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DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1966/199

EXAMINATION OF THE RUM JUNGLE PHOSPHATE DEPOSITS 1962-1964

by

P.W.Pritchard, J.Barrie, W.Jauncey

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SUMMARY

Eighteen deposits of phosphate rock containing 5 to 30 per cent P_2O_5 have been found in the Rum Jungle area. The deposits occur in a Precambrian sequence of hematite rich quartz breccia, sandstone and siltstone known as the Castlemaine Beds. The largest known deposit is Geolsec which contains proved and inferred reserves totalling 1.3 million tons of 12 per cent P_2O_5.

Total reserves outlined by drilling in the Rum Jungle area between 1962 and 1964 are 2.3 million tons of rock containing 10 to 12 per cent P_2O_5 but this is likely to be a gross under-estimate of the tonnage that is available.

The principal phosphate mineral in the deposits is fluorapatite, but the rock contains up to 25 per cent dusty hematite which makes it unsuitable for the manufacture of superphosphate.

INTRODUCTION

In late 1961 and early 1962 B.P. Ruxton and J. Shields of the Bureau of Mineral Resources Geology and Geophysics (BMR) found eight deposits of phosphate rock in the Rum Jungle area of the Northern Territory. Their finds are Geolsec, Easticks, Area 3, Area 4, Tartan, Rum Jungle Creek, Buckshee and Dysons. Following these discoveries, G.W. Patterson of Enterprise Exploration Pty. Ltd., found two deposits, Stapleton North, and Stapleton South, about 5 miles south of the Rum Jungle area (Fig. 1).

The first deposit found was Geolsec, a radiometric anomaly which the field party lead by Ruxton was examining as part of a geochemical prospecting programme for uranium and base metals. The discovery was made when D.A. Haldane and S. Baker, of the BMR chemical laboratory, found that the principal constituent of samples of radioactive siltstone from the deposit was apatite.

As a result of these discoveries, field parties were sent to the Rum Jungle area in 1962 and 1963 to determine the size, grade and economic potential of the deposits already found, to search for new deposits, and to determine the extent of phosphate mineralization in the area.

Reports by the BMR and other organisations on the chemistry, mineralogy, beneficiation, and utilization of the Rum Jungle phosphates appeared in BMR Record 1964/106 compiled by P.W. Pritchard. This should be read in conjunction with this paper.

REVIEW OF FIELD WORK

Field work commenced in May, 1962 and was completed in February, 1964. The 1962 field party consisted of three geologists (P.W. Pritchard, J. Barrie, W. Jauncey), a chemist (A.G. Fricker), and ten field assistants; the 1963 party consisted of one geologist (P.W. Pritchard), five field assistants and, for short periods, two other geologists (D. Maggs and D.J. French).

Geological Mapping

The results of the geological mapping carried out during the phosphate survey in the Rum Jungle area are recorded on a series of 1:1200 field sheets and on 1:4800 compilation sheets, which also show the results of previous BMR and T.E.P. field work. The grid for the sheets is the T.E.P. mine grid for the Rum Jungle area.

The working grids used during the investigation have been related to the mine grid by tape and theodolite traverses to Lands and Survey Department bench marks shown on the Department's survey plan A138, to bench marks on a survey line extending 13 miles south-west from Manton Dam, and to trigonometrical stations set up for T.E.P. by the Department in 1961. The last are listed in Table 1.

Table 1.

*HUNDRED OF GOYDER TRIGONOMETRICAL STATIONS

Station	** Mine Grid co-ordinates (feet)	
	Easting	Northing
Spike	28 460.06 E	25 720.78 N
Giants Reef	43 572.30 E	36 778.87 N
Mount Wimpey	31 647.52 E	28 373.79 N
Stratton	40 259.60 E	17 621.79 N
Red Ochre	27 107.51 E	13 124.94 N
Flynn	31 708.84 E	15 997.33 N
R.J.C.S.	29 175.65 E	9 627.95 N
Castlemaine	32 436.72 E	7 251.60 N
Mount Burton	14 245.21 E	35 154.11 E
Mount Fitch	13 109.33 E	40 475.45 N
Area 55		
Area 65A	51 406.53 E	5 739.71 S
Area 65B	50 658.21 E	7 872.26 S
Area 65	51 568.12 E	10 816.12 S

* Survey for T.E.P. by Department of Lands and Surveys, Darwin. October, 1961.

** Co-ordinates of local Mine Grid for Station "U" have been accepted for the conversion from the co-ordinate of the Transverse Mercator Zone 4 Australian Series. Mine Grid North is 2 minutes west of true north.

Station	Mine Grid Co-ordinates (feet)		Zone 4 Co-ordinates (yards)	
	Easting	Northing	Easting	Northing
U	33 735.46	31 378.12	401463.55	3345282.71

Drilling

The major part of the programme was based on drilling. Auger drilling, diamond drilling, and wet air-blast percussion rotary drilling techniques were used.

Most of the drilling was done by contractors (Table 2), but at the end of 1962 the BMR Gemco auger drilled 3000 feet for the phosphate investigation.

Table 2.

CONTRACT DRILLING

Operation	Contractor	Equipment	Period employed	footage drilled	Total cost	Cost per foot
BM, NX diamond drilling	Atlantic Drillers	Mindrill F20	18/7/62-28/3/63	4136	$33,735.94	$8.16
AXM, BX, NX diamond drilling	Associated Diamond Drillers Pty. Ltd.	Mindrill E1000 A5000	2/8/63-27/2/64	2470	$18,668.32	$7.56
Auger drilling	Monier Earth Drilling Pty. Ltd.	Gemco auger drill	2/8/62-13/11/62	19,996	$12,818.69	$0.64
Wet, air-blast, percussion rotary drilling.	Geophysical Services International.	2 Mayhew 1000 rigs.	15/7/63-21/11/63	14,988	$24,096.92	$1.54

Samples and core from the holes drilled during the 1962/64 phosphate survey and detailed lithological and radiometric logs of the holes are held by the Darwin Uranium Group. A set of bottom hole samples from the 1962 auger drilling was sent to the BMR Canberra laboratory for spectrographic analysis to supplement the 1961 and 1962 geochemical survey results.

The rotary and diamond drill holes sunk during the 1962/64 survey and the results are listed and summarised in Appendicies 1, 2 and 3 and on Plates 6 to 17.

The core from the following T.E.P. diamond drill holes was also tested for phosphate during the survey:

D115, D122, F226, D317, D320, D363, D520, D526, D527, D528, D529, D530, D537, D538, D539, D541, D553, D554, D555, D556, D559, D560, D562, D564.

Auger Drilling and Sampling

Auger drills were used in 1962 to examine the dimensions and grade of the known phosphate deposits and to prospect for new deposits on the slopes of Castlemaine Hill and at Buckshee in the Embayment area.

Most of the drilling was done with Gemco drills equipped with standard 3-$\frac{5}{8}$" diameter auger flights and bits supplied by George Moss Pty. Ltd. of Perth. This equipment can penetrate to maximum depths of about 120 feet and to average depths of about 50 feet. It is not capable of continually drilling anything harder than friable sandstone or shale and can penetrate only 20-30 feet of unconsolidated sand. It is capable of drilling between 200 and 400 feet in a nine hour day. Other types of drill, including a Failing 500, a truck mounted Mindrill E1000, a Pendrill and two types of custom-built hydraulically driven drills owned by Geotechnical and Engineering Services Pty. Ltd. of Adelaide (Geotech) were used for auger drilling in the Rum Jungle area between 1961 and 1964. Of these only the Failing and the Mindrill were satisfactory. All the drills except the Gemco and one of the two owned by Geotech were too powerful for the job and tended to shear off the rods and bits. The Gemco drill proved the most suitable machine for auger drilling.

Grab samples of the material extruded from the top of the hole were taken for every 2 feet drilled, and these were composited to make samples of intervals up to 12 feet long. A sample was also collected from the bit when it was removed from the hole.

Auger drilling is a satisfactory method of prospecting beneath alluvium and of probing for shallow concealed extensions of known mineralization. It has little use in prospecting in eluvial soil where, for the most part, phosphate mineralization can be located by surface sampling.

Auger samples cannot be used to obtain an accurate evaluation of the grade of mineralization because -

1. the depth from which the material sampled at the surface came can only be approximated;

2. above the watertable contamination of the sample by caving cannot be controlled, and below watertable the sample is merely part of a well mixed slurry representing the material penetrated between the watertable and the bottom of the hole when the sample was taken.

Rotary Drilling and Sampling

Rotary drilling was carried out in 1963 with truck-mounted Mayhew 1000 rotary rigs fitted with mud pumps and two-stage Gardner Denver compressors capable of delivering up to 440 cubic feet/min at 80 p.s.i. on single stage and at 120 p.s.i. on a two-stage operation.

For rotary drilling the bits used were 4$\frac{1}{2}$" to 4$\frac{3}{4}$" roller bits, and finger and tungsten insert blade bits. Hammer drilling was done with 4" and 4$\frac{1}{2}$" Halco down-the-hole hammers.

In dry air blast drilling samples were collected in two fractions. A coarse fraction collected in the first stage of the collecting device and a fine fraction collected in a cyclone. Wet samples were collected from mud pits near the collar of the hole by sampling and cleaning the slurry from the pit after each 5 feet had been drilled.

Adequate samples for determining the dimensions and grade of mineralized zones were usually obtained using rotary air blast and hammer drilling on dry holes. Samples from wet holes or holes drilled with mud were unsatisfactory because, like the auger samples, they are merely part of a well mixed slurry.

Bulldozing

Bulldozing required for costeaning, preparation of drill sites, and access tracks was done by the BMR and by local contractors (Table 3.)

Table 3.

CONTRACT BULLDOZING

Operation	Contractor	Equipment	Work done	Hours Worked	Cost
Costeaning	Territory Enterprises Pty. Ltd.	Caterpillar D7	Costeans 1, 2, 3.	33	$ 396
1) Costeaning	W. Childs Pty. Ltd.	International HD11.	Costeans 4-12	157	$1,727
2) Tracks and drill sites			Castlemaine Hill	40	$ 440
			Stapleton North		

Costean Results

In 1962-63 fourteen costeans were dug around the eastern side of Castlemaine Hill to prospect for phosphate rock. Channel samples over intervals of 5 feet or less were taken from the floors of the costeans and assayed for phosphate. Rock containing traces of phosphate was exposed in most costeans but only costeans 1, 3, 4 and 6 exposed material containing more than 5 per cent P_2O_5. Results for costean C1 are shown on Plate 19, and results for costeans C3, C4 and C6 are given in Appendices 4, 5 and 6. The assays were made by A.G. Fricker.

Duplicates of the channel samples are stored by the Darwin Uranium Group.

Supporting Services

Assaying

In 1962/63 all assaying required by the investigation was done in a field laboratory set up and run by A.G. Fricker with two field assistants. Routine assay results were available three days after the samples were taken in the field, and urgently required assays could be obtained on the day the samples were collected.

In 1963/64 semiquantitative assaying was done in the field by a field assistant (W. Frazer). Results were usually available the day after the sample had been taken. Quantitative assays were done in Canberra and it was usually several weeks before they were available in the field.

During both field seasons sample drying and crushing was done by BMR field assistants at T.E.P.'s Rum Jungle plant.

Laboratory note books are held by the Darwin Uranium Group.

Drafting

In 1963/64 drafting for the BMR's Rum Jungle phosphate investigation, geochemical survey and base metal prospect drilling was done in the field by R.G. Winchester.

THE GEOLOGY OF THE RUM JUNGLE AREA

Many BMR, T.E.P., Atomic Energy Commission and University geologists, geophysicists and geochemists have worked in the Rum Jungle area since J. White found uranium there in 1949. A considerable amount of information is therefore available about some aspects of the geology, but as yet only the broad outlines of the stratigraphy, and structure are known.

Precambrian and Tertiary rocks are found in the area. The Precambrian rocks are folded into two domes in which strongly folded but slightly metamorphosed "Lower Proterozoic" sediment intruded by small diorite bodies overlie cores of Archaean granite gneiss, schist, and granite, which have also been intruded by diorite.

Stratigraphy

Archaean

Until 1962 the granitic rocks forming the cores of the domes were thought to be intrusions into the overlying Lower Proterozoic metasediments, but in that year a series of outcrops where the contact between arkose at the base of the Lower Proterozoic sequence and the underlying granite gneiss is exposed, were found by B.P. Ruxton about a mile north of Batchelor on the eastern side of the road to Whites Mine. At this locality the arkose contains boulders of the underlying granite gneiss and it is evident that an unconformity separates the two rock bodies. The distribution of the schist, gneiss, metadiorite and the several types of granite which comprise the northern dome (the Rum Jungle Complex) has been mapped by Rhodes (1965). Richards and others (1966) have found that the age of the Archaean basement in the Rum Jungle area is more that 2550 m.y., and point out that as the age of granites intruding the metasediments of the Pine Creek Geosyncline is about 1700 m.y. the deposition of the sediments occurred at some time between these dates.

"Lower Proterozoic"

In the Rum Jungle area the "Lower Proterozoic" sedimentary succession from the base upwards appears to be:

1. Arkose, conglomerate, siltstone, ferruginous siltstone, and quartz sandstone (Beestons Formation and its possible equivalent the Crater Formation).

2. Dolomite, siltstone, ferruginous siltstone, quartz sandstone and chert (Celia Dolomite, and the Coomalie Dolomite which includes the Castlemaine Beds).

3. Carbonaceous and pyritic shale, chert and impure dolomite (Golden Dyke Formation), containing a lens of quartz sandstone, pyritic quartz sandstone, siltstone (Acacia Gap Tongue of the Masson Formation).

4. Siltstone, greywacke siltstone, greywacke (Burrell Creek Formation).

5. Quartz greywacke, greywacke, quartz pebble conglomerate, siltstone, (Noltenius Formation).

The Castlemaine Beds, which are included in the list as part of the Coomalie Dolomite, contain distinctive ferruginous and siliceous breccias which are consistently associated with the known phosphate deposits, and are commonly found near uranium deposits in the Katherine-Darwin region. The stratigraphic position and origin of these beds are the subjects for considerable controversy. Malone (1962a, b,) considered them to be part of the gently folded and unmetamorphosed Upper Proterozoic (now termed Adelaidean) sequence which overlies the "Lower Proterozoic" in various parts of the Katherin-Darwin region, and he suggested (1962a) that in the Rum Jungle area the breccias are valley fill deposits composed of material weathered from the underlying "Lower Proterozoic" rocks. Condon and Walpole (1955) concluded from their observations in the South Alligator Valley, at Sleisbeck, and Rum Jungle that they are silicified limestone reef breccias interbedded with the Lower Proterozoic sediments. Pritchard and others (1963) thought that the breccias in the Rum Jungle area represent an Upper Proterozoic or younger regolith from the weathered Coomalie Dolomite which they overlie, but now consider that they are part of the Lower Proterozoic sequence.

The Castlemaine Beds contain the following rock types: quartz breccia with a hematitic siltstone or sandstone matrix, hematitic red siltstone, hematitic siltstone breccia, chloritic sandstone, hematitic sandstone, hematite, and minor conglomerate and dolomite. These beds are exposed in the Embayment Area, on Castlemaine Hill and around the eastern, southern and western margins of the Waterhouse Complex. They have commonly been called the mudstone sequence or the quartz hematite breccia sequence. In Dyson's Open Cut they are folded with the Lower Proterozoic sediments. On the west side of Castlemaine Hill north of Rum Jungle Creek south they contain lenses of chlorite schist.

The quartz breccias with a hematitic siltstone matrix are the most obvious rock types in the beds. In places, such as on the south-western side of the Waterhouse Complex, the breccias can be traced into beds of unbroken interbanded hematitic mudstone and chert layers. The brecciation appears to be related to the folding of the Lower Proterozoic sediments, and to be a tectonic feature rather than sedimentary structures as Malone (1962a) and Condon and Walpole (1955) suggested.

Tertiary

Large parts of the Rum Jungle area are covered by laterite which is in places associated with deposits of sand and gravel. These deposits are preserved on the remnants of a Tertiary land surface whose eastern edge is shown on Fig. 2.

Major Structural Features

Rhodes (1965) has presented the available information about the structure of the Archaean rocks and their relationship to the overlying "Lower Proterozoic" metasediments.

Williams (1963) studied the structure of the "Lower Proterozoic" metasediments around the uranium mines and some of the uranium and base metal prospects. He reached the following conclusions:

A. The "Lower Proterozoic" metasediments have been multiply deformed in the following order:

1. by gentle folding about an east-west axis;

2. by intense refolding about a north-south axis which has transposed the bedding, has produced metamorphic layering parallel to the axial plane of this folding, and was accompanied by metamorphism of the rocks to greenschist facies;

3. by less intense monoclinal folding about gently plunging northerly trending axis;

4. by monoclinal folding about a steeply plunging west-trending axis.

B. The Archaean schist and gneiss in the Rum Jungle Complex has been retrogressively metamorphosed during the deformation of the overlaying "Lower Proterozoic" metasediments.

C. The domal shape of the Rum Jungle Complex could have been produced by the deformations listed in A.

D. The displacement of rocks on either side of the Giants Reef fault is similar to the relative displacement of rocks along monoclinal folds listed as A (4) above.

The Giants Reef Fault is a regional structure trending north-east. In the Rum Jungle area the relative movement along it is dextral strike slip with a displacement of the order of $3\frac{1}{2}$ miles. To the south-west it extends into the Tolmer Plateau area where mapping by Walpole and others (1959) shows that it displaces Adelaidean sediments and probably Lower Palaeozoic sediments in the Daly River Basin. The latest movement on the fault was therefore post Upper Proterozoic (Adelaidean) and probably post Middle Cambrian.

PHOSPHATE MINERALIZATION

The known phosphate mineralization occurs near the margin of the Castlemaine Beds. Deposits containing material assaying more than 5 per cent P_2O_5 occur in the Embayment Area, the Castlemaine Hill area, and the Stapleton area. Elsewhere in the Katherine-Darwin region similar mineralization has been found in the South Alligator Valley, at Sleisbeck, and at the Evelyn Mine.

Phosphate Rock

In hand specimen high grade (more than 25 per cent P_2O_5) phosphate rock is a lilac or pink coloured siltstone. Some if it is brecciated, some shows mamalliary structures, and some contains ladder veins up to 4 inches wide. Assay and X-ray diffraction results show that the principal phosphate mineral in unweathered material is fluorapatite, and thin sections show that the mineral is associated with hematite or goethite which gives the rock its lilac or pink colour.

Other minerals present in the rock are clays and minor amounts of quartz, muscovite, epidote, anatase, zircon and tourmaline (see Trueman and Ayres in Pritchard, 1963). The fluorapatite occurs in two phases, fine-grained, cryptocrystalline material enclosing dusty hematite; and coarse-grained, stubby fluorapatite crystals enclosing dusty hematite which commonly outlines "growth bands". The coarser fluorapatite either surrounds or traverses the aggregates of the finer material. Grainsize and modal analyses are shown in Table 4.

