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Geochemical Study on Part of the Manton Grid, Rum Jungle Area, Northern Territory

by

A. Annamalai

GEOCHEMICAL STUDY ON PART OF THE MANTON GRID, RUM JUNGLE AREA, NORTHERN TERRITORY

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Records 1969/18

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CONTENTS

SUMMARY

This report describes a geochemical study made on soil samples collected along the Manton grid in the Northern Territory. Analytical results of 295 soil samples were used for the purpose and the following observations were made:

1. The ratios of the element concentrations, such as Ni:Co, in the same sample help to delineate the probable geological boundaries between underlying concealed formations. They also provide a clue to the nature of these rock formations.

2. Correlation of the metal values of sub-surface samples with those of the corresponding near surface samples shows that the dispersion pattern of elements in the vertical soil profile is controlled by the nature of the underlying parent rock.

INTRODUCTION

The programme was designed to provide the writer with experience in the trace element analysis of geochemical samples using Atomic Absorption and emission spectrographic methods. For this purpose, systematic samples from a known area were preferred to random samples from unknown areas, in order to provide an opportunity for studying the dispersion pattern of the trace elements analysed in the samples. The study programme extended over a period of eight months from June 1968 to January 1969; two months of this were used for collecting the samples by the writer, working with the field parties of the Bureau of Mineral Resources in the Northern Territory. This report is an account of the observations made by the writer on the samples analysed for the study.

The study was sponsored by the United Nations Development Programme.

DESCRIPTION OF AREA

The area is located about four miles west of the Stuart Highway 40 miles south of Darwin in the Northern Territory. The area lies west of the Giant's Reef Fault and 2 miles west of Manton Dam (Fig. 1). Selection of the area for prospecting was guided by the fact that most of the mineral deposits around Rum Jungle are confined to the Lower Proterozoic Golden Dyke Formation. The geology of the area has been described in previous reports by various geologists. According to R.G. Dodson and D.O. Shatwell (1965) the area is underlain by a series of metamorphosed sediments of Lower Proterozoic age, resting unconformably on the Rum Jungle Granite Complex. Within the area of study, Coomalie Dolomite in the south is overlain by the younger Golden Dyke Formation to the north. Acacia Gap Tongue Quartzite, which forms the northern

boundary of the area, overlies the Golden Dyke Formation. The Quartzite, because of its resistance to weathering relative to the other formations, stands up as a low ridge. Examination of the auger cuttings revealed the existence of a narrow zone of amphibole-and mica-rich basic rocks just at the foot of the Quartzite ridge. The area is covered by a thick layer of soil with a mature profile, developed from the underlying rock formations. It is largely covered by forest. No outcrops, except a few thin quartz veins, were seen within the area under examination.

TECHNIQUES USED

(a) Field Techniques:

Samples were collected at 200-foot intervals along traverses 1200 feet apart. The traverse lines run north-south, roughly at right angles to the general trend of the formations. The present study covers samples from six traverse lines between 136W and 76W, which form the western and eastern limits of the area respectively. A power-operated auger drill was used for sampling. The top soil samples were collected at 12 to 18 inches below ground level. Visible exotic materials like quartz pieces of 1/3 inch and above in size, and plant roots, were removed by hand before packing the samples. The deep soil samples were taken at depths which varied from 17 to 29 feet below ground level. It is the writer's interpretation that none of the drill holes penetrated the 'C' soil horizon, and that the deep soil samples were obtained from the 'B' horizon of the soil profile. Precautions were taken to avoid contamination of the samples, and wet samples were allowed to dry completely in the kraft paper sample bags before tranporting them to the laboratory. The auger cuttings from the bottom of the holes were also visually examined in the field to get all possible information regarding the underlying rock formations.

(b) Laboratory Techniques:

In the laboratory the samples were analysed as follows:

(i) Top soil and deep soil samples along traverse line 112W to 76W:
The full samples were ground to pass through an 80-mesh metal-free sieve. Grinding was done in a Siebtechnic chrome steel mill. The mill was washed with metal-free water between every sample.

(ii) Top soil samples along traverse line 124W:
The samples were sieved with a metal-free 80-mesh sieve. Two grams of the under-size were taken for analysis. The rest of the under-size fraction was mixed with the ground product (-80 mesh) of the coarse fraction (+80 mesh) of the original sample and the mixture was homogenized in a SPEC5000 mill.

(iii) Three pairs of samples along traverse line 136W were analysed mineralogically by Mr J. Mitchell of the B.M.R., and the mineral content of the top soil samples was compared with that of the corresponding deep soil samples to establish the relationship between the samples from each hole. At two of the localities, heavy mineral assemblages from the surface and deep soil samples were similar, but at the third locality no heavy mineral fraction was recovered from the deep soil sample, suggesting that the surface soil at this point may have been transported.

(iv) In addition to the samples from the Manton grid, 29 samples were collected from a known zone of base metal anomalies in the Acacia area of the Rum Jungle district. The object was to study the dispersion pattern in the vertical soil profile in a mineralized area. Samples for every 3 feet below ground level were collected. Only the -80 mesh fractions of these samples were analysed for 17 elements by direct reading optical spectrograph and for a few elements by the Atomic Absorption technique. No consistent distribution patterns were found, however, and the results of these analyses are not discussed in detail in this report.

Extraction of the metal into solution for Atomic Absorption techniques was done by hot concentrated hydrochloric acid. For emission spectrographic work the sample was mixed with 'specpure' graphite in 1:2 ratio. Palladium was used as the internal standard. The samples were arced in duplicate by Anode excitation under DC 8 amps and 180 volts for 130 seconds. Natural rock standards (W1, G1, Sy1, T1 and Bcs 269) were used for calibration.

DISCUSSION OF RESULTS

Previous workers in adjacent areas of the Rum Jungle district have assumed the following background values (Dodson and Shatwell, 1965):

Cu 100 ppm; Pb 30 ppm; Zn 100 ppm; Co 40 ppm; and Ni 50 ppm.

The range of background values for shale and soil as given by Hawkes and Webb (1962) are:

Shale: Cu 30-150 ppm; Pb 20 ppm; Zn 50-300 ppm; Co 10-50 ppm; Ni 30-100 ppm.

Soil: Cu 20-100 ppm; Pb 2-200 ppm; Zn 10-300 ppm; Co 1-40 ppm; Ni 5-500 ppm.

Comparing the present analytical values with the figures given above shows that, except for a few zinc values, the concentrations do not rise significantly above the background. Hence no attempt is made to assess the possible economic significance of the results within the small area studied. However, the values above 50 ppm, when plotted in their correct position along each traverse line, give a clear picture of the underlying rock types (see Figures 3a-d). The peaks exhibited by zinc, copper, cobalt and nickel, and less prominant peaks of lead, are grouped in three zones which correspond to the occurrence of three major rock types in the area, namely Coomalie Dolomite in the south, Golden Dyke Formation in the centre and the basic rocks in the north.

