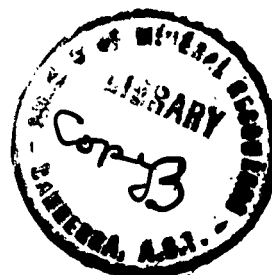


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REPORT ON
RADIOACTIVE SURVEY WORK
IN THE PILBARA AREA, W. A.

DURING 1948

By

D. W. KEAM
Geophysicist

REPORT NO. 79/1948

GEOPHYSICAL REPORT NO. 13/1948

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REPORT

ON

RADIOACTIVE SURVEY WORK IN THE PILBARA AREA W.A. DURING 1948.

I. INTRODUCTION

The Pilbara gold field (as originally defined) is situated in the north of Western Australia, and includes most of the area enclosed between latitudes $20^{\circ}S$ and $22^{\circ}30'S$, and longitudes $118^{\circ}30'E$ and $121^{\circ}30'E$. In more recent years it has been widened to include the area previously defined as the "West Pilbara Gold field", but no work was done in this portion of the field.

The Pilbara gold field area contains many other minerals besides gold. It has long been known that radio-active minerals, including monazite and certain rare-earth tantalates, occur in portions of the Pilbara field. There is also one known highly radio-active deposit of pilbarite at Wedgina.

The rare-earth tantalates contain up to 15 per cent of uranium and occasionally very small amounts of thorium. They also contain tantalum, niobium, titanium and the rare-earth elements, yttrium, cerium, etc. The principal recorded rare-earth tantalates, which occur almost exclusively in the Pilbara district, include fergusonite, formanite, euxenite, tantouxenite, yttriotantalite, samarskite and tantalopolyrase. A report on the known deposits of these minerals is found in "Tantalum and Niobium", Bulletin No.3, 1945, Western Australia Department of Mines by Keith R. Miles, Dorothy Carroll and H.P. Rowledge.(referred to later as W.A.D.M. Bulletin No.3).

Pilbarite is more radio-active than the rare-earth tantalates mentioned above since it contains about 27 per cent of uranium oxides and 31 per cent of thorium oxide. Monazite contains a trace of uranium and may have up to 16 per cent of thorium in it.

A survey to determine the position and extent of radio-active occurrences in the Pilbara area was carried out during the period September - October, 1947. In the report on this survey a number of recommendations was made, and subsequently a further field party was sent to the area during the period September - October, 1948. This report is an account of the geophysical work done by this second party.

Investigations were carried out at a few specific localities - (i) Mount Francisco, (ii) Wedgina, (iii) Eastern Creek, (iv) Pilgangoora, (v) Abydos, (vi) Trig Hill, (vii) Cooglegong and (viii) Eley's well. These are shown on the geological sketch map and each is treated in turn below.

The main part of the work consisted of testing known or suspected rare-earth tantalate deposits. Also, a further search was made for monazite in areas on and near the Cooglegong tin fields.

The field party consisted of W.C. Smith, geologist and D.W. Keam, geophysicist of the Bureau of Mineral Resources, Geology and Geophysics, and Mr. A. Jones, prospector-guide. It is desired to acknowledge the assistance rendered by Mr. A.L. Kennedy, manager of Tantalite Ltd. mine at Wedgina who kindly acted as guide in the Mount Francisco area, and made available valuable information that he had gathered concerning the Wedgina, Eastern Creek and Pilgangoora areas.

The writer is indebted to other officers of the Bureau for help given both in the field and during the preparation of this report.

II. TECHNICAL PROCEDURE.

Tests for radio-activity were carried out with portable counting-rate meters of the Austronic type PRM 200. These use gamma-ray type Geiger-Muller tubes, and measure intensity of gamma radiation only. The dimensions of the instrument are 7 $\frac{1}{2}$ " x 9" x 4 $\frac{1}{2}$ " overall, and the weight, complete with headphones, is approximately 7 $\frac{1}{2}$ lbs.

A switching arrangement allows for any one of four operating ranges to be used. On these ranges, full-scale deflection of the meter represents rates of 250, 1000, 2500, and 10,000 counts per minute.

Headphones are provided for audible checking of operation. Also, the circuit is so arranged that both high and low tension batteries may be tested. Batteries were changed once during the survey, but no other trouble with the meters was experienced.

