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DEPARTMENT OF SUPPLY AND DEVELOPMENT.  
BUREAU OF MINERAL RESOURCES  
GEOLOGY AND GEOPHYSICS.

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REPORT No.

1952/92



URANIUM-COPPER DEPOSITS RUM JUNGLE  
AUSTRALIA

by

C.J. Sullivan and R.S. Matheson

(Prepared May 1952, for publication in Economic Geology)

# URANIUM-COPPER DEPOSITS, RUM JUNGLE

## AUSTRALIA

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C.J. Sullivan<sup>1</sup> and R.S. Matheson<sup>2</sup>

### ABSTRACT

Uranium mineralisation was discovered in association with copper minerals at Rum Jungle in September 1949, and investigations carried out since that time, and which are still proceeding, have led to the discovery of additional occurrences, and have shown that the field is likely to prove an important one.

The prospects are mainly uranium-copper deposits, but autunite deposits, which are poor in copper, also occur.

In addition, radioactivity has been found in a bed of conglomerate over a length of 2.5 miles. No uranium minerals have yet been positively identified from the outcrop of this conglomerate, which shows no sign of sulphide mineralization.

This paper presents a preliminary account of the geology and type of mineralization in the Rum Jungle area.

### SITUATION

The Rum Jungle uranium-copper deposits are situated approximately 55 miles south-south-east of the port of Darwin, Northern Territory, Australia, and are 2½ miles north-east of the Rum Jungle Siding, which is 56 miles by rail south of Darwin.

Rum Jungle is situated in the summer rainfall area and the monsoonal wet season lasts from November to April inclusive.

### HISTORY

Copper was discovered in the Rum Jungle area late in the 19th century, and small parcels of secondary copper ore were mined from shallow open-cuts and shafts. The occurrence of uranium minerals in the area was not known, and the zone of primary

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mineralization was not adequately tested.

In September 1949, a prospector, J. White, after reading a handbook on prospecting for uranium issued by the Commonwealth Bureau of Mineral Resources, re-examined the old copper workings and submitted for examination samples which were found to contain torbernite and uranium ochres. The discovery was inspected by Bureau of Mineral Resources geologists and geophysicists in October 1949, and detailed investigations in the area were commenced by the Bureau in May 1950.

#### GENERAL GEOLOGY

The known uranium deposits are situated on the southern flank of a domal structure in Pre-Cambrian meta-sediments, which have been regionally folded and faulted and intruded by granite. The sediments, which consist of interbedded grits, quartzites, pebble beds, conglomerates, breccias, crystalline limestones and slates (partly carbonaceous and graphitic), are mainly shallow water types, and are assigned to the Brooks Creek Group of Lower Proterozoic age (Noakes <sup>1</sup>, 1949).

The core of the domal structure is occupied by the granitic complex, consisting of granite and granitized sediments. The core is about 10 miles from north to south, and averages about 6 miles from east to west. Quartz veins, representing at least two periods of injection, occur in the area.

Basic dykes, which may be younger in age than the granite, are present. Superficial deposits of soil, alluvium and laterite, of Recent to Tertiary age, obscure the basement rocks in many parts of the area.

#### GEOLOGICAL STRUCTURE

Both regional and local folding and faulting of the Brooks Creek Group occurred in the area in Pre-Cambrian times.

The Rum Jungle domal structure, and also adjoining geological structures which have been investigated, are folded on approximately north-south axes, and during this period of