Plotting the ratios: deep soil values to top soil values along the various traverse lines also indicates a clear relationship to the nature of the underlying bed rock (Figures 4a-d). The graphs so obtained have three distinct groups of peaks on every line, corresponding to the approximate position of the rock types inferred from the auger cuttings and from the concentrations of the individual elements along the same traverse lines. The contacts between rock types are clearly indicated by the sharp dips in the graphs. The peaks indicate a high value for the deep soil samples relative to the top soil samples. This may be due to dilution or leaching of the top soil, or to enrichment at the zone from which the deep soil samples were collected. The former could be due to the deposition of detritus from the quartzite ridge in topographic depressions along the traverse lines, or to incipient leaching at these points due to processes like lateritization. However, field observations provide no support for either of these suggestions, although the examination of heavy mineral fractions, referred to above, suggests that surface soil in parts of the area may have been transported. The probability of enrichment of the metals at the level from which the deep soil samples were collected is thought to be low, as the five elements possess different mobility, but the graphs for the different elements along each traverse line are sympathetic. R.E. Gilbert (1951) concluded from his geochemical work in Park City district that in areas of abundant and long persistant vegetation, samples of top soil will yield results as satisfactory as those from samples taken at a depth of several feet. However, R.B. Fulton (1950) demonstrated that variation in metal content of soil from sample hole to sample hole were less erratic at depths greater than 2 feet. In the Manton area, the present investigation suggests that slightly more reliable results can be expected from deep samples, but the available evidence is not sufficient to determine the process responsible for the differences between surface and deep soil samples.

It is clear, however, since the graphs obtained by plotting the ratios of metal values in the deep soil samples to those in the top soil samples along any one traverse are not straight lines, that the underlying formations have had a different influence on the dispersion patterns of the elements, which may originally have been present either in uniform concentrations or in different concentrations within each rock type.

The histograms obtained by plotting the ratio of whole sample value to -80 mesh fraction for the various elements are shown in Figure 5 for the top soil samples along traverse line 124W. The peak for copper and lead occurs at 200, thereby showing that higher values may generally be expected for the whole sample analysis than for the -80 mesh fraction. The peaks for Zn, Co and Ni are around 100, with a skewing towards the right. This shows that the analytical values for these metals will be similar for the -80 mesh fractions and for the full samples, with a slight probability that the full samples will show somewhat higher values than the fine fractions. The whole sample will therefore give a better picture of the metal content. Taking only the -80 mesh fraction of the sample will eliminate the work of grinding the sample to pass through 80 mesh, but the values will be somewhat lower than those for the full samples.

ACKNOWLEDGEMENTS

The writer thanks the officers of the Bureau of Mineral Resources, and the Commonwealth Scientific and Industrial Research Organization at Canberra for valuable technical help and the United Nations Development Programme for the financial assistance provided.

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TABLE 1 : Crustal Abundance of Cobalt, Nickel, Selenium and Vanadium from Turekian and Wedepohl (1961)

Igneous Rocks	Co ppm	Ni ppm	Se ppm	V ppm
Ultrabasic	150	2000	0.05	40
Basaltic	48	130	0.05	250
Ca-rich granites	7	15	0.05	88
Ca-low granites	1.0	4.5	0.05	44
Sedimentary rocks				
Shales	19	68	0.60	130
Sandstones	0.3	2.0	0.05	20
Carbonates	0.1	20.0	0.08	20
Deep-sea sediments				
Carbonates	7.0	30	0.17	20
Clay	74.0	335	0.17	120

APPENDIX 1. ANALYTICAL RESULTS FOR TOP SOIL SAMPLES AND DEEP SOIL SAMPLES, MANTON AREA

Co-ordinates		Cu (ppm)			Pb (ppm)			Zn (ppm)			Co (ppm)			Ni (ppm)		
(1)		(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)
112W	202N	5	2	50	10	5	50	2	1	50	4	2	50	5	2	40
	204N	7	5	66	15	5	33	3	1	33	9	2	22	7	2	28
	206N	15	5	30	20	10	50	6	2	30	17	2	12	17	2	12
	208N	20	10	50	20	52	260	6	5	76	20	12	60	17	7	41
	210N	19	10	52	25	35	140	6	5	91	17	9	51	15	10	66
	212N	15	5	33	20	10	50	6	2	30	17	4	22	10	2	20
	214N	15	7	50	15	10	66	7	3	48	15	6	41	15	2	13
	216N	15	5	33	25	10	40	18	3	15	20	6	31	20	5	25
	218N	15	2	16	25	5	20	21	1	59	25	2	8	25	2	10
	220N	36	116	322	35	67	191	35	77	220	31	47	152	32	55	172
	222N	74	92	111	25	52	208	46	105	228	25	47	188	27	50	185
	224N	39	100	256	30	30	100	25	48	192	67	17	25	35	40	114
	226N	62	95	153	25	15	70	32	54	169	84	15	18	67	50	75
	228N	31	19	61	47	15	32	26	9	33	59	4	63	45	10	22
	230N	24	7	31	35	10	28	20	19	95	52	6	12	35	27	77
	232N	19	29	152	30	15	50	17	18	106	31	4	12	30	10	33
	234N	15	10	66	20	15	75	11	4	34	20	2	10	20	2	12
	236N	15	20	133	24	15	62	12	16	133	22	2	9	20	2	12
	238N	15	30	200	20	15	75	13	22	169	22	9	40	20	7	37
	240N	15	2	16	32	5	56	12	1	8	22	2	9	20	2	10
	242N	12	2	20	39	5	-	9	1	11	12	2	17	15	2	13
	244N	9	2	28	24	5	21	6	1	16	11	2	18	10	2	20
	246N	6	5	80	15	10	66	6	2	32	6	2	33	5	2	40
	248N	5	5	100	24	20	83	8	10	115	11	6	55	10	2	25
	250N	9	12	143	20	15	75	13	15	115	15	11	73	7	2	33
	252N	6	12	200	30	10	33	11	141	1280	11	85	772	10	7	75
	254N	6	6	100	15	15	100	10	51	510	11	6	55	5	5	100
	256N	2	55	2200	10	10	100	7	64	853	2	22	1100	2	60	2400
	258N	20	30	150	32	15	47	11	147	1330	9	17	194	15	60	400
	260N	2	2	100	10	5	50	1	1	100	2	2	100	2	2	100
	262N	2	2	100	5	15	300	1	1	100	2	2	-	2	2	-
	264N	2	2	100	5	24	480	1	1	100	2	2	-	5	2	40
	266N	9			15			3			2			2		
	268N	2	2	100	5	42	840	1	2	140	2	2		2	2	

(2) Values for Top Soil Samples (whole sample ground to -80)
(3) Values for deep soil samples (whole sample ground to -80)
(4) (3)/(2) x 100

APPENDIX 1. (contd.)

