COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS.

Records 1954/26

REGIONAL GEOLOGY OF THE RUM JUNGLE DISTRICT, NORTHERN TERRITORY, AUSTRALIA.

by

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and

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SUMMARY.

The importance of the Rum Jungle deposits required a geological survey of the surrounding district to determine whether or not additional deposits were to be found. None have been found as a result of the work so far completed. This work is also intended to contribute to a larger scale compilation of the regional geology of the Northern Territory.

Rum Jungle is centrally located within the area which extends 27.6 miles north-south and 20.2 miles east-west within the county of Palmerston, Northern Territory.

The rocks of the area include metasediments (some of which are tuffaceous) which are intruded by granite, quartz and quartz-tourmaline veins and dolerite dykes. The metasediments are assigned to the Brock's Creek Group of Lower Proterozoic age, (Noakes, 1949). The original sediments were deposited in a shallow-water geosynclinal environment close to a granitic (?) land-mass. Granites intruded the sediments towards the close of geosynclinal development. Diastrophism, which extended over a wide area, caused strong folding, brecciation, possible thrust-faulting and transcurrent faulting close to the granites.

Gold, copper, and uranium have been found and mined in the area. The gold is associated with quartz and quartz-tourmaline veins. The genesis of the copper and uranium deposits has not been satisfactorily determined. Only uranium and associated copper are being mined today.

INTRODUCTION

LOCATION

This report deals with the regional geology of the Hundred of Goyder, and parts of the Hundreds of Cavenagh, Colton, Howard, Waterhouse and Playford, county of Palmerston, Northern Territory. The area extends 27.6 miles north-south and 20.2 miles east-west with Rum Jungle centrally situated within the area. The northern border is near the 41 mile peg south of Darwin along the Stuart Highway.

MINING HISTORY

Gold. Gold was worked late in the 19th Century in the vicinity of Stapleton Siding on the Darwin-Birdum Railway. The "Map of Metalliferous Regions, Northern Territory" shows numerous workings in the area as the "Stapleton Mines" and as "Dean's Mine". J.V. Parkes (1900) refers to the Stapleton Reef and to the Virginia Gold Mine located 1½ miles south-east of Stapleton Crossing. Ore from the Virginia Gold Mine treated by the last owner yielded 15 dwt gold per ton with 11 dwt per ton in the tailing. The previous owners recovered 2 oz. gold per ton. Work ceased in the Stapleton Mines area about the end of the 19th Century.

The occurrence of gold near Batchelor, N.T., was first examined by the Bureau in 1946 (Sullivan, 1946, and Noakes, 1949). "A gold-bearing quartz-tourmaline vein was discovered in the Batchelor area (approximately 1¼ miles north of the junction of Coomalie Creek with the Batchelor Road) in 1943, and many leases were subsequently pegged in 1946. Twelve leases were still held in the area in 1948, but geological examination and further prospecting have shown that the area is unlikely to contain significant mineral deposits...." (Noakes, 1949). In 1943 a trial parcel from "The Shirley", G.M.L. No. 11B, in this area yielded 12.65 oz of gold for 0.6 tons of ore treated. The ore was reported to be of"... granite origin being mainly rose quartz and green tourmaline" and to have come from an ore body 7 feet in width. Noakes (1949) also states that "In 1947/48 a small parcel of ore from this district was crushed at the Black and White Mine, at Fountain Head, and produced over 5 oz of gold per ton."

Copper. The "Map of Chief Metalliferous Regions, Northern Territory" shows the Rum Jungle Copper Show, located 2½ miles north of Rum Jungle Siding. This location is near the present site of Brown's Prospect.

Reference is made in the S.A., 1900 - Record of Mining in the Northern Territory of South Australia - to the Rum Jungle Silver and Copper show, located one and a half miles south-east of Rum Jungle Siding. This prospect is described as an outcrop of siliceous ironstone intermixed with cerussite and copper carbonates. The writers have not seen this show although they have been in the vicinity. It is possible that an error in describing the location has been made and the actual deposit is Brown's Prospect.

Uranium. "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 (in the vicinity of Brown's Prospect) and submitted for examination samples that 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" (Sullivan and Matheson, 1952).

The only producing uranium deposits are located at White's and Dyson's deposits (Rum Jungle), and at Mount Fitch about 5 miles north-west of Rum Jungle. A number of radiometric anomalies are being tested by private concerns.

OBJECTIVES.

This mapping was done in order to evaluate the Rum Jungle deposits with regard to their relationships with the regional geology. This, it was hoped, might lead to the discovery of some of the controls responsible for the concentration of uranium and, possibly, to the discovery of new deposits.

An equally important objective was to start the geological mapping of the 1 inch to one mile military sheets of the area. This is part of the Bureau of Mineral Resources' larger plan of mapping in the N.T.

