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BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS.

RECORDS:

1964/125

RUM JUNGLE GEOCHEMICAL SURVEY 1963
THE RUM JUNGLE COPPER MINE

by

P.W. Pritchard

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RUM JUNGLE GEOCHEMICAL SURVEY 1963

THE RUM JUNGLE COPPER MINE

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P.W. Pritchard

Records No.1964/125

SUMMARY

In 1963 an auger survey was made across the Rum Jungle Copper Mine to obtain:-

1. geochemical data for comparison with data from auger surveys elsewhere in the Rum Jungle area.
2. information about the value of auger drilling in sampling the upper part of near surface mineralisation.

The Rum Jungle Copper Mine orebody occurs in the Golden Dyke Formation near its contact with the Coomalie Dolomite. A sedentary weathering profile consisting of A, B and C horizons has developed on these formations and copper, cobalt, nickel and radiometric anomalies occur within this profile over the orebody.

Isochemical contours outlining the anomalous areas can be selected by an analysis of the cumulative frequency distributions of the assays. Assays collected either specifically from the C horizon or indiscriminately from the C and/or B horizons can be used and give similar results.

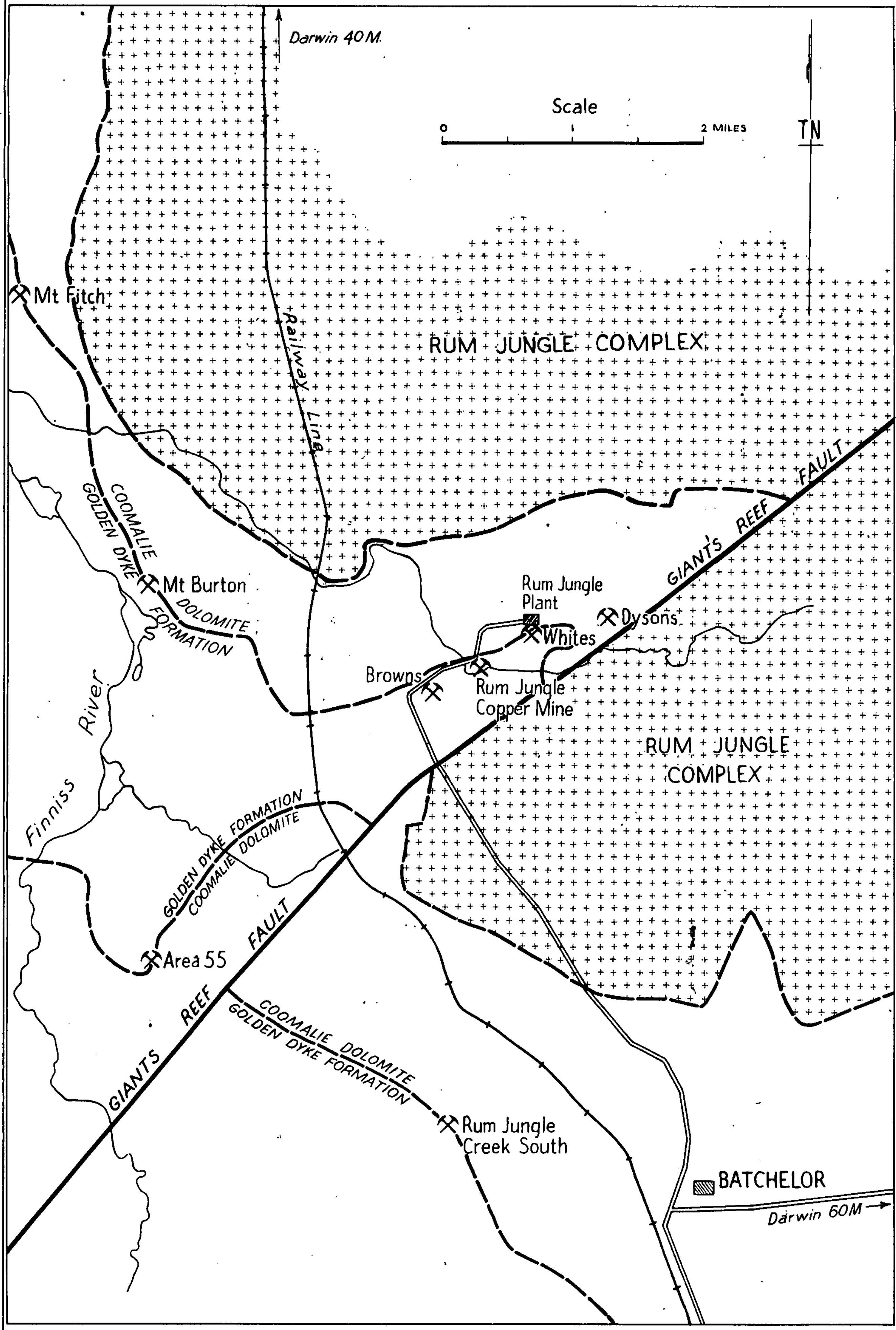
Isochems and isorads outlining the anomalous areas were obtained by an analysis of the cumulative frequency distributions of the assays and of the radiometric drill hole probe readings. The copper isochem outlines an area including most of the top of the copper orebody and the isorad outlines an area overlying the orebody. The cobalt and nickel isochems are restricted to the area occupied by the peak of the copper anomaly which overlies the northern side of the copper orebody.

The results from auger holes drilled at twenty-five-foot intervals along traverse 6190W show that the top of the ore zone is 180 feet wide along this traverse and indicate that the ore zone contains two shoots one poorer in copper but richer in cobalt and nickel than the other.

Radiometric results from the closely spaced holes along traverse 6190W locate a small, intense radiometric anomaly between 125N and 140N which should be followed up by further auger drilling.

Fig. 1

LOCALITY MAP



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INTRODUCTION

Surface copper mineralisation has been known near the site of the Rum Jungle Copper Mine (Fig.1) since the end of the nineteenth century. In the 1950's this mineralisation was intersected by exploratory drilling for uranium deposits west of White's Opencut. In 1963 the Australian Mining and Smelting Company proved a small copper orebody at the Rum Jungle Copper Mine which is now being mined.

The Bureau of Mineral Resources (B.M.R.) has undertaken geochemical prospecting in the Rum Jungle area since 1958. In that year shallow geochemical sampling by Haldane and Debnam (1959) on an 800 x 400 feet grid outlined a copper anomaly more than 4,500 feet long in the Rum Jungle Copper Mine - Browns area. This anomaly straddles the contact of the Golden Dyke and Coomalie Dolomite formations and has three peaks. The smallest peak overlies the Rum Jungle Copper Mine and further prospecting for copper is needed over the rest of the anomaly.

In 1963 auger samples were collected across the Rum Jungle Copper Mine area to obtain geochemical and radiometric data over an orebody for comparison with results from auger drilling elsewhere in the Rum Jungle area, and to evaluate auger drilling as a sampling tool for outlining the top of near surface mineralization.

GEOLOGY

The Rum Jungle Copper Mine orebody occurs in graphitic and chloritic schist of the Golden Dyke Formation near its contact with the Coomalie Dolomite. These formations are Lower Proterozoic in age and are described by Malone (1962).

WEATHERING PROFILE

The weathering profile in the Rum Jungle Copper Mine area can be divided into A, B and C horizons and consistent differences can be recognised between those parts of the profile over the Golden Dyke Formation and those parts over the Coomalie Dolomite. The variations in the profile are shown in Table 1.

The consistent relationship between the characteristics of the weathering profile and the underlying Lower Proterozoic formations shows that the material in the profile is derived from the weathering of these formations, and even though the sandy part of the profile developed over the Coomalie Dolomite transgresses the Coomalie Dolomite/Golden Dyke Formation boundary (e.g. see Plate 1), the profile can be classed as sedentary. Apart from containing secondary copper minerals and anomalous amounts of copper,cobalt,nickel and radioactive material the profile is similar to the profile developed on the Coomalie Dolomite and Golden Dyke Formation in unmineralised parts of the Rum Jungle area.

TABLE 1

VARIATIONS IN THE WEATHERING PROFILE
RUM JUNGLE COPPER MINE AREA

Horizon	General Features	Golden Dyke Formation	Transition Zone	Coomalie Dolomite
A	Grey, relatively humus rich silty soil a few inches thick.	Present in only a few places		
B	Well developed brown or red zone enriched in iron oxides, mostly leached of clay. In most places a pisolitic zone occurs below two feet or less from the surface and extends to the bottom of the C horizon.	Ferruginous brown sandy silt 4-16 feet thick.	Cemented red-brown, ferruginous breccia with quartz fragments in a sandy and silty matrix. Not penetrated by the auger drill.	In most places 8-10 feet of brick red hematitic, silty sand with rounded grains. Brown, ferruginous silty sand with rounded grains >6 feet thick.
	Transition Zone	Change from B to C horizon over 1-2 feet . White clay in places.	Not reached	White clayey sand with rounded grains. Not penetrated.
C	Unbleached clay grading down into softened bedrock and then into bedrock.	Olive brown or grey clay grading down into softened chloritic or graphitic schist 28-60 feet thick.	Not reached.	Not reached.

AUGER DRILLING

The B.M.R. Gemco auger drill took nine days to drill 1754 feet in 88 holes. In 1963 contract rates for auger drilling at Rum Jungle were 6/6 to 7/6 a foot and the drilling at the Rum Jungle Copper Mine would have cost £585 at the lower contract rate. The actual cost of the drilling and sampling was of the order of £300.

Nineteen holes were drilled on a hundred foot square grid (Plate 4), and sixty-nine holes were drilled five feet apart along traverse 6190W (Plates 1 and 4) to obtain information for the interpretation of the results from the holes drilled on the hundred foot square grid. Traverse 6190W is located ten feet from the ideal grid westing to avoid costeans.

All the holes on the one hundred foot square grid and the holes twenty five feet apart on traverse 6190W were drilled as deep as possible. The maximum depth reached was 74 feet. The other holes along traverse 6190W were drilled two feet into the C horizon.