Table 4.

*GRAINSIZE AND MODAL ANALYSES

Sample Number	Coarse-grained apatite		Fine-grained apatite		Hematite	
	Grainsize	Modal analysis	Grainsize	Modal analysis	Grainsize	Modal analysis
	(mm)	%	(mm)	%	(mm)	%
10792	0.13	5	0.018-0.045	34	0.0001-0.027	20
12824	0.02-0.1	67	0.004-0.012	25	0.0005-0.007	3
12825	-	-	0.036-0.12	38	0.0005-0.013	17

*Information from W. Morgan (Pritchard, 1964)

Much of the lower grade (less than 25 per cent P_2O_5) phosphate rock is quartz breccia with a hematitic phosphatic siltstone matrix. Some breccia with a sandy matrix also contains phosphate.

Phosphatic clay in the present day weathering profile developed on the phosphate rock outcropping at Geolsec contained small amounts of iron and aluminium phosphate minerals (millisite, a member of the variscite-strengite series, and wavellite) in addition to the fluorapatite which was the main constituent (Trueman in Pritchard, 1964). Apart from the veins in some of the deposits, the phosphatic rocks in the Rum Jungle area resemble one or other of the lithologies found in the non-phosphatic parts of the Castlemaine Beds.

The phosphate rock is more radioactive than most other rocks in the Rum Jungle area and a limited amount of laboratory work indicates that the radioactivity is due almost entirely to uranium. Roberts (in Pritchard 1964) found that surface samples from Geolsec contained up to 500 p.p.m. U_3O_8 and Goadby found by X-ray spectrochemical analysis that material from diamond drill hole D.G.11 at Geolsec contained up to 280 p.p.m. U_3O_8.

The core from diamond drill hole D.G.9 was spectrographically assayed for copper, cobalt, nickel, lead, molybdenum and vanadium. The results are given in the drill logs at the end of the report but no unusual amounts of these elements were detected.

The Phosphate Deposits

The boundaries of the deposits are commonly defined by assays. The only deposit whose shape and relationship to the enclosing rock are well known is Geolsec, where the phosphatic rocks occur in a lenticular mass whose shape and orientation conform with the shape and orientation of lithological bodies in the enclosing metasediments (see Plate 14).

Origin of the Phosphate Mineralization

It has been suggested that the Rum Jungle Phosphate deposits

(a) are hydrothermal;

(b) are secondary and have been formed by Upper Precambrian or younger weathering of phosphatic Lower Proterozoic dolomite in the Coomalie Formation;

(c) are metamorphosed Precambrian phosphate-rich iron bearing sediments deposited in the "Lower Proterozoic" Pine Creek Geosyncline.

Whatever hypothesis is accepted it has to account for the facts that the mineralization has been found only in the Castlemaine Beds, that the mineralized rock masses appear to be conformable with other lithological masses in the beds, that some of the deposits contain small ladder veins of apatite and hematite, that thin sections of the phosphate rock show two phases of apatite, and that the coarser grained phase has a stubby crystal habit which Wyllie and others (1962) consider is developed only during crystallization at low temperatures from a solid phase.

Barrie favours hypothesis b, Jauncey hypothesis a, and Pritchard hypothesis c.

THE PHOSPHATE DEPOSITS

Rock containing more than 5 per cent P_2O_5 has been found at seventeen localities (Fig. 2.), in the Rum Jungle area. Four are in the Embayment Area 2 miles north of Batchelor, eleven are on the slopes of Castlemaine Hill north-west of Batchelor, and two are in the Stapleton area 4 miles south of Batchelor. At each locality the phosphate rock occurs in the Castlemaine Beds and is associated with a radiometric anomaly.

The Embayment Area (Plate 2)

Location

The Embayment Area is the wedge of Lower Proterozoic metasediments which lies east of Dolerite Ridge and is bounded on the north by the Rum Jungle Complex and on the south by the Giants Reef Fault.

Geology

Lower Proterozoic metasediments mapped by Malone and others (1960) and Malone (1962 a and b) as the Crater Formation, Coomalie Dolomite and Golden Dyke Formation are exposed and dip southwards into the Giants Reef Fault. The eastern end of these formations fold around against the Giants Reef Fault. Sullivan and Matheson (1952) found that in the Whites area the closure of this fold plunges east and not west as might be expected from casual inspection of Figure 2.

The Castlemaine Beds which contain the phosphate deposits are associated with the Coomalie Dolomite, and their outcrop follows the trend of the Lower Proterozoic sediments. Three of the deposits, Buckshee, Powerplant and Dysons, are located on the northern side of the outcrop of the Castlemaine Beds, and Whites East is on the southern side. At the western end of the Embayment area deposits of high grade hematite in the Castlemaine Beds are exposed over a distance of about a mile.

The geological information available to the end of 1963 is shown on Plate 2. Apart from the Buckshee and Powerplant areas it is based on previous T.E.P. and BMR mapping.

Exploration

The available exposures of the Castlemaine Beds in the Embayment Area have been examined, core from T.E.P. diamond drill holes which intersected the Castlemaine Beds were tested for phosphate, and additional drilling was done on the Whites East and Dysons deposits.

Most of the edges of the belt in which the Castlemaine Beds occur in the Embayment area are concealed either by sand, or by tailings and mullock heaps from the uranium mining. If further prospecting for phosphate rock is carried out at Rum Jungle, the area bordering the northern edge of the outcrop of the Castlemaine Beds and extending from Dysons Opencut to the western end of the tailings dam should be examined.

BUCKSHEE (Plate 6)

Location

Buckshee is 4500 feet west of Whites Opencut. It was located by B.P. Ruxton and J. Shields in 1961.

Exploration

In 1962 the Buckshee area was mapped and auger drilled on a 200 foot square grid, and in 1963 one diamond drill hole (D.G. 32), and six rotary holes (R121, R123, R125, R127, R129A, R131A) were drilled to test its dimensions and grade.

Stratigraphy

The deposit occurs in hematitic siltstone which contains minor lenses of hematite rock, hematitic quartz breccia and chlorite schist. It is overlain by hematitic quartz breccia and sandstone, and it is underlain by dolomite, tremolite schist and tremolite mica schist.

Structure

The shape of the zone of the phosphate mineralization proved by drilling indicates that the zone may be folded about an axis which plunges to the east or south-east and that the limb of one of the folds in the south-western corner of the prospect is sheared and attenuated.

The deposit

Phosphate rock is exposed in an arcuate zone about 700 feet long and up to 120 feet wide.

Drill hole D.G.32 intersected two lenses of higher grade material, an upper one averaging 10.1 per cent P_2O_5, over 60 feet, and a lower one averaging 8.1 per cent P_2O_5 over 60 feet. Auger drill holes A1028, A1027, R123 and R131A appear to have intersected the upper lens, and have proved reserves of 80,000 tons of material assaying 10.8 per cent P_2O_5. The grade calculations used semiquantitative assays of drill cuttings as well as assays of the diamond drill core from D.G.32. In addition to these reserves, Buckshee contains inferred reserves of 80,000 tons of 10 per cent P_2O_5. The limits of the deposit have not been established.

POWERPLANT

Location

Two areas of phosphate rock rubble are located on the eastern side of the East Finniss River about 2500 feet west of Whites Open Cut. The northernmost area is at the site of the Powerplant radiometric prospect and is about 700 feet north-east of the second area.

Exploration

The area was costeaned and percussion drilled by T.E.P. during its search for uranium. It was remapped in 1962. The exposures are too small to warrant further drilling. T.E.P. drilled percussion holes (CD 10-24) into the northernmost area. All bottomed in dolomite at less than 72 feet.

Geology

The deposits occur in rocks which are similar to those at Buckshee and appear to be continuations of the Buckshee horizon.

Size and Grade

At the Powerplant locality phosphate rock is scattered over an area of about 150 by 120 feet and is exposed in the east-west T.E.P. costean. Logs of the churn drill holes show that dolomite occurs beneath the deposit at a depth of 40 to 72 feet. Assuming that the deposit extends to 40 feet and that the rubble covered area represents its outcrop the inferred reserves are 50,000 tons.

At the south-western occurrence a band of phosphate rock rubble up to 25 feet wide occurs over a length of 220 feet. No information is available on its thickness.

DYSONS (Plate 7)

Location

Dysons Opencut lies 2000 feet east of Whites Opencut. Phosphate mineralization extends 1400 feet north-west and 2000 feet south-west of Dysons Opencut around the edge of the outcrop of the Castlemaine Beds. Much of the Dysons uranium ore consisted of secondary uranium phosphate but high grade phosphate rock was not known in the Dyson's area until it was recognised by B.P. Ruxton and J. Shields in 1961.

Exploration

Numerous holes have been drilled in and near the opencut by T.E.P. At the beginning of the phosphate survey in 1962 the T.E.P. holes which penetrated the Castlemaine Beds were examined and some were found to have intersected phosphate mineralization. Now that more is known about the origin and occurrence of the Rum Jungle phosphate mineralization, further work in the Dysons area should start with the re-examination of the T.E.P. drilling.

In 1963 twelve rotary holes were drilled around the edge of the Castlemaine Beds outcrop on either side of Dysons opencut to obtain information about the length of the mineralized zone.

Geology

The phosphate mineralization occurs in hematitic mudstone, hematitic quartz breccia and dolomite of the Castlemaine Beds. The Castlemaine Beds overlie carbonaceous schist and pyritic quartzite. The contact between the Castlemaine Beds and these rocks in Dysons Opencut area dips to the north-east.

Mineralization

In the Dysons area phosphate mineralization occurs in a belt at least 4000 feet long around the edge of the outcrop of the Castlemaine Beds. Intersections of phosphate mineralization in this belt assayed less than 25 per cent P_2O_5.

WHITES EAST (Plates 8 & 9)

Location

Phosphate mineralization occurs in a belt extending from Whites Opencut around the nose of the fold outlined by the edge of the Castlemaine Beds to a point 1600 feet east of the opencut.

In 1962 examination of T.E.P. drill core from the Whites-Dysons area located phosphate mineralization in D.317 on the eastern edges of Whites opencut. Phosphate rock is now known to be exposed about 800 feet east of Whites Opencut near the collar of rotary drill hole R157. This area is an old radiometric prospect called Whites East or Whites Extended.

Exploration

The Whites East radiometric prospect was located and drilled by the BMR during its examination of the Rum Jungle uranium mineralization between 1949 and the end of 1952. Between 1953 and 1955 T.E.P. tested it with rotary and diamond drill holes and with costeans. Subsequently parts of the area were used as a mullock dump and little outcrop is now visible.

In 1963 four rotary and two diamond holes, (R122, R124, R155, R157, D.G.34, D.G.35,) were drilled by the BMR to test its potential as a phosphate prospect.

The results of the T.E.P. and 1963 BMR drilling are summarized in the sections on Plates 8 and 9. The geological information on Plate 2 is taken from mapping by T.E.P. and from a BMR map by McKay, Gates and Carter.

Geology

Phosphate mineralization occurs in the Castlemaine Beds around the nose of the Embayment Area structure along their contact with the overlying Golden Dyke Formation. These sediments are intensely folded and most of the observable lithologic banding in them is transposed bedding.

Secondary uranium mineralization is present in talcose slate found along this boundary (Thomas 1956) and T.E.P. drill logs show the presence of chalcocite and chalcopyrite in black slate and carbonaceous schist at the base of the Golden Dyke Formation.

In the Whites East area, the phosphate bearing Castlemaine Beds are hematitic mudstone, chlorite schist, red and grey dolomite and minor hematitic quartz breccia.

Mineralization

Drilling has intersected three apparently unconnected bodies of phosphate mineralization.

The westermost body was intersected by D.317 but did not continue to R155 or D.G.35. As can be seen from Figure 6, two long intersections made of phosphate rock containing up to 28 per cent P_2O_5. Outcrop in this area is obscured by mullock and as no structural information was obtained from the surface the structure of the deposit indicated in the section in Plates 8 and 9 is conjectural.

Some 700 feet east of D317, phosphate rock is exposed near the collar of R157 which penetrated 60 feet into the deposit but did not pass through it. This mineralization was not intersected downdip by drill holes D297, D298 or D311, and its extent on the surface is obscured by mullock dumps. The grade of the intersections range up to 28 per cent P_2O_5.

A third body of lower grade was intersected 700 feet further east by drill holes or sections 29973N and 30108N. This mineralization did not continue to section 30208N. Its southern limit is unknown. Of the holes drilled into it only D130 on section 29973N intersected better than 10 per cent P_2O_5 mineralization, the best intersection being 5 feet of 14.3 per cent P_2O_5 between 110 and 115 feet. The present information shows that the body is at least 100 feet long (with its southern limit unknown) and that grades of better than 5 per cent P_2O_5 occur over a thickness of the order of 20 feet perpendicular to the dip of the beds.

Conclusion

Phosphate mineralization occurs in the Whites East area in Castlemaine Beds near their contact with the Golden Dyke Formation. Mineralization is known over a distance of 1400 feet. The present drill hole information indicates that it occurs as discontinuous lenses, and that the lenses of phosphate rock are likely to be less than 400 feet long and 20 to 30 feet thick. This means that the possible size of the bodies is of the order of 200,000 tons.

Phosphate rock of material of higher grade than Dysons was intersected and the average grade of deposits in the Whites East area is expected to be of the order of 10 per cent P_2O_5.

Castlemaine Hill (Plates 3, 4, 5)

Location

Castlemaine Hill is a low hill about 3 miles long parallel to the western side of the railway line half a mile west of Batchelor.

Geology

The hill is the type area for the Castlemaine Beds.

As in the Embayment area, phosphate deposits are present on both sides of the belt of outcrop of the Castlemaine Beds. The non-phosphatic rocks between the phosphate deposits consist mainly of hematitic quartz breccia and sandstone. The phosphate bodies consist of hematitic mudstone and siltstone and hematitic quartz breccia with minor amounts of hematite rock, and dolomite. A small amount of chloritic schist occurs in the deposits on the western side of Castlemaine Hill.

The Castlemaine Beds are the continuation of the Castlemaine Beds exposed in the Embayment Area disrupted by the Giants Reef Fault.

The isoclinally folded and transposed Lower Proterozoic rocks in the Castlemaine Hill area appear to be folded about a monocline whose axis lies along the western side of the hill. This monoclinal fold may be a continuation of the monocline inferred to exist in the Buckshee-Whites area on the northern side of the Giant Reef Fault. In the Rum Jungle Creek South Opencut, Williams (1963) found that this monoclinal type of folding was the first of two deformations which have refolded the isoclinally folded Lower Proterozoic metasediments.

Mineralization

Phosphate mineralization occurs in the Castlemaine Beds around the edges of Castlemaine Hill and is known at eleven localities: Zeta, Rum Jungle Creek, Tartan, Castlemaine, Area 4, Powerline, Area 3, Geolsec, Easticks, Rum Jungle Laterites and Nell. Radiometric anomalies occur at each of these areas as well as at areas where no phosphate rock has been found.

Uranium mineralization has been found by T.E.P. in a belt extending from Rum Jungle Creek to Rum Jungle Creek South and was mined at Rum Jungle Creek South.

Some of the radiometric anomalies, Rum Jungle Creek, Castlemaine, Batchelor Laterites, Geolsec, Easticks and Rum Jungle Laterites have been prospected geochemically. Of these Castlemaine and Rum Jungle Laterites were associated with base metal geochemical anomalies (Ruxton and Shields 1962).

ZETA (Plate 10)

Location

The Zeta deposit is at the north-western end of Castlemaine Hill. Phosphate rock is exposed near the collar of diamond drill hole D363 and in costeans dug by T.E.P. during their examination of the radiometric anomaly associated with this deposit.

Exploration

T.E.P. have costeaned the area and drilled one hole D363 to test the radiometric anomaly. The 1962 B.M.R. phosphate survey drilled two traverses of auger holes across the area and in 1963 the survey followed this drilling with six rotary drill holes. Only one auger hole (that collared next to R66) penetrated phosphate rock.

Geology

All the holes were drilled in hematitic siltstone and hematitic quartz breccia. Circulation was lost at the bottom of several of the rotary drill holes and this may mean that the holes penetrated dolomite. The hematitic clay and silt intersected by R100 and R97 was very puddly and the ground around these holes would probably be very unstable if the prospect were to be mined.

Size and Grade

Outcrop in the Zeta area gives no information about the attitude of the deposit. It has been assumed that the phosphatic horizon follows the contact mapped between fairly massive breccia marked Pub and the finer rubble marked Qr on Plate 3, because this boundary is thought to mark a change from a lower predominantly hematitic mudstone and siltstone of the unit of the Castlemaine Beds to an upper predominantly hematitic quartz breccia unit. If this is the case phosphate rock may extend from the outcrop area to R95 some 500 feet to the east. R104, drilled to intersect the continuation of the deposit to the south-west did not interesect the phosphatic horizon. The drilling results do not give any information about the width of the deposit because although R96 about 400 feet north-west of the phosphate rock outcrop bottomed in medium grade material, neither R97 or R99 penetrated phosphate mineralization and it is probable that the mineralization is not continuous between R96 and the outcrop. R95 has probably clipped the southern side of the continuation of the deposit.

Three holes (D363, R66 and R93) have intersected the deposit near its outcrop. The average grade of the material interested in these holes are D363, 36 feet of 11.9 per cent P_2O_5; R66, 55 feet of 6.8 per cent P_2O_5; and R93, 145 feet of 8.8 per cent P_2O_5. If the assumption about the attitude of the body is correct these holes are spaced along the strike pf the Zeta deposit. Assuming that R93 and R66 have intersected a block of phosphate rock 100 feet wide and 150 feet long with a cross section as shown on section 3400W, Zeta contains 66,000 tons of 7 to 8 per cent P_2O_5 rock.

NELL (Plate 11)

Location

In 1963 rotary drill holes about 800 feet apart were used to continue prospecting the north-eastern side of Castlemaine Hill from Zeta along what, in the absence of outcrop, was judged from the distribution of rubble and the change in slope at the bottom of the hill to be the prospective horizon. The next intersection of phosphate mineralization was 3000 feet east of Zeta at a previously unknown occurrence now called Nell where 110 feet of phosphate mineralization averaging 8.5 per cent P_2O_5 was intersected by R62.

RUM JUNGLE LATERITIES (Plate 11)

Location

The phosphatic horizon was agin intersected 1600 feet east of Nell by a rotary drill hole R57 located 400 feet south of the Rum Jungle Laterites radiometric anomaly.

The area including Rum Jungle Laterites, Easticks, Geolsec and Area 3 is often referred to as Flynn's.

Exploration

R57 is the northernmost of a row of rotary holes drilled at 200-foot centres across Castlemaine Hill to test the predominantly hematitic quartz breccia part of the Castlemaine Beds. In addition to this drilling T.E.P. have drilled three diamond drill holes (D554, D556, D562) and four churn holes to test the radiometric prospect, and the 1961 B.M.R. geochemical survey drilled numerous auger holes to about 40 feet to collect soil and weathered rock samples. Only the diamond drill hole core and the rotary drill hole cuttings have been examined during the phosphate survey.