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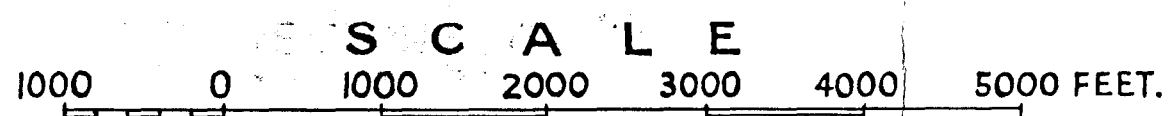
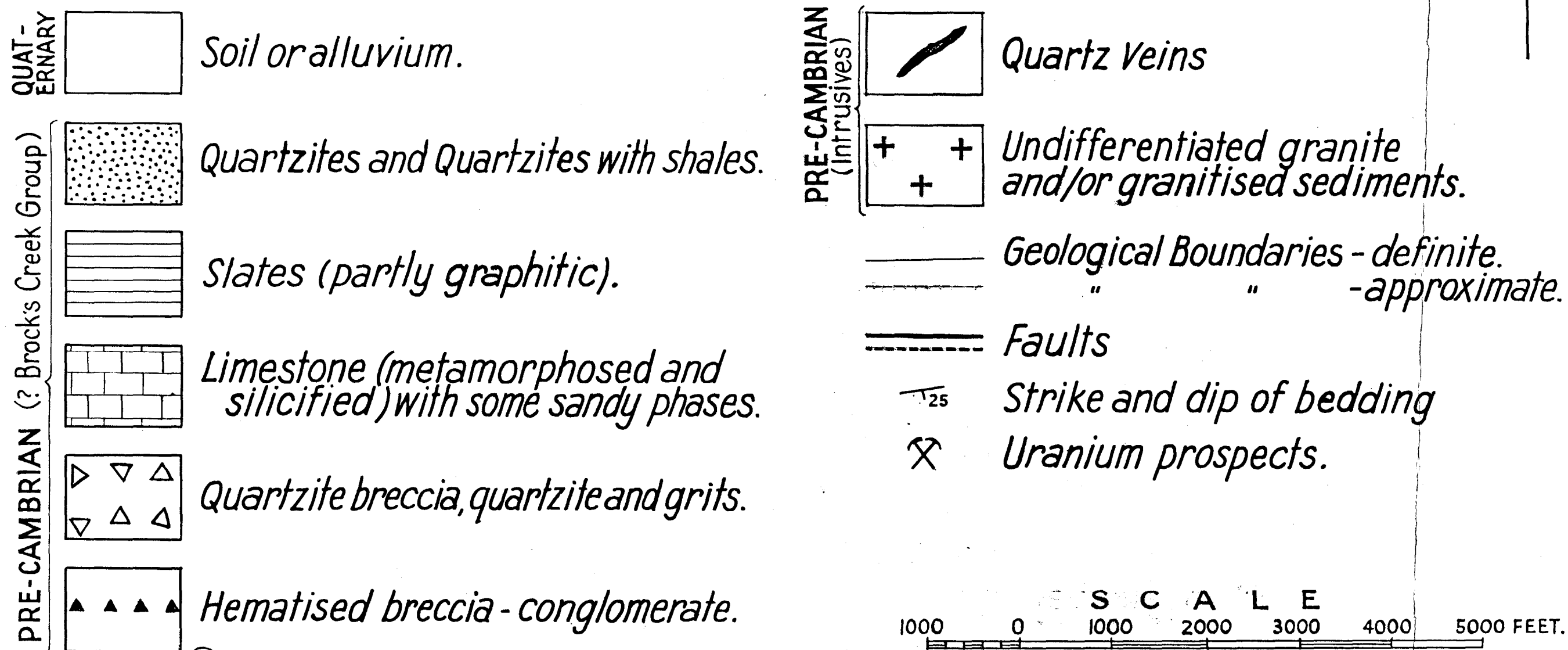
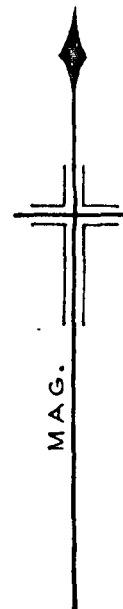
1. Noakes, L.C. 1949: A Geological Reconnaissance of the Katherine-Darwin Region, Northern Territory. Commonwealth Bur. Min. Res. Geol. and Geophys. Bull. 16.

