GEOCHEMICAL AND GEOPHYSICAL SURVEYS

MAPPING, ROCK SAMPLING & TRENCHING

- on the -

LOON 1-3 CLAIMS

OMINECA MINING DIVISION
BRITISH COLUMBIA

N.T.S. 93E/9 and F/12

- for -

MINGOLD RESOURCES INC.
405, 470 Granville Street
Vancouver, B.C.
V6C 1V5

- by -

K.J. TAYLOR, B.Sc., F.G.A.C.

May, 1990

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INTRODUCTION

The Loon claims were staked July and August of 1988 as a result of a reconnaissance prospecting/sampling program in the Ootsa Lake area.

A modest program of soil geochemistry, trenching, rock sampling and resistivity surveying (EM-16R) was carried out from October 8-18, 1989. The work was done over an area where initial prospecting and sampling indicated gold and silver bearing epithermal veins and breccias. The results of these surveys are the subject of this report.

LOCATION & ACCESS

The Loon property is located 70 kilometres south of Burns Lake and 216 kilometres west of Prince George (see Fig. 1). The claims occur in the Windfall Hills area north and east of Uduk Lake near the eastern boundary of Tweedsmuir Provinical Park. Latitude 53°38'N; longitude 125°59'W. The claims straddle the boundary between NTS mapsheets 93E/9 (Ghitezli Lake) and 93F/12 (Marilla). The camp was located on the west side of an unnamed lake referred to in the field as Loon Lake.

Access to the claims is by fixed-wing aircraft from Burns Lake to Loon Lake. Logging roads pass within 7 kilometres of both the northeastern and southeastern claim boundaries. These are seasonal roads used by Wests Fraser's Eurocan Division based out of their East Ootsa Camp. Ferry transportation across Ootsa Lake is on an availability basis only.

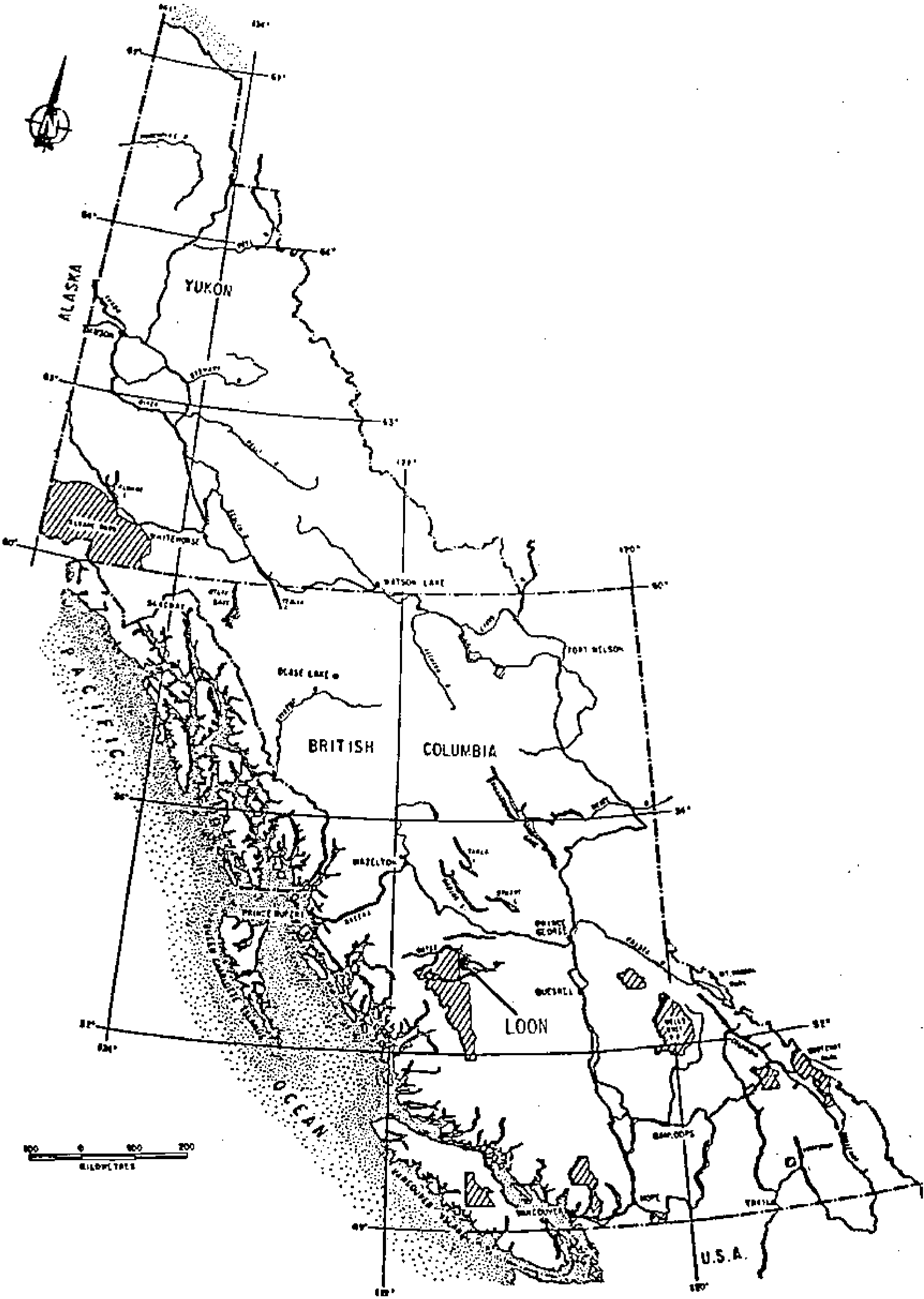
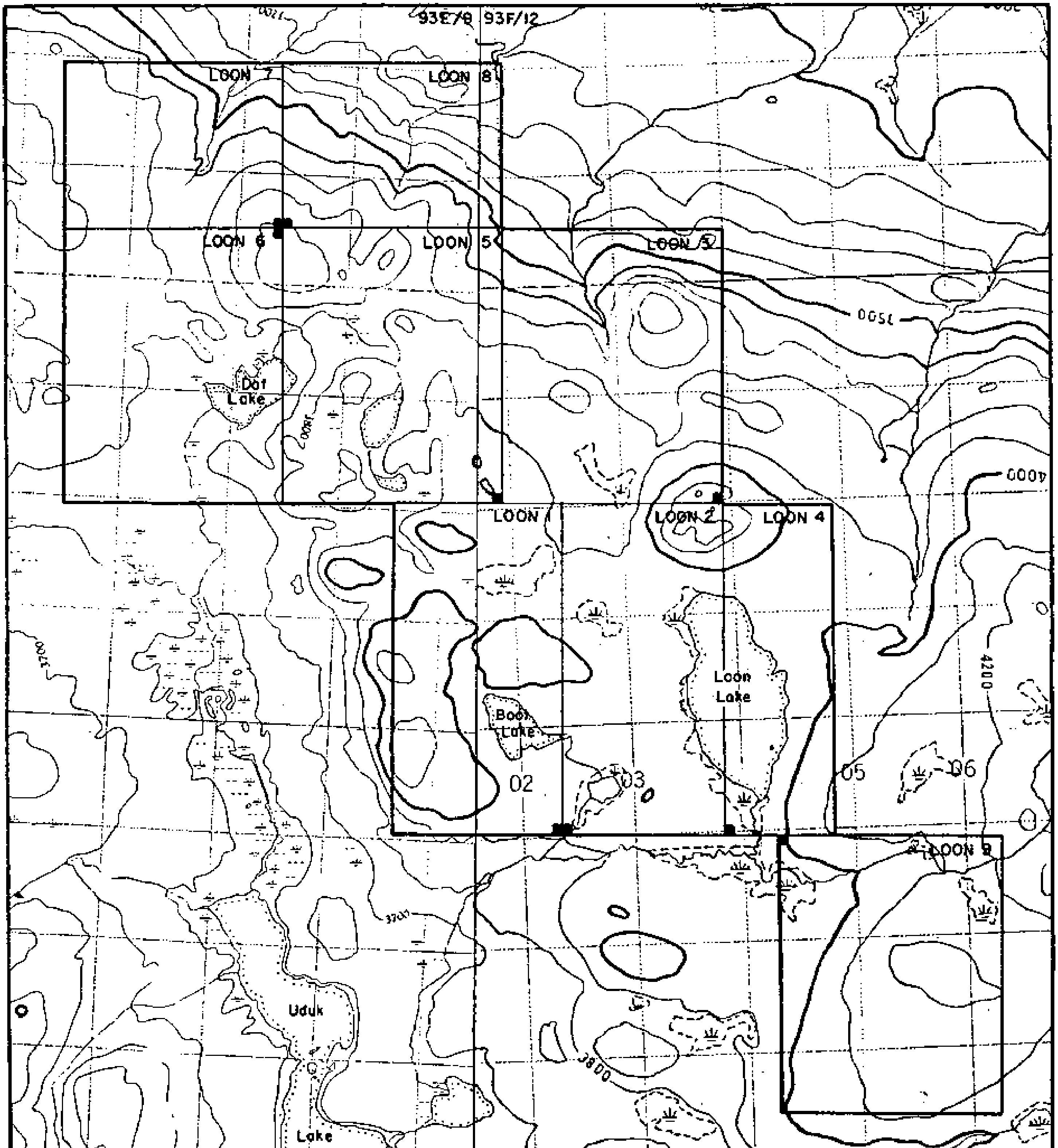


Figure 1. General Location Map (1:10,000,000)



MINGOLD RESOURCES INC.

VANCOUVER OFFICE

LOON CLAIMS
CLAIM MAP

93E/9, 93F/12 — OMINECA M.D.

DRAWN BY: K.T.	DATE: MAR. 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:50,000
	0 500 1000 2000 m.	PLATE NO. 2A

CLAIMS

The Loon property consists of a contiguous block of 9 claims totalling 152 units in the Omineca Mining Division. The claims are wholly owned by Mingold Resources Inc. A breakdown of the claim information is shown in Table 1 and the location of the claims on Plate 2A.

TABLE 1. Loon Claims Summary

Claim	No. of Units	Record No.	Record Date	Expiry Date*
Loon 1	18	9568	07/19/88	07/19/92
Loon 2	18	9569	07/19/88	07/19/93
Loon 3	20	9570	07/19/88	07/19/92
Loon 4	12	9661	08/17/88	08/17/91
Loon 5	20	9662	08/17/88	08/17/91
Loon 6	20	9719	08/18/88	08/18/90
Loon 7	12	9720	08/18/88	08/18/90
Loon 8	12	9721	08/18/88	08/18/90
Loon 9	20	9722	08/18/88	08/18/91

*Note the expiry dates shown include the assessment credits for work presently being applied.

The claims for which assessment is being applied have been grouped into a 56 unit contiguous block which includes Loon 1-3.

PROPERTY HISTORY

The first known work in the area was by H.W. Tipper of the Geological Survey of Canada in 1949. At that time, he carried out the initial government mapping of the area which was later published in G.S.C. Memoir 324. Since that time no further work is indicated until 1980 at which time Amax Exploration staked claims in the Uduk Lake area just south of the Loon property. The claims were allowed to lapse by Amax and were subsequently restaked by A & M Exploration as the Duk claims. These claims are presently

still in good standing and held by Comox Resources.
In 1988, Mingold Resources personnel found an accumulation of mineralized epithermal vein and breccia boulders south of Ootsa Lake. These boulders were subsequently traced "up ice" to outcrops of similar material on what is now the Loon 1 and 2 claims. In the course of staking, additional material was found in float or outcrop resulting in the expansion of the claim block to cover a total of 152 units. The claims tie onto the northern boundary of the Duk claims where similar material is found.

GEOLOGY

The Loon claims occur in the south-central part of the Intermontane Geological Belt of the Northern Cordillera.

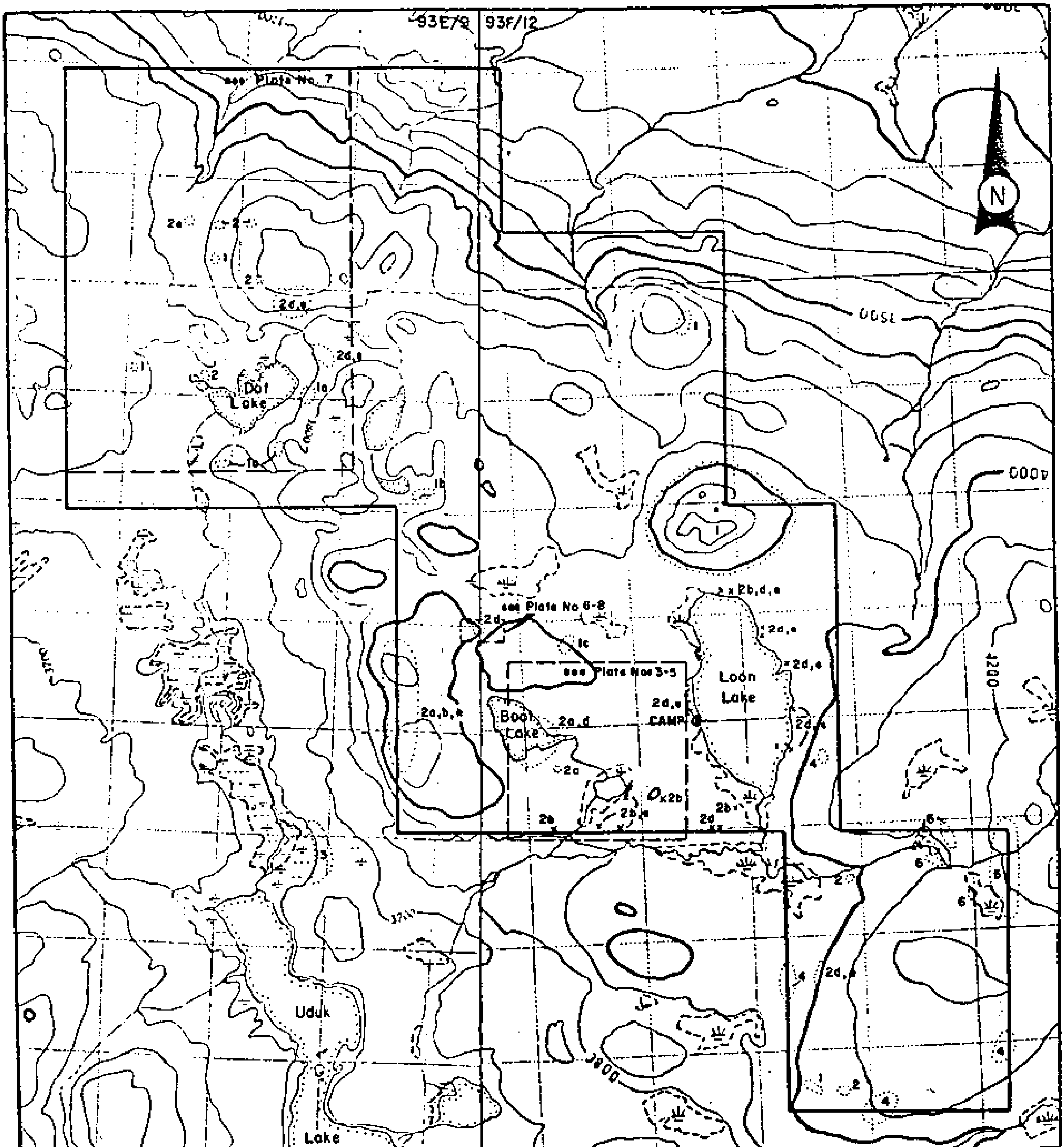
Lithologies range in age from late Triassic through Miocene with intermediate to felsic volcanics being the dominant rock types (see Plate 2B).

The oldest rocks exposed in the area are the U. Triassic Takla Group Volcanics which consist of island arc sequences of intermediate to basic volcanics. These were superceded by the Hazelton Group Volcanics in early to mid-Jurassic time. This package of dominantly calc-alkaline basaltic to rhyolitic volcanics is prevalent in the area surrounding the Loon claims but only occurs on Loon 4 and 9 within the claim block (units 4, 6).

The lower Mesozoic rocks are overlain unconformably by an extensive volcanic sequence known as the Ootsa Lake Volcanics (Unit 2). Recent work on the Whitesail (93E) mapsheet further west suggests this package is entirely Eocene in age (Drobe, 1988). These rocks occur over most of the claim area and consist typically of flows and tuffs of felsic to intermediate composition. The evolution of the rocks is believed to be related to a series of dome complexes within a collapsed cauldra setting. These rocks commonly host epithermal gold-silver mineralization in the area.

