

AS-107

AIRBORNE MAGNETOMETER SURVEY

over

OIL PERMIT No. 73 Part 3

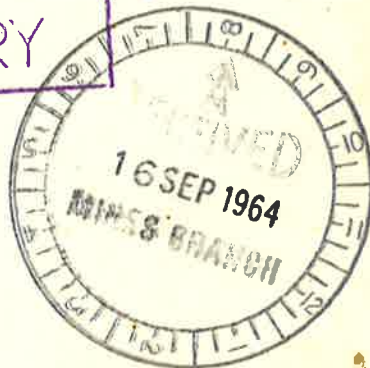
NORTHERN TERRITORY

for

BARKLEY OIL COMPANY PTY. LTD.

INTERPRETATION

MINES BRANCH
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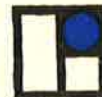


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INTERPRETATION REPORT
of
AIRBORNE MAGNETOMETER SURVEY
over
OIL PERMIT No. 73 Part 3
NORTHERN TERRITORY
for
BARKLEY OIL COMPANY PTY. LTD.

*Daly Waters
Lamunah*

Aero Service Limited.
Ronald R. Hartman.
Chief Geophysicist.
September, 1964.

NORTHERN TERRITORY
GEOLOGICAL SURVEY

PR63/023

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M. W. Crohn

Amendments to Aeromagnetic Survey, Daly Waters,
OP 73 (3) Barkley Oil Company Pty Ltd

DISCUSSION

(To accompany Interpretation Report
on Airborne Magnetometer Survey over
Oil Permit 73, Part 3, Northern Territory,
for Barkley Oil Company Pty. Ltd.)

It has been suggested that:- in view of the fact that basic volcanics (Antrim) occur in thicknesses up to 3,300 feet approximately 250 miles from the survey area and in thicknesses of approximately 500 feet about 100 miles from the survey area - the volcanics referred to in this report may be a few thin beds of basic volcanics rather than acid volcanics; and furthermore, that if this is true the area may be viewed more optimistically with regard to its petroleum potential.

In essence the above remarks are true enough, however the evidence in the magnetometer survey does not really support this.

Prior to commenting on the interpretation, it might be appropriate to express a definition which influences it. The term "basement" as used in this report is in the same sense, or context, as it is used in the paragraph on Regional Geology contained in the subsidy application, which is now appendix No. 5 in the interpretation report: that is, "that the volcanic sequence is assumed to be both magnetic and economic basement".

An object of the survey was to map the surface of this volcanic sequence.

The possibilities of a thick sedimentary sequence occurring within the area have been commented upon in the report and probably need no further elaboration, and the point in question is really whether the volcanics are acid or basic. It has been the author's experience that volcanic rocks of a basic nature (andesites and basalts) are very magnetic and that magnetite, as an accessory mineral, is sufficiently non-uniform throughout the material to cause rather large and variable anomalies. Even if these beds were thin it seems probable that there would be sufficient variations to create magnetic anomalies more to the order of 50 to 200 gammas than to the order of 5 to 25 gammas.

One alternate possibility exists in that the volcanics in the area are tuffs rather than flows, and in this case they would probably be rather uniform in magnetite distribution, and weakly magnetic.

In summary then, while it is not impossible for these magnetics to be produced by basic volcanic rocks, it seems unlikely from the magnetic evidence, and regardless of whether the volcanic rocks are basic flows, acid flows or tuffs the possibility of a thick sedimentary section inter-stratified with the volcanics is reasonably good.

INTRODUCTION

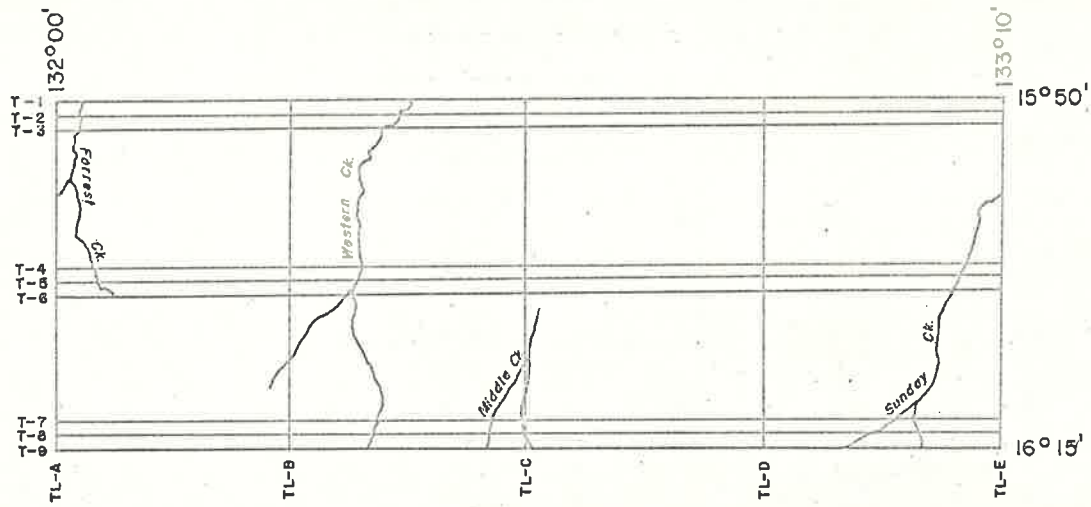
In March of 1964 a contract was negotiated between Aero Service Limited with offices in Ramsgate, New South Wales, Australia and Barkley Oil Company Pty. Ltd. with offices in Brisbane, Queensland for the performance of an airborne magnetometer survey over Oil Permit No. 73 Part 3 in the Daly Waters area of Northern Territory.