SAMPLING

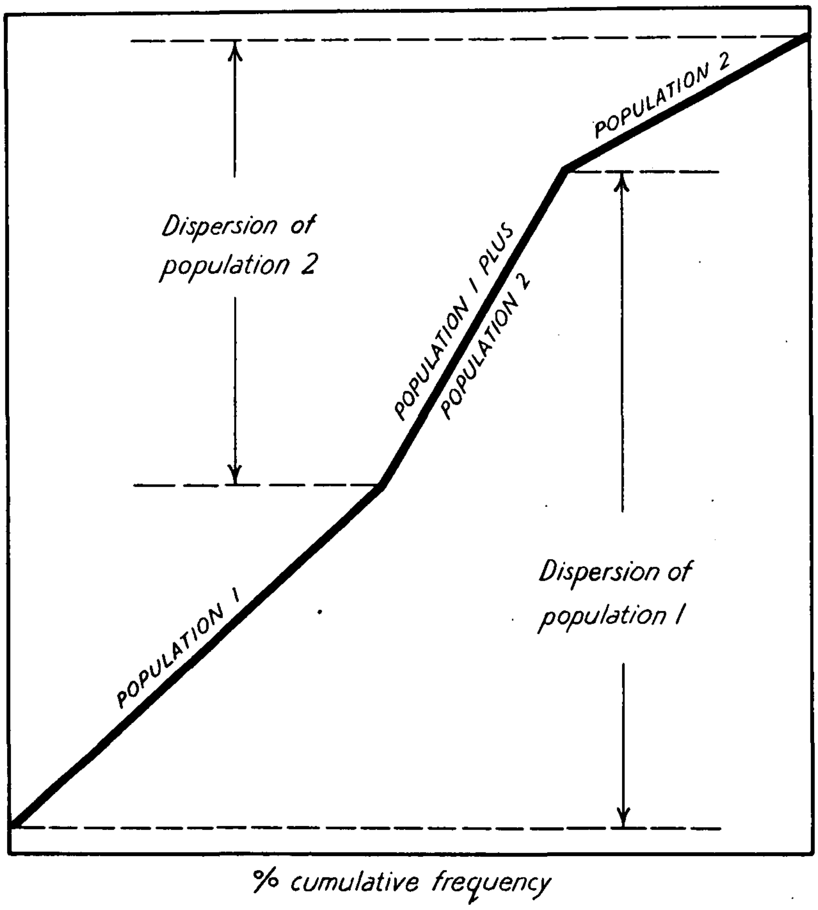
Two grab samples of every two foot interval were collected from the weathering profile material extruded from the holes during the drilling. These two foot samples were combined to form samples of intervals up to twelve feet long (interval samples) and to form samples representing all the C and B horizon penetrated in a particular hole (bulk"weathered rock " sample).

Bearing in mind the accuracies of the spectrographic or wet chemical methods normally used by the B.M.R. to analyse auger samples, this sampling procedure is sufficiently accurate for geochemical prospecting. But as can be seen from the discrepancies in the more accurate assays in Appendix 2 where assays of individual bulk samples are not the same as the average of the assays of the corresponding interval samples, a more rigorous sampling method is needed if auger drilling is to be used to test the grade of the upper part of near surface mineralisation.

CHEMICAL ANALYSES

An optical emission spectrograph was used to analyse the samples for copper, cobalt, nickel, lead, molybdenum and vanadium and the spectrograph plates were scanned for tin, beryllium and phosphorous (Howard, Appendix 1). This is the method used to analyse some of the samples collected during the B.M.R.'s geochemical surveys at Rum Jungle in 1961 and to assay all the samples collected in 1962 and 1963. The results in Appendix 1 are therefore the only ones used in the following discussion of the geochemical anomalies associated with the Rum Jungle Copper Mine orebody.

More accurate semiquantitative copper assays of samples from the deep auger holes were made using an X-Ray fluorescence spectrograph (Goadby, Appendix 2). These are used to assess the value of auger drilling in sampling near surface mineralisation.



Schematic cumulative frequency plot on log-probability paper of two approximately log normal populations in one suite of samples

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STATISTICAL ANALYSIS

Various authors (see Shaw 1961) have shown that the distribution of elements in igneous or metamorphic rocks is approximately log normal and Tennant and White (1959) have shown:

1. how the presence of several populations in a suite of samples can be recognised from the shape of the cumulative frequency distribution of the samples plotted on logarithmic probability paper.
2. that the limits of the population can be obtained from the points at which the plotted lines change slope.

Plate 2 shows the cumulative frequency distributions of copper, cobalt, nickel and radioactivity results along the section 6190W. The graphs were obtained by

1. counting the number of times (i.e. the frequency) each value occurs in a suite of samples.
2. converting this frequency to a percentage frequency.
3. plotting the cumulative percentage frequency on logarithmic probability paper.

The resulting plot of a lognormally distributed population is a straight line whose slope is related to the dispersion of the population. If overlapping populations of assays are obtained from a suite of samples the shape of the cumulative frequency plot of the assays will be a variation of the plot shown in Figure 2.

GEOCHEMICAL ANOMALIES

The optical emission spectrograph results in Appendix 1 show that anomalous amounts of copper, cobalt and nickel occur in the weathering profile over the Rum Jungle Copper Mine orebody.

The areal distribution of the geochemical anomalies are shown on Plate 4. Contours outlining the peaks of the anomalies and the areas in which statistically significant assays occur are shown. Both the assays of samples from the top of the C horizon and the assays of the bulk samples of "weathered rock" have been contoured for comparison with results from other areas.

The significant contours were derived from the results of the detailed sampling along traverse 6190W which provides a suite of samples for statistical analysis. Various populations can be recognised in the copper, cobalt and nickel suites of assays.

Variations in the trace element content of the sedentary weathering profile in the Rum Jungle Copper Mine area might be attributed to

1. variations in the parent rock.
2. variations caused by the processes which formed the soil horizons.

Both of these types of variation can be minimised by selecting the samples from the C horizon of the weathering profile over the Golden Dyke Formation. The cumulative frequency distribution of the copper assays (Plate 2) from the C horizon of the weathering profile over the Golden Dyke Formation shows the presence of two populations which are separate above 700 ppm. and below 100 p.p.m. copper (see Table 2)

The cumulative frequency distribution of the copper assays of "weathered rock" samples (i.e. all the B and C horizon samples) from traverse 6190W (Plate 2), also shows the presence of two populations which are separate below 100 p.p.m. and above 700 p.p.m., and the 700 p.p.m. copper contour (Plate 4) based on assays of bulk "weathered rock" samples outlines the area underlain by the top of the copper orebody. The area outlined by this contour is larger than the area outlined by the 700 p.p.m. copper contour based on C horizon samples but either could be used to outline the geochemical anomaly and to plan follow up work.

Plate 4 shows that the outlining of the area in which the anomalous population occurs is of particular interest because the peak of the copper anomaly outlined by the 5000 p.p.m. copper contour is offset from the centre of the orebody and has excluded the copper showings found in costeans and in the bed of the Finniss River. The use of the outline of the peak of the copper anomaly as a basis for further testing would therefore have been misleading.

The variations in the cumulative frequency distribution of the cobalt assays (Plate 2) are not as striking as the variations in the plots of the copper assays. The cobalt assays can, however, be split into two major populations (Table 2). the The areas outlined by the significant contours for the C and ~~for~~/ B and C horizons (bulk weathered rock) samples are shown on Plate 4. They overlie the northern side of the copper orebody and are similar to the area outlined by the 5000 p.p.m. copper contour to show the peak of the copper anomaly.

The cumulative frequency distribution diagram (Plate 2) for both the C, and the B and C horizon nickel assays show the presence of two populations separate above 200 p.p.m. nickel. The 200 p.p.m. nickel contours (Plate 4) outline areas similar to those outlined by the statistically significant cobalt contours.

The areas outlined by the cobalt and nickel isochems overlie that part of the copper orebody along traverse 6190W containing the highest grade cobalt and nickel.

Table 2
GEOCHEMICAL POPULATIONS - RUM JUNGLE COPPER MINE.

	C horizon populations		B and C horizon populations	
Metal	Background (p.p.m)	Anomalous (p.p.m.)	Background (p.p.m.)	Anomalous (p.p.m.)
Copper	20-700	100-5000+	20-700	100-5000+
Cobalt	5-500	150-2000+	5-700	150-2000+
Nickel	5-200	15- 700+	5-200	15- 700+

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT RUM JUNGLE GEOCHEMICAL SURVEY 1963 REMARKS

HOLE No. A4005 CO-ORDINATES 6190W 125N (Geophysicists' Grid) R L GROUND

LOCATION Rum Jungle Copper Mine ANGLE FROM HORIZONTAL Vertical DIRECTION

DESCRIPTION OF CORE

Brown quartz sand and silt 8'

Transition. Grey-brown quartz sand with graphite schist fragments 10'

Grey graphitic schist

Radiometric results were obtained with a 1292A Harwell Ratemeter and a probe containing one G24H geiger tube. The hole was probed twice. (Calibration curves are given at the end of the text.)

RADIOMETRY 0.25 Scale

.034

.036
.040
.046
.040
.044
.050
.057
.052
.044
.049
.047
.051
.064
.061
.058
.065
.061
.060
.057
.075
.103
.122
.143
.189
.110
.099
.132
.680
.900
.810
.720
.790
.510
.115
.135
.165
.170
.180
.150
.145
.160
.160

DEPTH 10' 20' 30' 40' 50' 60'

SAMPLES 8' 10' 12' 20' 26' 36' 46' 56'

REMARKS

See appendix I for spectrographic assays of Ni, Co, Cu, V, Mo, Pb.

Standing water table - 18'

Water encountered at 26' during drilling

Bottom hole sample taken from auger bit.