Geology

The diamond drill hole information indicates that in the Rum Jungle Laterites area the contact between the Castlemaine Beds and the underlying tremolite schist and dolomite dips at less than 30° to the south-west.

Mineralization

R57 intersected three phosphatic zones, all containing less than 9.5 per cent P_2O_5, and bottomed in phosphate rock. Phosphate mineralization was not intersected by any of the T.E.P. diamond drill holes.

EASTICKS (Plates 12, 13)

Location

Easticks is 1200 feet south-east of R57.

Exploration

Easticks is a radiometric anomaly which T.E.P. tested with three diamond drill holes (D553, D560, D564). It was auger drilled by the BMR, in 1961 for geochemical samples and was auger drilled in 1962 and rotary drilled (R75 to R 86) in 1963 by the BMR phosphate survey.

Geology

The phosphate mineralization occurs in a sequence of hematitic siltstone and minor hematitic quartz breccia which overlies dolomite.

Mineralization

Two areas covered by phosphate rubble are known at Easticks. Both are small, the western one covers an area roughly 80 feet in diameter and the eastern one is 120 feet long and 25 feet wide.

The western deposit extends westwards in to the Castlemaine Hill. It was intersected by two holes, R76 which intersected 60 feet of phosphate rock between 20 and 150 feet, and bottomed in phosphate rock; and by D564 which penetrated 123 feet of phosphate rock between 20 and 143 feet. The top 20 feet of this hole was not cored. These holes and the outcrop, outline a block of 44,000 tons of 12.2 per cent P_2O_5 phosphate rock. The limits of the deposit are not defined.

The eastern deposit was penetrated by only one hole A2064. Quantitative results are not available for cuttings from this hole. It intersected material containing more than 10 per cent P_2O_5 between 0 and 44 feet. It was not intersected by other adjacent holes.

Other holes between Easticks and Geolsec intersected phosphate mineralization but more drilling will be needed to outline the mineralization between these two areas. A few boulders of phosphate rock occur at K9 between the two deposits.

GEOLSEC (Plate 14)

Location

Geolsec was the first phosphate deposit found in the Rum Jungle area and is the largest of the known deposits. It is on the eastern side of Castlemaine Hill 2 miles north-west of Batchelor. It outcrops 1400 feet south-east of Easticks.

Exploration

Before phosphate rock was recognized there Geolsec was known as a radiometric anomaly and had been tested by T.E.P. with three diamond drill holes (D550, D555, D559) during the search for uranium.

Most of the detailed work by the 1962-63 phosphate parties was concentrated on this deposit. It was costeaned, and sixteen diamond drill holes (D.G.1-D.G.16), seven rotary (R87 to R92, R94) and numerous auger holes were used to define its limits which are better known than those of the other deposits in the Rum Jungle area. Two rotary holes were drilled during the 1963-64 field season to compare the results from rotary drilling with those from the previous diamond drilling.

Outcrop is poor at most of the phosphate deposits and this is especially true of the Geolsec deposit. For the most part the geological boundaries on Plate 4 are rubble boundaries. The poor outcrop probably results from the ease with which the breccias associated with the phosphate deposits disintergrate during weathering, but most of the resulting rubble does not appear to have moved far and the boundaries are thought to be reasonably accurate.

The phosphate mineralization occurs in phosphatic hematitic siltstone and quartz hematite breccia which overlie red dolomite and underlie a sequence consisting predominantly of hematitic quartz breccia and sandy hematitic quartz breccia.

The closely spaced diamond drilling shows that the mineralization occurs on the flat limb of a monocline whose axis trends west-north-west along the southern edge of the outcrop.

Mineralization

The diamond drilling has proved reserves of 1,014,000 tons of 12.5 per cent P_2O_5, and inferred reserves of at least 300,000 tons of similar grade phosphate rock. These reserves do not include the aluminium phosphate in the clay exposed at the northern end of costean C1.

AREA 3 (Plate 15)

Auger drilling has shown that the phosphatic siltstone and breccia in the Geolsec Deposit continues for 2000 feet around the edge of Castlemaine Hill to Area 3, where several small boulders of phosphate rock were found by B.P. Ruxton, in 1961.

Exploration

The area was costeaned and auger drilled in 1962 and in 1963 testing was continued with one diamond drill hole (D.G.21) and three rotary drill holes (R42, R43 and R55).

Geology

The geology is a continuation of that at Geolsec. The phosphatic unit overlies red and grey dolomite, which was intersected by D.G.21 and R55. Small lenses of hematite are exposed north of the spot where the phosphate boulders were found.

Mineralization

The mineralization at Area 3, is patchy and the drill hole intersections gave assays lower in grade than the phosphate rock drilled at Geolsec.

R43 penetrated the longest and highest grade intersection of phosphate rock of any of the holes drilled in the area. Between 20 and 70 feet it intersected 50 feet averaging 12.2 per cent P_2O_5. This intersection and the shorter and poorer grade intersections in holes to the north indicates that the mineralized zone thins in this direction and thickens and increases in grade to the south-south-west.

The minalization was not traced east of section 4100E.

POWERLINE

Auger drilling on a 200-foot square grid along the eastern side of Castlemaine Hill between Area 3, and Area 4, located only traces of phosphate mineralization. Material containing more than 1 per cent P_2O_5 was drilled only near costean C12 in the vicinity of 7800E-1600N, and at the Powerline Prospect near 10500E-800N where a few boulders of phosphate rock were found.

No rotary or diamond drilling has been done on these prospects.

AREA 4 (Plate 16)

Three small areas of phosphate rock rubble and outcrop which occur at Area 4, on the south-eastern edge of Castlemaine Hill just north of the road from Batchelor to Meneling Station, were found by B.P. Ruxton in 1961.

Geology

The mineralization occurs in the lower unit of the Castlemaine Beds.

Exploration

The softer rocks east of the edge of Castlemaine Hill were prospected with auger drill holes and four rotary drill holes (R101, R103, R106, R108) were drilled to test the harder rocks containing the deposit.

Size and Grade

No extensions to the outcropping mineralization were intersected along the probable strike of the mineralized zone.

Assuming that the deposits are pipe-like and extend downward to the maximum depth drilled, the three bodies aggregate 100,000 tons of 10 per cent P_2O_5 phosphate rock.

CASTLEMAINE (Plate 17)

Castlemaine is at the southern end of Castlemaine Hill. Phosphate rock is exposed at 10600E-1600N and was penetrated by some of the T.E.P. drilling to test the radiometric anomaly which exists there.

Exploration

The area was auger drilled for soil and weathered rock samples by the 1961 and 1962 BMR geochemical parties (Ruxton and Shields 1963a and b).

It was tested as a phosphate prospect in 1963 with two diamond drill holes (D.G.18, D.G.19) and 12 rotary drill holes (R22, R23, R24, R105, R107, R109, R110, R111, R114, R115, R116).

Geology and Mineralization

The mineralization occurs in the upper phosphatic member of the Castlemaine Beds. It is associated with an elongated radiometric anomaly trending north-west around the edge of Castlemaine Hill and with a base metal geochemical anomaly. Phosphate mineralization extends along most of this radioactive zone and is known over a length of 1800 feet from section 9400E to 11600E. It was not intersected by drill holes R22, R24 north-west of section 9400E and appears to be closed off in this direction. Its south-easterly limits are not known.

When the drilling was first laid out at the beginning of 1963 it was assumed that the mineralization would extend from where it was known around the edge of Castlemaine Hill northwards under the hill. D.G.18 and D.G.19 showed that this was not so.

RUM JUNGLE CREEK (Plate 18)

This is a radiometric prospect on the north-western side of Castlemaine Hill 3500 feet north-west of Rum Jungle Creek Opencut. No phosphate rock was found at the surface but some of the T.E.P. drill holes intersected phosphate mineralization.

Exploration

The radiometric prospect and its continuation south-east towards Rum Jungle Creek South was pattern drilled by T.E.P. in its search for uranium. The T.E.P. diamond drill core was examined for phosphate mineralization and two rotary drill holes R70 and R71 were drilled to try to intersect the continuation of the phosphatic zone.

Geology and Mineralization

The mineralization occurs in a sequence of hematitic siltstone and quartz hematite breccia which dip steeply south-west under the carbonaceous and chloritic schists of the Golden Dyke Formation. The mineralization has only been found in drill holes D520 and D299. The best intersection was in D520 which penetrated 40 feet of 10.6 per cent P_2O_5 between 155 and 195 feet. The true thickness of this mineralized zone is likely to be of the order of 10 feet. R70 and R71 which were drilled to intersect the continuation of the phosphatic zone failed to do so.

TARTAN (Plate 18)

In 1961 Ruxton found phosphate rock north of Rum Jungle Creek South mine in the area referred to by T.E.P. geologists as Tartan.

Exploration

One rotary and one diamond drill hole (R30, D.G.20) were drilled in the Tartan area. Continuation of the phosphate mineralization were sought, but not found, along strike by rotary drill holes.

Geology

The phosphate rock is hematitic siltstone which dips steeply west under the Golden Dyke Formation. It is exposed over a zone about 20 feet wide.

Stapleton Area

Location

The Castlemaine Beds are again exposed in a belt which starts 5 miles south of Batchelor and extends around the southern and south-western edges of the Waterhouse Granite Complex.

Geology

More work is needed to define the regional geology in this area. At Stapleton North quartz hematite breccia which appears to be part of the Castlemaine Beds is interbanded with chert breccia and schist which has been mapped (Malone and others 1960) as part of the Golden Dyke Formation.

Mineralization

Phosphate mineralization is known to occur at Area 65, Waterhouse No. 2, Stapleton North and Stapleton South. Radiometric anomalies occur at these localities and the first two are also base metal anomalies (Ruxton, 1961; Ruxton and Shields, 1963a). No base metal geochemical survey has been made over the other two deposits. In the Stapleton area, phosphate rock containing more than 5 per cent P_2O_5 has been found only at Stapleton North and Stapleton South.

STAPLETON NORTH (Figure 3)

Location

An outcrop of phosphate rock 140 feet long and 90 feet wide was found 7½ miles south of Batchelor by G.W. Patterson in 1961.

Exploration

In 1963 this was mapped and was tested with one diamond drill hole (D.G.29) and eight rotary drill holes (R135, R137, R139, R141, R145, R149, R151).

Geology

The phosphate mineralization occurs in the Castlemaine Beds at their junction with the overlying chert breccia which have been mapped as part of the Golden Dyke Formation. The phosphate deposit is located in the nose of a west-plunging syncline.

Mineralization

The diamond drill hole and three of the rotary holes (R135, R137, R139) intersected phosphate material. Of these only D.G.29 and R137 intersected material containing more than 2 per cent P_2O_5.

The prospect is of interest only in that it indicates that a phosphatic horizon is present in the Castlemaine Beds in the Stapleton Area.

STAPLETON SOUTH

Location

A small deposit of phosphate rock is exposed on the edge of the Old Daly River track 2½ miles south-west of Stapleton Homestead. It is the site of a small radiometric anomaly.

Geology

The phosphate rock is hematitic siltstone occurring in a sequence which is mostly quartz hematite breccia. This sequence is underlain by amphibolite which has been mapped as part of the Golden Dyke Formation. (Malone and others 1962b).

Mineralization

The deposits outcrop is some 60 feet long and 20 feet wide. Auger drilling to prospect for a subsurface extension of the deposit to the south-east did not penetrate material containing more than 5 per cent P_2O_5.

WATERHOUSE No. 2

In 1960 two diamond drill holes (D.D.H.2, D.D.H.4) drilled to test the Waterhouse No. 2 radiometric prospect intersected phosphatic rock. D.D.H.2 (Ruxton 1961) intersected phosphatic hematitic quartz breccia between 162 and 250 feet. The highest grade material lay between 171 and 176 feet and 196 and 201 feet, and contained 2 per cent P_2O_5. D.D.H.4 intersected an apatite rich amphibolite between 112'5" and 117'.

This prospect was not tested in the 1962-64 survey.

AREA 65

Parts of the chert breccia and of the amphibolite exposed at this prospect contain traces of phosphate. A sample of amphibolite assayed 1 per cent P_2O_5.

This prospect was not tested in the 1962-64 survey.

CONCLUSIONS

Eighteen deposits of phosphate rock have been found in the Rum Jungle area. They range in size and grade from Geolsec which contains proved reserves of 1 million tons of 12.5 per cent P_2O_5 phosphate rock and inferred reserves of 300,000 tons of a similar grade, to the western deposit at Easticks which contain estimated reserves of 44,000 tons of 12 per cent P_2O_5 rock (Table 10).

The phosphate content of the rock included in the ore reserve calculation varies from an arbitrary lower cut-off value of 5 per cent P_2O_5 to 38 per cent P_2O_5. The principal phosphate mineral is fluorapatite which is always associated with large amounts (up to 25 per cent) of dusty hematite making the rock unsuitable for use in the manufacture of superphosphate. Weathered parts of the deposits also contain aluminium phosphate minerals.

The total proved, estimated and inferred reserves in the Rum Jungle area of phosphate rock containing more than 5 per cent P_2O_5 is 2,300,000 tons (Table 5). This figure is calculated using the results from auger drilling and is most likely to be a gross under-estimate. The average grade of phosphate deposits in the area are probably close to 10 to 12 per cent P_2O_5 and when the rock's high content of finely disseminated iron oxide is also considered it is apparent that even if larger tonnages are available the deposits are not an economic source of material for the manufacture of superphosphate.

TABLE 5

RESERVES - RUM JUNGLE PHOSPHATE DEPOSITS

Deposit	Proved		Estimated		Inferred	
	Tonnage	Grade (% P_2O_5)	Tonnage	Grade (% P_2O_5)	Tonnage	Grade (% P_2O_5)
Embayment Area Buckshee						
Upper lens			80,000	10.8	80,000	10
Lower lens					60 feet of 8.1% intersected by D.G.32	
Powerplant					50,000	-
Whites					600,000	10
Castlemaine Hill Zeta					60,000	10
Easticks						
Western deposit			44,000	12.2		
Eastern deposit	Insufficient information to outline the deposit					10
Geolsec	1,014,000	12.5			300,000	12.5
Area 4	Three bodies aggregating				100,000	10

Deposits at the following locations are known but not enough work has been done to allow estimates of tonnage or grade:

Dysons,	Nell,	Rum Jungle Laterites,	Area 3,
Castlemaine,	Rum Jungle Creek,	Tartan,	Stapleton North,
Stapleton South			

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APPENDIX I

DIAMOND DRILL HOLES - 1962-64 RUM JUNGLE PHOSPHATE SURVEY

Number	Location			Direction	Depression	Length
DG 1	Geolsec	25.5E,	11N	22.5°	60°	500'6"
DG 2	"	25.5E,	11N	Vertical		231'8"
DG 3	"	25.5E,	13N	"		140'0"
DG 4	"	25.5E	15N	"		111'
DG 5	"	23.5E	15N	"		125'
DG 6	"	25.5E,	10N	"		284'
DG 7	"	25.5E,	8N	"		201'
DG 8	"	25.5E,	6N	"		600'
DG 9	"	27.5E	13N	"		422'6"
DG 10	"	29.5E	11N	"		524'1"
DG 11	"	23.5E	13N	"		131'3"
DG 12	"	29.5E	15N	"		147'9"
DG 13	"	27.5E,	17N	"		115'8"
DG 14	"	25.5E,	19N	"		196'6"
DG 15	"	25.5E,	00N	"		204'9"
DG 16	"	25.5E	6S	"		201'
DG 18	Castlemaine	98 E	16N	"		157'2"
DG 19	"	94 E	12N	"		336'
DG 20	Rum Jungle Creek	2 E	3N	201°	50°	298'
DG 21	Area 3	35.5E	25N	20°	50°	198'
DG 29	Stapleton North	4.8W	1.7N	315° Mag.	56°	291'
DG 32	Buckshee	2W	2S	277°	55°	220'
DG 33	Dysons	35.5E	25N	45° Mag.	55°	
DG 34	Whites East	33,500E	30,400N	090°	55°	
DG 35	"	32,700E.	30,200N	200° Mag.	55°	

APPENDIX 2

ROTARY HOLES - DRILLED BY BMR AT RUM JUNGLE 1963

Number	Locality	Map	Co-ordinates Easting	Co-ordinates Northing	Depth (feet)	Comments
1.	Red Ochre Trig.	E83	200 W	900 N	63	
2.	"	"		1100 N	140	
3.	"	"		1300 N	97	
4.	"	"		1500 N	136	
5.	"	"		1700 N	70	
6.	"	"		1900 N	45	
7.	"	"		2100 N	46	
8.	"	"		2300 N	75	
9.	"	"		700 N	85	schist
10.	"	"		500 N	80	
11.	"	"		300 N	68	
12.	"	"		100 N	80	graphite schist
13	Geolsec	"	2550 E	1300 N	35	phosphate rock
14.	"	"		1700 N	75	phosphatic
15.	"	"		1000 N	50	phosphatic
16.	Area 4. (Meneling)	E93	11400 E	1600 N	95	high radioactivity
17.	" "	"		1200 N	55	dolomite
18.	" "	"		800 N	57	dolomite
19.	" "	"		400 N	80	
20.	" "	"		00 N	110	
21.	" "	"		400 S	55	
22.	" "	"		800 S	107	schist
23.	Meneling	"	9000 E	900 N	75	high radioactivity
24.	"	"		1000 N	80	high radioactivity
25.	Red Ochre	E83	600 E	1300 N	70	
26.	"	"		1700 N	75	
27.	"	"		900 N	70	
28.	"	"		2100 N	90	
29.	"	"		500 N	235	high radioactivity
30.	"	"		100 N	180	phosphatic
31.	Rum Jungle Creek Sth.	"	2200 E	700 S	80	high radioactivity
32.	Geolsec	"		1200 N	100	high radioactivity
33.	"	"	1400 E	1100 N	70	
34.	"	"		1500 N	100	
35.	"	"	3000 E	2100 N	80	
36.	"	"		2300 N	105	phosphatic
37.	"	"		1900 N	80	high radioactivity
38.	Rum Jungle Creek Sth.	"		1200 N	90	high radioactivity
39.	" "	"		600 N	90	

ROTARY HOLES - DRILLED BY BMR AT RUM JUNGLE 1963 (continued)

