reached subweathering velocity horizons.

Processing of data to Brute stack stage was carried out urgently to aid evaluation of the experimental data in PEL 23. The Vibroseis data (at Brute stack stage) was in no way superior to Thumper data recorded in the same area during 1983 and 1984.

SEDIMENTOLOGY

During the quarter diamond drilling for Minerals was undertaken in the PEL 30 area under Comalco Mineral Exploration Licence tenements. Detailed sedimentology of cores from the drill holes was commenced by Comalco and Baas Becking Geobiological Laboratory personnel. A paper was under preparation for the forthcoming 8th Australian Geological Convention. Sonic and porosity wireline logging conducted in the Mineral holes was costed to PEL 30 and copies of these logs will be submitted to SADME under PEL 30 reporting.

PEL 30 – 1985 SEISMIC LINES

6991-1

SA-85-897

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH NOVEMBER 1985.

G. WESTE
COMALCO ALUMINIUM LIMITED.

SEISMIC

Processing of the 76 km of 60 fold Vibroseis data recorded during the last quarter was completed to preliminary final stack stage during this quarter by Hosking Geophysical Corporation. Paper copies of stacks were received and films are expected by Christmas.

Detailed interpretation of the 1983, 1984 and 1985 seismic data was almost completed at the end of the quarter. Structure is complex and data quality poor because of strong faulting. It is anticipated that potential fault traps will be delineated for drilling in 1987.

STRATIGRAPHY/SEDIMENTOLOGY

Two diamond drill holes Marla 8 and Marla 9, were drilled within PEL 30 area as part of Comalco's 1985 Mineral exploration programme (see attached plan).

The holes, together with Marla 4 which lies on the boundary of PEL 30, were wireline logged for Mineral and Petroleum purposes. Cores are being logged by Comalco and Baas Becking Geobiological Laboratory geoscientists and shall be evaluated for hydrocarbon source rock and reservoir potential.

000011

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH FEBRUARY 1986

G. WESTE

COMALCO ALUMINIUM LIMITED

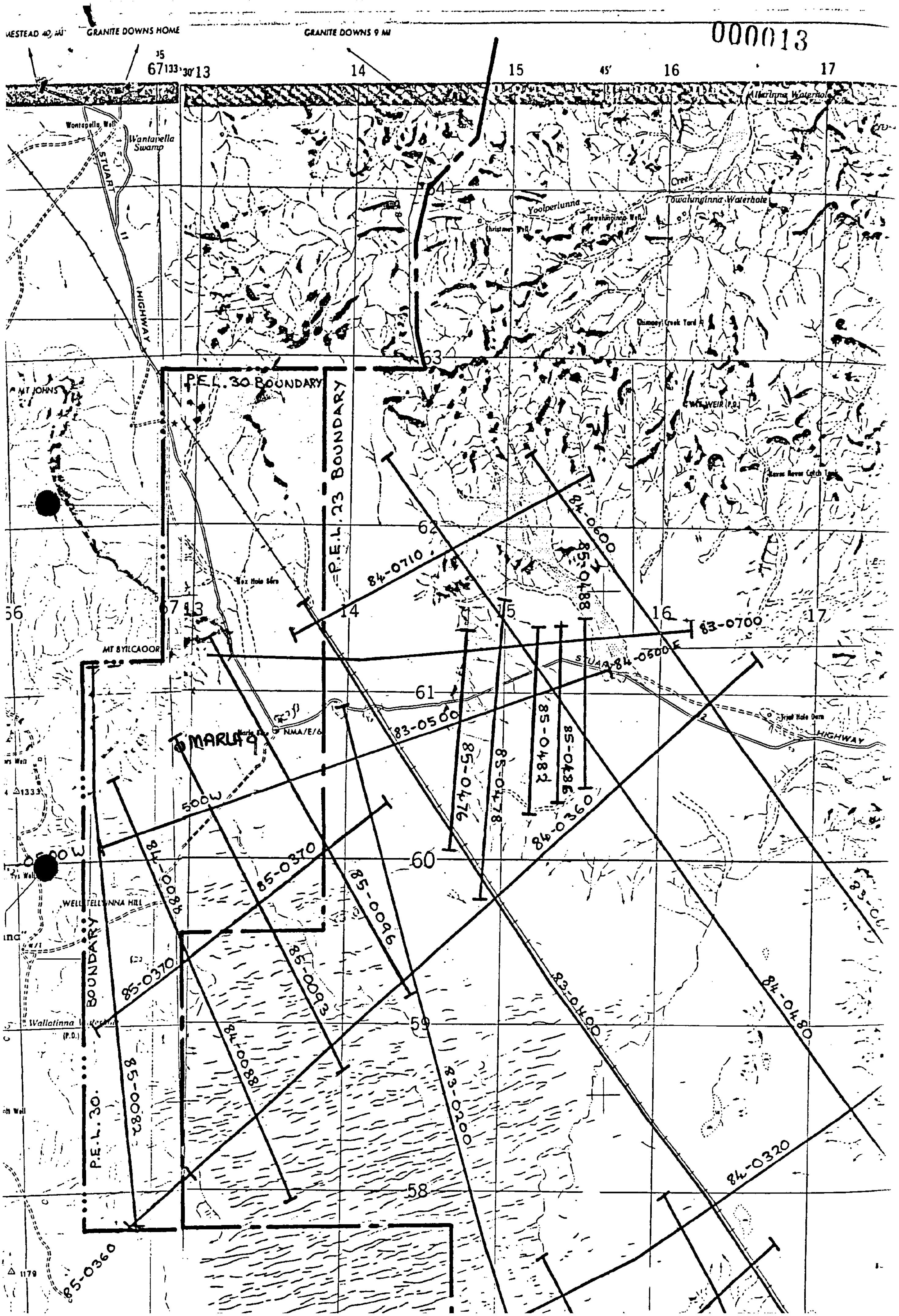
SEISMIC

All processing of the 76km of 60 fold Vibroseis data was completed during the quarter and film displays of Final Stacks, Migrated Stacks and Compressed Sections received from the processing house - Hosking Geophysical, Perth. The sections and shot point plans are being copied for delivery to SADME. First pass interpretation completed during the quarter shows a number of N.E. trending overthrust faults located just south of the Mt.-Byilkaoora-Mt. Johns Range. Correlation across these faults is difficult even with the aid of the closely spaced diamond core holes drilled as part of our mineral search in the area. No seismic or drilling is planned for 1986. Detailed seismic interpretation and field mapping are proposed, aimed at locating a petroleum well target for 1987.

SOURCE ROCKS

Marla 9, a trona core hole, drilled under mineral Exploration Licence 1070, which partly coincides with PEL 30, was terminated in probable Rodda Beds at 436 metres. The location of the drill hole is shown on the attached plan. A minor, bituminous oil bleed, at 256.3 metres in the Rodda Beds was submitted to Amdel for detailed analysis and comparison with oils from the nearby younger Observatory Hill beds located in SADME Byilkaoora 1, Comalco Byilkaoora 2, Byilkaoora 3. It is possible that the oil may have a different source.

000013



GRANITE DOWNS HOME
GRANITE DOWNS 9 MI
14
15
16
17
Wantapella Well
Wantapella Swamp
STUART
HIGHWAY
Creek
Yoolperlunna
Towalunginna Waterhole
Christmas Well
Chimney Creek Yard
64
63
62
61
60
59
58
MT JOHNS
P.E.L. 30 BOUNDARY
P.E.L. 23 BOUNDARY
84-0710
84-0600
85-0488
83-0700
84-0500 E
83-0500
500W
0500 W
MT BYLCAOOR
MARLA 9
85-0476
85-0478
85-0482
85-0486
84-0360
85-0370
85-0096
85-0093
84-0086
84-0088
83-0400
84-0480
83-0200
85-0082
85-0360
84-0320
P.E.L. 30.
BOUNDARY
Wallatinna
WELL TELLUNNA HILL
HIGHWAY

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12th MAY1986

G. WESTE,
COMALCO ALUMINIUM LIMITED.

SEISMIC

Transparencies of all sections (final stacks, migrated stacks, compressed stacks) and a 1:250,000 scale shot point plan, covering all seismic recorded in PEL 30 during 1985, were delivered to SADME during the quarter.

The PEL 30 area is structurally complex and the data quality poor. It has been decided that initial interpretations of the seismic in the area were inadequate more detailed reinterpretation has commenced.

Although seismic is no longer planned for PEL 30 this year, scouting was carried out along proposed lines now deferred to 1987. The scouting was conducted by the Pitjantjatjara Council, and covered proposed detailed mapping and possible soil/rock sampling to be carried out later in the year.

OTHER WORK

Initial results of source rock analyses from Marla-9 have been completed. More detailed analyses are now being carried out by the Baas Becking Geobiological Laboratory in Canberra.

Detailed sedimentological studies of the Observatory Hill Beds in collaboration with the Baas Becking Laboratory are continuing.

A formal review of the stratigraphy of the PEL 23 and 30 area is being prepared.

000016

7

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12th AUGUST 1986

G. WESTE,
COMALCO ALUMINIUM LIMITED.

SEISMIC

Detailed interpretation of the PEL 30 area is continuing. Most lines have been interpreted and some digitized. The area is structurally complex and data is of poor quality. Comalco's Mineral Exploration Licence drill-holes are being tied to the seismic sections using reinterpreted well velocity data. Well velocities have been corrected for 'misfits' with the surface seismic statics and replacement velocities.

The Pitjantjatjara Council has agreed to a number of short seismic lines in the Mt. Byilkaoora area totalling approximately 30 kilometres. It was originally planned to record this seismic in 1986. Budget cuts have forced deferrment to 1987 and no application to conduct the survey has been lodged. The Pitjantjatjara Council requested stricter conditions than normal on line clearing, including the non-use of grading, and a line width maximum of twelve feet.

OTHER ACTIVITIES

Preparations are being made to carry out detailed structural field mapping in PEL 30 in October this year. Soil and rock sampling will also be carried out. This work has been agreed to by the Pitjantjatjara Council. Air photograph and Landsat studies of the area are being prepared.

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH FEBRUARY, 1987

G. WESTE
COMALCO ALUMINIUM LTD

GENERAL

Complex faulting, including overthrusting in the PEL 30 area make seismic interpretation difficult. Seismic data recorded in the area during 1983 is being examined with a view to reprocessing using more recent techniques to enhance the quality of data.

MAPPING

Field mapping was carried out in the Mt. Byilkaoora area during the quarter. Fracture type, density and orientation were recorded to help evaluate the possibility of a fracture play in the Observatory Hill Beds.

Hunting Geology and Geophysics completed detailed air photograph interpretation of the area to identify fractures and fracture orientation and to map fold structure and so assist the field mapping.

Reports are being compiled for submission to SADME.

000020

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH MAY, 1987

G. WESTE
COMALCO ALUMINIUM LTD

MAPPING

Field structural mapping completed during the previous quarter produced data which did not agree well with airphotograph structural interpretations carried out by Hunting Geology and Geophysics. It was planned to use the airphotograph data as a base for the field mapping. During the quarter the two data sets were examined to find an explanation for this variation, prior to completion of a report.

A short field mapping exercise with SADME geologists was conducted over the northern portion of PEL 30 and north of Mt. Johns in the Pitjantjatjara Lands during February. The purpose of the exercise was to examine probable Precambrian Rodda Beds and glacials, prior to publication of a paper in the Quarterly Geological Notes.

MICROSEEPAGE

A portion of PEL 30 (Byilkaoora-2 area) will be included in a soil-gas microseepage survey to be completed during the next quarter.

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH AUGUST, 1987

G. WESTE
COMALCO ALUMINIUM LTD

MAPPING

No further data analysis was carried out during the quarter. Plans were drafted showing various structural data sets.

MICROSEEPAGE

The area in the vicinity of Comalco mineral diamond drill hole, Byilkaoora-2 was included in an interstitial soil-gas microseepage survey conducted during early August. The Byilkaoora-2 area was included to:

1. test the ability of the technique to detect significant oil bleeds at depths of approximately 700 metres, and

2. rank the Byilkaoora-2 area prospectivity compared to that of nearby areas in PEL 23.

The survey was conducted by Recon Exploration (Australia). Samples were analysed by a mobile field data laboratory on the day of collection.

Data interpretation was not completed at the end of the quarter.

000024

HYDROCARBON MICROSEEPAGE

GEOCHEMICAL SURVEY

PEL 23 & PEL 30

South Australia

Complete copy in Envelope ~~5805~~ 5073 Vol. 14.

to

Comalco Aluminium Ltd.
Conyngham St.
Glenside
South Australia

16 September 1987

RECON EXPLORATION (AUSTRALIA) PTY LTD

August, 21, 1987

Comalco Aluminium Ltd
Conyngham Street,
GLENSIDE SA 5065

Attn: Mr. Griff Weste

Dear Mr. Weste,

Ref: Hydrocarbon Geochemical Survey, PEL 23 & PEL 30 South Australia

This letter reports the result of our recently completed ~~grouped~~ ground geochemical sampling survey in PEL23 and PEL 30, South Australia. The purpose of this survey was to identify and quantify the hydrocarbon gas microseepage occurring over several areas and seismic anomalies COMALCO ALUMINIUM LTD had previously identified in the areas. Interstitial gas samples were collected along parts of several seismic lines. Since there were no producing oil wells in the survey area, it was not possible to compare the measured microseepage to a "Benchmark" for the area. However, when compared to Recon's world-wide experience and data-base, several of these anomalies exhibit favourable hydrocarbon gas microseepage.

GROUND HYDROCARBON SAMPLING SURVEY

Field Conditions

RECON EXPLORATION staff arrived at Comalco's caravan camp in PEL 23 on 5 August where the laboratory and operations base was established and utilized through 7 August. On 8 August the laboratory and operations were moved to Marla and remained there until completion of the survey on 11 August.

RECON EXPLORATION (AUST) PTY LTD mobilised three staff from Adelaide: Mr. David Strachan (Manager), Mr. Ray Burson (Chief Chemist) and Mr. Dixon Bunt (Chief Sampler).

The PEL 23 and PEL 30 sampling area consists mainly of undulating plain with dunes, gibber areas and no surface water. Minor sampling in PEL 30 occurred in the hilly terrain of "Cunje Country". Native shrubland and woodland is dominated by mulga (Acacia aneura) and mallee (Eucalyptus spp) with shrubs and grasses. It has a very hot, dry desert climate, with short cool to cold winter. The mean annual rainfall is an unreliable 150 mm. Although cattle grazing occurs, the area is unsuitable, with a very low stocking rate of <1 cow per 5 square kilometres.

Cool dry weather made work conditions comfortable. No rain fell during the survey. Barometric pressures ranged from 1018 hPa to 1028 hPa.

Sampling conditions were good, allowing an average of 127 samples per day. Soils sampled were highly compact clayey silts and sands, gibber and occasional rock outcrop/subcrop. Samples were not pulled on the crests of loose sand dunes.

Sampling and Analysis

A total of 634 interstitial gas samples were collected by our field crew along profiles in these structural areas and analysed in our Field Geochemical Laboratory located in the field near the sampling sites. The samples were collected at each site using RECON EXPLORATION'S patented unique gas sampling probes. This stainless steel probe was hammered into the soil and the interstitial gas sample taken by syringe through a rubber septum seal at the top of the probe. The samples were spaced at 200-metre intervals along seismic lines and then transported to our field laboratory for same-day analysis. In the laboratory we used a hydrogen-flame ionization gas chromatograph for analysis, and associated integrator and computer for collating the analytical data. By having this instrumentation near the sample sites, it was possible to perform preliminary evaluations of the data and provide more efficient quality control of all operations.

Results and Interpretation

The areas were graded as Significant, Moderate, and Minor "reservoir-type" microseepage. These represent an increase over background hydrocarbon gas microseepage of approximately four-, two- and one-times respectively. This type of microseepage appears as anomalous over several adjacent samples. "Fault-type" microseepage was clearly evident in several of the areas evaluated. These appear as narrow spikes on the profile graph.

Profiles from the areas that were sampled (see map) during August, 1987 are interpreted as follows:

1. Line 86-0185

   This profile was sampled in two separate parts and the results are presented in two graphs (86-0185-A and 86-0185-B). A significant microseepage signature is observed on the southwestern portion of this long line with minor microseepage along the central to northeastern portion.

measured along the southwestern half is moderate and increases to significant along the northeastern end. Numerous isolated high values could again be fracture related.

11. Line 86-0154

This line was also sampled in two parts (86-0154-A and 86-0154-B) from a southwestern to northeastern direction. The microseepage is moderate toward both the southwestern and northeastern ends, with background to minor microseepage along the central portion.

12. Line 86-0036

Moderate hydrocarbon gas microseepage is exhibited along the southeastern third of this profile, becoming minor toward the northwestern half.

13. Hole #107201 Traverse

This profile essentially exhibits background microseepage along its entire length. The higher than normal value for methane background are probably related to the coal formations in this area.

14. Line 86-0440

Significant reservoir-type hydrocarbon gas microseepage is exhibited along southeastern half of this line, becoming moderate as it moves towards the northwest. The concentration of spikes in this area are perhaps fracture-related.

15. Line 85-0082 PEL 30

This profile was sampled in two portions (85-0082-A and 85-0082-B). It exhibits moderate hydrocarbon gas microseepage at points 17 and 18, with the remainder of the line at the background concentration level.

The results of these analyses are presented on the attached quantitative profile graphs and contrast-to-background graphs of methane, ethane, propane and butane. Chromatographic analysis data for each sample are also included along with several summations and ratios that are helpful in interpreting the results.

These summations and ratios have the following applications to interpretations of the geochemical analytical data:

Sum C1-C4: This is the sum of all the hydrocarbons measured from methane through normal butane.

Sum C2-C4: This is the sum of the petroliferous hydrocarbons (excluding methane). This summation is very useful for evaluating the petroleum potential of an area based on these components concentrations in the soil gases. It excludes methane, which may have a biogenic origin.

Ethane/Ethene and Propane/Propene Ratios: These are the alkane/alkene ratios sometimes useful in identifying fracture related (or fault) microseepage. The normal values are usually in the range of 1-2. An unusual sample with ratios in the range of 3-5 usually indicates seepage up fractures or joints above the reservoir.

Ethane Ratio The ration of methane to ethane (methane/ethane). Values near 10 indicate a more liquid petroleum source, whereas values in the 20-30 range are related to a dry gas source.

Propane Ratio The propane to methane ratio (propane x 1000/methane). Values in the range >10 are more liquid prone, where as values in the range <10 are more gas prone.

% Methane The percent methane in the total hydrocarbon gas. A value >95% indicates a dry gas source.

% Wetness The percent of the sum of C2-C4 (ethane through butanes) in the sample. This and the % Methane total 100%. A value >10% indicates a liquid character to the gas source.

The interpretation of the attached profiles is relatively straightforward, that is, the most concentrated amounts of hydrocarbon gases were collected and measured over the areas where the petroleum source potential is the greatest. Statistical evaluation of the hydrocarbon gas sample data to determine the contrast-to-background of these primary hydrocarbon gases supports our interpretations. Each sample line that was ranked from minor to moderate has microseepage exceeding background levels. The areas ranked as significant have microseepage concentrations exceeding approximately three-times background levels. We believe these anomalous hydrocarbon microseepage patterns define the areas of primary interest for further petroleum exploration. With the aid of these quantitative hydrocarbon microseepage analyses, a thorough evaluation of each prospect identified is suggested. (Note: We have included some special geochemical ratio data for each sample, which was requested by Mr. John Dunster, Senior Field Geologist, in previous work we performed for COMALCO ALUMINIUM LTD.)

SUMMARY

Interstitial hydrocarbon gas samples were collected and analysed along profiles from many of the seismic lines previously interpreted by COMALCO ALUMINIUM LTD in PEL 23 and PEL 30 in South Australia. Along these seismic anomalies, parts of them are interpreted as exhibiting hydrocarbon gas microseepage. Our interpretation is derived by evaluating the amounts of hydrocarbon gas microseepage measured in past surveys of known oil and gas fields through Australia. In particular, RECON EXPLORATION has made comparisons with past surveys over water-drive oil reservoirs, i.e. low gas drive. These oil fields include Mt. Horner (W. Aust.), Rough Range (W. Aust.), Merrimelia (S. Aust.), and Kenmore (Qld.). In our opinion, the moderate to significant hydrocarbon gas microseepage prospects warrant further detailed evaluation.

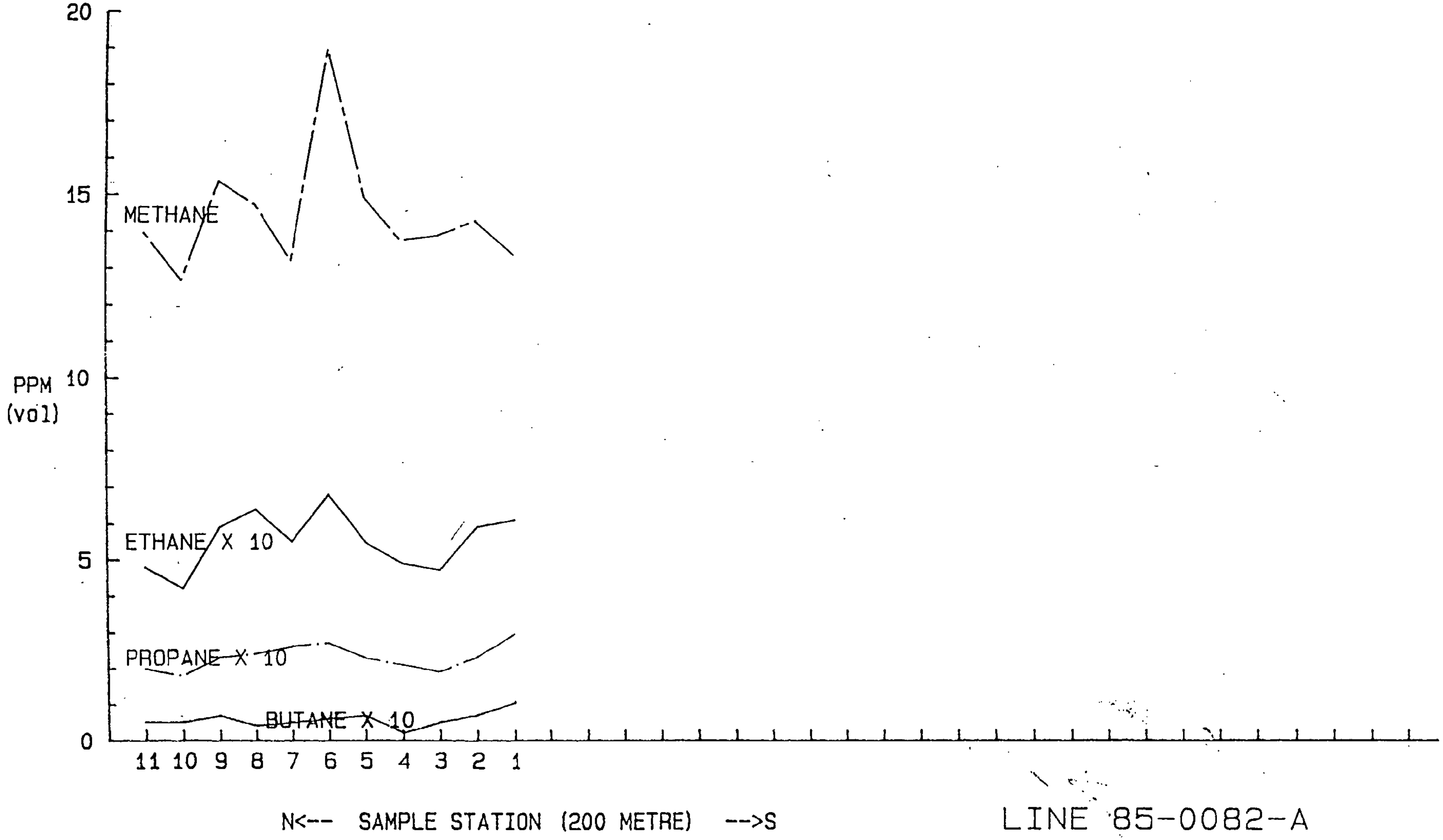
It has been a pleasure conducting this survey on your behalf, especially with such encouraging results. We hope these findings will aid your evaluation of hydrocarbon microseepage surveys. If you should have any questions with regard to this report, or the survey method, please do not hesitate to call.