ASSAYS

eU_3O_8	eU_3O_8	eU_3O_8
%	lbs/ton	lbs/ton
.006	0.13	0.6
.005	0.11	0.6
.006	0.13	0.8
.008	0.18	0.8
.008	0.18	0.8
.009	0.20	0.8
.011	0.24	1.3
.009	0.20	2.1
.011	0.24	1.7
.018	0.40	3.7
.022	0.48	8.6
.022	0.48	9.0
.022	0.48	7.2
.024	0.53	1.9
.035	0.77	2.4
.054	1.18	2.1
.051	1.12	2.2
.060	1.42	
.073	1.61	
.040	0.88	
.034	0.75	
.030	0.66	
.026	0.57	
.020	0.44	
.020	0.44	

Columns 1 and 2 are radiometric assays by A. Douglas, 27-6-63. Absorption tests show the radioactivity to be essentially from uranium

Column 3 is assays derived from the probe results in column 2 on this page.

DRILL B.M.R.
TYPE Gemco auger

EXPLANATION

CASING IN HOLE DURING DRILLING ▮

DRILLER M. Wallis
COMMENCED May, 1963
COMPLETED

REFERENCES

HEAD OFFICE

LOGGED BY A.L. Mather and P.W. Pritchard
DRAWN BY
CHECKED BY

SHEET 1 OF 1
DRAWING NO. D52/A8/123

RADIOMETRIC ANOMALIES

The Rum Jungle Copper Mine lies within the area of the radiometric anomaly previously known as the Intermediate Prospect. The radiometric readings obtained during the 1963 auger sampling were generally more than three times those found in unmineralised parts of the Rum Jungle Area. They can be converted to mR/Hr or lbs/ton eU_3O_8 by the graphs on Plates 5 and 6.

Plate 3 shows the frequency distribution of the auger hole probe readings one foot below ground level and suggests the presence of several populations which can be discriminated from one another at 0.023, 0.028 and 0.038 radiometric units. These populations show very little dispersion.

Plate 3 also shows the frequency distribution of the radiometric readings in the C soil horizon. An obvious change in the distribution of the readings occurs above 0.027 units and at least two major populations can be distinguished, one with values ranging up to 0.027 units and the other with higher values. In the latter population the distribution of the radioactivity above 0.500 units should be disregarded because the sample of the radioactivity in this range is too small.

The area enclosed by the 0.027 isorad derived from readings at the top of the C soil horizon and by the 0.028 isorad one foot below ground level in the auger holes on a one hundred foot grid, overlies the centre of the copper orebody (Plate 4).

The results from the detailed traverse along the section 6190W show another, areally smaller but very intense fifteen feet wide anomaly in holes A4005 to A4008 (Plate 1) which is missed by the hundred foot square grid sampling used to compile the figures on Plate 4. The radiometric readings in hole A4005 at 6190W/125N are the highest recorded by the Rum Jungle auger surveys between 1961 and the end of 1963, and may reflect economic uranium mineralisation. Alternatively, bearing in mind the small increases in copper, cobalt and nickel values in the C horizon in these four holes and the association of a radiometric anomaly with the Rum Jungle Copper Mine orebody, the anomaly may reflect the presence of an en echelon copper body south of the orebody now being mined. The anomaly should be followed up by geochemical sampling and radiometric probing of auger holes drilled on traverses on either side of the anomaly.

The results from A4005 (Table 1) are a problem in themselves. The radiometric readings obtained using the drill hole probe correspond to readings obtained from test blocks containing up to 9.0 lbs/ton eU_3O_8, whereas radiometric assays of the auger samples show a maximum grade of 1.6 lbs/ton eU_3O_8. This discrepancy may be caused by radon, and the possibility that this gas may be an important source of radioactivity in radiometric anomalies in the Rum Jungle area should be examined.

AUGER DRILLING TO SAMPLE NEAR SURFACE MINERALISATION.

The spectrographic assays (Appendix 2) of samples from the deep auger holes drilled in the Rum Jungle Copper Mine area provide cheap information about the size and the grade of the orebody. In particular the data from the holes twenty five feet apart on traverse 6190W (Plate 1) indicates that the ore zone is about 180 feet wide and that it contains two relatively higher grade shoots, one on the northern side of the orebody and the other on the southern side. The northern shoot is poorer in copper and richer in cobalt and nickel than the southern one.

Such information would have been valuable in the early stages of assessing the size and grade of the orebody and in providing a basis for more expensive testing.

ACKNOWLEDGEMENTS

Mr. R.N. Spratt of the Australian Mining and Smelting Co. provided the orebody outline and the position of the Golden Dyke Formation/ Coomalie Dolomite contact shownin Plates 4 and 5. Mr. J. Barrie advocated statistical method used to evaluate the geochemical data.

CONCLUSION

Copper, cobalt and nickel geochemical anomalies, and radiometric anomalies occur in the weathering profile over the Rum Jungle Copper Mine orebody.

Statistical analysis can be used to discriminate between anomalous and background populations in suites of geochemical or radiomet-/ric results. and to then select significant isochems or isorads. In the Rum Jungle Copper Mine Area these bear sensible relationships to the underlying orebody.

The geochemical and radiometric data from the C horizon of the weathering profile over the Rum Jungle Copper Mine orebody delineate the anomalous areas more accurately than the data from the C and/or the B horizons. ("weathered rock") but either can be used.

Statistical analysis can be used with confidence in the assessment of geochemical prospecting data. It is especially useful because it provides results which are independent of the absolute size of the values obtained during the prospecting.

In view of the extension of geochemical and radiometric anomalies throughout the sedentary weathering profile of the Rum Jungle Copper Mine area and the extent and economy of the 1958 geochemical survey (Haldane and Debnam 1959), prospecting in those parts of the Rum Jungle area where sedentary weathering profiles are present can be carried out in the following order:

1.a.) Shallow reconnaissance sampling of the top of the B horizon on 1000 x 200 foot grids.

b.) Chemical or spectrochemical analysis.

c.) Statistical analysis and plotting of this information.

d.) Evaluation of the results to outline the anomalous areas.

2.a.) Shallow detailed sampling of the top of the B horizon on 200 x 100 foot grids in the anomalous areas outlined by the procedure in 1.
b.), c.) and d.) as in 1 to delineate the anomalous areas.

3. Deep detailed auger drilling and sampling of the weathering profile on 100 x 25 foot grids in the anomalous areas delineated by 2.
b.), c.), and d.) as in 1.

Provided an auger drill can penetrate near surface mineralisation it is a useful tool for the delineation and evaluation of the mineralisation preparatory to diamond drilling.

The radiometric anomaly located on traverse 6190W between 125N and 140N is the most intense yet found by auger drilling in the Rum Jungle area and should be followed up by probing and geochemical sampling in deep auger holes ten feet apart on traverses 100 feet on either side of 6190W.

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APPENDIX I

SPECTROGRAPHIC ANALYSIS OF AUGER SAMPLING FROM RUM JUNGLE COPPER MINE, NORTHERN TERRITORY.

by

E.J. Howard.

(Results are expressed in parts per million).

Hole No.	Depth (Feet).	Ni.	Co.	Cu.	V.	Mo.	Sn.	Pb.	Be.
4000	6 -8	10	30	50	150	20	a	50	a
"	8 - 10	10	15	50	150	15	a	30	a
"	10 - 18	5	10	30	150	15	a	100	a
"	18 - 28	60	40	50	150	20	a	200	a
"	28 - 38	80	80	100	150	30	a	300	a
"	6 - 38	60	60	100	150	30	a	300	a
4001	8 - 10	5	10	50	100	20	a	300	a
4002	8 - 10	60	40	100	100	10	a	200	a
4003	10 - 12	60	20	70	100	15	a	200	a
4004	8 - 10	100	150	100	100	15	a	200	a
4005	8 - 10	200	150	70	100	10	a	100	a
"	10 - 12	200	100	100	100	10	a	50	a
"	12 - 20	150	100	100	150	10	a	50	a
"	20 - 26	60	30	70	150	15	a	100	a
"	26 - 36	80	30	50	200	10	a	200	a
"	36 - 46	80	60	50	200	15	a	200	a
"	46 - 56	60	40	100	200	15	a	300	a
"	8 - 56	80	60	100	150	15	a	200	a
4006	10 - 12	80	40	100	100	10	a	100	a
4007	8 - 10	80	30	100	150	20	a	70	a
4008	8 - 10	30	10	70	150	15	a	20	a
4009	12 - 14	20	10	70	100	10	a	30	a
4010	14 - 16	5	5-	70	200	30	a	30	a
"	16 - 18	5	5	70	150	30	a	50	a
"	18 - 28	5-	5-	50	200	20	a	20	a
"	28 - 38	30	15	50	300	30	a	50	a
"	38 - 48	30	15	30	200	30	a	50	a
"	BOH	40	15	20	100	20	a	20	a
"	14 - 28	15	10	50	200	50	a	50	a
4011	10 - 12	10	10	100	200	15	a	20	a
4012	10 - 12	10	10	100	150	10	a	20	a
"	12 - 16	5	5	150	150	20	a	20	a
4013	14 - 16	10	10	200	200	50	a	20	a
4014	Not assayed.								
4015	8 - 10	5	15	200	200	30	a	10	a
"	10 - 12	10	15	150	300	50	a	50	a
"	12 - 22	5	5-	100	300	70	a	20	a
"	22 - 30	5	5-	70	500	70	a	30	a
"	30 - 38	10	10	70	300	70	a	20	a
"	38 - 46	30	15	200	300	70	a	30	a
"	10 - 46	20	10	150	300	70	a	20	a
"	BOH	30	15	70	100	30	a	20	a
4016	8 - 10	30	40	500	200	70	a	50	a
4017	10 - 12	30	40	1000	200	70	a	20	a
4018	10 - 12	20	30	1500	300	10	a	70	a