This survey was conducted during the month of June, 1964 and the following pages and the accompanying maps constitute a final operational report and interpretation of the survey.

The primary purpose of the aeromagnetic survey and the interpretation was to locate and define geologic information as it is reflected in the aeromagnetic records. Specifically this would include the delineation of the basement surface by contouring depth estimates obtained from the magnetic anomalies, and the delineation of contacts, faults, intrusive bodies and any other structural or lithologic information that may be indicated by the magnetic data. The survey was planned to record the magnetic intensity at an elevation of 1,500' above mean sea level along East-West traverses spaced 1 mile apart in bands of three. The bands were spaced approximately $11\frac{1}{2}$ miles apart. For this configuration a total of three bands of three profiles each were recorded. The isomagnetic maps and interpretation maps are presented at a regional scale of 1:126,720 on 1 sheet. A composite reduction of the isomagnetic contours is also presented. The magnetic values indicated that all

of the anomalies were very small features both in amplitude and in frequency and therefore it was impossible to make valid assumptions for positioning the contours between the bands. The depth estimates referred to on the map and in the report are in feet sub sea level except where a plus sign preceeding the depth indicates that it is in feet above sea level.

The statistical data relevant to the aircraft, instruments, area and daily operations is tabulated in appendices at the end of this report.



LOCALITY SKETCH
 AEROMAGNETIC SURVEY
 OP-73 PART 3
 DALY WATERS AREA
 SCALE 1:1,000,000



FIG. 1



INTERPRETATION

The magnetic pattern over the area is uniform in every respect and the analysis of the magnetics in the light of the known geology can be summed up very briefly as follows:-

- (a) There is no evidence of structural events of any consequence within the survey area.
- (b) The entire area is very shallow.
- (c) The basement surface is uniform with respect to rock type and is essentially horizontal. It is probably composed of thick, weakly-magnetic volcanic flows which have not been disturbed since their deposition.

The weakly-magnetic character suggests that they are acid volcanics.

A few depth estimates representative of the entire area have been placed on the interpretation sheet; obviously no depth contours are appropriate.

Very little information can be obtained as to the thickness of the inferred volcanics. However, their upper surface is very uniform across the entire survey and absence of deeper indications from broad anomalies within the area suggests that they are very thick. The persistent small 10 to 25 gamma anomalies suggest that the section is, in addition to being thick, very uniform in a vertical direction (section profile). Normally if there are any fundamental faults or vents from which the volcanics arise there are large anomalies over these. The absence of these

large anomalies suggests that the volcanism occurred someplace else and this area was only a basin in which the flows were deposited. Normally under these conditions true sedimentary rocks are also deposited and I would suppose that this is the case here.

There is one anomaly in the area which can be attributed to a very deep source. This anomaly is weak in itself and is complicated by the typical superimposed features caused by the volcanics. Nevertheless a chording process can be used to obtain the general shape and character of this feature. This was done and it is illustrated in Figure 2. This Figure is to the same scale as the original magnetometer record profile No. 5. The great breadth of the anomaly suggests that it arises from a very deep source and it is undoubtedly a sub-regional basement anomaly. i.e. It arises from a source deep within the basement. Depth estimates, for what they are worth, on the eastern flank of this feature indicate a source near the Curie Point which in the normal temperature gradient of the earth would be to the order of 60,000'. It is highly unlikely that this feature has any practical significance and it is included here mostly because of its academic interest.

Probably the only area of future exploration lies in the possibility that the volcanics were deposited under marine conditions and that they were accompanied by a sufficient amount of marine interbedded sediments. Since it is suggested that these sediments are horizontal they may be of interest. Other than the suggestion that they are horizontal I cannot speculate on their condition. Actually it seems to me that there could be considerable thicknesses

of these sediments. Nevertheless to map them may be very difficult.

Respectfully submitted,



Ronald R. Hartman,
Chief Geophysicist,
Aero Service Limited.
September, 1964.

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APPENDIX No. 1.