Minerals contained in lode material were tested by placing the rate meter as near as possible to the lode. Where minerals existed in alluvial or eluvial form, they were concentrated and tested by placing the rate meter directly on top of them. Concentrates were obtained by Mr. A. Jones using a process known as "yandying". This is a process by which heavy detrital minerals are concentrated at one end of a slightly curved oval-shaped sheet of wood or iron, by means of a continuous rippling gyratory motion supplied by the operator.

The background count of the rate meters, due to cosmic rays and possibly slight radio-active content in the material of the equipment, was approximately 50 counts per minute. By subtracting the background count from that observed for a particular sample, the activity due to the sample alone is obtained. This has been done in all cases where activities are quoted in the following results.

III RESULTS

(1) Mount Francisco.

Mount Francisco lies about 16 miles south south-west of Wedgina, but is about 28 miles by road. Several mineral deposits on or near Mining Claim 121 (Tantalite Ltd.) were investigated. This claim is approximately one mile east of Francisco well.

Manganotantalite occurs in a highly micaceous pegmatite which outcrops in an area about 20 feet square. Only a very slight activity of 60 counts per minute was found over this outcrop. The tantalite occurs in small sheaves of tabular crystals, and so is generally referred to as "radiating" tantalite.

No activity could be detected on or near the beryl lode worked by Rodgers, Hookey and Radley. The tin lode on the Congo Mining Lease, which is on the southern edge of Mining Claim 121, also showed no activity.

About 100 feet south of the south-east corner peg of Mining Claim 121 is a lode containing mineral which was believed to be columbite. This mineral proved to be fairly active, an average count of 750 per minute being obtained on placing the rate meter on various parts of the lode. The lode material outcropped in a very small area about 2 feet square,

and indications were that there was very little remaining mineral. A small quantity of screenings scattered nearby showed an activity of 145 counts per minute.

A 2 lb. sample of the mineral previously identified as columbite, BLR/ANI/WCS, which had an activity of 540 counts per minute, was left at the Perth Chemical Laboratories to be assayed. The fact that this mineral was radioactive seems to indicate that it is probably one of the rare-earth tantalates and not a normal columbite. Rare-earth tantalates usually have a specific gravity between 5.5 and 5.9, which, according to Dr. Simpson's specific gravity chart², is the same as that of columbites containing between 14 per cent and 30 per cent tantalum. Thus, if any rare-earth tantalates are not assayed and are wrongly assumed to be normal ferro- or manganotantalites, then the specific gravity test would indicate that they were columbites. Consequently it was decided to check, where practicable, all deposits in the area which were believed to contain columbite.

On page 37 of U.A.D.E. Bulletin No. 3 it states that "tanteuxenite associated with monazite has been recorded in tin concentrates from a find five miles south of Mount Francisco". Then, on page 134 is reported that, "alluvial tin ore from P.A.630, 6 miles south east of (Francisco) well contained some limonite, monazite and tanteuxenite".

These apparently both refer to the same deposit which must be just south of White well. White well is about 5 miles south-east of Francisco well. An unsuccessful search of this area was made.

The track to "Hoolley's columbite lode", which is about 4 miles east-south-east of Francisco well could not be found. Mr. Kennedy who had visited it in 1937 could not find it from landmarks. In any case, the lode is reported locally to have been almost completely worked out and would therefore be of no great interest. A sample supplied by Mr. Kennedy, which he thought probably came from this area, showed no activity.

(11) Wedgina

Wedgina is situated about 70 miles by road due south of Port Hedland. The majority of the known mineral deposits in this area were investigated by the 1947 party.

So as to be able to give an approximate estimate of the intensity of other deposits, the pilbarite lode was tested. Both counters gave a count of 1600 per minute when placed as near as possible to the lode.

As columbite had been mined from two of the gullies on Mining Claim 140 (Tantalite Ltd.), these were investigated. These gullies had been almost worked out, and it was only with difficulty that a 2 lb. sample of columbite was obtained. This showed no activity.

The calcio-tantalite workings on the same lease also showed no activity.

A hole about 10 feet long, 4 feet wide and 5 feet deep from which manganotantalite had been mined was also tested. In the bottom of this pit the average activity was 600 counts per minute, but no "high spots" could be found either near the albite pegmatite or near a micaceous material which was present. Samples of both the albite pegmatite and micaceous material were taken but failed to show any activity. The nearby screenings

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² See p.16 of U.A.D.E. Bulletin No. 3

showed a fair activity of 150 counts per minute when the heap was tested, and a 4 lb. sample of the screenings showed an activity of 50 counts per minute. As the yandy failed to produce any active concentrate from the screenings, it is presumed that the activity present in the hole is due to very small traces of some highly active material, possibly pilbarite or maitlandite. The small amount of lode material remaining there did not warrant any further investigations.