Number	Locality	Map	Co-ordinates Easting	Co-ordinates Northing	Depth (feet)	Comments
40.	Rum Jungle Creek Sth.	E83		00 N	20	
41.	" "	"		800 S	85	
42.	Area 3.	"	3800 E	2600 N	60	phosphatic
43.	" "	"		2400 N	95	phosphatic
44.	Powerline	"	5400 E	1200 N	70	
45.	"	"		400 N	60	high radioactivity
46.	"	"		400 S	75	
47.	"	"		1200 S	68	
48.	"	"		2000 S	140	
49.	Castlemaine Trig.	"	9800 E	1200 N	110	
50.	"	E93		400 N	85	
51.	"	"	10400 E	1200 N	140	high radioactivity
52.	"	"	9800 E	400 S	60	high radioactivity
53.	"	"	10400 E	2000 N	230	high radioactivity
54.	"	"		400 S	60	high radioactivity
55.	Area 3.	E83	3800 E	2200 N	95	
56.	Rum Jungle Laterites	"	1000 W	2500 N	95	
57.	" "	"	200 W	2500 N	250	phosphatic
58.	Castlemaine Trig.	E93	10400 E	400 N		
59.	Castlemaine North	E 83	2600 W	1700 N	170	phosphatic
60.	Rum Jungle Creek	"		900 N	85	high radioactivity, schist
61.	Castlemaine North	"	1800 W	2500 N	165	dolomite
62.	"	"		2250 N	120	phosphatic
63.	Zeta	"	3395 W	2000 N	95	
64.	"	E82	4200 W	1950 N	170	
65.	"	E83	3395 W	1800 N	140	
66.	"	E82	3400 W	1600 N	100	phosphatic
67.	"	"	2000 W	1300 N	90	
68.	"	"	2800 W	800 N	85	phosphatic
69.	"	"	2000 W	1100 N	115	
70.	Rum Jungle Creek	E83	1200 W	800 N	60	carbonaceous schist high radioactivity
71.	" "	"	400 E	900 N	125	schist, carbonaceous schist
72.	" "	"	400 W	1150 N	60	high radioactivity
73.	Easticks	"	900 E	1900 N	115	phosphatic
75.	Rum Jungle Creek Sth.	"	1200 E	1000 N	105	phosphatic
75.	Easticks	E83	1000 E	18pp N	115	phosphatic
76.	"	"	800 E	1600 N	106	phosphatic
77.	"	"	1230 E	1800 N	197	dolomite, phosphatic

ROTARY HOLES - DRILLED BY BMR AT RUM JUNGLE 1963 (continued)

Number	Locality	Map	Co-ordinates Easting	Co-ordinates Northing	Depth (feet)	Comments
78.	Easticks	E83	900 E	2100 N	220	phosphatic
79.	"	"	1100 E	1900 N	120	phosphatic
80.	"	"		2100 N	120	
81.	"	"	1300 E	1900 N	120	phosphatic
82.	"	"		2300 N	65	
83.	"	"	1500 E	1900 N	198	phosphatic
84.	"	"	1300 E	2100 N	120	
85.	"	"	1700 E	1700 N	145	
86.	"	"		2100 N	120	
87.	Geolsec	"	1800 E	1200 N	55	
88.	"	"	2100 E	2100 N	60	phosphatic
89.	"	"	1000 E	1400 N	50	
90.	"	"	1400 E	1200 N	65	
91.	"	"	1800 E	1300 N	95	phosphatic
92.	"	"	1400 E	1300 N	70	
93.	Zeta	"	3400 W	1700 N	210	phosphatic
94.	Geolsec	"	1400 E	1400 N	75	
95.	Zeta	E82	4400 W	1900 N	130	phosphatic
96.	"	"	3800 W	1700 N	85	phosphatic
97.	"	"	3600 W	1900 N	47	
98.	"	"	3800 W	1300 N	60	
99.	"	"	3600 W	1500 N	235	phosphatic
100.	"	"	3800 W	2100 N	60	
101.	Area 4.	E93	12400 E	1300 N		phosphatic
102.	Zeta	E82	3400 W	2100 N	60	phosphatic
103.	Area 4.	E93	11850 E	1500 N	115	phosphatic
104.	Zeta	"	3400 W	1200 N	65	
105.	Castlemaine Prospect	"	10200 E	1350 N	105	grey schist
106.	Area 4.	"	12200 E	1450 N	75	
107.	Castlemaine Prospect	"	10200 E	1550 N	100	
108.	Area 4.	"	11600 E	1450 N	60	
109.	Castlemaine Prospect	"	10600 E	1700 N	145	phosphatic
110.	"	"		1400 N	40	high radioactivity
111.	"	"	11600 E	1600 N	80	phosphatic
112.	"	"	10600 E	1500 N	140	+ dolomite, high radioactivity
113.	"	"	11400 E	1200 N	60	high radioactivity
114.	"	"	9825 E	1300 N	60	phosphatic
115.	"	"	11510 E	1360 N	145	phosphatic
116.	"	"	11600 E	1200 N	15	grey schist
117.	Sargents	"	8200 E	800 N	80	high radioactivity
118.	Dysons	E63	34400 E	30200 N	80	
119.	Sargents	E93	8200 E	600 N	70	high radioactivity
120.	Dysons	E63	34280 E	30290 N	100	phosphatic
121.	Buckshee	"	200 E	100 S	35	

ROTARY HOLES - DRILLED BY BMR AT RUM JUNGLE 1963 (continued)

Number	Locality	Map	Co-ordinates		Depth (feet)	Comments
			Easting	Northing		
122.	Dysons	E63	33725 E	30400 N	65	
123.	Buckshee	"	200 W	300 S	80	phosphatic
124.	Dysons	"	33666 E	30400 N	50	
125.	Buckshee	"	200 W	100 S	65	phosphatic
126.	Dysons	"	34225 E	31325 N	65	phosphatic
127.	Buckshee	"	200 W	100 N	80	phosphatic
128.	Dysons	"	33300 E	32000 N	155	dolomite phosphatic
129.A.	Buckshee	"	500 W	300 S	50	dolomite, phosphatic
129.B.	Dysons	"	33355 E	32070 N	50	dolomite
130.	Mt. Fitch	E41	11700 E	44200 N	65	dolomite
131.A.	Buckshee	E63	350 W	300 S	95	phosphatic
131.B.	Dysons	"	34315 E	31355 N	75	
132.	Mt. Fitch	E41	11620 E	44200 N	70	dolomite
133.	Dysons	E63	33395 E	31400 N	60	phosphatic
134.	Mt. Fitch	E41	11780 E	43200 N	120	dolomite, copper
135.	Stapleton North	-	700 W	215 N	85	phosphatic
136.	Mt. Fitch	E41	11650 E	43315 N	130	dolomite
137.	Stapleton North	-	521 W	218 N	120	phosphatic
138.	Mt. Fitch	E41	11680 E	43785 N	130	dolomite
139.	Stapleton North	-	200 W	300 N	100	phosphatic
140.	Mt. Fitch	E41	12170 E	42420 N	140	dolomite
141.	Stapleton North	-	100 W	300 N	60	
142.	Mt. Fitch	E41	11610 E	44450 N	195	dolomite, copper
145.	Stapleton North	-	300 W	400 N	60	
147.	"	-	300 W	700 N	100	
149.	"	-	100 W	700 N	90	
151.	"	-	305 W	805 N	75	
153.	Dysons	E63	33950 E	39750 N	50	phosphatic
155.	"	"	32600 E	?30000 N	45	
157.	"	32880 E		30015 N	60	phosphatic
159.	"	"	33985 E	29635 N	40	
161.	"	"	32900 E	29470 N	65	
163.	"	"		29380 N	10	phosphatic
165.	Mt. Fitch	E41	11850 E	43000 N	190	dolomite
167.	"	"	11890 E	42800 N	125	dolomite.

All the holes except those at Mt. Fitch were drilled in the Castlemaine Beds, and except where the comments indicate otherwise penetrated hematitic quartz breccia, hematitic silstone and hematitic sandstone.

APPENDIX 3

INTERSECTIONS OF PHOSPHATE ROCK IN BMR 1963 DRILL HOLES

Deposit	Hole No.	Local Grid Co-ordinates (000 feet)		Intersection		
				Interval (feet)	Thickness (feet)	Grade (% P_2O_5)
Easticks	R73	9 E	19 N	0 - 115	115	
	R76	8 E	16 N			
	R77	12.3 E	18 N			
	R81	13 E	18 N			
Area 3	R43	38 E	26 N	35 - 65	30	15.3
Zeta	R66	34 W	16 N	5 - 20	15	13.7
	R93	34 W	17 N	20 - 60	40	6.2
Area A	R101	124 E	13 N	30 - 40	10	12.5
	R103	118.5 E	15 N	10 - 65	55	19.3
				75 - 115	40	15.7
Castlemaine	R109	106 E	17 N	60 - 45	85	12.9
	R111	116 E	16 N	40 - 60	20	
	R114	98.25 E	13 N	12 - 60	60	18.1
Nell	R59	26 W	17 N	75 - 95	20	9.7
	R62	18 W	25.5 N	15 - 80	65	9.6
Whites-Dysons	R120	2.9 N	42.8 E	0 - 100	100	7.5
	R126	42.25 E	18.25 N	35 - 65	30	9.3
	R131B	43.15 E	13.55 N	35 - 55	20	18.5
	R153	39.5 E	97.5 N	5 - 50	95	7.7
	R157	28.8 E	00.15 N	0 - 60	60	21.3
	R163	29 E	93.8 N	0 - 10	10	13.0
Buckshee	R123	2 W	3 S	30 - 45	15	9.3
	R131A	3.4 W	3 S	0 - 95	95	11.5
Stapleton North	R137	5.21 W	2.18 N	0 - 15	15	14.0

APPENDIX 4

COSTEAN C3. ASSAYS OF CHANNEL SAMPLES

Footage	Semi-quantitative (% P_2O_5)	Quantitative (% P_2O_5)
0 - 4	trace	
4 - 8.5	2	
8.5 - 10	trace	
10 - 12	1	
12 - 17	$\leqslant$ 0.5	
17 - 22	1	
22 - 27	15	17.1
27 - 30	6	
30 - 31.5	4	
31.5 - 36.5	6	
36.5 - 42	11	
42 - 47	20	19.9
47 - 49	2	
49 - 53	2	
53 - 56	1	
56 - 60	1	
60 - 64	3	
64 - 65	$\leqslant$ 0.5	
65 - 70	4	
70 - 75	26	15.3
75 - 80	28	27.9
80 - 82	28	25.0
82 - 83	5	18.6
83 - 86	32	33.8
86 - 89	7	14.8
89 - 90	42	38.0
90 - 94.5	22	22.1
94.5 - 95.5	38	36.9
95.5 - 98	25	23.5
98 - 103	29	28.9
103 - 105	18	16.0
105 - 108	2	
108 - 110	$\leqslant$ 0.5	

APPENDIX 5

COSTEAN C4. ASSAYS OF CHANNEL SAMPLES

Footage	Semi-quantitatives (% P_2O_5)	Quantitative (% P_2O_5)
0 - 52	trace	
52 - 57	2	
57 - 62	3	
62 - 67	4	
67 - 72	6	
72 - 77	9	
77 - 82	7	
82 - 87	15	
87 - 92	10	15.6
92 - 97	4	
97 - 99	4	
99 - 102	9	
102 - 103	23	19.0
103 - 108	15	15.6
108 - 110	9	
110 - 115	3	
115 - 117	11	7.8
117 - 120	22	23.6
120 - 123	32	27.9
123 - 127	30	29.5
127 - 130	29	35.8
130 - 132.5	18	18.5
132.5 - 137	15	13.3
137 - 142	4	
142 - 147	3	
147 - 152	15	17.8
152 - 157	14	13.9
157 - 162	4	
162 - 166	4	
166 - 171.5	trace	
171.5 - 176	9	8.3
176 - 177	32	29.5
177 - 180	18	22.9
180 - 185	3	
185 - 187	trace	
187 - 192	1	
192 - 195	trace	
195 - 200	3	
200 - 205	8	
205 - 210	9	
210 - 212	5	
212 - 214	8	

COSTEAN C4. ASSAYS OF CHANNEL SAMPLES (continued)

Footage	Semi-quantitatives (% P_2O_5)	Quantitative (% P_2O_5)
214 - 219	5	
219 - 221	13	
221 - 222	1	
222 - 222.5	11	
222.5 - 223	3	
223 - 223.5	trace	
223.5 - 226	11	
226 - 230	3	
230 - 237.5	trace	
237.5 - 242.5	3	
242.5 - 247	1	
247 - 295	trace to 1	
295 - 299	2	
299 - 300	3	

APPENDIX 6

COSTEAN C6. ASSAYS OF CHANNEL SAMPLES

Footage	Semi-quantitatives ($\% P_2O_5$)	Quantitative ($\% P_2O_5$)
0 - 10	not sampled	
10 - 15	28	26.6
15 - 20	12	13.8
20 - 25	7	9.3
25 - 30	2	
30 - 35	2	
35 - 40	1	
40 - 45	1	
45 - 50	4	
50 - 55	1	
55 - 60	1	
60 - 65	23	20.8
65 - 70	4	6.7
70 - 75	5	
75 - 80	3	
80 - 85	1	
85 - 90	3	
90 - 95	2	
95 - 105	1	
105 - 130	trace	
130 - 135	5	
135 - 145	trace	
145 - 170	not detected	

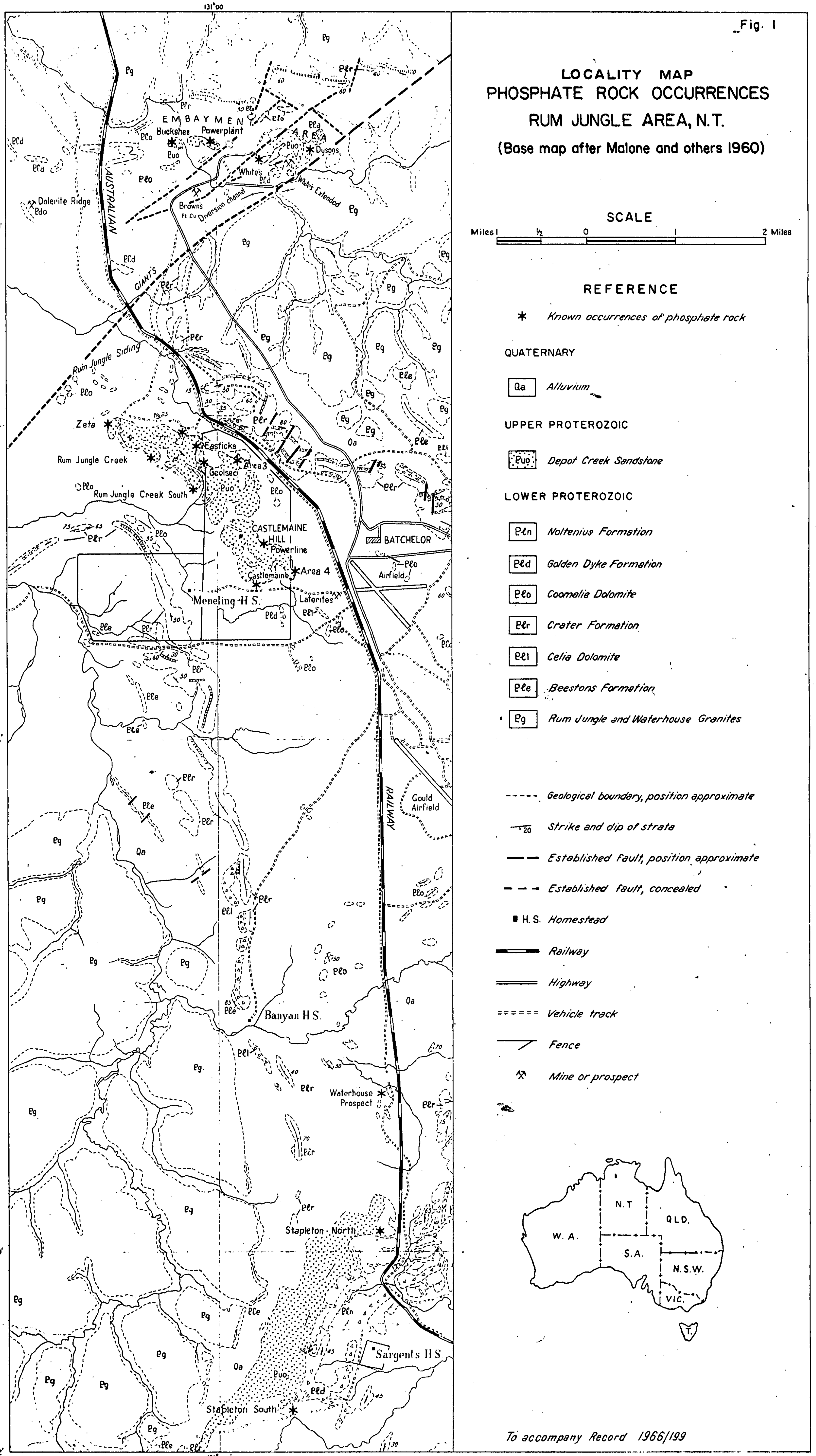
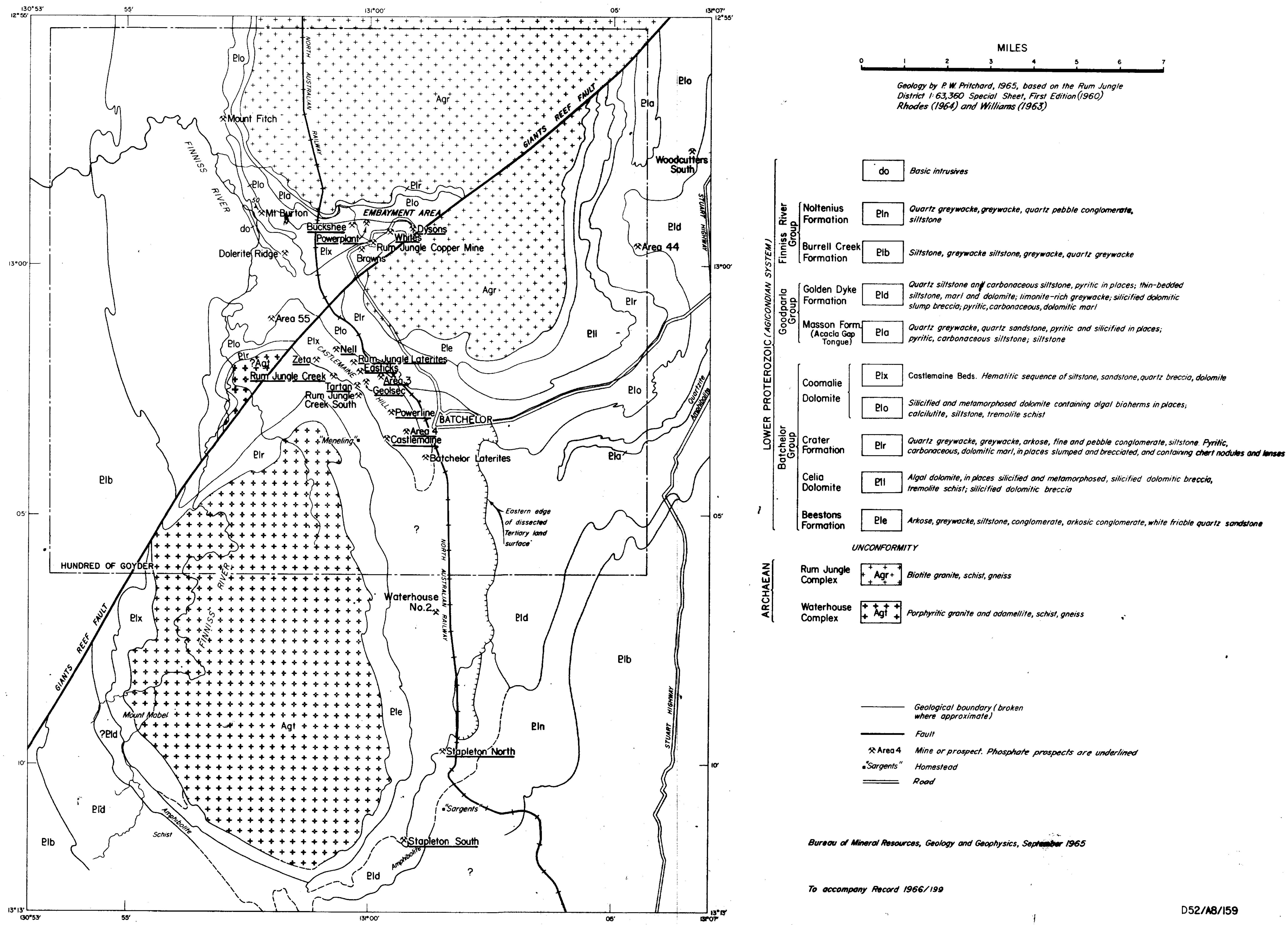