The Ootsa Lake Group is in turn overlain and intruded by andesitic to basaltic flows, dykes and plugs of the Oligocene to Miocene Endako Group (Unit 1). These rocks are typically basaltic and have likely resulted from "plateau-type" extrusion into the area. Alteration prevalent in the Ootsa Lake rocks seldom extends into the Endako sequence suggesting that the epithermal mineralizing event occurred prior to or contemporaneous with the implacement of the Endako volcanics. A quartz monzonite plug (unit 5) occurs on the northeastern part of Loon 9 and likely is part of the Cretaceous and/or Tertiary Quanchurs Intrusions.

The region is structurally complex with the complexity becoming all the more evident with the more intensive work in the area. Heavy glaciation has precluded the G.S.C. extrapolating the faulting evident both north and south of the area into the Ootsa Lake region. Our detailed work along with airphoto interpretation indicates that the northwesterly and northeasterly trending faults do in fact continue into this area along with a strong northerly trending system.



LEGEND

1 ENDAKO GP. BASALT
- 1a: perlite (maybe 2)
- 1b: pyroclastic flow
- 1c: amygdaloidal

2 OOTSA LAKE GP. RHYODAC.
- 2a: bedded tuff
- 2b: argillically altered
- 2c: propylitized
- 2d: silicified
- 2e: brecciated

3 Quartz-eye porphyry

4 ANDESITE

5 QZ. MONZONITE

6 ARGILL., CONGL.

x Float

Outcrop

MINGOLD RESOURCES INC.

VANCOUVER OFFICE

LOON CLAIMS
GEOLOGY

93E/9, 93F/12 OMINECA M.D.

DRAWN BY: K.T.	DATE: MAR. 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:50,000
	0 500 1000 2000 m.	PLATE NO. 2B

GEOCHEMISTRY

Soil Geochemistry

A total of 199 soil samples were collected over the Loon 1 and 2 claims during the period of October 14 and 15, 1989. These are denoted by larger dots on the Boot Lake area geochem plots (Plates 3-5). All the N. Boot Lake samples were taken in 1989 so no designation has been made.

Soil sampling was carried out on lines 50N, 53N, 56N, 58N, 63N, 64N, and 65N with 25 meter stations. The section lines were flagged in concurrent with the sampling.

Samples were collected from a depth of 15 to 25 cm using a grubhoe and then placed in a Kraft soil bag. The entire area has been glaciated however a rusty brown to grey brown soil has been developed within the till which represents a false "B" horizon. It is believed that sampling of this horizon yields a measure of the in-situ metal content however values may be somewhat suppressed due to the relatively impervious nature of the till. Overburden depths do not appear to be excessive in this area however further work may indicate otherwise.

Samples were air-dried and sent to Acme Analytical Labs in Vancouver for analysis. All samples were run for a 30 element ICP package plus A.A. for gold and mercury.

Analytical Procedure

In the lab, the soils are sieved to -80 mesh and then a 0.5 gram sample is digested with 3 ml. of 3-1-2 $HCl-HNO_3-H_2O$ at 95^{o}C for one hour. This is then diluted to 10 ml. with water and analysed by an ICP unit. Gold detection limit by ICP is only 3 ppm so separate analysis was done for gold by AA. This method uses a 10 gram sample which is ignited at 600°C, digested with hot aqua regia and extracted by MIBK. This is then analysed using a graphite furnace AA unit. Mercury analysis uses the solution extracted during the ICP digestion. The aliquots of the extract are added to a stannous chloride-hydrochloric acid solution. The reduced mercury is swept out of solution and passed into the mercury cell of a cold vapor AA using a F & J scientific mercury assembly.

Discussion of Results

The 1989 soil results are plotted along with earlier results on Plates 3-8. with the tighter line spacing some trends in the soil geochemistry are apparent. Silver seems to be the best element for tracing out the known epithermal mineralization. It indicates that a zone coinciding with the western most trenches (TR88-4, 5, 6) trends about 020° and extends over 300 meters along strike. The southern portion of this anomaly has not been followed up and is therefore a priority target for future work. This anomaly may extend an additional 200 meters south to line 51N where a 1.2 p.p.m. silver anomaly occurs. Similarly, the zone may extend northward through lines 57N and 60N where 0.4 p.p.m. silvers are located. This would give a possible strike length of 1100 meters which is still open to the north.

The anomaly associated with the eastern trenches (TR88-1, 2, 3; 89-10, 11) is confined to single silver and gold (different station) values on line 55+19N (reconn. line). No obvious extensions occur north or south of this area.

The trace elements commonly associated with epithermal precious metal occurrences show variable response. Arsenic and molybdenum show fair to good correlation with the precious metal anomalies while mercury and antimony appear independent.

Geochemical response is muted by the glacial till and overall, flat terrain. There appears to be minimal (<50 m) transporting of soil geochem anomalies due to glacial activity. Many of the precious metal highs are confined to a single station anomaly so sample spacings should be no greater than 25 meters. Earlier work may have failed to detect anomalies due to too wide (50 meter) a station spacing.

TRENCH SAMPLING/MAPPING

A total of four trenches were completed in 1989 (TR89-8, 9, 10, 11) with an aggregate length of 64.0 meters. Trenches were cleared of overburden, drilled on a 30 cm grid pattern and blasted. The rubble was then cleaned out and the fresh rock sampled, typically at 2.0 meter intervals. All samples were proper channels about 3.0 cm wide by 3.0 cm deep. Samples were sent to Acme Analytical Labs where they were pulverized and then analysed by the same methods described under "Soil Geochemistry" above.

Mapping was carried out at the same time as the sampling. All the trenched areas consist of cream coloured rhyolite to dacite of the Ootsa Lake Group. The rock has been subjected to varying degrees of silicification and argillic alteration. Silica is amorphous, occassionally banded (chalcedonic), and varies from nearly white to black apparently depending on the pyrite content. Silica occurs as veins, lenses, vugs and breccia (often healed by later silica). Pyrite is the only observable metallic comprising up to 5% of the host rock and commonly tr-1%. No direct relationship is evident between the pyrite and precious metal content although pyrite is part of the epithermal system.

Table 2: Trench Dimensions

Trench No.	Length (m)	Width (m)	Depth (m)
TR89-8	16.0	0.5	0.5
TR89-9	17.0	0.5	0.5
TR89-10	22.0	1.0	0.5-0.7
TR89-11	9.0*	1.0	0.3-0.6

(*Excludes TR88-2 in centre of trench)

Discussion of Results

The 1989 trench sampling results were very disappointing. Although the silicification and argillic alteration associated with the epithermal system are present, precious metals are noticeably absent. The highest gold value was 200 ppb and the highest silver value 4.5 ppm, both from sample 00215 in trench TR89-9. These results indicate that if further precious metal potential exists within the trenched areas it is around TR88-4 or at depth.

GEOPHYSICS

The only geophysics done on the claims in 1989 was a 600 meter resistivity test line using a Geonics EM-16 equipped with the resistivity meter attachment. Specifications and operating instructions for this instrument are included as Appendix II at the end of this report.

The resistivity survey results are shown on Plate No. 12. The line location was chosen to test the known areas of epithermal activity. The instrument was not expected to respond to the mineralization but rather to the silicification associated with it. It is apparent that the EM-16R effectively located the silicified zones, registering a 200 ohm-meter or greater reading in these areas. The test line indicates that additional resistivity surveying is warranted.

CONCLUSIONS

The soil sampling carried out in 1989 has outlined a zone of high silver concentration to the south of trench TR88-4. Followup of this area, initially with trenching and then possibly with drilling, is warranted.

The EM16R resistivity instrument appears to be effective at locating the silicified zones associated with the epithermal system. It should aid significantly in delineating these zones where the soil geochem response is poor or significant transporting of anomalies has occurred.

The 1989 trenching was unsuccessful at locating any new precious metal mineralization. It did however confirm the north northeasterly trend of the epithermal mineralization suggested by the soil geochemistry.

Although results have not been as encouraging as hoped on the Loon property it must be borne in mind the capriciousness of epithermal precious metal deposits. We may be in the upper part of the system where gold and silver values are extremely erratic (or absent) or on the flanks of more significant mineralization.

K.J. Taylor
Senior Project Geologist
Mingold Resources Inc.

SELECTED BIBLIOGRAPHY

Andrew, K. "Epithermal Precious Metal Mineralization in the Ootsa Lake Group, Wolf Prospect, Central British Columbia" Paper presented at the G.A.C. - Smithers Exploration Group Workshop; October, 1988.

Drobe, J. "Stratigraphy and Petrology of the Ootsa Lake Group in the Whitesail Range", Paper presented at the G.A.C. Smithers Exploration Group Workshop; October, 1988.

Taylor, K.J. "Geochemical and Geophysical Surveys, Mapping, Rock Sampling, trenching and Linecutting Loon 1-5, Loon 8 claims", Report for assessment March 1989."

Tipper, H.W. Nechako River Map-area, British Columbia", Geol. Surv. Can. Memoir 324; 1963.

Loon 1-3 Claims

STATEMENT OF EXPENDITURES

Personnel

K. Taylor - Geologist/Supervisor	$ 200/day
T. Roberts - Fieldman	$ 150/day
S. Soby - Contract Blaster	$ 252/day

Geochemical

Soil Sampling (Oct. 14, 15)

Analyses - 199 soil samples @ $14.85/sample	2,955.15
- 199 sample preps @ $.85/sample	169.15
Sampling - 1.5 man days @ $150/day	225.00
- 1.5 man days @ $252/day	378.00
Room/Board - 3 man days @ $25/man day	75.00
Supplies - bags, flagging, etc.	30.00
Shipping - 1/2 Beaver load @ $290/load	145.00
- Bus from Burns Lk to Vancouver	65.00

Trench (rock) Sampling (Oct. 14, 15, 16, 17)

Analysis- 33 channel samples @ $14.85/sample	490.05
- 33 sample preps @ $3.00/sample	99.00
Sampling- 2 man days @ $200/day	400.00
- 1 man day @ $150/day	150.00
Room/Board - 3 man days @ $25/man day	75.00
Supplies - included with soils above	-
Shipping - included with soils above	-

Geological

Trench Mapping (Oct. 14, 15, 16, 17)

Mapping four trenches - 2 man days @ $200/day	400.00
Room/Board - 2 man days @ $25/man day	50.00

Geophysical

EM-16R (Resistivity) Survey (Oct. 16)

1/2 man day @ $200/day	100.00
1 man day @ $150/day	150.00
Room/Board - 1.5 man days @ $25/man day	37.50

Physical

Trenching (Oct. 9, 10, 11, 12, 13, 14)

Overburden Removal - 2 man days @ $200/day	400.00
- 2 man days @ $150/day	150.00
Drilling - 1 man day @ $200/day	200.00
- 1 man day @ $150/day	150.00
Blasting - 3 man days @ $252/day	756.00
- Powder, fuse, caps	636.54
- Magazine Rental	165.00
Clean out - 1 man day @ $200/day	200.00
- 1 man day @ $150/day	150.00
- 1 man day @ $252/day	252.00
Room/Board - 12 man days @ $25/man day	300.00

Mob/Demob (Burns Lk - Loon Claims): Oct. 8, 11, 15, 18, 19

Mob into Loon - 2 Beaver loads @ $290/load	580.00
Travelling/camp construction - 1 man day @ $200/day	200.00
- 1 man day @ $150/day	150.00
Blaster Mob In (sep. flights for powder/caps on Oct. 11)	
- 1 Beaver load (split charter)	185.00
- 1 Cessna load @ $240/load	240.00
Blaster Demob - 1 Cessna load @ $240/load (Oct. 15)	240.00
Travelling for blaster - 2 man days @ $252/day	504.00
Demob to Burns - 1 1/2 Beaver loads @ $290/day	435.00
Travelling/Camp teardown - 1 man day @ $200/day	200.00
- 1 man day @ $150/day	150.00
Room/Board - 6 man days @ $25/man day	150.00

Report Preparation

Writing - 1.5 days @ $200/day	300.00
Drafting - 2 days @ $200/day	400.00
TOTAL	13,087.39

STATEMENT OF QUALIFICATIONS

I, Kenneth J. Taylor of 15732 - 92 B Avenue, Surrey, British Columbia do hereby certify that:

1. I am a geologist with a B.Sc. in Geology from the University of British Columbia, 1973.

2. I have practised my profession continuously since 1973.

3. I supervised and co-executed the 1989 field work on the Loon 1-3 Claims in the Omineca Mining Division.

4. I have been involved with exploration in the Ootsa Lake area since 1985. During this time I have worked on a number of epithermal gold/silver occurrences similar to that on the Loon.

5. I have examined the fieldwork on which this report is based and found it to conform to accepted standards within the mining industry.

K.J. Taylor
Senior Project Geologist
Mingold Resources Inc.
May 7, 1990

APPENDIX I

GEOCHEMICAL

ANALYSIS

CERTIFICATES

ACME ANALYTICAL LABORATORIES LTD. 852 E. HASTINGS ST. VANCOUVER B.C. V6A 1R6 PHONE(604)253-3158 FAX(604)253-1716

GEOCHEMICAL ANALYSIS CERTIFICATE

LOON

ICP - .500 GRAM SAMPLE IS DIGESTED WITH 3ML 3-1-2 HCL-HNO3-H2O AT 95 DEG. C FOR ONE HOUR AND IS DILUTED TO 10 ML WITH WATER.
THIS LEACH IS PARTIAL FOR MN FE SR CA P LA CR MG BA TI B W AND LIMITED FOR NA K AND AL. AU DETECTION LIMIT BY ICP IS 3 PPM.
- SAMPLE TYPE: P1-P6 SOIL P7 ROCK AU* ANALYSIS BY ACID LEACH/AA FROM 10 GM SAMPLE. HG ANALYSIS BY FLAMELESS AA.