(iii) Eastern Creek.

Eastern Creek is about half a mile east of the Wodgina-Mount Francisco track and about 15 miles by road from Wodgina.

On Tantalite Ltd's Mining Claim 119 are two alluvial patches both of which have been worked for "columbite". The larger area is of very flat topography and about 150 feet by 50 feet. This has been almost completely worked out. The other area nearby is also very flat but is smaller in size. It has been partially worked but does not appear to be very rich in columbite. The total amount of columbite remaining in both areas would probably be less than half a ton.

A 3 lb. sample of hand picked columbite, BER/AM3/WCS, was collected from the first area, and this had an activity of 330 counts per minute. A 1 lb. sample of similar material from the second area, BER/AM3/WCS, showed an activity of 150 counts per minute. Both of these samples have been left at the Perth Chemical Laboratories to be assayed.

(iv) Pilgangoora.

Pilgangoora lies about 14 miles east-north-east of Wodgina. The range of hills (McPhoe's Range) contains many narrow pegmatite veins of limited length carrying cassiterite, tantalite, columbite and microlite, but the bulk of the tin and tantalite production has been derived from alluvial deposits in the creeks and from eluvial detritus on the slopes.

Concentrates of tin, iron and tantalite yandied from Paradise and Webster's gullies showed only very slight activities of less than 50 counts per minute. The Mt. York tin lode showed no activity.

(v) Abydos.

A small parcel of "columbite" which Mr. Kennedy had received from Mr. D. Watkins showed fair activity. It appeared sufficiently interesting to warrant investigation of the deposit if possible. Crystals were up to 3 inches in length and on the whole much larger than the normal alluvial columbite found in the Wodgina area. A 2 lb. sample, BER/AM4/WCS, showed an activity of 460 counts per minute and has been left at the Perth Chemical Laboratories, to be assayed.

A very vague description of the location of this deposit between Abydos and Ailsa Downs was given by Mr. J. Parker of Port Hedland. It was found impossible to find the deposit from these instructions. According to information obtained later from Mr. G. Hall the deposit was further east of the area searched.

The Pinger gully was tested and found to contain a small amount of monazite mixed in with the tin. A 1 lb. sample of mineral concentrate showed an activity of 135 counts per minute. Monazite was also found in the tailings around the old jig plant near the Pinger well. This jig plant had been used for testing samples from a number of surrounding gullies.

(vi) Trig Hill

On page 36 of W.A.D.M. Bulletin No. 5 it is stated that "fergusonite has been recorded in situ in a pegmatite dyke on Trig Hill, Cooglegong" and on page 130 that "the mineral from here first described as fergusonite has since been proved to be yttrotantalite being orthorhombic in crystallisation and containing much more tantalum than niobium. The first sample, discovered in 1906, came from a gully on the side of Trig Hill, but the locality is not very definite. In 1913 a small sample was got from a pegmatite outcrop. The alluvial sample consisted wholly of clean yttrotantalite in subangular fragments up to 20 grams in weight".

These statements have apparently been written on information gained from descriptions given by prospectors who have sent in samples to the Mines Department. No yttrotantalite could be found in the pegmatite which was apparently the one referred to above. This was verified by Mr. G. Lamont, a local prospector who claims to have sampled the pegmatite without success.

The small amount of yttrotantalite left in this area is almost certainly of no commercial importance. Two bags would be a very liberal estimate of the amount of this mineral left there, and this quantity was considered insufficient to warrant a plane table survey with detailed testing.

A steep narrow gully runs from near the pegmatite down the side of the hill into a slightly larger gully which runs in a semi-circle at the bottom of the hill. By far the biggest concentration of yttrotantalite was found at the junction of these two gullies. This was borne out by activities shown when the rate meter was placed on the surface at various points along both of the gullies. The activity at the junction was 420 counts per minute, and at no other point either along the gullies, or on or near the pegmatite, was a count of greater than 60 per minute obtained. Hence, providing the radioactive minerals are near the surface as they were here, the Geiger-Muller counter or rate meter can give a good indication as to where the greatest concentrations are situated.