Fig. 1
LOCALITY MAP
PHOSPHATE ROCK OCCURRENCES
RUM JUNGLE AREA, N.T.
(Base map after Malone and others 1960)
SCALE
Miles 1 ½ 0 1 2 Miles
REFERENCE
* Known occurrences of phosphate rock
QUATERNARY
Qa Alluvium
UPPER PROTEROZOIC
Puo Depot Creek Sandstone
LOWER PROTEROZOIC
Pℓn Noltenius Formation
Pℓd Golden Dyke Formation
Pℓo Coomalie Dolomite
Pℓr Crater Formation
Pℓl Celia Dolomite
Pℓe Beestons Formation
Pg Rum Jungle and Waterhouse Granites
Geological boundary, position approximate
Strike and dip of strata
Established fault, position approximate
Established fault, concealed
H. S. Homestead
Railway
Highway
Vehicle track
Fence
Mine or prospect
N.T
QLD.
W. A.
S.A.
N.S.W.
VIC.
T.
EMBAYMENT AREA
Buckshee
Powerplant
Whites
Dysons
Whites Extended
Browns
Diversion channel
Dolerite Ridge
AUSTRALIAN
GIANT'S
Rum Jungle Siding
Zeta
Easticks
Rum Jungle Creek
Area 3
Geolsec
Rum Jungle Creek South
CASTLEMAINE HILL
Powerline
Castlemaine
Area 4
BATCHELOR
Airfield
Meneling H.S.
Laterites
RAILWAY
Gould Airfield
Banyan H.S.
Waterhouse Prospect
Stapleton North
Sargents H.S.
Stapleton South
131°00'
13°00'
05'
10'
13°12'
To accompany Record 1966/199
D52/A8/173

Rum Jungle Survey 1963

GEOLOGY OF RUM JUNGLE DISTRICT
NORTHERN TERRITORY

Figure 2



Bureau of Mineral Resources, Geology and Geophysics, September 1965

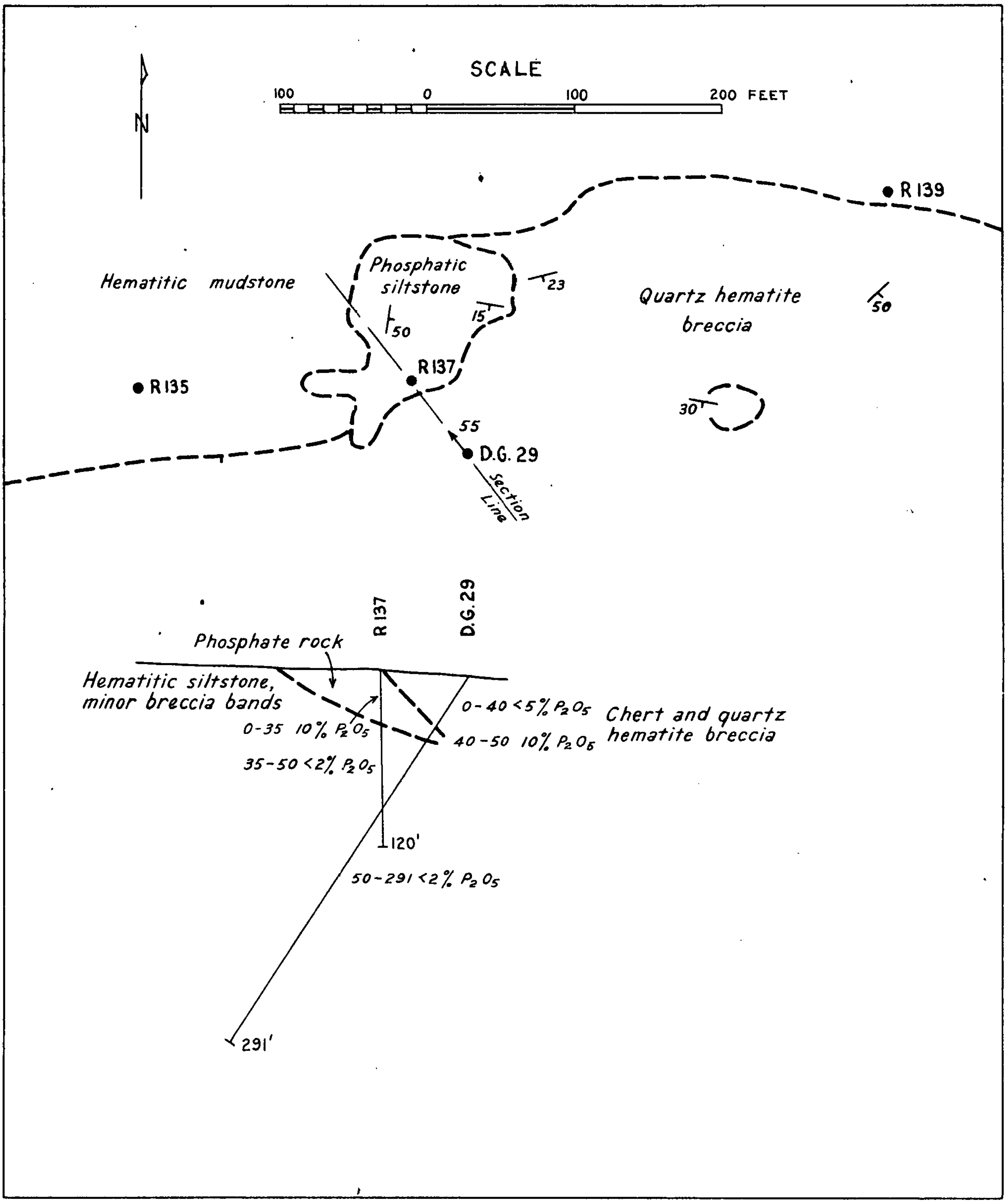
To accompany Record 1966/199

D52/A8/159

STAPLETON NORTH PHOSPHATE DEPOSIT

RUM JUNGLE, N.T.

20-3-64

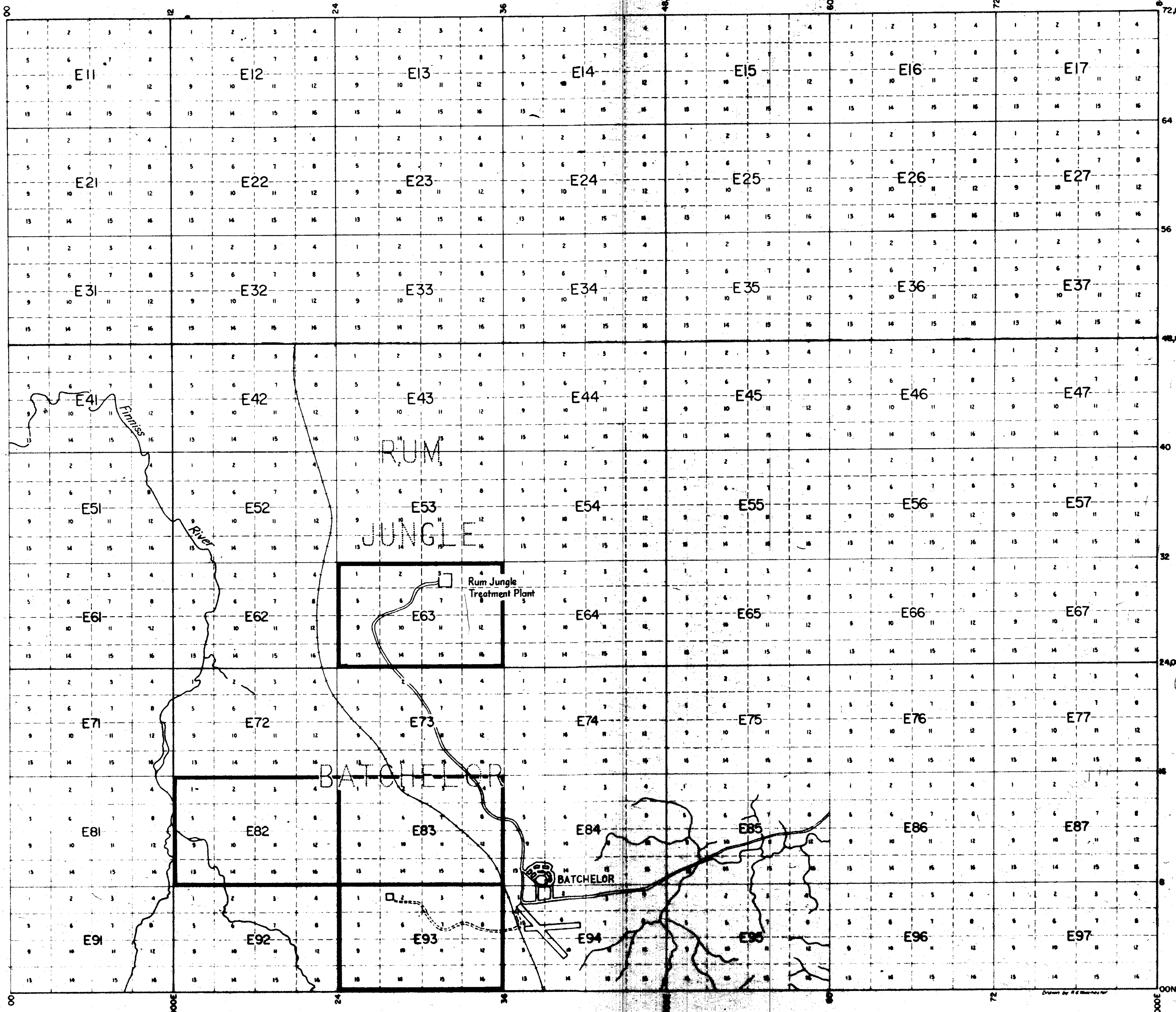


Bureau of Mineral Resources, Geology and Geophysics

RUM JUNGLE SURVEY 1963

PLATE 1

MAP INDEX



Sheets outlined by heavy lines are included in the Record as Plates

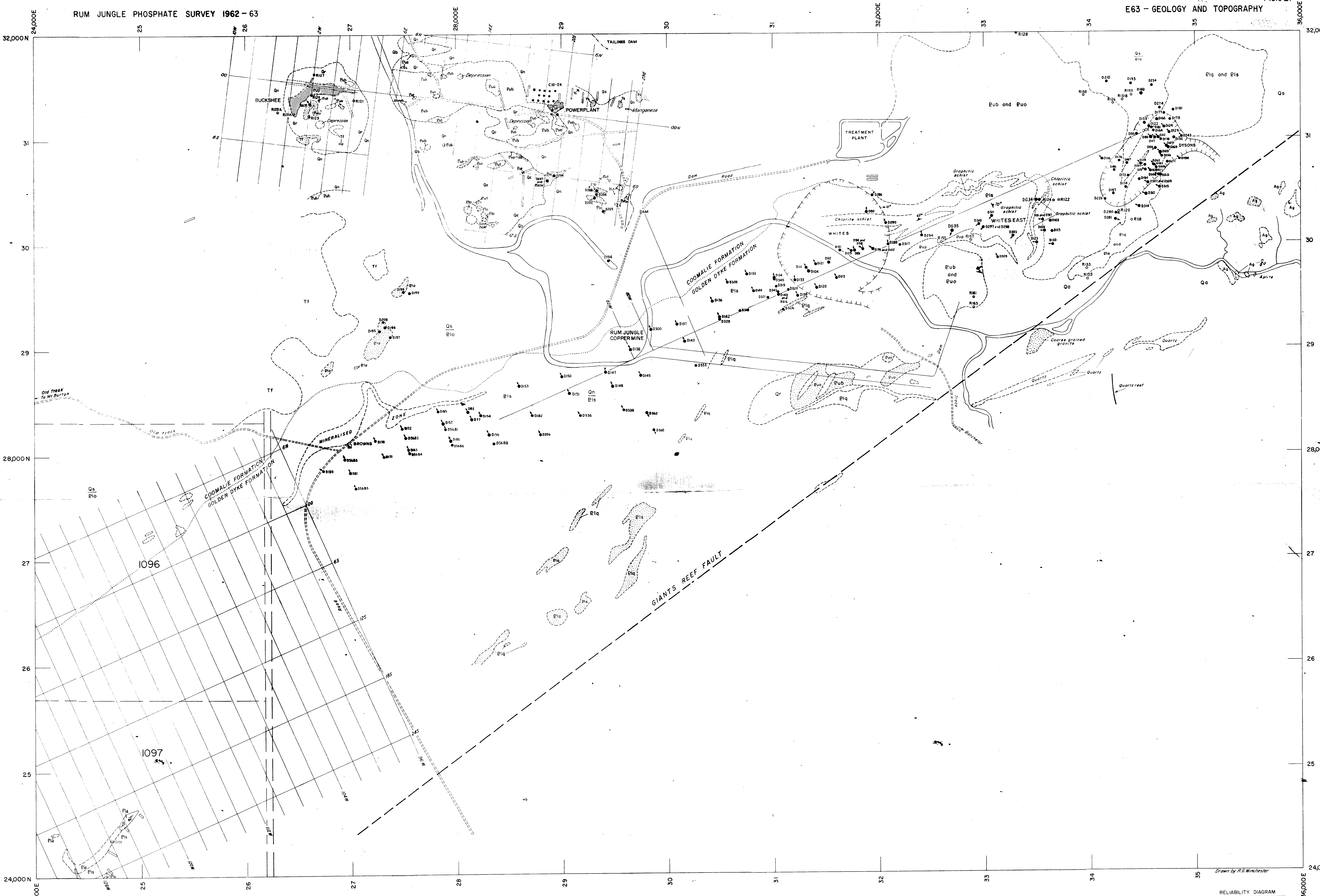
To accompany Record 1966/199

D52/A8/81

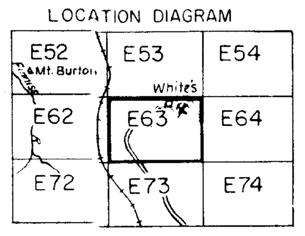
RUM JUNGLE PHOSPHATE SURVEY 1962-63

Plate 2.

E63 - GEOLOGY AND TOPOGRAPHY



LOCATION DIAGRAM



MAJOR GRID: T.E.P. mine grid, bearing 359°58'00"

MINOR GRID: BMR geophysical grid, 1960-62

REFERENCE

Qa	Alluvium, undifferentiated
Qr	Rubble, undifferentiated
Qb	Black and grey soil
Qn	Red-brown earth
Qe	Red earth
Qs	Sand
Tf	Ferruginous breccia, mostly pisolitic
Ts	Ferruginous sandstone
Pub	Hematitic quartzite breccia
Pup	Phosphate rock
Puh	Iron oxide, mainly hematite
Puo	Quartzite, pink, medium bedded
Pus	Sandstone and conglomerate
Put	Limonitic siltstone and sandstone
Plo	Dolomite marble
Pla	Amphibolite
Pls	Schist and slates
Plq	Quartzite
Ag	Rum Jungle Complex

Outcrop

Phosphate rock outcrop

Fault

Mine Shaft

Strike and dip of foliation

Geological boundary

Strike and dip of strata

Diamond drill hole

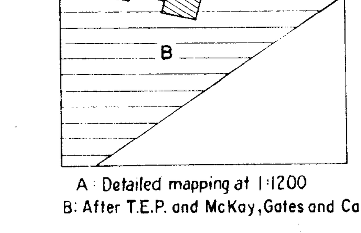
Churn drill hole

Costean

Vehicle track

1097 Subdivision boundary

RELIABILITY DIAGRAM



A: Detailed mapping at 1:1200

B: After T.E.P. and McKay, Gates and Carter 1950-1951.

SCALE

Feet 400 200 0 400 800 Feet

Bureau of Mineral Resources Geology & Geophysics

To accompany Record 1966/199

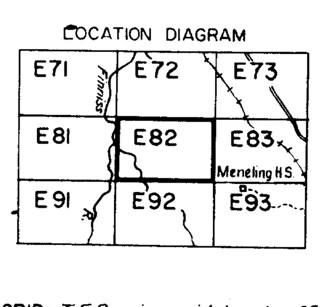
D52/A8/117

RUM JUNGLE PHOSPHATE SURVEY 1962-63

E82 GEOLOGY AND TOPOGRAPHY

Plate 3.