Hole No.	Depth (Feet)	(Parts per million)							
		Ni.	Co.	Cu.	V.	Mo.	Sn.	Pb.	Be.
4019	12 - 16	30	40	1500	300	30	a	10	a
"	16 --20	15	80	1000	200	5	a	50	a
"	20 - 22	5	60	1000	200	a	a	30	a
"	22 - 24	20	40	1000	300	10	a	50	a
"	BOH 24	40	10	300	150	2	a	100	a
4020	8 - 10	10	20	700	10	5	a	30	a
"	10 - 14	30	80	1500	70	15	a	50	a
"	14 - 18	10	100	1500	150	5	a	150	a
"	18 - 28	10	30	1000	150	10	a	50	a
"	28 - 36	15	30	1000	150	15	a	50	a
"	36 - 46	20	20	1500	150	30	a	30	a
"	46 - 52	40	60	5000+	200	30	a	30	a
"	52 - 60	100	100	5000+	200	50	a	30	a
"	BOH 60	150	150	5000+	200	30	a	70	a
4021	12 -14	40	80	1500	200	20	a	100	a
4022	14 - 16	30	20	5000+	200	5	a	50	a
"	BOH	30	80	5000+	200	20	a	70	a
4023	14 - 16	60	40	5000+	300	20	a	30	a
4024	10 - 12	10	40	5000+	300	20	a	30	a
4025	6 - 8	20	60	1500	500	50	a	50	a
"	8 - 12	80	150	5000	300	50	a	150	a
"	12 - 20	300	150	5000+	300	30	a	50	A
"	20 - 30	300	150	5000+	300	50	a	50	a
"	30 - 42	500	200	5000+	500	50	a	50	a
"	42 - 54	300	150	5000+	300	70	a	50	a
"	54 - 64	300	150	5000+	200	70	a	70	a
"	BOH	200	100	5000+	200	30	a	70	a
4026	6 - 8	60	60	1500	500	30	a	50	a
4027	4 - 6	30	40	1500	300	15	a	50	a
4028	6 - 8	40	60	1000	300	15	a	30	a
4029	8 - 10	40	80	1500	150	15	a	30	a
4030	8 - 10	40	30	1000	200	15	a	30	a
"	10 - 12	30	40	1000	200	15	a	20	a
"	12 - 14	40	30	1500	200	20	a	30	a
"	14 - 24	40	30	5000	300	30	a	20	a
"	24 - 32	60	40	5000+	300	50	a	20	a
"	32 - 42	60	40	5000+	300	70	a	30	a
"	42 - 52	60	40	5000+	300	70	a	20	a
"	10 - 52	40	30	5000+	200	50	a	20	a
"	BOH	100	80	5000+	200	30	a	50	a
4031(1)	8 - 10	30	60	1000	500	30	a	10	a
" (2)	8 - 10	30	60	1500	500	20	a	30	a
4032(1)	6 - 8	80	40	1500	300	20	a	10	a
" (2)	6 - 8	60	40	1500	300	30	a	20	a
4033(1)	4 - 6	100	60	1000	200	20	a	10	a
4033(2)	4 - 6	200	150	1500	200	50	a	10	a
4034 (1)	6 - 8	100	80	1000	300	30	a	20	a
" (2)	6 - 8	70	60	1000	500	50	a	30	a
4035	6 - 8	150	150	1500	300	70	a	30	a
"	8 - 10	100	100	1000	200	70	a	20	a
"	10 - 20	80	80	700	200	70	a	20	a
"	20 - 30	80	60	500	200	30	a	20	a
"	30 - 40	200	100	1000	200	30	a	30	a
"	40 - 52	200	150	1500	150	20	a	20	a
"	6 - 52	200	150	1000	200	30	a	20	a
4036	8 - 10	40	20	500	200	20	a	20	a
4037	8 - 10	60	60	1500	300	70	a	50	a

(Parts per million)

Hole No.	Depth (Feet)	Ni.	Co.	Cu.	V.	Mo.	Sn.	Pb.	Be.
4038	8 - 10	60	40	3000	300	50	a	50	a
"	BOH	150	80	2000	200	30	a	70	a
4039	6 - 8	40	40	1000	300	15	a	20	a
"	8 - 10	200	80	3000	300	10	a	30	a
4040	10 - 14	150	80	2000	500	30	a	50	a
"	14 - 18	200	100	5000+	300	30	a	50	a
"	18 - 2	300	150	5000	200	15	a	50	a
4041	4 - 6	300	80	3000	500	15	a	20	a
"	6 - 8	200	100	3000	500	15	a	30	a
"	16 - 26	200	60	5000	500	10	a	20	a
"	26 - 36	300	80	5000	500	15	a	70	a
"	36 - 46	500	200	5000	200	5	a	70	a
"	46 - 56	500	300	5000+	300	7	a	100	a
"	56 - 62	300	300	5000+	200	5	a	50	a
"	62 - 74	300	300	5000+	200	7	a	50	a
"	4 - 74	300	200	5000	200	7	a	50	a
"	BOH	300	500	5000	300	15	a	50	a
4042	8 - 10	150	60	5000	300	15	a	30	a
4043	6 - 8	150	80	3000	300	15	a	30	a
4044	4 - 6	150	150	3000	300	20	a	50	a
4045	4 - 6	500	150	5000	300	30	a	100	a
"	6 - 8	300	100	3000	200	15	a	50	a
"	8 - 12	500	150	5000	150	10	a	30	a
"	12 - 16	500	200	5000	150	10	a	30	a
"	4 - 16	300	200	5000	150	15	a	50	a
"	BOH- 16	500	700	5000+	100	20	a	30	a
4046	6 - 8	200	100	2000	150	15	a	30	a
"	8 - 12	300	100	2000	150	10	a	100	a
"	12 - 14	300	150	5000	100	5	a	20	a
"	BOH	300	500	5000	70	10	a	70	a
4047 - 4049 . Not drilled.									
4050	10 - 20	300	150	3000	300	10	a	100	a
"	20 - 26	300	200	5000	300	15	a	100	a
"	10 - 26	300	200	5000	300	15	a	100	a
"	BOH	500	300	3000	150	15	a	70	a
4051	6 - 8	300	500	5000	300	15	a	100	a
4052	6 - 8	300	300	2000	200	10	a	50	a
4053	6 - 8	700	150	5000+	200	15	a	50	a
4054	8 - 10	300	700	5000	200	10	a	100	a
4055	8 - 10	300	500	2000	200	5	a	100	a
"	10 - 20	300	500	5000	300	10	a	100	a
"	20 - 30	500	1000	5000+	200	7	a	100	a
"	30 - 40	500	1000	5000+	200	10	a	100	a
"	8 - 42	300	700	5000+	200	5	a	150	a
"	BOH 42	300	1000	5000+	150	10	a	70	a
4056	6 - 8	500	500	5000	200	5	a	70	a
4057	6 - 8	300	300	5000+	300	10	a	50	a
4058	6 - 8	200	300	3000+	100	5	a	50	a
4059	6 - 8	300	700	3000+	100	5	a	50	a
4060	8 - 10	300	1000	5000+	150	5	a	70	a
"	10 - 12	200	1000	5000+	100	5	a	50	a
"	12 - 22	300	1500	5000+	100	5	a	50	a
"	22 - 30	300	700	5000+	100	5	a	50	a
"	30 - 38	300	700	5000+	100	5	a	70	a
"	8 - 38	500	1000	5000+	150	5	a	50	a
"	BOH	300	2000	5000+	100	5	a	50	a

(Parts per million)

Hole No.	Depth (Feet)	Ni	Co	Cu	V	Mo	Sn	Pb	Be
4061	Not drilled								
4062	6 - 8	100	700	5000	100	5	a	50	a
4063	8 - 10	150	700	5000	150	5	a	100	a
4064	4 - 8	100	200	1500	100	5	a	50	a
"	8 - 10	150	1000	5000+	150	7	a	100	a
4065	8 - 10	200	2000+	5000+	200	7	a	50	a
"	10 - 14	200	2000	5000+	200	7	a	50	a
"	8 - 14	200	2000	5000+	200	7	a	70	a
"	BOH	150	1500	5000+	150	5	a	50	a
4066	4 - 8	300	2000+	5000+	200	10	a	50	a
4067	4 - 6	60	500	1500	150	10	a	50	a
4068	4 - 6	150	700	2000	150	7	a	30	a
4069	8 - 10	500	700	5000+	150	7	a	30	a
4070	4 - 10	150	200	1000	70	10	a	70	a
"	10 - 12	150	300	1500	50	5	a	50	a
"	12 - 16	150	300	2000	70	7	a	50	a
"	4 - 16	150	300	1500	70	7	a	50	a
4071	4 - 6	300	700	5000+	150	10	a	30	a
4072	6 - 8	300	300	3000	100	10	a	20	a
"	8 - 10	300	700	5000+	200	15	a	50	10
4073	4 - 6	100	200	2000	100	10	a	30	a
4074	4 - 8	150	200	5000	150	10	a	70	a
4076	4 - 6	80	100	700	70	5	a	30	a
4077	12 - 14	200	100	1500	50	5	a	30	a
4078	8 - 10	150	100	500	30	5	a	30	a
4079	8 - 10	60	30	200	50	5	a	30	a
4080	8 - 10	100	20	300	30	a	a	20	a
"	1[illegible] - 18	200	80	500	50	5	a	20	a
"	18	200	100	700	50	5	a	10	a
4081	6 - 8	200	100	500	70	5	a	10	a
4082	Not assayed.								
4083	14 - 16	300	60	2000	300	5	a	20	a
"	16 - 18	300	60	3000	150	3	a	20	a
"	6 - 8	150	40	2000	150	2	a	10	a
4084	6 - 8	10	15	300	30	a	10	50	a
"	8 - 10	15	30	700	30	5	10	50	a
"	10 - 12	60	60	1500	150	10	a	50	a
"	12 - 22	150	60	2000	200	50	a	100	a
"	22 - 32	80	40	5000	300	50	a	100	a
"	BOH 32	100	100	5000+	200	70	a	70	a
"	12 - 32	60	30	2000	100	30	a	30	a
4085	6 - 8	5-	15	30	70	15	a	70	a
"	14 - 22	15	20	50	100	15	a	100	a
"	6 - 14	5-	5-	30	70	10	a	70	a
4086	10 - 20	300	1000	5000+	20	3	a	70	a
"	20 - 30	500	1000	5000+	50	5	a	20	a
"	30 - 40	1000	2000	5000+	100	7	300	30	a
"	40 - 48	500	1000	5000+	50	2	150	20	a
"	48 - 54	1000	1000	5000+	70	5	200	30	a
"	BOH 54	1000	1500	5000+	70	5	700	30	a
"	10 - 54	500	1000	5000+	50	5	a	50	a
4087	4 - 8	500	2000+	6000+	70	7	a	30	a
"	8 - 12	500	2000+	5000+	70	7	a	50	a
"	BOH 12	500	2000+	5000+	50	5	a	20	a
"	4 - 12	500	2000+	5000+	50	5	a	50	a

