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PRELIMINARY REPORT ON AIRBORNE SURVEYS (SCINTILLOGRAPH AND MAGNETOMETER)

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of

GERALDTON-ONSLOW REGION, W.A., 1956

by

W.D. PARKINSON

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PRELIMINARY REPORT ON AIRBORNE SURVEYS (SCINTILLOGRAPH AND MAGNETOMETER) of GERALDTON-ONSLOW REGION, W.A., 1956

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W. D. PARKINSON

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ILLUSTRATION

1. GENERAL

During June, July, August and part of September, 1956, the D.C.3 aircraft VH-MIN, owned by the Bureau of Mineral Resources, carried out a magnetometer and scintillograph survey over selected parts of the Carnarvon Basin. The area surveyed (Plate 1) consists of four zones each 30 minutes of latitude in width and extending from the pre-Cambrian exposures in the east to the coast in the west. For convenience, each zone has been given a name (chosen to avoid confusion with military one-mile or four-mile sheet areas) as follows :-

(i) Freycinet Area; 26°15'S to 26°45'S and 116°30'E to the west coast, including part of Shark Bay.

(ii) Gascoyne Area; 24°45'S to 25°15'S and 116°30'E to the west coast of Bernier and Dorre Islands. For ease of reference, the western part of this area has been designated Couture Area.

(iii) Birrabiddy Area; 23°45'S to 24°15'S and 116°E to the west coast.

(iv) Rough Range Area; 22°15'S to 22°45'S and 115°30'E to the west coast, including part of Exmouth Gulf.

The total area surveyed was approximately 24,800 square miles of which 2,200 square miles were over the ocean. The total survey mileage flown was 27,300 including 3,100 miles of tie lines.

A traverse was flown over the Indian Ocean, extending 90 miles west of Point Cloates. About 1,000 square miles requiring 2,000 flight miles were reflown at different heights to assist in the interpretation of the magnetometer results.

Personnel from the Bureau of Mineral Resources who took part in the survey were Miss C. Leary, Messrs. W. A. L. Forsyth, F. J. Merrick, A. Turpie, L. Jackson, W. A. Irving, B. C. Hamilton and G. Lamberts. Personnel from Trans-Australia Airlines involved in the survey were Captain D. K. Duffield and Messrs. B. Wales, C. Renshaw, R. Tuck, M. Gatley and R. McNamee.

2. SURVEY TECHNIQUE

Flight lines were generally spaced one mile apart and were east-west. Over the Couture Area, between the coastline and Bernier and Dorre Islands, flight lines were spaced 2 miles apart. All surveying, except special reflown traverses and the ocean traverse, was done at an altitude of 500 feet above ground.

Each zone was covered by north-south tie lines spaced not more than 25 miles apart. These were flown in both directions, without pause, so that instrumental drift and magnetic time variations could be allowed for. Adjacent zones were tied together by "link ties", also flown in both directions. As some of the zones are 60 miles apart, short "cross ties" were flown crossing both legs of each link tie at distances of 25 miles or less. In this way, only non-linear time variations occurring in less than about 10 minutes create errors in contouring.

Over most of the zones surveyed, navigation was effected by vertical air photographs and positioning by strip photography, later compared with the air photographs. Over the four-mile areas of Edel and Shark Bay continuous vertical photography does not exist. Navigation was possible from the existing photography and "dead reckoning". Positioning was effected by the ground position indicator, the data from which were later corrected according to aerial photographs. A similar technique was used over the Salt Lake in the Birrabiddy Area and over Exmouth Gulf.

Over the Couture Area and on the ocean traverse, the ground position indicator was used for both navigation and positioning.

3. EQUIPMENT

(a) Magnetometer.

An ASQ-1 fluxgate magnetometer was used. The detector element was mounted in a boom behind the tail of the aircraft. Sensitivities of 600 and 2,500 gammas full scale were used. The total recording ranges can be extended to 3,500 and 14,000 gammas respectively by an automatic zero-switching device. During most of survey of the Freycinet Area (the first area to be surveyed) a full scale sensitivity of 2,500 gammas was used, because some of the anomalies encountered exceeded 3,500 gammas and there was too much instrumental noise to use the higher sensitivity. In the other zones, however, the 600-gamma sensitivity was used.