We appreciate the opportunity to perform this exciting work for COMALCO ALUMINIUM LTD and look forward to the next opportunity to serve your group. Our special thanks to your superb field support and keep staff.

Yours faithfully,

DAVID STRACHAN
Manager

RAY BURSON
Manager, Geochemical Programmes



RECON EXPLORATION (AUSTRALIA) PTY LTD

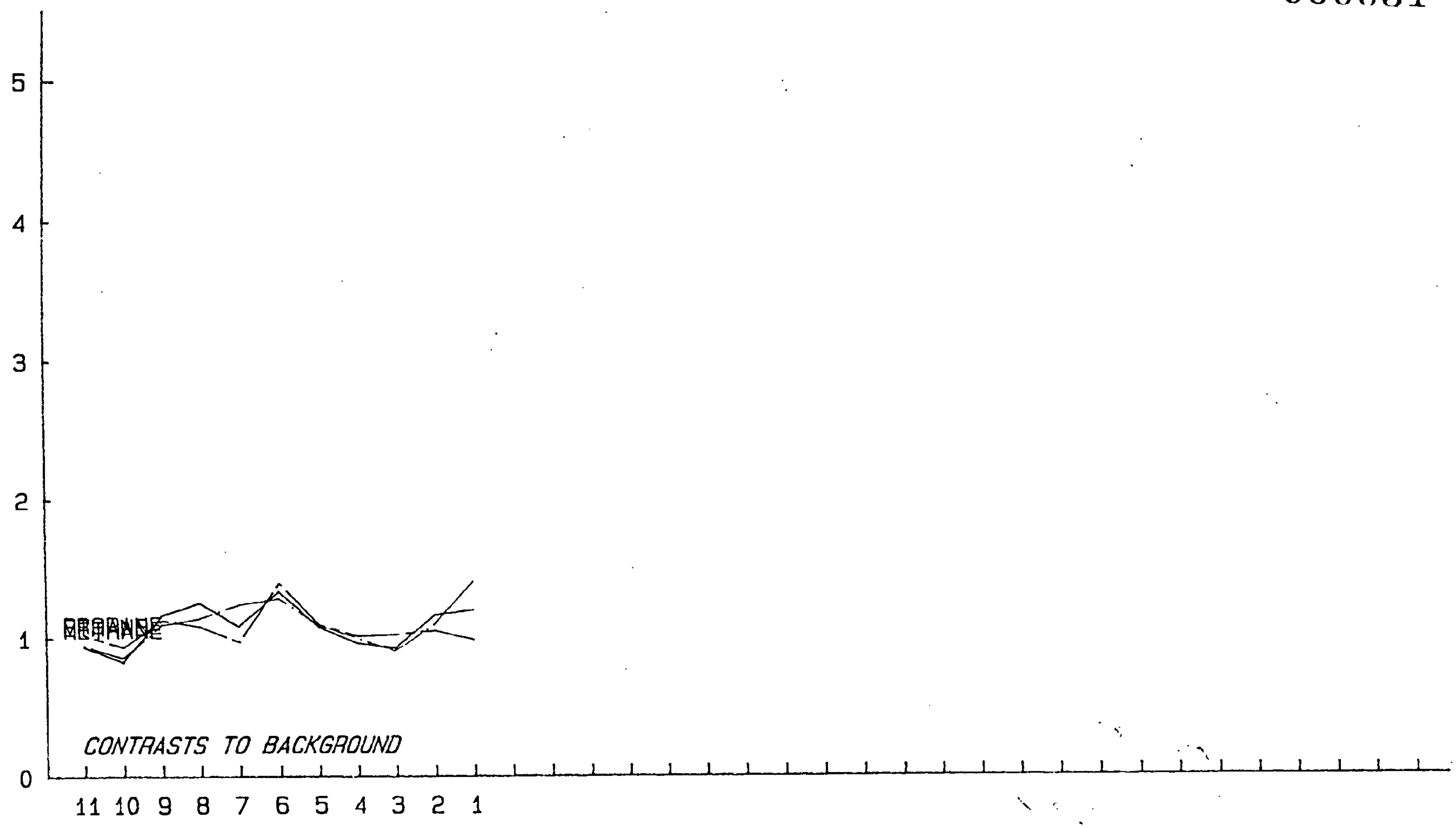
LINE 85-0082-A

PEL 30 - SOUTH AUSTRALIA

GEOCHEMICAL EXPLORATION PROGRAM, AUGUST 1987

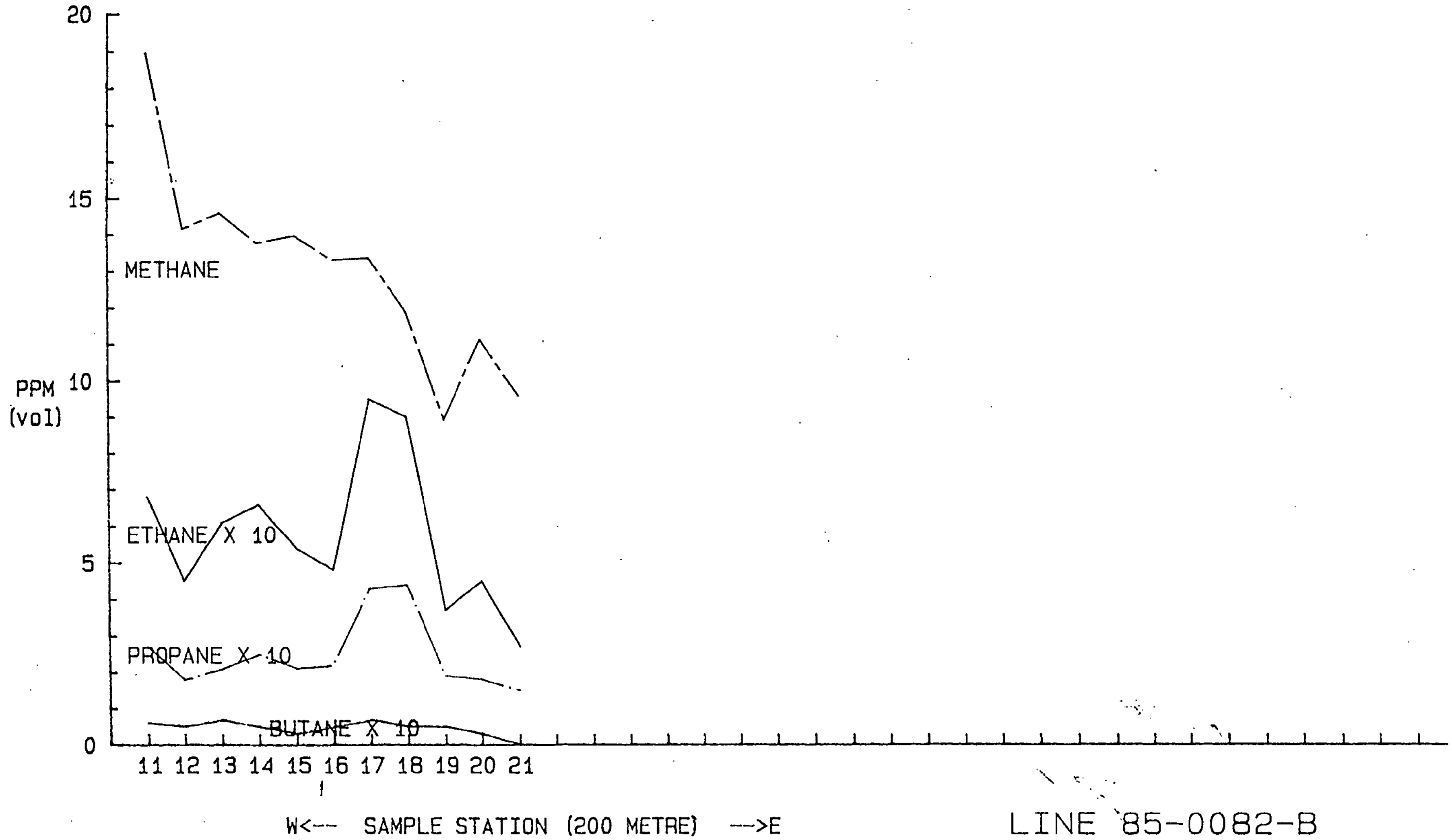
COMALCO ALUMINIUM LTD

000031



RECON EXPLORATION (AUSTRALIA) PTY LTD

LINE 85-0082-A
PEL 30 - SOUTH AUSTRALIA
GEOCHEMICAL EXPLORATION PROGRAM, AUGUST 1987
COMALCO ALUMINIUM LTD.



• RECON EXPLORATION (AUSTRALIA) PTY LTD

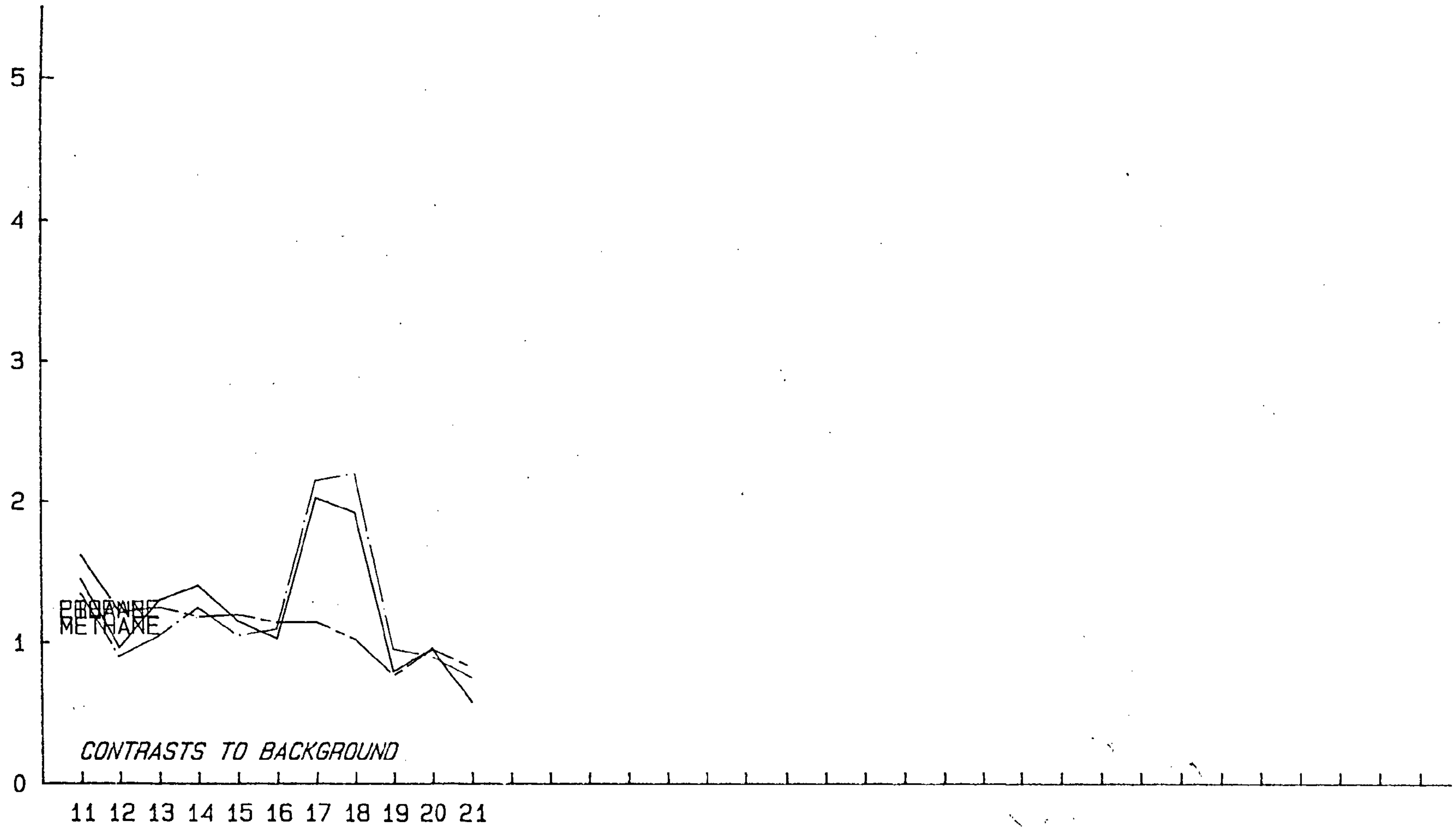
LINE 85-0082-B

PEL 30 - SOUTH AUSTRALIA

GEOCHEMICAL EXPLORATION PROGRAM, AUGUST 1987

COMALCO ALUMINIUM LTD

000033



W <-- SAMPLE STATION (200 Metre) --> E

RECON EXPLORATION (AUSTRALIA) PTY LTD

LINE 85-0082-B

PEL 30 - SOUTH AUSTRALIA

GEOCHEMICAL EXPLORATION PROGRAM, AUGUST 1987

COMALCO ALUMINIUM LTD.

COMALCO ALUMINIUM LTD.
PEL 30 - South Australia

85-0082-A

DATA SUMMARY TABLE

Sample #	Methane	Ethane	Ethene	Propane	Propene	i-Butane	n-Butane
1	13.33	.61	.23	.30	.26	.03	.08
2	14.24	.59	.22	.23	.24	.02	.05
3	13.85	.47	.21	.19	.15	0.00	.05
4	13.72	.49	.22	.21	.22	0.00	.02
5	14.90	.55	.26	.23	.23	0.00	.07
6	18.95	.68	.35	.27	.29	0.00	.06
7	13.17	.55	.20	.26	.15	0.00	.05
8	14.71	.64	.32	.24	.25	0.00	.04
9	15.36	.59	.30	.23	.27	0.00	.07
10	12.64	.42	.23	.18	.25	0.00	.05
11	13.94	.48	.27	.20	.23	0.00	.05

SUMS AND RATIOS

Sample #	Sum C1-C4	Sum C2-C4	Ethane/ Ethene	Propane/ Propene	Percent Methane	Ethane Ratio	Propane Ratio	Percent Wetness
1	14.82	1.49	2.71	1.16	89.95	21.86	22.13	10.05
2	15.59	1.35	2.68	.96	91.34	24.14	16.15	8.66
3	14.92	1.07	2.24	1.27	92.83	29.47	13.72	7.17
4	14.88	1.16	2.23	.95	92.20	28.00	15.31	7.80
5	16.24	1.34	2.12	1.01	91.77	27.10	15.43	8.23
6	20.60	1.65	1.94	.93	91.99	27.86	14.25	8.01
7	14.38	1.21	2.75	1.73	91.59	23.95	19.74	8.41
8	16.20	1.49	2.00	.96	90.80	22.99	16.31	9.20
9	16.82	1.46	1.97	.85	91.32	26.04	14.97	8.68
10	13.77	1.13	1.83	.72	91.80	30.11	14.24	8.20
11	15.17	1.23	1.78	.87	91.89	29.04	14.35	8.11

RECON EXPLORATION (AUST) Pty Ltd
South Australia Field Laboratory
August, 1987

COMALCO ALUMINIUM LTD.
PEL 30 - South Australia

85-0082-A

SUMS AND RATIOS (COMALCO's)

Sample #	Wh Ratio	Bh Ratio	Ch Ratio	Percent Butane
1	7.04	43.57	.36	.71
2	5.88	59.34	.30	.45
3	4.88	75.38	.26	.34
4	4.99	67.66	.10	.13
5	5.40	67.19	.30	.43
6	5.06	72.70	.22	.29
7	6.13	52.77	.19	.35
8	5.89	63.96	.17	.25
9	5.48	69.36	.30	.42
10	4.89	72.58	.28	.36
11	4.98	72.10	.25	.33

RECON EXPLORATION (AUST) Pty Ltd
South Australia Field Laboratory
August, 1987

COMALCO ALUMINIUM LTD.
PEL 30 - South Australia

85-0082-B

DATA SUMMARY TABLE

Sample #	Methane	Ethane	Ethene	Propane	Propene	i-Butane	n-Butane
6 ~~11~~	18.95	.68	.35	.27	.29	0.00	.06
12	14.15	.45	.31	.18	.28	.02	.03
13	14.59	.61	.37	.21	.29	.02	.05
14	13.76	.66	.36	.25	.27	0.00	.05
15	13.97	.54	.29	.21	.26	0.00	.03
16	13.29	.48	.24	.22	.24	0.00	.05
17	13.36	.95	.84	.43	.50	0.00	.07
18	11.88	.90	1.09	.44	.81	0.00	.05
19	8.90	.37	.50	.19	.49	0.00	.05
20	11.13	.45	.31	.18	.26	0.00	.03
21	9.56	.27	.30	.15	.31	0.00	0.00

SUMS AND RATIOS

Sample #	Sum C1-C4	Sum C2-C4	Ethane/ Ethene	Propane/ Propene	Percent Methane	Ethane Ratio	Propane Ratio	Percent Wetness
11	20.60	1.65	1.94	.93	91.99	27.87	14.25	8.01
12	15.42	1.27	1.45	.64	91.76	31.44	12.72	8.24
13	16.14	1.55	1.65	.72	90.40	23.92	14.39	9.60
14	15.35	1.59	1.83	.93	89.64	20.85	18.17	10.36
15	15.30	1.33	1.86	.81	91.31	25.87	15.03	8.69
16	14.52	1.23	2.00	.92	91.53	27.69	16.55	8.47
17	16.15	2.79	1.13	.86	82.72	14.06	32.19	17.28
18	15.17	3.29	.83	.54	78.31	13.20	37.04	21.69
19	10.50	1.60	.74	.39	84.76	24.05	21.35	15.24
20	12.36	1.23	1.45	.69	90.05	24.73	16.17	9.95
21	10.59	1.03	.90	.48	90.27	35.41	15.69	9.73

RECON EXPLORATION (AUST) Pty Ltd
South Australia Field Laboratory
August, 1987

COMALCO ALUMINIUM LTD.
PEL 30 - South Australia

85-0082-B

SUMS AND RATIOS (COMALCO's)

Sample #	Wh Ratio	Bh Ratio	Ch Ratio	Percent Butane
6 ~~11~~	5.06	72.70	.22	.29
12	4.59	73.00	.28	.32
13	5.75	66.09	.33	.43
14	6.52	57.68	.20	.33
15	5.29	69.10	.14	.20
16	5.34	62.59	.23	.34
17	9.79	33.28	.16	.43
18	10.47	29.05	.11	.33
19	6.41	48.79	.26	.48
20	5.60	64.33	.17	.24
21	4.21	65.53	0.00	0.00

RECON EXPLORATION (AUST) Pty Ltd
South Australia Field Laboratory
August, 1987

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH NOVEMBER, 1987

G. WESTE
COMALCO ALUMINIUM LTD

MAPPING

A report on the structural geology of the outcropping sandstones in the Mt. Johns Range area within PEL30 has been completed and is submitted with this report. The report was part of a study to assess structure and fracturing in the area with a view to defining targets for seismic and drilling associated with possible fracture generated reservoir in the Observatory Hill Formation. Photogeological studies by Hunting Geology and Geophysics are included in the report.

GEOCHEMISTRY

A small interstitial soil gas microseepage survey was conducted in the vicinity of Comalco mineral hole Byilkaoora-2 which intersected significant oil bleeds in the Observatory Hill Formation. No significant microseepage anomalies were detected. The extent of the survey was limited by lack of soil and this problem also affected most of the sampling completed. Data for this survey is submitted with this report.

ATTACHMENTS

Structural geology of the Mt. Byilkaoora area, Mt. Johns Range, J.N. Dunster, Comalco Aluminium Limited, September, 1987.

Excepts from "Hydrocarbon Microseepage geochemical survey, PEL 23 and PEL 30, South Australia", Recon Exploration (Australia) Pty. Ltd., 16th September, 1987.

PEL 30 SOUTH AUSTRALIA

REPORT FOR QUARTER ENDING

12TH FEBRUARY, 1988

G. WESTE
COMALCO ALUMINIUM LTD

SEISMIC

Reinterpretation of the 416 kilometres of seismic sections covering PEL 30 has commenced. The aim of the reinterpretation is to more successfully identify overthrusting in the area and to enable more comprehensive isopach contour plans to be prepared.

MAPPING AND GEOCHEMISTRY

Consideration of the reporting on structural mapping in the Mt. Byilkaoora area, Mt. Johns Range shows that it is difficult to identify drilling targets in the immediate area covered by the report. The lack of any interstitial soil gas microseepage anomaly over mineral drill hole Byilkaoora-2 which recovered oil in the mud-pit further complicates assessment of the area.

000042

STRUCTURAL GEOLOGY OF

THE MT. BYILKAOORA AREA,

MT. JOHNS RANGE.

September 1987

J.N. DUNSTER

Env. 6991 Vol. 2

SUMMARY

The structure of the Mt. Johns Range is governed by several shallow listric thrust faults. Outcrop in the Mt. Byilkaoora area, on the southern flank of the Mt. Johns Range, is the surface expression of a thrust which has displaced and gently folded Precambrian to Ordovician sediments. The Cambrian Observatory Hill Formation is known to contain oil bleeds in this area and this study attempts to define intraformational structural plays and fracture fairways within PEL30. Field mapping, detailed airphoto interpretation and preliminary seismic interpretations were used to delineate ten structural domains and map several macroscopic structures.

Fractures were found to be a function of outcrop and it is not possible to nominate any structural domains that are more prospective as fracture plays than others. There is no direct relationship between photo-lineaments and fractures measured on the ground. Photo-lineaments were found to be a function of sun angle over about twenty five percent of the study area.

Two broad synclines have been mapped. The first, and most prospective of these, trends almost directly east-west with a fold axis plunging west at less than 10° and probably passing within a few hundred metres north of drillhole Byilkaoora-2. This interpretation is confirmed by airphoto studies and seismic data. Lack of outcrop in critical areas makes it impossible to confirm the existence of a fracture fairway. If it is assumed that the most prospective zone must be closer to the fold axis than drillhole Byilkaoora-2, a total area of just over two square kilometres is considered prospective.

The second syncline extends northeast from Mt. Byilkaoora. It is not considered prospective because of the gentle degree of flexure and the fact that the Observatory Hill Formation is very shallow over much of the area.

Small anticlines were mapped to the southwest of Mt. Byilkaoora and to the north-northwest of drillhole Byilkaoora-1. Neither anticline provides viable structural or fracture plays because the Observatory Hill Formation is very shallow or subcrops and both areas are less than one square kilometre in areal extent.

The thrusts responsible for the existence of the Mt. Johns Range have caused only gentle folding of known source rocks in the Mt. Byilkaoora area and are unlikey to have significantly enhanced the potential of a petroleum reservoir in the area.

Contents

List of Figures and Tables

Introduction

The Mt. Johns Range is one of the few exposures of the Cambrian to ?Early Ordovician sediments of the Officer Basin in South Australia. The range consists of just over 20 km of low cliff exposures. Mt. Johns in the north and Mt. Byilkaoora in the south are the topographic highs, each with less than 150 m of relief.

This study of the structural geology of the southern portion of the Mt. Johns Range is part of the petroleum exploration programme by Comalco Aluminium Limited in PEL 30. Field mapping in the vicinity of Mt. Byilkaoora, detailed air-photo interpretation and a limited amount of seismic data were used to delineate joint trends, faults and folds. This work should help define potential fracture fairways and structural traps in the Mt. Byilkaoora area.

Locality

The study area covers approximately 36 square kilometres of PEL 30, south and east of Mt. Byilkaoora on the southern flank of the Mt. Johns Range. The range is located less than 10 km west of the township of Marla, 1,200 km north of Adelaide and 500 km south of Alice Springs (Figure 1).

Access

Much of the Mt. Johns Range is included in Pitjantjatjara Aboriginal lands. The study area lies outside these lands but traditional landholders were consulted before entry. Vehicular access to the area is restricted to the Old Stuart Highway, unsealed public roads between Marla and Mintabie and several seismic lines. The mapping of the range itself was undertaken on foot.

Previous Work

The surface geology of the area has been described by Krieg (1973) and Benbow (1982). The latter author mapped the Mt. Johns Range and outlined the Cambrian to ?Early Ordovician stratigraphy. Cored drillholes (SADME Byilkaoora-1, Comalco Byilkaoora-2, Marla-8, Marla-9) and several non-cored upholes in the vicinity have confirmed the portion of the stratigraphy described by Benbow (1982) (see inset Figure 1) and Brewer et al. (1987).