FIELD CREW

Edward Newman - Pilot

Responsibility - Field Operations and Aircraft.

Experience - 6,500 operational hours in
Australia.

William Clark - Magnetometer Operator

Responsibility - Magnetometer and all elec-
tronic equipment.

Experience - 8 years' experience as
Electronics Technician
1 year's experience as
airborne magnetometer
technician.

David Lyus - Magnetometer Operator

Responsibility - Magnetometer and all elec-
tronic equipment.

Experience - 10 years' experience as
Electronics Technician
1,750 airborne hours as
Magnetometer Technician.

APPENDIX No. 2.

SURVEY PROCEDURES AND EQUIPMENT

Compilation Procedures:

The initial phase of a survey is performed in the office prior to entering the field with the aircraft. Maps or photographs of the area must be obtained. The proposed traverses are then plotted on these maps.

The flight crew uses these maps in the field to position the lines as accurately as possible as they are shown on the maps.

In the aircraft is a 35 mm. Aeropath camera synchronized with all the other recorders. This camera records the actual course that the pilot flew and the synchronizing device affords correlation with the geophysical records. The film is used in the office along with base maps or photo mosaics of the area to recover the true flight path and these positions are then plotted on a manuscript with geographic co-ordinates.

The raw magnetic values as they appear on the record paper cannot be plotted directly on this manuscript because they are subject to various sources of error which include diurnal drift, instrument drift, heading effects and altitude variations. These errors result in various levels for the magnetic records. It is necessary to remove these and place all of the records on a convenient level or base. This is done by locating the exact value of the intersection of all the traverses with the control lines which were flown for this purpose. The intersection is then plotted on each magnetic

record and the difference in the traverse and the tie line values is recorded and adjusted. Then a linear drift between traverses can be applied so that they will read at the intersection point the same value as the tie line. A base line is then constructed on each of the traverses from which all magnetic values are then read.

The regional variation is also removed for anomaly clarity.

Since in magnetic surveying there is no interest in the actual value of the magnetic field but only in the variations or changes relative to one another, the value of the base line is arbitrary and is chosen at some convenient level for contouring and map reading.

The magnetic values must then be transferred to the map and this is done by use of a transcriber, (a variable ratio machine).

The correlation of all data is illustrated in Fig. 3.

Contouring of the magnetic maps is a simple process to explain but it is a very complex and time-consuming operation. The process is simply that of connecting up points of equal value along each of the flight lines. The complexity of the operation lies in the fact that each of the magnetic trends (magnetic highs and lows) must be properly related from traverse to traverse.

The final operation is the drafting of the sheets at the delivery scale with an appropriate grid and legend.

CORRELATION OF AIRBORNE GEOPHYSICAL RECORDS



FLIGHT MAP



STRIP CAMERA - PRINT



PHOTO MOSAIC

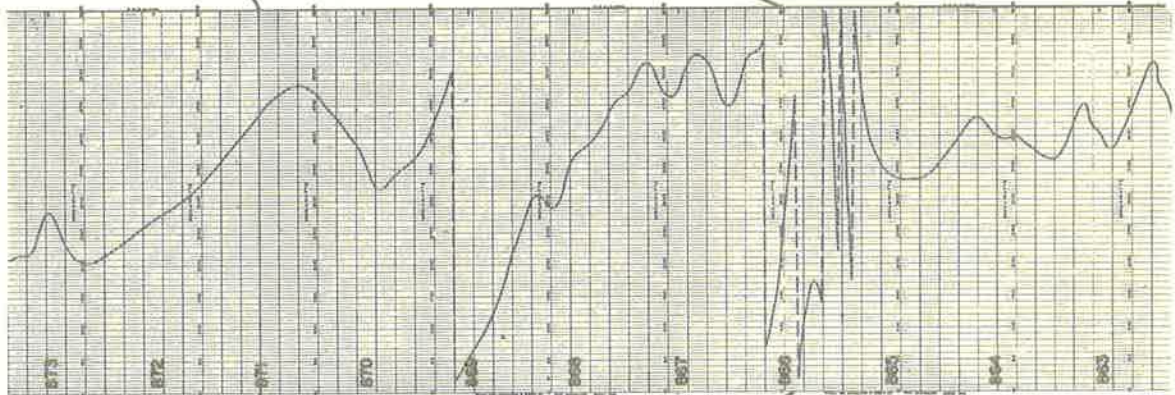


TOPOGRAPHIC MAP



T-1

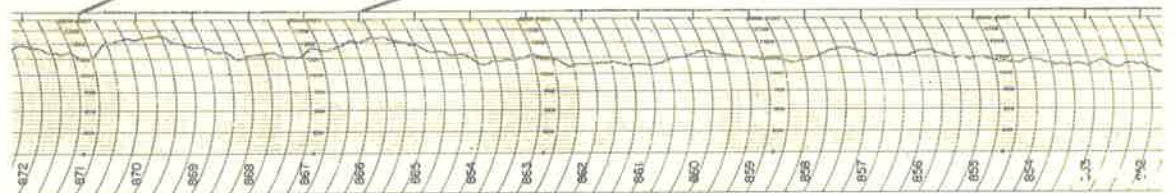
MANUSCRIPT



MAGNETIC RECORD



MANUSCRIPT



RADIO ALTIMETER RECORD

Fig. 3.

