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GEOLOGY AND GEOPHYSICS.

RECORDS.

1956/4.

GEOCHEMICAL PROSPECTING FOR LEAD AND COPPER AT PEKO, TENNANT CREEK, N.T., 1955.

by

A. H. Debnam.

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CONTENTS

INTRODUCTION

A geochemical prospecting survey for lead carried out in the vicinity of the Peko outcrop was an attempt to determine whether a lead orebody, which was revealed by underground drilling, extends upwards to the surface of the bedrock. The sub-outcrop is covered by alluvial soil to depths of 20 to 30 feet. Sampling the soil proved to be more complicated than expected, but after much experimentation samples from a depth of 5 feet were obtained with hand-operated augers. Testing indicated a positive anomaly in the alluvial overburden.

Geochemical testing of hematite outcrops occurring in various parts of the Tennant Creek Goldfield for copper indicated that this type of prospecting for copper could be extremely useful in this district. Strong positive indications of copper were obtained at the Peko outcrop and at other outcrops below which copper mineralization is known to occur. Indications of copper were absent at outcrops and mines known to have little or no copper mineralization.

SAMPLING TECHNIQUES

1. Soil Sampling

The presence of 20 to 30 feet depth of alluvium in the vicinity of the Peko outcrop presented a difficult sampling problem.

First a diamond drill was tried but after 5 days of fruitless effort it was abandoned as uneconomic. Two sludge samples were collected from depths of 5 and 8 feet, but they were of questionable origin and purity, as mine water was used for drilling, and this contained some copper and possibly a trace of lead. The use of many gallons of this slightly acid water in a neutral or alkaline soil environment could cause serious contamination. Although the drill penetrated the "soil" to a depth of 25 feet a core sample could not be obtained either of soil or bedrock, owing to an inefficient air-compressor. This drilling was discontinued because of the loss of diamonds from the bit when attempting to penetrate hematite "floaters".

Secondly a mechanical post-hole digger was tried. Mechanical faults prevented this tool penetrating the hard soil for more than 2½ feet, and sampling by this method was discontinued after sinking 26 holes.

Finally a hand auger 6 feet long and 1 inch in diameter was used. It proved suitable for collection of samples to depths of 5 feet. Sampling was a slow process, and water was necessary to soften the soil. Two men were able to average 4 holes per day. Although slow and costly it served to obtain sufficient samples to indicate the presence of a lead anomaly.

Samples were collected from depths of 3 and 5 feet on a grid pattern, spacings being 50 feet in an east-west direction and 25 feet in a north-south direction.

2. Rock Sampling.

Rock samples are relatively easy to collect, only 3 or 4 chips from the outcrop in the vicinity of the sampling point being required. Crushing of rock samples was tedious and time-consuming. An average of 5 samples per hour can be handled if an efficient dolly-pot is used. As a consistent degree of fineness should be sought, sieving would eliminate errors from this source. The results for copper tests have been corrected to allow for variations in the fineness of the crushed samples.

TESTING PROCEDURES.

The usual dithizone techniques for copper and lead (Debnam, 1954) were used for the survey. A cold dilute acid extraction of 10 grams of sample (measured by volume) served as the test solution. A list of the chemicals and apparatus used is given in Appendix I. The single box of equipment weighed about 35 pounds.

RESULTS.

The results are reported as the number of millilitres of 0.001% dithizone solution required to remove all the copper or lead from 30 mls. of test solution. These values are reduced to parts per million acid soluble metal in the sample by dividing the copper values by 5 and the lead values by 2. The results are only approximate because of the varying fineness of crushing and the measurement of the sample by volume. It is relatively easy to distinguish between promising and unpromising outcrops from the results of the tests for copper.

1. Lead Results

Twelve holes were drilled with the hand-operated auger, and 21 soil samples were tested. The results are given in Table I, and plotted on Plate 1 (NT1i/8). On Plate 1 the southern boundary of the lead anomaly is outlined. Time did not permit the collection of samples to the north and east; testing of such samples would indicate the areal extent of the anomaly. Further work should be carried out when a power-operated soil auger is available, as hand drilling is slow and expensive.

TABLE 1.

Lead Results for Soil Samples from Grid.