Co-ordinates		Cu (ppm)			Pb (ppm)			Zn (ppm)			Co (ppm)			Ni (ppm)		
1	(1)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)
100W	202N	9	5	57	15	10	66	4	1	29	7	2	33	10	2	25
	204N	5	5	100	10	10	100	4	21	560	7	2	33	7	6	83
	206N	11	42	382	30	15	50	9	16	171	17	10	59	12	24	200
	208N	12	5	42	35	5	14	11	1	12	24	2	10	17	2	14
	210N	12	55	458	35	15	43	12	57	475	17	12	71	17	22	129
	212N	15	67	446	35	15	43	11	51	463	17	70	412	22	60	272
	214N	27	67	248	40	20	50	21	49	244	37	40	108	37	55	149
	216N	52	97	187	70	15	21	58	150	259	180	116	64	70	70	100
	218N	30	72	240	30	70	233	25	94	376	34	92	270	37	55	149
	220N	24	70	291	80	20	25	17	55	323	31	22	71	24	40	166
	222N	21	21	100	30	15	50	10	10	100	22	6	28	22	6	27
	224N	34	27	79	30	20	66	8	16	192	22	6	28	17	7	43
	226N	25	49	196	30	15	50	7	32	474	24	31	125	22	17	77
	228N	37	97	262	20	15	75	17	87	512	34	56	165	34	82	241
	230N	30	82	273	22	16	73	19	77	405	47	37	79	32	59	184
	232N	24	77	328	20	30	150	25	291	1164	40	92	230	37	182	492
	234N	20	65	325	22	22	100	17	109	641	29	30	103	29	85	293
	236N	19	59	310	22	20	91	13	270	2077	30	35	117	22	105	477
	238N	16	1	78	20	5	25	6	1	21	22	2	9	20	2	10
	240N	10	1	10	22	5	22	7	1	19	16	2	13	11	2	18
	242N	1	1	100	5	5	100	2	2	82	2	2	-	2	2	-
	244N	2	1	50	20	15	133	5	4	83	2	2	100	5	2	40
	246N	5	12	240	15	15	100	13	285	2192	10	135	1350	5	14	280
	248N	5	12	240	10	10	100	5	90	1800	10	29	290	2	2	100
	250N	2	10	400	10	10	100	3	121	4033	2	22	1100	2	2	100
	252N	5	16	320	20	37	185	4	90	2250	10	14	140	2	14	560
	254N	1	89	7120	5	22	440	2	127	5555	2	25	1000	2	75	3000
	256N	19	56	295	27	35	129	13	97	746	2	47	2350	7	54	720

APPENDIX 1. (contd.)

Co-ordinates		Cu (ppm)			Pb (ppm)			Zn (ppm)			Co (ppm)			Ni (ppm)		
(1)		(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)
88W	202N	35	9	26	5	5	-	36	13	36	87	9	10	37	9	-
	204N	15	23	153	5	5	-	18	44	244	48	16	33	20	22	110
	206N	21	5	24	5	5	-	42	28	66	58	12	20	47	15	31
	208N	15	10	66	12	5	40	16	47	293	35	24	68	27	45	166
	210N	16	47	293	47	5	10	20	72	360	33	20	60	34	56	164
	212N	12	19	158	47	5	10	12	37	308	27	16	59	27	35	129
	214N	18	8	44	40	5	10	14	38	271	31	19	61	35	35	100
	216N	15	8	53	32	5	15	17	40	235	37	16	43	35	36	102
	218N	17	12	70	40	5	10	18	47	261	39	26	66	40	50	125
	220N	21	119	566	30	5	16	45	240	533	80	34	42	92	100	108
	222N	47	37	78	25	15	60	39	99	253	60	25	41	80	75	107
	224N	47	66	140	35	15	42	94	140	148	102	66	64	92	100	108
	226N	29	12	41	25	10	40	28	9	31	40	2	5	45	7	17
	228N	40	29	72	40	10	25	48	45	93	10	12	120	62	40	64
	230N	35	12	34	40	10	25	28	2	9	96	2	2	44	2	7
	232N	29	17	58	35	10	28	27	3	11	70	2	3	44	7	17
	234N	15	40	266	20	5	25	7	3	43	17	12	70	17	21	123
	236N	5	47	940	5	10	200	2	2	100	2	2	100	7	2	33
	238N	10	7	75	15	5	33	4	4	100	6	2	33	7	7	100
	240N	5	12	240	15	20	133	2	12	480	2	6	250	7	7	100
	242N	12	31	258	15	10	66	4	25	691	6	2	250	10	17	170
	244N	7	40	533	15	20	133	3	109	3633	9	27	3085	7	55	733
	246N	2	5	50	5	11	220	1	95	7600	2	37	1480	2	5	200
	248N	2	17	680	11	22	200	1	15	1166	2	12	500	2	7	375
	250N	19	9	46	30	15	50	10	121	1210	5	25	500	7	2	33
	252N	7	79	1053	20	10	50	3	53	1766	2	25	1250	2	57	2280
	254N	1	49	3920	5	40	800	2	100	5000	2	37	1850	2	70	3500

APPENDIX 1. (contd.)

Co-ordinates		Cu (ppm)			Pb (ppm)			Zn (ppm)			Co (ppm)			Ni (ppm)		
	(1)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)
76W	202N	24	5	21	25	11	44	12	42	350	35	2	6	36	7	19
	204N	17	4	24	20	11	55	11	4	36	20	2	10	30	10	33
	206N	17	6	35	20	20	100	13	8	61	25	5	20	30	10	33
	208N	24	99	412	25	85	340	16	66	412	25	135	540	36	99	275
	210N	50	80	160	30	15	50	25	14	56	52	12	23	52	17	32
	212N	37	32	86	20	11	55	30	11	36	52	5	9	52	10	19
	214N	32	29	90	32	32	100	47	262	557	47	22	46	7	45	643
	216N	26	32	123	20	15	75	28	84	300	35	27	77	52	67	128
	218N	32	16	50	25	11	44	20	90	450	27	30	111	50	7	14
	220N	29	20	68	25	30	120	21	90	428	37	17	45	45	39	86
	222N	52	35	67	32	11	34	23	31	134	67	20	29	67	30	44
	224N	47	52	110	39	22	56	62	82	135	90	62	68	87	54	62
	226N	42	190	452	27	11	40	27	48	177	62	82	132	42	56	133
	228N	50	10	20	39	16	41	25	1	-	76	2		35	2	7
	230N	30	10	33	45	5	11	17	1	-	75	2		32	2	8
	232N	15	25	166	27	16	59	5	1	-	17	2	14	14	2	18
	234N	35	30	85	32	11	34	4	2	50	137	2	2	7	5	66
	236N	15	15	100	16	16	100	6	2	27	2	2	100	7	2	33
	238N	7	25	333	16	27	168	4	17	446	2	10	400	2	16	640
	240N	2	55	2200	5	27	540	2	110	6200	2	27	1350	2	94	3760
	242N	10	50	500	22	39	177	6	65	1083	7	50	666	10	70	700
	244N	27	32	118	32	27	84	26	117	450	20	20	100	27	59	218
	246N	22	32	145	32	16	50	29	137	472	20	47	235	14	5	36
	248N	20	20	100	39	16	41	20	105	525	20	47	235	27	5	18
	250N	12	55	458	11	11	100	10	52	520	10	27	270	10	59	590
	252N	5	77	1540	5	32	640	2	82	3644	2	20	1000	7	77	1027
	254N	30	27	90	32	32	100	22	4	18	12	6	50	20	5	25

APPENDIX 2.