(Parts per million)

Hole No.	Depth (Feet)	Ni	Co	Cu	V	Mo	Sn	Pb	Be
4088	10 - 14	40	100	3000	300	10	a	20	a
"	14 - 24	40	60	5000+	200	70	a	300	a
"	24 - 32	30	30	5000	100	50	a	150	a
"	32 - 40	100	100	2000	200	20	a	100	a
"	40 - 48	200	200	3000	200	15	a	70	a
"	BOH 48	300	700	5000	200	10	a	100	a
"	10 - 48	30	100	3000	150	30	a	50	a
4089	12 - 16	30	80	700	200	a	a	100	a
"	16 - 26	30	60	700	200	5	a	70	a
"	26 - 34	20	60	1000	200	10	a	100	a
"	34 - 42	40	80	5000	200	20	a	100	a
"	BOH 42	300	1000	5000	200	10	a	100	a
"	18 - 42	20	40	1500	200	5	a	100	a
4090	12 - 20	10	15	100	100	15	150	50	a
"	20 - 28	40	30	50	150	20	50	150	a
"	28	30	30	70	100	15	a	70	a
"	12 - 28	15	5-	10	50	10	a	70	a
4091	16 - 24	15	20	150	100	20	a	50	a
"	24 - 32	30	20	100	200	30	a	50	a
"	32 - 42	30	30	70	100	20	a	50	a
"	42 - 52	30	30	500	100	15	a	50	a
"	16 - 52	15	15	70	50	10	a	20	a
4092	8 - 14	300	60	3000	200	7	a	20	a
"	16 - 24	10	20	300	300	20	a	20	a
"	24 - 32	30	40	500	300	30	a	30	a
"	32 - 42	80	80	2000	150	70	a	50	a
"	42	300	200	5000+	200	50	a	50	a
"	16 - 42	15	30	500	100	30	a	10	a
4093	18 - 28	150	700	1500	30	5	a	50	a
"	28 - 38	300	1000	5000	50	7	a	30	a P
"	38 - 48	300	1000	5000	100	10	a	20	a P
"	BOH 48	300	700	5000	70	10	a	10	a P
"	18 - 48	200	700	5000	50	5	a	20	
4094	4 - 8	10	15	50	5	2	a	20	a
"	8 - 12	40	15	100	20	2	100	30	a
"	BOH 12	30	20	150	5	2	20	10	a

1. The analyses have been made using an optical emission spectrograph.

2. Phosphorous was sought in each sample and where present it is indicated by P.

APPENDIX 2.

X-RAY SPECTROCHEMICAL ANALYSES OF AUGER SAMPLES RUM JUNGLE COPPER MINE.

by

S.C.Goadby.

Drill Hole. (A)	Interval (feet)	Copper (%)
4000	6 - 8	0.13
"	8 - 10	0.08
"	10 - 18	0.06
"	18 - 26	0. 5
"	28 - 38	0.10
"	6 - 38	0.09
4005	8 - 10	0.08
"	10 - 12	0.08
"	12 - 20	0.10
"	20 - 26	0.07
"	26 - 36	0.08
"	36 - 46	0.08
"	46 - 56	0.10
"	8 - 56	0.09
4010	14 - 16	0.06
"	16 - 18	0.06
"	18 - 28	0.05
"	28 - 38	0.05
"	38 - 48	0.05
"	BOH	0.05
"	14 - 48	0.06
4015	8 - 10	0.10
"	10 - 12	0.09
"	12 - 22	0.06
"	22 - 30	0.06
"	30 - 38	0.07
"	38 - 46	0.08
"	46	0.08
"	10 - 46	0.08
4020	8 - 10	0.14
"	10 - 14	0.37
"	14 - 18	0.34
"	18 - 28	0.22
"	28 - 36	0.22
"	34 - 36	0.32
"	46 - 52	3.31
"	52 - 60	6.10
"	BOH	5.50
4025	6 - 8	0.44
"	8 - 12	2.68
"	12 - 20	4.61
"	20 - 30	3.41
"	30 - 42	3.39
"	42 - 54	3.98
"	54 - 64	3.17
	BOH	3.47
4030	10 - 12	0.34
"	12 - 14	0.52
"	14 - 24	2.56
"	24 - 32	2.36
"	32 - 42	1.77
"	10 - 52	2.02

Drill Hole (A)	Interval (feet)	Copper (%)
4035	6 - 8	0.34
"	8 - 10	0.23
"	10 - 20	0.10
"	20 - 30	0.18
"	30 - 40	0.27
"	40 - 52	0.37
"	6 - 52	0.31
4041	4 - 6	0.61
"	6 - 8	0.94
"	16 - 26	0.69
"	26 - 36	0.78
"	36 - 46	1.89
"	46 - 56	1.94
"	56 - 62	1.84
"	68 - 74	1.93
"	4 - 74	1.77
	74	1.52
4045	4 - 6	0.57
"	6 - 8	0.40
"	8 - 12	0.95
"	4 - 16	0.87
"	12 - 16	1.25
"	16	0.97
4050	10 - 20	0.81
"	20 - 26	0.77
"	26	0.48
"	10 - 26	0.77
4055	8 - 10	0.71
"	10 - 20	1.85
"	20 - 20	2.29
"	8.- 42	2.19
4060	8 - 10	2.45
"	10 - 12	2-43
"	12 - 22	2.76
"	22 - 30	2.44
"	38	2.14
"	8 - 38	2.63
4065	8 - 10	0.80
"	14	0.65
"	8 - 14	0.99
4070	4 - 10	0.14
"	10 - 12	0.21
"	12 - 16	0.30
"	BOH	0.30
"	4 - 16	0.22
4075	4 - 6	0.34
4080	8 - 10	0.12
"	10 - 18	0.12
"	18	0.12
4081	6 - 8	0.09
"	BOH	0.14
4082	52	1.15
4083	6 - 18	0.64
"	14 - 16	0.41
"	16 - 18	0.56
"	6 - 8	0.50

Drill Hole (A)	Interval (feet)	Copper (%)
4084	6 - 8	0.09
"	8 - 10	0.16
"	10 - 12	0.24
"	12 - 22	0.63
"	12 - 32	0.57
"	32	1.08
"	22 - 32	0.75
4085	6 - 8	0.07
"	8 - 14	0.06
"	14 - 22	0.08
4086	10 - 20	0.88
"	20 - 30	1.31
"	30 - 40	1.43
"	40 - 48	0.96
"	48 - 54	0.94
"	54	0.60
"	10 - 54	1.26
4087	4 - 8	3.23
"	4 -12	3.39
"	8 - 12	3.53
"	12	2.79
4088	10 - 14	1.58
"	14 - 24	2.71
"	24 - 32	2.07
"	32 - 40	1.28
"	40 - 48	1.83
"	48	2.59
"	10 - 48	3.97
4089	12 - 16	0.23
"	16 - 26	0.21
"	26 - 34	0.25
"	34 - 42	1.64
"	42	2.12
"	18 - 42	0.33
4090	12 - 20	0.06
"	20 - 28	0.06
"	28	0.05
"	12 - 28	0.05
4091	16 - 24	0.06
"	24 - 32	0.06
"	32 - 42	0.06
"	42 - 52	0.14
"	16 - 52	0.11
4092	8 - 14	0.65
"	16 - 24	0.15
"	24 - 32	0.13
"	32 - 42	0.43
"	42	1.07
"	16 - 42	0.26
4093	18 - 28	0.22
"	28 - 38	0.38
"	38 - 48	0.72
"	48	0.48
"	18 - 48	0.59
4094	4 - 8	0.05
"	8 - 12	0.05
"	12	0.05
"	4 - 12	0.05

The analyses have been made using an X-Ray fluorescence spectrograph.

Plate 1

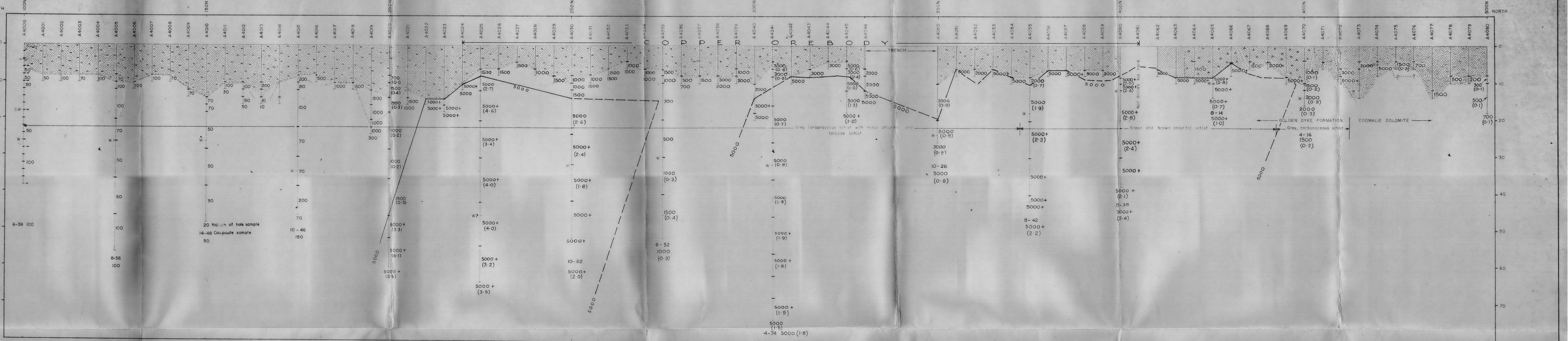
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RUM JUNGLE GEOCHEMICAL SURVEY 1963

