COMMONWEALTH OF AUSTRALIA

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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1961-152

GARDINER RANGE, KILLI KILLI, AND TANAMI AIRBORNE RADIOMETRIC SURVEY, N.T. AND W.A. 1961

by

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Plate 1. Map showing radiometric anomalies (G389-3)

ABSTRACT

A low-level airborne radiometric survey was made by the Bureau of Mineral Resources during July and August 1961 in the Gardiner Range, Killi Killi, and Tanami areas of Western Australia and Northern Territory.

In the Killi Killi area the only radiometric anomaly recorded was due to a known uranium prospect. Several anomalies recorded in the Gardiner Range were found to be caused by surface laterite. In the Tanami area one anomaly is considered to warrant further investigation on the ground.

1. INTRODUCTION

A discovery of radioactive rocks in the Killi Killi area 50 miles west-north-west of Tanami, Northern Territory, was reported by New Consolidated Gold Fields (Australasia) Pty Ltd in August 1960. Later in the same month officers of the Bureau of Mineral Resources, accompanied by Mr. A.B. Clark, senior field geologist of the Company, inspected the area on behalf of the Australian Atomic Energy Commission. The inspection confirmed the occurrence of uranium in the basal conglomerates of the Upper Proterozoic sequence. Because of the remoteness of the locality and the low-grade and refractory nature of the mineral, it was considered that a drilling programme was not warranted at that stage. However, it was recommended that a low-level airborne radiometric survey should be carried out over the Upper Proterozoic rocks in the area to determine whether other similar prospects were present (Prichard, Dallwitz, and Roberts, 1960).

A request was later received from the Company for an airborne radiometric survey of two areas of Upper Proterozoic rocks within the Company's mining reserves; one area near the Killi Killi prospect, the other in the Gardiner Range. The survey described in this Record included these two areas, the locations of which are shown on Plate 1. Although the primary object of the survey was to detect localised sources of radioactivity, which might indicate uranium prospects, it was also hoped that the radiometric method would be useful for tracing exposures of the basal conglomerates, which were considered to be of interest as a possible host rock for gold and other minerals in addition to uranium.

The survey was extended to the east to include outcrops of Upper Proterozoic rocks in the Tanami area. This area forms the northern portion of a prospecting authority currently held by Enterprise Exploration Pty Ltd.

The aircraft used for this survey was a Cessna 180 equipped with a scintillograph and a radio altimeter. Operations were based on Tanami.

Bureau Officers who took part were J.M. Mulder, geophysicist (Party leader), A. Crowder, drafting officer, and I. Parkinson field assistant. The aircraft was piloted by First Officer J. Barton of Trans-Australia Airlines. A.B. Clark, geologist, and N. Richards, field assistant both of New Consolidated Gold Fields, assisted in the survey over the Company's reserves.

2. GEOLOGY

The areas included in the survey form part of the fringe area of the East Kimberley Plateau. The oldest exposed rocks are the Lower Proterozoic geosynclinal metamorphic rocks, which are strongly folded and faulted and are considered to be equivalent to the Halls Creek Metamorphics. They include steeply dipping, slightly schistose, fine-grained quartz greywacke (Prichard et al, 1960). In places they can be seen to underlie the Upper Proterozoic rocks that form the Gardiner Range, and elsewhere, as in the Tanami survey area, they crop out sparsely as low hills.

Sediments of Upper Proterozoic age, which unconformably overlie these metamorphics, crop out in the Gardiner Range and in the Killi Killi and Tanami areas. They contain medium to coarse sandstone, conglomerate, and some shale and have also been folded and metamorphosed. A.B. Clark of New Consolidated Gold Fields has recognised three units in the Upper Proterozoic. The basal member of the lowest unit, which contains conglomerate, grit, and current-bedded sandstone (Clark and Bockley, 1960) is uraniferous in the Killi Killi Hills; a geological investigation indicated that the highest uranium content occurs where the dip of the formation is less than about 8 degrees.

Granitic rocks occur near the north-western end of the Gardiner Range and in the extreme north-eastern corner of the Tanami area. The soil which covers most of the survey areas has probably been formed in situ by weathering of the underlying rocks. East and west of Tanami there are ridges of outcropping sandstone. The extreme eastern part of the Tanami survey area is covered by Cainozoic strata consisting mainly of Quarternary sand, laterite, alluvium, and residual soil.