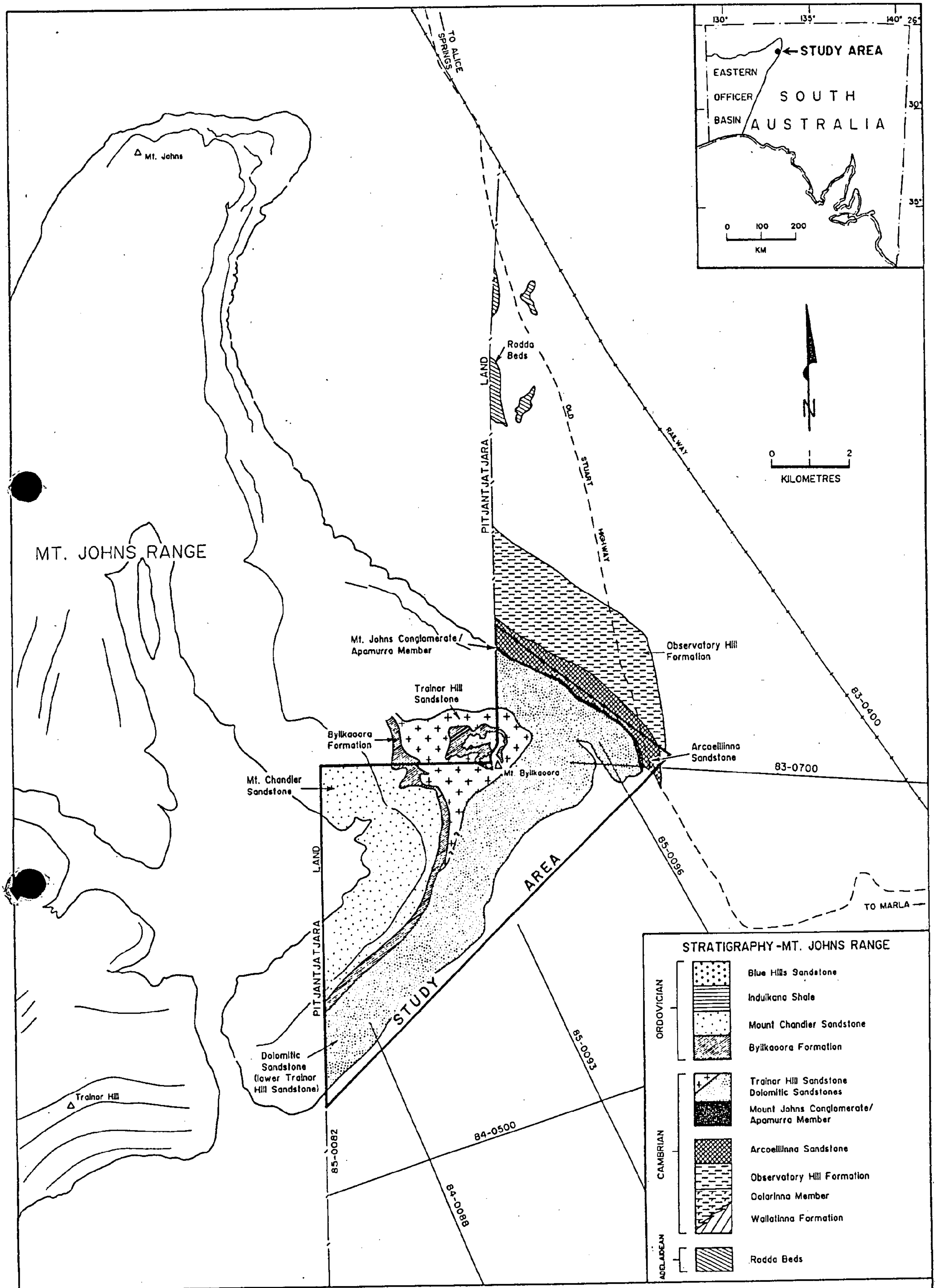


FIGURE I. LOCALITY MAP - MT. BYILKAOORA AREA.
GEOLOGY AFTER BENBOW (1982).

The structure of the area has received little attention other than the work by Krieg (1973) and Benbow (1982) who described the Mt. Johns Range as "a very gentle west plunging syncline with a prominent east and north margin of some 20 km length".

Methods

This study incorporates data from field mapping, Comalco seismic sections and a detailed aerial photography interpretation.

During the field work for this study, over 300 dip and strike measurements and over 800 joint orientations were recorded from areas of best exposure in the Mt. Byilkaoora area. The location and orientations of all faults, mesoscopic tectonic folds and the presence of slickensides were also noted. Sample stations were located on aerial photographs enlarged to approximately 1:20,000. The field work was undertaken by Bob Henry and the author during November 1986.

Comalco have undertaken seismic surveys in the area. Lines 83-0700 and 85-0096 are located east of Mt. Byilkaoora and line 85-0082 runs along the north-south boundary fence delimiting the study area in the west. There are also a number of other seismic lines a few kilometres southeast of the study area.

Detailed air-photo and Landsat interpretations have been undertaken by Hunting Geology and Geophysics and the author. Bedding orientations were photogrammetrically measured using a Zeiss SMM stereomicrometer and Wild ST4 parallax bar. Photo-lineaments were marked directly onto 1:43,000 coloured air-photos by Hunting. A parallel study by the authors utilized enhanced Landsat imagery at 1:250,000; coloured air-photos at 1:80,000 and 1:85,000 with differing sun angles; and an enlargement to approximately 1:20,000. All recorded lineaments, except those obviously related to strike-oriented differential weathering of inclined beds, were compiled on a 1:20,000 map.

Sub-surface Structure

Comalco seismic data from east and southeast of Mt. Byilkaoora shows at least six shallowly dipping northeast-southwest trending listric thrust faults. These faults displace basement and Adelaidean to Ordovician sediments. Movements indicate up to eight kilometres of overthrust from the northwest. Seismic lines 85-0082, 85-0096 and 83-0700 (Figure 2) show that the southern and southeastern flanks of the Mt. Johns Range are the surface expression of a single thrust block dipping at about 05° to the northwest. The seismic data shows only very gentle folding within the thrust block. A gentle syncline in the vicinity of drillhole Byilkaoora-2 is shown on line 85-0082, and line 83-0700 shows a broad anticline east of drillhole Byilkaoora-1.

Structural Domains

A series of maps (Figures 3-8) have been compiled to show the salient structural features in the Mt. Byilkaoora area. Figure 3 gives the locations of Sample Stations. Field measurements of bedding orientations (Figure 4) and mesoscopic joints (Figure 6) were used to define ten structurally homogeneous domains within the study area. Faults, slickensides and mesoscopic folds recorded during the field mapping are shown on Figure 5.

The results of air-photo interpretations are shown on Figures 7 and 8. The structural domains have been superimposed on the photo-lineament map and the prominent lineament trends in each domain are included in the discussions below.

DOMAIN-A

Domain-A occupies a large area along the southeastern flank of the Mt. Johns Range, southeast of Mt. Byilkaoora. The beds dip to the northwest (Figure 9) between 03° and 28°. The modal dip is 06°. There is a gradual change in dip direction from an average of 330° in the southeast of the Domain to 315° in the northwest.

Mesocopic Features

Faults

There are several mesocopic faults located in Domain-A. A small fault at Sample Station 221 is associated with local deformation and jointing. This fault lies along strike (050° to 055°) from Sample Station 248. Here, the fault is

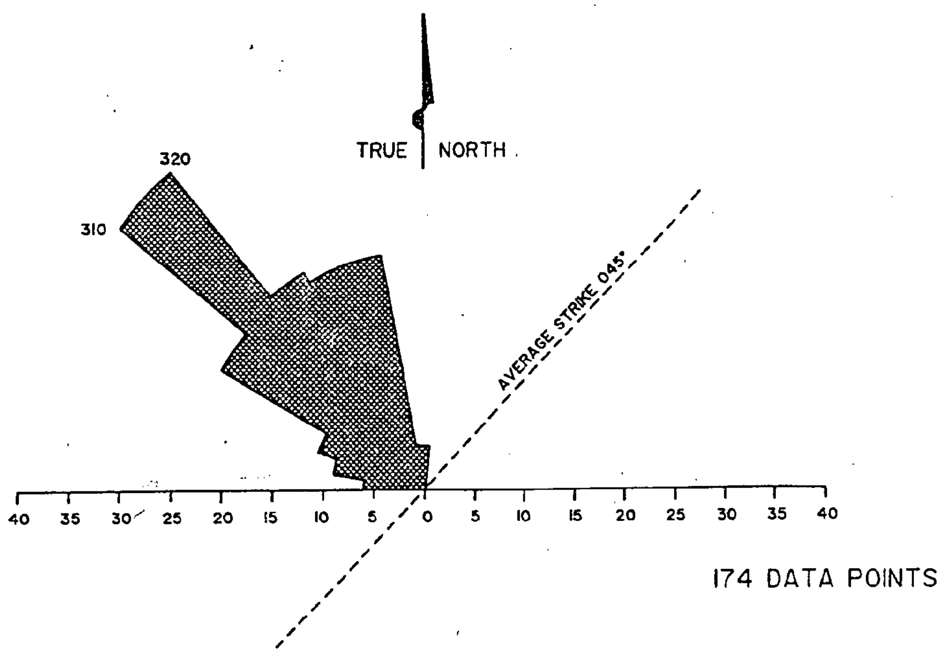


FIGURE 9. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 310°-320° IN DOMAIN-A. THIS CORRESPONDS TO A STRIKE OF 045°.

expressed as a small shear zone 10 cm wide with obvious dissimilarity of lithology on either side. Possible fault-induced deformation at Sample Station 257 is also close to this strike. In all three cases outcrop is poor and no sense of offset can be measured.

Another mesoscopic fault at Sample Station 317 strikes northwest-southeast. The near-vertical fault plane contains slickensides. Sample Station 2 also shows possible fault-induced deformation, resulting in Domains B to E.

Slickensides

Slickensides are present in sandstone float from nine Sample Stations in Domain-A. Only two examples of slickensides were found in situ .

The area around Sample Stations 220, 237 and 239 contains numerous examples of well-developed slickensides in sandstone float. The samples shown in Figure 10 were all collected from within arm's reach. The slickensides are invariably at a low angle to bedding, indicating near-concordant fault movement. Some examples (such as the specimen top left) have slickensides on two faces at an obtuse angle, sub-parallel to bedding. The striations on the two faces are very nearly at right angles to each other.

The slickensides result from grooving of the sandstone itself and the development of a very thin ribbed coating of ferrugenous and quartz minerals. Characteristic small steps facing in one direction and oriented more or less normal to the striations are ubiquitous (Figure 11).

Sandstone float with slickensides is also common along the western end of seismic line 83-0700 (Sample Stations 270, 307-309, 311). It appears to come from the same stratigraphic interval as the previous examples, but typically the slickensides consist of quite thick ribbed coatings of silica, and calcite with minor ferrugenous minerals. These coatings range up to a centimetre in thickness. The steps of the slickensides are less pronounced. The majority of examples from Sample Station 309 indicate movement at a low angle to the bedding, although isolated specimens appear to be cross-cut by a second generation almost at right angles to bedding.

Slickensides are also locally abundant in float to the northeast of Mt. Byilkaoora at the boundary of Domains-A and G (Sample Stations 321, 323, 324).

FIGURE 10. SLICKENSIDES IN SANDSTONE FLOAT, SAMPLE STATION 220.

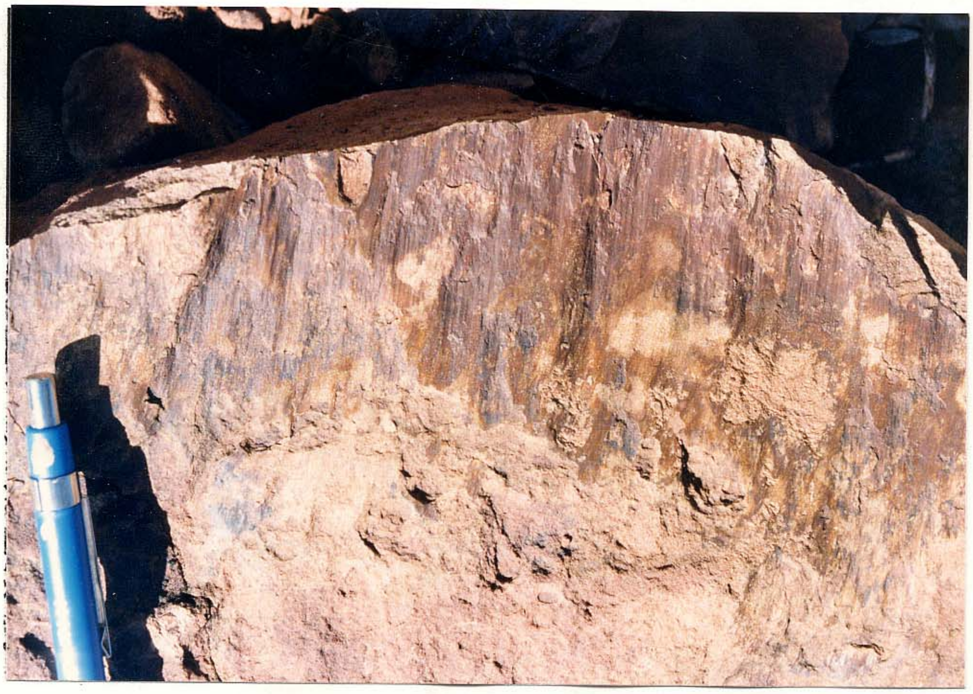


FIGURE 11. CLOSE-UP OF SLICKENSIDES IN SANDSTONE FLOAT, SAMPLE STATION 220.

These examples are similar in appearence to the type figured, but come from stratigraphically higher sandstones and siltstones. Slickensides were observed in situ nearby at Sample Stations 324. One set of near-concordant striations striking 023° can be traced over 50 cm along the contact between two silty sandstones. Stratigraphically higher in the same outcrop near-horizontal slickensides, at 04° to bedding, strike 016° and dip slightly to the SSW, with the steps facing to the NNE. It is often suggested that such steps face the direction of movement of the opposite block. If this is the case, the slickensides indicate that the upper block was overthrust from the SSW.

Slickensides were also observed in situ on a near-vertical fault plane at Sample Station 317. The striations can be traced for 45 cm and plunge slightly to the northwest, with the stepped faces to the southeast. This suggests that the southwestern block has moved northwest with a downthrow of less than 10°.

Folds

There are few examples of mesoscopic folding in Domain-A. A symmetrical, open, sub-horizontal anticline or monocline is evident in patchy outcrop at Sample Station 313. Very poor outcrop in the vicinity of Sample Station 257 shows possible fault-induced deformation including a broad, open, sub-horizontal anticline and syncline. Both these examples are restricted to quite small areas.

Joints

The majority of the mesoscopic joints are vertical with strikes ranging from 040° to 080°. There is a strong modal trend at 060° to 070° (Figure 12).

Macroscopic Features

Folds

Domain-A is the southeastern limb of a large, open syncline. Photo-interpretation suggests that the fold axis is gently curved, trending almost directly east-west, plunging at less than 10° to the west, and probably passing within a few hundred metres of drillhole Byilkaoora-2 (Figure 7).

Photo-lineaments

The photo-lineaments in Domain-A correspond to small gulleys, clefts in the cliff exposures and somewhat more-vague linear tonal anomalies at an angle

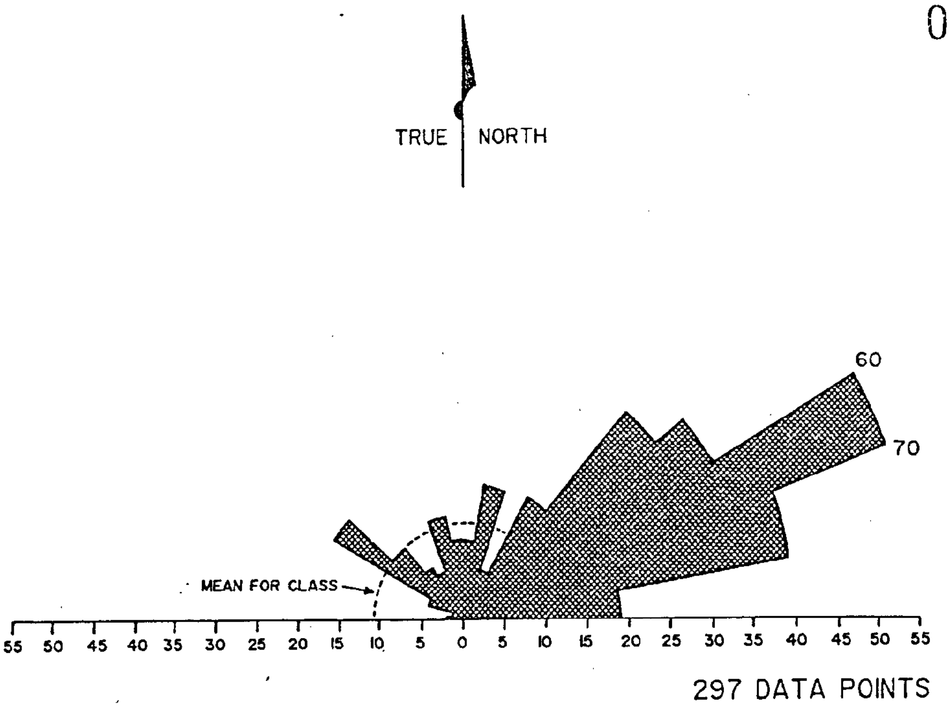


FIGURE 12. ROSE DIAGRAM SHOWING THE STRIKES OF VERTICAL JOINTS, DOMAIN-A MT. BYILKAOORA AREA. THERE IS A STRONG MODAL TREND IN THE 60°-70° CLASS.

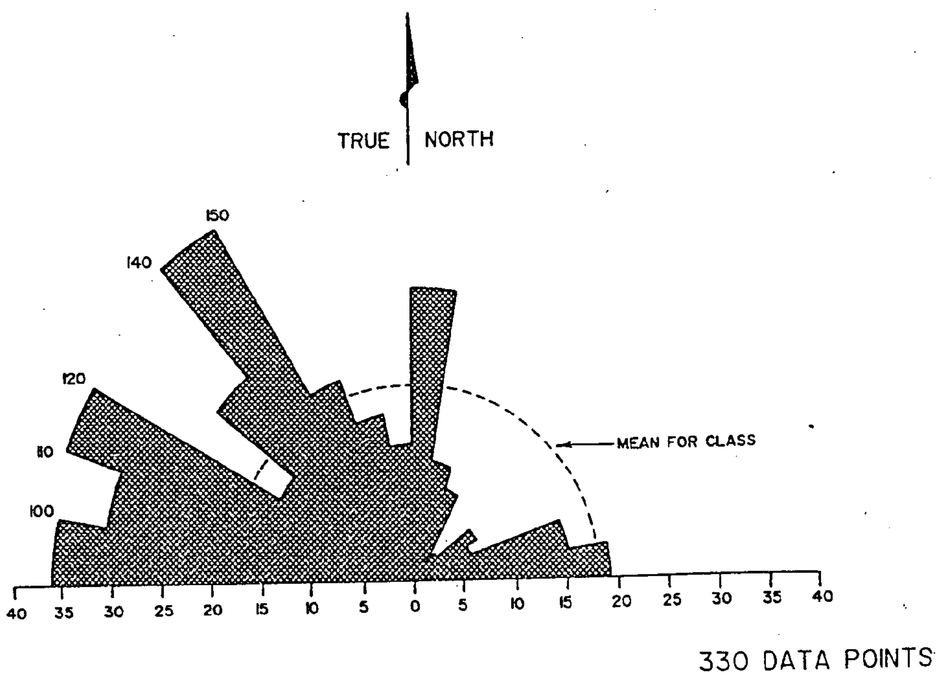


FIGURE 13. ROSE DIAGRAM SHOWING TRENDS OF PHOTO-LINEAMENTS, DOMAIN-A. MAXIMA OCCUR AT 90°-100°, 110°-120°, 140°-150°.

to strike. There were no significant differences in the populations of lineaments recorded from air-photos with different sun angles. The lineament density is entirely a function of outcrop; with the greatest density occuring in the more disected areas of Trainor Hill/Dolomitic Sandstone. The majority of the photo-lineaments trend northwest-southeast with maxima at 090°-100°, 110°-120° and 140°-150° (Figure 13). There is a gradual change in the trend of the photo-lineaments as the dip direction swings from NNW in the southwest of Domain-A to northwesterly in the northeast of the Domain. The east-west trending photo-lineaments are restricted to the area just east of drillhole Byilkaoora-2. These lineaments, recognized by Hunting on 1:43,000 air-photos, correspond to poorly defined tonal anomalies over an area of very limited outcrop. A corresponding vague tonal anomaly is visible on enhansed Landsat imagery.

Interpretations

There is no obvious relationship between bedding orientation and joint direction in Domain-A. The 060°-070° joint set is all-pervasive and independant of the changes in dip direction. Other joints parallel mesoscopic faults locally. Comparison of Figures 12 and 13 shows no similarity between photo-lineaments and joints measured in outcrop. Photo-lineaments are a function of dip direction.

The large thrusts visible on seismic sections suggest a southeast-northwest compressional regime. If the 060°-070° maximum of strikes of vertical joints represent tensional fractures ($sigma_3$), the theoretical direction of maximum horizontal compression ($sigma_1$) is 150°-160°. This is in agreement with the predicted southeast-northwest compressional regime. Shear fractures would be expected to strike 355°-010° and 120°-135°. The trends of photo-lineaments show corresponding maxima at 000°-010° and 110°-120°. Another photo-lineament maximum at 140°-150° is very close to the theoretical direction of tensional fractures parallel to $sigma_1$. Only the east-west trending photo-lineaments remain unexplained. These lineaments are restricted to the area just east of Byilkaoora-2 and correspond to the axis of the broad syncline. They may reflect basement irregularity.

The presence of locally abundant slickensides testifies to some fault movement in the north of Domain-A. Both near-vertical transcurrent faulting and concordant thrusting is involved, but appears to be only locally significant in outcrop. Possible thrusting from the SSW recorded at Sample Station 324 is not consistent with the thrusts visible on seismic sections; nor is it consistent with a southeast-northwest compressional regime.

DOMAINS B, C, D, E.

Domains B, C, D, and E occupy an area of approximately 35 m^2 of good outcrop at Sample Station 2. Each structural domain is characterized by different bedding orientations. Domains-B (Figure 14) and D have similar dip directions (235°-270°) (Figure 15) but dips in Domain-D are consistently steeper, up to 28°. Dip directions in Domains-C (Figure 16) and E are closer to those in Domain-A but range from 225° to 340°, dips range up to 30°.

Mesocopic Features

Joints

Jointing isn't particulary well developed in Domains-B, C, D and E. The strongest set of joints parallels the 060°-070° maximum recorded in Domain-A, while the strikes of others range from 003° to 130°.

Interpretations

The steeper dips, varying dip directions and joint orientations in Domains-B, C, D and E are probably related to local deformation associated with faulting. Sample Station 2 corresponds to an area of near-surface deformation visible on seismic line 85-0082 (Figure 2) between Shot Points 880 and 940.

DOMAIN-F

Domain-F is a structurally complex area of approximately 0.75 km^2 less than a kilometre to the west of Mt. Byilkaoora. The dip direction is variable from 090° in the east, through 185° to 085° in the west (Figure 17). A plot of the poles to bedding suggests a broad, near-horizontal fold (Figure 18). Domain-F is flanked by Domain-G to the southwest and northeast and Domain-A to the southeast.

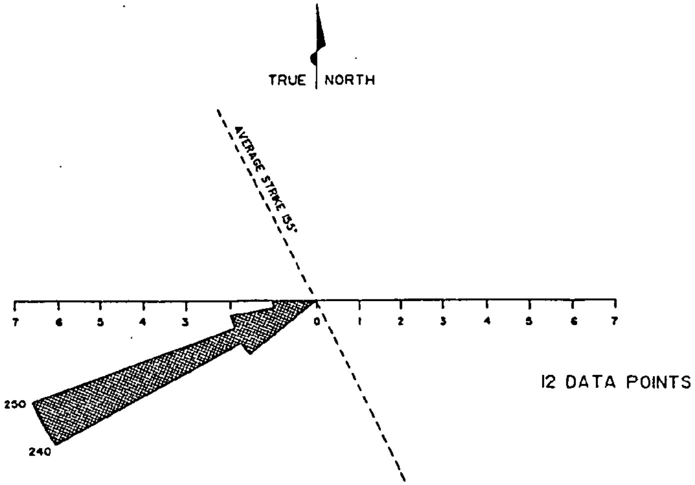


FIGURE 14. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 240°-250° IN DOMAIN-B. THIS CORRESPONDS TO A STRIKE OF 155°.