Sample No. (Point on Grid)	Depth, ft.	Minimum no. of mls. required to extract Pb	Approx. ppm. dil. acid sol. Pb in sample
9C.3	3	2	1.0
9C.5	5	3	1.5
11C.3	3	1	0.5
11C.5	5	3	1.5
13C.3	3	3	1.5
13C.5	5	4	2.0
13E.3	3	3	1.5
13E.5	5	Less than 1	Less than 0.5
15C.4½	4½	" " 1	" " 0.5
15E.2½	2½	1	0.5
15E.5	5	4	2.0
15G.3	3	Less than 1	Less than 0.5
15G.5	5	" " 1	" " 0.5
9E.3	3	" " 1	" " 0.5
9E.5(D.D.Sample)	5?	2	1.0
9G.3	3	1	0.5
9G.5	5	Less than 1	Less than 0.5
9J.3½	3½	1	0.5
11E.3½	3½	Less than 1	Less than 0.5
11E.5	5	" " 1	" " 0.5
15J	3	" " 1	" " 0.5

The presence of a lead anomaly near the surface of such deep alluvial overburden was unexpected. Lovering (1955) has encountered similar anomalies ("superimposed diffusion haloes") in alluvial cover (barren detritus). He explains that "they reflect diffusing of the ore metals through damp silty and clayey overburden in contact with the oxidizing ore of the bedrock. Such diffusion may be related to the electric field that attends the oxidation of the sulphide orebody". This explanation may not apply in the vicinity of the Peko mine, where the depth of oxidation extends to 300-400 feet. Secondary lead minerals probably occur at the surface of the bedrock and traces of lead may be drawn from this source by capillarity, assisted by "breathing" of the soil caused by temperature, humidity and atmospheric pressure changes. Surface water is supplied only by torrential downpours during summer. Most is lost as run-off. Some moisture may penetrate the soil to a depth of a few inches but it is rapidly lost by evaporation, and would play little part in leaching of lead into the upper soil horizons.

2. Copper Results

The first indications that copper tests on rock samples would be of some use for prospecting in the district were obtained from the Peko outcrop. Eleven samples collected from various parts of the outcrop all gave positive copper indications. The results are given in Table 2 and sampling positions, with results, are presented on Plate 1.

TABLE 2.

Peko Outcrop Copper Results.

Sample Number	Minimum no. mls. .001% Dz required to extract all Cu		Approx. ppm. dil. acid sol. Cu in sample	
	Original test	(Repeat test)	Original test	(Repeat test)
PO1	4		1	
PO2	8	(12)	2	(2½)
PO3	5	(8)	1	(1½)
PO4	6		1	
PO5	37	(30)	7	(6)
PO6	9	(8)	2	(2)
PO7	4	(4)	1	(1)
PO8	5	(6)	1	(1)
PO10	6		1	
PO11	4		1	

The Peko outcrop results supplies the prospecting criteria for the district. Samples were collected from many quartz-hematite outcrops in the Tennant Creek Goldfield, and tested for traces of copper. The results for these samples will be considered in three groups:

A. Peko Eastern Leases, collected by the writer.

B. Samples from outcrops close to the road from Tennant Creek to Peko, collected by J. Smith, Develmt.Engineer.

C. Samples from all parts of the Tennant Creek Goldfield, collected by J. Elliston, Consulting Geologist.

A. Peko Eastern Leases

Seventeen samples were collected from 4 hematite outcrops which are numbered 2, 3, 4 and 5, to correspond with the geophysical anomalies (magnetic) with which they are associated. Results are given in Table 3, and presented on Plate 2 (NT11/9) on which sampling positions are also shown.

The Eastern Leases outcrops present excellent opportunities for proving the geochemical prospecting method. One has already been drilled, another is at present being drilled, and other drill holes have been proposed.

Of direct importance is the fact that No. 2 outcrop, which geochemically gives strong indications of copper mineralization has been drilled, and intersections of 100 feet of 1% and 10 feet of 5% copper mineralization obtained.

Values for the group of 3 outcrops at No. 3 Anomaly are sporadic, 3a and 3c being low or nil, and 3b indicating possible mineralization. Sample 3d is probably associated with Outcrop 2 and not 3 as previously thought.

Outcrop 4 is a large quartz-hematite body, and more samples will be required to obtain a reliable result.

No. 5 outcrop, at present being drilled (present depth 120 feet), shows no geochemical anomaly. There are no indications of commercial grade copper mineralization.