A careful check was kept on heading errors. These are due partly to permanent magnetisation of the aircraft and partly to induced magnetisation. The former, and part of the latter, vary with cos Ø where Ø depends on the magnetic heading of the aircraft, while part of the errors due to induced magnetisation varies with cos 2Ø. After some initial difficulty, compensation of the heading errors proportional to cos Ø was achieved to with ± 10 gammas. The part depending on cos 2Ø amounted to ± 8 gammas and was not compensated. The heading errors for each flight are known to within about 3 gammas.

There was considerable drift in the backing-off current early in the survey, when the source of current was a battery. This causes errors, because the quantity recorded on the trace is the difference between the ambient field and the part compensated by the backing-off current. Late in June (i.e. just after completion of the Freycinet Area), the circuit was modified so that, although stabilised by a battery, most of the back-off current was supplied by a regulated 300-volt power supply. This reduced the drift to a negligible amount.

(b) Scintillograph.

The scintillograph consisted of a Chalk River (MEL) type radiation monitor and an Esterline Angus recorder. The output from two detector heads (i.e. four crystals each with its own photomultiplier tube) was fed into one ratemeter. The ratemeter had been modified so that the full-scale reading was 1000 counts per second. The response time of the counting circuit had been reduced to handle the higher count rate, and the output time constant had been decreased to about 1 sec. No attempt was made to restrict the angle of vision of the scintillograph detector by shielding.

Normal surveying was carried out at a height of 500 feet above terrain. Any radiation anomalies that appeared to be due to restricted sources were re-surveyed at 200 feet.

Relative sensitivity was determined at the beginning and end of each flight, by placing a gamma ray source at a standard distance from the detectors while flying above 2,000 ft., or over water. Only slight variations in sensitivity were experienced. The 5-microcurie source gave a count of about 200 per sec. at a distance of 5 feet.

(c) Navigation and Positioning.

Navigation and positioning equipment consisted of a vertical camera, a radioaltimeter, a gyro-syn compass and a ground position indicator.

The radioaltimeter is an STR-3CA frequency-modulated micro-wave type. Its calibration was periodically checked against the barometric altimeter. Considerable difficulty was experienced with the calibrations. At times, errors of up to 100 feet existed. Most of the time these were known and allowed for in the flying, but on a few flights the aircraft height was near 400 feet. This has very little effect on the magnetometer trace, and does not adversely affect the detection of anomalies by the scintillograph, although it might cause difficulty in the construction of an isorad map.

The ground position indicator operates by integrating data from the gyro-syn compass, air speed and wind. The wind must be set manually, and is the most uncertain parameter. When flying above 2,000 feet (e.g. on the ocean traverse), drift and ground speed can be determined continually and a fairly accurate wind can therefore be fed into the instrument, but at a height of 500 feet this is impossible.

4. RESULTS

(a) Scintillograph.

In general, the gamma radiation level increases from west to east across the surveyed area. All anomalies of any magnitude occur over pre-Cambrian rocks to the east of the sedimentary basin. These are large areas of particularly high radiation over the one-mile areas of Chulya Warra and Nanutarra.

Four fairly sharp first-order anomalies were reflown at 200 feet above terrain. None gave a figure of merit as high as those recorded over the uranium prospects near Mt. Isa (Parkinson, 1956), but two of them approach the figures for the poorer Mt. Isa prospects. One of these is about 10 miles south-west of Yinnietharra Homestead in the Mt. Steere one-mile area and the other is near Mt.Dugel in the Yourdar one-mile area.

(b) Magnetometer.

The outstanding feature of the magnetometer traces is the difference in type between those recorded over the sedimentary rocks and those recorded over the pre-Cambrian region. The former traces are smooth, each feature covering several miles, while the latter show large variations over small distances. In the Freycinet and Birrabiddy areas, the

change from one type of trace to the other is sudden, whereas in the Gascoyne and Rough Range areas, there is a transition zone where moderately sharp anomalies are found.