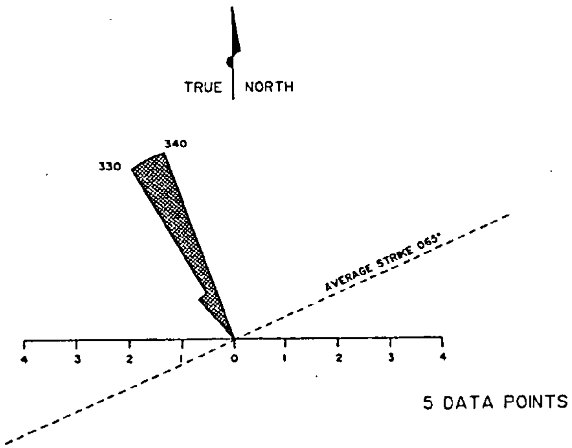


FIGURE 16. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 330°-340° IN DOMAIN-C. THIS CORRESPONDS TO A STRIKE OF 065°.

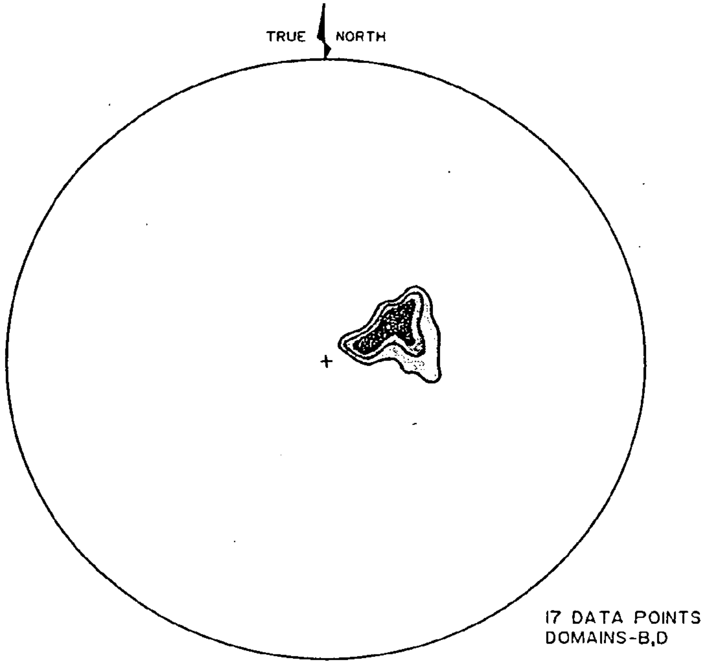


FIGURE 15. CONTOURED S-POLE DIAGRAM SHOWING DISTRIBUTION OF POLES TO BEDDING IN DOMAINS B AND D, SAMPLE STATION 2.
EQUAL AREA, LOWER-HEMISPHERE PROJECTION, CONTOURS AT 4, 8, 12% AREA, COUNTING CELL AREA 0.17.

Mesoscopic Features

Folds

A small broad anticline with the axis plunging 08° on 190° was recorded at Sample Station 50 in Domain-F.

Joints

Jointing is not particularly well expressed in outcrop; the few readings available are insufficient to comment on similarity, or otherwise, with other domains.

Macroscopic Features

Folds

Photo-interpretation shows a broad, near-horizontal anticline trending north-south through Domain-F and possibly extending further to the southeast.

Photo-lineaments

The photo-lineaments in Domain-F have modes in the 040°-050° and 100°-110° classes (Figure 19), this shows little similarity with trends of photo-lineaments from neighbouring Domain-G. The 100°-110° class is common to both Domain-F and Domain-A, however.

Interpretations

The photo-interpretation, plot of poles to bedding and the orientation of the mesoscopic anticline measured in outcrop are all in general agreement in defining Domain-F as a broad, near-horizontal anticline with an axial plane striking approximately north-south.

DOMAIN-G

Domain-G is a large structurally homogenous area to the northeast and southwest of Mt. Byilkaoora. Domain-G is flanked by Domain-A to the southeast and Domain-H to the northeast. Outcrop is patchy and consists mainly of ground level exposures in the west and erosion gullies in the east.

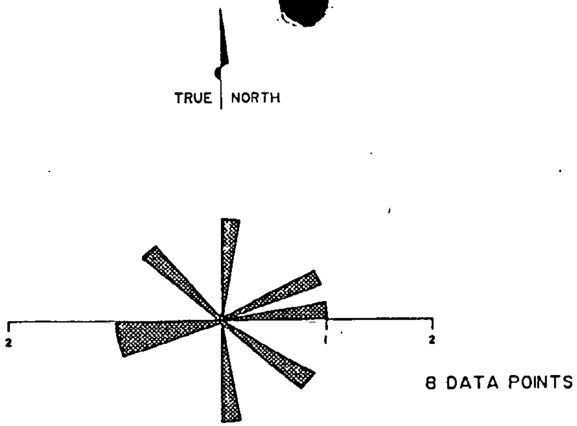


FIGURE 17. 360° ROSE DIAGRAM SHOWING DIP DIRECTIONS IN DOMAIN-F.

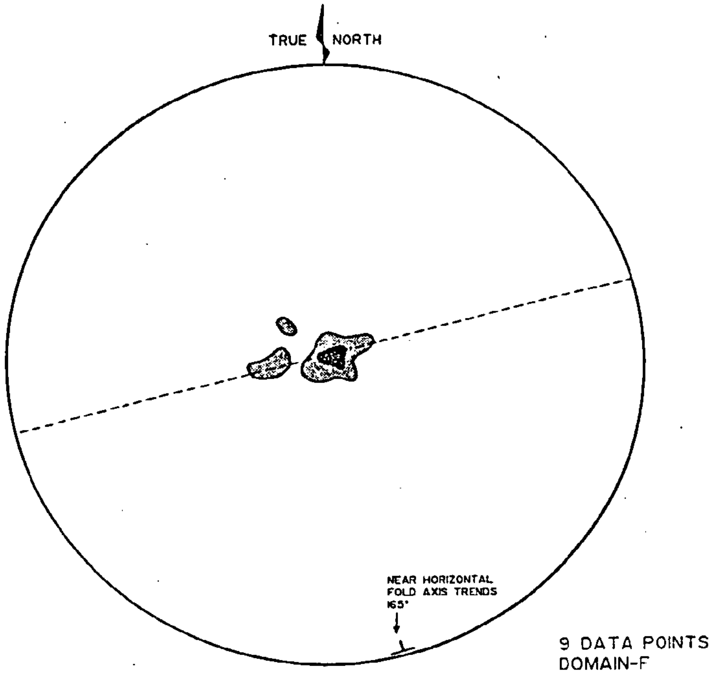


FIGURE 18. CONTOURED S-POLE DIAGRAM SHOWING BROAD, NEAR HORIZONTAL FOLD, WEST OF MT. BYILKAOORA.

EQUAL AREA, LOWER-HEMISPHERE PROJECTION, CONTOURS AT 8, 24 % AREA, COUNTING CELL AREA 0.17.

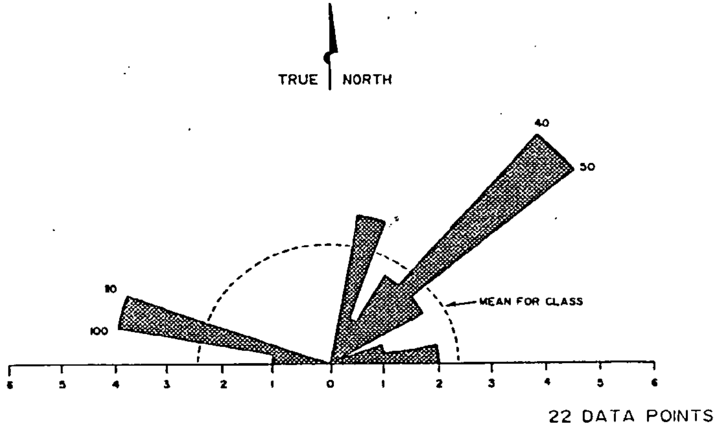


FIGURE 19. ROSE DIAGRAM SHOWING THE STRIKES OF PHOTO-LINEAMENTS, DOMAIN-F.

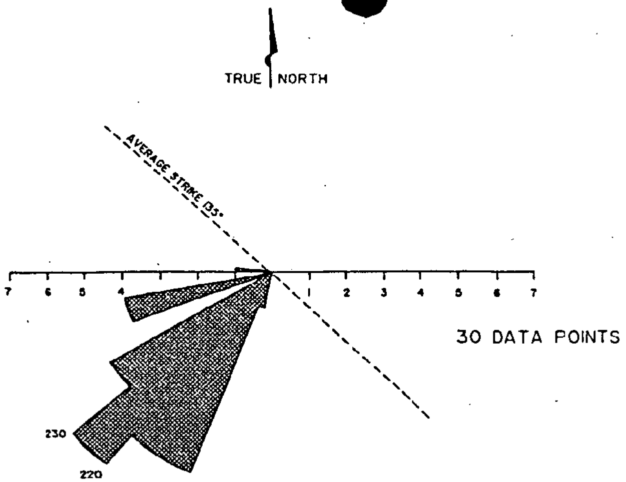


FIGURE 20. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 220°-230° IN DOMAIN-G. THIS CORRESPONDS TO A STRIKE OF 135°.

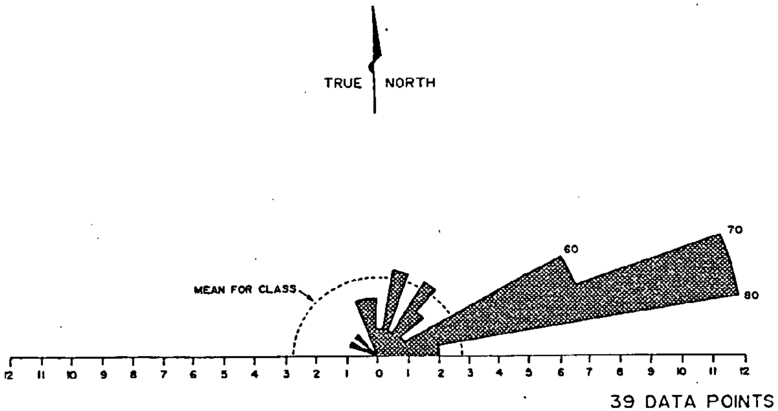


FIGURE 21. ROSE DIAGRAM SHOWING THE STRIKES OF VERTICAL JOINTS, DOMAIN-G, ADJACENT TO MT. BYILKAOORA. THERE IS A STRONG MODAL TREND IN THE 60°-80° CLASSES.

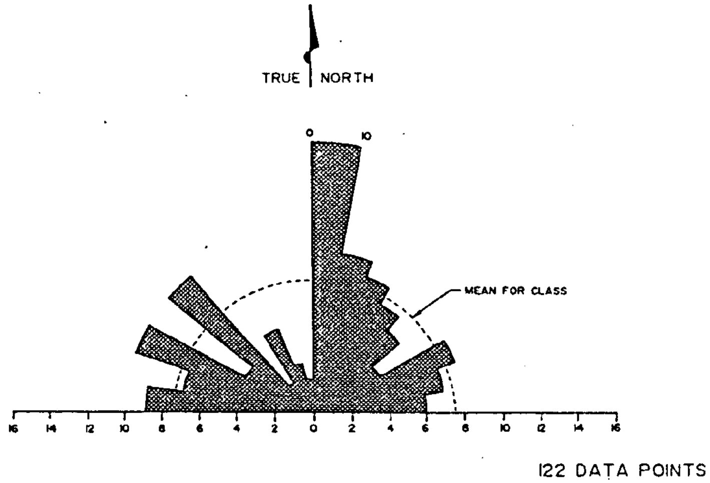


FIGURE 22. ROSE DIAGRAM SHOWING THE STRIKES OF PHOTO-LINEAMENTS, DOMAIN-G. THERE IS A STRONG MODAL TREND IN THE 0°-10° CLASS.

Dip directions are predominantly to the southwest with a modal dip direction of 220°-230° (Figure 20). Dips are generally less than 10°.

Mesoscopic Features

Slickensides

Slickensides were recorded in situ and in sandstone float in Domain-G. Examples from float at Sample Stations 329 and 330 are very similar to the nearby examples from Domain-A. The slickensides in situ at Sample Station 322 indicate a near-horizontal lateral movement on a bearing of 035°.

Joints

Jointing is predominantly vertical with a strong modal trend between 060° and 080° (Figure 21). This is similar to the joints in the neighbouring Domain-A.

Macroscopic Features

Folds

Air-photo interpretation shows Domain-G is the northern limb of a large, open syncline. Domain-A to the south occupies the other limb. Photo-interpretation suggests that the fold axis is gently curved, trending east-west and plunging less than 10° to the west.

Photo-lineaments

The rose diagram of strikes of photo-lineaments in Domain-G shows a strong modal trend in the 0°-010° class (Figure 22). This agrees with one of the subordinate photo-lineament trends recorded in Domain-A. The subordinate east-west to northeast-southwest trend in Domain-G agrees with one of the major photo-lineament directions in Domain-A. There is no direct correlation between photo-lineaments and joints measured on the ground.

The photo-lineaments recorded in Domain-G correspond to small gulleys in the more-disected topography in the east of the Domain and vague tonal anomalies in the west of the area. The lineament density is a function of outcrop and there is a significant difference between the lineaments recorded from air-photos with different sun angles.

Interpretations

There is no obvious relationship between bedding orientation and joint direction in Domain-G. The 060°-080° joint set parallels that in Domain-A and suggests a similar structural history with a southeast-northwest compressional regime. If the maxima of strikes of vertical joints represent $sigma_3$ tensional fractures as they appear to in Domain-A, the theoretical direction of maxium horizontal compression ($sigma_1$) is 150°-170°. This is in agreement with the predicted southeast-northwest compressional regime. Shear fractures would be expected to strike 355°-020° and 120°-145°. Photo-lineaments show maxima at 0°-010° which falls within the predicted range of 355°-020°. Over 20 percent of the recorded photo-lineaments also fall into the predicted 120°-145° range.

The presence of slickensides testifies to some fault movement in Domain-G; the near-horizontal in situ slickensides suggest lateral thrusting at 035° which is not consistent with a northwest-southeast compressional regime.

DOMAIN-H

Domain-H occupies an area of approximately 9 km² northeast of Mt. Byilkaoora, in the north of the study area. Outcrop is generally good with low cliff exposures and partly silicified outcrop at ground level. Domain-H is flanked by Domains-A, G, I and J to the south. The dip direction ranges from 200° to 230° (Figure 23), giving an average strike of 122°. The modal dip is 10°.

Mesoscopic Features

Faults and Folds

A mesoscopic anticline at Sample Station 348 appears to be associated with a fault. The axis of the fold trends almost due north-south and plunges to the south about 30°.

Joints

The majority of mesoscopic joints in Domain-H are vertical with strikes between 070°-080° and 160°-180° (Figure 24). The 070°-080° set is common to neighbouring Domains-A, G, I and J. The 160°-180° set is also present in Domains I and J but absent from A and G.

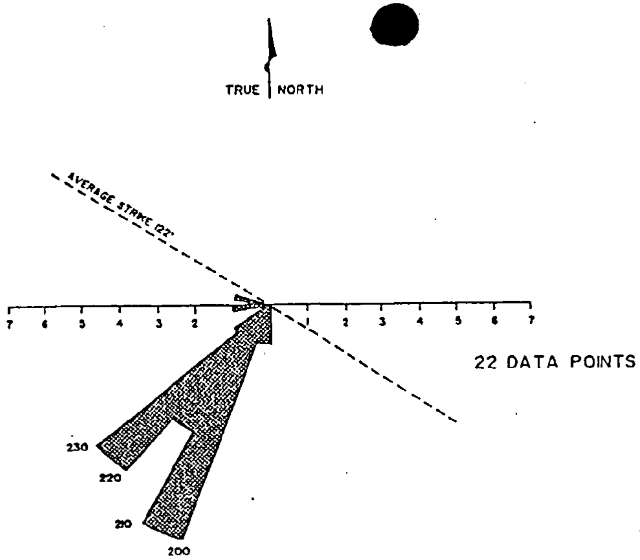


FIGURE 23. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 200°-230° IN DOMAIN-H. THIS CORRESPONDS TO A STRIKE OF 122°.

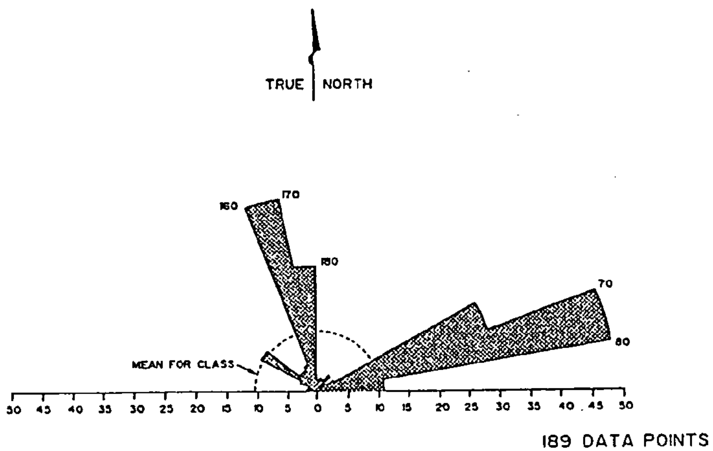


FIGURE 24. ROSE DIAGRAM SHOWING THE STRIKES OF VERTICAL JOINTS, DOMAIN-H, NORTHEAST OF MT. BYILKAOORA. THERE ARE STRONG MODAL TRENDS IN THE 70°-80° AND 160°-180° CLASSES.

000067

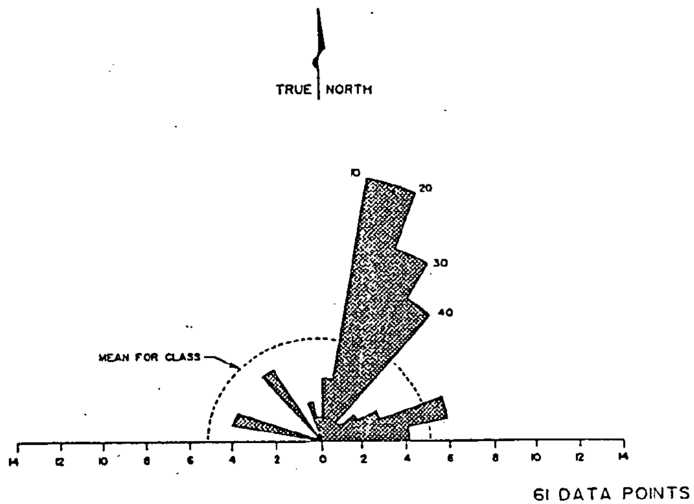


FIGURE 25. ROSE DIAGRAM SHOWING THE STRIKES OF PHOTO-LINEAMENTS, DOMAIN-H.

Macroscopic Features

Photo-lineaments

The photo-lineaments in Domain-H correspond to clefts and gulleys in low cliffs and linear tonal anomalies in areas of less relief. There is a marked difference in the lineaments recorded from photos with differing sun angles. The maxima at 010°-040° (Figure 25) has no direct relationship with the orientation of joints measured on the ground. It suggests that the photo-lineaments correspond to the acute bisectrix of the joint directions. The photo-lineaments recorded in Domain-H are also significantly different from those in the neighbouring domains.

Interpretations

The similarities in joint direction (070°-080°) (160°-180°) to the neighbouring domains suggests a broadly similar structural history to Domains-I and J. The joints in Domain-H include one set common to all neighbouring domains. This, and the southwesterly dip, indicate that Domain-H occupies the northeastern limb of the same broad syncline as Domains-A and G. The relationship between mesoscopic joints and photo-lineaments in Domain-H may indicate that the two populations of mesoscopic joints correspond to $sigma_1$ (160°-180°) and $sigma_3$ (070°-080°) tensional fractures, while the photo-lineaments represent shear fractures within the predicted range of 25°-30° to $sigma_1$.

DOMAIN-I

Domain-I occupies a small area to the northeast of drillhole Byilkaoora-1. Outcrop is good with terraced cliff exposures totalling up to 35 m relief. Domain-I is bordered by Domain-H to the north and Domain-J to the southwest. The modal dip direction of 210°-220° (Figure 26) is similar to Domain-H, dips in Domain-I are generally steeper with a modal dip of 12°.

Mesoscopic Features

Joints

Vertical jointing is particularly well expressed in Domain-I (Figure 27). Jointing is obviously more intense in the sandstone cliffs of Domain-I than in similar outcrop in Domain-H. The joints show strong modal trends in the 070°-080° and

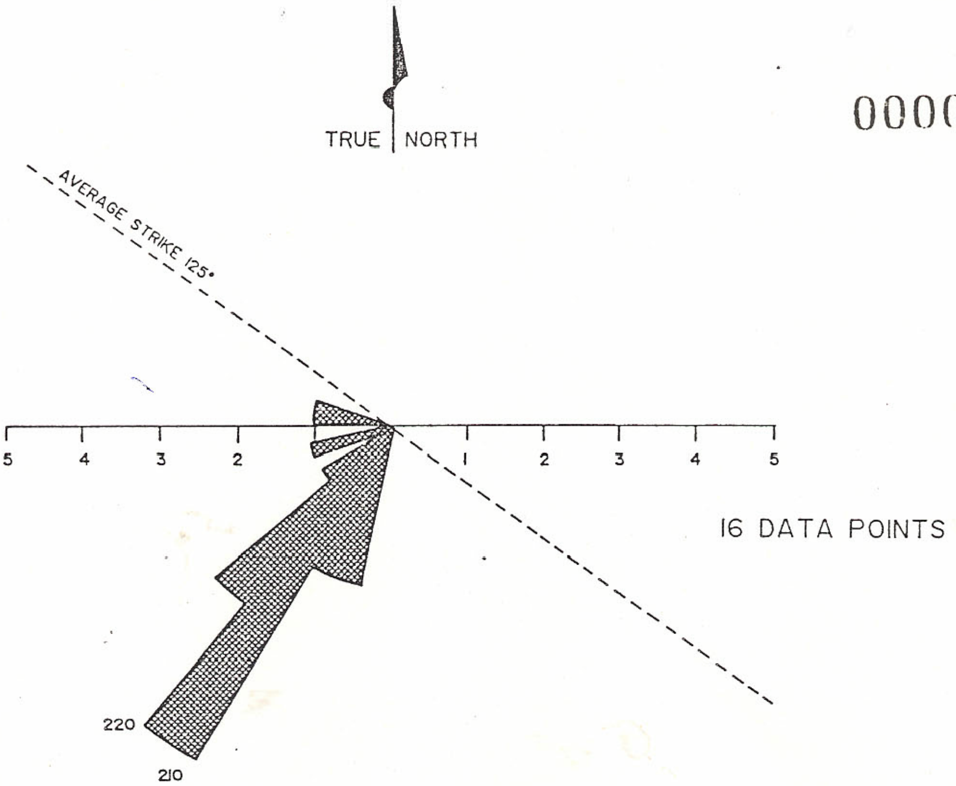


FIGURE 26. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 210°-220° IN DOMAIN-I. THIS CORRESPONDS TO A STRIKE OF 125°.

FIGURE 27. PROMINENT JOINTING IN SANDSTONE OUTCROP, SAMPLE STATION 278.