The resultant map was also intended to provide a geologic base on which to plot radiometric anomalies located by the aerial scintillometer survey made by the Geophysical Section of the Bureau.

PREVIOUS WORK.

The Bureau of Mineral Resources started the first geological work in the area in 1949. Development of White's uranium deposit and intensive geologic mapping began in May 1950. R.S. Matheson, and others, mapped much of the area surrounding White's mine. The remainder of the area was mapped by F.J. Frankovich, F. Joklik, J.B. Firman and others during the 1953 field season.

METHOD.

Photographs, together with the mosaics and map compilations made from the Darwin-Pine Creek Aerial Survey 1950, were used for geological mapping. Outcrops were recorded, with descriptions where possible, on the photographs. This data was transferred to the mosaics. Tracings of the map compilations were overlaid on the mosaics - with drainage as the principal control - and the geological data transferred to the tracings to make an outcrop map. Dyeline prints were made from the tracing and interpretations made on the prints. The data on the prints was then transferred to the final map at reduced scale. Geological and photographic interpretation were employed extensively in large areas covered by alluvium.

GEOLOGY.

GENERAL.

In this district the principal geological features are the two granite masses which have intruded Lower Proterozoic metasediments. The outcrops of these metasediments now rim the granites and dip away from them on all sides.

The metasediments as a whole are essentially clastic, except for a few thin limestones. Uranium and copper mineralization occur within a brecciated zone of interbedded chloritic and graphitic schists and slates.

A great regional fracture, Giant's Reef Fault, trangresses the district from south-west to north-east and displaces all the rocks and structures in the area.

METASEDIMENTARY ROCKS (BROCK'S CREEK GROUP.)

These metasediments have been assigned to the Brock's Creek Group of Lower Proterozoic age by Noakes (Noakes, 1949) who states that members of the group "...constitute the basement rocks of the northern portion of the Northern Territory and outcrop over the greater part of the region lying north and west of Katherine." The metasediments have been subjected to regional folding and low grade dynamothermal metamorphism. This type of metamorphism is indicated by a well-developed cataclastic structure and the presence of sericite in some of the fine-grained rocks, the prominent flaser structure of some of the coarse-grained rocks, the crystalline nature of the metalimestone, and the absence of minerals formed by high grade dynamothermal metamorphism.

Dynamic metamorphism has produced quartzite-breccias by repeated fracturing of the more competent metasediments. Where brecciation is well developed the breccia may be easily traced, but these rocks are not persistent and show marked variation along the strike. They are, therefore, poor horizon markers. At least three different stratigraphic horizons produce similar quartzite breccias when fractured. The quartzite breccias are hematised in many places.

Many characteristic features of the original sedimentary rocks may be seen in the metasediments and these features have been used as a basis for subdivision into Beds. The metasedimentary sequence is described by Beds, proceeding, in turn, from the older to the younger rocks. Rocks units formed by fracturing and silicification of the metasediments are included in these descriptions.

Only the Crater Grit Formation is consistent enough in character and persistent enough in outcrop within the area mapped to be termed a formation.

Rocks Marginal to the Granites.

The area between the granites and the Crater Grit Formation is generally low and largely soil covered. Coarsely crystalline limestone, shale, talcose and chloritized shale, schistose slates, schists, sandstones and quartzites, and conglomerates have been found outcropping over the granite and under the Crater Grit Formation. In places a coarsely crystalline limestone marks the top of this unit. Numerous quartz veins and some quartz-tourmaline veins occur in these rocks.

The granite is discordant with the rocks marginal to the granites and in some areas transgresses it entirely and is in contact with the overlying Crater Grit Formation. The granite-metasediment contact is obscure and difficult to map.

Crater Grit Formation.

The Crater Grit Formation as here defined includes a basal and top member in addition to that sequence previously termed the Crater Formation (Dodd, 1953). Because of its fluviatile or littoral marine deposition the formation varies considerably in thickness and with the added members varies from approximately 800 to 2000 feet in thickness.

The Crater Grit Formation consists of three members: the lower, middle (Hematized Boulder Conglomerate) and the top member.

The basal unit of the lower member is a light grey quartzite which overlies a coarsely crystalline limestone. Good outcrops of these rocks occur south of the Rum Jungle granite. The top of the lower member is a highly sericitic grit found invariably under the Hematized Boulder Conglomerate. The writers consider the sericite in this grit to have been derived from the dynamic metamorphism of a clayey matrix in the original grit. Others who have mapped this unit consider the sericite to be a result of granitization (Matheson, 1953, Carter, 1953, and Dodd, 1953.) The constant character of this sericitic grit, regardless of its distance from the granites, is the writers' chief support for their belief.