ANALYTICAL RESULRS FOR -80 FRACTION AND WHOLE SAMPLES, MANTON AREA.

The samples are listed by co-ordinate position. All results, unless otherwise indicated, are expressed in parts per million; missing values are indicated by 'M'. and signs in front of a number means "less than" and "more than" respectively.

The samples were analysed by the writer in the laboratories of Bureau of Mineral Resources and Commonwealth Scientific and Industrial Research Organization at Canberra.

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Co-ordinates	Cu (ppm)			Pb (ppm)			Zn (ppm)			Co (ppm)			Ni (ppm)			Mn (ppm)		Fe (ppm)
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(1)
124W 202N	10	5	50	17	10	59	5	3	63	12	6	52	12	6	500	1250	575	M
204N	6	5	80	10	10	100	4	3	82	7	6	83	10	6	62	950	575	15125
206N	2	5	200	10	10	100	3	3	116	5	6	125	5	6	125	875	1500	8185
208N	6	7	120	5	15	-	4	4	100	10	12	120	12	9	73	1400	1750	8625
210N	7	12	166	17	25	148	4	7	170	12	16	133	12	12	100	2650	4625	>23250
212N	7	12	166	12	20	166	5	7	152	12	16	133	12	15	125	3100	5250	>23250
214N	10	12	120	12	20	166	5	12	228	12	19	158	15	15	100	3300	11000	>23250
216N	7	17	233	12	25	208	6	15	250	10	32	320	17	17	100	3650	25500	>23250
218N	7	17	233	17	32	188	7	17	242	12	27	225	20	22	110	4700	23000	>23250
220N	4	22	600	17	32	188	6	23	353	15	50	333	15	32	213	6800	43750	>23250
222N	15	41	273	17	37	217	7	72	960	20	82	410	20	65	325	11350	>50000	>23250
224N	20	57	285	17	57	335	11	65	590	22	110	500	27	92	341	16500	>50000	>23250
226N	17	55	323	17	50	294	22	87	395	22	100	454	32	130	406	16500	>50000	>23250
228N	25	67	268	22	70	318	36	117	325	25	100	400	37	150	405	16500	>50000	23250
230N	21	57	271	17	50	294	27	62	230	17	94	553	37	100	270	12100	>50000	22000
232N	21	57	271	22	65	295	27	60	222	20	127	635	42	92	219	11600	>50000	23250
234N	20	57	285	22	65	295	22	62	282	25	121	484	30	111	121	13200	>50000	17500
236N	17	45	265	22	67	259	20	62	310	22	105	477	35	80	228	5876	>50000	23250
238N	24	39	162	22	47	214	42	50	119	20	66	330	20	55	275	4350	42500	14000
240N	17	31	182	10	170	170	36	60	166	20	55	275	12	45	375	1250	19625	16375
242N	12	17	142	27	32	119	16	21	131	12	22	183	20	17	85	1750	6625	10625
244N	10	22	220	14	37	264	15	29	193	15	22	147	5	27	375		3250	9125
246N	4	7	200	17	15	88	5	5	105	5	9	175	2	9	350	100	575	6750
248N	2	5	200	10	30	300	3	3	116	2	6		5	6	120	100	<300	5125
250N	4	5	133	14	25	179	4	8	188	2	6		5	9	175	250	300	12375
252N	4	5	133	14	30	214	4	4	100	5	6	120	7	9	116	375	300	22000
254N	4	5	133	10	20	200	6	5	83	7	12	160	7	9	116	700	<300	23250
256N	6	12	192	14	32	229	11	12	109	17	22	130	12	9	73	1100	300	23250
258N	10	10	100	27	25	95	26	19	76	15	50	333	12	9	73	500	1500	23250
260N	12	10	83	27	30	111	19	12	63	12	6	50	M	6		M	<300	M
262N	M	7		M	20		M	6		M	6		M	6			<300	M
264N	M	5		M	10		M	3		M	6		M	6			<300	M
266N	M	5		M	10		M	2		M	6		M	5			<300	M
268N	M	5		M	30		M	9		M	6		M	9			<300	M
270N	M	5		M	15		M	3		M	6		M	9			<300	M
272N	M	2		M	5		M	1		M	6		M	5			<300	M
274N	M	10		M	15		M	7		M	6		M	6			300	M

(1) Values for -80 fraction of the top soil sample. (2) Values for whole sample (after grinding to -80). (3) Ratio (2)/(1) x 100.

Rec. 1969/18.

APPENDIX 3.

ANALYTICAL VALUES FOR 26 SAMPLES FROM ACACIA AREA (PROFILE STUDY)

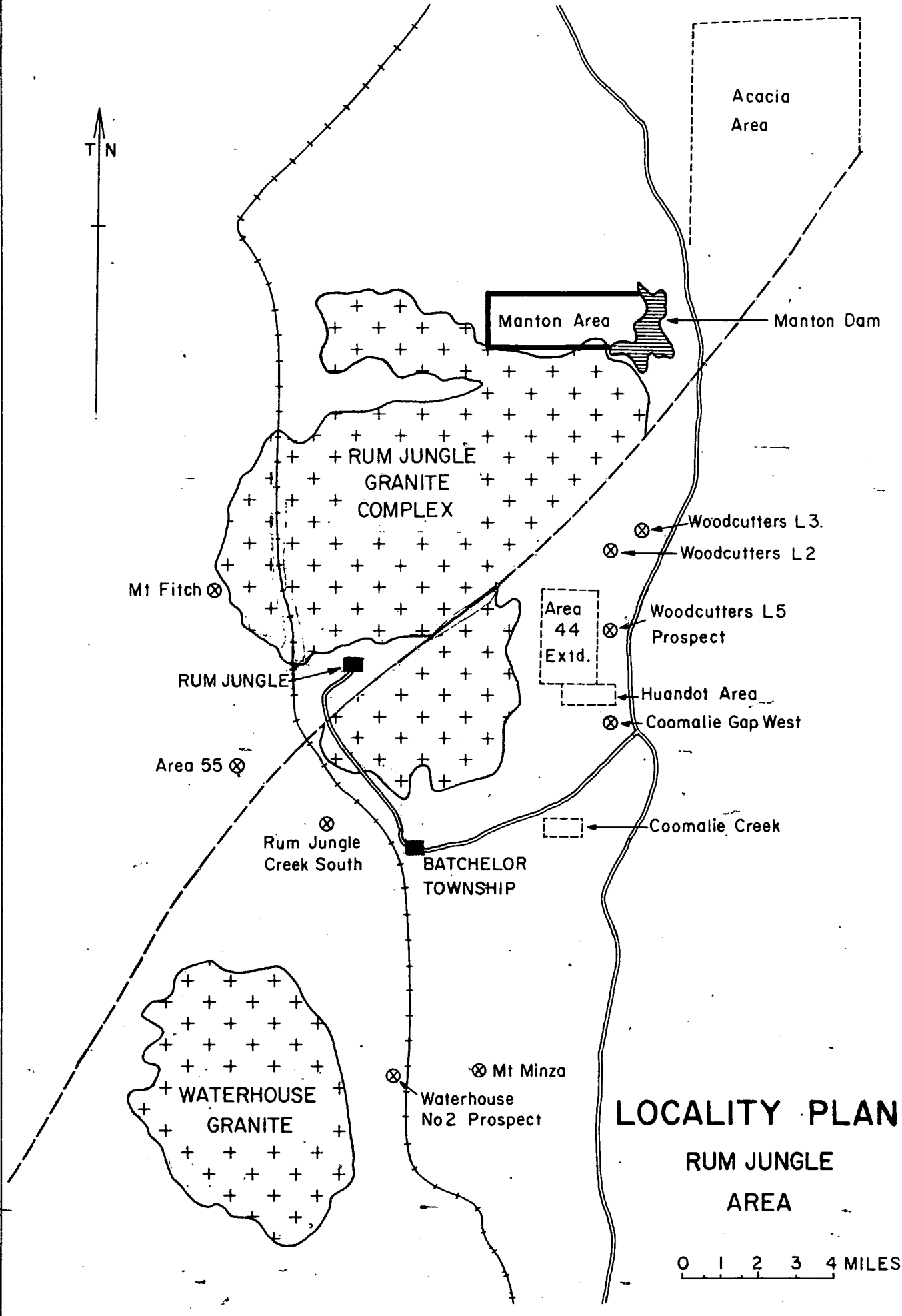
(1) Optical spectrograph - Direct reading