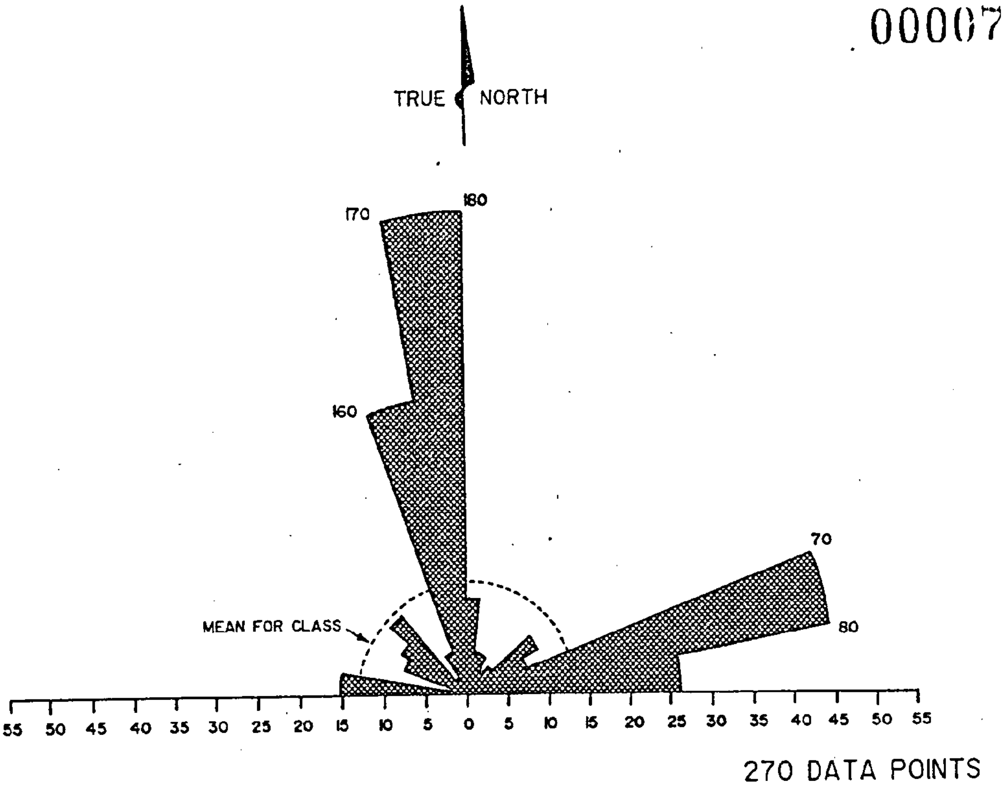


FIGURE 28. ROSE DIAGRAM SHOWING THE STRIKES OF VERTICAL JOINTS, DOMAIN-I, EAST OF MT. BYILKAOORA. THERE ARE STRONG MODAL TRENDS IN THE 70°-80° AND 160°-180° CLASSES.

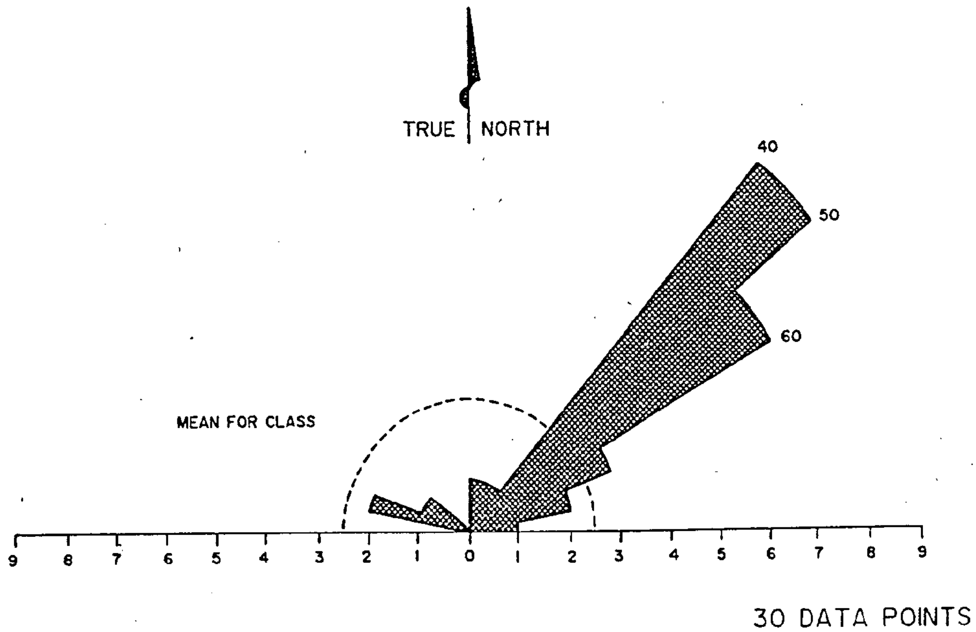


FIGURE 29. ROSE DIAGRAM OF STRIKES OF PHOTO-LINEAMENTS, DOMAIN-I. THERE IS A STRONG MODAL TREND IN THE 40°-60° CLASSES.

160°-180° classes (Figure 28). This is identical to the neighbouring Domain-H. The 160°-180° set is also present in Domain-J.

Photo-lineaments

The photo-lineaments in Domain-I show a strong modal trend in the 040°-060° class (Figure 29). This is similar to Domain-J but significantly different from Domain-H.

Interpretations

Domain-I obviously shares a similar tectonic history with the neighbouring Domains-H and J. The dip direction opposes that in Domain-J and indicates that Domain-I represents the northeastern limb of a small southeast-northwest trending syncline. This interpretation is supported by air-photo interpretation by Hunting (1986).

DOMAIN-J

Domain-J is an area of approximately 0.75 km^2 at the NNW end of seismic line 85-0096. It is flanked by Domain-A to the southwest and Domain-I to the northeast. Outcrop is poor, consisting mainly of partly silicified bedding surfaces exposed at ground level. The few dip and strike measurements available show dip directions of 045°-055° (Figure 30) with dips ranging up to 030°. These dips oppose those in the neighbouring Domain-I.

Mesoscopic Features
Faults and folds

A possible fault and associated small scale folding was recorded from Sample Station 301 in Domain-J. The fault strikes approximately 008°; it was not possible to obtain accurate orientations on the folds.

Joints

The strikes of vertical joints in Domain-J are shown on Figure 31. There does not seem to be any one preferred orientation. One set of joints is parallel to the fault striking 008°, while another set at 070°-080° is on a similar strike to

000072

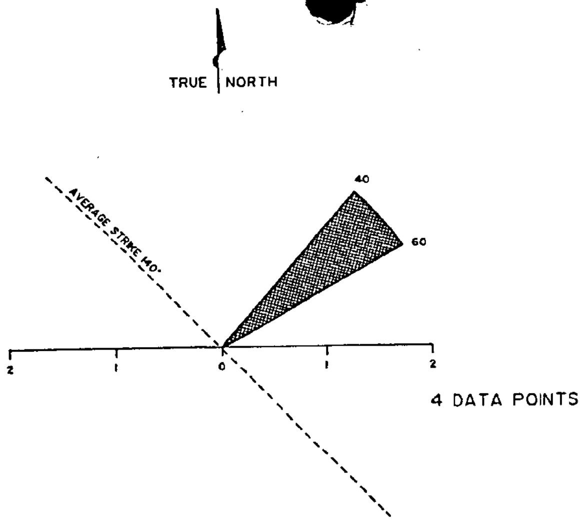


FIGURE 30. 360° ROSE DIAGRAM SHOWING A MODAL DIP DIRECTION OF 40°-60° IN DOMAIN-J. THIS CORRESPONDS TO A STRIKE OF 140°.

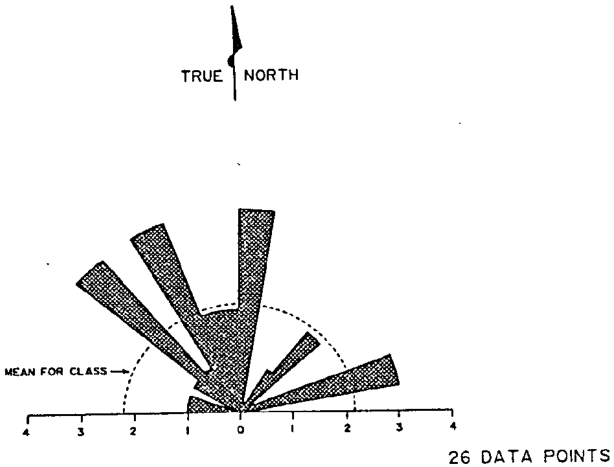


FIGURE 31. ROSE DIAGRAM SHOWING THE STRIKES OF VERTICAL JOINTS, DOMAIN-J, NORTH OF THE CONTINUATION OF LINE 85-0096.

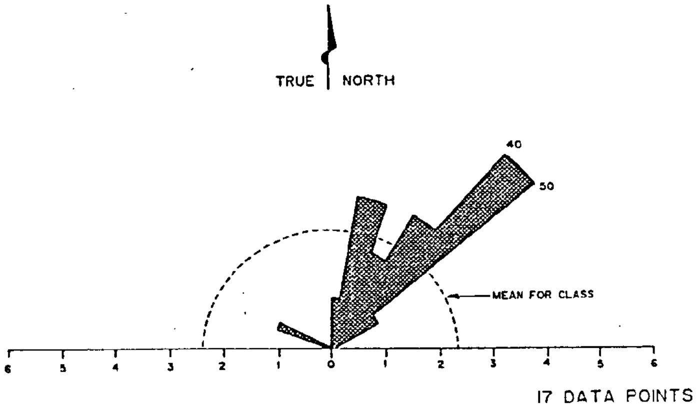


FIGURE 32. ROSE DIAGRAM SHOWING THE STRIKES OF PHOTO-LINEAMENTS, DOMAIN-J.

some joints from the neighbouring Domain-I. The 060°-070° joint trend which is expressed so strongly in Domain-A to the southwest is absent in Domain-J.

Macroscopic Features

Photo-lineaments

Almost all the photo-lineaments recorded from Domain-J strike northeast-southwest with a maximum at 040°-050° (Figure 32). This bears no similarity to the distribution of joints measured on the ground, but suggests that the majority of lineaments identified are orthogonal to strike. The 040°-050° lineament maximum in Domain-J agrees with that of Domain-I to the northeast but is significantly different from the trends seen in Domain-A.

Interpretations

Domain-J represents the southwestern limb of a southeast-northwest trending syncline. In terms of faulting, jointing and trends of photo-lineaments, Domain-J has little similarity with Domain-A. Since Domain-J has not inherited a structural similarity with Domain-A, the syncline of which Domain-J is a part is not simply a second generation of deformation cross-folding Domain-A.

Synthesis

This study of the structural geology of the southern portion of the Mt. Johns Range incorporates data from field mapping, Comalco seismic sections and detailed air-photo interpretation. These data are used to define potential fracture fairways and structural traps in the Observatory Hill Formation in the Mt. Byilkaoora area of PEL 30.

Early work by Kreig (1973) and Benbow (1982) described the Mt. Johns Range as a "very gentle west plunging syncline with a prominent east and north margin." A plot of over 240 data points (Figure 33) from the southern end of the range, in the vicinity of Mt. Byilkaoora shows a poorly defined, broad, shallowly plunging fold with a fold axis trending approximately east-west.

Seismic data shows that the broad-scale, subsurface structure of the Mt. Johns Range is controlled by anastomosing, shallowly-dipping, northeast-southwest trending listric thrust faults. The southern portion of the range is the surface expression of single thrust block. Existing seismic data from the study area shows only very gentle folding in the form of a syncline in the vicinity of drillhole Byilkaoora-2.

Field mapping showed that mesoscopic folds and, in some cases, joint direction are related to small-scale faulting. Locally abundant slickensides confirm that at least some fault movement was at a very low angle to bedding. The majority of joints are vertical and their density is a function of outcrop. There is no direct relationship between mesoscopic joints measured in outcrop and photo-lineaments. If the joints are interpreted as tensional fractures (parallel to $sigma_3$), the photo-lineaments in the same area correspond to the theoretical directions of shear fractures (25°-30° to $sigma_1$) and tensional fractures (parallel to $sigma_1$). Photo-lineaments were found to be a function of sun angle over approximately 25 percent of the study area.

Based on field mapping, ten structurally homogenous Domains (A-J) (Table 34, Figure 35) were defined within the study area to the east, southeast and south of Mt. Byilkaoora. Domains A and G correspond to the limbs of a large broad syncline, the axis of which is gently curved, trending almost directly east-west, plunging at less than 10° to the west, and probably passing within a few hundred metres of drillhole Byilkaoora-2. This interpretation is confirmed by air-photo studies and seismic interpretations. Domains B, C, D and E represent a small area of local fault-related deformation. Domain F is a small area of approximately 0.75 km^2 less than a kilometre to the west of Mt. Byilkaoora which represents a broad, near-horizontal anticline with a north-south trending fold axis. Domains I and J correspond to the limbs of a small southeast-northwest trending syncline north of Byilkaoora-1. Domains G, H and the northern section of Domain A define a syncline which extends from Mt. Byilkaoora northeasterly to Domain J.

Implications for Petroleum Prospectivity

This structural interpretation was undertaken to assist in the assessment of the petroleum prospectivity of the Observatory Hill Formation in the Mt. Byilkaoora area of PEL 30. Specifically, to confirm the presence and orientation of a syncline in the vicinity of drillhole Byilkaoora-2 which intersected oil bleeds in the Observatory Hill Formation (Appendix 3) and to ascertain if a fracture fairway was associated with the syncline axis. Additionally, it was hoped to identify further structural traps in the Byilkaoora area.

The data indicate that:

i) a broad syncline, incorporating Domains A and G extends roughly east-west probably passing within a few hundred metres north of drillhole Byilkaoora-2. Air photo interpretation shows a set of lineaments which roughly correspond to the postulated fold axis. The lack of outcrop in this critical area makes it impossible to confirm the existence of a fracture fairway,

ii) the postulated synclinal axis can be traced less than 3.5 km, and assuming that the most prospective zone must be closer to the fold axis than drillhole Byilkaoora-2, a total area of just over two square kilometres of the syncline axis in PEL 30 is considered prospective,

iii) there is no data on the tightness of folding away from seismic line 85-0082; it is suggested that the syncline becomes broader to the east, further reducing the prospective area.

The small anticline defined in Domain F and the small syncline defined by Domains I and J are not considered prospective as structural or fracture plays because of the small areal extent and because the Observatory Hill Formation subcrops or is very shallow.

The broad syncline postulated between Domains G, H and A is not considered prospective because the gentle degree of flexure would not have enhanced any fracturing and the Observatory Hill Formation is very shallow over much of the area.

Field mapping and detailed airphoto interpretation failed to identify any further suitable structural or fracture plays within the Observatory Hill Formation in this portion of PEL30. Seismic interpretations of the area have not been finalized and the presence of the Rodda beds in Domains other than Domain A remains problematical.

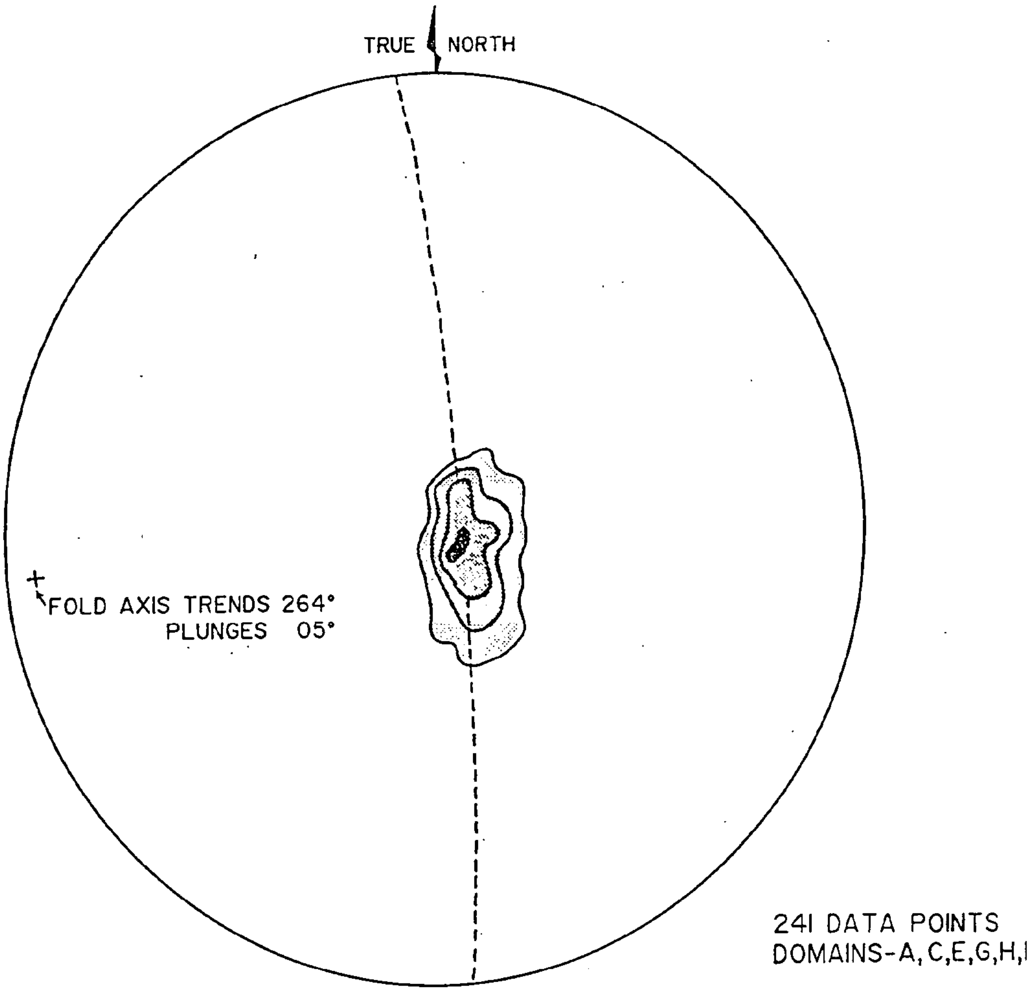


FIGURE 33. S-POLE DIAGRAM SHOWING A BROAD, POORLY DEFINED, SHALLOWLY PLUNGING FOLD WITH FOLD AXIS TRENDING APPROXIMATELY EAST-WEST, OVERALL STUDY AREA.
EQUAL AREA, LOWER-HEMISPHERE PROJECTION, CONTOURS AT 2, 4, 8, 12% AREA, COUNTING CELL AREA 0.17.

Structural Domain	Modal Dip	Modal Dip Direction	Average Strike of Bedding	Strikes of Most Abundant Vertical Joints	Major Photo-lineament Trends	Structural Regime and Cause of Deformation
A	06° (174)	310°-320° (174)	045°	060°-070° (297)	090°-100° 110°-120° 140°-150° (330)	Southeastern limb of large, broad syncline
B	12° (12)	240°-250° (12)	155°	003°, 060° (2)	-	)
C	12° (5)	330°-340° (5)	065°	-	-	) Small area of structural deformation at Sample Station 2, possibly fault related
D	22° (5)	230°-240° 260°-270° (5)	-	025°, 037°, 130° (3)	-	)
E	26° (3)	225°-325° (3)	-	055°, 075° (2)	-	)
F	-------VARIABLE------- (8)		-	050°, 090°, 165° (3)	040°-050° 100°-110° (22)	Small, broad near horizontal anticline, fold axis trends approximately N-S
G	07° (30)	220°-230° (30)	135°	060°-080° (39)	0°-010° (122)	Northwestern limb of large, broad syncline
H	10° (22)	200°-230° (22)	122°	070°-080° 160°-180° (189)	010°-040° (61)	Northeastern limb of large, broad syncline
I	12° (16)	210°-220° (16)	125°	070°-080° 160°-180° (270)	040°-060° (30)	Northeastern limb of syncline north of Byilkaoora-1
J	25° (4)	040°-060° (4)	140°	0°-010° 130°-140° 150°-160° (26)	040°-050° (17)	Southwestern limb of syncline north of Byilkaoora-1

Table 34: Summary of structural data for various structural domains, overall study area

(The number of readings is shown in brackets)

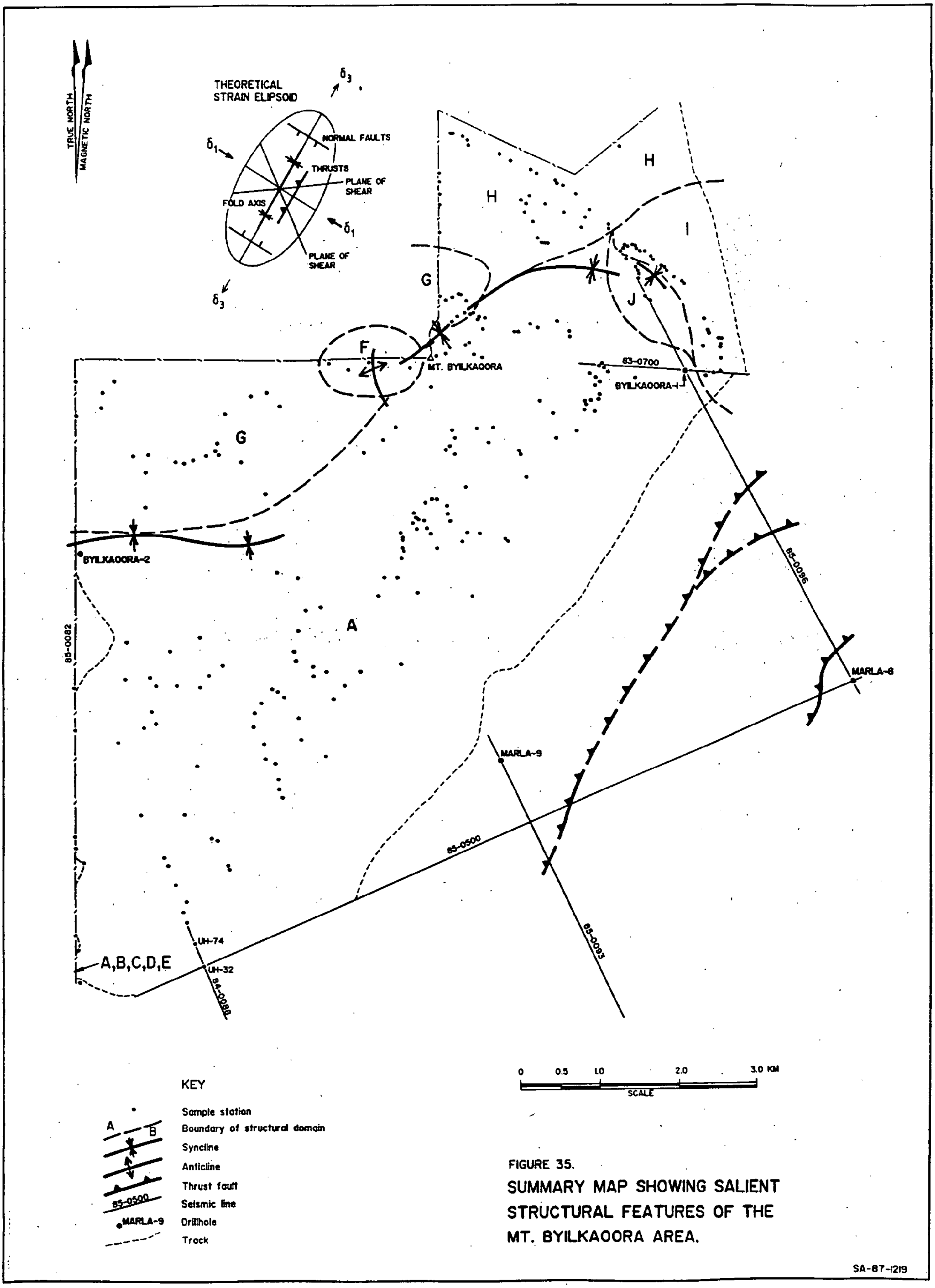


FIGURE 35.

SUMMARY MAP SHOWING SALIENT STRUCTURAL FEATURES OF THE MT. BYILKAOORA AREA.

SA-87-1219

References

Benbow, M.C., 1982. Stratigraphy of the Cambrian - ?Early Ordovician, Mount Johns Range, NE Officer Basin, South Australia. Trans. R. Soc. S. Aust., 106, 191-211.

Brewer, A.M.; Dunster, J.N.; Gatehouse, C.G.; Henry, R.L.; and Weste, G. 1987. A revision to the stratigraphy of the eastern Officer Basin. Quarterly Geological Notes of the Geological Survey of South Australia, 102, 1-15.