3. EQUIPMENT

The aircraft used during the survey was equipped with an Austronic Engineering Laboratories scintillograph type AS1, consisting of a detector head and ratemeter.

The detecting element of the scintillograph was a thallium-activated sodium iodide crystal $4\frac{1}{2}$ in. in diameter and 2 in. thick. The crystal was optically coupled to a photomultiplier tube, Dumont type 6364. The output of the photomultiplier was fed to a ratemeter which produced an output current proportional to the count rate input. This output current was registered on an RD-47A dual-channel recording milliameter to provide a continuous trace of the gamma-ray intensity at the detecting crystal.

An AN/APN-1 radio altimeter was used to indicate the height of the aircraft above the ground. The output of this instrument was fed to the second channel of the recording milliameter. A set of limit lights was incorporated in this altimeter, to provide the pilot with an indication of the height of the aircraft with respect to the pre-determined height limits; viz. 180-210 ft above ground level.

4. OPERATIONS

The survey took place between 20th July and 1st September 1960.

The aircraft was flown at a nominal height of 200 ft above ground level. At this height, the lane scanned by the scintillograph is approximately 500 ft in width. The width of lane scanned varies, however, in rugged country where the nominal height cannot always be maintained.

In parts of the Gardiner Range and Killi Killi areas the steep escarpments made it impossible to fly at a constant height along lines at right angles to the strike of the basal conglomerate. The Upper Proterozoic rocks crop out in the escarpments and in places the basal conglomerate occurs at the base of, or from $\frac{1}{2}$ to $\frac{3}{4}$ mile in front of, the escarpments. In these circumstances it was necessary to fly along the outcrops or obliquely over them.

The line separation was chosen according to the geology and ranged from 1/5 mile near the escarpments in the Gardiner Range and Killi Killi areas, to 1/2 to 1/3 mile in the Tanami area. The speed of the aircraft was maintained at approximately 120 m.p.h.

K-17 aerial photographs, at a scale of approximately 1.3 inches to one mile, were used for navigation. Flight lines and check points were plotted by the observer on these photographs during flight. Anomalies that were considered to warrant re-flying were re-flown at a separation of 6 lines to one mile.

Before and after each survey flight the response of the scintillograph equipment was checked by measuring the signal from a standard radioactive source placed at a predetermined distance from the detector head. This test was done at an altitude of 2000 ft, where the ground radiation is effectively zero. Regular checks on the operation of the radio altimeter were made by flying at 200 ft over the airstrip and comparing the radio altimeter and the barometric altimeter indications. Owing to the irregular behaviour of the radio altimeter and its limit lights, it was necessary to depend on the barometric altimeter for height control during many of the survey flights.

At the conclusion of the survey, 3150 line miles had been flown over a total area of 840 square miles.

5. DISCUSSION OF RESULTS

(1) Gardiner Range and Killi Killi areas

In the interpretation of the survey data from these areas, the scintillograph records were inspected for anomalies that could be due to localised sources containing a high concentration of radioactive minerals or to linear sources of disseminated radioactive material. The linear sources were of interest because they might be associated with exposures of the basal conglomerate.

The criterion normally adopted in low-level airborne scintillograph surveying for selection of anomalies due to localised sources or to linear sources flown at right angles to the strike is that the width of the anomaly at half maximum amplitude (half-width) should not exceed 6 seconds on the scintillograph record, or approximately 1000 ft in terms of distance. When a linear source is flown obliquely to the direction of strike the anomaly is modified; in particular, there is an increase in width. In the Gardiner Range and Killi Killi areas the lines were mainly flown obliquely to the strike and the method of interpretation was modified to accept anomalies of half-width equal to or less than 10 seconds.

The records were inspected initially to determine the background level of gamma radiation over the Upper and Lower Proterozoic rocks in the area. Increases in this level that could not be regarded as part of the background radiation were accepted as anomalies provided they satisfied the modified width criterion. These anomalies were further examined to determine whether they were caused by topographical features; this was done by inspection of the relevant aerial photographs. If such a cause could be established, the anomalies were discarded. The remaining anomalies were re-flown at a closer line spacing and the resulting records analysed in a similar manner to the original records.