B. Samples collected by J. Smith

The results for the 12 samples collected by J. Smith from outcrops along the road between Tennant Creek and Peko are tabulated in Table 4.

The only two samples for which sample localities are known are SS8 and SS9 which are from the Susan Mine. They showed no indication of copper. The outcrops from which samples SS6, SS7 and SS10 were collected should be resampled.

TABLE 3.

Peko Eastern Leases Copper Results

Sample Number	Min. no. mls. .001% Dz to extract all Cu: Original	Repeat	Approx. ppm. dil. acid sol. Cu in sample: Original	Repeat	Remarks
EL2a	200		40		Good indications of copper mineralization
EL2b	70	(80+)	14	(16+)	
EL2c (slate)	60		12		
EL3a.1	3		0.5		Doubtful
EL3a.2	2		0.5		
EL3b.1	13	(18)	3	(4)	Possible copper mineralization
EL3b.2	28	(33)	6	(7)	
EL3c	Less than 1		0		No copper
EL3d	55		11		Possible copper may be associated with EL2
EL4a	7	(7)	1	(1)	Doubtful. A large outcrop; more samples required.
EL4b	2		0.5		
EL4c	1		0.2		
EL4d	4		1		
EL5.1	Less than 1	(0)	0	(0)	No commercial grade copper mineralization
EL5.2	" " "	(0)	0	(0)	
EL5.3	3	(3)	0.5	(3)	
EL5.4	Less than 1	(0)	0	(0)	

TABLE 4.

Samples Collected by J. Smith, Copper Results.

Sample Number	Min. no. mls. .001% Dz to extract all Cu	Repeat	Approx.ppm. dil. acid sol.Cu.in sample	Repeat	Remarks
SS1	1		0.2		Single outcrop
SS2	1		0.2		Single outcrop
SS3	4		1		)From one out-
SS4	0		0		)crop copper
SS5	0		0		)mineralization)unlikely
SS6	3		0.5		Single outcrop
SS7	16	(16)	3	(3)	Single outcrop
SS8	0	(0)	0	(0)	)Susan Mine. No
SS9	0		0		)copper mineral-)ization.
SS10	2		0.5		Single outcrop
SS11	0		0		)Same outcrop,
SS12	0		0		)no copper.

C. Samples Collected by J. Elliston.

Ninety rock samples were collected by J. Elliston from outcrops (mainly hematite) in all parts of the Tennant Creek Goldfield. The results are reported in Appendix 2. Details of sample localities are not yet available.

CONCLUSION.

The results obtained for both lead in soils and copper in rocks in the Tennant Creek Goldfield indicate that geochemical prospecting may be one of the most useful aids so far introduced into this area.

Extremely deep oxidation of the outcrops and extensive alluvial cover limit the use of other prospecting methods but do not obscure results obtainable by geochemical techniques.

Only large-scale geochemical testing of outcrops and soils will supply sufficient detail for correlation with structural and geophysical anomalies to allow the most favourable areas to be determined. Such a survey should be carried out during part of the 1956 field season.

REFERENCES.

Debnam, A.H., 1954 - Geochemical Prospecting at Mt. Isa, Queensland. Bull.Instn.Min.Metall. 63 (6), 269.

Lovering, T.S., 1955 - Work of the Geochemical Section of the U.S. Geological Survey. Min.Engng. 7 (10), 963.

APPENDIX I.

List of Requirements for Geochemical Prospecting Survey at Peko (2 weeks).

1. SPACE AND FIXED EQUIPMENT	Number.
Room, about 20' x 15', equipped with an efficient fan	1
Refrigerator, for keeping dithizone solutions (essential)	1
Table, large (work bench)	1
Table, small (sample bench)	1
Chairs	2