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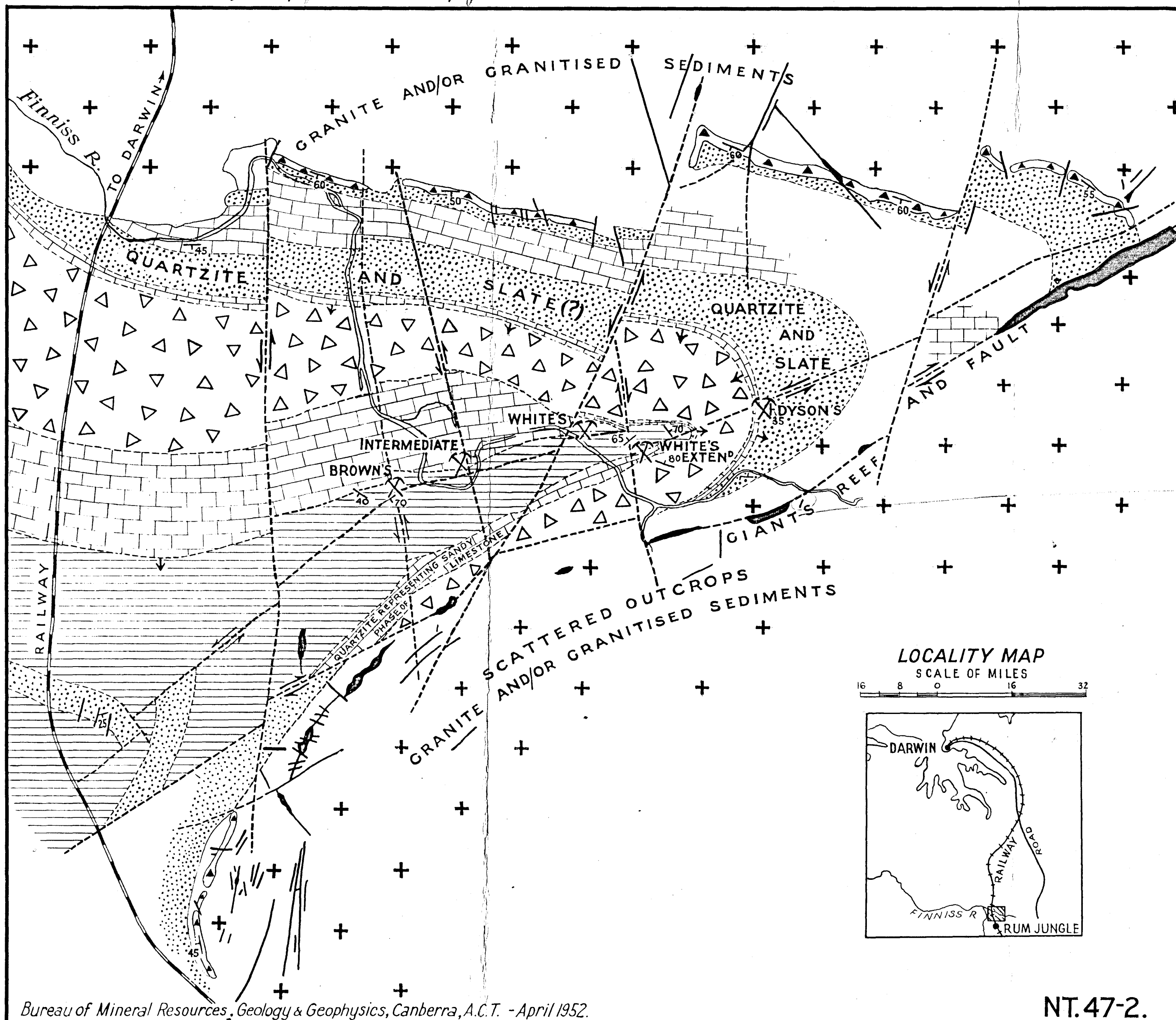
**Fig. 1. Geological Map Rum Jungle,  
Northern Territory, Australia.**