The Crater Grit Formation includes the Hematized Boulder Conglomerate, the only good "marker bed" exposed in the entire district. This member "... is thirty five to one hundred feet in thickness and is composed of lenses of pebbles, cobbles, and boulders of grey and black quartzite, and a finely banded, highly folded siliceous hematitic rock bearing a field classification of 'iron formation'. Grit and sand-size quartz, quartzite, and hematite particles full the interstices; the cement is silica and specularite. The pebbles are sub-angular to rounded with a tendency toward ellipsoidal shapes possibly resulting from dynamic metamorphism. It is believed that the hematite was derived from the "iron formation" sediments and that it has been redistributed and recrystallised by metamorphic processes" (Dodd, 1953).

Above the Hematized Boulder Conglomerate lies a thick sericitic sequence of lenticular sandstones, pebble beds, and coarse conglomerates interbedded with thin shales. Some of the sandstones are slightly pyritic and the coarser clastics are often arkosic.

Quartzites interbedded with thin beds of hematitic slate and siltstone are found in the top of the Crater Grit Formation. In some places they have been strongly brecciated and hematized and contain abundant fragments of vein quartz. In numerous places the thin bedded sedimentary structure of this unit can be seen grading through all stages of brecciation into a rock type called "hematized quartzite breccia."

These top quartzites with their brecciated and hematized equivalents were not included in the Crater Grit Formation by Dodd, but are included here because they were deposited during the same cycle.

The Crater Formation is partcularly well developed south of the Rum Jungle Granite. North of the Waterhouse granite the members of the Crater Formation either thin out or grade laterally into quartzites and shales. South-west of the Waterhouse granite the Hematitized Boulder Conglomerate and associated grit beds thin out and are overlain by light red sandstones and quartzites (brecciated in part) which contain grit bands and a bed of dark grey and red and grey banded slates. These rocks on the south-west of the Waterhouse granite are not present in the type-area described by Dodd, but they are included here as members of the Crater Grit Formation because of their similar character.

Rum Jungle Beds.

The bottom of this Bed is marked by thin-bedded brown and black slates interbedded with thin dark limestones which overlie the coarse clastics of the Crater Grit Formation. This bed consists of a wide variety of thin-bedded rock types. The outcrops of any particular rock type or bed are not continuous enough, with one exception, to permit even restricted correlation or detailed description of the complete Bed.

The Bed is composed largely of fine clastics with thin limestones in the lower half. One of these limestones which is thin black and impure - makes a good marker bed south and east of the Rum Jungle granite and is shown on Plate I. The other beds in the lower portion are slates (chloritic, micaceous, and graphitic), thin-bedded white and red sandstones, siltstones, and thin lenses of pebble and granule conglomerates. The upper portion contains grey pyritic slates with interbedded pyritic quartzites which are also found in some places in the lower half of the bed.

The thin-bedded white and hematitic sandstones and siltstones found about in the middle of the bed have been brecciated in some places and are exposed in about six different areas in the district. These breccias all have essentially the same character and are very similar to a breccia commonly found in the top of the Crater Formation and to one found in the lower Mt. Minza bed. It is not sound to correlate the various breccias since the type, thickness, and stratigraphic position of the outcrop is wholly dependent on the intensity of the dynamic metamorphism.

Interbedded chloritic slates, graphitic slates, and argillites of this sequence are the host rocks for the uranium and copper mineralization of the Rum Jungle deposits.

Mt. Minza Beds.

This bed is an interbedded sequence of sandstones and slates with great variations in the relative amount of the two rock-types along the strike. From Mt. Minza north to Manton Dam and west around the north of the Rum Jungle granite the bed contains many members of grey pyritic sandstone which form ridges. West of the Rum Jungle granite the bed apparently contains little sandstone and is a sequence of slates covered by soil. The wedging out of the sandstone members is so abrupt that the aerial mosaics suggest a fault termination of the bed north-west of the Rum Jungle granite. Investigation has proved this not to be the case.

A zone of thin ferruginous slates interbedded with white quartzitic sandstones and siltstones has been severely brecciated by movement along its strike during folding. The rocks of this zone are known as the Mt. Minza hematized quartzite breccia.

Lenses of pebble conglomerate are also found in the vicinity of Mt. Minza where the bed as a whole is more coarsely clastic.

The grey, reddish brown, and grey and red banded slates and shales of the bed vary considerably in character - being partly argillaceous, silty, pyritic, limonitic, and graphitic.

Bands of tuff are found in the bed west of the Rum Jungle granite. One of these tuff bands has a very high carbonate content.

More volcanic rocks are found in this bed in the vicinity of Stapleton Siding. These were earlier named the "Stapleton Volcanics" which "include tuffs, tuffaceous shales, quartz grits, and lavas which range in composition from rhyolite to basalt" (Joklik, 1953).