LOCATION DIAGRAM



REFERENCE

- Qa Alluvium, undifferentiated
- Qr Rubble, undifferentiated
- Qs Sand
- Tf Ferruginous breccia, mostly pisolitic
- Ts Ferruginous sandstone
- Pub Hematitic quartzite breccia
- Pup Phosphate rock
- Puh Iron oxide, mainly hematite
- Plo Dolomite marble
- Outcrop
- Phosphate rock outcrop
- Geological boundary
- 30 Strike and dip of strata
- D363 Diamond drill hole
- Costean
- 320 Surface contours at intervals of 10, dashed where approximate. Datum R.L. mean sea-level Darwin, N.T.
- Formed road
- Vehicle track

RELIABILITY DIAGRAM

A Detailed mapping at 1:1200

MAJOR GRID: T.E.P. mine grid, bearing 359°58'00"

MINOR GRID: B.M.R. geophysical grid, 1960-62

SCALE

Feet 400 200 0 400 800 Feet


RUM JUNGLE PHOSPHATE SURVEY 1962-63
E83 GEOLOGY AND TOPOGRAPHY
Plate 4.
NELL
RUM JUNGLE LATERITES
Flynn's Homestead
FLYNN
EASTICKS
RUM JUNGLE CREEK
RED OCHRE
TARTAN
GEOLSEC
AREA 3
ORE DUMP
RUM JUNGLE CREEK SOUTH
OPEN CUT
Approximate limit of mine workings
WASTE DUMP
RUM JUNGLE CREEK SOUTH
POWERLINE
16,000 N
12,000 N
8,000 N
24,000 E
28,000 E
32,000 E
36,000 E
Drawn by R.G. Winchester
LOCATION DIAGRAM
E72
E73
E74
E82
E83
E84
E92
E93
BATCHELOR
REFERENCE
Qa Alluvium, undifferentiated
Qr Rubble, undifferentiated
Tf Ferruginous breccia, mostly pisolitic
Puo Quartzite, pink, medium bedded
Pus Sandstone and conglomerate
Pub Hematitic quartzite breccia
Pup Phosphate rock
Puh Iron oxide, mainly hematite
Puq Quartzite/quartzite breccia
Pul Limonitic quartzite breccia
Put Limonitic siltstone and sandstone
Pus Grey shale
Pls Schist
Calcareous slate
Dolomite marble
Grits
Outcrop
Phosphate rock outcrop
Geological boundary
Strike and dip of strata
D62 D665 Diamond drill hole
C4 Costean
R18 Rotary drill hole
Surface contours at intervals of 10', dashed where approximate. Datum R.L. mean sea level, Darwin, N.T.
Formed road
Vehicle track
Railway line
Telephone line
Power line
Fence
RELIABILITY DIAGRAM
A Detailed mapping at 1:1200
SCALE
MAJOR GRID: T.E.P. mine grid, bearing 359°38'00"
MINOR GRID: B.M.R. geophysical grid, 1960-62
Bureau of Mineral Resources Geology & Geophysics
To accompany Record 1966/199
D52/A8/113

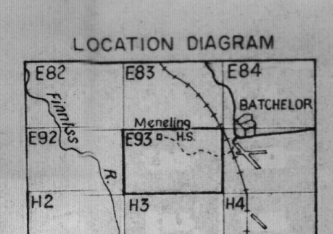
RUM JUNGLE PHOSPHATE SURVEY 1962-63

Plate 5.

E93 GEOLOGY AND TOPOGRAPHY

Drawn by R.G. Winchester

LOCATION DIAGRAM



REFERENCE

Qa	Alluvium, undifferentiated
Qr	Rubble, undifferentiated
Qb	Black and grey soil
Qn	Red-brown earth
Qe	Red earth
Qs	Sand
Tf	Ferruginous breccia, mostly pisolitic
Ts	Ferruginous sandstone
Pub	Hematitic quartzite breccia
Pup	Phosphate rock
Puh	Iron oxide, mainly hematite
Puq	Quartzite/quartzite breccia
Pul	Limonitic quartzite breccia
Put	Limonitic siltstone and sandstone
Pue	Grey shale
Pum	Silicified mudstone
Pls	Schist
Plo	Dolomite marble

Outcrop

Phosphate rock outcrop

Geological boundary

Strike and dip of strata

Strike and dip of foliation and plunge of lineation

D618 D536 Diamond drill hole

Churn drill hole

R17 Rotary drill hole

340 Surface contours at intervals of 10', dashed where approximate. Datum R.L. mean sea level, Darwin, N.T.

Formed road

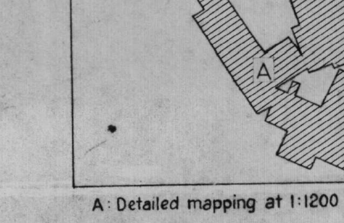
Vehicle track

Telephone line

Fence

Gravel pit

RELIABILITY DIAGRAM



A: Detailed mapping at 1:1200

SCALE

Feet 400 200 0 400 800 Feet

MAJOR GRID: T.E.P. mine grid, bearing 359°58'00"

MINOR GRID: B.M.R. geophysical grid, 1960-62

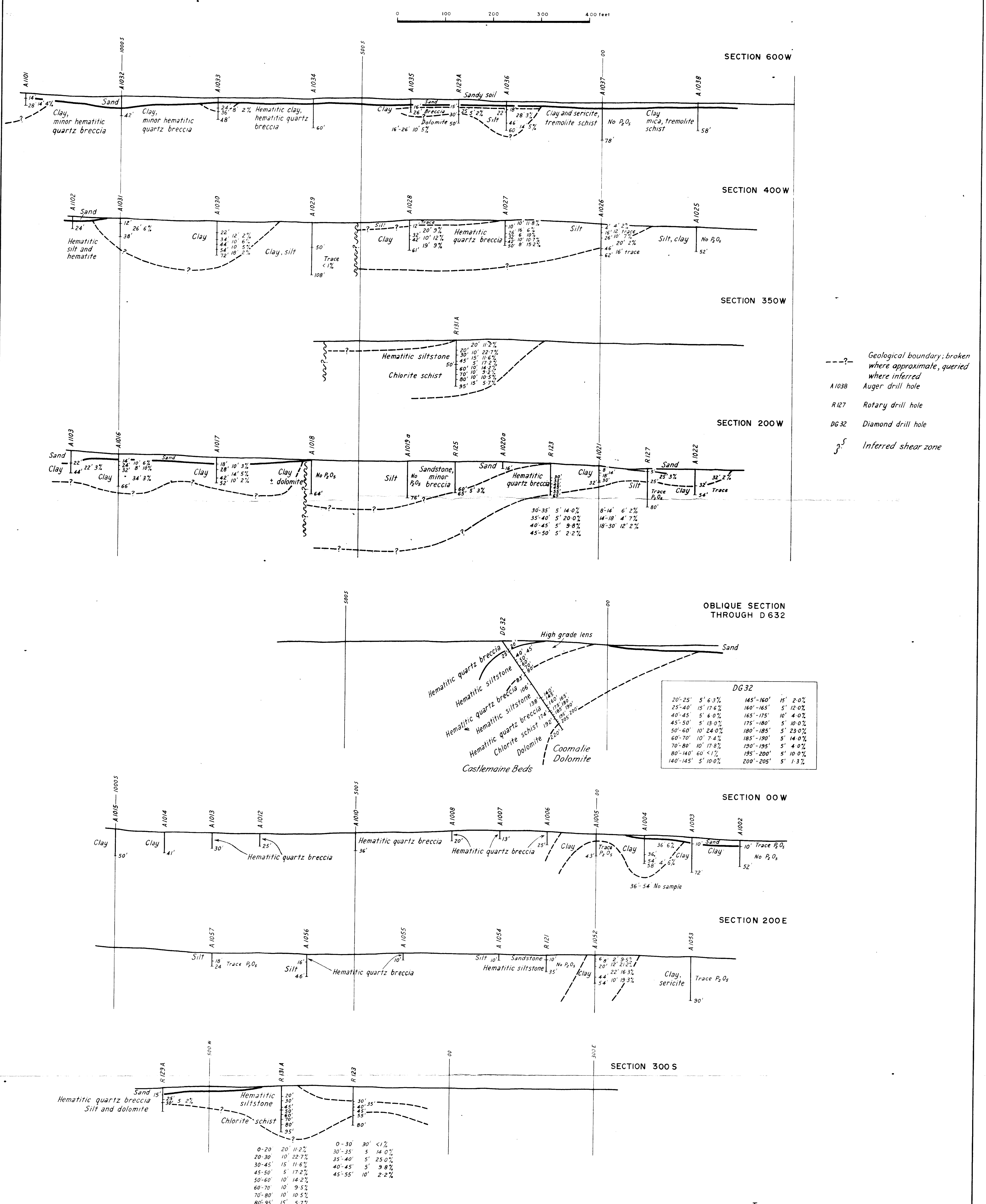
To accompany Record 1966/199

D52/A8/112

Rum Jungle Survey 1963

BUCKSHEE PHOSPHATE DEPOSIT

Plate 6



To accompany Record 1966/199

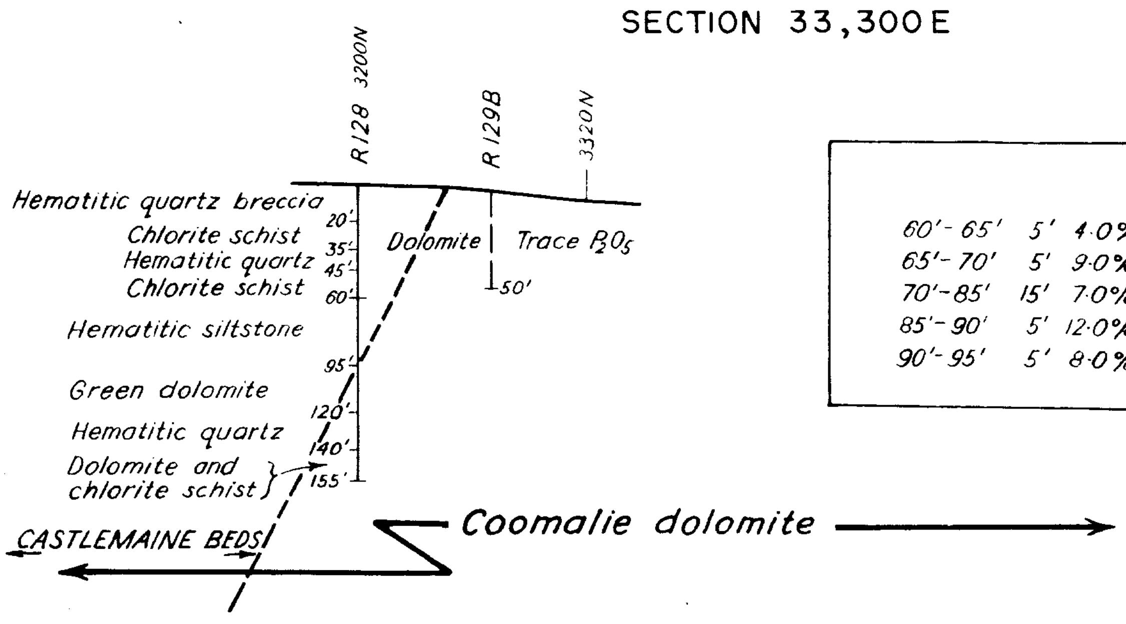
D52/A8/181

Plate 7

Rum Jungle Survey 1963

DYSONS

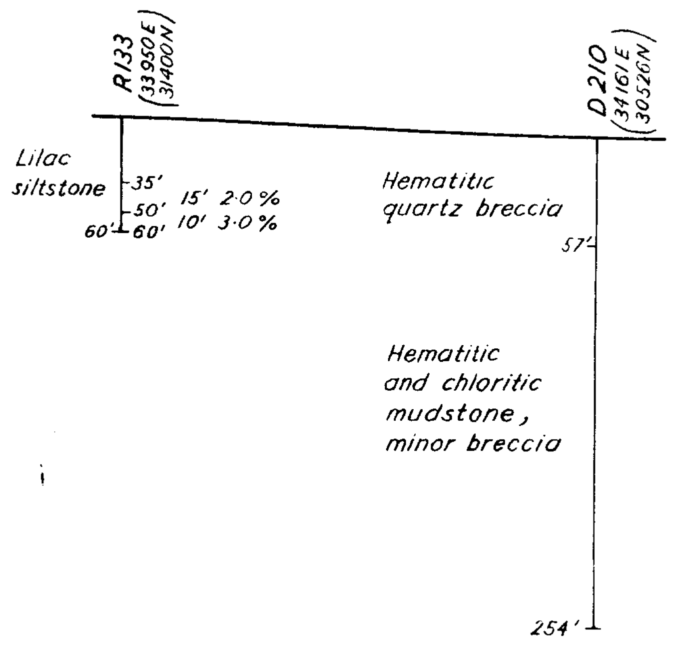
SECTION 33,300E



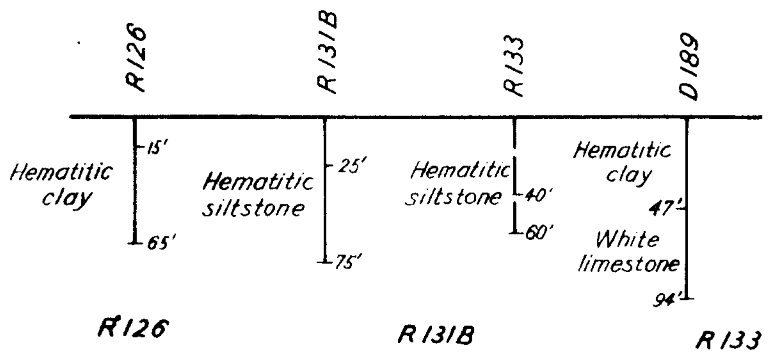
R128

60'-65'	5'	4·0%	95'-110'	15'	<2·0%
65'-70'	5'	9·0%	110'-120'	10'	6·0%
70'-85'	15'	7·0%	120'-135'	15'	12·0%
85'-90'	5'	12·0%	135'-145'	10'	6·9%
90'-95'	5'	8·0%	145'-155'	10'	10·2%

SECTION R133-D210



SECTION R126-R131B-R133-D189



R126

0-15'	trace
15'-20'	2·0%
20'-25'	14·0%
25'-30'	trace
30'-35'	3·0%
35'-40'	13·0%
40'-50'	8·0%
50'-55'	2·0%
55'-65'	21·0%

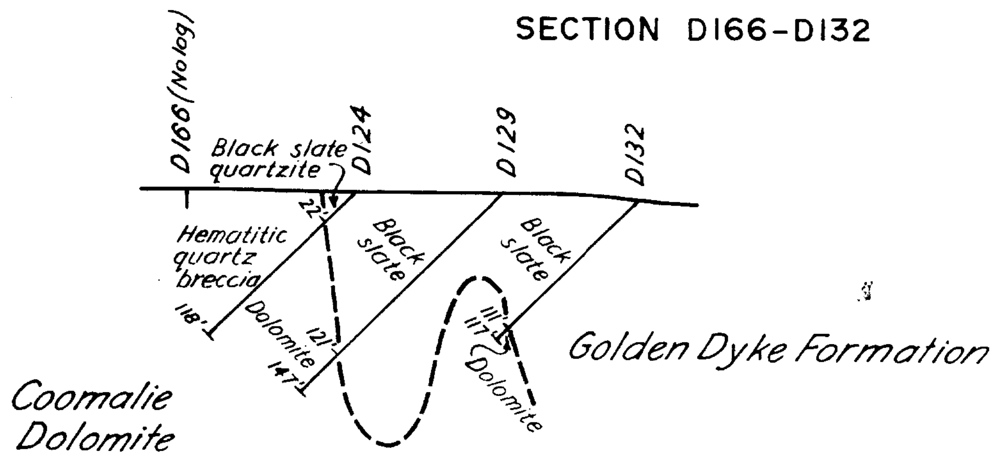
R131B

0-25'	trace
25'-30'	15·0%
30'-35'	trace
35'-45'	23·0%
45'-55'	9·0%
55'-75'	<2%

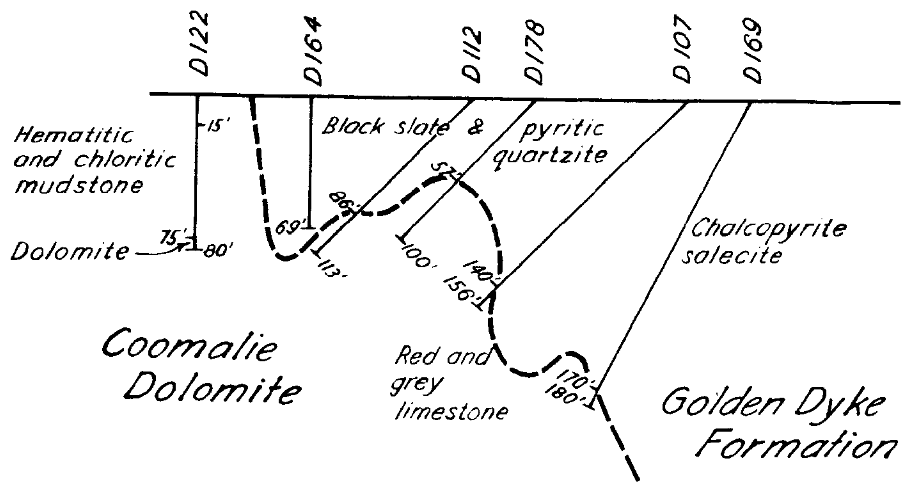
R133

0-40'	trace
40'-60'	3·0%

SECTION D166-D132



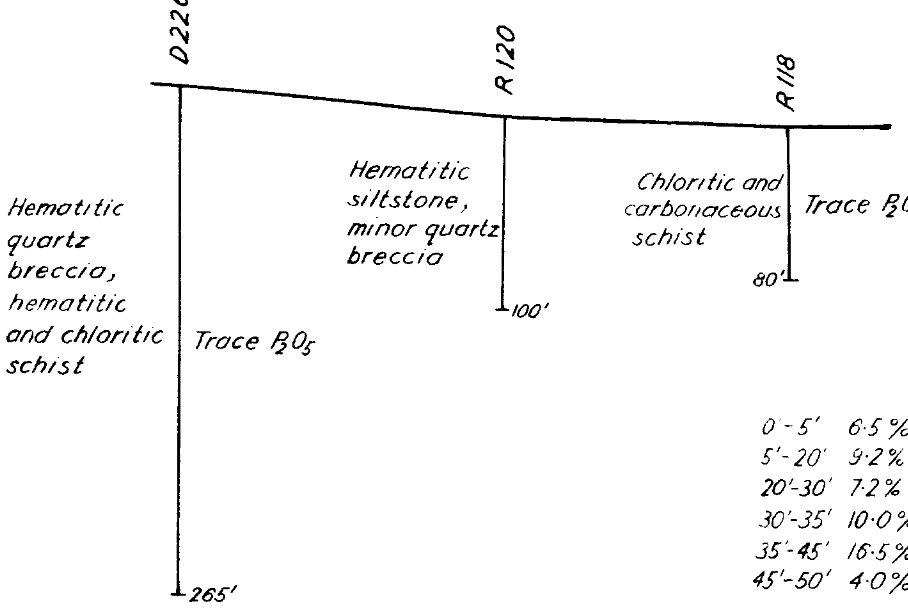
SECTION D122-D169



D122

0'-15'	trace
51'-54'	24·1%
54'-59'	17·8%
59'-63'	15·6%
63'-68'	13·6%
68'-73'	21·0%
73'-75·5'	3·9%

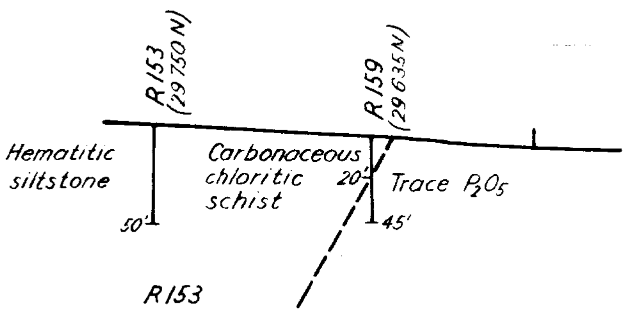
SECTION D226-R120-R118



R120

0-5'	6·5%	50'-65'	7·5%
5'-20'	9·2%	65'-70'	11·0%
20'-30'	7·2%	70'-80'	7·7%
30'-35'	10·0%	80'-90'	6·0%
35'-45'	16·5%	90'-100'	10·5%
45'-50'	4·0%		