A 4 lb. sample of almost clean yttrotantalite collected at the junction of the two gullies showed an activity of 2090 counts per minute.

(vii) Cooglegong.

(a) Granite Investigation.

The Cooglegong Creek is rather a large sandy creek which is crossed some 4 miles from Pilga on the Pilga-Hillside track. It joins the Shaw river about 20 miles north of Hillside. Many gullies running into the Cooglegong creek have been worked for tin and quite a few of them carry a small amount of monazite.

An area described under "Beryl Lode, Cooglegong Area" (1947 report) was investigated during the 1947 survey. By careful study of the aerial photographs, a large granite outcrop which appeared to be an extension of the granite country investigated in 1947, was chosen for investigation. This outcrop was about 2 miles north west of the "Beryl Lode", and just on the western side of the Pilga-Hillside track.

Small quantities of monazite were found in several small gullies in this granite. Counts of the order of 50 per minute were obtained over the whole of the area including the soil-covered parts along the edge of the granite outcrop. No perceptible increase in activity could be noticed on any of the narrow pegmatite veins which were found in the granite. Also,

no biotite-rich patches, such as were found in the 1947 survey to be slightly more active than the normal granite, could be detected in this granite outcrop.

The majority of the gullies in this granite area carry a small amount of monazite, but, of those investigated, none carry quantities of economic importance. The small activity in the granite is probably due to microscopic intrusions of some radioactive mineral. This is possibly monazite, since monazite is found in the gullies, but chemical analyses of the granite have so far failed to detect it.

(b) Reward Gully

At the suggestion of Mr. A. Jones, Reward Gully, about 5 miles south-south-east of Pilga station was visited and tested. The gully runs along the eastern side of a large dolerite dyke.

Mineral concentrates were very small along this gully except on the down-stream side of a few rock bars which run across it. A 2 lb. sample was collected and this showed an activity of 650 counts per minute. As there was insufficient mineral in this gully to be of any economic importance, this sample was not sent to be assayed.

(c) Little Two Mile Alluvial Workings.

This area is about 4 miles south-south-east of Pilga and was originally worked for tin. Mr. Williams, who was prospecting for tin in the surrounding area, claimed to have obtained a $\frac{1}{2}$ lb. sample of monazite from a kerosene tin full of surface material from this place. No monazite whatsoever could be found in the ground immediately surrounding the hole from which the sample was supposed to have been obtained. Scattered pieces of monazite were found in the area, but there was no appreciable concentrate in any of the ground tested. It seemed impossible that such an amount of monazite could come from the small hole indicated and probably the origin of mineral was misreported.

(viii) Eley's Well

It was intended to make a further search for the yttriotantalite and tantauxenite which was reported from "Eley's creek between the old and the new Government wells". No trace of these minerals could be found during the 1947 investigations. In order to reach this area, the Shaw river had to be crossed at either of two crossings near Hillside. These were both impassable owing to large pools of water covering them and so the Eley's area investigation could not be carried out.

IV CONCLUSIONS

(i) All radioactive deposits investigated were found to be very limited in size.

(ii) Apart from the pilbarite occurrence at Wodgina, no deposit showed any very high activity. This indicates that none of the deposits examined contain appreciable quantities of thorium or uranium.

(iii) A few mineral deposits, which have been worked as columbite, were tested and found to be radioactive. This is probably due to radioactive rare-earth tantalates being present. As explained above, these could quite easily be mistaken for columbite. This points to the desirability of testing known columbite deposits for radioactivity.

(iv) There is very little yttrotantalite in the lode at Trig Hill, and the quantity of alluvial yttrotantalite in the gully is probably less than 2 bags.