2. EQUIPMENT

Beakers, conical, 250 ml.	10
Beaker, 1000 ml.	1
Cylinders, graduated, glass-stoppered, 50 ml.	3
Cylinders, graduated, 50 ml.	2
Cylinder, graduated, 100 ml.	1
Cylinder, graduated, 10 ml.	1
Funnel, separating, graduated, glass-stoppered, 50 ml.	1
Tubes, test	3
Tubes, glass, narrow-bore (dropping)	3
Bottles, reagent (liquid), narrow neck, 1000 ml.	2
Bottles, " " " " 300 ml.	3
Bottles, " " " " 125 ml.	1
Bottles, " " " ", Brown, 250 ml.	2
Burettes, 10 ml.	2
Stand, burette, wooden	1
Funnel, filter	1
Papers, filter, No. 41 Whatman, pkts.	1
Cartridge, demineralizer	1
Tubes, test, small (to measure 5, 3, 1 gms)	12
Pestle, and mortar, agate, 3"	1
Plate, pounder, and cylinder, iron (dolly pot)	1
Hammer, geological	1
Tins, waste	2
Labels, pkts.	1
Bands, rubber, pkts.	1
Dispenser, pHydrion, (1211), and refills	1
Spatulas, horn, spoon	3
Towel, tea	2
Book, note; pencil, paper, razor blade, etc.	1
Compass	1
Bags, brown paper, 1 lb. (satchels)	500
Tape, 100 ft.	1
Rule, scale	1

3. CHEMICALS.

Carbon tetrachloride, A.R., lbs.	20
Hydrochloric acid, 5N, 300ml. bottle	1
Ammonium Hydroxide, 1:1, 300 ml. bottle	1
Potassium cyanide, A.R., 100 gm. bottle	1
Hydroxylamine hydrochloride, 100 gm. bottle	1

APPENDIX 2.

Samples Collected by J. Elliston.