(2) Atomic Absorption Spectroscopic technique

Co-ordinate	Depth in ft	Cu (ppm) (1)	Cu (ppm) (2)	Pb(ppm) (2)	Zn (ppm) (2)	Co (ppm) (1)	Co (ppm) (2)	Ni (ppm) (1)	Ni (ppm) (2)	Fe % (1)	Mn % (1)	Mn (ppm) (2)	Mg % (1)	Cr(ppm) (1)	V(ppm) (1)	Mo(ppm) (1)	Ca % (1)	Ti % (1)	Sr(ppm) (1)	Ba(ppm) (1)	Sc(ppm)	Y(ppm)
28N 4E	3	54	25	145	45	24	12	60	22	8.0	.03	36	.16	120	100	12	0.4	0.23	31	168	21	69
	6	64	25	155	40	23	12	46	17	7.0	.05	36	.17	147	130	10	.4	.26	50	179	23	51
	9	39	20	309	50	9	7	26	7	6.0	.02	14	.42	165	140	5	.2	.28	27	249	22	30
	12	56	32	925	195	23	10	44	22	6.0	.05	26	.60	258	170	10	.4	.31	57	420	27	54
	15	37	30	537	235	13	10	24	22	3.3	.02	34	.48	165	125	3	.2	.29	28	128	18	32
	18	66	60	700	402	22	17	46	45	5.0	.03	96	.45	180	108	4	.3	.29	34	325	20	44
	21	57	42	775	275	16	12	39	30	3.9	.02	50	.50	248	155	3	.2	.40	42	393	20	41
	23	38	37	375	357	15	17	33	36	4.5	.02	84	.36	160	127	3	.2	.26	28	255	19	25
30N 4E	3	52	21	125	25	23	12	46	15	8.2	.03	60	.14	96	88	11	.4	.26	26	114	21	58
	6	110	47	246	69	41	20	79	25	12.8	.05	72	.32	228	175	14	.5	.36	52	253	27	80
	9	66	40	255	75	21	15	39	20	7.6	.05	62	.58	166	111	7	.3	.27	29	269	23	46
	12	70	32	125	64	43	15	63	20	5.0	.05	72	.51	189	132	14	.3	.32	57	147	32	122
	15	84	45	70	177	70	22	93	40	7.6	.07	152	.78	180	144	23	1.0	.31	55	575	37	204
	18	64	52	85	144	20	17	41	36	3.6	.03	152	.5	145	123	4	.3	.29	22	347	19	44
	21	43	27	115	154	26	17	39	31	4.1	.03	164	.5	161	142	5	.4	.33	34	408	23	56
	23	52	32	145	157	29	15	48	29	4.3	.04	66	.56	232	142	7	.5	.36	44	475	23	135
32N 4E	3	56	24	85	21	30	15	41	15	8.0	.04	164	.16	116	85	9	.5	.28	37	204	20	88
	6	104	40	135	50	31	17	46	20	9.8	.03	96	.29	155	129	9	.4	.35	25	224	22	66
	9	40	15	85	16	22	5	44	5	2.2	.03	16	.78	278	168	8	.5	.28	52	410	24	79
	12	35	15	125	16	19	5	37	5	2.4	.03	19	.7	192	204	7	.5	.27	54	410	23	79
	15	44	17	165	25	16	5	30	7	2.0	.03	40	.8	175	175	5	.4	.27	38	440	20	64
	18	112	110	277	193	16	17	59	47	3.6	.02	103	.56	184	153	3	.2	.31	33	365	19	40
	21	37	30	266	45	10	5	21	10	1.45	.01	26	.59	194	151	2	.2	.31	38	385	13	34
	24	16	10	246	12	10	5	11	2	.6	..01	14	.65	205	240	1	.2	.34	30	393	13	33
	27	18	5	180	4	10	5	13	2	.6	.02	7	.74	201	119	3	.3	.35	43	435	15	43
	29	27	19	225	12	10	5	14	5	.7	.01	7	.5	178	173	2	.3	.28	32	332	13	32

Note: The variation in the values obtained by optical spectrograph and atomic techniques is attributed to the background effect caused by the presence of iron in the samples. This is very obvious when the samples from the top of the profile ~~with~~ are compared with those at the deeper levels, as the former are richer in iron than the latter. The effects caused by the difference in matrix in the sample and the standards used for calibration may also be partly responsible for the difference observed.

Fig 1



To accompany Record 1969/18

NT/A/189

Fig. 2

MANTON AREA

12—10 COPPER (PPM)
27—35 LEAD (PPM)
22 62 ZINC (PPM)

0 600 FEET

Magnetic North

274 N
256 N
238 N
220 N
202 N

148 W
136 W
124 W
112 W
100 W
88 W
76 W
64 W
52 W

Quartz
Quartzite
Quartzite hill
Laterite
Amphibolite
Quartzite
Laterite
Spring
Amphibolite
Laterite + Quartzite
Quartzite
Laterite
Creek
Quartzite
Laterite
Laterite + Quartzite
Quartz
Laterite + Quartzite
Quartzite
Quartz
Laterite
Plo
Plo/Pld
BASE LINE

Fig. 3(a)

COPPER (Cu)

MANTON AREA

0 600 FEET

Magnetic North

256N

238N

220 N

202N

124W

112W

100W

88W

76W

150 100 50 150 100 50 150 100 50 150 100 50 150 100 50

p.p.m. p.p.m. p.p.m. p.p.m. p.p.m

D52/A4/119

To accompany Record 1969/18

Fig. 3(b)