The writers did a little additional mapping north and east of Stapleton Siding: sufficient to conclude that the "Stapleton Volcanics" embraced a stratigraphic unit now divided into the Mt. Minza and Pell beds.

The boundaries of the Mt. Minza beds, as shown on Plate I, west of the Rum Jungle granite, could not be mapped because of soil cover, and as shown are only extrapolations of the stratigraphic position.

Pell Beds.

This unit has been subdivided into three members. The lower member overlies the Mt. Minza beds and includes felspathic sandstones, siltstones and sandy shales interbedded with slates and shales. These rocks are overlain by reddish-brown and black slates which are interbedded with thin beds of micaceous sandy shale.

The middle member contains felspathic and micaceous sandstones, with intercalated grit and shale bands, well developed near Stapleton Siding. These rocks have been correlated with grey pyritic sandstones, shales and dark grey arkose found two and a half miles south-east of Pell Airfield.

The upper member contains reddish-brown slates and shales, sandy shales and dark grey arkose.

The correlation of the members of this sequence is based on lithologic similarities, the interpretation of strikes and dips, and photo-interpretation across extensive alluvial flats and soil covered areas.

The Pell Beds may be correlated with the rocks which overlie the Mt. Minza Beds west of the Rum Jungle and Waterhouse granites. The rocks west of the granites are felspathic grits, felspathic sandstones (some beds may be arkose) and sandy micaceous shale (felspathic in places) which are interbedded with light red-brown buff and grey slates and shales. The Pell Beds west of the Rum Jungle granite are thin and do not show the variation in thickness and lithologic character found in the Pell Beds east of the Rum Jungle granite.

Snake Creek Beds.

All the rocks younger than the Pell Beds have been grouped together because no marked change in the type of sedimentation took place within the beds. Good exposures of these rocks are found in the hills near the headwaters of Snake Creek, approximately one mile west and two and a half miles north of the junction of the Stapleton track and Stuart Highway.

The Snake Creek beds contain greyish brown grits, sandstones (some pyritic), sandy and non-sandy shales which are micaceous in places, and dark bands of arkoses some of which are very limy. These beds have been divided into three units as shown on Plate I. This division is based on some rather vague lithologic changes and is not marked by easily followed contacts. The lowest of the three units is the most sandy, the middle is most shaly, and the top unit consists mostly of shales with beds of coarse calcareous arkose. The top unit is the least resistant.

IGNEOUS ROCKS.

Rum Jungle and Waterhouse Granites.

These granites are stock-like in plan and consist of numerous scattered outcrops in soil-covered areas. The granites are approximately six miles apart and are separated by metasediments in a shallow synclinal trough. It is probable that the granites are connected at depth to form a ridge extending in a N.N.E. direction.

The granites range from coarse to fine grain and large phenocrysts of felspar are a common feature in the coarser grained varieties. In some places marginal to the granite the rock has a gneissose structure and could be termed a gneissic granite.

The contact between the granite and the overlying metasediments is obscured by soul. The granite aureole is restricted because some granite outcrops are located within fifty feet of the metasediments and no extensive alteration of these rocks may be seen.

Quartz-Tourmaline Veins.

Quartz-tourmaline veins have been found stratigraphically above the Waterhouse and Rum Jungle granites and below the Crater Formation. The veins trend parallel to the granite margins and are usually less than ten feet in width.

Quartz Veins.

Numerous outcrops of vein quartz occur in the mapped area. In general the outcrops are not prominent, but large outcrops are a common feature along the Giant's Reef Fault near the Rum Jungle granite.

Close to the granites the quartz reefs occupy fractures which radiate from the granite and fractures which are subparallel to the granite margins.

Outcrops of quartz veins in the Mt. Minza and younger Beds tend to follow the strike of the metasediments.

Dolerite Dykes.

A map issued by the Bureau of Mineral Resources in June, 1952 entitled "Geological Map of Rum Jungle Structure, Northern Territory, Australia", shows a basic dyke approximately two miles west of Brown's Prospect in the Rum Jungle mining area. A second less prominent dyke intrudes granitized rocks between Rum Jungle Siding and the Fetlers Camp. Another area of dolerite rubble is found 1¼ miles east of the 47 mile peg on the Stuart Highway.

GEOLOGICAL STRUCTURES.

Folding.

The most important structural features in the District are the two eroded domes, the cores of which are occupied by the Rum Jungle and Waterhouse granites. The metasediments strike parallel to the margin of the granites and dip away from them. The metasediments between the granites are folded into a syncline. Regional folding probably occurred contemporaneously with granite emplacement and was accompanied by considerable drag folding of the less competent rocks.

(1) East of the granites the metasediments are closely folded. The axes of the folds trend north-south through the area and plunge generally to the south.

(2) West of the granites the metasediments have a regional strike trending north-south.

(3) Folds north of the intrusives plunge north.