# GEOLOGICAL MAP RUM JUNGLE AREA, NORTHERN TERRITORY, AUSTRALIA.

*Interpretation based on regional and detailed mapping by  
Bureau of Mineral Resources field parties.*



*? Hematized  
as pyritised and pyritised*



folding the incompetent slate formations in the Brocks Creek Group were internally folded and marked schistosity and cleavage were developed in them.

Giant's Reef fault (Figure 1), which intersects the southern end of the Rum Jungle structure, is one of the most striking structural features in the area. It trends north-easterly, has a very steep variable dip, and a horizontal displacement of  $3\frac{1}{2}$  miles, the south-eastern side being displaced to the south-west. Large quartz reefs occur in places along the line of the fault, which, from the examination of aerial photographs, is known to continue to the south-west for at least 50 miles. Reference to Fig. I will show that, during faulting, a major east-pitching dragfold developed in the formations of the Brocks Creek Group on the northern side of Giant's Reef. Detailed investigations have shown that the formations north of the fold axis have a general southerly dip, while the formations south of it, representing the south-eastern limb of the dragfold, are overturned to the north-west. An axial plane shear parallel to Giant's Reef fault has developed in the dragfold, and, as will be seen later in this report, one of the authors (R.S.M.) considers it has had an important bearing on ore deposition.

Other major faults parallel to Giant's Reef fault intersect the Rum Jungle structure, and parallel shearing has no doubt developed in many places during this period of faulting.

After the Giant's Reef period of faulting another period of faulting occurred in the area. This system of cross-faults strikes in a north-north-east to north-west direction. These faults have caused displacements of Giant's Reef fault, and consequently also of the axial plane shear of the dragfold associated with it. They are, in part, also occupied by quartz. Some post-ore cross-faults which may belong to this period of faulting, or a still younger period, occur in the area.

#### THE DEPOSITS.

Five uranium prospects, namely Dyson's, White's Extended, White's, Intermediate and Brown's prospects, are shown on the accompanying plan (Figure 1); they occur at irregular intervals



along a line trending in a north-easterly direction. Two additional prospects, namely the Crater and Mt. Fitch prospects, occur outside the map area. With the exception of the Crater prospect, which is associated with a conglomerate bed in a grit formation and which may possibly be of detrital origin, all deposits are of hydrothermal origin and are closely associated with the carbonaceous slates and graphitic schists.

Exploratory work, which commenced in the area in 1950 and is still in progress, has shown that White's and Dyson's Prospects are likely to be the most important deposits.

Copper mineralization is closely associated with the uranium mineralization at White's, Intermediate and Brown's prospects, but at Dyson's and White's Extended prospects the occurrence of copper minerals is extremely rare. The deposits can therefore be conveniently separated for description on the relative abundance of copper minerals.

At White's prospect, which can be regarded as a type locality for the copper-rich uranium deposits, surface exposures were not very impressive. The country rock slates are fairly widely stained by secondary copper minerals, and small parcels of secondary copper ore were mined in the early days from shallow workings, but a little torbernite occurred at the surface. Prospecting work later revealed the presence of uranium ochres, including phosphuranylite, in addition to torbernite, in the oxidized zone. These secondary uranium minerals occurred in association with azurite, malachite, iron oxides, and pseudomalachite and dihydrite (alteration products of torbernite).

The primary minerals chalcopyrite, bournonite, bornite, pyrite and uraninite first began to appear below ground water level at 28 feet V.D. from the surface, and the secondary copper sulphides, chalcocite and covellite were in evidence near the water table. The primary minerals occur mainly as selective replacements of bedding and of cleavage in the contorted graphitic schist, but chalcopyrite, pyrite and uraninite have also been found in quartz veinlets intersecting the carbonaceous slates and graphitic schists.