DATE RECEIVED: OCT 23 1989 DATE REPORT MAILED: Nov 1/89 SIGNED BY. ....D.TOYE, C.LEONG, J.WANG; CERTIFIED B.C. ASSAYERS

Mingold Resources Inc. File # 89-4437 Page 1

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
65+00N 39+50E	1	12	14	66	.2	6	5	206	2.41	7	5	ND	1	22	1	2	2	47	.17	.029	14	17	.22	93	.10	2	1.40	.01	.03	2	1	10
65+00N 39+75E	1	13	13	73	.2	15	8	283	2.81	7	5	ND	2	16	1	2	2	50	.17	.092	12	20	.28	113	.10	7	1.92	.01	.03	1	1	20
65+00N 40+00E	1	15	10	72	.2	9	7	247	2.42	5	5	ND	1	27	1	2	2	40	.23	.049	15	15	.26	115	.07	2	1.71	.01	.04	1	1	10
65+00N 40+25E	1	12	10	59	.1	9	7	259	2.29	3	5	ND	1	18	1	2	2	41	.18	.031	10	14	.35	72	.10	4	1.36	.01	.04	1	2	5
65+00N 40+50E	1	13	12	64	.1	11	8	273	2.71	3	5	ND	1	25	1	2	2	46	.30	.064	15	18	.39	105	.09	2	1.76	.01	.04	1	1	5
65+00N 40+75E	1	11	9	92	.2	12	9	446	3.01	7	5	ND	1	17	1	2	2	52	.18	.087	10	17	.25	97	.08	3	1.76	.01	.04	1	1	10
65+00N 41+00E	1	21	12	117	.2	24	14	1216	3.71	3	5	ND	1	36	1	2	2	57	.30	.094	23	24	.39	178	.10	2	2.52	.01	.07	1	3	20
65+00N 41+25E	1	8	10	57	.1	6	4	185	1.72	2	5	ND	1	18	1	2	2	35	.20	.042	12	17	.20	61	.11	13	.91	.01	.03	1	1	5
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65+00N 42+50E	1	12	10	74	.1	14	10	228	3.27	6	5	ND	2	13	1	2	2	55	.12	.101	11	21	.29	91	.09	4	2.26	.01	.04	1	1	10
65+00N 42+75E	1	20	8	74	.3	14	6	316	2.13	2	5	ND	1	78	1	2	2	26	.77	.095	33	15	.35	182	.01	2	2.93	.01	.06	1	2	70
65+00N 43+00E	1	10	12	69	.1	12	8	217	3.26	5	5	ND	1	18	1	2	2	57	.14	.091	8	17	.22	99	.08	2	1.96	.01	.04	1	1	5
65+00N 43+25E	1	12	17	75	.1	8	7	181	3.97	6	5	ND	2	10	1	2	2	69	.10	.156	9	21	.15	68	.10	6	1.76	.01	.04	1	2	20
65+00N 43+50E	1	11	13	103	.1	19	10	216	3.60	6	5	ND	2	13	1	2	2	59	.09	.150	9	22	.26	105	.09	2	2.79	.01	.06	1	14	10
64+75N 41+50E	1	9	10	74	.1	11	6	193	2.04	5	5	ND	1	21	1	2	2	37	.27	.063	13	18	.30	91	.09	3	1.40	.01	.03	1	2	5
64+50N 41+50E	1	11	13	72	.1	8	6	218	2.38	2	5	ND	1	14	1	2	2	45	.17	.046	11	16	.27	61	.10	2	1.09	.01	.03	1	1	5
64+25N 41+50E	1	14	13	87	.2	11	11	691	2.90	6	5	ND	1	25	1	2	2	50	.24	.043	13	18	.38	100	.08	4	1.91	.01	.04	1	1	20
64+00N 39+50E	1	15	10	75	.3	12	10	335	2.90	3	5	ND	1	26	1	2	2	46	.19	.049	13	18	.33	121	.07	3	1.95	.01	.04	1	1	10
64+00N 39+75E	1	20	16	62	.1	15	8	323	3.22	7	5	ND	2	51	1	2	2	53	.41	.051	16	21	.51	140	.10	2	1.96	.02	.06	1	1	30
64+00N 40+00E	1	10	15	61	.1	9	6	202	2.27	2	5	ND	1	17	1	2	2	41	.18	.045	10	14	.29	70	.09	2	1.48	.01	.03	1	1	30
64+00N 40+25E	1	11	13	78	.1	12	8	295	2.85	4	5	ND	1	15	1	2	2	50	.15	.060	9	18	.29	94	.10	2	2.06	.01	.04	1	1	20
64+00N 40+50E	1	9	11	68	.1	11	8	275	2.92	4	5	ND	1	13	1	2	2	53	.14	.069	10	22	.25	91	.10	3	1.70	.01	.03	1	3	20
64+00N 40+75E	1	11	13	71	.1	10	8	641	2.51	3	5	ND	1	28	1	2	2	45	.25	.050	15	19	.30	99	.08	3	1.73	.01	.04	1	1	40
64+00N 41+00E	1	11	9	67	.1	10	7	293	2.41	7	5	ND	1	14	1	2	2	46	.15	.045	10	17	.24	78	.10	2	1.28	.01	.03	1	2	20
64+00N 41+25E	1	8	10	60	.1	7	5	208	1.90	2	5	ND	1	15	1	2	2	36	.17	.035	10	16	.22	61	.11	4	1.09	.01	.03	1	2	10
64+00N 41+50E	1	8	9	71	.1	7	6	344	1.97	2	5	ND	1	17	1	2	2	38	.20	.038	11	15	.25	60	.10	3	1.05	.01	.03	1	1	5
64+00N 41+75E	1	12	12	65	.1	10	8	446	2.36	6	5	ND	1	23	1	2	2	41	.23	.045	14	17	.34	87	.09	2	1.71	.01	.04	1	1	20
64+00N 42+00E	1	10	15	62	.1	10	6	204	2.22	4	5	ND	1	16	1	2	2	40	.17	.042	10	16	.29	87	.09	6	1.53	.01	.03	1	1	10
64+00N 42+25E	1	9	11	60	.1	8	6	210	2.46	5	5	ND	2	14	1	2	2	48	.15	.044	9	18	.27	69	.11	3	1.42	.01	.03	1	1	20
64+00N 42+50E	1	12	12	62	.1	12	8	225	3.21	4	5	ND	1	16	1	2	2	57	.15	.063	9	21	.32	97	.09	8	2.24	.01	.03	1	2	10
64+00N 42+75E	1	12	11	53	.1	10	7	255	2.43	2	5	ND	1	21	1	2	2	42	.21	.044	11	16	.33	78	.08	2	1.74	.01	.03	2	2	10
64+00N 43+00E	1	8	11	63	.1	10	6	184	2.13	2	5	ND	1	17	1	2	2	38	.16	.030	9	14	.26	85	.09	10	1.47	.01	.03	1	4	20
64+00N 43+25E	1	12	14	78	.2	13	10	841	2.86	5	5	ND	1	34	1	2	2	50	.25	.074	15	19	.28	136	.09	2	1.63	.01	.04	1	1	30
STD C/AU-S	18	61	43	132	6.6	67	31	1016	4.06	39	16	7	37	48	17	15	23	57	.49	.090	38	54	.89	175	.06	35	1.99	.06	.14	13	48	1400

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
64+00N 43+50E	1	8	10	63	.1	7	5	289	1.91	15	5	ND	1	15	1	2	2	36	.18	.062	9	11	.24	55	.08	2	1.15	.01	.04	1	2	10
63+75N 41+50E	1	8	12	75	.1	6	6	334	2.22	2	5	ND	1	12	1	2	2	43	.13	.034	10	16	.21	49	.11	7	1.32	.01	.02	1	1	5
63+50N 41+50E	1	8	12	56	.1	7	8	292	2.27	3	5	ND	1	17	1	2	2	42	.15	.030	9	13	.28	73	.09	6	1.52	.01	.03	1	2	5
63+25N 41+50E	1	11	11	80	.1	12	7	187	2.84	2	5	ND	1	20	1	2	2	49	.16	.060	10	16	.30	119	.09	7	2.55	.01	.03	2	1	10
63+00N 39+50E	1	8	12	94	.1	8	6	155	2.68	4	5	ND	1	14	1	2	2	48	.12	.094	9	15	.16	58	.09	2	1.81	.01	.04	1	1	5
63+00N 39+75E	1	9	13	89	.1	10	8	285	3.04	3	5	ND	1	17	1	2	2	55	.16	.103	12	18	.22	97	.10	6	2.18	.01	.05	1	1	10
63+00N 40+00E	1	10	8	133	.1	12	9	282	3.02	2	5	ND	1	10	1	2	2	46	.16	.223	9	17	.24	91	.09	7	2.60	.01	.04	1	240	30
63+00N 40+25E	1	7	12	52	.1	6	5	172	1.71	2	5	ND	1	27	1	2	2	34	.23	.029	14	13	.18	76	.10	8	.98	.01	.03	1	2	20
63+00N 40+50E	1	8	12	66	.1	10	8	190	2.51	2	5	ND	1	15	1	2	2	46	.18	.063	11	17	.30	97	.10	2	2.23	.01	.03	1	3	10
63+00N 40+75E	1	9	10	52	.1	7	5	182	1.83	2	5	ND	1	15	1	2	2	36	.17	.031	10	13	.25	60	.11	2	1.12	.01	.03	1	1	10
63+00N 41+00E	1	7	11	46	.1	7	6	192	1.90	8	5	ND	1	22	1	2	2	37	.16	.028	11	13	.31	95	.10	3	1.36	.01	.03	1	2	20
63+00N 41+25E	1	11	13	77	.1	15	11	354	2.89	3	5	ND	1	19	1	2	2	49	.21	.066	10	17	.46	90	.11	2	2.32	.01	.04	1	1	20
63+00N 41+50E	1	7	12	61	.1	8	6	216	2.35	2	5	ND	1	18	1	2	3	42	.16	.034	9	13	.22	75	.08	7	1.69	.01	.03	1	3	10
63+00N 41+75E	1	11	12	118	.1	18	11	719	2.89	4	5	ND	2	21	1	2	2	47	.23	.082	9	20	.37	105	.11	6	2.68	.01	.04	1	1	20
63+00N 42+00E	1	10	10	77	.1	12	8	288	3.24	2	5	ND	1	18	1	2	2	57	.24	.123	7	20	.25	71	.10	5	2.39	.01	.05	1	1	30
63+00N 42+25E	1	8	10	58	.1	8	7	202	2.16	3	5	ND	1	16	1	2	2	42	.18	.040	10	15	.30	60	.13	4	1.60	.01	.03	1	5	10
63+00N 42+50E	1	9	10	56	.1	11	6	199	2.17	4	5	ND	1	15	1	2	2	41	.16	.040	8	15	.28	60	.12	4	1.42	.01	.03	1	1	50
63+00N 42+75E	1	43	11	109	.1	26	11	171	4.45	2	5	ND	1	45	1	2	2	50	.34	.085	20	26	.53	225	.02	3	7.08	.01	.07	4	3	80
63+00N 43+00E	1	16	16	68	.1	14	7	165	2.61	16	5	ND	1	22	1	2	2	38	.18	.036	11	17	.37	105	.07	4	3.27	.01	.05	1	1	70
63+00N 43+25E	1	15	14	66	.1	10	6	165	2.19	2	5	ND	1	23	1	2	2	37	.22	.030	12	15	.35	97	.07	12	2.60	.01	.04	1	2	50
63+00N 43+50E	1	24	12	103	.1	19	17	630	4.41	2	5	ND	1	40	1	2	2	65	.35	.088	17	22	.51	174	.04	2	5.23	.01	.06	1	3	60
58+00N 45+00E	2	13	12	62	.1	16	8	230	2.63	12	5	ND	1	31	1	2	2	48	.26	.030	10	21	.45	80	.12	10	1.98	.01	.04	1	1	50
58+00N 45+25E	1	10	11	77	.1	8	8	383	2.49	8	5	ND	1	32	1	2	2	44	.26	.061	15	16	.30	91	.08	8	1.85	.01	.05	1	1	40
58+00N 45+50E	1	9	9	79	.1	9	7	279	2.04	4	5	ND	1	20	1	2	2	37	.19	.024	10	15	.30	62	.11	5	1.29	.01	.04	1	1	20
58+00N 45+75E	1	13	11	121	.2	16	11	992	2.60	3	5	ND	1	35	1	2	2	40	.30	.057	19	18	.42	109	.08	2	2.60	.01	.06	1	1	30
58+00N 46+00E	1	11	11	63	.1	9	8	301	2.15	8	5	ND	1	21	1	2	2	38	.21	.047	13	15	.29	83	.09	6	1.42	.01	.05	1	1	40
58+00N 46+25E	1	13	10	93	.1	22	12	659	3.01	4	5	ND	1	30	1	2	2	44	.26	.047	11	23	.72	104	.11	2	2.53	.01	.04	1	1	20
58+00N 46+50E	3	19	10	101	.4	22	14	413	3.68	16	5	ND	1	46	1	2	2	55	.34	.050	15	24	.69	113	.07	2	3.38	.01	.06	1	2	30
58+00N 46+75E	1	11	12	60	.2	10	8	300	2.11	6	5	ND	1	27	1	2	2	35	.23	.038	14	15	.32	74	.08	5	1.61	.01	.04	1	1	20
58+00N 47+00E	1	9	11	65	.2	10	5	203	1.99	8	5	ND	1	18	1	2	2	36	.16	.032	14	15	.25	65	.09	2	1.19	.01	.03	1	1	10
58+00N 47+25E	1	10	14	55	.6	8	5	186	1.93	20	5	ND	1	17	1	3	2	36	.15	.030	13	16	.28	64	.09	3	1.04	.01	.04	1	1	40
58+00N 47+50E	1	9	13	57	.2	6	5	162	1.69	10	5	ND	1	16	1	2	2	30	.14	.024	13	13	.24	62	.08	10	1.07	.01	.04	1	2	10
58+00N 47+75E	1	9	11	56	.1	10	6	221	1.97	9	5	ND	1	19	1	2	2	32	.19	.028	12	14	.29	65	.06	4	1.56	.01	.04	1	3	20
58+00N 48+00E	1	7	12	38	.1	7	4	143	1.45	8	5	ND	1	15	1	2	2	27	.16	.023	12	12	.26	55	.09	2	1.12	.01	.04	1	4	10
58+00N 48+25E	1	8	12	45	.1	9	5	188	1.74	9	5	ND	1	16	1	2	2	32	.17	.027	15	13	.25	47	.08	4	1.09	.01	.03	1	1	5
58+00N 48+50E	1	12	14	70	.1	12	9	408	2.31	10	5	ND	1	23	1	2	2	37	.21	.027	15	16	.36	76	.05	4	2.07	.01	.05	1	1	20
STD C/AU-S	18	58	37	133	7.2	68	30	923	4.03	38	18	7	36	47	18	14	20	57	.49	.089	37	55	.90	175	.06	34	1.99	.06	.14	12	49	1300

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
58+00N 48+75E	3	29	16	112	.3	18	24	1091	3.59	23	5	ND	1	31	1	2	2	44	.25	.128	18	25	.42	141	.01	2	3.36	.01	.09	2	5	70
58+00N 49+00E	2	10	14	57	.1	8	4	168	1.83	13	5	ND	1	24	1	2	2	31	.17	.038	15	15	.23	80	.06	2	1.26	.01	.05	1	4	20
58+00N 49+25E	1	7	13	44	.1	7	3	142	1.41	7	5	ND	1	13	1	2	4	26	.13	.022	14	16	.18	53	.08	2	.97	.01	.03	1	1	30
58+00N 49+50E	1	8	13	44	.1	5	4	160	1.41	9	5	ND	1	13	1	2	2	29	.11	.023	13	13	.16	53	.09	5	.81	.01	.03	1	1	20
58+00N 49+75E	1	5	12	41	.1	3	3	125	1.12	5	5	ND	1	13	1	2	2	23	.11	.016	13	9	.12	40	.07	2	.64	.01	.04	1	4	10
58+00N 50+00E	1	5	9	32	.1	1	2	113	.83	4	5	ND	1	14	1	2	2	17	.13	.013	14	8	.07	49	.06	2	.58	.01	.04	1	2	40
56+00N 46+50E	1	10	12	88	.1	11	7	257	2.26	9	5	ND	1	23	1	2	2	38	.23	.047	14	18	.26	85	.07	2	1.34	.01	.05	1	4	20
56+00N 46+75E	2	8	15	144	.3	10	9	636	2.47	18	5	ND	1	15	1	2	2	38	.12	.075	15	16	.14	97	.04	2	1.90	.01	.05	1	1	40
56+00N 47+00E	3	9	16	133	.2	6	4	492	2.15	34	5	ND	1	22	1	2	2	32	.07	.068	20	14	.12	95	.02	2	1.48	.01	.05	1	1	30
56+00N 47+25E	4	18	20	96	.4	12	7	280	2.48	41	5	ND	1	27	1	2	2	28	.16	.069	23	18	.29	150	.01	4	2.66	.01	.08	2	6	50
56+00N 47+50E	2	10	13	75	.2	7	5	495	2.10	20	5	ND	1	14	1	2	2	34	.12	.048	19	16	.15	71	.05	7	1.20	.01	.04	1	1	30
56+00N 47+75E	1	7	14	57	.1	6	3	278	1.61	13	5	ND	1	14	1	2	2	28	.16	.039	16	12	.17	55	.05	3	1.14	.01	.04	1	1	40
56+00N 48+00E	1	6	12	55	.1	6	3	146	1.28	4	5	ND	1	11	1	2	2	21	.12	.022	16	12	.20	46	.06	2	1.17	.01	.04	1	1	30
56+00N 48+25E	2	8	15	64	.1	6	4	157	1.81	16	5	ND	1	12	1	2	2	29	.12	.042	18	14	.18	54	.05	10	1.18	.01	.04	1	1	50
56+00N 48+50E	1	7	13	59	.1	6	4	182	1.50	8	5	ND	1	12	1	2	2	25	.13	.033	16	13	.19	58	.05	6	1.23	.01	.04	1	10	30
56+00N 48+75E	5	10	14	64	.2	5	4	172	2.01	19	5	ND	1	15	1	2	2	37	.12	.036	18	16	.18	87	.07	3	.95	.01	.05	1	14	20
56+00N 49+00E	3	6	13	30	.1	4	2	96	1.00	9	5	ND	1	11	1	2	2	19	.08	.012	17	9	.10	45	.06	4	.54	.01	.04	1	4	10
56+00N 49+25E	2	9	13	70	.1	6	4	207	1.92	18	5	ND	1	13	1	2	2	28	.11	.028	18	13	.18	56	.03	7	1.31	.01	.05	1	2	30
56+00N 49+50E	5	11	18	61	.5	5	4	111	3.10	57	5	ND	1	15	1	2	2	40	.05	.073	24	16	.13	92	.02	3	1.91	.01	.06	2	1	50
56+00N 49+75E	3	11	14	96	.1	9	5	232	2.53	32	5	ND	1	17	1	2	3	31	.13	.059	19	16	.27	73	.03	2	1.92	.01	.06	1	1	20
56+00N 50+00E	2	10	15	139	.2	9	6	248	2.50	24	5	ND	2	13	1	2	2	36	.08	.053	21	16	.21	91	.03	8	2.26	.01	.06	1	1	30
56+00N 50+25E	1	5	11	39	.1	2	2	121	1.04	8	5	ND	1	10	1	2	3	20	.08	.020	19	8	.06	39	.04	2	.63	.01	.04	1	2	20
56+00N 50+50E	3	13	19	80	.1	8	6	196	2.40	17	5	ND	1	24	1	2	2	32	.17	.048	22	16	.30	96	.03	7	1.93	.01	.08	1	1	30
56+00N 50+75E	4	11	15	99	.3	7	17	1779	2.60	13	5	ND	1	17	1	2	2	32	.13	.073	20	16	.21	91	.01	2	2.00	.01	.07	1	9	10
56+00N 51+00E	1	4	10	22	.1	1	1	94	.68	2	5	ND	1	9	1	2	2	16	.07	.014	15	7	.04	45	.04	2	.51	.01	.02	1	1	10
56+00N 51+25E	2	21	20	95	.2	16	7	220	2.74	15	5	ND	1	26	1	2	2	31	.20	.059	23	24	.40	173	.01	2	3.27	.01	.08	1	1	20
56+00N 51+50E	2	8	12	52	.2	6	4	136	1.55	12	5	ND	1	14	1	2	2	25	.12	.037	15	12	.15	69	.04	2	1.16	.01	.04	1	1	10
56+00N 51+75E	1	11	17	66	.1	8	6	260	2.16	12	5	ND	1	18	1	2	2	39	.15	.036	16	16	.26	70	.09	4	1.44	.01	.04	1	1	20
56+00N 52+00E	1	10	12	53	.6	7	4	148	1.71	14	5	ND	1	19	1	2	2	29	.17	.032	19	14	.17	65	.05	3	1.15	.01	.04	1	1	30
56+00N 52+25E	2	6	11	31	.1	4	2	111	1.05	7	5	ND	1	10	1	2	2	22	.11	.016	15	10	.07	41	.06	9	.64	.01	.03	1	1	10
56+00N 52+50E	2	10	17	71	.1	10	5	194	2.05	8	5	ND	1	17	1	2	3	36	.18	.044	11	18	.21	77	.09	2	1.43	.01	.04	1	1	20
56+00N 52+75E	3	28	17	131	.2	18	14	674	3.80	10	5	ND	1	45	1	2	2	44	.37	.138	22	25	.47	242	.01	4	4.56	.01	.10	1	1	50
56+00N 53+00E	3	22	9	95	.1	16	11	331	3.30	9	5	ND	1	30	1	2	2	45	.26	.065	17	24	.45	156	.04	2	3.32	.01	.07	1	1	20
56+00N 53+25E	3	20	12	101	.1	19	10	292	2.82	9	5	ND	1	35	1	2	2	33	.32	.085	16	26	.47	156	.03	2	3.52	.01	.08	1	1	30
56+00N 53+50E	2	9	13	103	.1	13	9	185	2.88	6	5	ND	2	13	1	2	2	46	.12	.094	11	22	.20	90	.09	7	2.41	.01	.04	1	1	20
56+00N 53+75E	2	8	16	55	.1	8	6	201	1.89	7	5	ND	1	13	1	2	2	37	.14	.030	13	16	.25	65	.11	2	1.02	.01	.05	1	2	30
STD C/AU-S	18	63	41	132	7.1	68	31	1024	4.08	40	22	7	37	47	18	16	22	58	.50	.090	38	55	.91	175	.06	34	1.97	.06	.14	12	51	1300