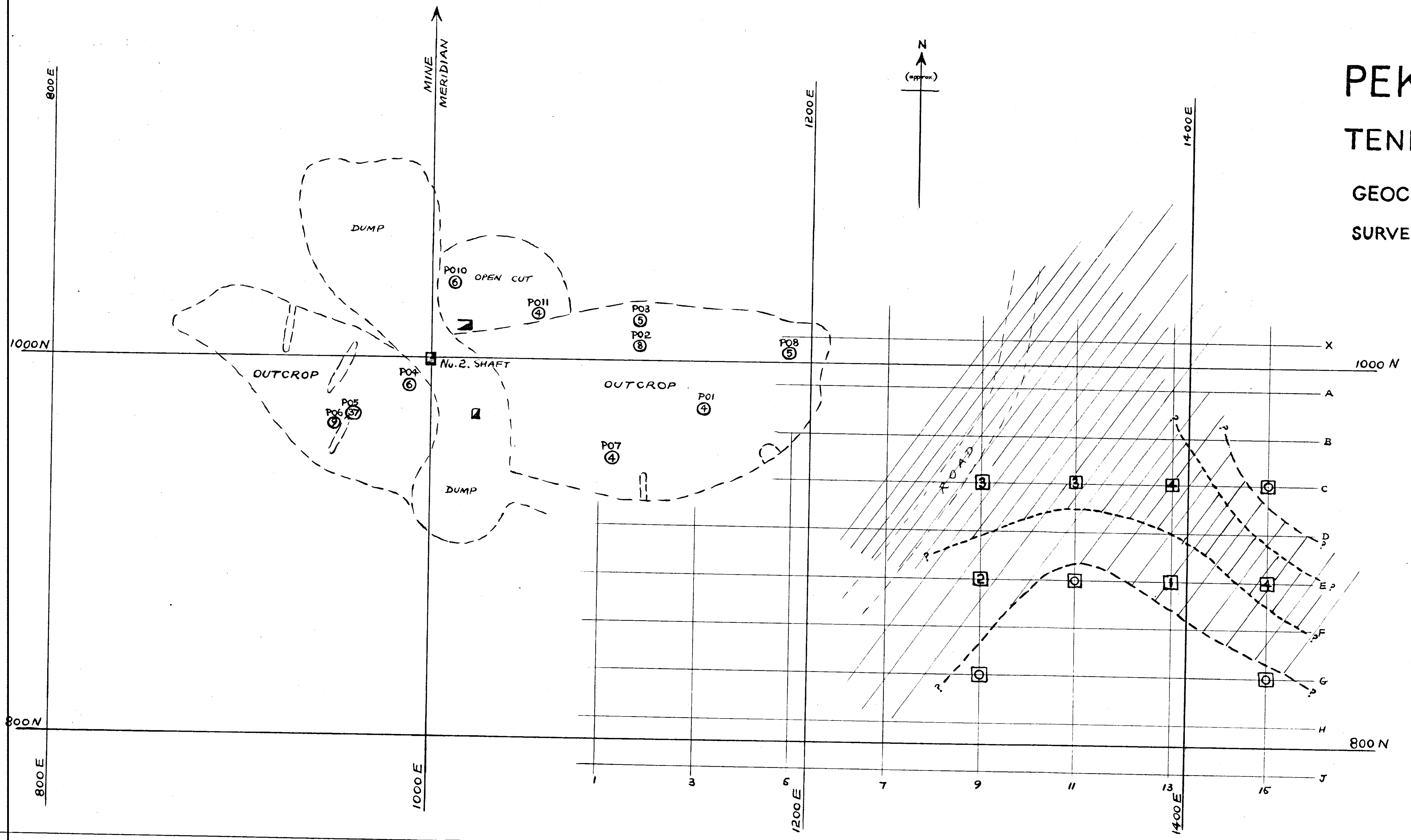
Sample Number	Min.no. mls. .001% Dz to extract all Cu. Original	(Repeat)	Approx. ppm. dil. acid sol.Cu in sample Original	(Repeat)	Remarks
JE1	1		0.2		
JE2	0		0		
JE3	10	(11,10)	2	(2,2)	
JE4	0		0		
JE5	0		0		
JE6	1		0.2		
JE7A	15	(13)	3	(3)	
JE7B	65	(60)	13	(12)	
JE8	24	(28)	5	(6)	
JE9	100+	(400+)	20+	(80+)	
JE10	60	(80)	12	(16)	
JE11	7	(7)	1	(1)	
JE12	60	(72)	12	(14)	
JE13	2		0.4		
JE14	1		0.2		
JE15	1		0.2		
JE16	4		1		
JE17	4		1		
JE18	4		1		
JE19	10	(16)	2	(3)	
JE20	20	(40)	4	(8)	
JE21	30	(34)	6	(7)	
JE22	-		-		
JE23	-		-		
JE24	1		0.2		
JE25	Too high to determine		Very high		
JE26	10	(18)	2	(4)	
JE27	2		0.4		
JE28	9		2		
JE29	3		0.6		
JE30	2		0.4		
JE31	30	(22,22)	6	(4,4)	
JE32	4		1		
JE33	1		0.2		
JE34	7	(7)	1	(1)	
JE35	1	(1)	0.2	(0.2)	
JE36	2	(2)	0.4	(0.4)	
JE37	2	(1)	0.4	(0.2)	
JE38	3		0.6		
JE39	25	(25)	5	(5)	
JE40	12		2		
JE41	0		0		
JE42	0		0		
JE43	2		0.4		
JE44	0		0		
JE45	2		0.4		
JE46	50		10		
JE47	8		2		
JE48	3		0.6		
JE49	3		0.6		
JE50	3		0.6		
JE51	2		0.4		
JE52	0		0		
JE53	3		0.6		
JE54	5		1		
JE55	4		1		
JE56	4		1		
JE57	1		0.2		
JE58	1		0.2		
JE59	20		4		
JE60	10		2		

APPENDIX 2 (C'td.)

Sample Number	Min. no. mls. .001% Dz to extract all Cu.	Approx. ppm. dil. acid sol. Cu in sample	Remarks
JE61	0	0	
JE62	0	0	
JE63	3	0.6	
JE64	4	1	
JE65	2	0.4	
JE66	3	0.6	
JE67	0	0	
JE68	3	0.6	
JE69	70	14	
JE70	1	0.2	
JE71	2	0.4	
JE72	1	0.2	
JE73	1	0.2	
JE74	0	0	
JE75	0	0	
JE76	0	0	
JE77	0	0	
JE78	1	0.2	
JE79	10 (12)	2 (2)	
JE80	2	0.4	
JE81	2	0.4	
JE82	2	0.4	
JE83	0	0	
JE84	1	0.2	
JE85	3	0.6	
JE86	3	0.6	
JE87	1	0.2	
JE88	4	1	
JE89	28	6	

Canberra, A.C.T.
January, 1956.

PLATE. I.



PEKO OUTCROP
TENNANT CREEK, N.T.

GEOCHEMICAL PROSPECTING SURVEY FOR LEAD AND COPPER

1955

LEGEND

Lead Anomaly, medium intensity.

