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Report on the Geology of the Rum Jungle Uranium Bearing Area.

by A. S. Matheson

CONFIDENTIAL

REPORT ON THE GEOLOGY OF THE RUM JUNGLE URANIUM-BEARING AREA, NORTHERN TERRITORY.

By R.S. Matheson.

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SUMMARY

The Rum Jungle uranium-bearing area is situated in the vicinity of Rum Jungle railway siding 56 miles south of Darwin.

The area consists of interbedded, metamorphosed sedimentary rocks of the Brock's Creek Group of Lower Proterozoic age (Noakes, 1949), which have been regionally folded and faulted, and are intruded by granite and probably also by younger basic dykes. Superficial deposits of soil, alluvium and laterite obscure the basement rocks over much of the area examined.

Five uranium prospects, namely, White's Prospect, Dyson's Prospect, Brown's Prospect, Mt. Fitch Prospect, and one other prospect have so far been found in the area.

There have been at least two periods of quartz injection in the area, and it is considered that present evidence is in favour of two periods of mineralisation, the older copper and the younger uranium. This view is not supported by mineragraphic investigations (Stillwell, 1950) which have so far been undertaken, however. The primary uranium-bearing solutions emanating from the granite are thought to have entered the Brock's Creek Group by means of a set of north-westerly trending faults, and deposition to have occurred near the faults in slates, which are partly graphitic. With the exception of Dyson's Prospect, where the geology is not so well known as elsewhere, all prospects are close to the No.2 Limestone, and it seems likely that the limestone may have assisted in localising deposition.

There is scope for further prospecting in the area where other north-westerly faults intersect the known favourable graphitic slate-limestone belt, and also where they intersect areas with a similar lithological environment. The intersection with other formation junctions may also be of interest. This control of deposition may extend outside the limits of the area mapped.

In the search for new deposits regional mapping should be extended to embrace at least a wide belt of the Brock's Creek Group surrounding the whole of the Rum Jungle granitic complex.

INTRODUCTION

During the period 10th October to 15th November 1950, the writer visited the Rum Jungle area in order to direct the local and regional geological mapping, with a view to establishing the geological relationship between the various prospects, the manner of occurrence of the ore bodies, and if possible the control of mineralisation. The additional officers made available for this work were Geologists K.W.B. Iten, D.J. Gates, N.J. McKay and J. Sleis.

The regional mapping of the country extending from the vicinity of the Mt. Fitch Prospect to Dyson's Prospect, was undertaken by the writer and K.W.B. Iten, and a preliminary regional geological plan on a scale of 1,200 feet to 1 inch has been prepared partly by the use of aerial photographs and partly by traversing. A more detailed plan on a scale of 400 feet to 1 inch of the country embracing Dyson's, White's and Brown's Prospects, was prepared by D.J. Gates, and N.J. McKay, while J. Sleis assisted H.J. Ward, who had been in charge of the mining work throughout the year, with the surface and underground mapping in the vicinity of the prospects themselves.

Owing to the short time available for the field work, the present report must be regarded as a critical preliminary study of the area to aid future planning, rather than as a complete investigation. Revision will be necessary when a thorough geological survey of the area is undertaken.

Only the broader aspects of mineralisation are dealt with in this report, and the mining geology will be described in a report being prepared by H.J. Ward.

GEOLOGY

GENERAL DESCRIPTION OF AREA.

White's, Brown's, and Dyson's uranium prospects are situated approximately 2½ miles north-east, and the Mt. Fitch prospect approximately 5½ miles north-west of Rum Jungle Siding which is 56 miles by rail south of Darwin. All prospects are near the east branch of the Finniss River.

These deposits occur in a group of Pre-Cambrian metamorphosed sedimentary rocks, which have been regionally folded and intruded by granite, and have been correlated with the Brock's Creek Group of Lower Proterozoic age (Noakes,1949). Basic dykes, which may be younger in age than the granite are also present. Superficial deposits of soil, alluvium, or laterite, of Recent to Tertiary age, obscure the basement rocks in many parts of the area examined.