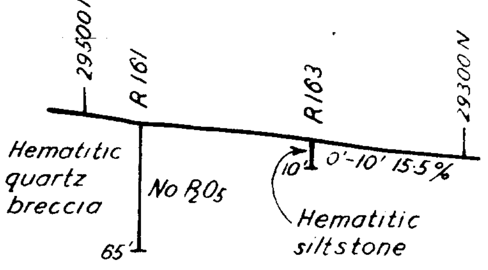
SECTION 33985E



R153

5'-15'	9·5%
15'-25'	7·5%
25'-40'	11·5%
40'-50'	8·0%

SECTION 29000



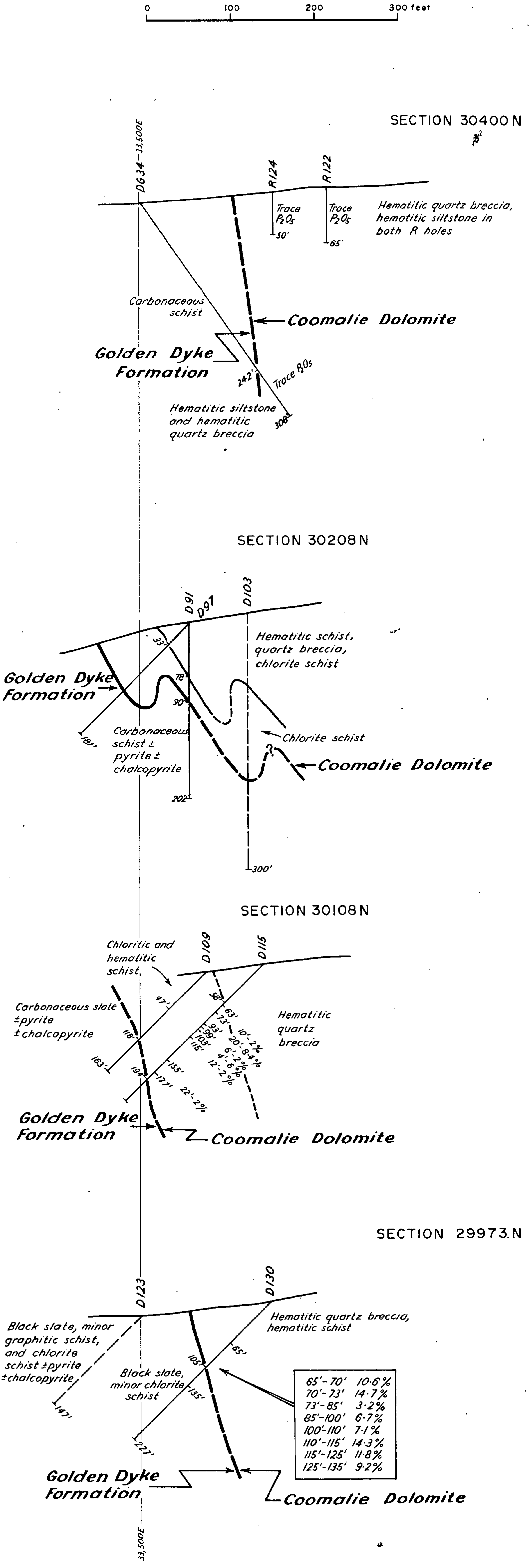
To accompany Record 1966/199

D52/A8/182

Plate 8

Rum Jungle Survey 1963

WHITES EAST



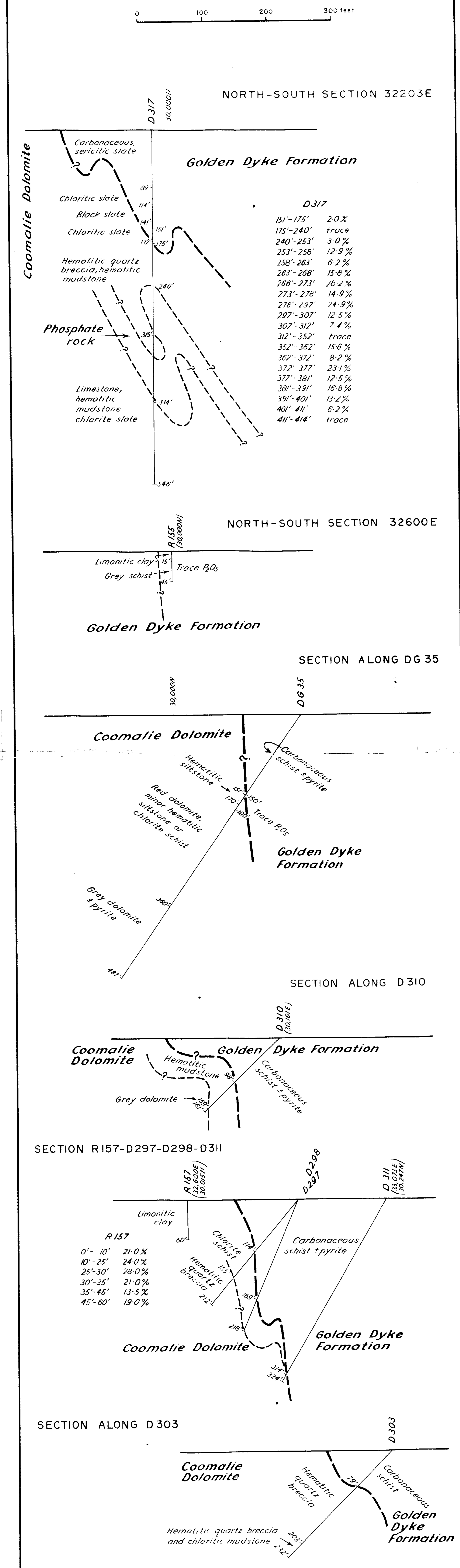
To accompany Record 1966/199

D52/A8/183

Plate 9

Rum Jungle Survey 1963

WHITES EAST



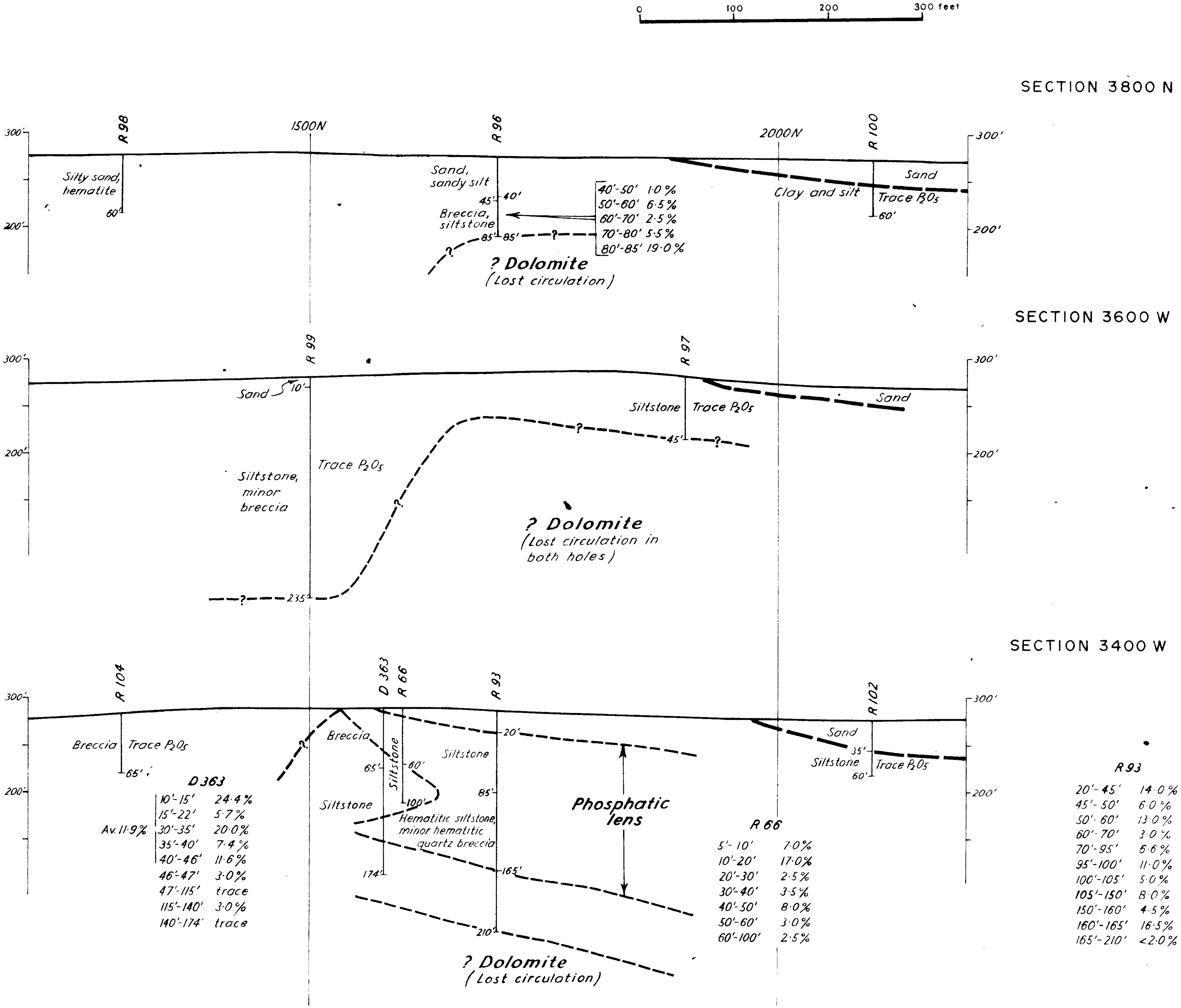
To accompany Record 1966/199

D52/A...

Rum Jungle Survey 1963

Plate 10

ZETA



To accompany Record 1966/199

D52/A8/18.

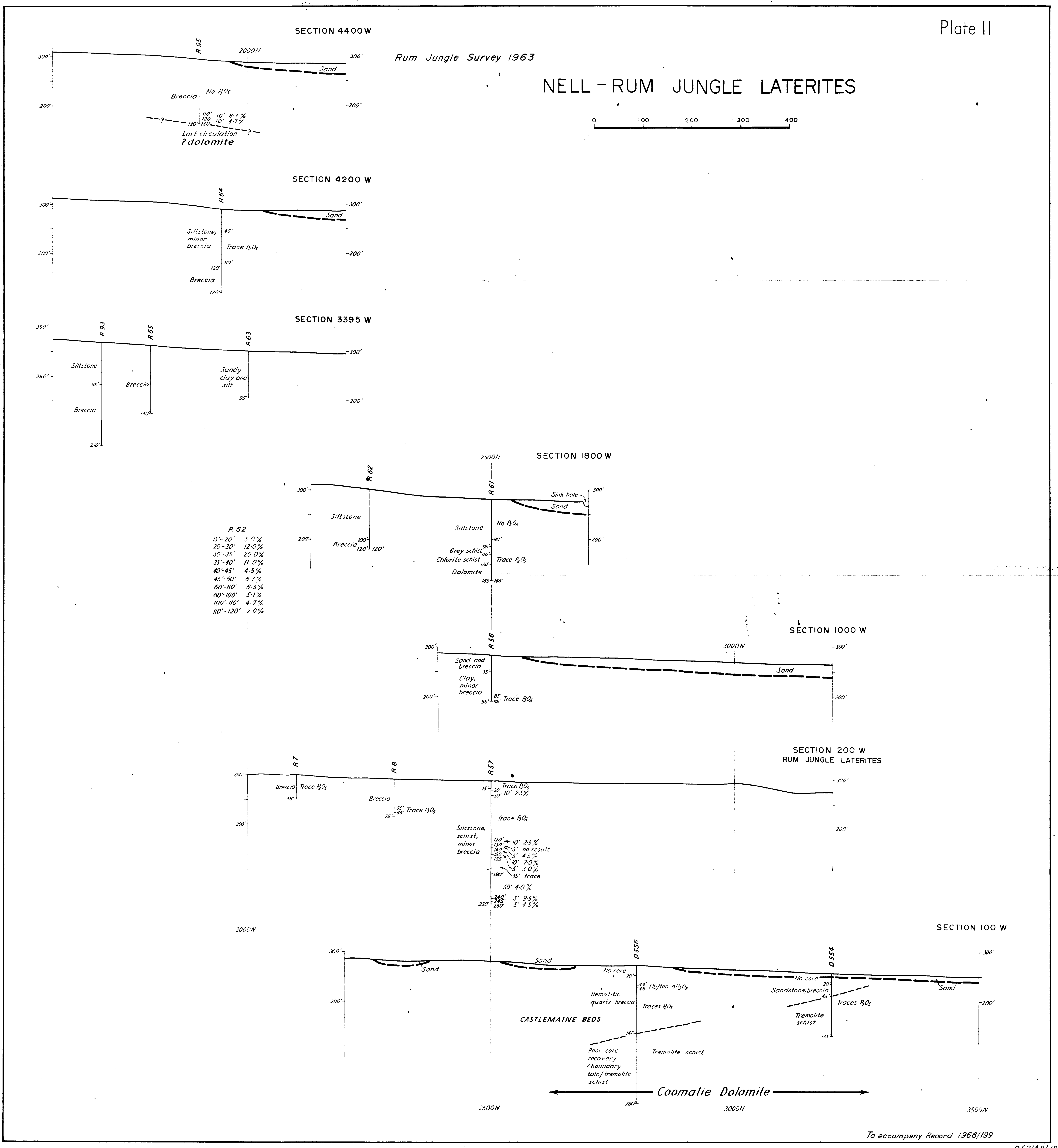
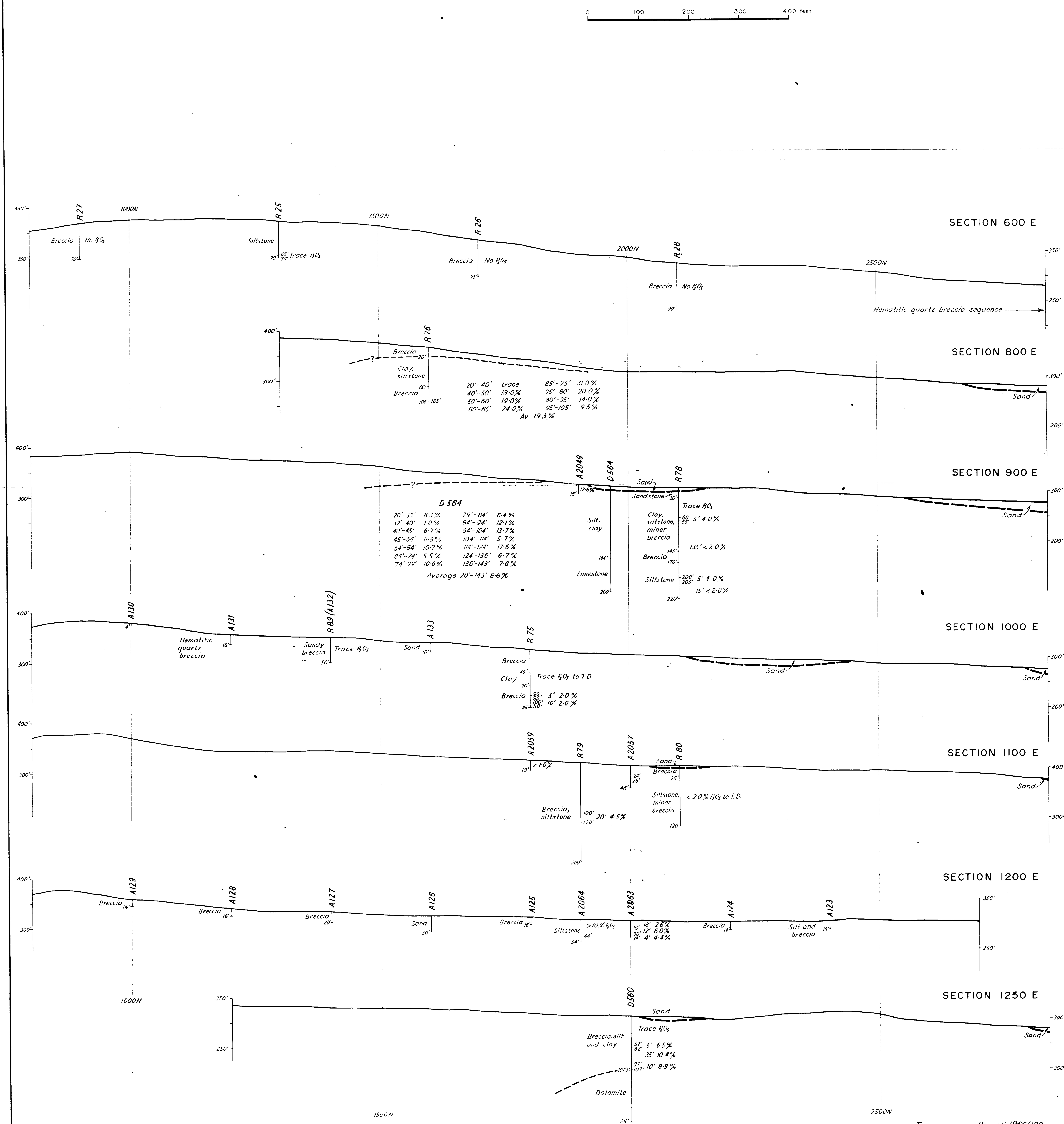


Plate II
Rum Jungle Survey 1963
NELL - RUM JUNGLE LATERITES
0 100 200 300 400
SECTION 4400 W
R 95
2000N
Sand
Breccia
No P_2O_5
110' 10' 8·7%
120' 10' 4·7%
130'
Lost circulation
? dolomite
SECTION 4200 W
R 64
Sand
Siltstone, minor breccia
45'
Trace P_2O_5
110'
120'
Breccia
170'
SECTION 3395 W
R 93
R 65
R 63
Siltstone
85'
Breccia
Breccia
140'
Sandy clay and silt
95'
210'
SECTION 1800 W
2500N
R 62
R 61
Sink hole
Sand
Siltstone
Siltstone
No P_2O_5
Breccia
100'
120'
120'
80'
95'
Grey schist
110'
Chlorite schist
130'
Trace P_2O_5
Dolomite
165'
165'
R 62
15'-20' 5·0%
20'-30' 12·0%
30'-35' 20·0%
35'-40' 11·0%
40'-45' 4·5%
45'-60' 6·7%
60'-80' 6·5%
80'-100' 5·1%
100'-110' 4·7%
110'-120' 2·0%
SECTION 1000 W
R 56
3000N
Sand and breccia
35'
Clay, minor breccia
85'
95'
95'
Trace P_2O_5
Sand
SECTION 200 W
RUM JUNGLE LATERITES
R 7
R 8
R 57
Breccia
Trace P_2O_5
46'
Breccia
55'
65'
Trace P_2O_5
75'
15'
20'
30'
Trace P_2O_5
10' 2·5%
Trace P_2O_5
Siltstone, schist, minor breccia
120' 10' 2·5%
130' 5' no result
140' 5' 4·5%
150' 10' 7·0%
155' 5' 3·0%
190' 35' trace
50' 4·0%
240' 5' 9·5%
245' 5' 4·5%
250'
250'
2000N
SECTION 100 W
D 556
D 554
Sand
Sand
No core
20'
44'
46'
1 lb/ton eU_3O_8
Hematitic quartz breccia
Traces P_2O_5
CASTLEMAINE BEDS
141'
Poor core recovery
? boundary talc/tremolite schist
Tremolite schist
No core
20'
Sandstone, breccia
45'
Traces P_2O_5
Tremolite schist
135'
Sand
Coomalie Dolomite
280'
2500N
3000N
3500N
300'
200'
To accompany Record 1966/199
D52/A8/186