In the Killi Killi area the only anomaly recorded was over Prospect No. 1. This prospect was not easily detected by the airborne scintillograph, and the anomaly recorded over it had a count rate of only $1\frac{1}{4}$ times background and a half-width of 5 seconds. A ground inspection made at the time by A.B. Clark showed that the radioactive grit was almost completely overlain by sandstone, which accounted for the difficulty in detecting it from the air.

Several flights were made over the locality of Killi Killi Prospect No. 2 but no anomaly could be recorded over this prospect.

Seven anomalies were recorded in the Gardiner Range area, located as shown on Plate 1. From the airborne results these anomalies were interpreted as being caused by surface laterite, but confirmation by ground inspection was considered desirable to ensure that they were not associated with the basal conglomerate. The anomalies were investigated on the ground by A.B. Clark and were found to be caused by deposits of surface laterite. None of the anomalies was associated with radioactive mineralisation or with the basal conglomerate.

(2) Tanami Area

The interpretation of the results from this area followed the procedure already described except that attention was paid to only those anomalies that could be associated with localised sources; i.e. anomalies with half-widths equal to or less than 6 seconds.

Several anomalies showing count rates of twice background were located in the Tanami area. These were re-flown at closer line spacing and with one exception were found to be caused by surface laterite and were therefore discarded for further follow-up. The exception is shown as anomaly No. 9 on Plate 1. It occurs near a scarp of outcropping metamorphic sandstone and is recommended for ground inspection.

6. CONCLUSIONS

The results of the survey of the Gardiner Range and Killi Killi areas show that, with the exception of the one at Killi Killi Prospect No. 1, none of the radiometric anomalies is associated with deposits of radioactive minerals or with the presence of the basal conglomerates of the Upper Proterozoic sequence.

In the Tanami area, only one anomaly has been selected for further follow-up by ground inspection.

In view of the results of this survey, no further airborne radiometric work in the region is recommended.

7. ACKOWLEDGEMENT

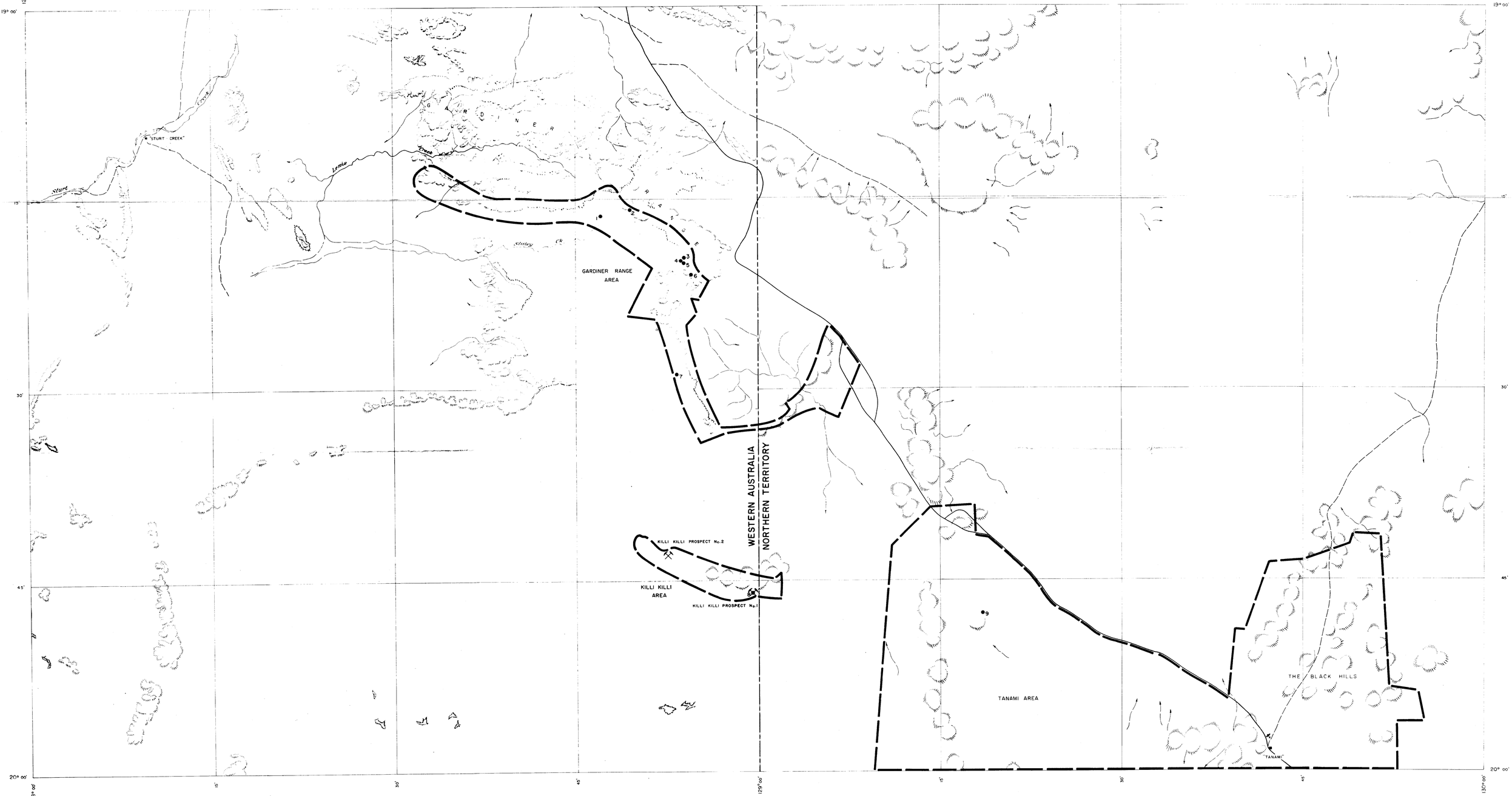
The author is indebted to A.B. Clark of New Consolidated Gold Fields for the geological information on the Killi Killi prospects and the Gardiner Range and for his co-operation in other ways during the course of the survey.