BROCK'S CREEK GROUP.

The formations comprising the Brock's Creek Group in the area, which has been investigated, consist of metamorphosed, interbedded, arenaceous rocks, argillaceous rocks, and limestones.

Arenaceous Rocks.

Three principal arenaceous formations outcrop in the area mapped, namely, The Mt. Fitch Quartzite which is the youngest, that underlying the No.2 Limestone, and that underlying the No.1 Limestone. The latter two formations will be named at some future date.

The Mt. Fitch Quartzite consists chiefly of quartzites, but contains some thin argillaceous bands.

The formation underlying the No.2 Limestone consists chiefly of a mixture of quartzite, haematised quartzites, breccias, and grits, but some sandy slates and slate occur in places over a narrow width near its junction with the No.2 Limestone. This formation appears to lens out in the direction of Mt. Fitch. As will be seen below, the haematisation of the quartzite breccia is regarded as part of the process of granitisation.

The formation underlying the No.1 Limestone consists chiefly of arenaceous rocks with subordinate interbedded slates. The arenaceous rocks consist of quartzites and breccia-conglomerates, which are extensively haematised near their junction with the granitic complex. Some silicification has probably also occurred. The haematisation is thought to have occurred during the period of granitisation, the source of the iron being some of the now granitised sediments. The breccia conglomerate appears to have been particularly suited to haematisation, perhaps because it offered relatively easy access to iron-bearing solutions, or perhaps because it has been enriched during granitisation by concentration of iron originally contained within it. Field observations suggest that it is very risky to attempt correlation of the haematised beds, as different parts of a formation may be haematised in different places. It is not yet clear where the haematised breccia-conglomerate near the railway line at the south-western end of Giant's Reef fits into the geological section, but it can definitely not be correlated with that at the southern boundary of the northern granitic area.

Argillaceous Rocks.

Two formations of argillaceous rocks, which are separated by the Mt. Fitch Quartzite, occur in the area. The formation stratigraphically below the Mt. Fitch Quartzite consists of slates, graphitic slates and sandy slates. Some lenses of silicified limestone occur within this formation near its junction with the No. 2 Limestone. The other slate formation, which so far has been less important economically, consists chiefly of slates and sandy slates.

The slate formations have been incompetent during regional folding, and the beds are contorted. The slates also show silicification near some of the quartz reefs, and this is particularly noticeable in the vicinity of the Mt. Fitch prospect.

Limestones.

Two limestone formations, which can be conveniently referred to as the No. 1 and No. 2 Limestones, occur in the section. Both formations show considerable thinning in the direction of Mt. Fitch. Where seen in the fresh state the limestone is a white crystalline metamorphosed rock, ranging from finely to coarsely crystalline, with scattered patches showing rosette structure. The limestone ranges in composition from fairly pure limestone to sandy limestone. Extensive silicification of the limestone has occurred, and a suite of specimens indicating various stages in the process has been obtained for the Bureau collection. The silicification is believed to have occurred chiefly during the period of granitic intrusion, but some of it can possibly be attributed to weathering processes.

As a result of metamorphism an asbestiform mineral has been developed in the limestone in numerous places.

GRANITIC COMPLEX.

This complex consists of undifferentiated, massive granite, granitised sediments and quartz veins. The granite is believed to have been intruded contemporaneously with or during the period of regional folding.

Granite.

The massive granite occurs throughout the area as scattered small outcrops and large "rocks" protruding through granitised sediments or granitic soil. It is a pink biotite granite ranging from fine to coarse grained. Jointing is well shown in some of the large "rocks", the principal directions of jointing being north-easterly, and between N20°W and N60°W. On the old east-west track, to the east of the railway and north of the Finniss River, some narrow pegmatite dykes can be seen showing small displacements on faults striking N20°W.

Granitised Sediments.

The granitised sediments are well developed around the margin of the granitic complex, but isolated patches of them also occur within the complex at some distance from the boundary.