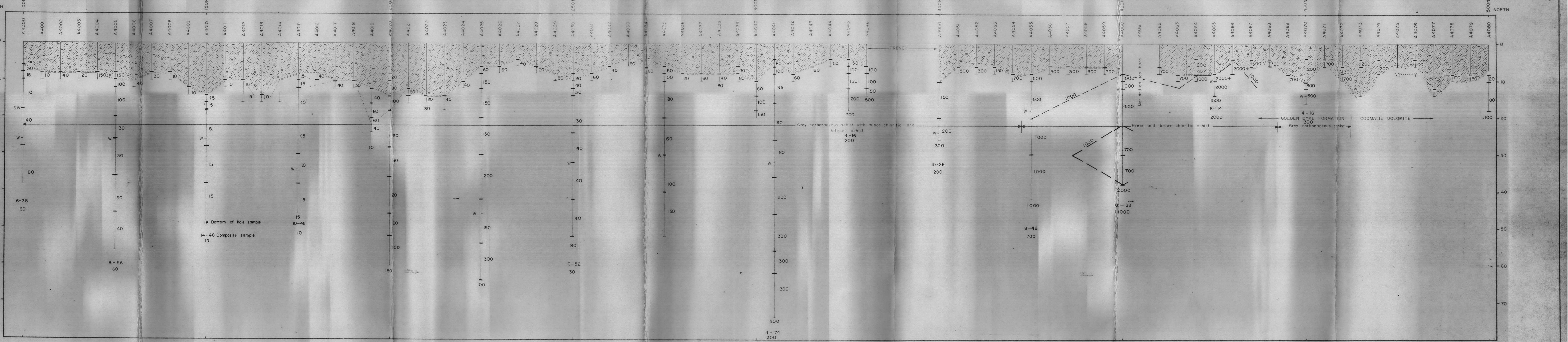
RUM JUNGLE COPPER MINE

SECTION 6190W (looking west)

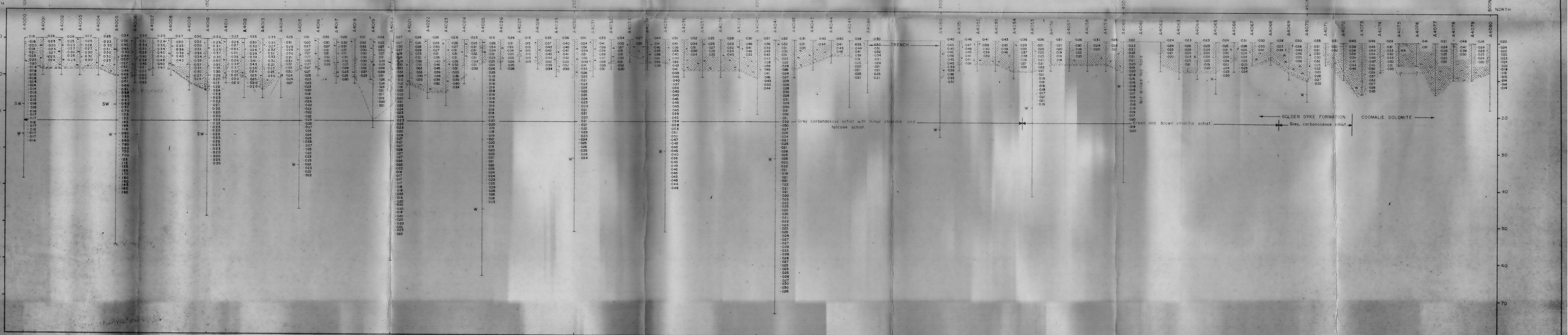
DISTRIBUTION OF COPPER IN WEATHERED ROCK



DISTRIBUTION OF COBALT IN WEATHERED ROCK



DISTRIBUTION OF RADIOACTIVITY IN WEATHERED ROCK



REFERENCE

10 0 10 20 30 40 50 FEET

▨ Sandy silt and clay

▨ Silty sand

▨ Sandy silt with fragments of quartz

☐ Clay grading downwards into unweathered carbonaceous, chloritic or talcose schist.

– – – – – – Lithological boundary

– · – · – Boundary between the B and C horizons of the weathering profile

………… Base of the brick red hematitic zone in the B horizon over the Coomalie Dolomite.

W First intersection of saturated material during the drilling

SW Standing water table

A4000 Auger drill hole

ASSAY DATA

1000 parts per million copper or cobalt (optical emission spectrograph assay)

(0·3) percent copper (x-ray fluorescence spectrograph assay)

·040 radiometric probe result (see plates 2&3 for relationship to mR/Hr and eU_3O_8 lbs/ton)

—5000— outline of material containing more than 0·5% copper

—1000— or more than 0·1% cobalt.

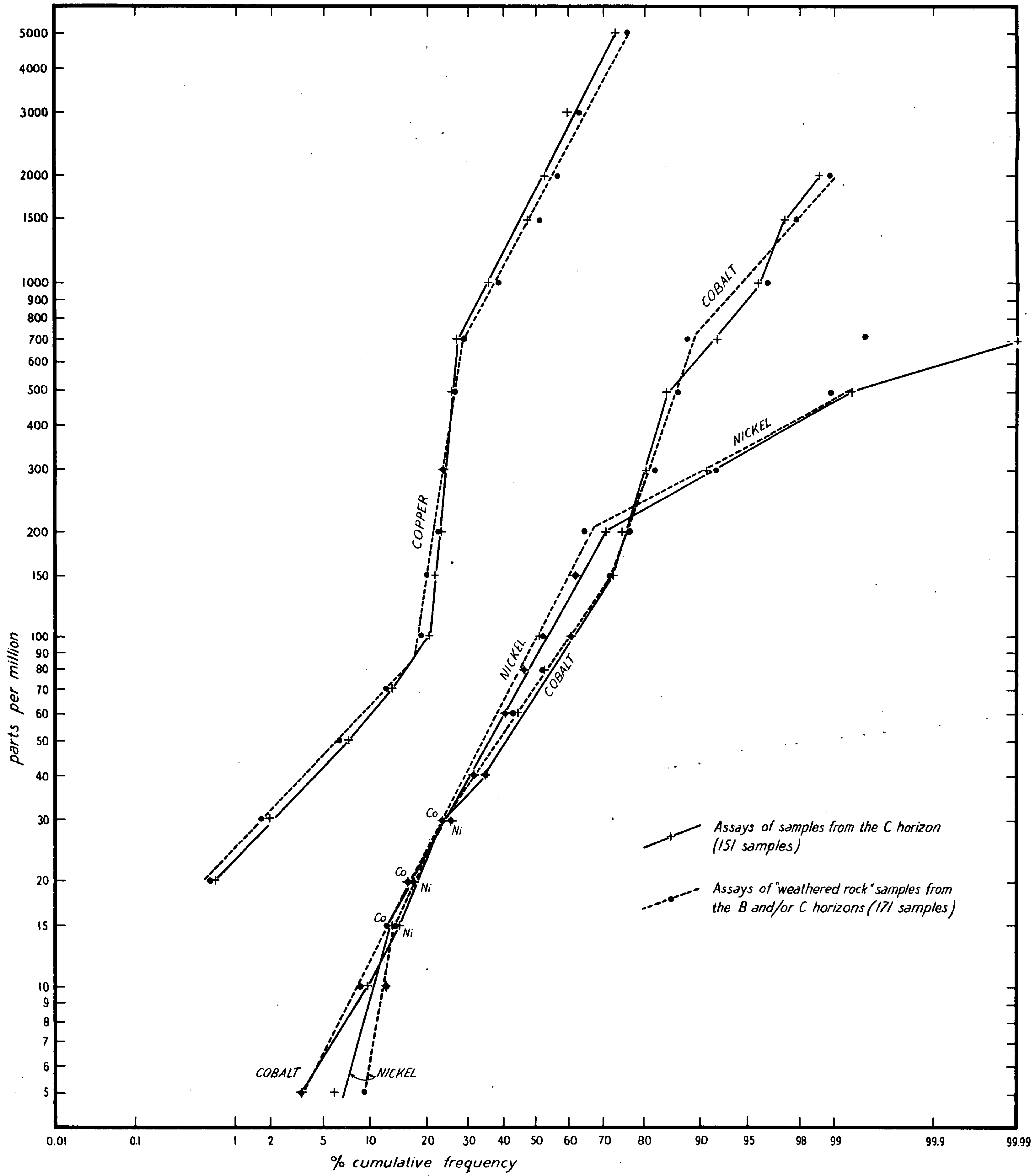
Bureau of Mineral Resources, Geology & Geophysics. Aug '64.