LEAD (Pb)

MANTON AREA

0 600 FEET

Magnetic North

256 N

238 N

220 N

202 N

124 W

112 W

100 W

88 W

76 W

150 100 50 150 100 50 150 100 50 150 100 50 150 100 50

p.p.m. p.p.m. p.p.m. p.p.m. p.p.m

To accompany Record 1969/18

D 52/A4/120

Fig. 3(c)

ZINC (ZN)

MANTON AREA

0 600 FEET

Magnetic North

256N

238N

220 N

202N

124W

112 W

100 W

88 W

76 W

150 100 50 150 100 50 150 100 50 150 100 50 150 100 50

p.p.m. p.p.m. p.p.m. p.p.m. p.p.m

To accompany Record 1969/18

D 52 / A4 / 121

Fig. 3(d)

COBALT (Co) ——

NICKEL (Ni) - - - -

MANTON AREA

0 600 FEET

Magnetic North

256 N

238 N

220 N

02 N

124 W

112 W

100 W

88 W

76 W

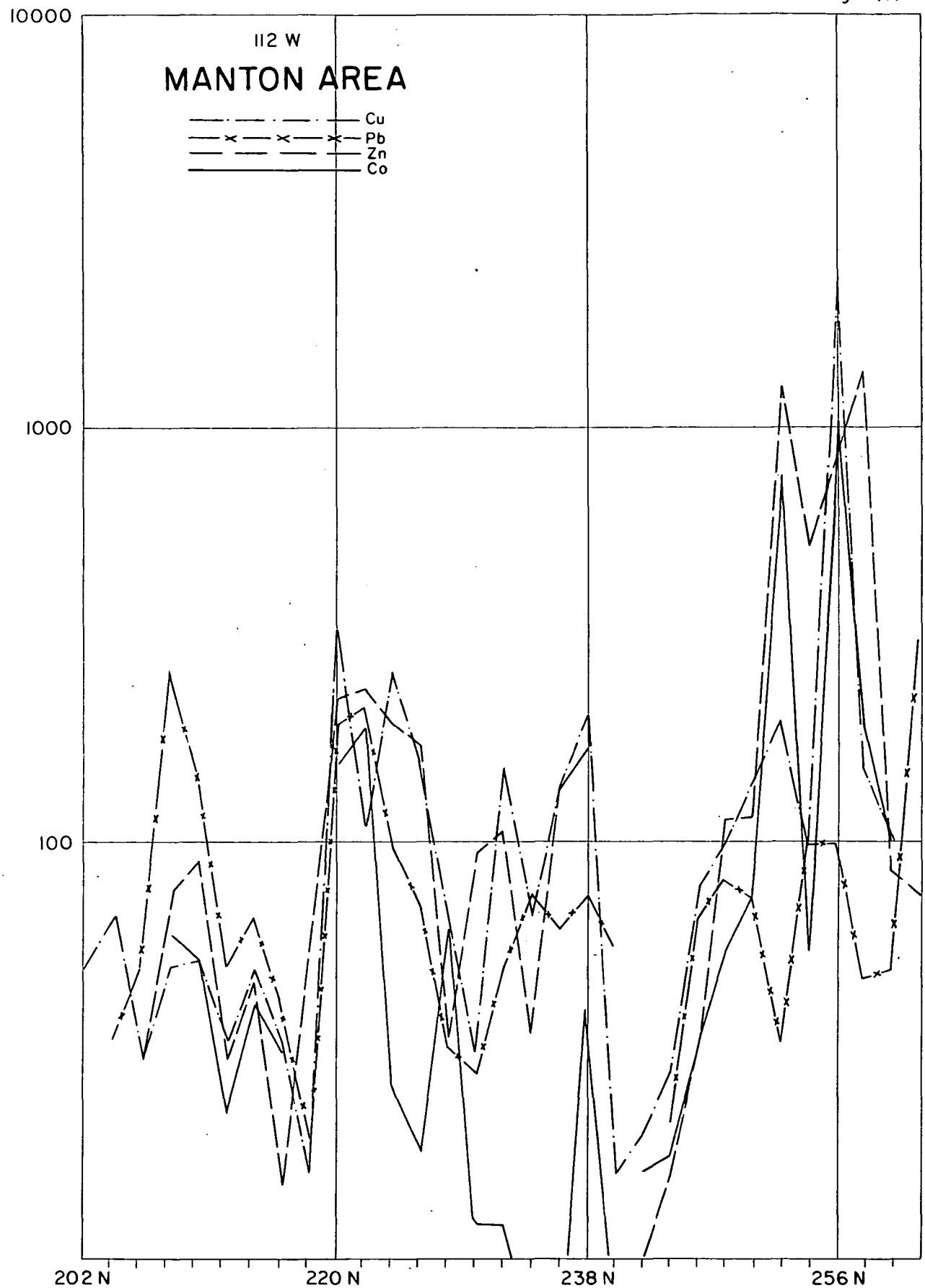
150 100 50 150 100 50 150 100 50 150 100 50 150 100 50