Sericitisation is very noticeable in the granitised rocks near their junction with the Brock's Creek Group, and rocks representing intermediate stages in the granitisation process can be seen in several places. They have inherited structure or composition from the rocks which have been granitised.

Quartz Veins.

Quartz veins representing at least two periods of injection have been recognised in the area.

The older is that represented by Giant's Reef, which forms a prominent ridge in the Rum Jungle area. This reef is rather peculiar, and appears to consist of a mixture of quartz veins and veinlets and completely silicified sediments of various types. Some of the small veinlets are entirely crystalline and show "dog-tooth" structure suggesting mechanical fissure filling. It seem likely that Giant's Reef represents an early major fault line, but confirmation of this will only be obtained during future mapping. Some small quartz veins, which strike in a north easterly direction, and which may belong to the same period of injection as Giant's Reef, have been noted in the Brock's Creek Group, for examample, north-east and east of Mt. Burton.

Reference to the accompanying regional plan will show that numerous displacements of Giant's Reef have occurred on faults trending N20°W, and in places quartz occurs in this system of faults. This quartz represents the younger period of quartz injection. The quartz occupying the faults trending N60°W in the Mt. Fitch area is believed to be of similar age.

Quartz veins trending in a northerly direction also occur in some parts of the area, but they are not abundant. Some of these veins undoubtedly belong to the younger period of injection, but both periods are probably represented.

BASIC INTRUSIVES.

A bouldery basic rock (probably dolerite) forms prominent outcrops in an area of slates in the south-western corner of the area mapped. Its trend is not conformable with the general strike of the Brock's Creek Group, and it is regarded as an intrusive. The age of the dyke is yet not clear, but it is possibly later in age than the granite.

Laterite.

Laterites of Tertiary age obscure the basement rocks in many parts of the area, but by a careful study of them inferences can frequntly be made as to the nature of the underlying rocks.

All the laterites are ferruginous to a varying degree, and in places appear to consist almost entirely of iron oxides (limonite and haematite), in which case it is difficult to determine the nature of the underlying rocks. Elsewhere, however, the following variations have been noted. Where the laterite overlies shales, it is generally bauxitic rather than ferruginous in composition, and some parts contain shale fragments. The laterite overlying the arenaceous rocks is generally gritty, while that overlying the limestones frequently shows a "worm hole" structure and contains fragments of silicified limestone.

In one area of laterite, about 2000 feet north-west of White's Prospect, some manganiferous laterite was noted.

Soil and Alluvium.

Soil and alluvium obscure the underlying rocks over considerable parts of the area examined. There are noticeable differences in soil types based on the nature of the underlying rocks, but no attempt has yet been made to study these superficial deposits.

GEOLOGICAL STRUCTURE.

The basement rocks of the area have been regionally and locally folded, faulted and jointed in Pre-Cambrian times.

Folding.

Reference to the geological plan of the Katherine - Darwin Region (Noakes, 1949), indicates that the area under consideration is near the southern end of a roughly elliptical granitic area about 10 miles long and 2 to 4 miles wide.

In the Rum Jungle area the Brock's Creek Group shows a change from a northerly strike and westerly dip in the Mt. Fitch area, to an easterly strike and a southerly dip near White's Prospect, which suggests that the area is close to, or actually on, the nose of a regional anticlinal fold pitching to the south. The approximate conformability of the granite boundary with the Brock's Creek Group, and the broad elliptical distribution of the granitic core of the structure, also suggests that the south-pitching anticline is the southern nose of a broad domal structure the longer axis of which strikes in a northerly direction.

During the regional folding of the Brock's Creek Group the slate formations were incompetent, and as a result were contorted by internal folding, and a flow schistosity, which frequently masks the bedding, was developed.

Faulting.

There were probably two periods of major faulting in the area.

