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REPORT ON GRAVITY SURVEY
at

ANDADO, NORTHERN TERRITORY
Flatt
~~McDills~~
by

GEOSURVEYS OF AUSTRALIA LIMITED.

Rto/b

TABLE OF CONTENTS.

INTRODUCTION

A gravity survey was conducted near Andado, Northern Territory, by Geosurveys of Australia Limited, between May 1 and July 27, 1960, between September 30 and December 9, 1960. Most of the area surveyed is bounded by latitudes 24½ degrees and 26 degrees south and longitudes 135 degrees and 136 degrees east and lies almost completely within the Northern Territory. The Application for Prospect is No. 45. Ties have been made to Finke and Abminga on the Adelaide-Alice Springs Railway beyond the limit of this lease.

The object of the survey was to continue an oil exploration programme in the area by acquiring gravity data, which would indicate trends of buried structure and their extension into the desert, preliminary to surveys by the reflection seismograph.

GEOLOGY AND GENERAL INFORMATION

The prospect area lies on the western edge of the Simpson Desert and consists mainly of flat alluvial plains relieved by isolated low mesas and cuestas. The more formidable sand dunes, of the true desert, start at the eastern edge of the area.

Gravity stations were laid out principally along tracks used by local graziers, and access to all stations was possible with the small four wheel drive vehicles used by the crew.

Although no surface water was encountered at the time of the survey, ample supplies of drinking water were obtained from bores in the area. These bores made convenient camp sites

for the crew.

The Simpson Desert obscures the junction of several Palaeozoic sedimentary basins. These include basins overlapping the Westralian continental shield, and also the margin of the Mesozoic Great Artesian Basin.

Rocks in the marginal desert area range in age from Archaean through Proterozoic into Cambrian, Ordovician, Devonian (?), Carboniferous, Permian and Cretaceous. These become obscured by thin veneers of Quaternary alluvial and aeolian deposits in the desert proper.

The basement complex of pre-Proterozoic metasediments is intensely folded and igneous intruded. Its surface was deeply peneplained, after which several distinct cycles of Proterozoic-Palaeozoic sedimentation, accompanied by orogenic and epi-orogenic movement, produced coalescing basins and developed a number of internal unconformities.

Proterozoic (?), Cambrian, Ordovician and Cretaceous sedimentation in the area was predominantly marine. Late Palaeozoic and early Mesozoic sediments, on the other hand, appear to be mainly of continental origin in the marginal outcrop areas. Recent discoveries by the South Australian Department of Mines, around the south western margins of the Great Artesian Basin, suggest that the marine Permian may also have spread into the Simpson Desert depression.

Little is known of geological structure and stratigraphy in the Simpson Desert, of which the Andado area is a part. Only Cretaceous, marine sediments occur in outcrop in slightly elevated

zones. Elsewhere alluvial plains and parallel seif sand dunes dominate. Drilling at Andado has shown that the Cretaceous shales range from a few hundred feet to about one thousand feet in thickness. They overlie sands of presumed Lower Cretaceous, or earlier Mesozoic age, and these in turn have been proved to rest on Permian sediments at Andado homestead.

To the west, presumed Permian periglacial sediments occur around Crown Point, near Finke, where they overlie fossiliferous beds of Ordovician age. These Palaeozoic sediments are mostly flat lying, in this general zone, although further to the north, they, and other Palaeozoic sediments, are folded extensively and faulted along selected zones.

The Cambrian, which outcrops only far to the northwest, is dominated by black, marine limestones and shales. The former tend to be bituminous. They are overlain by marine, Ordovician sediments, which, by contrast, are generally far more sandy. Ordovician outcrops extend to south Mt. Kingston (west of Finke), and presumably plunge eastward beneath the Simpson Desert.

An Archaean buried ridge which is the eastward continuation of the Musgrave Mountain belt, has been traced beneath Finke and Lilla Creek Station (S.E. of Finke). Granite, was in fact, encountered at approximately 500 feet in a well 8 miles east of the Lilla Creek Homestead.

Prediction of the deeper sedimentary developments in the Simpson Desert away from the foregoing buried basement ridge is extremely difficult. In that several Cambro-Ordovician basins

converge in the desert area, which is itself structurally negative, it is reasonable to expect that a thick section of Lower Palaeozoic sediments will be preserved within this province. Permian sediments are known to outcrop widely about the northern and western margins of the desert and can thus be expected to aggregate considerable thicknesses beneath Andado, where their presence has already been demonstrated by drilling. Other Palaeozoic accumulations can be expected. In more negative geomorphic zones, covered by low lying deserts, more marine facies may be anticipated.

Structurally the Simpson Desert occupies a negative topographic trend. It is presumably a province of ancient and continuing basin tendency. From the north-west the Amadeus geosyncline trends into the desert as does the Georgina from the north. The Officer basin comes in from the west. All of these are predominantly Lower Palaeozoic developments and all exhibit strong Jura type folding in the approaches to the pre-Proterozoic outcrops or shield areas. In the western, geosynclinal belts the fold axes strike prominently east-west. In the Georgina, where the folding is less well pronounced, WNW-ESE axes predominate, or the folds tend to be centripetal.

Folding in the Mesozoic strata is subdued or only basinal. North from about Oodnadatta gentle folds are aligned with north-south axes, and include in turn the dome like anticlines of Mt. John and Charlotte Waters extending north to the State border near Mt. Dare.

Andado occupies a low outcrop in Cretaceous shales extending slightly above the general desert area. This more positive topographic expression has previously been predicted to be anticlinal (company report by R. C. Sprigg, 1960). It occupies the general zone of intersection of the Oodnadatta, Mesozoic folds, and the earlier Palaeozoic trends of the Amadeus geosyncline.

