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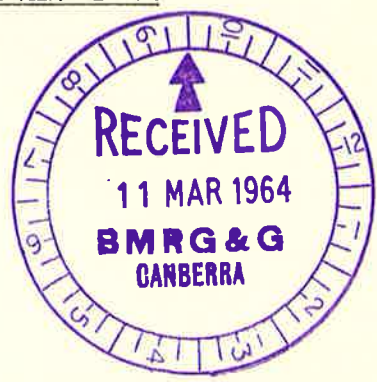
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Call: +61 8 8999 6443
Click: geoscience.info@nt.gov.au
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Centrepoint Building
Smith Street Mall
Darwin
Northern Territory 0800



GEOPHYSICAL INTERPRETATION REPORT

on



AIRBORNE MAGNETOMETER SURVEY

O.P. 53 - NORTHERN TERRITORY

Ason Downs - Sandstone River.



for

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GEOPHYSICAL INTERPRETATION
AIRBORNE MAGNETOMETER SURVEY
O.P. 53 - SANDOVER RIVER, NORTHERN TERRITORY

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ENCLOSURES:-

- Plate 1 - Contours on Magnetic Basement; Scale 4 miles = 1 inch
- Plate 2 - Total Magnetic Intensity Profiles; Scale 4 miles = 1 inch
(Bureau of Mineral Resources Map No. F.53/B1-16)

ABSTRACT

Subsea depth contours on magnetic basement have been drawn for O.P. 53 in the Northern Territory. The contours based on the depth estimates show that a large proportion of the Permit area is underlain by very shallow magnetic basement. This shallow area is not considered to be prospective for hydrocarbon accumulation. In the remaining area there are several places where reliable depths in the - 4000 foot range have been mapped.

The most interesting area is a basement depression in the south east of the Permit area. This depression has good depth estimates in the - 4000 foot range and there is a possibility that the deepest parts of the depression are in the -5000 foot range. The local basement high area at latitude $21^{\circ}30' S$ and longitude $137^{\circ}25' E$ in the depression may be interesting structurally.

Two other areas of interest are the northeastern corner of the Permit area, where depths in the -4000 foot range have been mapped; and a small locally deep area west of a basement high area in the south-central part of the Permit area.

INTRODUCTION

This interpretation is based on data obtained in 1963 by the Geophysical Branch of the Bureau of Mineral Resources during an airborne magnetometer survey of the Georgina Basin in the Northern Territory and Queensland.

The data were obtained using a fluxgate magnetometer mounted in a tail cone on a DC 3 aircraft. A total of 1978 line miles of data has been used in this interpretation, which is based on an analysis of the magnetometer tapes only. The survey was flown at a height of 2000 feet above sea level along east-west flight lines spaced two miles apart.

Complete flight path recovery is not yet available and the flight lines have been positioned on the base map with an accuracy of $\pm 1/4$ mile by control at two points about fifty miles apart near longitudes $136^{\circ}50'$ E and $137^{\circ}40'$ E. The horizontal scale for each tape has been calculated from the control points by assuming that the aircraft maintained a constant ground speed between and beyond them to the eastern and western limits of the Permit area. There is little likelihood of serious error in the depth estimates due to this assumption if the control points are accurately located. The quality of the data is good, and the noise envelope on the magnetometer profiles is less than 2 gammas for a sensitivity of 500 gammas full scale deflection.

INTERPRETATION METHODS

The magnetic basement depth contours are based on an analysis of the magnetometer profiles. In the Permit area a large number of anomalies are available, both in the shallow and deep areas, and good depth estimates were possible.

Two methods have been used. In the first method the horizontal distances of the straight slopes on the flanks of the anomalies were measured. This was done for all anomalies. The horizontal distances were converted to feet using the horizontal scale factor calculated for each profile, and then converted to depths subsea. The formula used was depth subsea = depth factor \times straight slope in feet - 2000. The values were then studied and graded for reliability on the basis of anomaly correlation from profile to profile. After this stage the second method was used.

INTERPRETATION METHODS (Cont'd.);

The method is that of Dr. Peters (1); and it was confined to selected well defined anomalies. It is commonly known as the half-slope method and the results were used in conjunction with the estimates from the straight slope method.

The combination of the two methods has provided depth estimates accurate to within 10 - 15 percent. This means that a depth estimate of 4000 feet is reliable within a range of -3400 to -4600 feet. This accuracy is less than the 10 percent generally quoted for detailed aeromagnetic surveys. This is due to a combination of two factors, the flight line spacing and the lack of total intensity contours. The flight line spacing of two miles is too great for proper definition of all anomalies in this area of relatively shallow basement. The lack of total intensity contours contributes to this lack of definition and it is often not possible to apply accurate azimuth factors to depth computations.

GEOLOGY

The geology of the Permit area is not known in detail. The Tectonic Map of Australia shows that the area is in a region where we might expect a thin veneer of Quarternary and Tertiary sediments overlying Middle Devonian to Cambrian strata. A bore in the centre of the Permit area at approximately 21° 30' S and 137° 10' E reached a total depth of 1036' in unfossiliferous Cambrian ? strata. The bore is located where the depth to magnetic basement is estimated to be between -2000 and -3000 feet subsea.