p.p.m. p.p.m. p.p.m. p.p.m. p.p.m

To accompany Record 1969/18

D 52 /A4/122

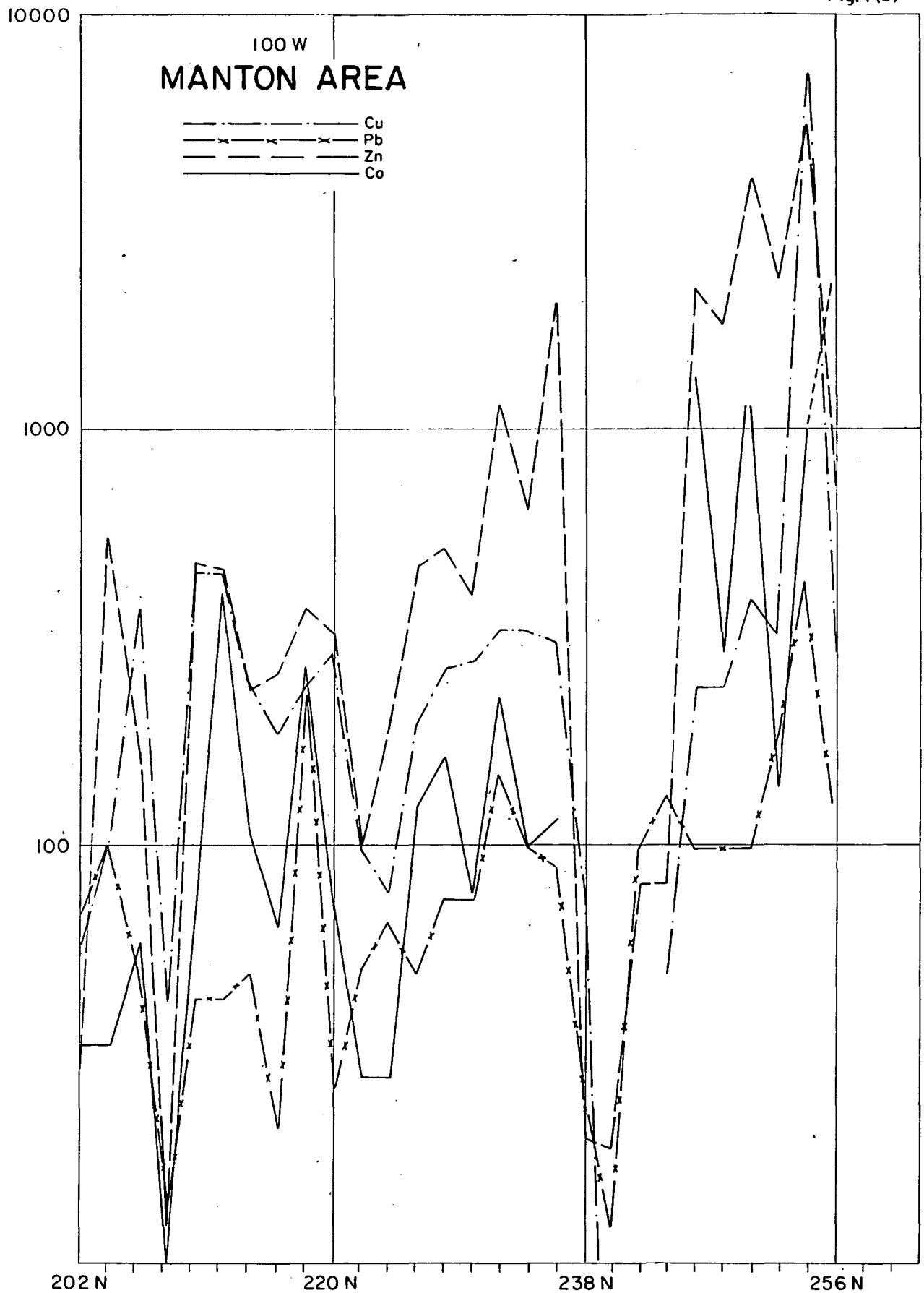
Fig.4(a)



To accompany Record 1969/18

D 52 /A4/114

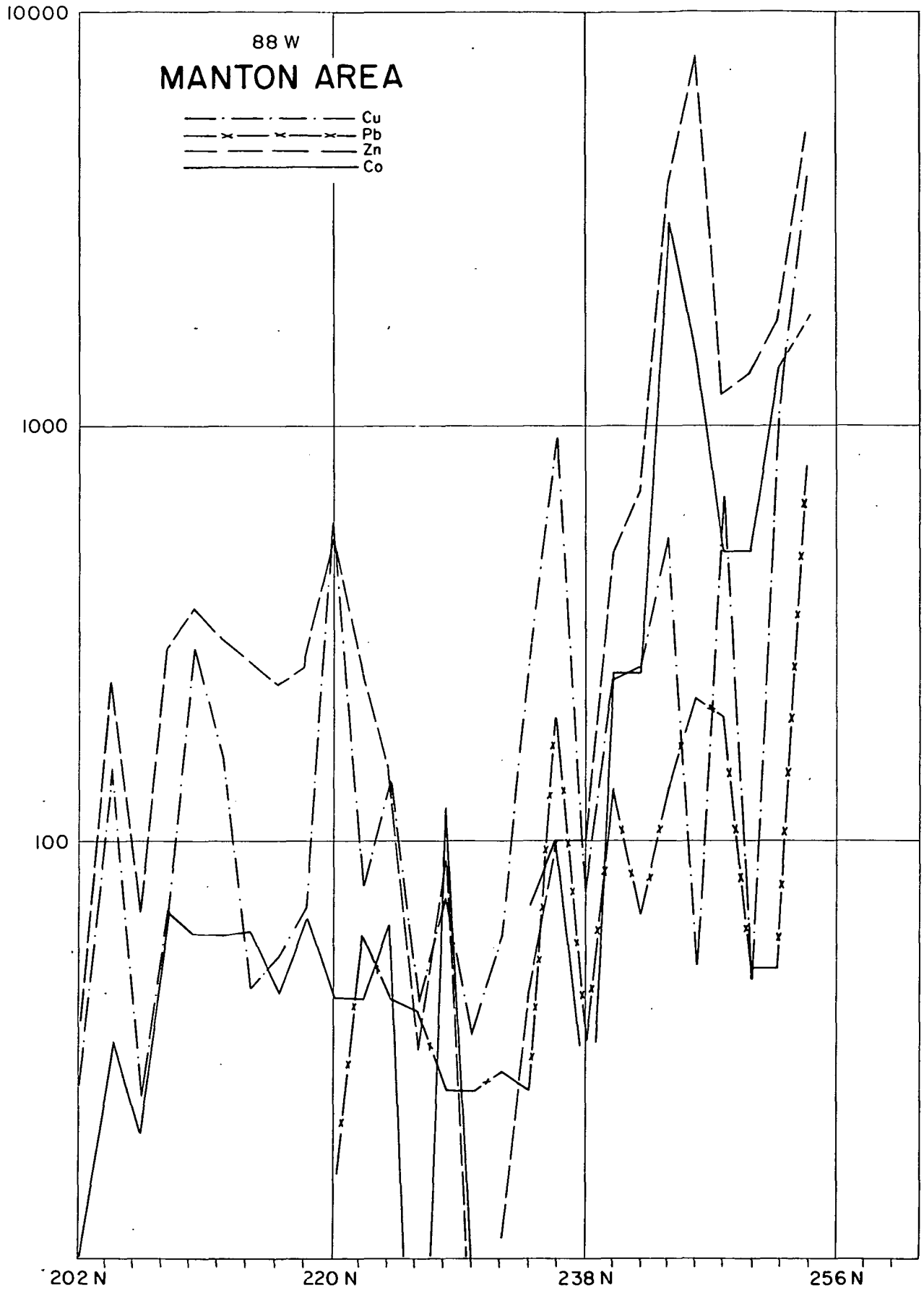
Fig.4 (b)