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
56+00N 54+00E	1	7	14	68	.1	11	5	207	2.30	4	5	ND	1	18	1	2	2	47	.19	.048	9	18	.25	76	.12	2	1.72	.01	.04	1	1	20
56+00N 54+25E	1	6	14	72	.1	7	6	398	1.79	6	5	ND	1	19	1	2	2	37	.20	.033	13	15	.25	70	.09	4	1.25	.01	.04	1	2	10
56+00N 54+50E	1	11	13	74	.1	13	7	222	2.53	6	5	ND	1	36	1	2	2	46	.37	.047	15	21	.34	105	.10	7	1.86	.01	.05	1	2	10
56+00N 55+00E	2	12	18	104	.1	15	8	327	2.26	17	5	ND	1	34	1	2	2	41	.39	.040	18	22	.38	140	.07	2	2.37	.02	.05	1	3	30
56+00N 55+25E	1	7	9	55	.1	8	5	180	1.88	5	5	ND	1	17	1	2	2	42	.17	.030	11	18	.27	67	.13	2	1.32	.01	.03	1	1	5
56+00N 55+50E	1	9	16	64	.1	11	6	235	2.37	7	5	ND	2	19	1	2	2	47	.22	.065	14	24	.34	85	.12	2	1.75	.01	.04	1	1	10
56+00N 55+75E	1	14	31	140	.3	22	9	247	3.80	13	5	ND	1	16	2	2	2	53	.18	.109	9	29	.47	104	.09	3	4.45	.01	.07	1	1	20
56+00N 56+25E	1	7	18	56	.1	9	4	194	1.91	8	5	ND	1	18	1	2	2	42	.19	.035	13	17	.27	79	.12	3	1.51	.01	.04	1	1	10
56+00N 56+50E	2	12	19	84	.2	14	8	334	2.90	5	5	ND	1	32	1	2	2	44	.28	.063	18	22	.35	175	.06	4	2.83	.01	.06	1	1	20
56+00N 56+75E	1	12	19	121	.1	19	9	531	3.76	15	5	ND	1	21	1	2	2	58	.22	.131	11	26	.32	157	.09	2	3.66	.01	.05	3	1	20
56+00N 57+00E	1	12	34	95	.1	14	8	321	2.65	7	5	ND	1	27	1	2	2	42	.28	.068	14	24	.40	128	.07	2	2.65	.01	.05	1	1	10
56+00N 57+25E	1	11	10	69	.1	13	7	230	2.49	4	5	ND	1	22	1	2	2	49	.22	.041	11	22	.32	94	.14	5	1.90	.01	.03	1	1	5
56+00N 57+50E	1	9	15	77	.1	13	6	267	2.57	2	5	ND	1	17	1	2	3	54	.19	.050	9	22	.28	62	.15	2	1.63	.01	.03	1	2	5
53+00N 48+50E	1	8	17	55	.1	15	7	214	2.30	5	5	ND	1	24	1	2	2	47	.26	.021	12	24	.45	72	.12	2	2.24	.02	.04	1	1	10
53+00N 49+00E	5	15	29	145	.4	19	14	786	5.16	25	5	ND	1	33	1	2	2	82	.30	.133	11	34	.39	144	.11	6	2.63	.01	.05	1	1	30
53+00N 49+25E	5	13	14	82	.1	18	8	370	2.99	12	5	ND	1	29	1	2	2	50	.29	.059	15	28	.46	110	.11	2	2.15	.01	.05	1	1	10
53+00N 49+50E	6	14	23	81	.1	14	7	263	2.56	11	5	ND	1	35	1	2	2	43	.42	.064	17	24	.43	108	.09	2	2.29	.02	.06	1	9	20
53+00N 49+75E	6	35	24	52	.2	28	7	110	4.32	6	5	ND	1	37	1	2	2	60	.55	.043	25	33	.47	191	.06	3	5.00	.02	.05	1	3	30
53+00N 50+00E	1	16	21	168	.2	21	11	253	3.79	7	5	ND	1	15	1	2	2	63	.17	.126	9	31	.33	112	.11	2	3.45	.01	.04	1	1	40
53+00N 50+25E	1	14	9	114	.2	23	12	260	4.12	9	5	ND	2	23	1	2	3	74	.22	.086	10	33	.39	94	.15	2	2.50	.01	.06	1	1	20
53+00N 50+50E	4	13	20	89	1.0	18	8	365	3.67	40	5	ND	1	12	1	2	2	58	.10	.086	13	25	.29	94	.09	2	2.84	.01	.05	1	4	30
53+00N 50+75E	62	18	30	130	4.7	18	9	384	4.65	97	5	ND	2	14	1	2	2	68	.09	.119	17	29	.34	123	.06	2	3.93	.01	.07	1	3	50
53+00N 51+00E	5	13	20	118	2.0	22	9	303	3.51	25	5	ND	1	14	1	2	2	54	.12	.110	14	25	.32	110	.08	5	3.26	.01	.05	1	1	80
53+00N 51+25E	22	14	37	184	1.6	10	6	373	5.44	324	5	ND	2	47	1	2	2	52	.08	.163	19	20	.22	332	.03	2	3.11	.02	.16	1	1	70
53+00N 51+50E	1	10	23	108	.5	17	8	356	2.93	17	5	ND	1	16	1	2	3	50	.12	.098	11	24	.23	101	.09	6	2.71	.01	.04	1	1	20
53+00N 51+75E	2	12	9	82	.1	19	10	241	3.66	4	5	ND	2	21	2	2	2	65	.19	.088	9	26	.35	126	.13	2	3.00	.01	.04	1	1	10
53+00N 52+00E	1	9	20	65	.1	13	7	202	2.59	6	5	ND	1	19	1	2	3	48	.21	.054	10	20	.34	117	.12	2	2.36	.01	.04	1	1	10
53+00N 52+25E	1	8	14	112	.1	13	7	305	2.63	10	5	ND	1	21	1	2	2	51	.20	.044	10	22	.34	90	.15	10	1.79	.01	.04	1	1	20
53+00N 52+50E	1	10	8	112	.1	18	11	368	3.47	6	5	ND	1	27	1	2	2	58	.27	.066	8	27	.52	100	.16	2	1.95	.02	.04	1	1	10
53+00N 52+75E	1	8	13	51	.1	12	6	252	2.18	7	5	ND	1	22	1	2	2	45	.22	.030	9	20	.38	64	.13	11	1.53	.01	.03	1	1	5
53+00N 53+00E	2	32	25	107	.2	32	14	393	5.80	12	5	ND	1	45	1	2	2	75	.38	.065	17	41	.70	162	.05	6	5.13	.02	.08	1	1	40
53+00N 53+25E	1	7	19	54	.1	10	5	250	1.84	8	5	ND	1	20	1	2	2	39	.20	.039	17	18	.29	64	.11	13	1.39	.01	.04	1	1	10
53+00N 53+50E	1	8	18	59	.1	10	5	243	1.92	9	5	ND	1	22	1	2	3	40	.21	.028	16	17	.31	74	.09	6	1.51	.01	.04	1	1	20
53+00N 53+75E	1	12	18	72	.1	13	7	310	2.29	11	5	ND	1	26	1	2	2	39	.24	.049	17	22	.38	101	.06	3	2.15	.01	.06	1	2	20
53+00N 54+00E	1	7	16	48	.1	7	4	197	1.67	6	5	ND	1	19	1	2	3	36	.18	.031	14	17	.28	64	.10	2	1.32	.01	.03	1	3	10
53+00N 54+25E	1	7	12	41	.1	10	3	190	1.68	10	5	ND	1	19	1	2	4	35	.18	.028	15	17	.29	63	.08	4	1.39	.01	.04	1	1	5
STD C/AU-S	17	62	42	132	7.7	67	31	1023	4.26	44	17	6	36	45	19	16	22	58	.48	.099	35	56	.87	173	.06	35	1.97	.06	.14	12	51	1400

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
53+00N 54+50E	1	13	13	57	.2	14	7	461	2.17	9	5	ND	1	33	1	2	2	38	.29	.038	17	19	.35	95	.07	4	1.71	.01	.06	1	4	60
53+00N 54+75E	1	10	13	58	.2	10	5	218	1.90	5	5	ND	1	21	1	2	3	37	.20	.017	13	16	.30	63	.11	4	1.26	.01	.03	1	2	30
53+00N 55+00E	2	17	15	109	.2	17	12	946	3.32	7	5	ND	1	29	1	2	2	51	.21	.047	15	23	.43	134	.05	2	3.04	.01	.06	1	1	20
53+00N 55+25E	2	28	18	110	.2	28	16	903	4.26	19	5	ND	1	54	1	2	2	61	.39	.077	24	34	.61	212	.02	2	4.54	.01	.09	3	22	50
53+00N 55+50E	2	28	19	119	.3	25	16	819	4.25	11	5	ND	1	45	1	2	2	58	.32	.071	23	29	.56	203	.03	2	4.87	.01	.09	1	7	30
53+00N 55+75E	1	12	12	61	.2	12	7	251	2.42	3	5	ND	1	24	1	2	2	44	.22	.030	11	22	.34	77	.12	5	1.83	.01	.03	1	2	20
53+00N 56+00E	1	16	15	78	.2	17	8	254	2.71	6	5	ND	1	22	1	2	2	44	.22	.045	12	22	.41	99	.08	3	2.53	.01	.04	1	5	10
53+00N 56+25E	1	15	12	71	.2	17	8	245	2.40	4	5	ND	1	24	1	2	3	43	.24	.031	12	21	.37	79	.10	10	1.79	.01	.04	1	3	20
53+00N 56+50E	1	11	13	66	.1	12	6	232	2.11	4	5	ND	1	42	1	2	3	39	.31	.033	16	20	.36	95	.09	3	1.56	.01	.04	1	2	30
53+00N 56+75E	2	23	22	116	.1	29	14	441	4.23	3	5	ND	1	28	1	2	2	63	.23	.045	11	29	.64	134	.05	7	4.53	.01	.05	1	3	30
53+00N 57+00E	1	15	14	78	.1	18	9	214	2.99	5	5	ND	1	21	1	2	4	52	.20	.050	9	25	.41	73	.12	2	2.47	.01	.03	1	4	40
53+00N 57+25E	3	31	16	121	.2	31	14	347	4.87	12	5	ND	1	35	1	2	2	71	.25	.070	13	32	.66	177	.05	3	5.19	.01	.08	1	1	20
53+00N 57+50E	1	10	12	77	.1	20	10	185	3.26	9	5	ND	2	13	1	2	2	51	.11	.086	10	24	.27	104	.10	5	2.76	.01	.04	1	3	40
50+00N 44+00E	1	8	8	50	.1	10	5	192	1.84	5	5	ND	1	19	1	2	2	35	.22	.047	15	16	.24	78	.10	11	1.18	.01	.03	1	3	20
50+00N 44+25E	1	8	13	67	.1	10	5	232	1.87	2	5	ND	1	24	1	2	2	37	.24	.029	13	19	.27	75	.13	3	1.29	.01	.03	1	3	30
50+00N 44+50E	1	11	15	58	.1	12	7	386	1.94	5	5	ND	1	31	1	2	2	35	.32	.044	17	20	.34	99	.11	13	1.69	.02	.05	1	8	40
50+00N 44+75E	1	13	12	86	.1	14	9	421	2.74	7	5	ND	1	26	1	2	2	51	.23	.034	12	20	.35	85	.12	13	1.82	.01	.04	1	6	20
50+00N 45+00E	2	19	9	84	.1	18	8	365	2.89	5	5	ND	2	41	1	2	2	45	.40	.050	33	23	.29	123	.08	8	3.03	.02	.04	1	5	50
50+00N 45+25E	3	32	21	101	.2	28	14	1389	4.30	11	8	ND	2	65	1	2	2	67	.68	.060	44	34	.58	220	.06	2	4.26	.02	.07	1	3	40
50+00N 45+50E	1	14	13	76	.1	13	7	311	2.63	7	5	ND	1	25	1	2	2	48	.23	.039	12	20	.33	92	.10	2	2.07	.01	.03	1	5	20
50+00N 45+75E	1	8	11	53	.1	12	5	199	1.77	2	5	ND	1	19	1	2	2	34	.20	.028	12	18	.26	65	.12	9	1.26	.01	.03	1	3	30
50+00N 46+00E	1	9	11	55	.1	10	6	220	2.06	3	5	ND	1	20	1	2	2	40	.20	.028	11	19	.29	58	.13	5	1.40	.01	.03	1	1	50
50+00N 46+25E	1	10	13	50	.1	12	5	217	1.81	5	5	ND	1	21	1	2	2	33	.23	.039	13	18	.29	76	.13	5	1.47	.01	.03	1	3	40
50+00N 46+50E	1	17	15	83	.1	19	12	668	3.16	5	5	ND	1	40	1	2	2	54	.37	.053	15	24	.50	119	.09	4	3.01	.01	.06	1	2	30
50+00N 46+75E	1	9	14	68	.1	9	7	395	2.00	3	5	ND	1	16	1	2	2	42	.15	.033	14	20	.20	60	.13	3	1.28	.01	.03	1	1	20
50+00N 47+00E	1	6	14	45	.1	7	4	153	1.28	2	5	ND	1	14	1	2	2	27	.14	.020	11	14	.16	45	.13	13	1.08	.01	.03	1	3	20
50+00N 47+25E	1	11	13	60	.1	13	8	265	3.14	4	5	ND	2	13	1	2	2	55	.11	.109	10	22	.21	61	.11	3	1.97	.01	.04	1	2	30
50+00N 47+50E	1	11	12	67	.1	12	7	203	2.51	2	5	ND	1	30	1	2	2	42	.30	.063	14	21	.31	88	.11	3	2.05	.01	.05	1	3	10
50+00N 47+75E	1	12	14	74	.1	16	9	253	2.93	5	5	ND	2	25	1	2	2	53	.25	.060	11	24	.42	110	.13	4	2.36	.01	.04	1	2	10
50+00N 48+00E	1	15	13	100	.1	22	13	621	3.67	4	5	ND	2	26	1	2	2	60	.21	.109	11	28	.40	137	.12	10	3.41	.01	.04	1	6	30
50+00N 48+25E	1	17	14	114	.1	22	11	236	3.19	7	5	ND	2	21	1	2	2	52	.18	.065	11	26	.36	139	.11	5	3.10	.01	.04	1	5	30
50+00N 48+50E	1	14	14	68	.1	17	9	333	2.77	5	5	ND	2	29	1	2	2	50	.33	.066	13	27	.47	88	.15	7	2.25	.02	.05	1	3	20
50+00N 48+75E	1	16	14	73	.1	17	9	331	2.62	2	5	ND	1	40	1	2	3	44	.41	.053	20	26	.46	137	.09	8	2.76	.02	.06	1	4	40
50+00N 49+00E	2	26	14	99	.1	23	12	584	3.34	4	5	ND	1	58	1	2	2	47	.54	.080	24	30	.52	195	.04	8	4.43	.02	.07	1	4	60
50+00N 49+25E	1	13	10	59	.1	13	6	216	2.20	5	5	ND	1	29	1	2	2	36	.31	.043	17	23	.40	120	.09	4	2.48	.01	.05	1	3	30
50+00N 49+50E	1	14	11	66	.1	16	7	327	2.11	3	5	ND	1	29	1	2	2	35	.30	.044	17	26	.36	112	.09	4	2.25	.02	.05	1	4	20
STD C/AU-S	18	60	42	132	6.6	68	30	1023	4.00	41	20	7	37	48	18	15	22	57	.48	.088	38	54	.88	175	.06	34	1.99	.06	.14	12	48	1300