Hunting Geology and Geophysics, 1986. Unpublished report to Comalco.

Krieg, G.W., 1973. Everard, South Australia 1:250,000 Geological Series, Explanatory Notes. Sheet SG/53-13. Geol. Surv. S. Aust.

APPENDIX I

FIELD MEASUREMENTS
(Data corrected to true North)

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
1	13/325	10/325	53/160	68/130	
	14/340	14/345	075	75/070	
	13/320	13/325	55/155	68/125	
	12/332		335	78/155	
			75/170		
2 domain A	20/343	22/345			
	18/335	25/275			
	12/335				
2 domain B	10/256	10/245	183	060	
	18/265	28/235			
	26/235	22/245			
	28/255	12/245			
	12/245	12/247			
	12/249	28/243			
2 domain C	12/340	12/325			
	18/335	22/340			
	30/339				
2 domain D	28/285	20/265	025	130	
	22/235	22/237	037		
	26/270				
2 domain E	16/325	26/240	075	75/165	
	26/225		235		

000083

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
3	12/345	09/340	035	075	
	08/295	13/260	045	033	
	08/305		040	320	
			125	125	
			060	058	
			056	059	
			168	033	
4	nil - sample only				
5	10/310	10/345	70/175	060	
	08/325	07/315	025	075	
	04/330		355	075	
	10/005	10/354	85/240		
	20/320	16/340	080	080	
	26/330	24/327	075	077	
	12/350	10/335	080	073	
	15/355	10/355	063	070	
	11/325	10/035	060	060	
	18/046	25/003	055	020	
	28/004		070	075	
			058		
6	06/315	15/345	080	050	
			070		
7			060-075	145	
8			295-315	355	
9	10/210	05/215	300	035	
	09/213		130		

000084

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
10	05/235	08/205	290-300 315	035	
11	21/345	20/335	350		
12	10/335	09/335	065-070 83/155	340 88/165	soft sed fold? plunge 08/340 axial plane 83/087
13	15/315				
14	nil				
15	09/297		69/135	75/188	
16	27/315 20/300	20/320 27/305	70/125 315 84/045	050 055-075 68/145	
17	12/310		307	69/125	
18	12/335	15/325	060	330	
19	17/315	15/315	080 090	345 355	
20	22/345		86/345	80/085	
21	10/320	15/315			
22			045		
23			070		

000085

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
24	06/335 14/305	05/320 08/295	070	79/165	
25	13/330				
26	07/290		050-070 73/060	325	
27	08/250				
28	09/237		295		
29	11/295	09/305	325	055	
30	15/325		050-055		
31	12/315		060		
32	10/295		320		
33	10/305		050		
34	20/323		075		
35	10/295		345	075	
36	10/317		075	070	
37	13/315		065	305	
38	12/275		025 005	075	
39	08/275		010	80/105	

000086

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
40	07/305		83/135		
41			030		
42	12/320		030-045		
43	12/345				
44	10/325		035-045		
45	06/315		037 090	305	
46	02/285 near horizontal low dip to 325	05/315	035	090	
47	nil				
48			075	355	
49	16/085				
50	09/070	12/130 11/260	090	345	gentle fold or warp axis plunges 08/190
51	04/255 02/005 near horizontal	04/310	050		
52	04/175				
53	06/235		075	005	

000087

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
54	04/285 near horizontal				
55	07/340				
56	06/350				
57	09/255		060	300	
58	02/225	04/205	070		
59	04/235 dip to 225		310	020 035	
60	13/340	15/335	355		
61	08/310		065	345	
62	07/350		025	300-305	
63			80/105		
64	13/315	11/321	015		
65	nil				
66	18/330		075		
67	12/325		84/165 075	345	
68	10/321		075	335-355	

000088

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
69	10/315		080	345	
70	10/335		080		
71	08/225	07/217	300	025	
72			080	350-005	
73	06/225		070	345	
74	09/230		325	040	
75	06/225		325	050	
76	08/215		320		
77	07/220		320	040	
78	05/235			015	
79			325	050	
80	04/240		070 320	040	
81	07/260		320		
82	07/235	09/225	340 080 015	080 330	
83			350		

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
84	07/210	06/195	080-085	015	
85	06/200		080		
86	nil				
87	07/200		075	325	
	shallow dip to 205				
88			329	065	
89	gentle dip to 225		315-325	070	
90	06/235				

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION 000090
201	nil - sample only				
202	19/315	24/313			
	16/311	16/326			
	16/310				
203	28/311	24/312			
204	11/310	16/327			
	10/350	07/345			
	06/348				
205	14/305		045	088	
			006		
206	06/004	16/341	063	075	cliff forming joints
	06/349		067	068	
			063	062	
			060	073	
			070	083	
			015	013	
207	12/349	20/350	046	069	cliff forming joints
	21/345	?06/343	067	067	
	15/346	10/343	067	073	
			073	010	
			002		
208	nil - sample only				
209	?05/275	13/338	325	070	many curved joints
	08/350	07/328			

000091

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
210	nil - sample only				
211			020 120 123 107 121	063 065 125 119	strongly jointed area of subsidence
212	14/348	15/353			
213	13/335	11/337			
214	10/335				
215	15/336				
216	06/337	08/340			
217	10/333	09/336	047 047	046 045	cliff forming joints
218			065		
219	06/315	08/317			
220			055		slickensides in float
221	27/045	26/041	055		fault induced deformation strongly jointed on 055
222	nil - sample only				
223	06/325		050 043	047 037	cliff forming joints strike 050

000092

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
224			043 044 045	047 043	
225			045		
226	03/305		315		
227	04/347				
228	?10/305		335		
229	06/345				
230			035 039	041 037	
231	06/305	04/307			
232	06/297 05/308	06/306			
233	04/313	06/315	068		
234			069 007 068 043	005 068 070	
235	?05/305		087	072	

000093

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
236			067	015	
			069	066	
			065	065	
			058	067	
			087	078	
			015		
237	?05/305				slickensides in float
238	04/307	03/305			
	10/302				
239					slickensides in float
240			073	067	
			070	065	
			068	066	
			068	060	
			012	083	
			015	077	
241	06/280?				
242	04/333		068		
243	<10/294	06/288			
244	04/313?				
245	04/315				
246	04/315	04/313			
	03/311				

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION 000094
247	sample only				
248					small fault strikes 050, shear zone 10 cm wide with obvious dissimilarity of rocks on either side
249	03/285?	05/335?	355	039	
250	04/290	05/275			
251	06/345				
252			033	087	
253	04/305		195 095	093	
254			055	053	
255			325 055	050 053	
256			330		
257					possible fault induced deformation, very poor outcrop
258	? dip to north				
259	06/295		085 087 085	088 085	well developed cliff forming joints
260			080	013	

000095

SAMPLE STATION	BEDDING (dip and dip direction)	JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
261		065 068	087	
262	? dip to north	130 067 073	015 013	
263		083 053	055	
264		077	133	
265		055	083	
266		063		
267		063 057 057	067 058 075	
268		055 051	053 135	
269	? dip to north	063		
270				slickensides in float
271		060 143	061 155	
272		100	025	

000096

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
273	09/220 11/215	12/215	035 115 155 080 115	033 123 077 080	
274	12/200 13/200	11/221	077 083 077 175 170	047 110 073 160	
275			170 169 123 081 083	173 079 073 169 169	
276			133 173 128 083 031 168 173 169 133 081	131 123 081 171 173 073 167 078 077	

000097

SAMPLE STATION	BEDDING (dip and dip direction)	JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
277	11/215	077	083	
		133	083	
		036	047	
		181	128	
		174	109	
		169	173	
		170	167	
278	09/230	169	161	
		179	175	
		170	180	
		089	087	
		178	077	
		178	089	
		125	081	
		123		
279		170	086	
		132	078	
		080	177	
		136	193	
		119	177	
		084	166	
		074	116	
		077		
280		165	078	
		169	177	
		081	061	
		067	175	
		082	079	

000095

SAMPLE STATION	BEDDING (dip and dip direction)	JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
292		173	174	
		062	047	
		184	153	
		169	096	
293	08/225	180	067	
294		173	075	
		079	176	
295		061	057	
		159		
296		123	063	
		059	013	
		061	131	
		143	061	
		113	059	
		064	013	
		059		
297		183	123	
		053	073	
		091	123	
		013		
298		013	121	
		060	083	
		183	073	
299	nil - sample only			
300	18/045			

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
301	30/053 25/045	28/055	074 066	133	possible small fault strikes 008, possible folds
302			043		
303	? dip to SSE				
304			134 023	083 173	
305	03/290?				
306	12/277 14/288	08/280			
307	15/283?				possible slickensides in float
308					slickensides in float
309					abundant slickensides in float
310			181	073	also curved joints
311					slickensides in float
312	04/315 03/300	04/305	027 151 010 139 058 183 175 009	147 169 063 103 059 163 185	

000100

SAMPLE STATION	BEDDING (dip and dip direction)	JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
313	03/315	048 155 160	063 122	gentle folding
314		157		
315	? /260	131	048	
316	<05/340	082 077	083	
317	04/305?	165		slickensides in situ on near vertical fault, striations show SW block moved laterally with with slight down throw to NW
318	10/285	127	135	
319	14/315	041 122 041 045	131 134 129	
320	12/273	129 129 132 130	131 033 041	ferruginization parallel to 129 joint set
321		133		slickensides in float
322		035	153	slickensides in situ indicate lateral movement on 035
323				slickensides in float

000101

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
324			071	060	slickensides <u>in situ</u> strike 023, 016 dip slightly to S; ferruginized near vertical joints
			178	070	
			164	161	
325			161	183	
			180		
326			075	077	
327	08/?255	07/253	163	173	
			163	077	
			178	077	
			081	079	
			079		
328			072	116	
			133	148	
329			068		possible slickensides in float; ferruginized joints
330					abundant slickensides in float
331	08/278				
332	nil - sample only				nodular cherts as float
333	13/220		119	033	
			077	077	
334			081	097	also gently curved joints at 015
			015		

000102

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
335	?10/201	?12/215	137 139	013 123	
336			108	121	
337	? /207		079 122	067	
338			083	162	
339			071 163 171	167 183	also abundant curved joints
340			070 143 067	173 053 079	
341	? /185?				
342			116 068 153 068 065	138 159 063 067	
343	? /210?		068 067	148 139	
344			068 069	069	

000103

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
345	09/200		067	067	
			068	063	
			147	067	
			070	067	
346			069	069	
			149	163	
			135	151	
			070		
347	? /197		073	072	
			149	070	
			073	073	
			179		
348	? /200		183	173	possible anticline associated with fault in gulley; axis of fold tends almost due N-S and plunges to south about 30°.
			068	177	
			070	077	
			069	031	
			068	171	
349			073	171	
			167	073	
			164	177	
			067	174	
			076	079	
350	12/203	12/220	071	081	
			069	121	
			121	173	
			070	079	
			072		

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
351			168	079	
			171	169	
			077	169	
			077	077	
			068	067	
			073	069	
352			078	169	
			082	073	
			128	176	
			081	174	
			076	167	
			081	171	
			082	129	
353	? /215		163	169	
			081	171	
			171	078	
354			078	170	
			171	168	
355	12/230		079	168	
			168	077	
			123		
356	10/225	08/227	165	169	
			077	123	
357	09/221		079	172	
			078	168	
			167	055	
			170		

000105

SAMPLE STATION	BEDDING (dip and dip direction)		JOINTING (strike of vertical joints or dip and dip direction)		STRUCTURAL DEFORMATION
358	06/209		073	148	
			080	077	
			163	074	
			078	079	
359			130	077	
			173	174	
			164	084	
			076	173	
			067	169	
			085	169	
360	10/225?		040	037	
			067	078	
361	?16/213		065	114	
362	08/222	06/222	079	013	
			078	123	
			165	167	
363			078	077	
			087	173	
			172	170	
			015		
364	10/285?				
365	12/267		078	059	
			168	075	
366			078	076	
			097	123	
			167	165	
			163	023	
			168		

APPENDIX 2

MAPS COMPILED BY HUNTING GEOLOGY AND GEOPHYSICS (1986)

Hunting Geology and Geophysics (Australia) Pty. Limited

000107

Integrated Interpretation of Imagery, Aerial Photography and Geophysical Data
Applied Geomorphology in Association with Partridge, de Villiers and Associates

Hunting

Postal Address: P.O. Box 365, Fyshwick, A.C.T. 2609
Business Address: CentreCourt, 1 Pirie Street, Fyshwick, A.C.T. 2609
Telephone (062) 80 4277
Telex 62677
Telegrams: Astereo Canberra

Our Ref. MMC/dh/170/86
Project No. 55/86

7th November, 1986.

Mr. Bob Henry,
Comalco Aluminium Limited,
The Annexe - A.M.F.,
63 Conyngham Street,
GLENSIDE, S.A.

Dear Bob,

re: EVERARD PHOTOGEOLOGICAL STUDY

This letter is a preliminary report describing the detailed photogeological interpretation of eight colour photo enlargements at 1:42,000 scale. Particular attention has been given to structural data, e.g: attitude of beds, folding, lensing out, and dips. Attempts to measure the dips using a parallax bar have not been successful on these enlarged photographs. However, work is continuing using the unenlarged photographs and will be submitted at a later date.

Specific points may be highlighted to help the ground mapping programme:

(i) The sequence includes some beds which lens out, in particular unit 4. This brings into contact units 3 and 5 and may reflect a disconformity.

(ii) Unit 7 forms extremely good outcrops in the NW part of the study (near photo centre 040); further south however the unit disappears beneath sandy soil. The lack of bedding traces enables it to be inferred throughout much of the study area.

(iii) A significant fault zone or monocline trending NNE occurs in the western part of photograph No. 045, but its relationship with the overall structure is still obscure.

(iv) A number of discrete anticlinal ridges and dome structures have been identified in the NW and SE parts of the study area.

(v) Unit 8 (near the centre of photo 040 in the NW of the area) has been subdivided into three sub-units: a, b, c, on the basis of photo tone and expression to help the structure in this area.

(vi) The main fractures/faults trend dominantly ENE to NE. Some of these may be complex and merge with soft units, i.e. near photo centre 044 along unit 4, as indicated by bedding dip changes on either side. The alternative interpretation is that these bedding dip changes imply a disconformity.

(vii) The overall shape of the basin suggests a dissymmetrical geometry with considerably more thickness in the E than in the W, where large strike faults occur.

We trust the foregoing will be of assistance to your field programme.

Yours faithfully,
Hunting Geology and Geophysics (Australia) Pty. Limited,

M.M. Coupard,
Senior Consultant - Geology.

PHOTOGEOLOGICAL UNITS LEGEND

8. Sandstone with occasional interbeds of conglomerate?

7. Marker horizon - Shale, claystone.

6. Sandstone with common quartzite interbeds.

5. Flaggy sandstone; numerous thin shale/siltstone interbeds.

4. Marker horizon - shale and siltstone with bleached zones throughout.

3. Flaggy sandstone with kaolinized units in upper part; thin lenses of siltstone-shale in middle part.

2. Marker horizon - Shale and siltstone.

1. Flaggy sandstone.

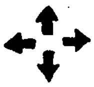

Trace of bedding

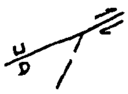

Photogeological boundary; approximate, inferred.


horizontal)
3 - 10^{0}) Strike and dip estimated
10 - 30^{0}) from the aerial photographs.
greater than 30^{0})


Syncline; trough, basin.


Anticline


Dome structure



Fracture, fault with relative sense of movement (U = up; D = down).

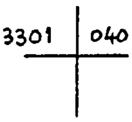


Photo centre showing flight sortie and print number.


Photo registration fiducial marks.

Hunting Geology and Geophysics (Australia) Pty Limited

000111

Integrated Interpretation of Imagery, Aerial Photography and Geophysical Data
Applied Geomorphology in Association with Partridge, de Villiers and Associates

Hunting

Postal Address: P.O. Box 365, Fyshwick, A.C.T. 2609
Business Address: CentreCourt, 1 Pirie Street, Fyshwick, A.C.T. 2609
Telephone (062) 80 4277
Telex 62677
Telegrams: Astereo Canberra

Our Ref. MMC/dh/068/86
Project No. 55/86

19 December 1986

Mr. Bob Henry,
Comalco Aluminium Limited,
The Annexe - A.M.F.,
63 Conyngham Street,
GLENSIDE S.A. 5065.

DELIVERY NOTE

We confirm having airfreighted to the above address, via Ansett Ansapak Numbers AC031005/6, the following maps/letter report/data relating to your Everard Photogeological Study, (Our Job No. 55/86):-

✓01 Letter report dated 19 December 1986.
08 Photograph enlargements scale 1:43,000.
14 Photographs scale 1:86,000.
15 Photographs scale 1:91,000.
02 Enlargements/topographic base maps.
01 Photogeological map scale 1:91,000.
01 Photogeological map scale 1:86,000.
04 Double clears - photogrammetry.
04 Double clears - fractures.
04 Double clears - units/bedding trends.
01 Legend - photogrammetry.

[signature]
HUNTING GEOLOGY AND GEOPHYSICS (AUSTRALIA) PTY. LIMITED

COMALCO ALUMINIUM LIMITED.

Date received____________________

SHEET 1:

UNITS/BEDDING TRENDS - MT. JOHNS RANGE.

6991-9

SHEET 2:

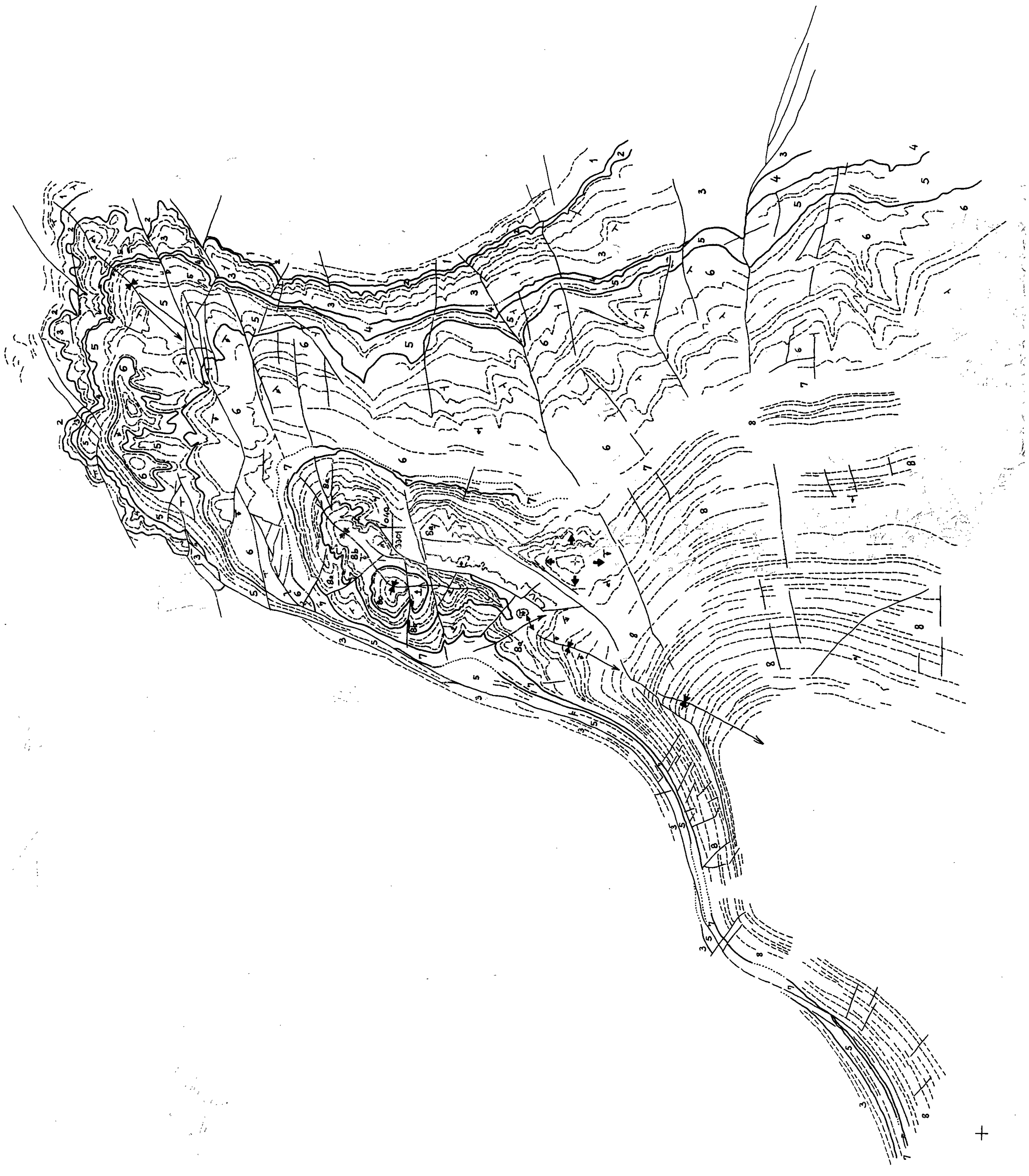
UNITS/BEDDING TRENDS - MT. JOHNS RANGE.

6991-10

SHEET 3:

UNITS/BEDDING TRENDS - MT. JOHNS RANGE.

6991-11



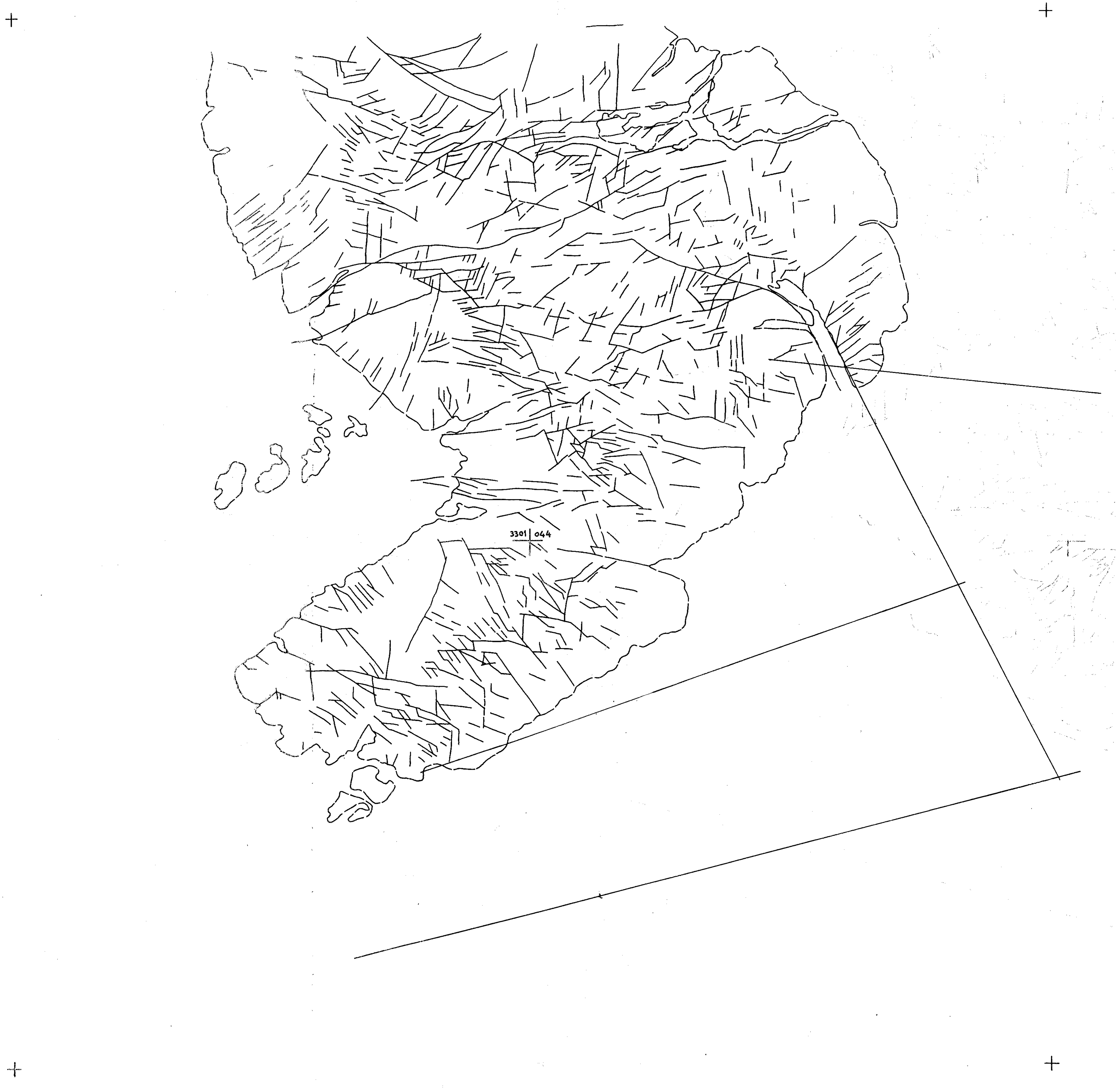
SHEET 4:

UNITS/BEDDING TRENDS -
MT. JOHNS RANGE.