To accompany Record 1964/

D52/A8/120

RUM JUNGLE COPPER MINE – GEOCHEMISTRY

CUMULATIVE FREQUENCY DISTRIBUTION DIAGRAM – SECTION 6190W



Bureau of Mineral Resources, Geology and Geophysics, September 1964

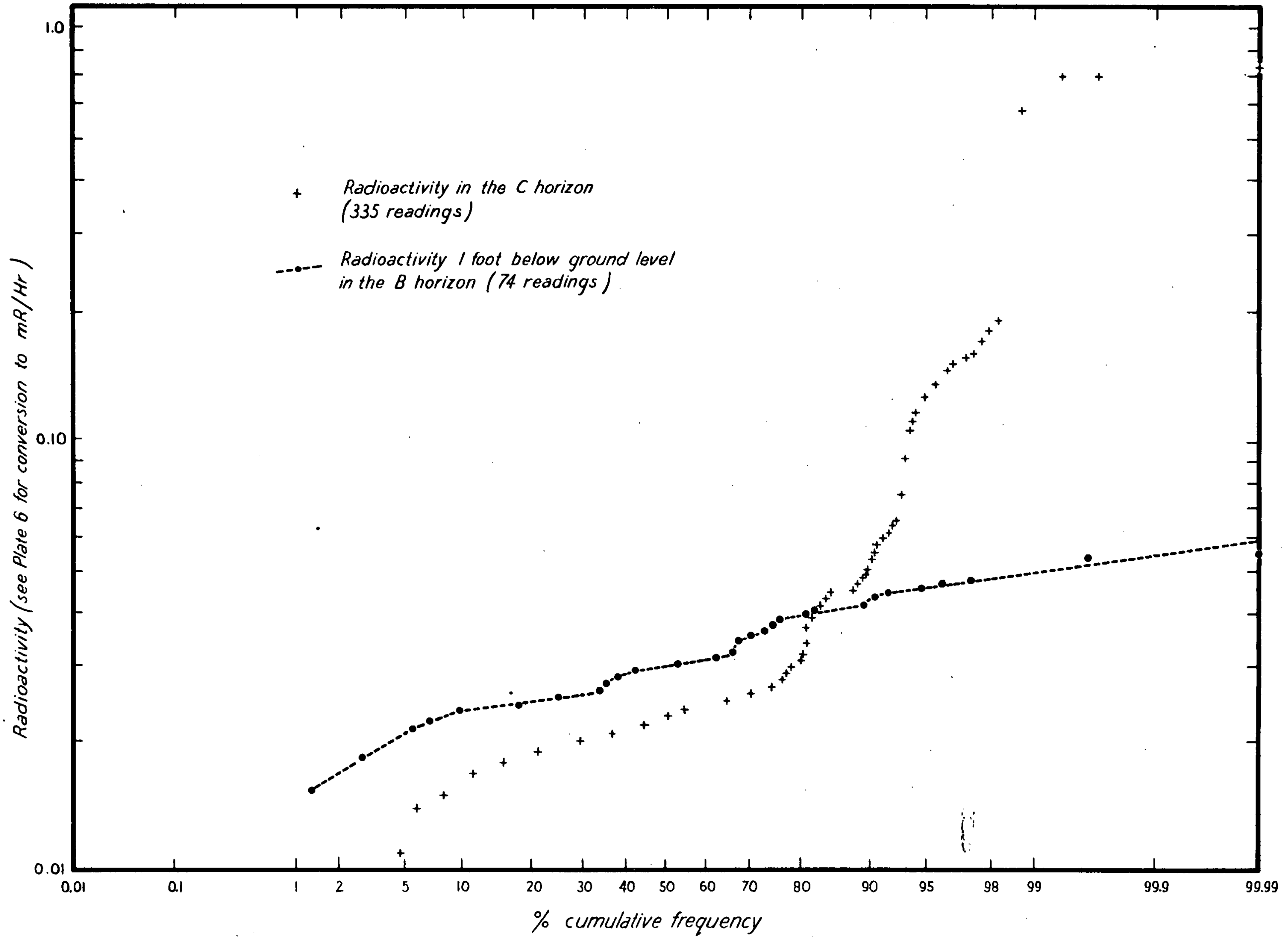
To accompany Record 1964/125

D52/A8/125

Rum Jungle Survey 1963 Plate 3

RUM JUNGLE COPPER MINE-RADIOACTIVITY

CUMULATIVE FREQUENCY DISTRIBUTION DIAGRAM - SECTION 6190W



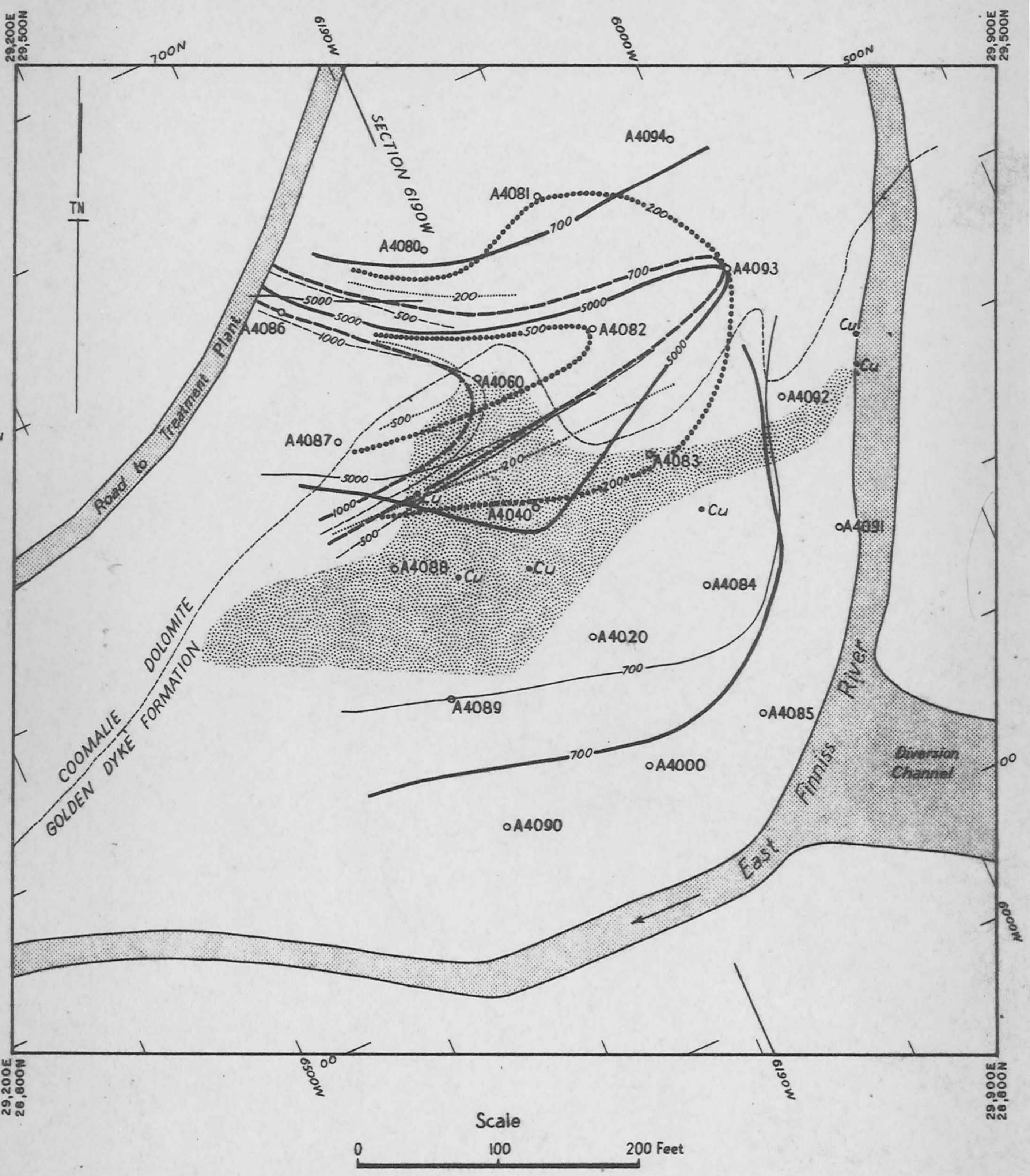
Bureau of Mineral Resources, Geology and Geophysics, September 1964

To accompany Report 1964/125

D52/A8/126

RUM JUNGLE COPPER MINE

GEOCHEMICAL ANOMALIES



ISOCHEMICAL LINES
values in parts per million

- —700— *Copper - based on bulk samples of weathered rock*
- —5000— *Copper - based on samples from the top of C horizon*
- —700— *Cobalt - based on bulk samples of weathered rock*
- —500— *Cobalt - based on samples from the top of C horizon*
- ●●●200●●● *Nickel - based on bulk samples of weathered rock*
- ......500...... *Nickel - based on samples from the top of C horizon*
- *Geological boundary showing dip (After Spratt, personal communication)*
- •Cu *Copper mineralization at the surface*
- ▨ *Copper orebody (After Spratt, personal communication)*
- ○A4093 *Auger drill hole*