(4) One syncline north-east of the Rum Jungle granite plunges arcuately from north to north-west. In general the beds dip steeply west, but vertical and steep east dips are also found. No marker bed has been found in this sequence and, although the metasediments appear to dip away from the western margin of the granites, they could be isoclinally folded.

Folding was accompanied in some areas by the development of conspicuous and resistant breccias. These breccias are found where the dynamic metamorphism was greatest, particularly along the synclinal trough between the two granites. The brecciated character of all the hematitic sandstones largely disappears away from the synclinal trough where they are not resistant to erosion and are soil covered.

Some breccias developed during folding due to the crushing of certain susceptible beds along their strike. These beds were originally thinly interbedded with hematitic siltstones and shales in thin white sandstones, the whole being cut by quartz veins. The change in character from the obvious fine-grained metasediment to a completely brecciated equivalent, containing angular quartz fragments, can be seen in places within a short distance along the strike.

Faulting.

The history of faulting in the Rum Jungle district is interpreted by the writers as follows:-

(1) Tension faults, radial from the granite, accompanied or followed its emplacement.

(2) Probable development of a small thrust fault in the west central part of the district before Giant's Reef Fault relieved regional stresses.

(3) Giant's Reef fault.

(4) Faults marginal to the granite-time unknown.

This interpretation of the history of the order of faulting in district does not agree with that of earlier Bureau of Mineral Resources investigations in the vicinity of Rum Jungle (Matheson, 1950 and Carter, 1953).

(1) Tension faults radial from the granites: In the metasediments, marginal to the granites can be seen many small faults perpendicular to the strike of the beds and roughly radial from the granites. These faults have not been mapped in detail except in the Embayment area (Carter, 1953) and south along the Crater Line (Dodd, 1953).

The maximum apparent horizontal displacement is about 1200 feet in the Embayment area. Similar displacements exist in the Crater Line area. Detail (nearly vertical plunging folds and crenulations) at the end of the Hematized Boulder conglomerate north of Whites mine indicates that the last movement on at least one of these faults was nearly horizontal with the western side uplifted a little. Such movement would be expected to be found on radial tension faults resulting from intrusion.

Minor quartz injections are found along these faults, which themselves are a minor feature in the complete structural geology of the district. They are locally important at White's Mine in Rum Jungle however, because they displace the uranium ore body. Conclusive evidence is not at hand to permit a decision on whether the faults are post or premineralisation.

Locally, in the top of the Crater formation and in parts of the Rum Jungle beds, these faults have produced hematized quartzite breccias.

(2) Probable development of small thrust fault: In the western part of the district just north of Giant's Reef fault, incongruous strikes and dips are noted on either side of the contact between the Mt. Minza bed and the Crater Grit Formation. The Mt. Minza beds have a variable, near vertical dip and overlie the Crater Grit Formation which dips 45 to 60 degrees west. The strikes of the two Beds just north of Giant's Reef fault are about 80 degrees to each other and the Mt. Minza Beds mask the underlying Rum Jungle beds.

On examining this structural relationship, two interpretations come to mind; 1) an unconformity or, 2) a thrust fault. Outcrop information in the critical area is meagre and does not afford conclusive evidence. The writers feel that a thrust fault is the more logical interpretation with the Mt. Minza beds overiding the Rum Jungle Beds and Crater Grit Formation from the west.

The thrust fault, as envisioned by the writers, is a relatively minor feature and fades out within 5 miles north and 3 miles south of Giant's Reef fault. It has small displacements and could have been produced by the regional stresses that were later relieved by the rupture along Giant's Reef Fault.

(3) Giant's Reef Fault: This great regional rupture transgresses all rocks and structures in the Rum Jungle District from south-west to north-east. The trace of the fault is conspicuous on the aerial mosaics and is marked in the Rum Jungle granite by large quartz outcrops. Few quartz outcrops, but often much quartz rubble are found where the fault trace is in meta-sediments.

The typical Giant's Reef outcrop consists of a mass of anastromosing quartz veins and veinlets enclosing abundant fragments of brecciated country rock. This suggests many minor periods of quartz injection and movement. A number of massive quartz veins branch at acute angles away from Giant's Reef fault. The quartz in the fault was no doubt derived from the last acidic fractions of the granites. Shears or fractures parallel to Giant's Reef are evident from certain topographical features visible on the aerial mosaics. Most of them, however, are too obscure to be mapped on the ground.

A study of the Hematized Boulder conglomerate outcrops on Plate I reveals the horizontal displacement along Giant's Reef fault to be about 2 miles, with the north-west block moved north-east. These outcrops also give an accurate idea of the true direction of movement. Outcrops of the Hematized Boulder conglomerate on the western and eastern flanks of the Rum Jungle granite and immediately north of the fault measure 2.15 miles apart. Immediately south of the fault they measure 2.0 miles apart. If there had been an appreciable vertical component to the movement on the fault the distance between the Hematized Boulder conglomerate outcrops north of the fault would be very different from the distance between the Hematized Boulder conglomerate outcrops south of the fault. As they are, they indicate a nearly horizontal movement with slight uplift on the north side of the fault. This is confirmed by additional data on outcrops south-west along the fault.