FIELD PROCEDURE.

Gravimeter stations were laid out at intervals of approximately one mile on all traverses. Survey observations were made with a Wild T-1 theodolite.

Horizontal control was established by stadia survey. Ties were made to bores, sign posts and other permanent marks in the area. From the traverse plots it is believed that the horizontal location of all stations is known to within three hundred feet.

All stations were levelled with the theodolite and tied to a bench mark established by the Commonwealth Railway at Finke railway station. A vertical mistie of 3.3 feet occurred between Stations K172 and K103. This represents a gravity mistie of 0.21 milligals, but as the final maps were contoured with an interval of 1 milligal the results of this traverse were not discarded. The reason for the mistie is not apparent from the survey notes and a re-run would be necessary to find exactly where it occurs. The maximum vertical mistie on all other loops is 1.4 feet. This represents a gravity error of 0.084 milligals and is considered to have an insignificant effect on the accuracy of this survey.

Gravity values at all stations were determined with Worden Gravity Meter No. 215. Compensation for meter drift was made by

traversing in a "leap frog" pattern. Repeat readings at stations, for the estimation of drift, were made within periods not exceeding one and a half hours.

REDUCTION OF GRAVITY DATA.

Meter readings were plotted against their times of observation and instrument drift corrections were made from the resulting curves.

Conversion to gravity units was made by using a meter constant of 0.1101 milligals per scale division. This constant was checked before starting the survey by observing meter readings at two pendulum stations, established by the Bureau of Mineral Resources, at the University of Adelaide and Mount Lofty, South Australia.

Free air and Bouger corrections were applied to the observed values of gravity. These corrections were computed by assuming a relative density of 2.4 for the surface rocks. For this density assumption a correction of 0.06344 milligals per foot, as proposed by Nettleton[1.], was applied to compensate for differences in elevation between stations. Levels were first referred to an elevation datum of 400 feet above sea level.

Corrections for differences in latitude between stations were computed from tables, also compiled by Nettleton, giving theoretical values of gravity on the international ellipsoid. Latitudes were determined from an astrofix conducted at Station K240. The latitude of this station, as computed from the astrofix, was 25 degrees 27 minutes 12 seconds south.

The prospect area is one of very low relief and no terrain corrections were applied.

INTERPRETATION OF GRAVITY DATA.

The corrected gravity values, or Bouger anomalies, were plotted on a map with a scale of 2 miles to 1 inch, and contoured. This map is submitted as Appendix I to this report.

Gravity profiles were constructed from the contour data to investigate regional gradients. The north-south gradient was observed to be 0.066 milligals per mile increasing to the south. The east-west gradient was observed as being 0.025 milligals per mile increasing to the east. These regional gradients are considered to be of insignificant magnitude and a residual map was not constructed.

The most prominent feature is the gravity high located approximately eleven miles north of the New Andado homestead. The crest of this anomaly trends in a NE-SW direction and has a closure of approximately six milligals. It is believed that this anomaly represents a deep seated anticline probably associated with a basement uplift.

The more irregular gravimetric contours to the south and west of Andado coincide with the known thinning of the sedimentary section (800 feet at Lilla Creek) in this direction. To the north the Bouger anomalies flatten markedly coinciding with a greatly deepened section as demonstrated in drilling and by seismic reflection surveys in the vicinity of Andado Homestead.

The negative anomaly to the northeast of the Andado high is considered to be a synclinal trough with a still greater thickness of sediments than are present under the Andado high. The relatively steep gravity gradient between the above anomalies

suggests faulting or the truncation of the deeper sediments against the basal uplifts, postulated as being present under the Andado high.

The surveys have demonstrated clearly that the Andado uplift has deep structural significance. This anticlinal structure continues the N-S trend of the Charlotte Waters line of Cretaceous folding and/or warping, and intersects the E-W trends of the Amadeus Basin.

CONCLUSION AND RECOMMENDATION

The lack of geological and density data precludes any unique interpretation of the gravity results at Andado. It is therefore recommended that some investigation be conducted in the area with the reflection seismograph. Preliminary work would include a north-south line across the Andado high and a northeast-southwest line across the presumed synclinal trough to the northeast of the prospect area. Mile correlation shooting would be sufficient to establish the nature of these anomalies. Continuous profiling is recommended for a third line connecting the above two anomalies. This line may indicate the reasons for the steeper gravity gradients in this transition zone, which may be important in assessing the area as an oil prospect.

Respectfully submitted,

E. R. Denton B.Sc.
Geophysicist.

R. G. Dennison B.Sc.
Geophysicist.

Approved by:

R. C. Sprigg M.Sc.
Managing Director,
GEOSURVEYS OF AUSTRALIA LIMITED.

OPERATION STATISTICS

Party Supervisor	E. R. Benton
Survey & Meter Operator	G. L. Paterson
Rodman	D. H. Byrne
Driver/Assistants	J. E. T. Woods
	J. M. Hinaks
Reduction of Gravity Data	F. de Castillejo
	L. R. Burton
Interpretation	E. R. Benton
	R. G. Dennison
Field Survey Commenced	May 1, 1960
Field Survey Completed	December 9, 1960
Number of Gravity Stations	336
Station Interval	1 mile
Miles Traversed	336
Horizontal Survey Accuracy	300 feet
Vertical Survey Accuracy	1.4 feet
Gravity Meter	Worden No. 215
Scale Factor	0.1101 milligals per scale division
Elevation Correction Factor	0.06344 milligals per foot
Elevation Datum	+ 400 feet

BIBLIOGRAPHY.

1. L. L. Nettleton "Geophysical Prospecting for Oil"