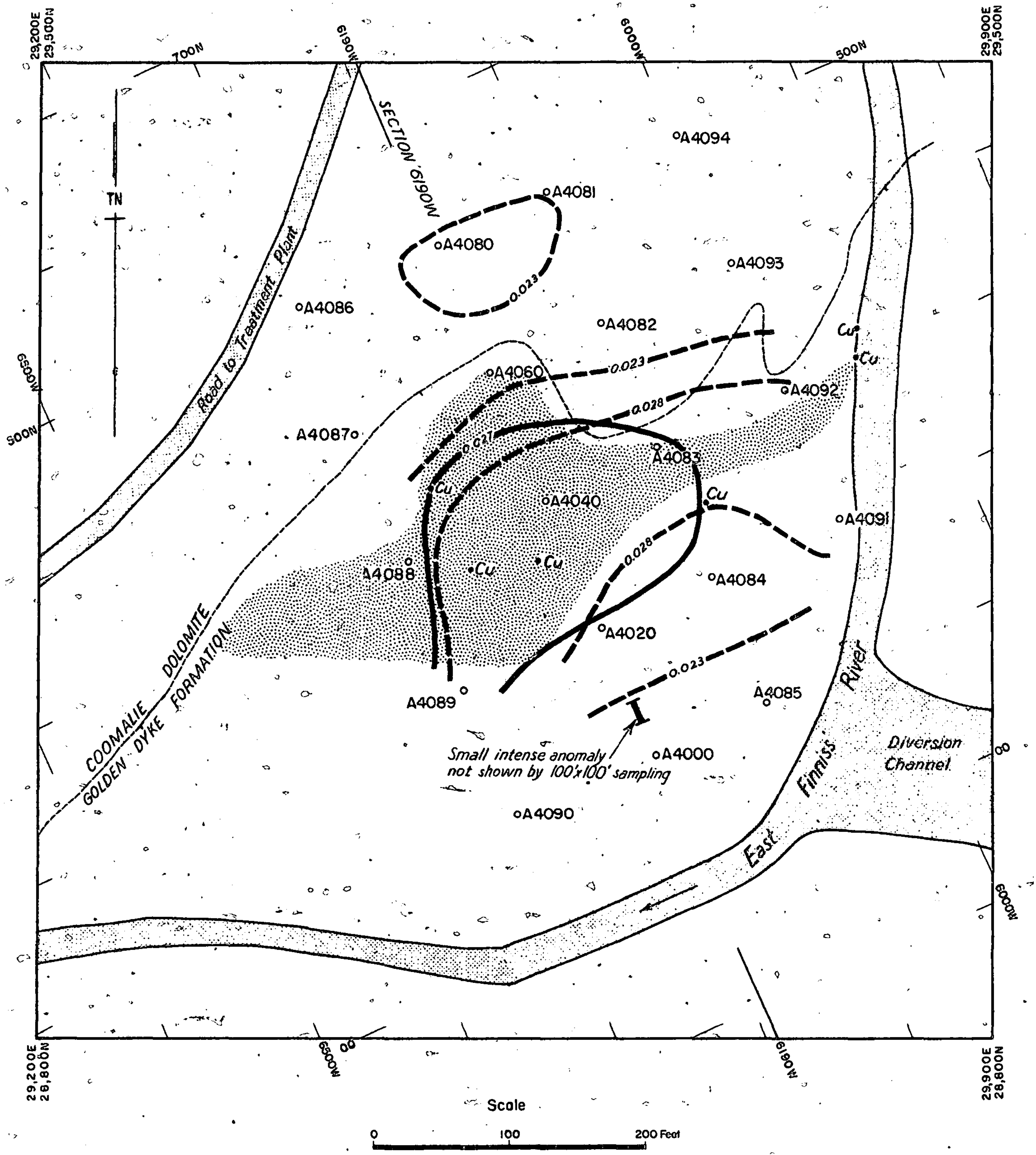
Major grid :- Mine grid

Minor grid :- Geophysicists' grid

To accompany Record 1964/125

RUM JUNGLE COPPER MINE

RADIOACTIVITY



▬ ▬ ▬	*Isorad from probe readings one foot below ground surface*
▬▬▬	*Isorad from probe readings at the top of the C horizon*
- - -	*Geological boundary showing dip (After Spratt, personal communication)*
• Cu	*Copper mineralization at the surface*
▨	*Copper orebody (After Spratt, personal communication)*
○A4090	*Auger drill hole*

Major grid:-Mine grid
Minor grid:-Geophysicists' grid

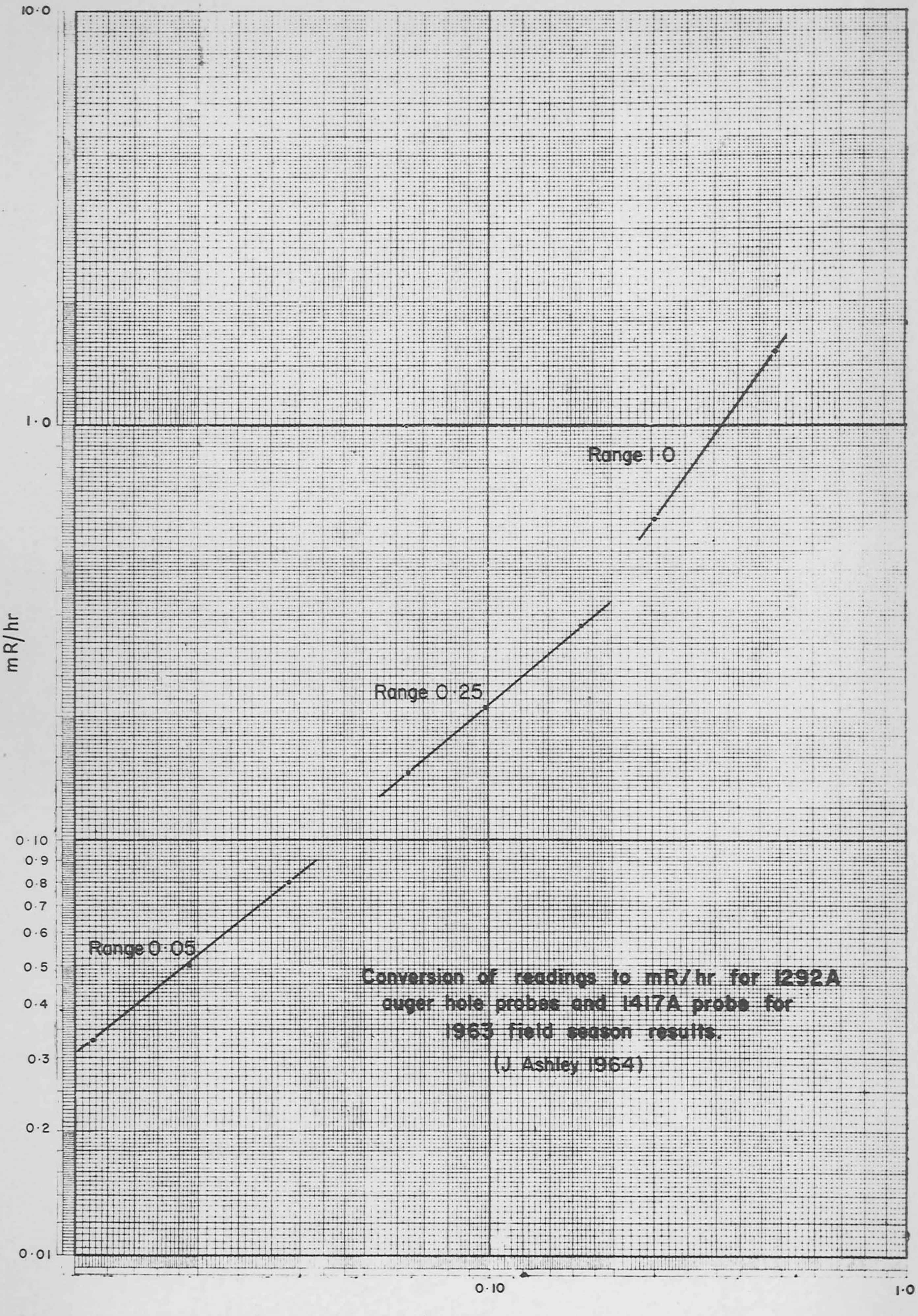
To accompany Record 1964/125

Bureau of Mineral Resources, Geology and Geophysics, September 1964

D52/A8/128

Rum Jungle Survey 1963

Plate 6



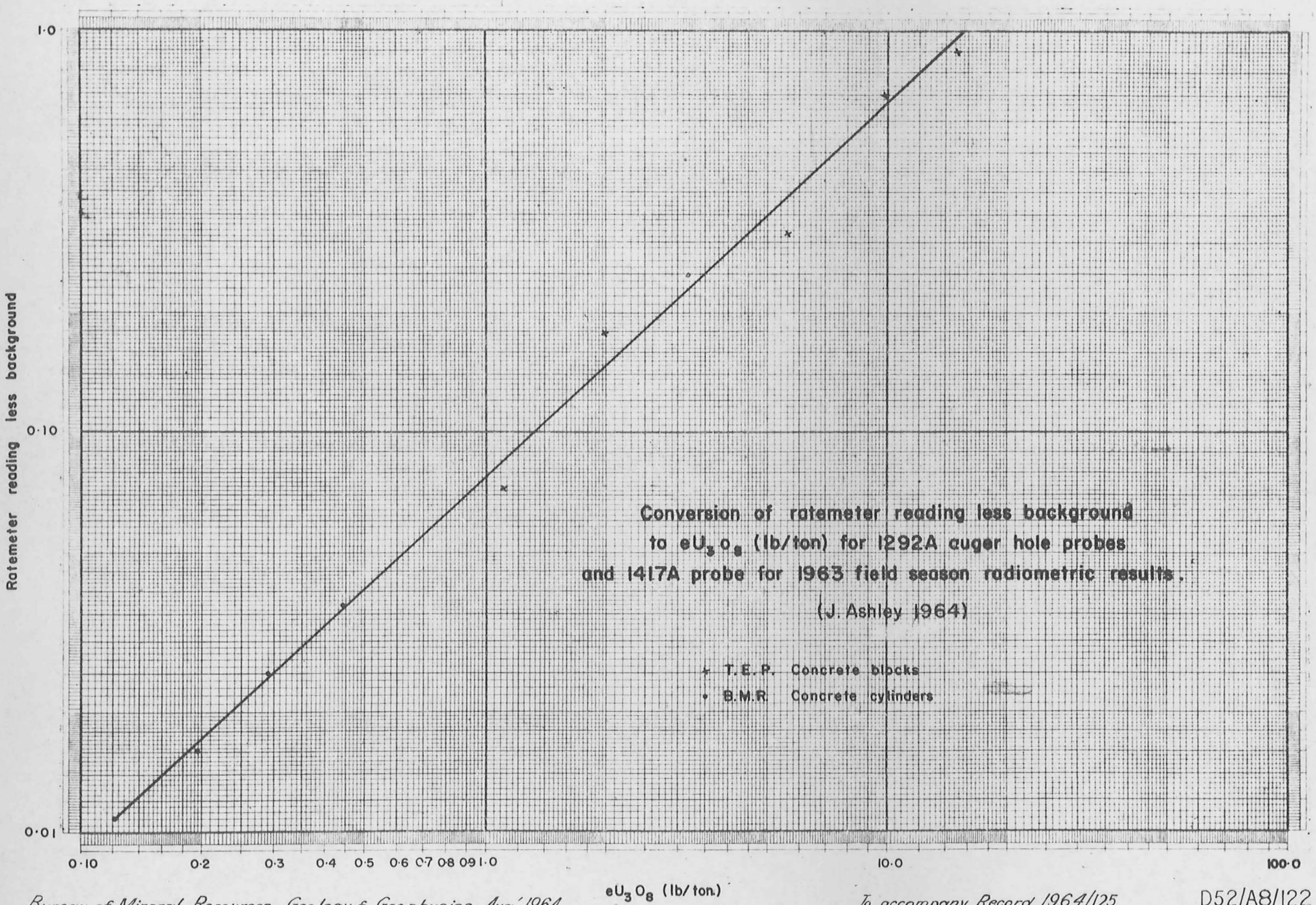
Conversion of readings to mR/hr for 1292A auger hole probes and 1417A probe for 1963 field season results.

(J. Ashley 1964)

Bureau of Mineral Resources, Geology & Geophysics. Aug '64 *To accompany Record 1964/125* D52/A8/121

Rum Jungle Survey 1963

Plate 7



Conversion of ratemeter reading less background to eU_3O_8 (lb/ton) for 1292A auger hole probes and 1417A probe for 1963 field season radiometric results.

(J. Ashley 1964)

Bureau of Mineral Resources, Geology & Geophysics. Aug' 1964

To accompany Record 1964/125

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