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
50+00N 49+75E	2	29	7	83	.1	21	7	221	2.86	2	5	ND	1	46	1	2	2	31	.47	.091	27	27	.48	202	.02	2	3.96	.01	.07	1	4	80
50+00N 50+00E	1	15	10	43	.1	11	5	178	1.56	6	5	ND	2	26	1	2	3	29	.31	.050	18	17	.27	100	.10	2	1.22	.02	.04	1	4	20
50+00N 50+25E	1	9	14	49	.1	8	4	129	1.32	2	5	ND	1	21	1	2	4	28	.22	.020	12	17	.19	67	.11	2	1.06	.01	.03	1	2	20
50+00N 50+50E	1	11	11	49	.1	9	6	174	1.67	2	5	ND	1	20	1	2	2	31	.23	.037	13	17	.27	107	.10	2	1.50	.01	.02	1	1	10
50+00N 50+75E	1	17	12	63	.1	16	8	215	2.87	3	5	ND	2	21	1	2	3	44	.22	.067	15	22	.38	114	.09	3	2.63	.01	.04	1	1	20
50+00N 51+00E	1	12	13	63	.1	11	6	171	2.27	2	5	ND	1	16	1	2	2	37	.16	.045	12	20	.29	97	.09	2	2.36	.01	.03	1	1	10
50+00N 51+25E	1	12	13	64	.1	13	7	199	2.60	2	5	ND	1	22	1	2	2	47	.21	.060	12	20	.30	117	.10	2	2.01	.01	.03	1	1	20
50+00N 51+50E	1	11	9	56	.1	12	6	199	2.04	2	5	ND	2	25	1	2	2	36	.27	.039	15	19	.36	98	.11	2	1.55	.01	.03	1	1	5
50+00N 51+75E	1	12	9	72	.1	12	7	460	2.56	7	5	ND	1	29	1	2	2	39	.35	.054	17	19	.34	80	.09	2	1.65	.02	.04	1	1	10
50+00N 52+00E	4	26	11	93	.1	21	8	499	4.78	27	5	ND	1	47	1	2	2	54	.50	.129	37	29	.38	108	.03	3	3.10	.01	.06	1	1	60
50+00N 55+25E	1	21	9	80	.2	16	9	363	2.91	2	5	ND	1	37	1	2	2	47	.34	.058	16	23	.45	115	.07	3	2.41	.01	.05	1	1	10
50+00N 55+50E	1	20	10	70	.2	17	7	313	2.69	6	5	ND	2	33	1	2	2	46	.31	.057	15	20	.45	106	.09	2	1.94	.01	.06	1	1	20
50+00N 55+75E	1	13	10	58	.1	12	6	245	2.18	4	5	ND	2	23	1	2	2	39	.26	.049	15	20	.32	74	.10	2	1.30	.01	.04	1	1	5
50+00N 56+00E	1	14	10	67	.1	13	9	497	2.41	4	5	ND	2	27	1	2	2	43	.25	.041	14	21	.37	89	.10	4	1.70	.01	.04	1	1	10
50+00N 56+25E	1	15	11	84	.1	15	10	453	2.79	6	5	ND	2	24	1	2	2	50	.24	.051	11	25	.41	82	.12	2	1.80	.01	.04	1	2	20
50+00N 56+50E	2	34	15	124	.2	28	35	2723	4.44	2	5	ND	1	59	1	2	2	63	.45	.095	25	33	.60	211	.05	2	4.39	.01	.06	1	1	40
50+00N 56+75E	1	23	8	99	.1	22	15	775	3.47	2	5	ND	1	35	1	2	2	54	.32	.100	13	27	.52	109	.08	6	2.95	.01	.05	1	2	30
50+00N 57+00E	1	15	11	71	.1	17	8	265	2.65	2	5	ND	1	26	1	3	2	47	.26	.037	11	23	.43	92	.11	3	2.08	.01	.04	1	1	10
50+00N 57+25E	1	14	14	92	.2	14	7	190	2.35	4	5	ND	1	21	1	2	3	41	.22	.034	10	21	.28	90	.11	4	1.98	.01	.03	1	2	20
50+00N 57+50E	1	15	12	97	.2	19	9	177	3.23	2	5	ND	1	13	1	2	2	52	.12	.079	9	25	.29	105	.09	2	3.14	.01	.03	1	1	30
STD C/AU-S	18	62	39	132	6.5	67	31	1009	3.99	39	22	7	37	47	17	15	21	56	.48	.088	37	55	.88	174	.06	36	1.94	.06	.14	13	48	1300

SAMPLE#	Mo PPM	Cu PPM	Pb PPM	Zn PPM	Ag PPM	Ni PPM	Co PPM	Mn PPM	Fe %	As PPM	U PPM	Au PPM	Th PPM	Sr PPM	Cd PPM	Sb PPM	Bi PPM	V PPM	Ca %	P %	La PPM	Cr PPM	Mg %	Ba PPM	Ti %	B PPM	Al %	Na %	K %	W PPM	Au* PPB	Hg PPB
C 00101	7	3	8	6	.8	4	1	11	.48	88	5	ND	4	5	1	4	2	1	.01	.004	22	4	.01	39	.01	2	.12	.01	.12	1	1	80
C 00102	4	4	7	8	.2	5	1	13	.27	31	5	ND	5	6	1	2	2	1	.01	.005	24	5	.01	37	.01	2	.20	.01	.13	1	9	20
C 00103	3	6	8	8	.4	4	1	8	.38	45	5	ND	5	6	1	2	2	1	.01	.004	28	3	.01	51	.01	2	.23	.01	.16	1	19	50
C 00104	5	3	12	9	.9	4	1	12	.43	115	5	ND	5	5	1	4	2	1	.01	.004	31	4	.01	43	.01	2	.15	.01	.14	1	32	110
C 00105	7	4	8	5	1.1	4	1	6	.46	95	5	ND	3	5	1	7	2	1	.01	.003	19	4	.01	44	.01	2	.13	.01	.14	1	34	120
C 00106	5	4	11	8	.6	4	1	15	.39	58	5	ND	4	6	1	2	2	1	.01	.005	27	4	.01	60	.01	2	.14	.01	.14	1	14	60
C 00107	5	5	7	6	.5	7	1	17	.45	48	5	ND	5	6	1	3	2	1	.01	.003	22	6	.01	37	.01	2	.15	.01	.13	1	2	150
C 00108	3	4	9	6	.4	5	1	11	.27	20	5	ND	5	3	1	2	2	1	.01	.005	22	4	.01	27	.01	3	.14	.01	.11	1	7	50
C 00109	3	4	8	4	.2	5	1	13	.27	13	5	ND	6	3	1	2	2	1	.01	.005	24	5	.01	35	.01	2	.18	.01	.14	1	2	90
C 00110	6	6	9	11	1.4	6	1	14	.54	160	5	ND	5	4	1	5	2	1	.01	.004	28	6	.01	35	.01	2	.17	.01	.15	1	2	110
C 00111	2	5	8	8	.4	4	1	8	.33	38	5	ND	5	4	1	2	2	1	.03	.003	29	4	.01	41	.01	2	.27	.01	.14	1	1	120
C 00204	7	4	8	10	.3	6	1	10	.39	74	5	ND	4	4	1	3	2	1	.01	.004	29	4	.01	46	.01	3	.23	.01	.15	1	23	60
C 00205	3	2	6	6	.3	5	1	11	.46	88	5	ND	4	3	1	3	2	1	.01	.003	25	3	.01	53	.01	2	.23	.01	.16	1	5	80
C 00206	14	4	8	8	2.5	4	1	9	.44	90	5	ND	4	3	1	5	2	1	.01	.004	29	4	.01	76	.01	2	.20	.01	.13	1	20	70
C 00207	19	3	7	3	1.2	3	1	7	.34	59	5	ND	5	3	1	4	2	1	.01	.003	28	3	.01	63	.01	2	.21	.01	.13	1	13	90
C 00208	21	3	8	6	2.0	8	1	13	.44	95	5	ND	4	3	1	6	2	1	.01	.005	25	12	.01	59	.01	5	.21	.01	.12	1	28	120
C 00209	5	2	4	4	.3	3	1	10	.28	63	5	ND	5	3	1	4	2	1	.01	.006	34	2	.01	47	.01	2	.17	.01	.11	1	23	70
C 00210	4	3	7	3	.4	3	1	6	.26	84	5	ND	6	3	1	2	2	1	.01	.005	32	3	.01	76	.01	5	.24	.01	.13	1	11	40
C 00211	10	2	12	5	.7	3	1	6	.44	136	5	ND	6	3	1	6	2	1	.01	.006	39	3	.01	57	.01	6	.22	.01	.14	1	10	80
C 00212	6	3	8	5	.3	4	1	9	.37	85	5	ND	3	3	1	4	2	1	.01	.004	30	4	.01	56	.01	2	.23	.01	.15	1	1	30
C 00213	4	5	4	5	.4	4	1	12	.39	94	5	ND	5	2	1	3	2	1	.01	.003	24	4	.01	76	.01	2	.22	.01	.14	1	3	40
C 00214	5	3	7	6	.5	3	1	8	.34	63	5	ND	4	2	1	3	2	1	.01	.004	26	3	.01	53	.01	2	.24	.01	.15	1	3	10
C 00215	29	4	6	8	4.5	5	1	11	.54	89	5	ND	5	4	1	5	2	1	.01	.006	25	4	.01	61	.01	2	.24	.01	.13	1	200	60
C 00216	6	1	4	4	.7	3	1	8	.36	74	5	ND	6	3	1	5	2	1	.01	.006	30	3	.01	51	.01	2	.25	.01	.14	1	12	30
C 00217	8	3	9	4	.7	3	1	14	.40	82	5	ND	6	3	1	3	2	1	.01	.005	37	3	.01	56	.01	12	.24	.01	.15	1	15	40
C 00218	27	5	8	5	2.5	4	1	7	.45	98	5	ND	4	3	1	2	2	1	.01	.011	23	3	.01	129	.01	2	.21	.01	.13	1	44	60
C 00219	22	4	9	18	1.7	5	1	10	.56	138	5	ND	4	3	1	9	2	1	.01	.007	28	4	.01	45	.01	2	.20	.01	.13	1	25	120
C 00220	5	4	9	30	.7	4	1	11	.57	80	5	ND	5	4	1	8	2	1	.01	.005	26	5	.01	59	.01	2	.21	.01	.14	1	2	90
C 00221	8	7	10	13	1.1	7	1	34	.77	120	5	ND	3	16	1	6	2	2	.01	.011	21	6	.01	76	.01	5	.14	.01	.12	1	1	80
C 00222	6	6	12	12	.9	2	1	10	.65	130	5	ND	4	7	1	6	2	1	.01	.009	28	3	.01	53	.01	2	.15	.01	.13	1	8	120
C 00223	5	4	12	6	.6	5	1	19	.51	63	5	ND	4	5	1	3	2	1	.01	.006	28	4	.01	51	.01	2	.15	.01	.15	1	19	70
C 00224	7	5	13	12	.9	5	1	10	.55	99	5	ND	5	5	1	6	2	1	.01	.005	32	5	.01	50	.01	12	.14	.01	.13	1	3	110
C 00225	4	5	8	8	.4	5	1	15	.57	78	5	ND	4	3	1	2	2	1	.01	.005	26	5	.01	45	.01	2	.17	.01	.13	1	1	100
STD C/AU-R	18	60	45	132	6.6	68	31	1030	4.13	41	20	7	37	48	18	15	18	58	.50	.092	38	55	.91	175	.06	34	1.97	.06	.14	12	510	1300

APPENDIX II

EM16R OPERATING MANUAL

GEONICS LIMITED
1745 Meyerside Drive, Unit 8, Mississauga, Ontario, Canada L5T 1C5 Tel. (416) 676-9580 Cables: Geonics

OPERATING MANUAL

for

EM16R VLF RESISTIVITY METER
(Attachment to EM16)

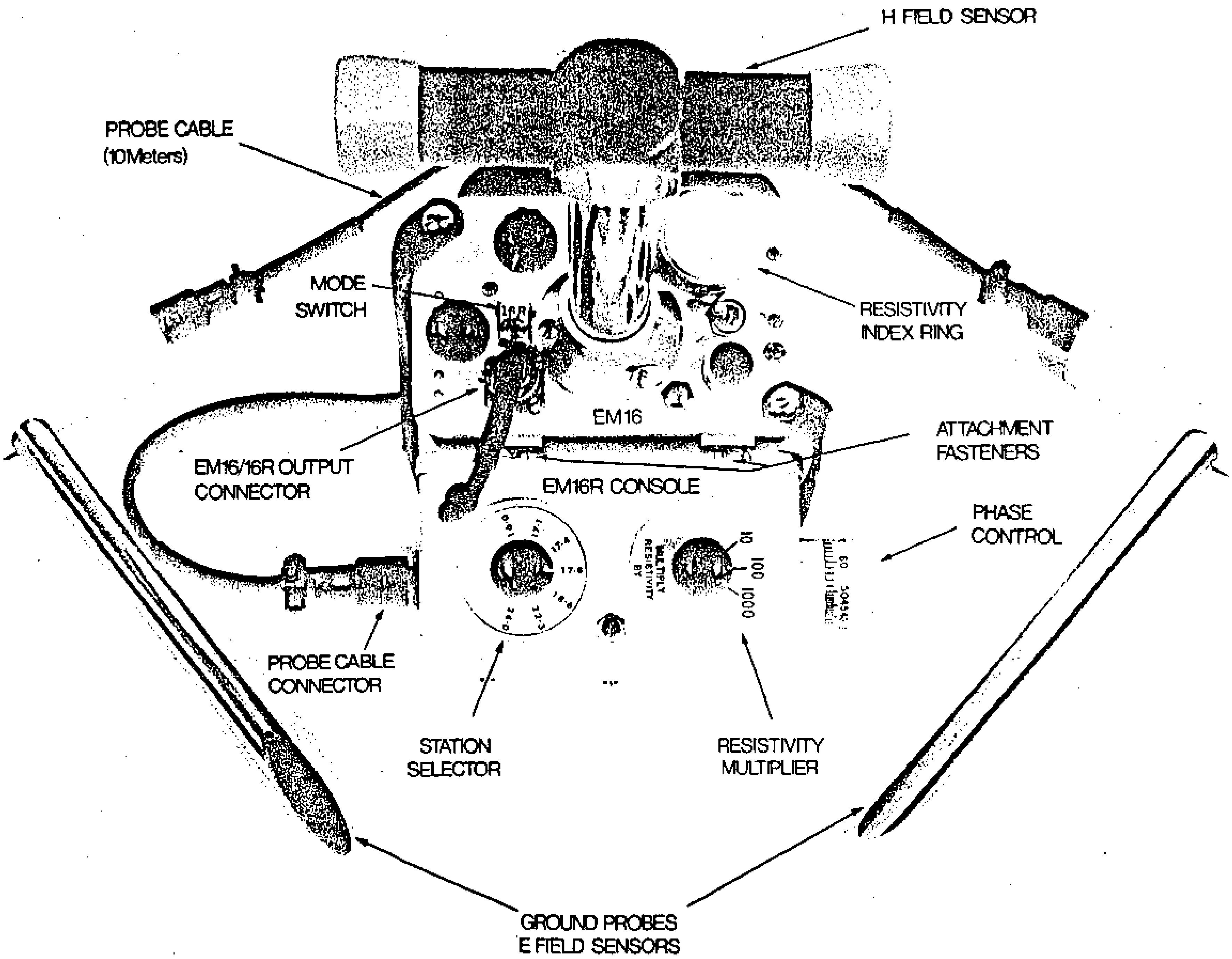
Revised Jan. 1979

EM16R - VLF Resistivity Meter (Attachment to EM16)

