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GROUND INVESTIGATION OF AIRBORNE SCINTILLOGRAPH ANOMALIES NEAR BAMBOO CREEK, WESTERN AUSTRALIA.

by

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ABSTRACT

A brief inspection of an area around the Bamboo Creek mining centre was made in August, 1955, in order to check the source of certain anomalies discovered during an aerial scintillograph survey over the Pilbara mining field. The anomalies were found to arise from slight radioactivity in acid volcanic rocks of the Nullagine series.

1. INTRODUCTION

During an airborne radiometric survey of the Pilbara area, Western Australia, between April and August, 1955, several strong anomalies were located in an area around the Bamboo Creek mining centre. A small area was surveyed in detail by air, and a ground party visited the area in August 1955 to investigate the source of the anomalies. The results of the survey have been described by Parkinson and Daly (1955), and a brief account of the results of the ground survey is included in that report. As the results are of interest in connection with the general problem of the interpretation of anomalies obtained by radiometric surveys with a DC3 aircraft, they are described in more detail in the present report. Some suggestions are also made as to the most suitable methods of ground investigation of the anomalies found by DC3 surveys.

It should be noted that the present report refers only to a small portion of the results of the airborne survey.

The field party spent a fortnight in the area, but because of heavy rain and the necessity for vehicle repairs, effective field work was restricted to one week. The party was accompanied in the field by Mr. J. Sophoulis, geologist of the Western Australian Department of Mines.

2. THE GEOLOGY OF THE PILBARA AREA

The most comprehensive description of the geology of the Pilbara area is by Maitland (1908). Several of the mining centres in the district have been reported on in publications of the Western Australian Department of Mines, and the Aerial, Geological and Geophysical Survey of Northern Australia. A general geological map of the area is included in Maitland's report, but it is understood that this map requires revision with regard to some of the detail. The following notes are based on Maitland (1908), and on information supplied by Mr. Sophoulis. This information was obtained in general discussion, and the notes do not necessarily represent the opinions of Mr. Sophoulis on matters of detail.

The geological succession in the Pilbara district has been established as follows (in order of decreasing age):-

(i) Warrawoona series, consisting of greenstones and schists.

(ii) Mosquito Creek series, consisting of slates, quartzites and conglomerates.

(iii) Granite, which intrudes both Mosquito Creek and Warrawoona series.

(iv) Nullagine series, consisting of conglomerates and other sediments, and volcanic rocks.

The rocks of the Mosquito Creek and Warrawoona series are generally tightly folded, and contain gold, antimony and copper ore bodies. Some doubt is felt as to whether these rocks are correctly separated into two series, in the sense required by modern geological terminology. It is possible that a more correct classification would be as a single group of which the Mosquito Creek rocks are the metasedimentary and the Warrawoona rocks the volcanic members. Detailed geological mapping is necessary to clarify this point.

The granite is developed over large areas. In several places, it contains numerous pegmatite dykes, from which the tin, tantalite and beryl deposits of the Pilbara area have been derived, together with small deposits of rare minerals such as gadolinite, and radioactive minerals such as monazite, tanteuxenite, yttrotantalite, and others.

The rocks of the Nullagine series overlie the older rocks unconformably. They are characteristically free from tight folding and fracturing and are generally unmineralised, with the exception of a little gold in the basal conglomerate, derived from the underlying older rocks, and the lead deposits of Braeside (Finucane, 1938).

3. TECHNICAL DETAILS

The anomalies obtained in the Bamboo Creek area were the most intense in the Pilbara field, and ground investigation was confined to them. An area covering the most striking group of anomalies was surveyed, using flight lines spaced about half-a-mile apart. The positions of the lines were checked by recording prominent features such as creeks, on the aerial photos. The positions of anomalies obtained along the lines were marked on the photo by interpolation between check points. The photos were then assembled into a rough mosaic. A tracing made from this mosaic, showing approximate positions of flight lines and anomalies, and geological boundaries, is attached (Plate 1). The geological boundaries have been sketched in visually from the air photos, and have not been checked on the ground, except in so far as the marked positions of anomalies have been visited and rock types identified by Mr. Sophoulis.

The airborne anomalies in the Bamboo Creek area consist of a plateau of high radioactivity and several strong isolated anomalies.

4. RESULTS

Ground investigation was directed in the first instance to the groups of anomalies near the Little de Grey River, which gave the highest intensities on the airborne record. A detailed examination of this area was made to see whether these anomalies were due to local concentrations of radioactive minerals. It was found that the whole area enclosing the anomalies consists of acid volcanic rocks of the Nullagine series, which gave uniformly high readings on a portable Geiger counter. General readings obtained were three times background rising to five times background near large rock exposures. It was impossible under such circumstances to locate any definite spot as causing a particular airborne anomaly.

Attention was then directed to the other anomalies shown on Plate 1, and it was found that all, without exception, lie in areas of Nullagine acid volcanics, which showed a fairly uniform level of radioactivity of about three times background on a portable Geiger counter. The area covered by the plateau of high radioactivity contains rocks of the same type, showing about the same level of radioactivity.

5. DISCUSSION OF RESULTS

The results indicate that all the radioactive anomalies shown in the sketch map arise from slight radioactivity in acid volcanics of the Nullagine series. Although Nullagine rocks are widely distributed over the Pilbara mining field, anomalies on a similar scale were not encountered in other parts. This fact suggests that the strongest radioactivity may be confined to a limited section of the volcanic sequence. As these rocks in this area show only very gentle folding and no fracturing or other structure it is considered that there is little possibility of mineralisation in them and little possibility of their containing radioactive minerals in economic concentrations.