(4) Faults Marginal to the Granites: These fractures may have developed after granite emplacement as the result of cooling and contraction of the main granite mass. They are filled in many places with vein quartz or vein quartz with tourmaline, which suggests that they were developed before the last phases of granite injection. Their age, however, in relation to other structures is uncertain.

GEOLOGICAL HISTORY

Noakes (1949) states that the original sediments of the Brock's Creek Group - including the rocks of this area - were marine sediments deposited in a great geosyncline, in Lower Proterozoic time.

A shallow water enviroment is indicated by the variable thickness and the lenticular nature of some of the beds (particularly in the Crater, Grit Formation), alternating thin beds of sediments showing marked variation in grain size, marked lateral variation in the beds, and the presence of coarse-grained rocks, such as the Hematized Boulder Conglomerate.

The relatively pur limestones below the Crater Grit Formation and in the Rum Jungle Beds indicate breaks in clastic sedimentation.

Tuffaceous rocks in the Mt. Minza beds and in overlying beds indicate vulcanism during deposition of the sediments.

The felspathic nature of many of the rocks indicates that the source rocks (including granitic) were close to the area of deposition, or part of a high source area.

Geosynclinal development was brought to a close by widespread diastrophism. The region was subjected to east-west compression, resulting in large folds trending north-south. That the folding happened before the intrusion of the granites is shown by the large anticlinal axis in the north-east corner of the district trending north beyond the influence of the granite intrusion. The anticline must have been formed before the intrusion.

Further compression was accompanied by the emplacement of the Waterhouse and Rum Jungle granites and the development of tight folds in the surrounding sediments. The emplacement of the granite probably was due largely to the release of pressure with upward folding and erosion of the overlying sediments. Some unbalance of forces must certainly have existed with the intrusive pressure causing tensioned radial faults in the surrounding meta-sediments.

Continued compression of the meta-sediments from the west against the granites, caused very tight folding of these sediments. Eventually a small area of the Mt. Minza meta-sediments began to override to the east of the more stable lower rock resting on the granite.

Continued regional stress finally resulted in the great regional rupture called Giant's Reef fault. Earlier workers in the vicinity of Rum Jungle postulated that the slope of the embayment area was due to dragging of the beds against the fault. The additional work done this season suggests a different interpretation. The writers do not believe that appreciable dragging developed along Giant's Reef fault, particularly in the vicinity of the Embayment area where the thin cover of meta-sediments rests on a rigid granite basement. The majority of strikes mapped adjacent to the fault do not show changes of direction that appear attributable to dragging.

One writer (F.J.F.) believes that the shape of the Embayment area is due to Giant's Reef fault striking along one limb and displacing a minor syncline developed in the Crater Grit Formation with the intrusion of the granite. A similar minor syncline has been mapped on the west side of the Rum Jungle granite, but it has not been faulted.

ECONOMIC GEOLOGY

Apart from the genetically related group of copper-uranium deposits at Rum Jungle and the uranium at Mt. Fitch there are few instances of significant mineralization in the Rum Jungle District. There are several small outcrops showing a little copper staining which examinations have shown to have little possibility for commercial exploitation.

Quartz veins occur throughout the area and quartz-tourmaline veins occur near the margin of the granites. Gold is associated with the quartz veins in the Stapleton mines area, and with quartz-tourmaline veins in the Batchelor occurrence which are described as "small high-temperature veins deposits" (Noakes, 1949). The Stapleton mines area was not examined to determine its gold potential, but elsewhere in the District there appears to be little hope for additional gold production.

The regional and local structural controls which might have influenced the mineralization at Rum Jungle are as yet unknown. The favourable host rocks for copper-uranium mineralization are sheared and highly brecciated argillites and chloritic and graphitic schists and slates, therefore, it might be said there is a general relationship of uranium mineralization to lithology.

The map of radiometric anomalies issued by the Bureau of Mineral Resources shows no pattern of distribution which can be related to either structure or any specific rock unit.

The preliminary map showing the distribution of magnetic maximum highs is similarly difficult to interpret in relation to structure or rock types. The preliminary plot of the anomalies does not place them over the Hematized Boulder Conglomerate which is a highly magnetic bed. It is possible that the bed in its mass effect is negligible, however, the final plot of the anomalies may place them over this known magnetic bed. The present plot of the anomalies, wherein the anomalies roughly follow the strike of the sediments, suggests magnetic beds, particularly within the Mt. Minza beds.