6991-12

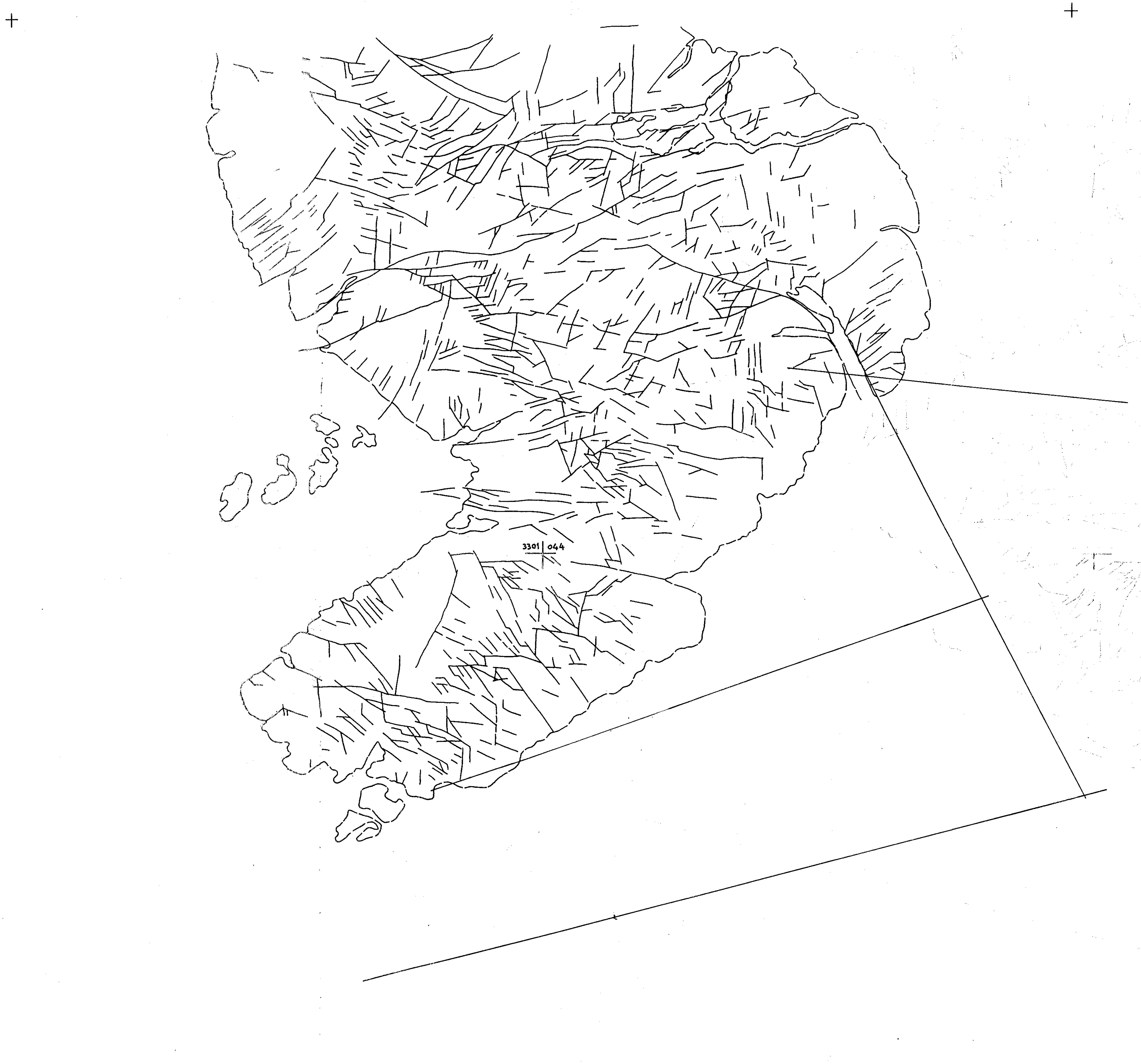
FRACTURES - MT. BYILKAOORA AREA.

6991-13

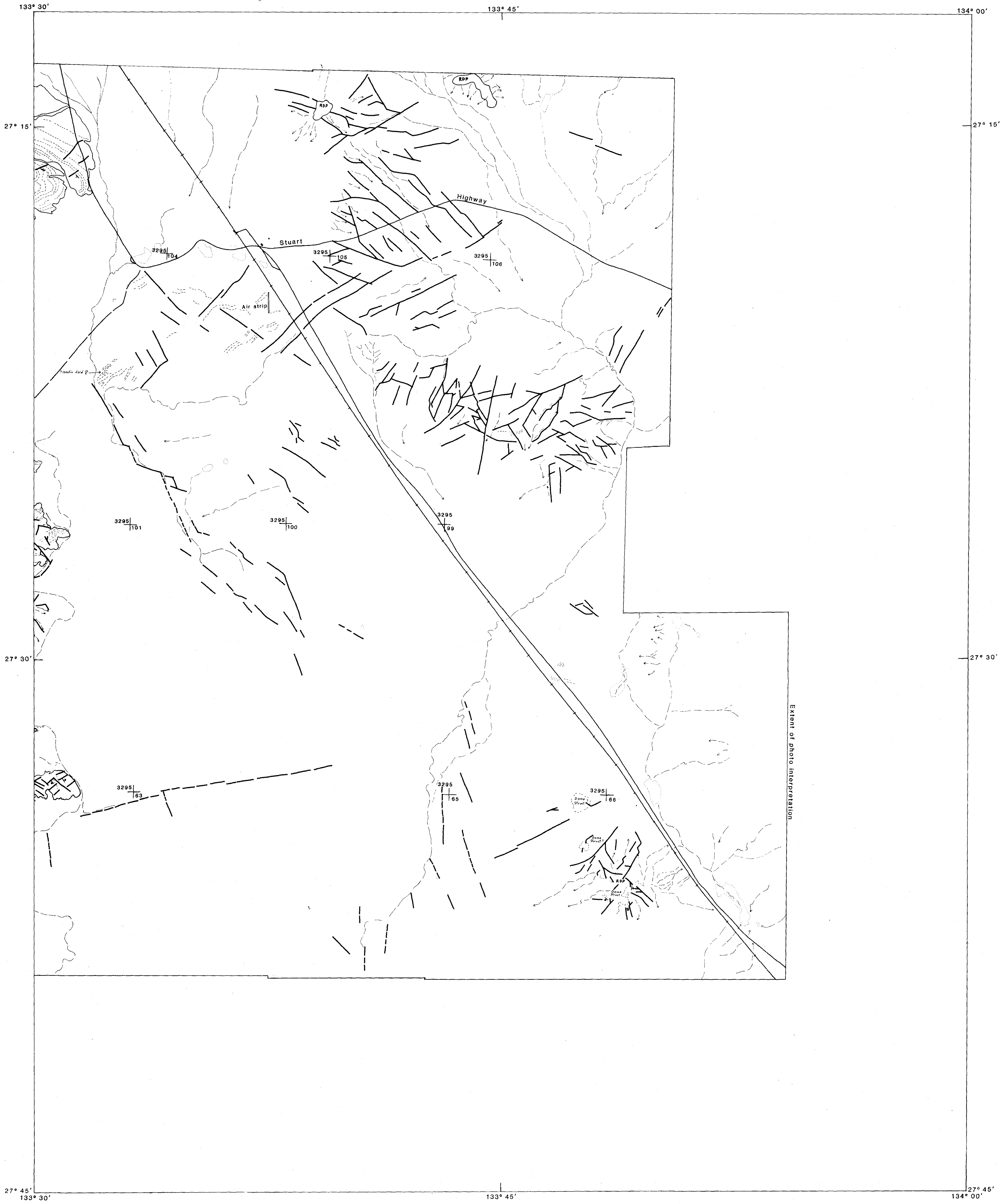


FRACTURES - MT. BYILKAOORA AREA.

6991-13



WINTINNA



PHOTOGEOLOGICAL MAP.

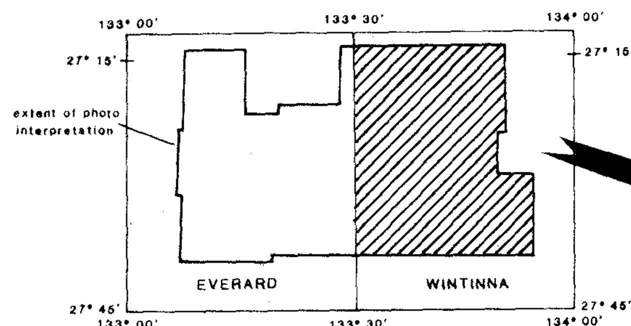
PORTION OF WINTINNA 1:250,000 SHEET.

PHOTOGEOLOGICAL MAP

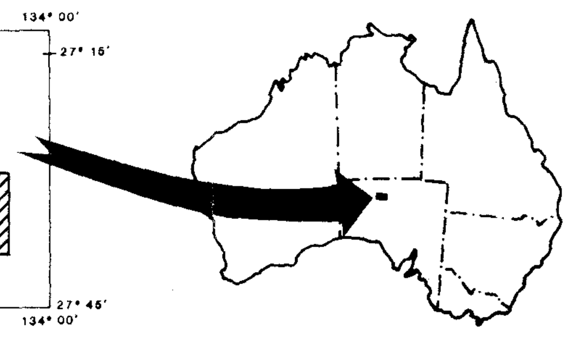
Scale 1:91 000 approx

4 3 2 1 0 2 4 6 8 10km

STUDY AREA



LOCATION DIAGRAM



REFERENCE

- Boundary of surficial deposits
- Bedding trace/Foliation
- Strike and dip of bedding (estimated from the aerial photographs)
  - 5° -10°
  - 10° -30°
  - 30° -45°
- Anticline
- Syncline
- Fault
- 3295 101 Principal point showing sortie and print number
- RDP Radial drainage pattern
- Road, track
- Railway line
- Building
- Clay pan
- Dam
- Ephemeral watercourse

Undertaken on behalf of Comalco Aluminium Limited, Job No.55/86, Dec 86

Hunting

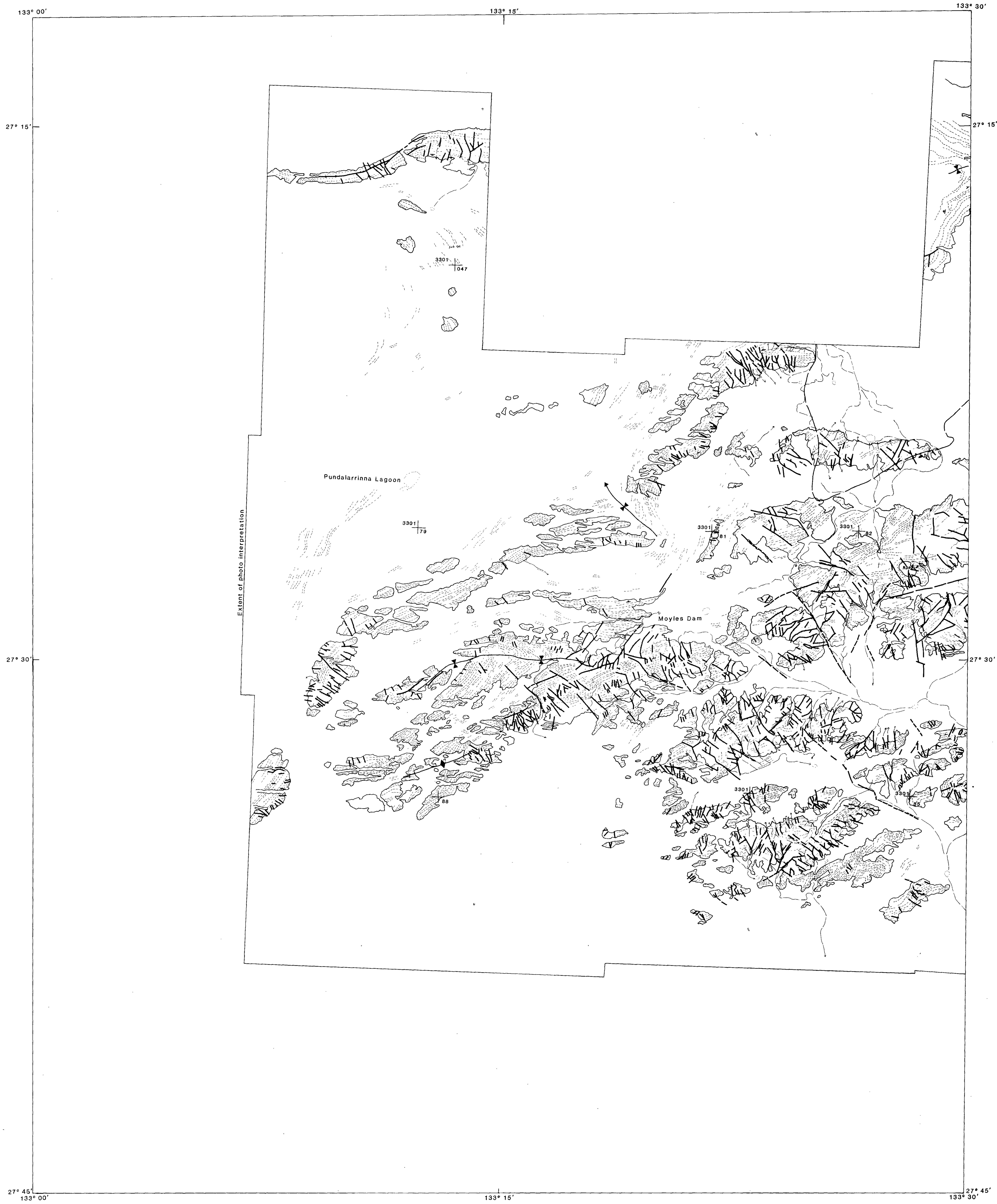
Hunting Geology and Geophysics (Australia) Pty Limited

P.O. Box 365 Fyshwick A.C.T 2609 Telephone (062) 80 4277

Hunting

6991-14

EVERARD



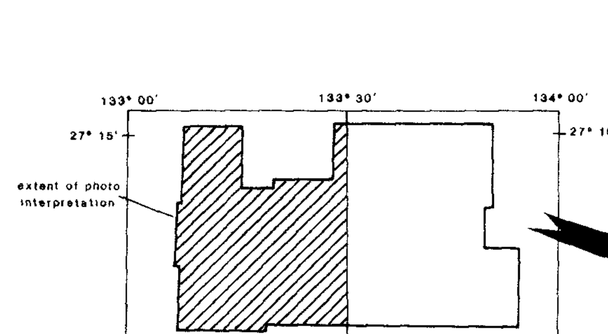
PHOTOGEOLOGICAL MAP.
PORTION OF EVERARD 1:250,000 SHEET.

PHOTOGEOLOGICAL MAP

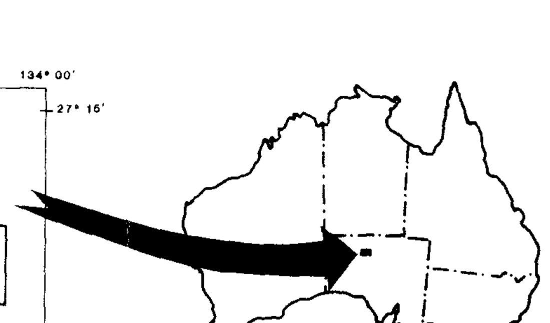
Scale 1:86 000 approx

4 3 2 1 0 2 4 6 8 10km

STUDY AREA



LOCATION DIAGRAM



REFERENCE

Boundary of surficial deposits
Bedding trace/Foliation
Strike and dip of bedding (estimated from the aerial photographs)
5° -10°
10° -30°
30° -45°
Anticline
Syncline
Fault
3295 101 Principal point showing sortie and print number
RDP Radial drainage pattern
Road, track
Railway line
Building
Clay pan
Dam
Ephemeral watercourse

Undertaken on behalf of Comalco Aluminium Limited, Job No.55/86. Dec 86

Hunting

Hunting Geology and Geophysics (Australia) Pty Limited
P.O. Box 365 Fyshwick, A.C.T. 2609 Telephone (062) 80 4277

6991-15

APPENDIX 3

PHOTOGRAPHS OF OIL BLEEDS IN CORE FROM BYILKAOORA-2

FIGURE 1: Oil bleeds in fractures from the Observatory Hill Formation, drillhole Byilkaoora-2 712.45 - 712.63 m. The fractures result from ductility contrasts between chert and silty carbonates.

FIGURE 2: Oil bleeds in vugs interconnected by fractures, drillhole Byilkaoora-2 672.90 m.

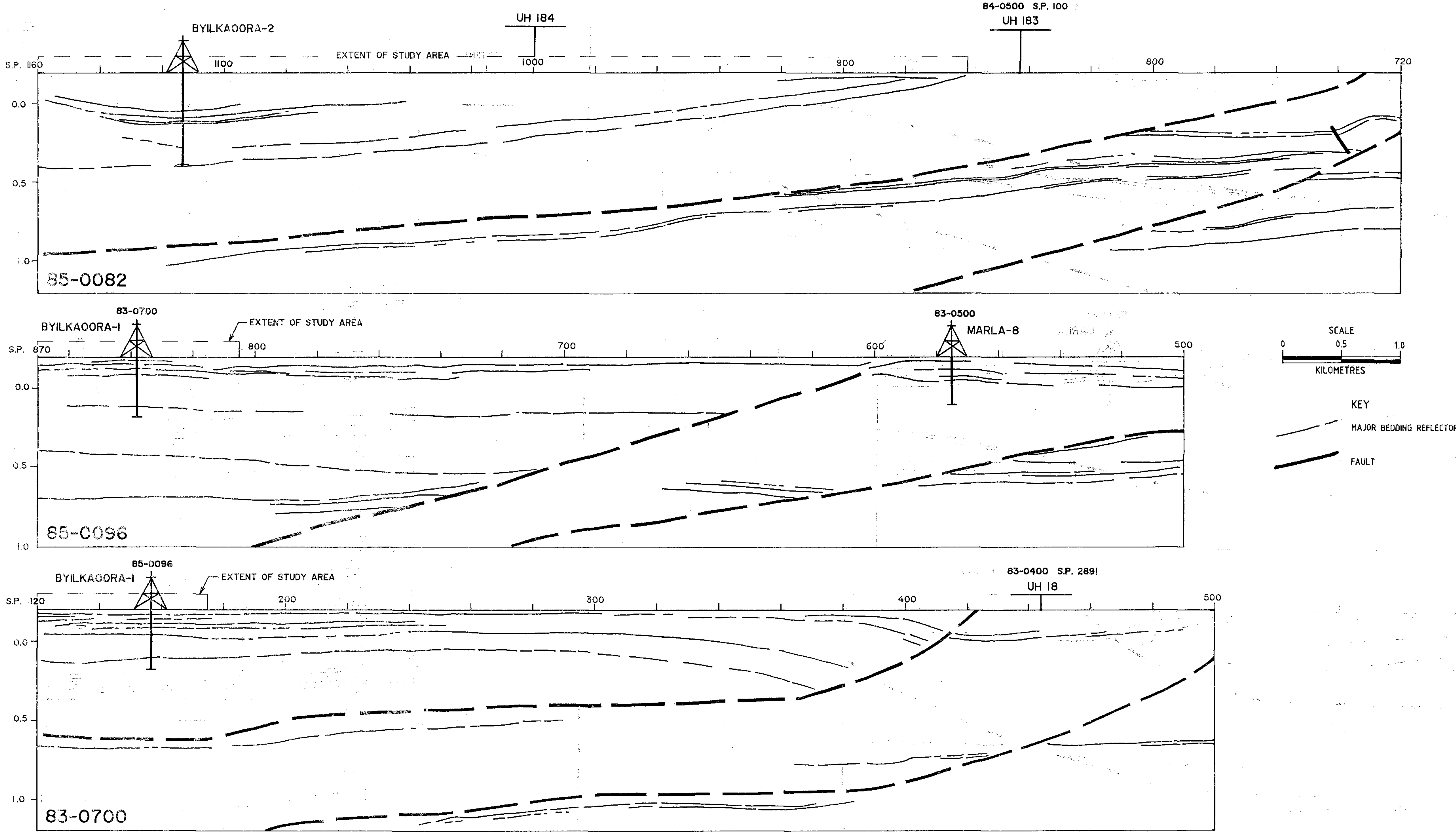
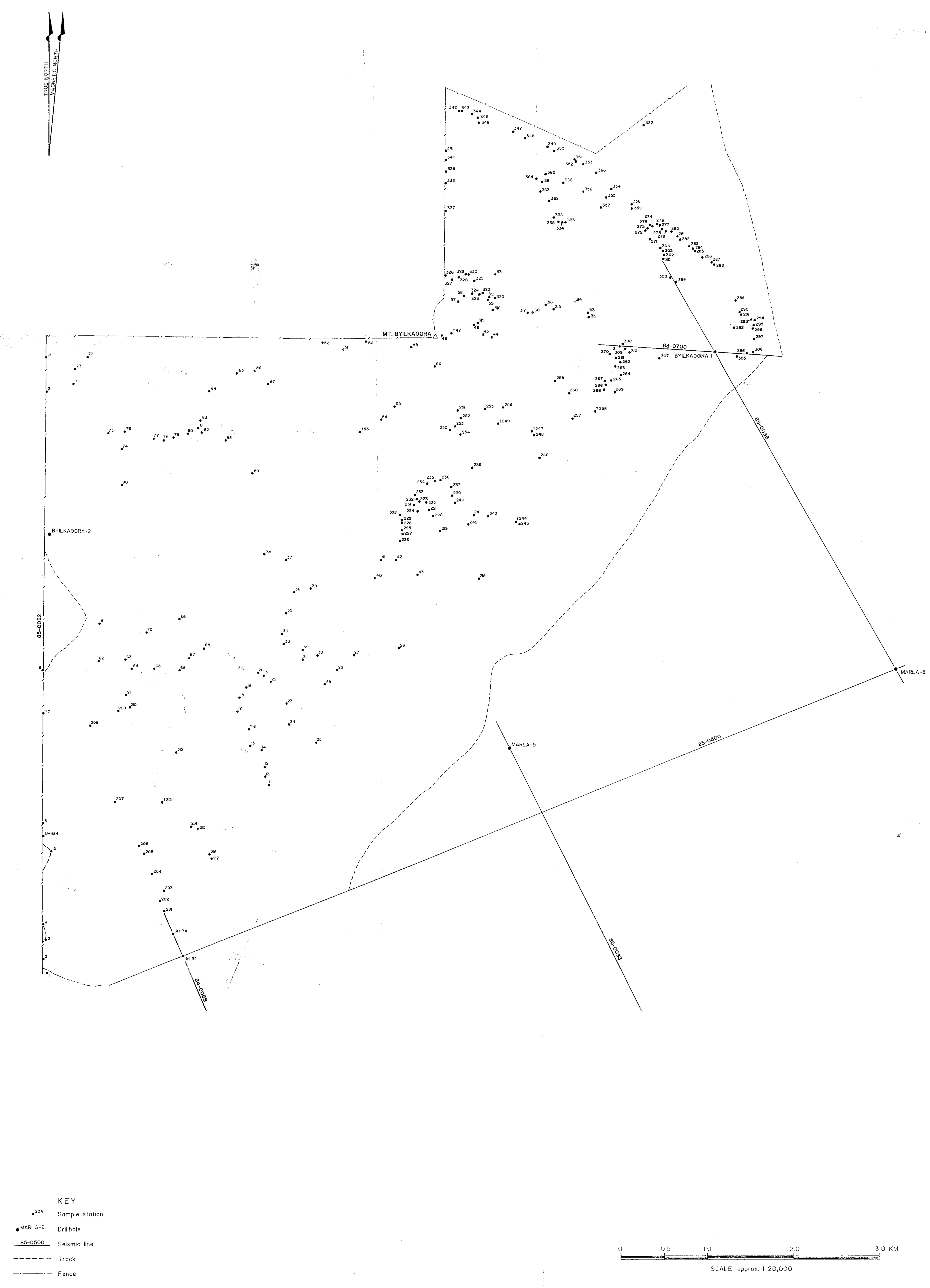


FIGURE 2. SCHEMATIC DIAGRAMS BASED ON COMALCO SEISMIC SHOWING THRUST FAULTS IN ORDOVICIAN TO PRECAMBRIAN SEDIMENTS IN THE BYILKAOORA AREA.