It is suspected that Giant's Reef, which strikes in a north-easterly direction, represents a line of major faulting, which occurred during the early stages of regional folding, but further geological work is required for confirmation. There may be some considerable displacement on this fault. There is unfortunately no aerial photograph coverage in the critical area, but aerial photographs Nos. 3026 and 3027 of Tumbling Waters Run No.11 indicate that the Giant's Reef line persists for a considerable distance to the north-east into the granite country, and may represent the north-western side of a fault block.

The sets of faults striking N60°W and N20°W are younger in age, and are considered to belong to a period of faulting, which occurred towards the latter stages of regional folding and granitic intrusion.

Small faults striking in other directions are recorded in the mine workings, but these are thought to be related to one or the other of the two main systems of faults described above.

Jointing.

Joints occur frequently in the granite "rocks", and their main trends are north-westerly and north-easterly, parallel to the directions of strike of the two systems of major faults.

Parallel joints have also been noted in the quartzites and quartzite-breccias of the Brock's Creek Group. It seems likely that this fracture pattern would be developed in all the competent beds of the Brock's Creek Group, but it can only be seen in a few places.

THE MINERALISATION AND ITS CONTROL.

Investigations to date have indicated five main areas of uranium mineralisation, namely White's Prospect, Dyson's Prospect, Brown's Prospect, Mt. Fitch Prospect and an additional prospect between White's and Brown's Prospects.

With the exception of Dyson's Prospect, they are all closely associated with copper mineralisation, but from information below it will be seen that this may only be fortuitous.

White's Prospect, which is the site of the original discovery, occurs in an area of slates, and uranium mineralisation therein appears to be closely associated with graphitic beds. Uranium minerals that have so far been identified are the secondary minerals torbernite and phosphuranylite and the primary mineral uraninite. The copper minerals which occur include malachite, pseudo-malachite and dihydrite (alteration products of torbernite), and chalcopyrite, some of the chalcopyrite occurring in quartz in association with pyirte. The zones of mineralisation in the slates are disturbed by minor faults, and it is not yet clear whether or not the primary uranium mineralisation conforms with the primary copper mineralisation. Several faults, which strike N20°W and cause displacements of Giant's Reef, must intersect the slates in the vicinity of White's Prospect, but none have so far been exposed in the workings. It is possible that the sudden termination of the limestone a short distance west of White's Prospect may also be explained by faulting.

Dyson's Prospect is situated in an area of slates, sandy slates and quartzites. Copper mineralisation and torbernite are both absent at this prospect. Uranium minerals present are pale greenish-yellow, limonitised autunite, and a yellowish ochre. The presence of autunite suggests a possible association with calcareous rocks. A reasonably strong N20°W fault, and also some minor faults, occur in the area in which the find is situated.

Brown's Prospect is situated in an area of slates, which is partly graphitic, close to their junction with the No. 2 Limestone. Geiger-Muller work has indicated that an area of high radio activity occurs at the limestone-slate junction near a probable fault, about 700 feet west of the Finniss River. A few other radio-active high spots have also been found westwards along the same line. Torbernite is the only mineral so far identified in this area, and it is closely associated with graphitic slate. Two lines of primary copper mineralisation associated with quartz veins occur in the vicinity of Brown's Prospect, one along the limestone-slate junction, and the other, more important one, within the slates about 100 to 150 feet farther south. Both lines of mineralisation trend in an east to east-north-east direction and dip steeply south. These lines show local drag and are brecciated and displaced at a few points along them, by faults trending N20°W. Little work has yet been done on this prospect.

Mt. Fitch Prospect is situated in an area of slates close to the western boundary of the No. 2 Limestone about 4½ miles northwest of Brown's Prospect. Minor copper deposition has occurred along both the western and eastern boundaries of the limestone in this vicinity, and the area is intersected by several faults striking N60°W, which have caused minor displacements. A yellowish radio-active mineral is the only uranium bearing mineral so far seen here, but very little underground work has yet been done.

There is another radio-active prospect in this area in slates close to the eastern boundary of the limestone, about ¼ mile south of the prospect referred to above. Some copper mineralisation also occurs in this vicinity.