Particularly large, sharp anomalies occur in the one-mile areas of Chulya Marra, Narryer and Nanutarra. There is a slight tendency for these to occur along lines with a north-west direction. The largest anomalies are of the order of 4,000 gammas.

Several extensive positive anomalies were recorded over the sedimentary rocks. The most prominent are as follows :-

(i) A very broad anomaly with its major axis running north-south through the one-mile areas of Curbur and Narryer. It is about 40 miles wide and has a maximum value about 150 gammas above the undisturbed field.

(ii) A small (50 gammas), fairly narrow anomaly near 26°15'S, 115°E.

(iii) A very broad anomaly with a maximum value of 200 gammas, near the centre of the Greypoint one-mile area.

(iv) A fairly sharp anomaly of 100 gammas in the northern part of the Yalbalgo one-mile area and another in the central part of the Doorawarrah one-mile area.

(v) A large, fairly sharp anomaly of 500 gammas, a few miles west of Wandagee Hill.

(vi) Two similar, but more irregular anomalies, one in the eastern part of the Giralia one-mile area and one in the south-western corner of the Wangaroo one-mile area.

(vii) A small anomaly of about 30 gammas in the south-western part of the Bundera one-mile area, on the Cape Range.

The western portions of the three southern zones have smooth undulations in the magnetic field. The western part of the Rough Range Area is almost featureless, except for (vii) above.

The magnetic field measured on the ocean traverse is flat, except for a smooth increase about 30 miles from the coast.

5. ANALYSIS OF RESULTS

(a) Scintillograph.

Attempts were made to draw isorad maps and correlate them with geology. Over the pre-Cambrian region it is impossible to draw contours from one-mile gridding. The radiation level fluctuates greatly and probably varies with the thickness of the soil.

It was found that maps showing sudden changes in radiation level ("metarad maps") give more information than isorad maps. Many of these sudden changes coincide with, or are near, known geological boundaries. In some places the pre-Cambrian sedimentary contact shows up as a change in radiation level, but in most places it does not.

(b) Magnetometer.

There is little doubt that the change from a smooth type of magnetometer trace over the western regions to the irregular type of trace over the eastern regions corresponds to the contact between post-Cambrian sedimentary rocks and pre-Cambrian igneous and metasedimentary rocks. In the southern three areas the change coincides closely with the contact as shown on geological maps. In the Rough Range Area, however, the contact, as shown by the magnetic traces, is near 115°E, i.e. up to 15 miles further west than the geologically mapped contact. Judging by the irregularity of the magnetometer traces in this zone, the basin as far west as 114°20'E (i. e. near Exmouth Gulf) is only one or two thousand feet deep.