The most interesting point about the results is that large areas of rocks of uniform radioactivity, as detected with a portable counter on the ground, give completely different effects on the airborne equipment. In the present case, it is difficult on the ground, to see much difference between the Nullagine acid volcanics in the centre of the area, over which the airborne equipment records a plateau of moderately high intensity, and the Nullagine acid volcanics near the Little de Grey river, which appear on the airborne records as several isolated anomalies of high intensity. Inspection of the air photos shows a pronounced difference between the two areas. The area corresponding to the radioactive plateau is relatively undissected and appears as an elevated area of little relief, clearly showing the characteristic Nullagine jointing pattern. Volcanics in other portions of the area are much more dissected, and appear on the photos as ranges of low hills, with the jointing pattern almost completely obscured. However, this distinction is by no means obvious on the ground, and it would be very hazardous to predict the response of airborne equipment on the basis of observations on the ground in an area covered by rocks of this type.

6. REMARKS ON THE INTERPRETATION OF AIRBORNE ANOMALIES

The following remarks apply only to detailed aerial surveys. Reconnaissance aerial surveys are generally performed in areas for which detailed, or sometimes even regional geological mapping, does not exist, and the results must be assessed on completely different principles.

Since the introduction by the Bureau of airborne radioactive surveying with a DC3 aircraft, a considerable amount of critical comment has been levelled at the results of such surveys, and the relative merits of fast and slow-flying aircraft have been the subject of much debate. The Bureau has now had sufficient experience of surveying with the DC3 to enable a tentative basis to be suggested for interpreting results. The Bureau's experience with lighter, slower-flying aircraft, such as Austers, is as yet rather limited. For the purpose of a mining company wishing to prospect a limited area in detail, the smaller aircraft has obvious advantages in convenience and economy of operation. It is not unreasonable to suppose that the results of an Auster survey could be correlated more directly with the geology than is the case with the larger aircraft, but this assumption requires a good deal more experience for complete justification.

The obvious advantages of the DC3 aircraft are that it can cover a large area rapidly, and that its size enables it to carry elaborate positioning equipment. It is therefore possible to publish the results of a DC3 survey as an accurate map, with a minimum amount of skilled drafting work. From the point of view of an official organisation such as the Bureau, these matters are of great importance. Experience of several surveys in the Northern Territory, confirmed by the present survey, proves that the results obtained by a DC3 survey give a definite reflection of radioactive conditions on the ground, but that the connection between airborne and ground results is not always a simple one. Any endeavour to interpret the results on the basis of a one to one correspondence between airborne anomalies and definite radioactive high spots on the ground is very likely to fail.

It is suggested that the correct method of interpreting the results of a detailed DC3 survey is to consider the anomalies in groups, in conjunction with an air photo mosaic and a detailed geological map. The anomalies should be spotted on to the mosaic, and the resulting pattern considered in the light of the regional geology. Depending on the terrain, the grouping of anomalies on the mosaic will suggest areas or formations worthy of prospecting. The geological map will often enable a reasonable conjecture to be made as to the likely cause of the anomalies. The most economical prospecting method for testing such conjectures can then be employed. For example, the presence of a plateau of radioactivity over an area of granite or volcanic rocks is not uncommon (though, as in the present survey, the area of outcrop of radioactive rock may be much larger than the extent of the plateau). Clusters of anomalies in soil-covered areas along creeks adjacent to an outcrop of this type are often due to refractory minerals weathered out of the granite. A brief field check, and laboratory tests on samples, will enable a decision to be made as to whether such an area is likely to be of any value. On the other hand, a line of anomalies along a formation which, on geological grounds, is considered likely to be mineralised warrants detailed prospecting along the formation.

These principles can be easily applied to the Pilbara field. As mentioned earlier, no accurate detailed geological map is available, except over small areas. However, the area is ideally suited to mapping from aerial photos, and it is generally obvious from the photos to which series the rocks in a particular area belong. The treatment of anomalies will vary according to the nature of the rocks over which they occur. As the Warrawoona and Mosquito Creek series carry the main mineralisation of the district, any anomalies occurring in rocks of these series are worthy of detailed investigation. Anomalies in the Nullagine rocks may generally be expected to be due to volcanics, unless the presence of quartz reefs should indicate the possibility of mineralisation of the Braeside type. The first possibility would require only a brief field check. In the second case, detailed investigation would be warranted. The granite is known to contain pegmatite dykes carrying various radioactive minerals such as tanteuxenite, yttrotantalite, monazite, etc., and narrow veins rich in biotite, which contain monazite. Certain of the creek sands may contain minerals of this type. The best method of testing could be decided from the air photos for each particular area of granite containing anomalies. Although several of the radioactive minerals found in this district are quite rare and of considerable mineralogical interest, it seems unlikely that any economic return could be expected from prospecting for deposits of radioactive minerals in the granite of the Pilbara area.

7. ACKNOWLEDGEMENTS

It is desired to acknowledge the assistance of Mr. J. Sophoulis, of the Western Australian Department of Mines.

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PLATE 1
NULLAGINE SERIES
WARRAWOONA SERIES
GRANITE
NULLAGINE SERIES
BATTERY
Bamboo Creek
Little River
Nyarrin River
LEGEND
Approximate Geological Boundary
Plateau of High Radioactivity
Radioactive Anomaly
7 Flight Line
SCALE IN MILES
PT. HEDLAND
YARRIE
MARBLE BAR
NULLAGINE
Marble Bar
Bamboo
Nullagine
4 MILE MILITARY MAPS
APPROXIMATE SCALE IN MILES
AERIAL SURVEY, PILBARA AREA
GEOLOGICAL SKETCH MAP OF BAMBOO CREEK AREA
BASED ON UNCONTROLLED AIR PHOTO MOSAIC
RADIOACTIVE ANOMALIES DETECTED
BY AIRBORNE SCINTILLOGRAPH
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