6991-2



DATE	AMENDMENTS

COMALCO EXPLORATION DEPARTMENT

MT. BYILKAOORA AREA

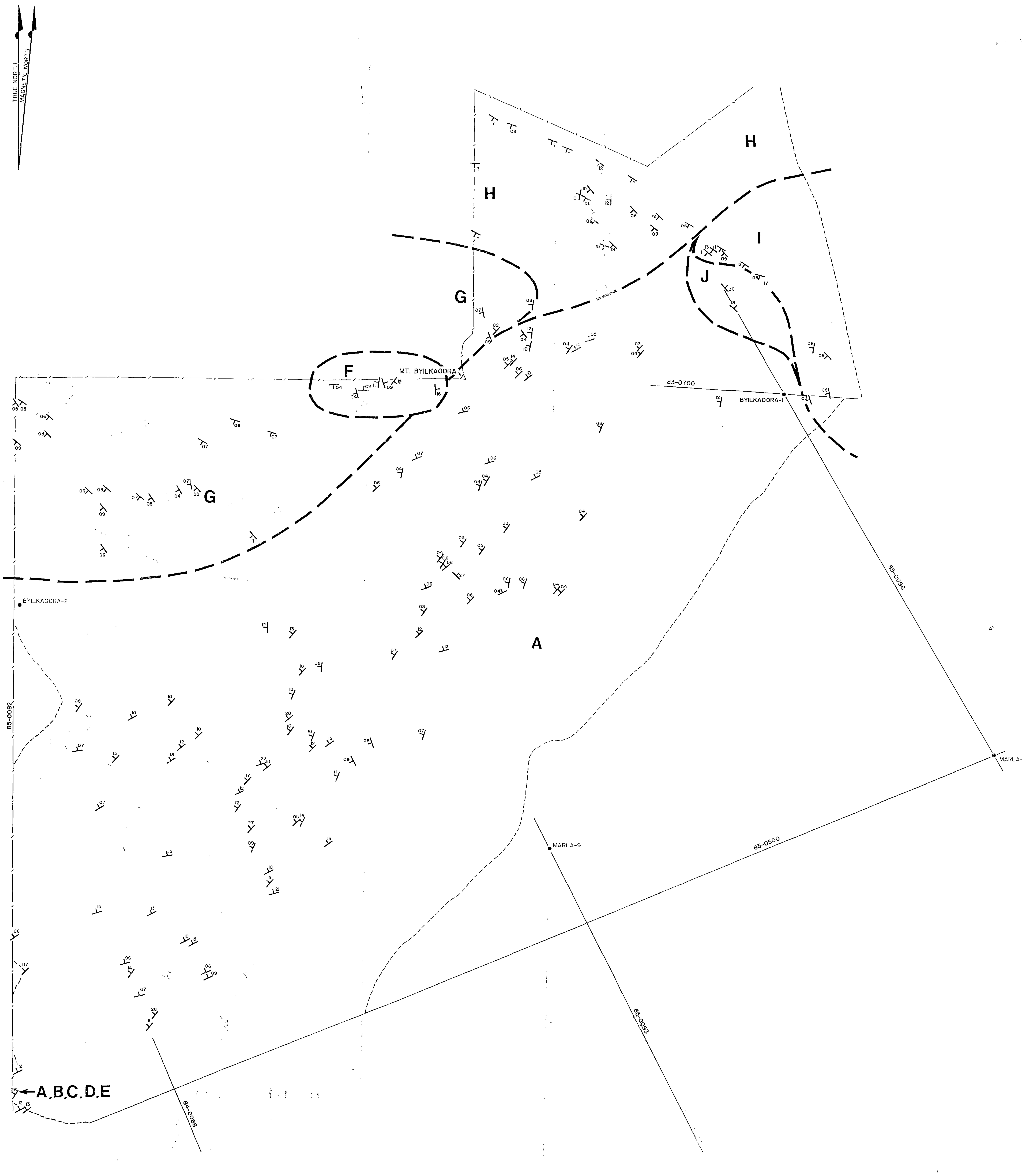
LOCATIONS OF SAMPLE STATIONS

OF FIELD MAPPING

6991-3

FIGURE 3.

COMPILED: J.N.Dunster	5/1/1987	1 : 100 000 SHEET REF.	DRAWING Nº
DRAWN: J.E.Harrison	12/1/1987	1 : 250 000 SHEET REF. WINTINNA SG. 53-14	SA - 87 - 1170



KEY

Strike and dip of beds

Boundary of structural domain

85-0500 Seismic line

Track

Fence

0 0.5 1.0 2.0 3.0 KM

SCALE. approx. 1:20,000

DATE	AMENDMENTS

COMALCO EXPLORATION DEPARTMENT

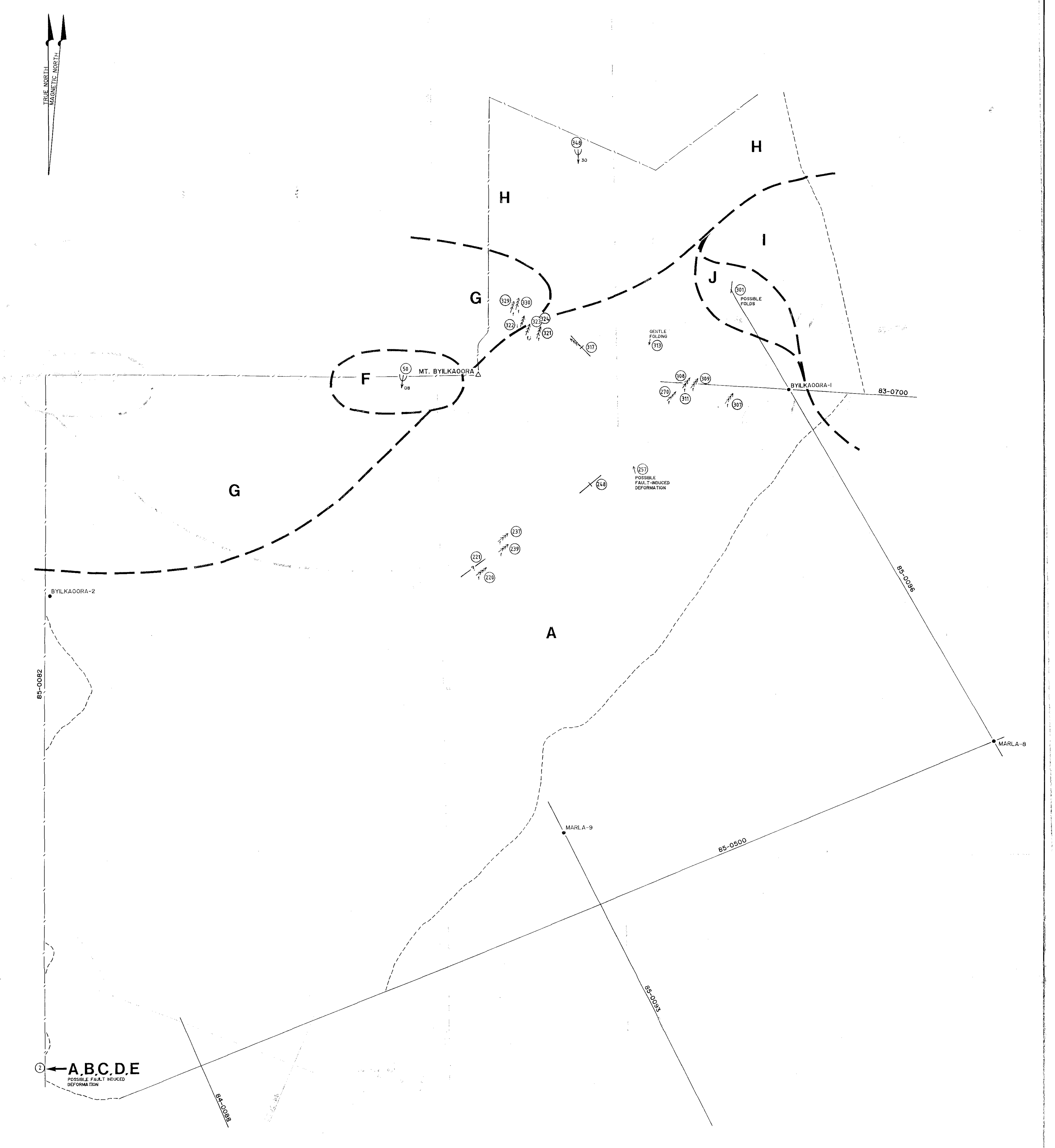
MT. BYILKAOORA AREA

BEDDING ORIENTATIONS AND STRUCTURAL DOMAINS

FROM FIELD MAPPING

6991-4 FIGURE 4.

COMPILED	J.N.Dunster	-/1/1987	1:100 000 SHEET REF.	DRAWING No.
DRAWN	J.E.Harrison	30/1/1987	1:250 000 SHEET REF. WINTINNA SG 53-14	SA - 87 - 1171



KEY

———	Fault
—+—	Vertical fault
—?—	Inferred fault
	Fault with slickensides, showing bearing and plunge
	Slickensides in float
	Slickensides *in situ*
	Plunge and trend of mesoscopic anticline
	Boundary of structural domain
85-0500	Seismic line
- - - -	Track
	Fence
(22)	Sample station

0 0.5 1.0 2.0 3.0 KM

SCALE approx. 1:20,000

DATE	AMENDMENTS

COMALCO EXPLORATION DEPARTMENT

MT. BYILKAOORA AREA

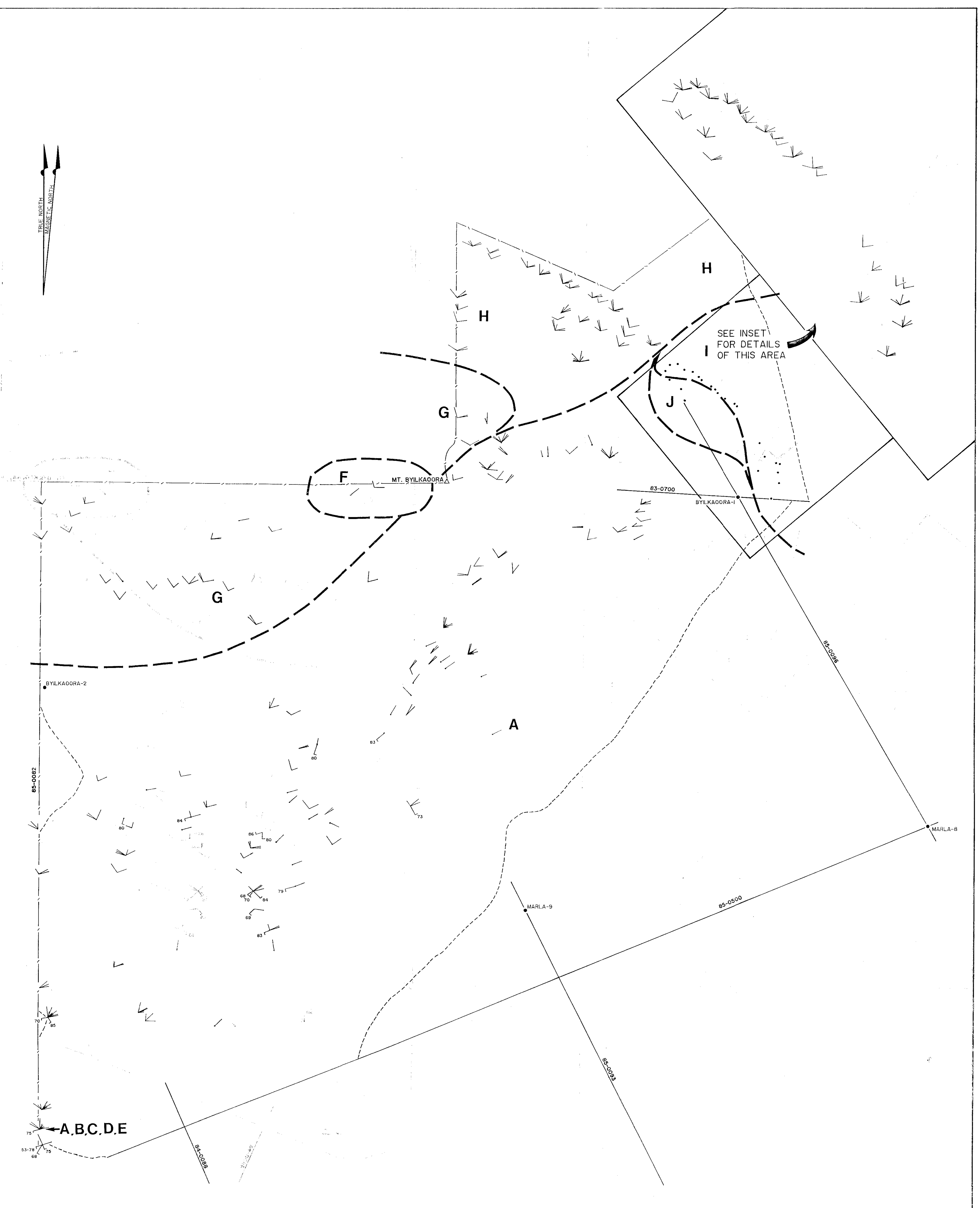
STRUCTURAL DOMAINS, MESOSCOPIC FOLDS AND FAULTS

FROM FIELD MAPPING

6991-5

FIGURE 5.

COMPILED J.N.Dunster -/1/1987	1:100 000 SHEET REF.		DRAWING No
DRAWN J.E.Harrison 30/1/1987	1:250 000 SHEET REF.	WINTINNA SG 53-M	SA - 87 - 1172



KEY

Strike of vertical joints plotted in the upper semicircle.

Strike and dip of non-vertical joints plotted in the lower semicircle.

Longer lines indicate more prominent joints.

85-0500 Seismic line

Track

Fence

Boundary of structural domain

0 0.5 1.0 2.0 3.0 KM

SCALE: approx. 1:20,000

DATE	AMENDMENTS

COMALCO EXPLORATION DEPARTMENT

MT. BYILKAOORA AREA

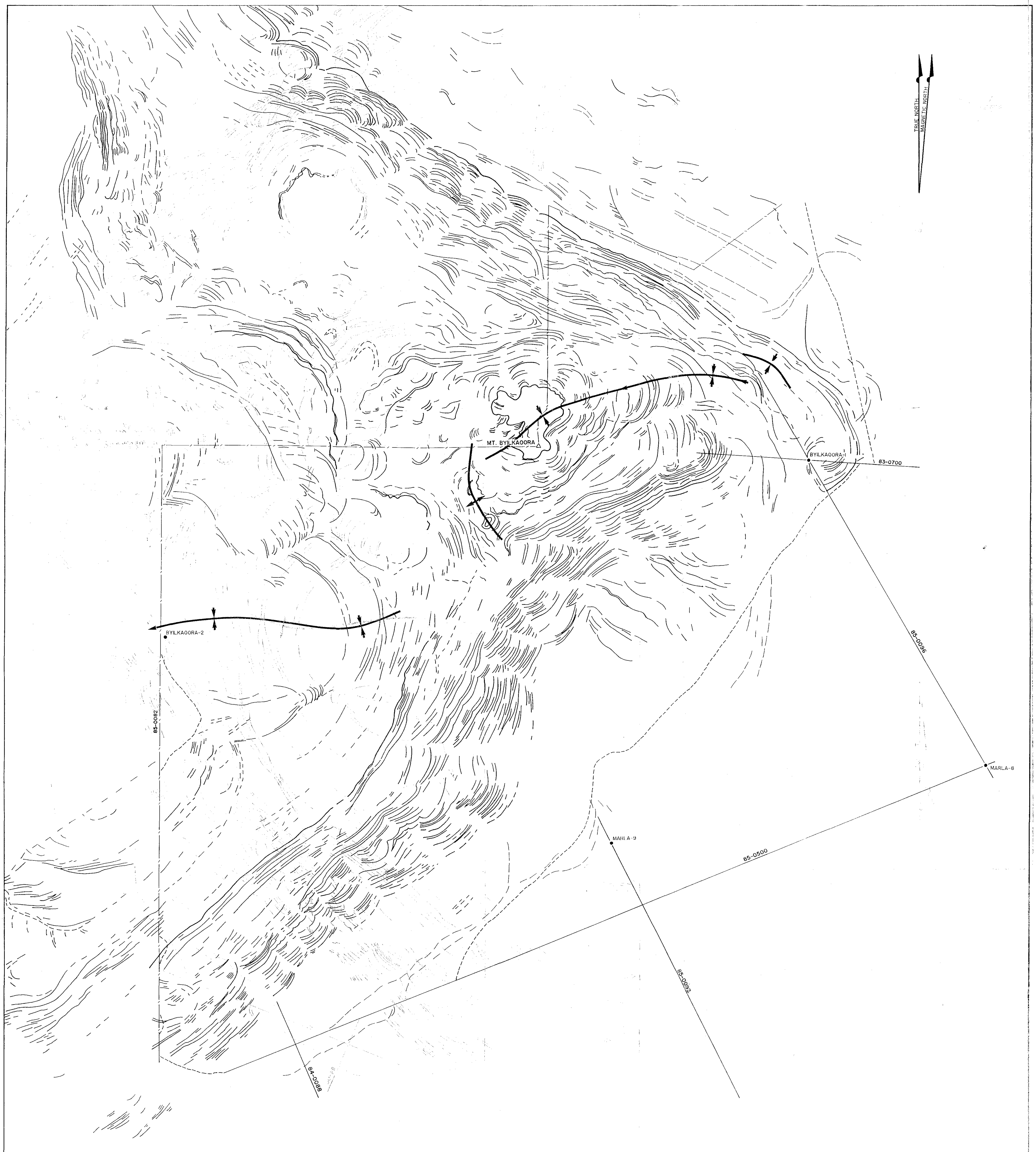
MESOSCOPIC JOINT ORIENTATIONS AND STRUCTURAL DOMAINS

FROM FIELD MAPPING

6991-6

FIGURE 6.

COMPILED: J.N.Dunster	-/1/1987	1:100 000 SHEET REF.	DRAWING Nº
DRAWN: J.E.Harrison	29/1/1987	1:250 000 SHEET REF.	SA - 87 - 1173



KEY

- Major bedding trace (cliff exposure)
- Bedding trace
- Possible bedding trace
- 85-0500 Seismic line
- Track
- Fence
- Syncline, showing plunge
- Anticline

0 0.5 1.0 2.0 3.0 KM

SCALE approx. 1:20,000.

DATE	AMENDMENTS

COMALCO EXPLORATION DEPARTMENT

MT. BYILKAOORA AREA

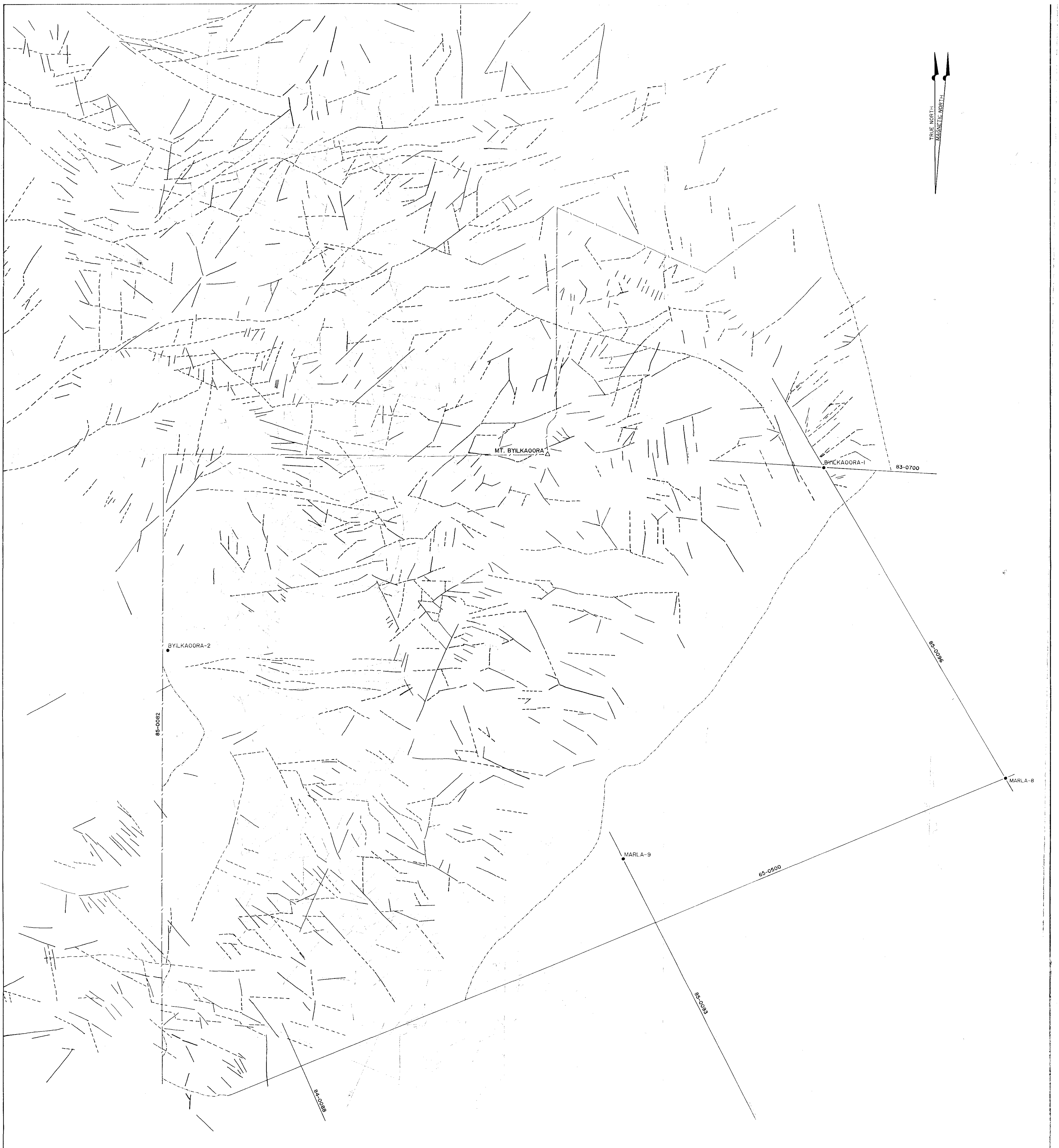
BEDDING TREND LINES AND INTERPRETED STRUCTURES

FROM AIR-PHOTO INTERPRETATION
PARTLY AFTER HUNTING (1986)

6991-7

FIGURE 7.

COMPILED J.N.Dunster	-/1/1987	1:100 000 SHEET REF.	DRAWING No.
DRAWN J.E.Harrison	29/1/1987	1:250 000 SHEET REF. WINTINNA SG 53-14	SA-87-1174



KEY

- Photo-lineament (this study)
- Photo lineament (after Hunting)
- 85-0500 Seismic line
- Track
- Fence

0 0.5 1.0 2.0 3.0 KM

SCALE. approx. 1:20,000

DATE	AMENDMENTS	COMALCO EXPLORATION DEPARTMENT	
		MT. BYILKAOORA AREA PHOTO-LINEAMENTS FROM AIR-PHOTO INTERPRETATION PARTLY AFTER HUNTING (1966)	6991-8 FIGURE 6.
		COMPILED J.N.Dunster -/1/1987	1:100 000 SHEET REF.	DRAWING No
		DRAWN: J.E.Harrison 30/1/1987	1:250 000 SHEET REF. WINTINNA SG 53-14	SA - 87 - 1175