**Fig. 2. Down pitch (easterly) view of minor  
anticlinal dragfold in carbonaceous slate  
showing characteristics of primary  
replacement ore. X2 natural size.**





FIGURE 2.

Some of the characteristics of the replacement ore are shown in the photograph reproduced as Figure 2, which gives a down-pitch (easterly) view of a minor anticlinal dragfold the limbs of which have been attenuated by shearing. Chalcopyrite and uraninite occur as selective replacements of certain beds and along cleavage planes.

Exploration is at present proceeding in the primary zone and assaying and geological mapping of cross-cuts have shown a more uniform distribution of both uranium and copper over a greater width than at the surface. This is partly due to the structure, but also strongly suggests extensive leaching and very localized secondary enrichment in the oxidized zone.

The deposits at Dyson's and White's Extended prospects were obscured and both were found by geophysicists using Geiger-Muller counters. Costeaning disclosed deposits containing autunite and uranium ochres. Diamond drilling has shown that the secondary uranium minerals persist to 100 feet vertical depth from the surface and, although pyrite occurs, no primary uranium minerals have yet been encountered. The occurrence of copper minerals is rare at both localities.

At Dyson's prospect the lode occurs in close association with thin beds of carbonaceous slates, which are interbedded with quartzite and limestone. Quartz veins some of which contain pyrite, are present near the prospect.

Due to poor core recovery and poor outcrop conditions the geology at White's Extended deposit is not yet clear, but the lode appears to occur in a brecciated zone near the contact of slates and limestone. Quartz veins are also present near the prospect.

The Mt. Fitch prospect,  $4\frac{1}{2}$  miles north-west of Brown's prospect, conforms in general characteristics to the White's type of deposit but the Crater type of deposit is unique for the Rum Jungle area.

The Crater prospect, which is situated approximately  $3\frac{1}{2}$  miles south-east of White's prospect, and which was discovered by one of the authors (R.S.M.) and Geophysicist D. Dyson in 1951, is

a type locality for a low-grade radioactive conglomerate bed occurring in a grit formation of the Brock's Creek Group and known to extend over a distance of about 2 miles. The conglomerate bed is situated a short distance south of junction with the granitic complex, and a major fault of the Giant's Reef system and several minor faults of the system of cross-faults intersect the area.

A mineralogical examination of a sample of the richer part of the conglomerate bed has been carried out, and it has been suggested that the radioactivity is due to detrital radioactive minerals such as zircon, xenotime and monazite, but the results are not conclusive. Radiation absorption tests suggest that uranium is present, and the occurrence of this radioactive conglomerate bed in an area where hydrothermal uranium deposits are known, suggests that the radio-active minerals may have a hydrothermal rather than a detrital origin.

It is thought that the deposit may represent the leached outcrop of a bed which is richer in uranium minerals in depth. The deposit will be tested by drilling in 1952.

#### THE MINERALIZATION AND ITS CONTROL

It has been pointed out in the preceding section the main uranium prospects occur irregularly along a line trending in a north easterly direction, and that two types of deposits, namely copper-rich and the copper-poor types, occur.

Field investigations have shown that an axial plane shear has developed in the dragfold associated with the Giant's Reef faulting, and because this shear follows closely the line of mineralization it is considered by one of the authors (R.S.M.) to have an important bearing on ore deposition. It is expected that it will be displaced similarly to Giant's Reef by the system of cross-faults.

The known uranium prospects occur at irregular intervals but there appears to be some localization near the intersections of the cross-faults with the axial plane shear. Although not shown on the map a strong cross-fault is believed to occur in the vicinity of Dyson's Prospect, but its position has not yet been accurately fixed. The most favourable host rock for both uranium and copper

deposition is carbonaceous slate, and it appears that deposition has been by selective replacement of carbonaceous slate beds adjacent to their intersection with the axial plane shear.