<u>Other Prospect</u>. This name is applied to the high radio-active area occurring on the north side and in the bend of the river between White's and Brown's Prospects. This prospect is again associated with slates (partly graphitic), close to their junction with the No. 2 Limestone, and copper mineralisation and faulting in a N20°W direction is also present. No underground investigations have been carried out yet on this prospect. Specimens of torbernite are reported to have been seen in the area.

From a review of the information concerning the various prospects given above, the following facts emerge.

(a) All prospects are situated close to faults striking either N20°W or N60°W. The uranium mineralisation is localised near the faults while copper mineralisation is more widespread.

(b) All prospects occur in shales (partly graphitic) and, with the exception of Dyson's Prospect, where the geology is not so well known, are close to a limestone formation.

(c) There are indications of copper mineralisation at all prospects with the exception of Dyson's Prospect, where autunite is present and torbernite is lacking. Copper mineralisation therefore is not necessarily associated with uranium mineralisation.

(d) The lines of copper mineralisation near Brown's Prospect are displaced by the N20°W set of faults.

The mineralisation in the area can be explained as having occurred either during one or two periods, and the granite magma is believed to have been the source of the mineralising solutions.

It is considered that available evidence is in favour of there being two separate periods of mineralisation, the youngest being the period of uranium mineralisation. It is thought that this view explains more satisfactorily the reason for the localisation of uranium deposition near the faults, and it is supported by the absence of indications of copper mineralisation at Dyson's Prospect and the displacement of some of the copper lodes. A similar lithological environment is believed to have been suited to both copper and uranium mineralisation. Following the entry of the uranium-bearing solutions, by the north westerly faults, it is possible that uranium deposition could occur along favourable beds or in any of the joints of the complicated pattern, which must have been intersected. Some deposits could occupy joints related to the earlier periods of movement.

If only one period of mineralisation (that is mixed copper and uranium mineralisation) has occurred in the area, then it is most likely older than the north westerly faults, as copper lodes near Brown's Prospect are displaced by faults of this system. With this explanation it is not very clear why uranium mineralisation is localised in the copper lodes near the faults, but it may be intensified at these points as a result of secondary enrichment. An alternative view is that the period of mineralisation is younger than the faulting, and that the mineralising solutions entered by the faults and deposition by replacement occurred in favourable beds, which had previously been displaced by faulting.

PROSPECTING RECOMMENDATIONS.

The broad control of ore deposition that is indicated, suggests that there are numerous localities warranting prospecting during future operations in the area. At many of these localities Geiger-Muller work would be handicapped by a thick soil cover over the basement rocks and bulldozing may be necessary before results are obtained by radio-metric surveys. The localities for prospecting are as follows :-

(a) Small areas where the north-westerly system of faults intersect the favourable graphitic slates near the junction of the No. 2 Limestone, or the continuation on the strike of the favourable host rocks at Dyson's Prospect.

(b) Other small areas along the faults where the lithological environment may be similar, e.g. near the base of the No. 2 Limestone where some slates occur at its junction before the arenaceous rocks are entered.

It should also be borne in mind during prospecting that parallel unmapped faults, which ~~may~~ be mineralised could occur in the obscured areas. The mineralisation control suggested, very likely extends outside the limits of the area mapped, and future regional mapping should at least embrace a wide belt of metasediments around the whole of the Rum Jungle granitic complex.

ACKNOWLEDGEMENTS.

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Valuable information was also obtained from discussions with the Geophysicists working in the area.

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GEOLOGICAL PLAN
VICINITY URANIUM PROSPECTS – RUM JUNGLE
NORTHERN TERRITORY

Scale : 400 feet to 1 inch

Plane Table & Telescopic Alidade Surveys & Geology by D.J. Gates & N.J. Mackay October–November 1950

PRELIMINARY REGIONAL GEOLOGICAL PLAN
VICINITY URANIUM PROSPECTS–RUM JUNGLE
NORTHERN TERRITORY