Some mineragraphic and petrographic studies on Rum Jungle rocks have been made (Stillwell, 1950 and 1951), but no attempt at textural interpretation and paragensis has been made on a comprehensive suite of specimens. Such study is now in progress at the Bureau of Mineral Resources laboratory and results should be available about the middle of 1954. The results of this work will provide the basis for theories on the origin of the mineralization, and later reappraisal of the structural geology may reveal the structural controls.

Preliminary examination of polished sections in the Bureau of Mineral Resources has indicated that highly fractured pyrite follows bedding control and that later copper minerals surrounding the pyrite are comparatively unfractured. This relationship suggests the following possible order of events:-

1. The pyrite was pre-folding and therefore, possibly, pre-granite.

2. The brecciated pyrite supplied the suitable chemical environment to precipitate the copper and uranium ions from mineralizing solutions.

Several additional observations lend some slight weight to the hypothesis. The widespread distribution of considerable pyrite in certain beds suggests sedimentary pyrite in much of the geologic section. This problem should soon be solved by the determination of the sulphur-selenium ratio in the pyrite which is fairly conclusive evidence of either a sedimentary or hydrothermal origin for the pyrite. Results of sulphur-selenium ratio determination will be available in the near future.

Recent researches on the synthesis of uranium minerals (Gruner, 1952) have shown that uraninite may be precipitated from solution under ordinary conditions of temperature and pressure by ferrous ions and others. Some of the copper mineral ex-solution textures suggest a minimum temperature of formation of 475°C. Such ferrous ions can be produced in solution by pyrite under anaerobic conditions.

The foregoing is only one possible interpretation of the data at hand and only emphasizes the fact that more valid theorizing must await additional laboratory information, particularly mineragraphic work on paragenesis.

CONCLUSIONS.

No important uranium deposits were discovered, nor were the geological controls responsible for the known deposits revealed. This survey does not provide conclusive evidence that more uranium deposits are not to be found in the District. However, more are not likely to be found without serious testing (drilling, costeaning, or similar means).

This survey has provided a base on which to plot the radiometric anomalies to asses the possibility of their being related to structure or rock type. No such relationships is apparent. The survey also has made clear the position of the Rum Jungle deposits within the regional geology.

Most of the radiometric anomalies found in the district by the aerial scintillometer Survey (Wood and McCarthy, 1952) are caused by good exposures of slightly radioactive rocks and laterite. The source of the radioactivity in a number of the anomalies is still unknown and its determination is beyond surface geological mapping.

Additional regional geological mapping in the adjoining areas should be continued, particularly to the south-west along the strike of Giant's Reef fault and north of the District in the vicinity of Frazer airfield.

REFERENCES

Dodd, P.H., 1953 - Crater-line investigation, Rum Jungle, N.T. Bur.Miner.Resour.Aust., Rec. 1953/29 (unpub.).

Frankovich, F.J., 1953 - Preliminary report on the Brodribb uranium deposit, N.T. Ibid., 1953/23 (unpub.).

Gruner, J.F., 1952 - New data on syntheses of uranium mineral. U.S.A.E.C., RMO-983.

________, 1953 - Annual report for July 1952 to March 1953. U.S.A.E.C., RME-3044.

Ivanac, J.F., 1949 - Geological report on Rum Jungle radioactive mineral deposit. Bur.Miner.Resour.Aust. (unpub.).

Joklik, G.F., 1953 - The Waterhouse area, N.T. Ibid., Rec. 1953/95a (unpub.).

McCarthy, E., 1952 - (See Wood, F.W., and McCarthy, E.)

Mackay, N.J., 1953 - Dyson's Find (1951). Bur.Miner.Resour.Aust., Rec. 1953/26 (unpub.).

________, 1953 - Intermediate Prospect (1951). Ibid., 1953/27 (unpub.).

________, 1953 - Crater prospect (1951). Ibid., 1953/28 (unpub.).

Matheson, R.S., 1950 - Report on the geology of the Rum Jungle uranium-bearing area, N.T. Ibid., 1950/47 (unpub.).

________, 1952 - Rum Jungle investigations 1951 and 1952. Progress report. Ibid., 1952/84 (unpub.).

________, 1953 - Progress report on Brodribb prospect at 31st October, 1953. Ibid., 1953/122 (unpub.).

Mumme, I.A., 1953 - Geophysical report on the Ella Creek radioactive deposits, N.T. Ibid., 1953/144 (unpub.).

Noakes, L.C., 1949 - A geological reconnaissance of the Katherine-Darwin region, Northern Territory, with notes on the mineral deposits. Ibid., Bull.16.

Parkes, J.V., 1891 - Report on Northern Territory mines and mineral resources. S.Aust. Parl.Pap. No.32.