Mineragraphic investigations on primary ore from White's prospect (Stillwell, <sup>2</sup> 1950) have shown that a close association exists between chalcopyrite and uraninite, and that the chalcopyrite has replaced uraninite and must therefore have crystallized later. Available evidence is in favour of a combined uranium-copper mineralization. However, while the copper mineralization is more or less restricted to the slate formation, uranium mineralization persists north-eastwards into stratigraphically lower beds (e.g. at Dyson's prospect). The most favourable environment for the deposition of copper minerals throughout the area has been the carbonaceous beds in the slate formation. These have been selectively replaced by the mineralizing solutions, deposition extending for some distance in the beds from their junction with the axial plane shear.

All known uranium prospects occur on the southern side of the axial plane of the dragfold. At White's prospect the deposit occurs as a north-easterly pitching truncated arch in carbonaceous slates and graphitic schists adjoining the shear, and available information suggests that similar structural features are present at Brown's prospect and probably elsewhere. Other carbonaceous beds occur in the slate formation, and there are good chances of recurrence of ore deposition where they meet the axial plane shear.

A plan and section at White's prospect showing the geological structure and the occurrence and possible recurrence of ore appear as Figure 3. The folds on the southern side of the axial plane shear are known to pitch 30 degrees north-easterly, and observations on lineation support this direction of pitch.

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2. Stillwell, F.L. 1950: Uraninite from East Finniss Deposit, Rum Jungle, N.T. C.S.I.R.O. Mineragraphic Investigations, Special Report.

Stillwell, F.L. 1951: Uraninite from Rum Jungle and Fergusson River.  
C.S.I.R.O. Mineragraphic Investigations.  
Report No. 473.


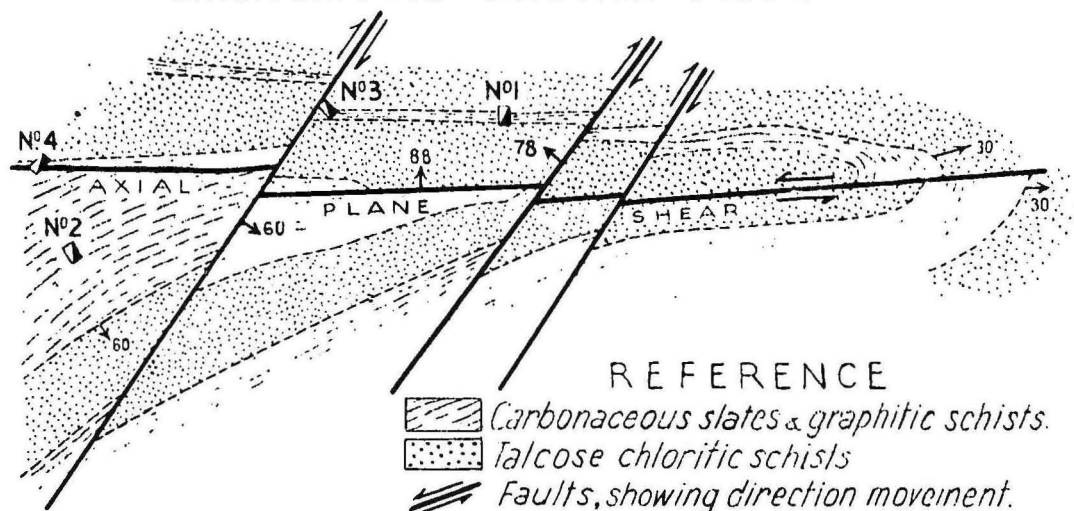


Fig. 3. Diagrammatic plan and section White's Prospect, showing geological structure, and the occurrence and possible recurrence of ore.