Lead Anomaly, low intensity.

P07 ④ Sampling position, and copper value for rock sample.

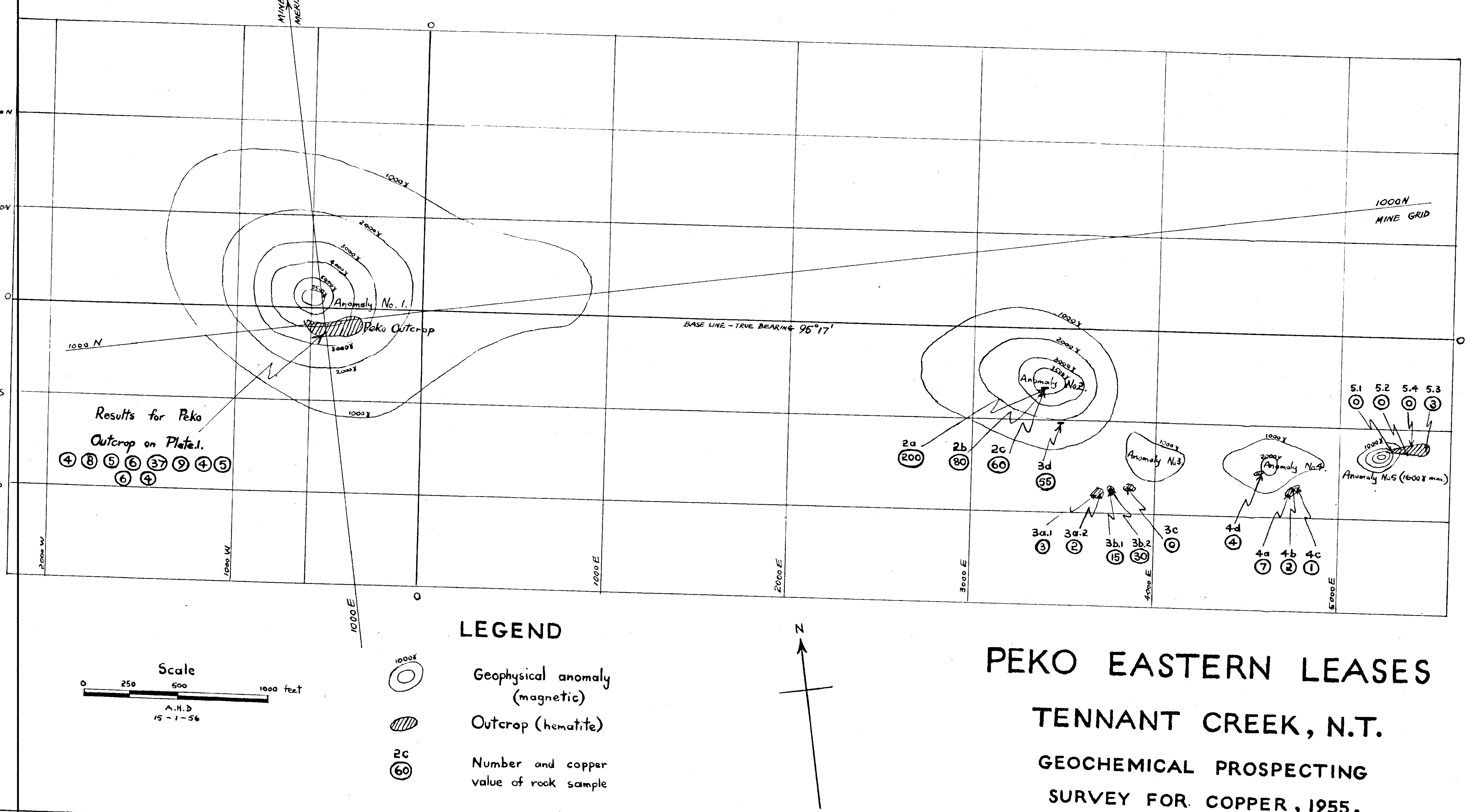
[3] Lead value for soil sample.

Scale
0 20 40 80 120 feet

A.H.D.
15 - 1 - 56

NT11/8

PLATE. 2.



PEKO EASTERN LEASES

TENNANT CREEK, N.T.

GEOCHEMICAL PROSPECTING SURVEY FOR COPPER, 1955.

NT 1i/9