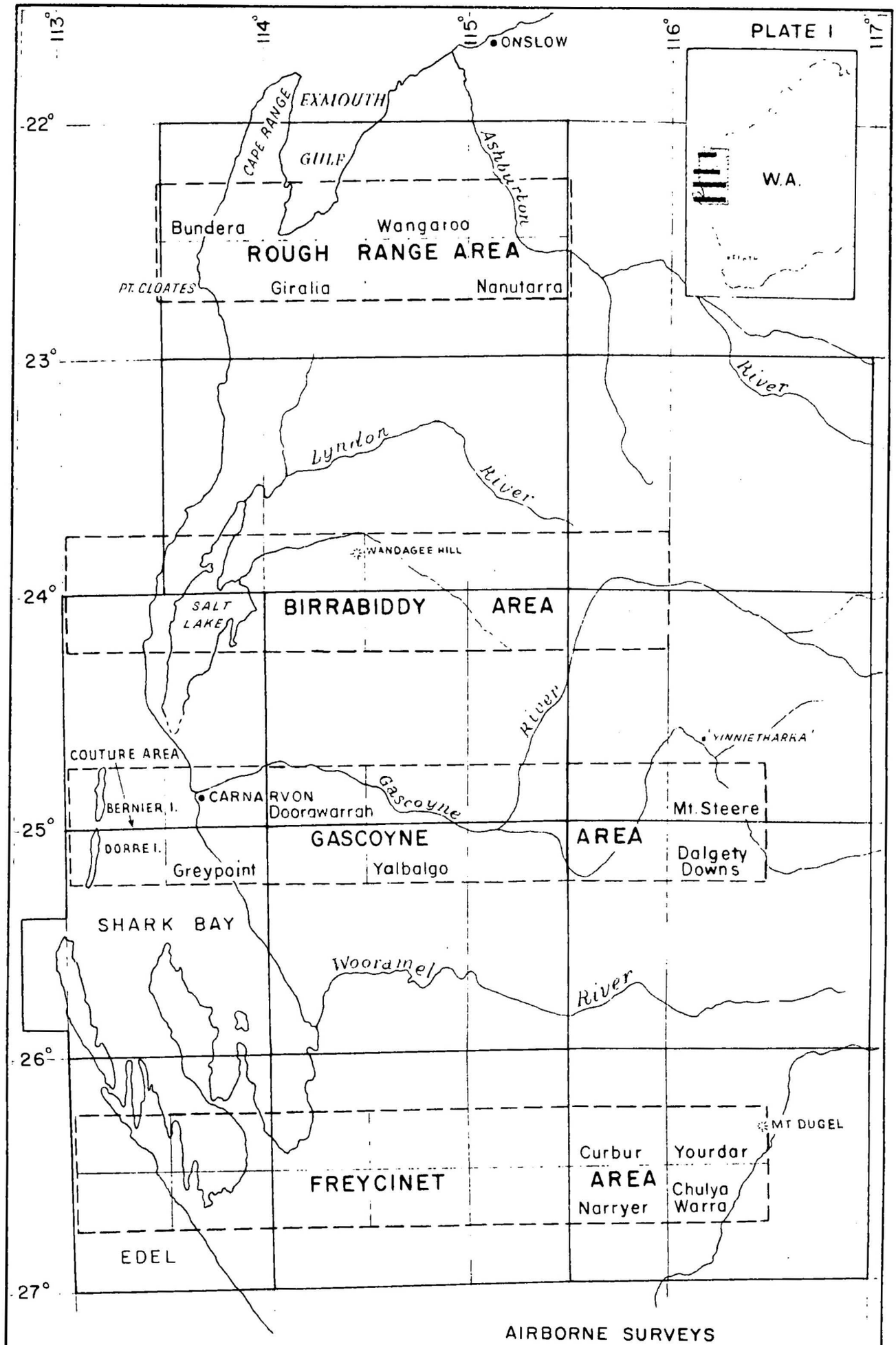
The magnetometer traces over most of the basin are consistent with a thickness of sediments considerably in excess of 10,000 feet. Those regions where the traces suggest a depth of 10,000 feet or less are either immediately west of the contact or in the zone of high gravity values that runs more or less parallel to the contact and about 50 miles west of it.

(c) Reflying of Traverses at High Level.

To assist in the interpretation of the magnetic results obtained at a height of 500 feet above ground, some flying was done in the Narryer, Chulya Warra, Mt. Steere and Dalgety Downs one-mile areas at altitudes up to 9,000 feet. Detailed analysis of these data has not yet been made but they indicate that reasonable estimates can be made of the depth to magnetic material. In particular, the magnetic traces recorded over much of the basin are considerably smoother than that recorded 9,000 feet above known pre-Cambrian basement rocks. This implies a thickness of sediments considerably greater than 9,000 feet.

6. REFERENCE

Parkinson, W. D., 1956 - Airborne Scintillograph Test Survey in the Cloncurry-Mt. Isa District, Queensland. Bur. Min. Resour., Aust., Records 1956, No. 109.



AIRBORNE SURVEYS
(SCINTILLOGRAPH AND MAGNETOMETER)
OF GERALDTON-ONSLOW REGION, W.A., 1956

LEGEND

EDEL — 4 MILE MILITARY MAP

Narryer — 1 MILE MILITARY MAP

AREA SURVEYED

LOCALITY MAP

SCALE IN MILES

50 0 50 100

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G 246-4