The A.P. Lake Nash No 1 well is located about six miles north of the northeast corner of the Permit area. It reached a total depth of 1315 feet and encountered Lower Cambrian or Upper Proterozoic rocks at 995 feet. Depth estimates in the northeast corner of the Permit area are about -4000 feet.

West of the Permit area there is a well defined system of northeast-southwest striking faults. The faulting is post Mid-Devonian and it was probably contemporaneous with the Kanimblan orogeny. The strike of the possible fault shown by the magnetics is parallel to this fault system.

RESULTS AND INTERPRETATION

The magnetics in the Permit area are characterised by

(1) Leo J. Peters 'The Direct Approach to Magnetic Interpretation and its Practical Application', Geophysics Vol. 14, No.3.

RESULTS AND INTERPRETATION (Cont'd);

high amplitude anomalies striking approximately meridionally with one outstanding exception; this is an anomaly associated with what appears to be a structural boundary. The boundary is probably a fault contact in the south part of the Permit area and it strikes southeast to the southern margin of SANDOVER RIVER* at longitude 137° 25' East.

The western and north-western parts of the Permit area have numerous shallow anomalies ranging up to 750 gammas in amplitude, and a relatively high total intensity level. The depth estimates show that these parts are underlain by very shallow basement, near surface in many places, and certainly within -1000 feet subsea.

The basement surface here is probably acid igneous, rather complex in composition and intruded by intermediate or basic dykes. Two possible dykes are shown on Plate 1.

This very shallow basement area is separated by a marked change in the magnetic anomaly form and pattern, from an area where depths to magnetic basement are generally in the range -2000 to -4000 feet. This marked change probably represents a structural boundary or discontinuity. The postulated structural discontinuity strikes approximately northwest from the southern edge of the Permit area to about latitude 21° 20' S. At this point the strike is east to about longitude 137° 40' E, then approximately north to the northern margin of the Permit area. Magnetically the area east of this postulated structural boundary is characterised by fewer anomalies than in the area to the west, amplitudes to 250 gammas, and a lower total intensity level.

The basement surface here is probably a relatively stable granitic complex. This observation is prompted by consideration of the amplitudes of the magnetic anomalies and the fact that most of the igneous rocks which crop out on the periphery of the Georgina Basin are acidic in composition. The possibility that the basement is composed of metamorphosed sediments is slight.

The magnetic results show that the area of thickest section is in the southeast part of the Permit area. This area has reliable depth estimates in the -4000 feet range, and there is some evidence for depths in the -5000 feet range. Not much faith is placed in these -5000 foot estimates, and the contours are included mainly to point up areas where the maximum thickness of section is likely to be. There is a small structurally high area at latitude 21°

* 4 mile sheet designated by Capital Letters

RESULTS AND INTERPRETATION (Cont'd);

30' S and 137° 30' E separating the two deepest areas as defined by the dashed -5000 foot contours. A depth estimate on a well defined anomaly in the middle of this high area gave -2400 feet.

This deep area of interest is flanked on the west side by two separate basement high areas separated by a narrow depression. The southern high is based on reliable depth estimates, but the northern high is not so well defined. It is possible that they may form a continuous high basement area.

The two highs are elongate in an east-west direction. This is approximately at right angles to the strike of most basement magnetic anomalies, but it is sub-parallel to the strike of the postulated structural discontinuity across the centre of the Permit area. The east-west elongation suggests that the high basement areas are not due to intrusive bodies but represent local areas of basement relief. The cause of the east-west directivity is obscure, but it is probably significant that the postulated structural discontinuity and the two basement highs are sub-parallel.

West from the shallow basement areas described above is a zone with depths in the -4000 foot range. The zone is about ten miles wide and is terminated on its western side by the structural discontinuity referred to earlier. The southern part of the discontinuity is shown as faulted, and the fault strikes southeast across the bottom portion of the SANDOVER RIVER sheet. Thus magnetic evidence south of the Permit area in this vicinity indicates that the deep zone shallows rapidly southwards.

In the northeastern corner of the Permit area the -4000 depth contour is considered to be reliable. South from this deep area are two small local shallow areas, then a moderate depression with depths in the -3000 foot range.

The only good fault evidence is on the south margin of the Permit area. More structural detail may be apparent after the data are compiled and total intensity contours are available. We understand that compilation of this area by the Bureau of Mineral Resources will commence in July, 1964.

CONCLUSIONS

A large part of O.P.53 is underlain by shallow magnetic basement and is thus non prospective for hydrocarbon accumulation. The most interesting area is a basement depression in the southeast of the Permit area. This depression has good depth estimates in the -4000 foot range and there is a possibility that the deepest parts of the depression are in the -5000 foot range. The local basement high area at latitude 21° 30' S and longitude 137° 25' E in the depression may be interesting structurally.

The deep area in the southwest of the Permit area is very limited in extent. This remark also applies to the deep area in the northeastern corner of the Permit. Both these areas have maximum depths in the -4000 foot range.



(Lindsay N. Ingall)

Geophysicist.

March 2, 1964.