INDEX — Page

EM16R SPECIFICATIONS

MEASURED QUANTITY	•Apparent Resistivity of the ground in ohm-meters •Phase angle between E_x and H_y in degrees
RESISTIVITY RANGES	• 10 - 300 ohm-meters • 100 - 3000 ohm-meters •1000 - 30000 ohm-meters
PHASE RANGE	0-90 degrees
RESOLUTION	•Resistivity: ± 2% full scale •Phase : ± 0.5°
OUTPUT	Null by audio tone. Resistivity and phase angle read from graduated dials.
OPERATING FREQUENCY	15-25 kHz VLF Radio Band. Station selection by means of rotary switch.
INTERPROBE SPACING	10 meters
PROBE INPUT IMPEDANCE	100 MΩ in parallel with 0.5 picofarads
DIMENSIONS	19 x 11.5 x 10 cm. (attached to side of EM16)
WEIGHT	1.5 kg (including probes and cable)


H FIELD SENSOR
PROBE CABLE
(10Meters)
MODE
SWITCH
RESISTIVITY
INDEX RING
EM16
EM16/16R OUTPUT
CONNECTOR
ATTACHMENT
FASTENERS
EM16R CONSOLE
PHASE
CONTROL
MULTIPLY
RESISTIVITY
BY
10
100
1000
PROBE CABLE
CONNECTOR
STATION
SELECTOR
RESISTIVITY
MULTIPLIER
GROUND PROBES
E FIELD SENSORS

FIELD PROCEDURE

1. Mounting of The EM16R Console To The EM16 Unit

Align the EM16R console, in respect to the EM16 cover, so that the station selector on the console is close to the EM16R output receptacle on the EM16 control plate. See photograph on facing page.

To mount the console on the EM16 use 4 stud fasteners.

To connect the EM16 console with the EM16 electrically, plug the EM16R console output plug in the corresponding receptacle on the EM16 control panel.

2. Orientation

The instrument measures resistivity along a line in the same direction as the station. After a VLF transmitting station has been selected EM16 is used to determine the direction to the transmitter.

The MODE selector switch is thrown to EM16, and the QUADRATURE/RESISTIVITY dial is turned to zero. With the two receiver coils in the handle of the EM16 in a horizontal plane, with the EM16R unit underneath, turn the whole instrument in a horizontal plane until the station signal goes to null. At this time the long axis of the EM16 handle (signal coil) is pointing towards the station, and the short axis (reference coil) is maximum coupled to the magnetic field. Switch mode to EM16R.

The EM16 QUADRATURE Knob zero line is used as a cursor for the EM16R RESISTIVITY Index ring, and the EM16R RESISTIVITY Index ring zero line is the cursor for the EM16R QUADRATURE Knob.

All EM16 calibrations are in black, all EM16R calibrations are in red.

3. Taking a Reading

To take a reading, orient the unit so that the shorter handle arm is at the right angle to the direction of the station and in the horizontal plane, as described in 2.

For convenience and stability the instrument can be laid on the ground during the reading, with the EM16R console beneath. Connect the probes to the EM16R console receptacle through the 10 meters long probe cable.

Ensure that the station selector switch on the EM16 and EM16R are both turned to the desired station frequency.

Push the probes into the ground 10 metres apart in the direction of the station, that is to say aligned with the long axis of the handle. The cable end with a red marker sleeve goes to the probe nearest the top of the EM16 instrument case, the unmarked cable goes to the probe off in the direction of the EM16 coil handle. Set the resistivity multiplier switch to x1000 position, rotate the EM16R RESISTIVITY CONTROL (same knob as for QUADRATURE when using EM16) for minimum sound intensity in the speaker.

Turn the phase control knob on the EM16R console to further minimize the sound.

Resistivity is read from the position of the red zero line on the quadrature dial against the red numerals on the index ring. Multiply by 1000 in this case to obtain actual resistivity in ohm meters.

If the number on the resistivity index ring is 3 or less, use a lower resistivity multiplier scale and re-do the nulling procedure.

The x10 resistivity multiplier scale should be used in the case of a resistivity reading of 300 ohm meters or less.

Record the phase angle by which the measured electrical field component leads the reference magnetic field component. This is 45° for homogeneous conditions, as when the depth of the layer being measured is more than one or two skin depths. When a lower layer more resistive is present the phase angle will generally decrease, and increases when a more conductive layer is present.

GEONICS LIMITED

TECHNICAL NOTE TN-1

EM16R (RADIOHM) Two-Layer Interpretation Curves

INTRODUCTION

This technical note provides a series of graphs, which permit the user of the Geonics EM16R to determine whether the subsurface electrical resistivity is constant down to the depth of penetration of the instrument or whether a two-layer situation is present. Furthermore, in the case of a two-layered earth, if either the resistivity of the upper layer or the lower layer, or the thickness of the upper layer is known, the use of these curves yields the value of the other two unknown parameters.

Typical applications of the EM16R using these curves might include determining the presence and depth of permafrost, locating and determining the depth to resistive gravel deposits or bedrock, and correcting the data from horizontal-loop electromagnetic surveys for the presence of a conductive overburden to yield more accurate values for the depth and conductivity-thickness product of subsurface conductors.

HOMOGENEOUS HALF SPACE

The EM16R measures the ratio and the phase angle between the horizontal electric and magnetic fields of the wave propagated by distant VLF radio transmitters in order to determine the electrical resistivity of the ground. In the case where the earth is of uniform resistivity there is a phase angle of 45^0 between these field components.

EM16R (RADIOHM) Two-Layer Interpretation Curves

The EM16R is calibrated to read resistivity and this phase angle directly and in the case where the earth is of uniform resistivity down to the depth of penetration it reads the correct resistivity and indicates a phase angle of 45°. This effective depth of penetration depends both on the electrical resistivity itself and very slightly on the frequency, as is shown in figure 1. If the terrain resistivity is 1000 ohm meters the instrument effectively senses down to at least 100 meters or 330 ft., if the resistivity be 200 ohm meters the penetration depth is 45 meters or 145 ft.

Should the results of the survey indicate a measured value of resistivity ρ_a and a phase angle of 45° the use of figure 1 will yield a minimum depth to which that value of resistivity is correct i.e. should the survey result give a value of 1500 ohm meters and a phase angle of approximately 45° the user knows that the resistivity is 1500 ohm meters down to at least 120 meters or 390 ft.

TWO-LAYER GEOMETRY

Suppose, however, that horizontal stratification exists and the earth is better represented by the geometry shown in figure 2. If the thickness of the upper layer t_1 is greater than the corresponding depth of penetration shown for the value ρ_1 on figure 1 the EM16R will still correctly read the value of ρ_1. If, however, the value of t_1 is less then the depth of penetration two things will happen. Firstly, the value of resistivity read by the instrument will no longer be the true value of ρ_1, since it will be influenced by the presence of ρ_2, and secondly, the phase angle will no longer be 45°. A value for this angle of other than 45° is always the key to a multi-layered earth situation.

Since the resistivity indicated by the instrument is no longer the correct resistivity we shall call it the apparent resistivity. Referring again to figure 2 it is seen that there are now three unknown quantities vis ρ_1, ρ_2, and t_1. The EM16R measures only two pieces of information, the apparent resistivity ρ_a, and the phase angle. Therefore, in the general case we are missing one piece of information and this must be supplied by the user. Let us assume for the time being that survey has been carried out in an environment which is represented by figure 3. When the operator was at station "A" he measured a resistivity of 600 ohm meters and a phase angle of 45^o. He, therefore, knew that the earth was homogenous at 600 ohm meters down to a depth of at least 88 meters or 290 ft. At station "B" the instrument read 330 ohm meters and a phase angle of 68^o. The operator assumes from a knowledge of the geology that the upper layer resistivity is still 600 ohm meters. To interprete this situation under the assumption of a two-layer case reference must be made to figures 4 through 13. Each of these figures refers to a different value of ρ_1 as seen in the upper right hand corner. Turning to the figure for ρ_1 equals 600 ohm meters (figure 8) we would use the curve in the following manner: locate on the vertical axis the reading of apparent resistivity as shown by the EM16R, locate on the horizontal axis the value of phase angle as shown by the EM16R. At the intersection of these two points read off from the parametric curve the value for the thickness of the upper layer and the resistivity of the lower layer. For example, suppose that the apparent resistivity shown by the EM16R was 330 ohm meters and the phase angle 68^o. The intersection of these values on figure 8 indicates a value for the thickness of the upper layer of 40 meters and a resistivity for the lower layer of 30 ohm meters.

Conversely, had the instrument readings at station "B" been 5400 ohm meters with a phase angle of 32^0 we would know that the resistivity of the lower layer was 10,000 ohm meters and that the layer thickness was 7 meters. This second example might be typical of a permafrost environment in which measurements were carried out in the discontinuous zone, and the high resistivity might then be indicative of massive ground ice. It should be noted that each of the curves for the various values of ρ_2 terminate at a phase angle of 45^0 to $\rho_a = \rho_2$. Thus if it is desired to interpolate between the various curves for a different value of ρ_2 one starts the curve at the corresponding value for ρ_a i.e. should we require a curve for 5000 ohm meters the start for this curve would occur at a phase angle of 45^0 and a value for apparent resistivity of 5000 ohm meters, and the curve can then be easily sketched in using the curve for 10,000 and 3000 ohm meters as models.

The example given above assumed that the known quantity was ρ_1, since nearby measurements had given this value and a phase angle of 45^0. In the case where the operator assumes that he knows ρ_2 (for example the bedrock resistivity) and wishes to determine ρ_1 and t_1 the various figures are examined to determine which gives values of apparent resistivity and phase angle which agree with the measured values; ρ_1 and t_1 are then read off the appropriate figure. For example, the operator knows the bedrock resistivity to be approximately 3000 ohm meters from nearby outcrops. In an other area he measured an apparent resistivity of 1000 ohm meters and a phase angle of 31^0. A scan of the two layer curves shows that figure 8 gives a best fit to the data and thus the upper layer resistivity is 600 ohm meters and the depth of bedrock approximately 35 meters.

LIMITING CASES

It was stated above that, in the general case, one of the unknown quantities would have to be supplied by the operator. It will now be shown that in two limiting cases the interpretation curves give only two pieces of information.

Consider for example the lower region of figures 7 to 14. For all of these cases ρ_2 is much less than ρ_1, i.e. the lower layer is the more conductive. Comparison of these figures shows that for this case the values of ρ_a and phase angle are a function of ρ_2 and t_1 only and are independent of ρ_1. Thus, for the case of a highly conductive lower layer the EM16R yields the lower layer resistivity and the upper layer thickness independently of the resistivity of the upper layer.

Consider now the upper region of figures 5 and 6 for which ρ_2 is much greater than ρ_1 and the upper layer is much thinner that the penetration depth as given by figure 1. Suppose that the instrument reads an apparent resistivity of 1800 ohm meters and a phase angle of 18^o. Figure 5 would lead to ρ_1 = 30 ohm meters, ρ_2 = 10,000 ohm meters, and t_1 = 1.2 meters. But figure 6 would yield ρ_1 = 100 ohm meters, ρ_2 = 10,000 ohm meters, and t_1 = 4.0 meters. Thus there is an ambiguity in the intepretation; however, if we divide t_1 by ρ_1 in each case we find that for both cases we obtain $t_1/\rho_1 = 0.040$ mhos $= \sigma_1 t_1$. In the case where the upper layer is both thin and highly conductive relative to the lower layer the results of the EM16R give the resistivity of the lower layer and the conductivity thickness product of the upper layer, which is often a useful result. If a knowledge of the upper layer resistivity is available from other sources (i.e. an adjacent reading where the earth is not two-layered as indicated by a 45^o phase angle) it is then, of course, possible to separate out the thickness of the upper layer.

Finally, another very useful application of the EM16R occurs in the case where we can consider the lower layer to be much more resistive than the upper layer and the upper layer is also assumed to be relatively thick. This case can arise if a thick layer of conductive overburden overlies resistive bedrock. Such a geometry can introduce serious errors in the interpretation of horizontal-loop electromagentic surveys (i.e. Geonics EM17 or EM17L). It has been shown by Lowrie and West (Geophysics, Volume 30, Number 4, August 1965, pp 624-632) that the presence of a conductive overburden rotates the phasor diagram, which is used for the interpretation of such survey results so as to make the conductor appear to be more deeply buried than it is and also to appear to be a better conductor in the sense that the ratio of inphase to quadrature response is enhanced. This effect is particularly strong at large intercoil spacing i.e. 400 ft.

For example, assume such a survey is carried out with 400 ft. intercoil spacing and that a vertical conductor is overlain by 7 meters of 10 ohm meter material. The conductivity thickness product for the overburden is then 0.7 mhos. The Argand diagram for this case would be rotated by approximately 25°. Suppose that the peak to peak inphase and quadrature phase amplitudes were 20% and 9% respectively. Ignoring the presence of the overburden would result in estimates of the depth and conductivity thickness of 120 ft. and 13 mhos. If, however, the correction factor for the overburden is taken into account the reinterpreted depth and conductivity thickness product are 80 ft. and 3.6 mhos so that substantial errors can result from ignoring the effect of the overburden. Referring to figure 4 it is seen that the EM16R with the two-layer interpretation curves easily resolves up to 10 meters of 10 ohm meter material and that furthermore the interpreted thickness of this material is relatively independent of the assumed resistivity for the basement rock. Figure 15 is a re-compilation of the two-layer curves for $\rho_2 = \infty$ and the caption on this figure illustrates a simple procedure to determine the conductivity-thickness product directly from the EM16R results.

FREQUENCY CORRECTION

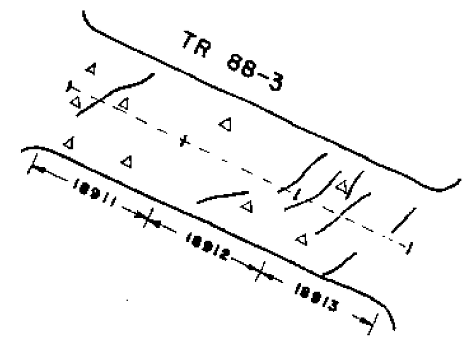
These curves have been calculated for a frequency of 20 kHz. Should a station operating at a frequency of other than 20 kHz be employed the values of thickness and conductivity-thickness will be slightly in error. Figure 14 gives the correction factor for both as a function of station frequency.

The two-layer curves are given for a reasonable selection of values of ρ_1. Should it be necessary to operate inbetween these values it is suggested that the relevent data from the bracketing figures be plotted out and interpolation carried through.