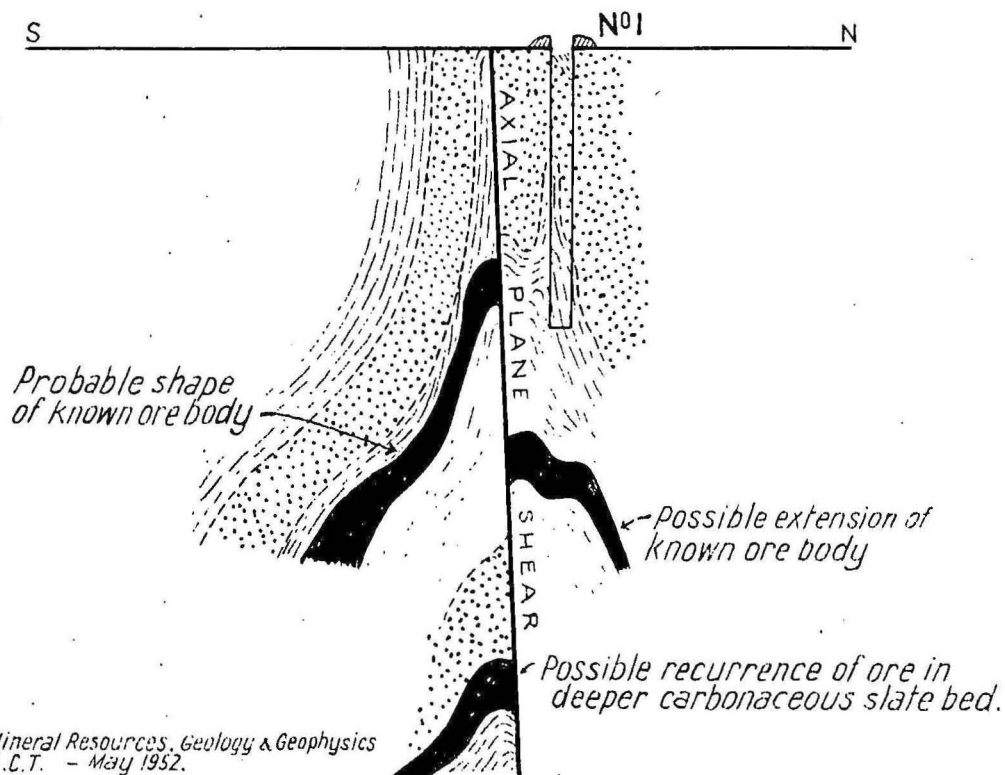
# WHITE'S PROSPECT RUM JUNGLE NORTHERN TERRITORY, AUSTRALIA.

FIGURE 3.

## DIAGRAMMATIC SURFACE PLAN.



## DIAGRAMMATIC TRANSVERSE SECTION showing possible recurrence of ore.





At present it appears, particularly at White's and Brown's prospects, that copper minerals have a much wider distribution than uranium minerals, but further exploration may locate lenses of uranium ore that have not been indicated by surface radiometric surveys. No ore occurrences have so far been proved on the northern side of the axial plane of the dragfold, but there appears to be no reason why they should be restricted entirely to the southern side.

In addition to the main axial plane shear it is thought that other parallel shears of the Giant's Reef system occur in the area, and the favourable carbonaceous beds could be mineralized where they intersect the shears.

#### ACKNOWLEDGMENTS.

This paper represents the authors' interpretation of the geology and nature of mineralization in the Rum Jungle area, and is based on their own work and that of other geologists of the Bureau of Mineral Resources who have done field work in the area, namely H.J. Ward, (who has worked in the area every field season since 1949), K.W.B. Iten, N.J. Mackay, E.K. Carter, J. Sleis, and D.J. Gates.

Valuable contributions to our knowledge of the field have resulted from mineragraphic investigations by F.L. Stillwell, from mineralogical and petrological work by W.B. Dallwitz; and from mineral determinations and assay carried out by the Western Australian, South Australian and Northern Territory chemical laboratories.