In the course of survey operations magnetic storms may occur and result in incorrect magnetometer readings from the aircraft. To monitor these magnetic storms and ensure that the flight crew is not recording data during the storms or to ensure that the data is rejected and re-flown, a Gulf Storm Monitor is operated throughout the period of the survey. This is a flux-gate type instrument. It is similar to the magnetometer used in the aircraft but it does not require the same orienting devices. It is permanently oriented in the earth's magnetic field near the operational base and monitored periodically.

APPENDIX No. 3.

STATISTICS

Client:	Barkley Oil Co. Pty. Ltd.
Contractor:	Aero Service Limited
Commencement of Flying:	14th June, 1964.
Termination of Flying:	15th June, 1964.
Aircraft:	Piper Apache VH-MJL.
Aircraft Base:	Daly Waters, Northern Territory.
Lost Time:	
Weather:	0
Diurnal:	0
Instrument Maintenance:	1 day
Aircraft Maintenance:	0
Ferry:	0
Other:	0
Flight Altitude:	1,500-ft. A.S.L.
Magnetometer:	Gulf Mark III Fluxgate type, continuous recording, total field magnetometer.
Magnetometer Installation:	Inboard (tailcone).
Recorder:	Gulf 10" recorder.
Tape Speed:	3 inches per minute
Full Scale Deflection:	600 gamma.
Camera:	Aeropath AS-5, continuous strip, .35 mm. camera.
Fiducial Interval:	1 mile.
Terrain Clearance:	900-ft. to 1,000-ft. approx.
Terrain Clearance Control:	APN-1 Radio Altimeter.
Magnetic Storm Monitor:	Gulf Storm Monitor (Fluxgate type).

Flight Direction: Traverses E - W
Control Lines N - S

Area: 5,976 sq. miles approx.

Mileage: 852 line miles.

Line Spacing: 3 bands of 3 traverses.
1 mile between traverses.
11 $\frac{1}{2}$ miles between bands.
5 control lines spaced at approx.
19.6 miles.

Compilation Scale: 1 : 126,720.

Final Map Scale: 1 : 126,720.

Base Maps: Compiled from an uncontrolled
photo laydown.

Regional Removed: 12.8 gammas per mile --- S.10 $^{\circ}$ W.

Inclination of earth's
magnetic field: 45 $^{\circ}$.

Declination: 4 $^{\circ}$ E.

Total Magnetic Field: 49,000 gamma.

Flight Strips: Compiled from an uncontrolled
photo laydown.

Flight Path Recovery: Visual method employed. Path
identified by matching images
on 35 mm. tracking film and
flight strips; thence trans-
ferring these points on to a
base map.

APPENDIX No. 4.

GEOPHYSICAL SURVEY

Altitude: 1,500' Baro.

Job 1663

Sensitivity: 600 gamma

Index to Profiles

<u>Line No.</u>	<u>Start</u>	<u>End</u>	<u>Flight</u>	<u>Date Flown</u>
T- 1W	154	217	Reflight 2	15. 6. 64.
T- 2E	218	320	Reflight 2	"
T- 3W	321	384	Reflight 2	"
T- 4E	762	841	Reflight 3	"
T- 5W	842	910	Reflight 3	"
T- 6E	911	992	Reflight 3	"
T- 7E	575	658	Reflight 2	"
T- 8W	506	574	Reflight 2	"
T- 9E	418	505	Reflight 2	"
TL-"A" S	385	417	Reflight 2	"
TL-"B" N	731	761	Reflight 3	"
TL-"C" S	689	730	Reflight 3	"
TL-"D" N	659	688	Reflight 3	"
TL-"E" N	122	153	Reflight 2	"

APPENDIX No. 5

REGIONAL GEOLOGY

Part 3 of Oil Permit 73 is covered by overlying Mesozoic sediments which completely conceal the older rocks. To the west, lower Cambrian basalts and tuffs form extensive sheets. These are the Antrim Plateau Volcanics; a section measured by D.M.Traves was 3,300 feet thick. The Volcanics dip gently eastwards into the basin and they will constitute both economic basement and magnetic basement. Overlying these rocks is the middle Cambrian Montejinni Limestone which varies in thickness from 500 feet to 2,000 feet and is overlain by approximately 200 feet of Mesozoic mudstone, sandstone, grit and conglomerate.