EM16R (RADIOHM) Two-Layered Interpretation Curves

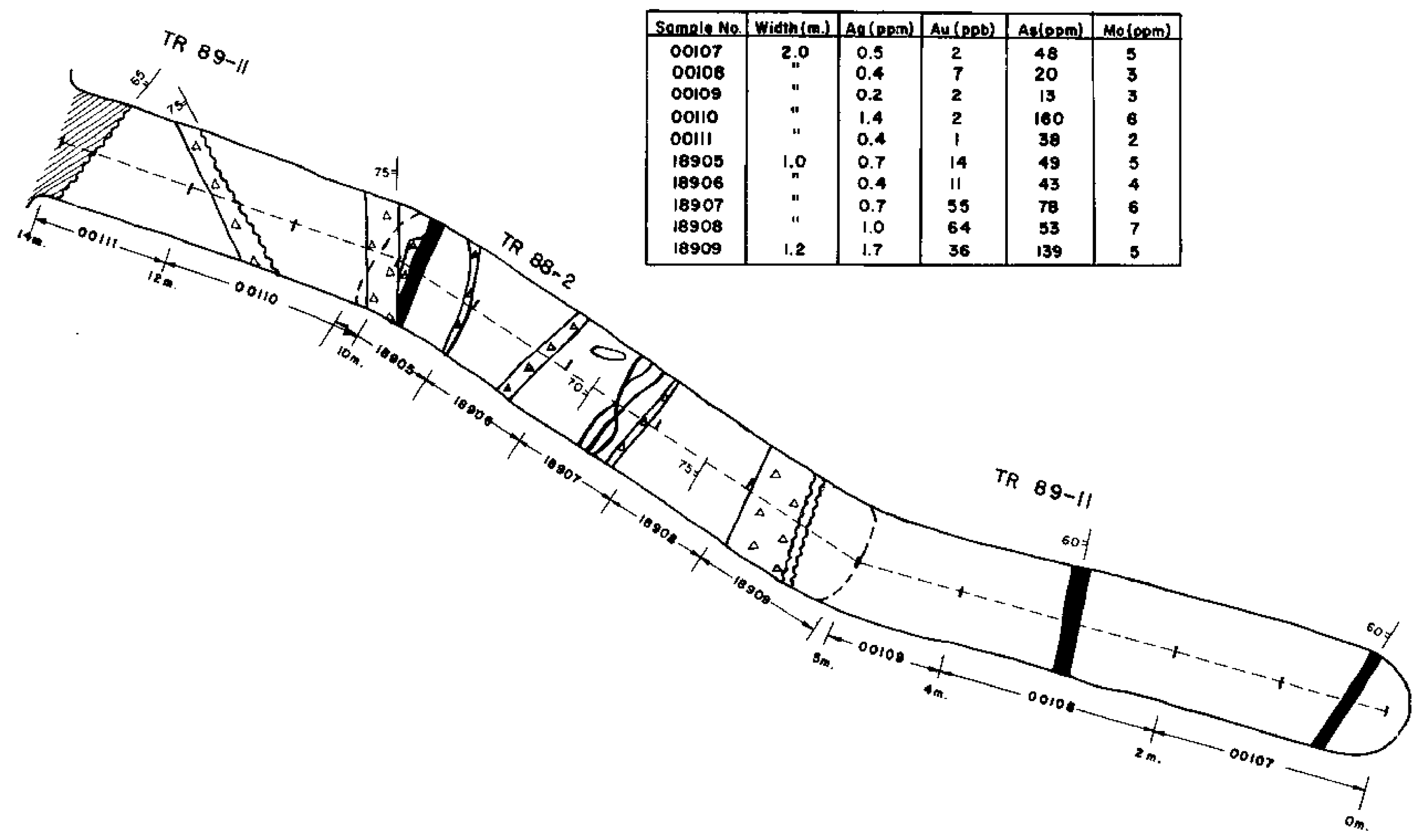
SUMMARY

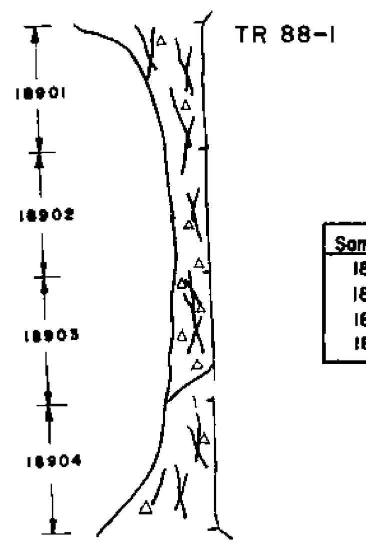
The curves presented in this note should prove useful in planning surveys, particularly for engineering geophysical applications. They illustrate the type of environment in which the EM16R will prove to be effective as well as those in which conventional resistivity may have to be employed. It is hoped that this technical note will assist owners of the Geonics EM16R in obtaining more useful data from their survey results. The principle advantages of the Geonics EM16R are the simplicity of the measurement technique and the speed with which it can be carried out, added to the fact that is is a one-man operation. These curves show that in many cases of practical interest the use of the EM16R will produce survey data which is almost equivalent to that with normal resistivity gear at a fraction of the cost and at much higher speed.



Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
18911	1.0	1.9	28	71	11
18912	"	1.5	20	103	9
18913	"	7.5	27	73	9

Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
00107	2.0	0.5	2	48	5
00108	"	0.4	7	20	3
00109	"	0.2	2	13	3
00110	"	1.4	2	160	6
00111	"	0.4	1	38	2
18905	1.0	0.7	14	49	5
18906	"	0.4	11	43	4
18907	"	0.7	55	78	6
18908	"	1.0	64	53	7
18909	1.2	1.7	36	139	5





Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
18901	1.0	2.2	8	82	4
18902	"	1.1	18	187	6
18903	"	1.5	20	141	10
18904	"	0.7	7	59	7

Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
00101	2.0	0.8	1	88	7
00102	"	0.2	9	31	4
00103	"	0.4	19	45	3
00104	"	0.9	32	115	5
00105	"	1.1	34	95	7
00106	"	0.8	14	58	5
00221	"	1.1	1	120	8
00222	"	0.9	8	130	6
00223	"	0.6	19	63	5
00224	"	0.9	3	99	7
00225	"	0.4	1	78	4

GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,123

LEGEND

- BANDED CREAM RHYOLITE
- AMORPHOUS SILICA VEIN
- AMORPHOUS SILICA BRECCIA
- INTENSE ARGILLIC ALTERATION
- SHEAR/FAULT ZONE (attitude unknown)
- SHEAR/FAULT ZONE (attitude known)
- STRIKE/DIP OF STRUCTURE

MINGOLD RESOURCES INC.

VANCOUVER OFFICE

LOON CLAIMS

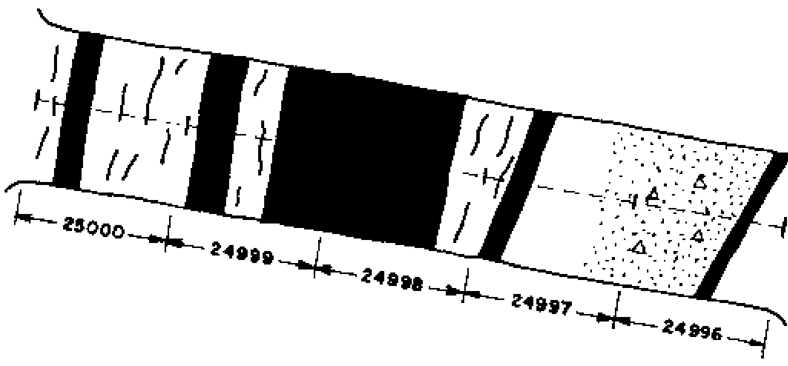
TR88-1, 88-2, 88-3, 89-10, 89-11

93F/12 OMINECA M.D.

DRAWN BY: K.T.	DATE: MAR 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:50

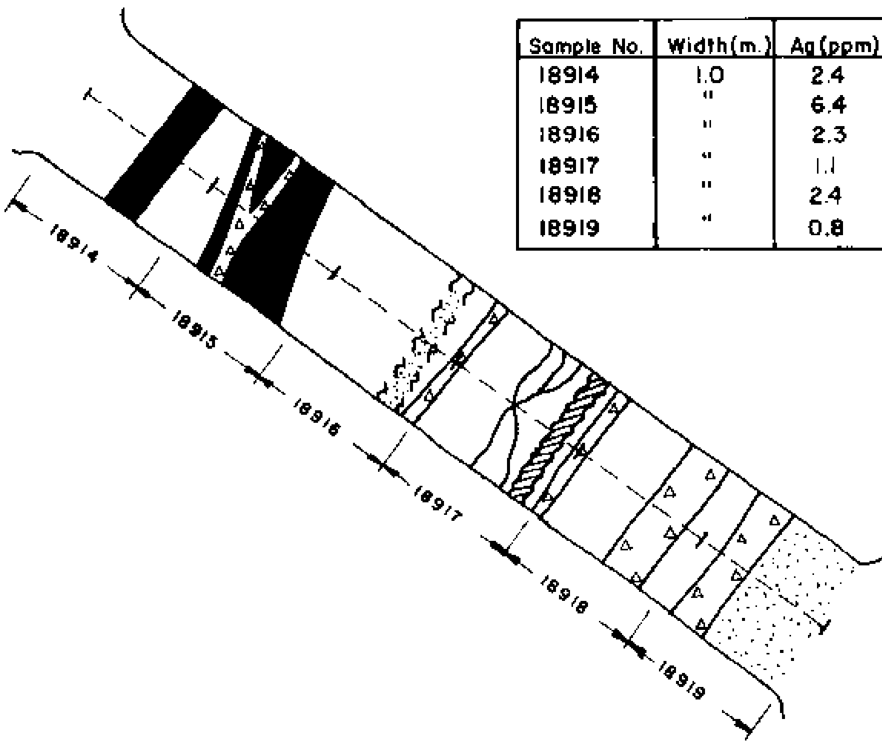
0 1 2 m.

PLATE NO. 11



Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
24996	1.0	10.2	2365	158	47
24997	"	7.3	1375	216	46
24998	"	25.0	1325	657	262
24999	"	10.4	385	339	293
25000	"	1.4	24	133	50

Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
18914	1.0	2.4	235	211	60
18915	"	6.4	128	522	198
18916	"	2.3	87	335	38
18917	"	1.1	42	125	22
18918	"	2.4	69	258	142
18919	"	0.8	34	123	27

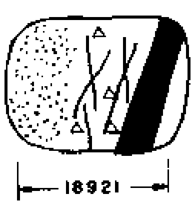


TR88-5

GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,123

Sample No.	Width(m.)	Ag(ppm)	Au(ppb)	As(ppm)	Mo(ppm)
18921	1.0	5.3	184	156	108



TR88-6

LEGEND

- BANDED CREAM RHYOLITE
- AMORPHOUS SILICA VEIN
- AMORPHOUS SILICA BRECCIA
- INTENSE ARGILLIC ALTERATION
- SHEAR/FAULT ZONE (attitude unknown)
- SHEAR/FAULT ZONE (attitude known)
- 80 STRIKE/DIP OF STRUCTURE

N

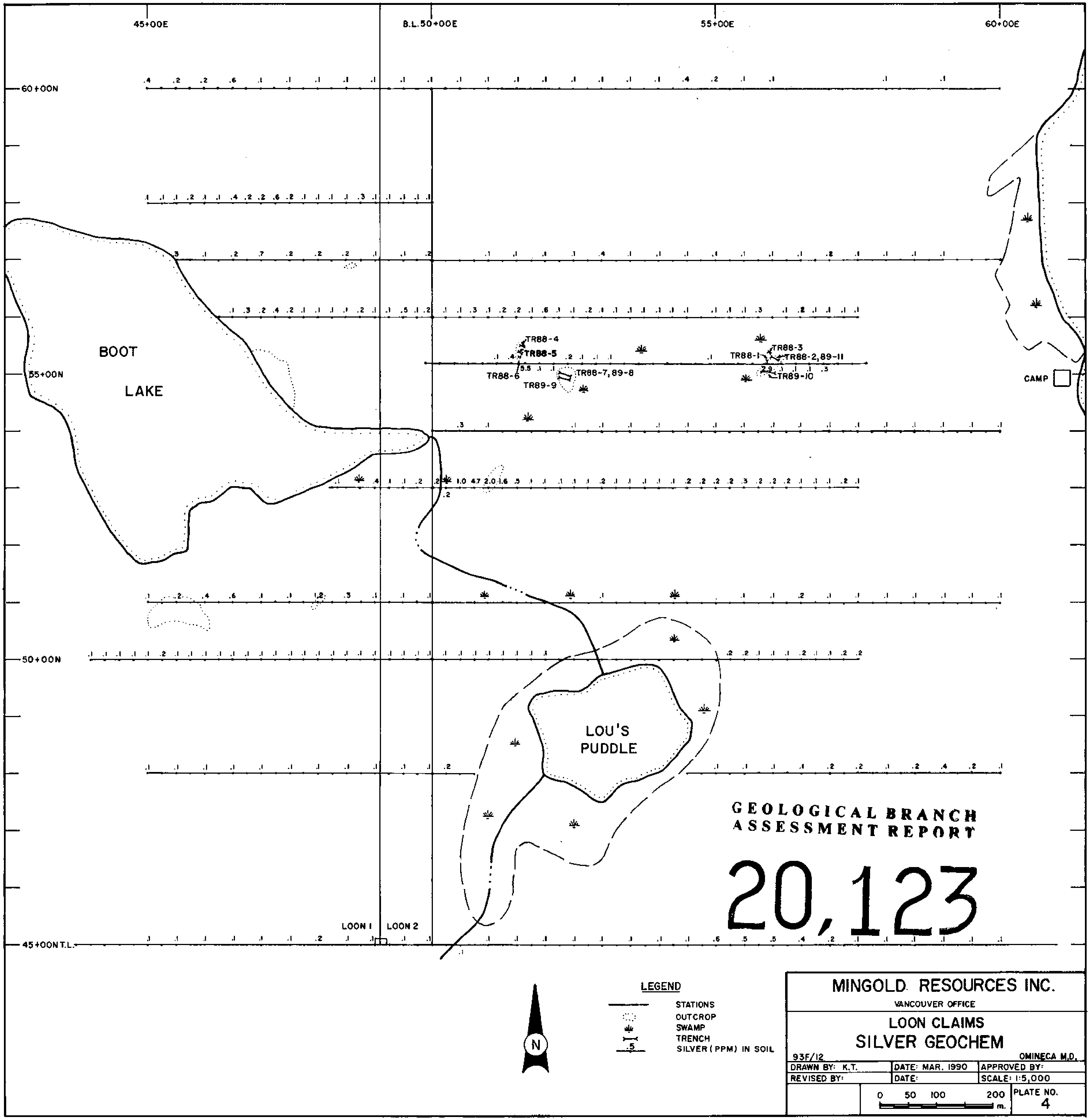
MINGOLD RESOURCES INC.