8. REFERENCES

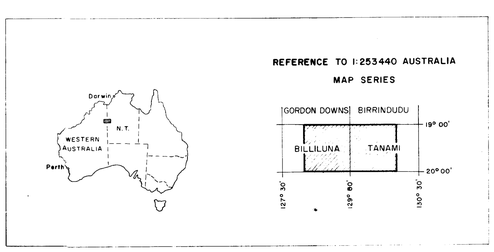
CLARK, A.B. and BLOCKLEY, J.G. 1960 A report on the geological reconnaissance Temporary Reserve 178H Kimberley Goldfield, Western Australia. New Consolidated Gold Fields (Australasia) Pty Ltd.

PRICHARD, C.E., DALLWITZ, W.B. and ROBERTS, W.M.B. 1960 The Killi Killi uranium prospects, Western Australia. Bur. Min. Resour. Aust. Records 1960-C4 (Confidential).

PLATE I



LOCATION DIAGRAM



True North
Mag North

WESTERN AUSTRALIA - NORTHERN TERRITORY

GARDINER RANGE, KILLI KILLI AND TANAMI AREAS

MAP SHOWING

RADIOMETRIC ANOMALIES

DETECTED BY AIRBORNE SCINTILLOGRAPH

SCALES

4 2 0 4 8 12 16 MILES

10 5 0 10 20 30 KILOMETERS

MAP DATA

PROJECTION : TRANSVERSE MERCATOR

PLANIMETRIC DETAIL : AFTER BILLILUNA 1:253440 W.A. DEPT. OF LANDS AND SURVEYS MAP AND I.C.A.O. WORLD AERONAUTICAL CHART OF HALLS CREEK

RELIABILITY : SKETCH ONLY

TOPOGRAPHICAL DATA

- RIVER OR CREEK
- ROAD
- TRACK
- AERODROME OR LANDING GROUND
- HOMESTEAD
- STATE BOUNDARY

SCINTILLOGRAPH DATA

- ANOMALY (ANOMALIES ARE NUMBERED FOR REFERENCE ONLY)
- LIMIT OF THE 1961 AIRBORNE SURVEY

G389-3

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

TO ACCOMPANY RECORD No. 1961-152