Plate 12

Rum Jungle Survey 1963

EASTICKS



To accompany Record 1966/199

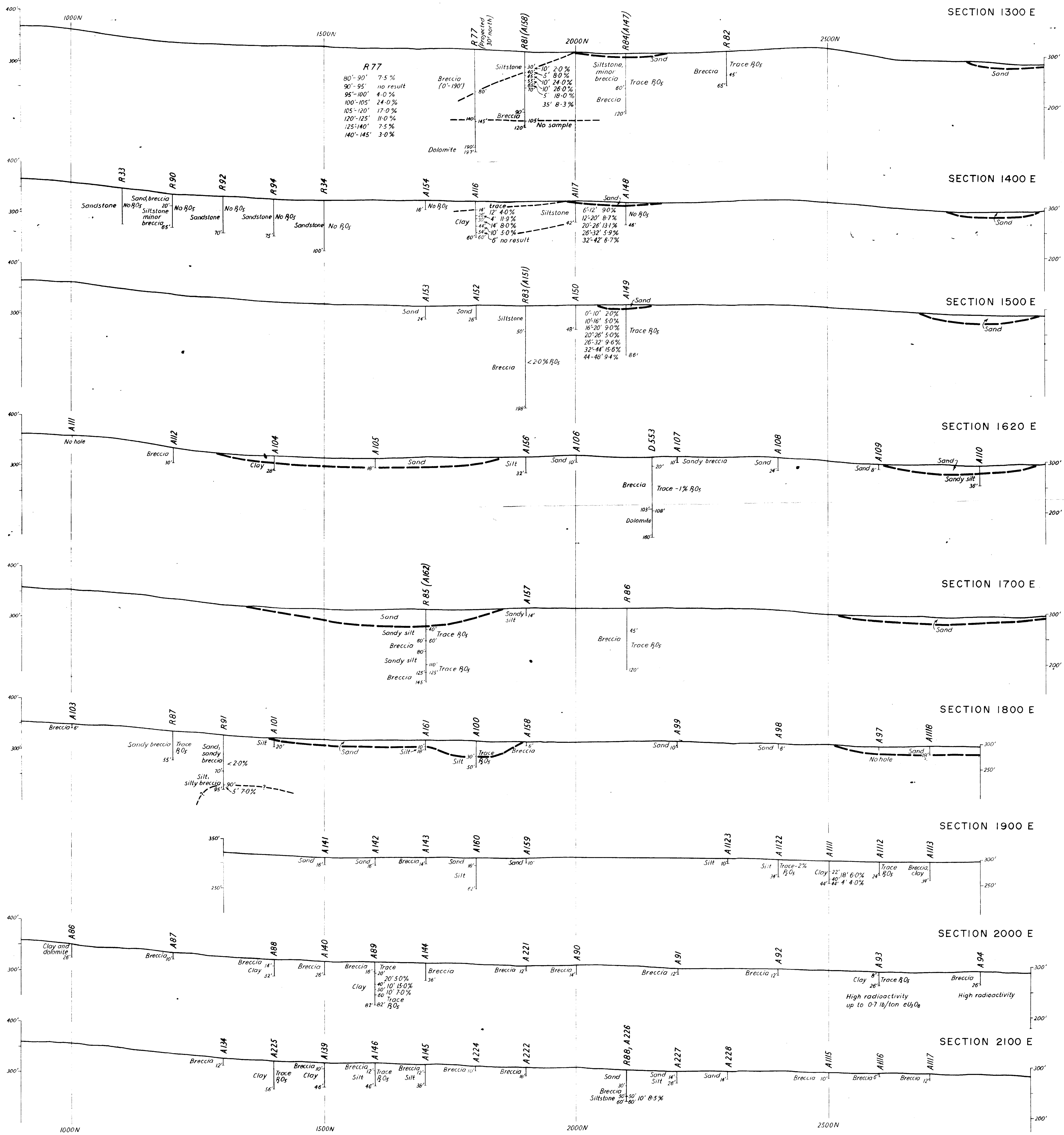
D52/A8/187

Plate 13

Rum Jungle Survey 1963

EASTICKS

0 100 200 300 400 feet



To accompany Record 1966/199

D52/A8/188

Rum Jungle Survey 1963

Plate 14

GEOLSEC

To accompany Records 1966/139

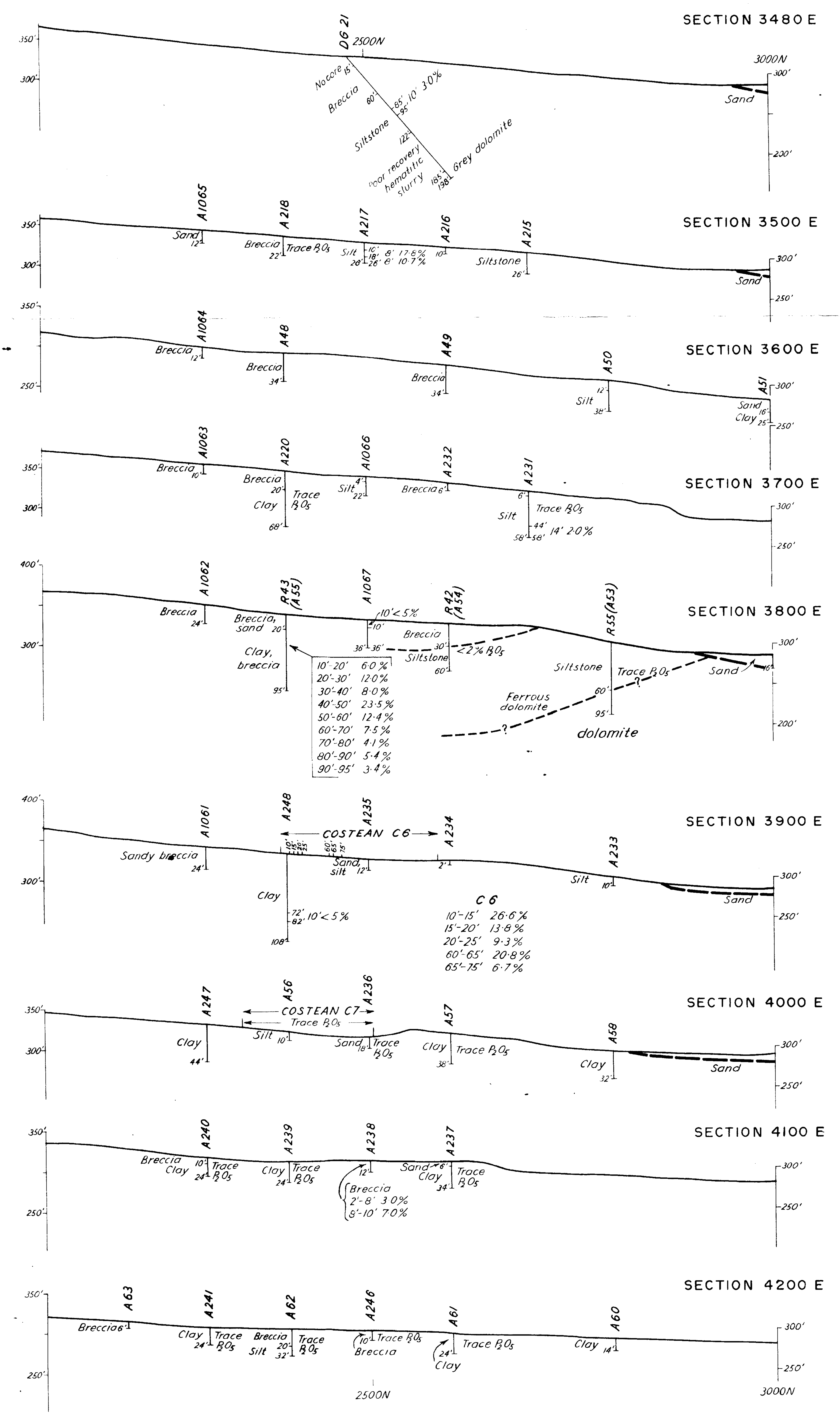
D52/A8/169

Plate 15

Rum Jungle Survey 1963

AREA 3

0 100 200 300 feet



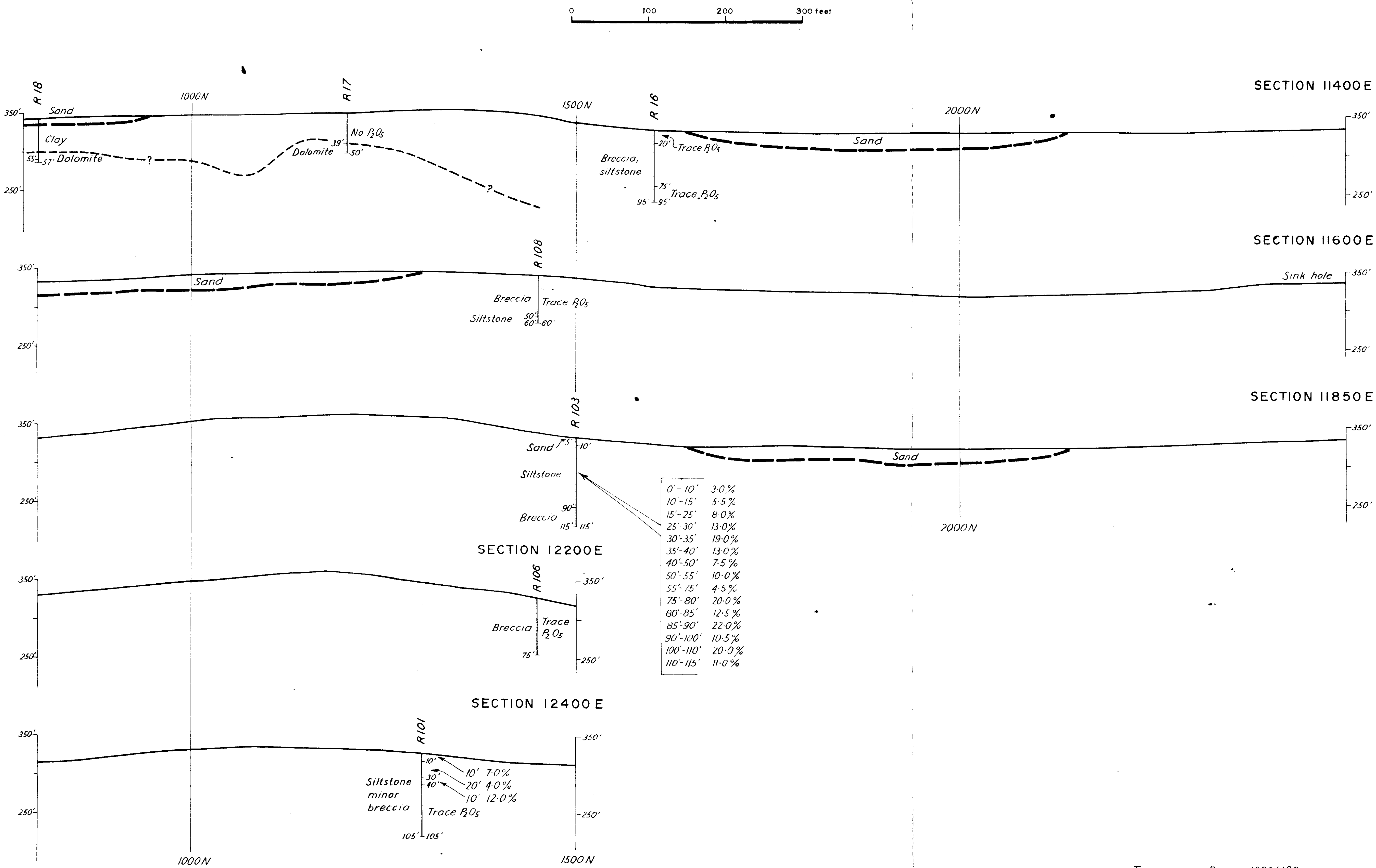
To accompany Record 1966/199

D52/A8/190

Rum Jungle Survey 1963

AREA 4

Plate 16



To accompany Record 1966/199

D52/A8/191

Rum Jungle Survey 1963

Plate 17

CASTLEMAINE

Rum Jungle Survey 1963

Plate 18

RUM JUNGLE CREEK TO TARTAN

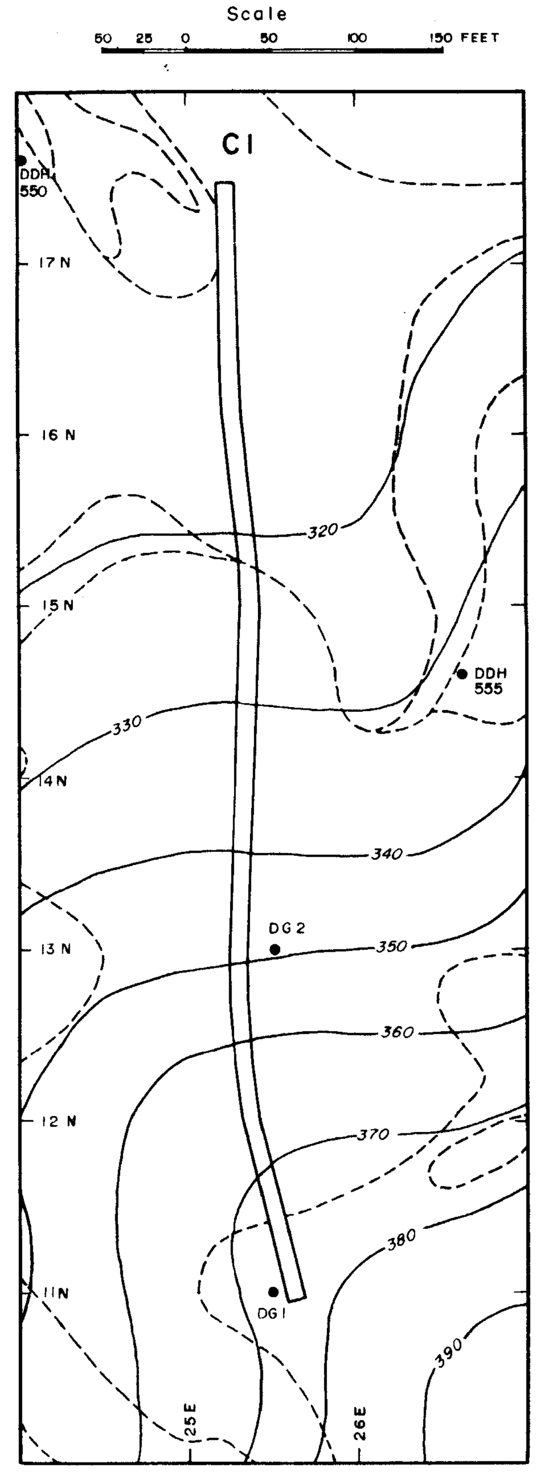
To accompany Record 1966/199

D52 ... 193

CROSS SECTION COSTEAN C1

Rum Jungle Survey 1962

LOCALITY MAP
Reference E 83·6



To accompany Record 1966/199

D52/A8/194 JK

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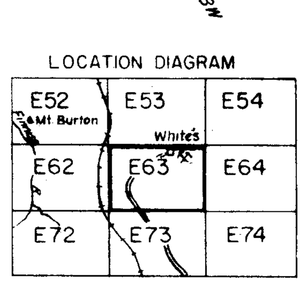
RUM JUNGLE SURVEY 1963

Plate 20

E63 RADIOMETRIC CONTOURS



REFERENCE

25 — Surface radiometric contour in counts per second at intervals of 10, 16, 25, 40, 63, 100 and 158
Background, Giant's Reef, 8 c.p.s.
Data from map by T.E.P. Ltd.

MAJOR GRID : T.E.P. mine grid, bearing 359° 58' 00"

MINOR GRID : BMR geophysical grid, 1962-63

SCALE

FEET 400 200 0 400 800 1200 FEET

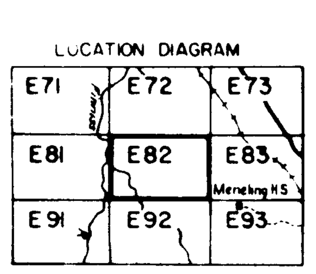
D52/A8/195

To accompany Record 1966/199

RUM JUNGLE PHOSPHATE SURVEY 1962-63

E82- SURFACE RADIOMETRIC CONTOURS

PLATE 21



—— – – Radiometric contours in mR/Hr

MAJOR GRID : T.E.P. mine grid, bearing 359°58′00″

MINOR GRID : B.M.R. geophysical grid 1960-62

SCALE

FEET 400 200 0 400 800 1200 FEET

Bureau of Mineral Resources Geology & Geophysics

To accompany record 1966/199

D52/A8/196

Bureau of Mineral Resources, Geology and Geophysics

RUM JUNGLE SURVEY 1963

PLATE 22

E83 SURFACE RADIOMETRIC CONTOURS

REFERENCE

.020 Radiometric contour in mR/hr

MAJOR GRID *TEP mine grid, bearing 359°58'00"*

MINOR GRID *BMR geophysical grid 1960-62*

SCALE

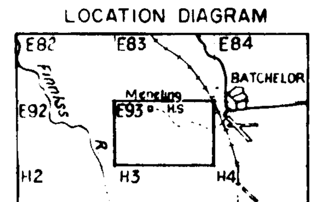
FEET 400 200 0 400 800 1200 FEET

Bureau of Mineral Resources Geology & Geophysics *To accompany Record Nº 1966/199* *D 52/A8/113*

PLATE 23

RUM JUNGLE PHOSHATE SURVEY 1962-63

E93 - SURFACE RADIOMETRIC CONTOURS



— 083 — *Radiometric contours in mR/Hr*

MAJOR GRID : *TEP mine grid, bearing 359°58'00"*

MINOR GRID : *BMR geophysical grid, 1960-62*

SCALE

Bureau of Mineral Resources Geology & Geophysics *To accompany Record Nº 1966/199* *D 52/A8/118*