Rosenhain, P.B., 1953 - Geological report on Waterhouse Uranium Prospect No.4, N.T. Bur.Miner.Resour.Aust., Rec. 1953/127 (unpub.).

________, and Alle, A.F., 1953 - Preliminary geological and geophysical report on the Waterhouse Uranium Prospect No.2, N.T. Ibid., 1953/105 (unpub.).

________, and ________, 1953 - Preliminary geological and geophysical report on the Waterhouse Uranium Prospect No.1, N.T. Ibid., 1953/140 (unpub.).

Sabine, G., 1907 - Report on Rum Jungle copper mine.

Smith, D.N., 1953 - Preliminary report on diamond drilling at the Brodribb prospect, N.T. Bur.Miner.Resour. Aust., Rec. 1953/143 (unpub.).

Smith, K.G., 1953 - Preliminary geological report on the Ella Creek uranium prospect, N.T. Ibid., 1953/120 (unpub.).

Stillwell, F.L., 1950 - C.S.I.R.O. Mineragraphic Investigations. Report No. 440.

______________, 1951 - Idem. No. 473.

Sullivan, C.J., 1946 - Report on Batchelor gold prospect, N.T. Bur. Miner.Resour.Aust., Rec. 1946/28 (unpub.).

______________, 1952 - The uranium-copper deposits, Rum Jungle, N.T. Abridged progress report. Ibid., 1952/18 (unpub.).

______________, 1953 - Uranium prospects, Waterhouse area, N.T. Ibid. 1953/95b (unpub.).

______________, 1953 - The uranium prospects of the Brodribb, Ella Creek, and Frazer areas, N.T. Ibid., 1953/101 (unpub.).

______________, and Matheson, R.S., 1952 - Uranium-copper deposits, Rum Jungle, Australia. Econ.Geol. 47 (7), 751-758.

Townley, K.A., 1950 - Report on Rum Jungle uranium deposits. Bur. Miner.Resour.Aust., Rec. 1950/23 (unpub.).

Wood, F.W., and McCarthy, E., 1952 - Airborne surveys over the Rum Jungle area and other portions of the N.T. Ibid., 1952/79 (unpub.).

Plate 1

REGIONAL GEOLOGY
RUM JUNGLE
NORTHERN TERRITORY

Compiled by : F.J. Frankovich and J.B. Firman, Nov. 1953
Geology based on ground surveys and interpretation from air photographs by : F.J. Frankovich, J.B. Firman, F. Joklik, and B.P. Walpole 1953 and R.S. Matheson 1950/52.

1 0 1 2 3 4 5 6 Miles

Legend

LOWER PROTEROZOIC

Granite

Brocks Creek Group

Snake Creek Beds:
- Greyish-brown grits, sandstones, sandy shales, micaceous shales and dark grey arkose bands (Ark)
- Red brown slates and shales, sandy shale (micaceous in places) and dark grey arkose bands (Ark)
- Grey pyritic sandstone, felspathic and micaceous sandstone with intercolated grit and shale bands. Red brown slates and shales and dark grey arkose bands (Ark)

Pell Beds: Red brown, red and grey banded slates and shales (some micaceous), and siltstones

Mt. Minza Beds: Grey, reddish-brown, pyritic slates and shales with interbedded grey pyritic and felspathic quartzites, tuffs, sheared siltstones, limonitic silty shales and hematized quartzite breccia

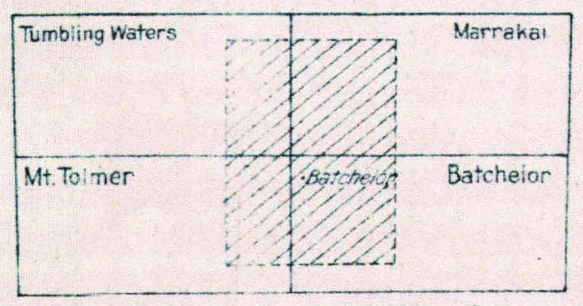
Rum Jungle Beds: Grey, brown and black slate interbedded with siltstone and quartzite (brecciated in places). Lenticular beds of impure and crystalline limestone. Sequence contains uranium bearing chloritic and graphitic slates at Rum Jungle.

Crater Grit Formation: Sequence of lenticular, irregularly bedded, felspathic quartzites, grits, sericitic grits, having a top-member of hematized quartzite breccia and containing hematized boulder conglomerate (shown in black)

Rocks Marginal to Granite: Covered area with few outcrops of metasediments and possibly granitized sediments

Beds of impure or crystalline limestone

Vein quartz
Areas of brecciation
Established geological boundary - position approximate
Probable geological boundary
Trend line
Strike and dip of strata
Top of bed as indicated by cross-bedding
Probable anticlinal axis with direction of plunge
Probable synclinal axis with direction of plunge
Established fault
Thrust fault
Mine working



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