To accompany Record 1969/18

D52/A4/115

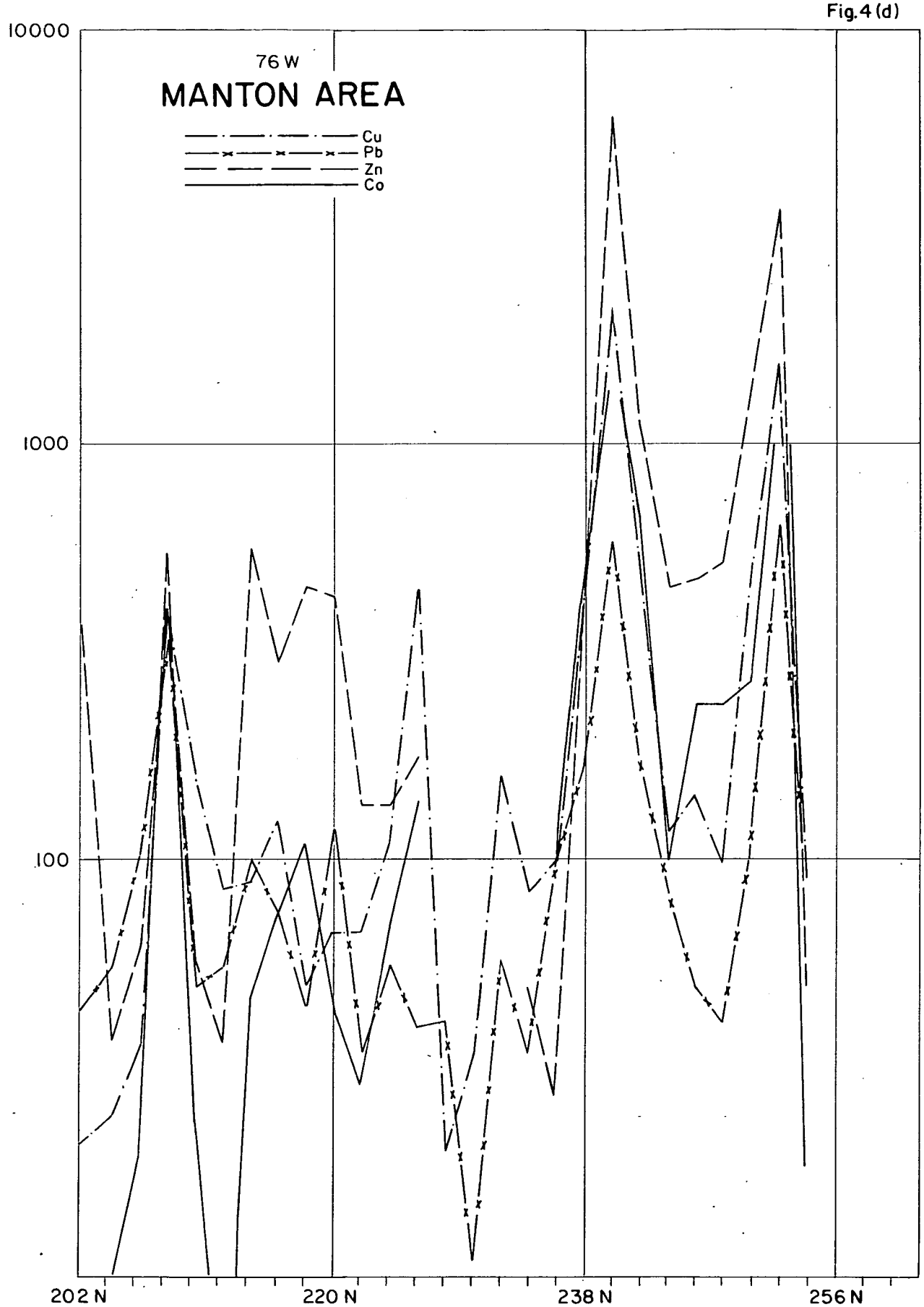
Fig. 4(c)



To accompany Record 1969/18

D52 /A4/116

Fig. 4 (d)



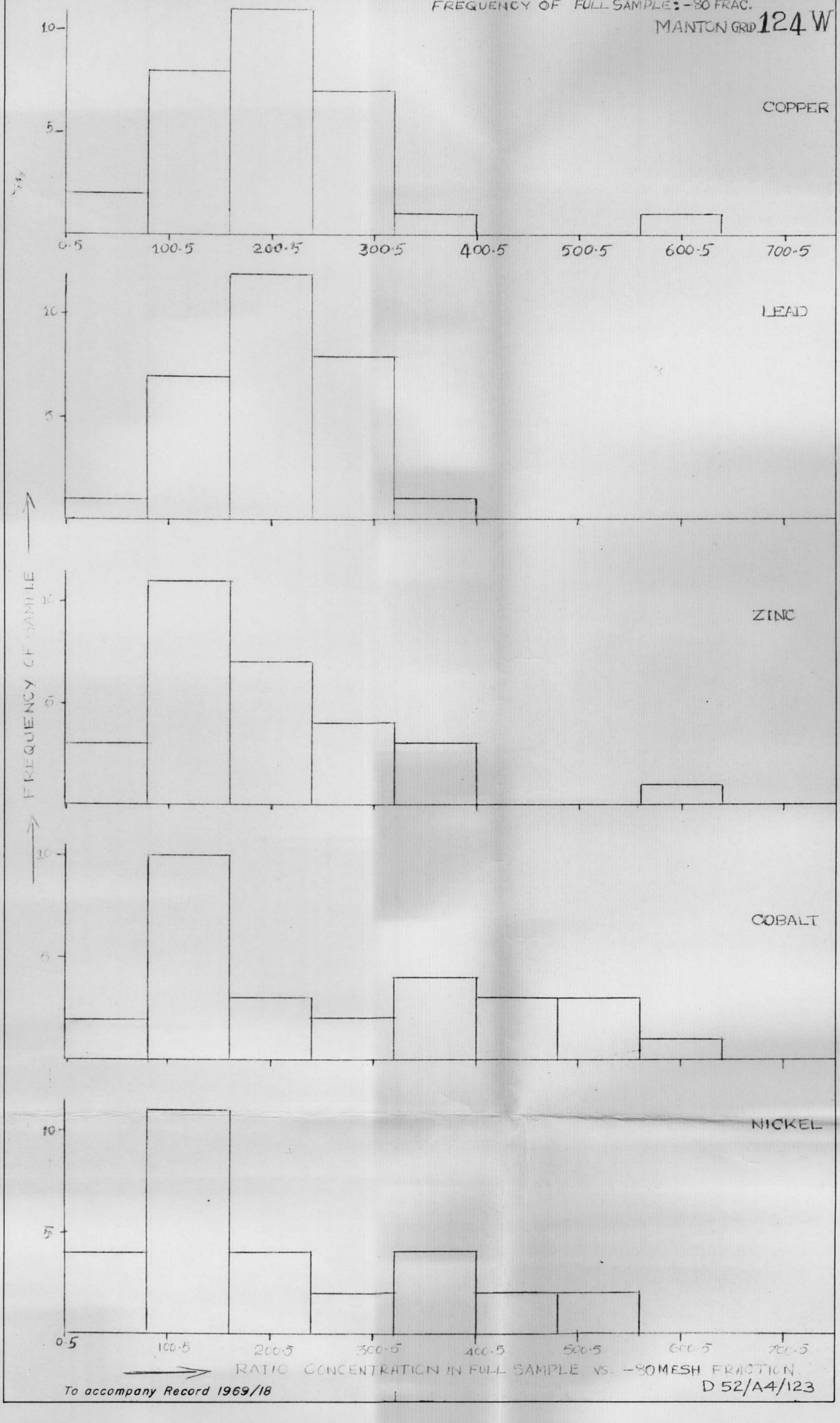
To accompany Record 1969/18

D 52 /A4/117

Fig. 5

FREQUENCY OF FULL SAMPLE:-80 FRAC.

MANTON GRID 124 W



To accompany Record 1969/18

D 52/A4/123