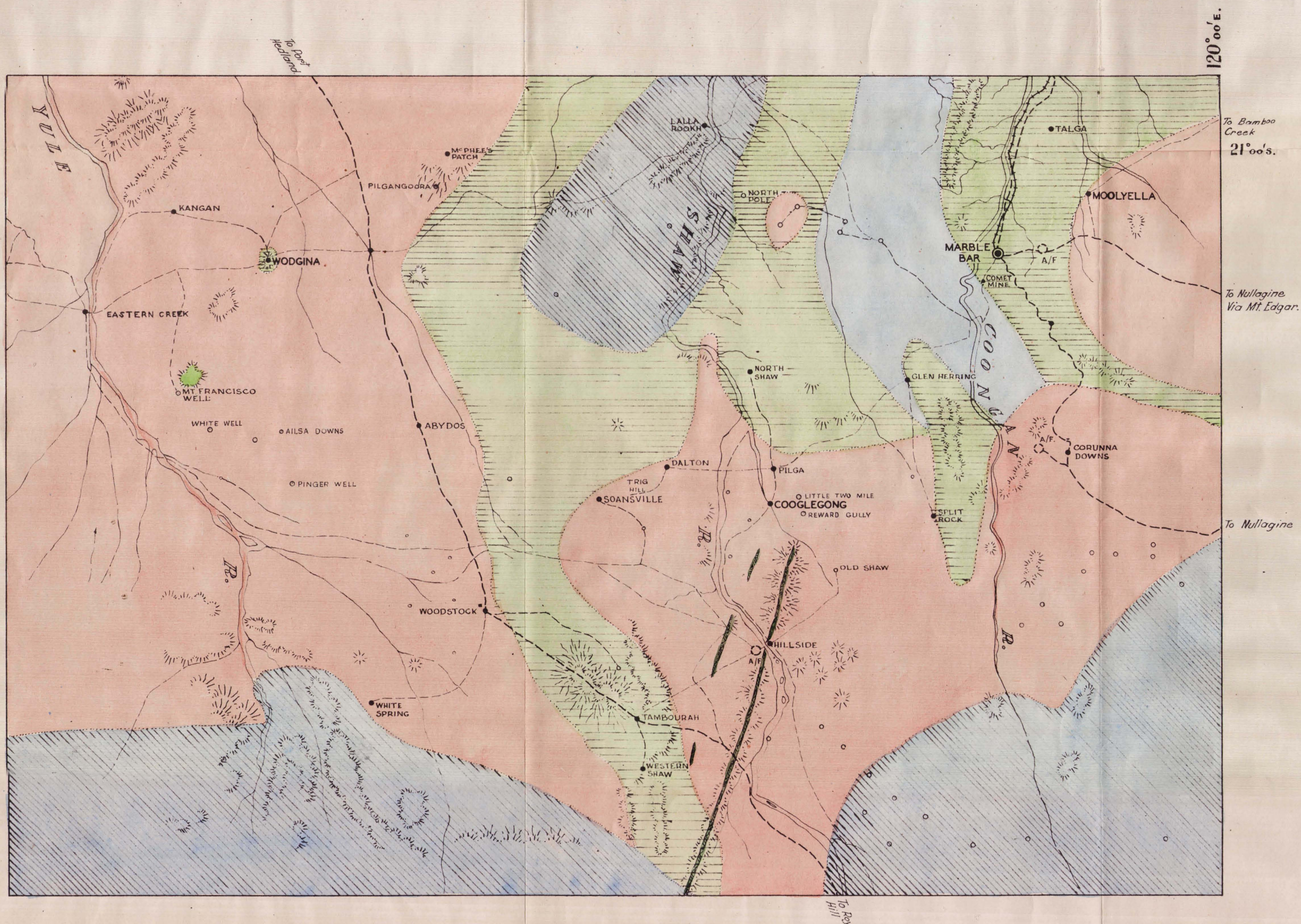
(v) The majority of the gullies in the Cooglegang area have some monazite in them, but no useful concentrations were found in the places tested.

(vi) The gullies near Finger well carry small amounts of tin and also very small amounts of monazite.

(vii) Provided the radioactive mineral is near the surface a Geiger Muller counter may be used successfully to locate the larger concentrations of the mineral. This fact was borne out by the work that was done at Trig Hill.

D. W. KEAN
Geophysicist.

Melbourne 10/12/48.



Geophysical Section, Bureau of Mineral Resources. Geology and Geophysics.

LEGEND

- NULLAGINE SERIES:-
Grits, Conglomerates, etc. Topography Rough. Hills to 300.'
- WARRAWOONA SERIES:-
Greenstones, etc. Topography Very Rough. Hills to 500.'
- GRANITE and GNEISS
Topography Fairly Flat with some Hills to 200.'
- DOLERITE DYKE

GEOLOGICAL SKETCH MAP OF PORTION OF PILBARA GOLDFIELD

Scale: 1" = 8 Miles (approx.)

0 4 8 16 24 Miles

G 40-1