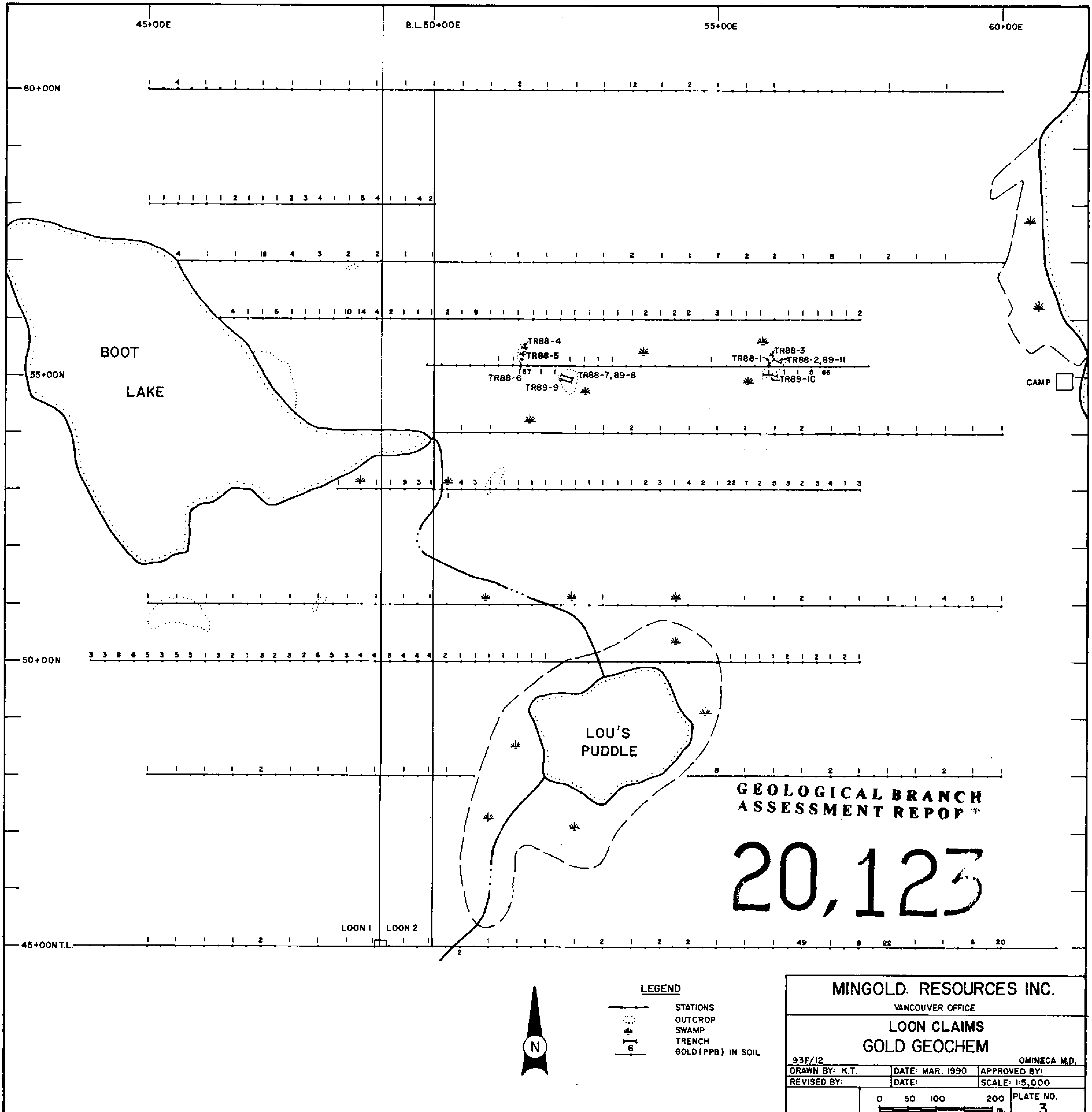
VANCOUVER OFFICE

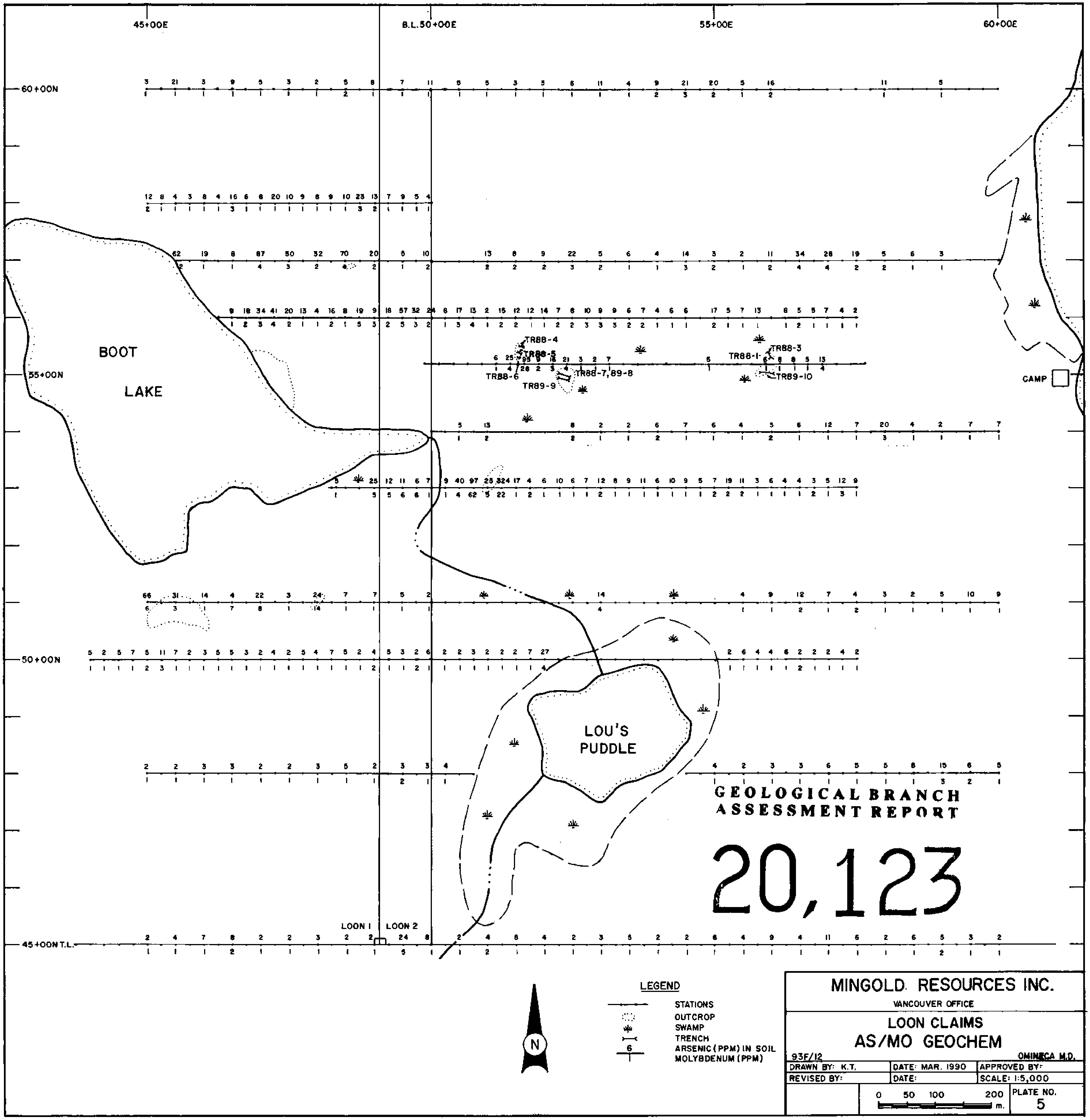
LOON CLAIMS

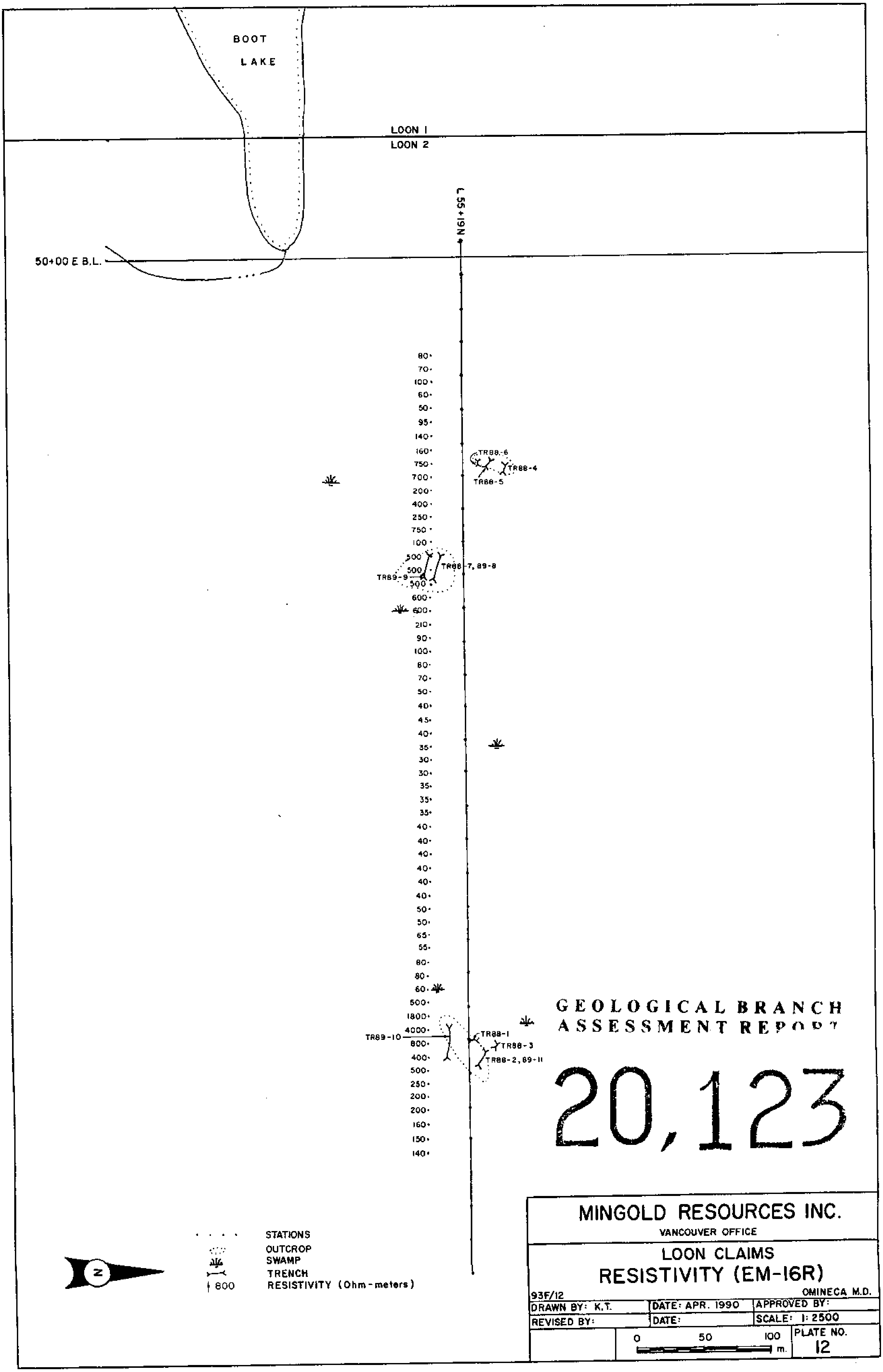
TR88-4, 88-5, 88-6

93F/12		OMINECA M.D.
DRAWN BY: K.T.	DATE: APR. 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:50
	0 1 2 m.	PLATE NO. 9


45+00E
B.L.50+00E
55+00E
60+00E
60+00N
55+00N
50+00N
45+00N T.L.
BOOT
LAKE
LOU'S
PUDDLE
CAMP
TR88-4
TR88-5
TR88-6
TR88-7, 89-8
TR89-9
TR88-1
TR88-3
TR88-2, 89-11
TR89-10
LOON 1
LOON 2
N
LEGEND
STATIONS
OUTCROP
SWAMP
TRENCH
.5
SILVER (PPM) IN SOIL
GEOLOGICAL BRANCH
ASSESSMENT REPORT
20,123
MINGOLD RESOURCES INC.
VANCOUVER OFFICE
LOON CLAIMS
SILVER GEOCHEM
93F/12
OMINECA M.D.
DRAWN BY: K.T.
DATE: MAR. 1990
APPROVED BY:
REVISED BY:
DATE:
SCALE: 1:5,000
0 50 100 200 m.
PLATE NO.
4


45+00E
B.L.50+00E
55+00E
60+00E
60+00N
55+00N
50+00N
45+00N T.L.
BOOT
LAKE
LOU'S
PUDDLE
CAMP
TR88-4
TR88-5
TR88-6
TR88-7, 89-8
TR89-9
TR88-1
TR88-3
TR88-2, 89-11
TR89-10
LOON 1
LOON 2
GEOLOGICAL BRANCH
ASSESSMENT REPORT
20,123
LEGEND
STATIONS
OUTCROP
SWAMP
TRENCH
GOLD (PPB) IN SOIL
N
MINGOLD RESOURCES INC.
VANCOUVER OFFICE
LOON CLAIMS
GOLD GEOCHEM
93F/12
OMINECA M.D.
DRAWN BY: K.T.
DATE: MAR. 1990
APPROVED BY:
REVISED BY:
DATE:
SCALE: 1:5,000
0 50 100 200 m.
PLATE NO.
3


45+00E
B.L.50+00E
55+00E
60+00E
60+00N
55+00N
50+00N
45+00N T.L.
BOOT
LAKE
LOU'S
PUDDLE
CAMP
TR88-4
TR88-5
TR88-6
TR88-7, 89-8
TR89-9
TR88-1
TR88-3
TR89-10
LOON 1
LOON 2
GEOLOGICAL BRANCH
ASSESSMENT REPORT
20,123
LEGEND
STATIONS
OUTCROP
SWAMP
TRENCH
ARSENIC (PPM) IN SOIL
MOLYBDENUM (PPM)
N
MINGOLD RESOURCES INC.
VANCOUVER OFFICE
LOON CLAIMS
AS/MO GEOCHEM
93F/12
OMINECA M.D.
DRAWN BY: K.T.
DATE: MAR. 1990
APPROVED BY:
REVISED BY:
DATE:
SCALE: 1:5,000
0 50 100 200 m.
PLATE NO.
5



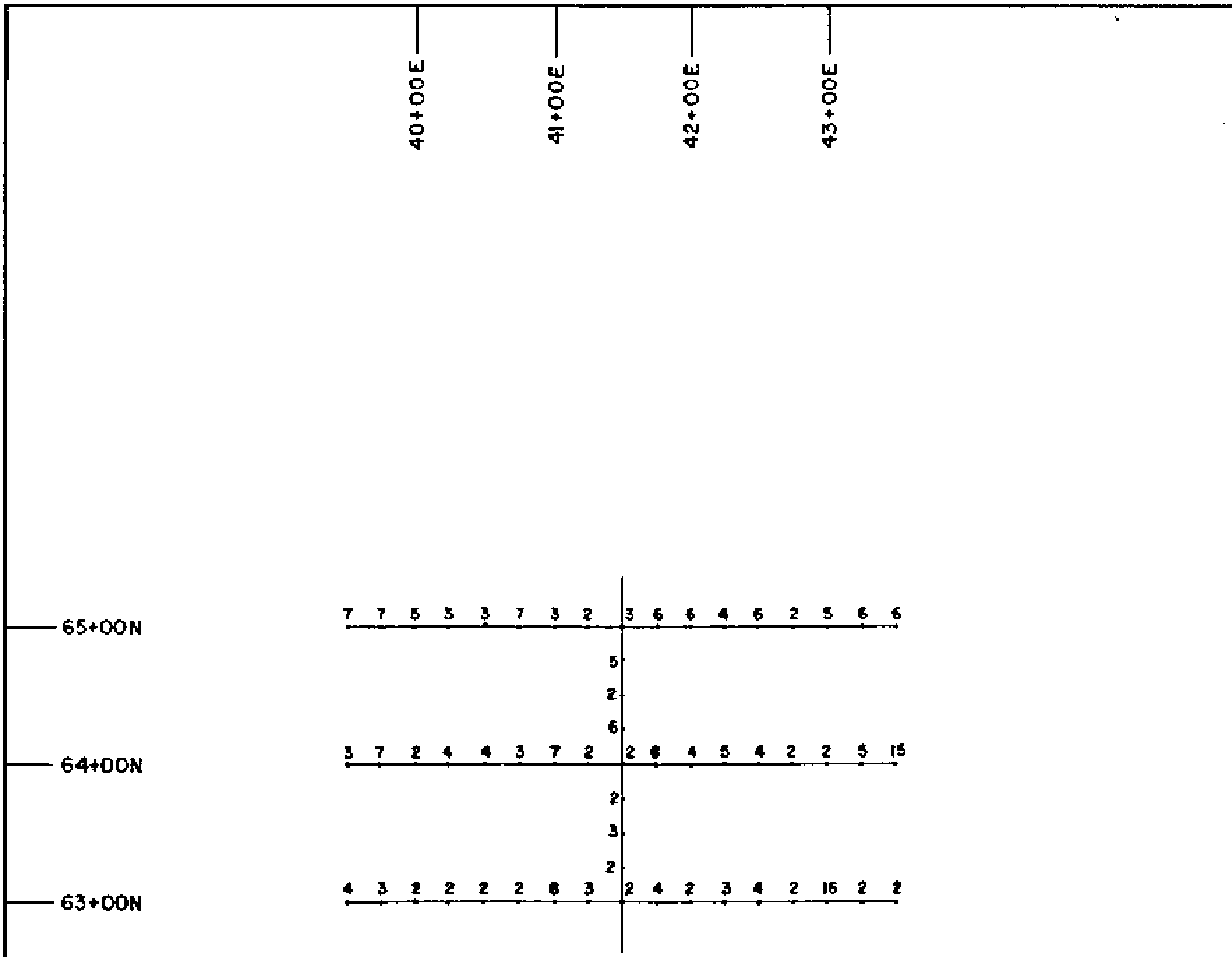
GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,123

MINGOLD RESOURCES INC.
VANCOUVER OFFICE

LOON CLAIMS
RESISTIVITY (EM-16R)

93F/12		OMINECA M.D.
DRAWN BY: K.T.	DATE: APR. 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1: 2500
	0 50 100 m.	PLATE NO. 12



GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,123

LEGEND

- STATIONS
- OUTCROP
- SWAMP
- TRENCH
- 12 ARSENIC (PPM) IN SOIL

MINGOLD RESOURCES INC.
VANCOUVER OFFICE

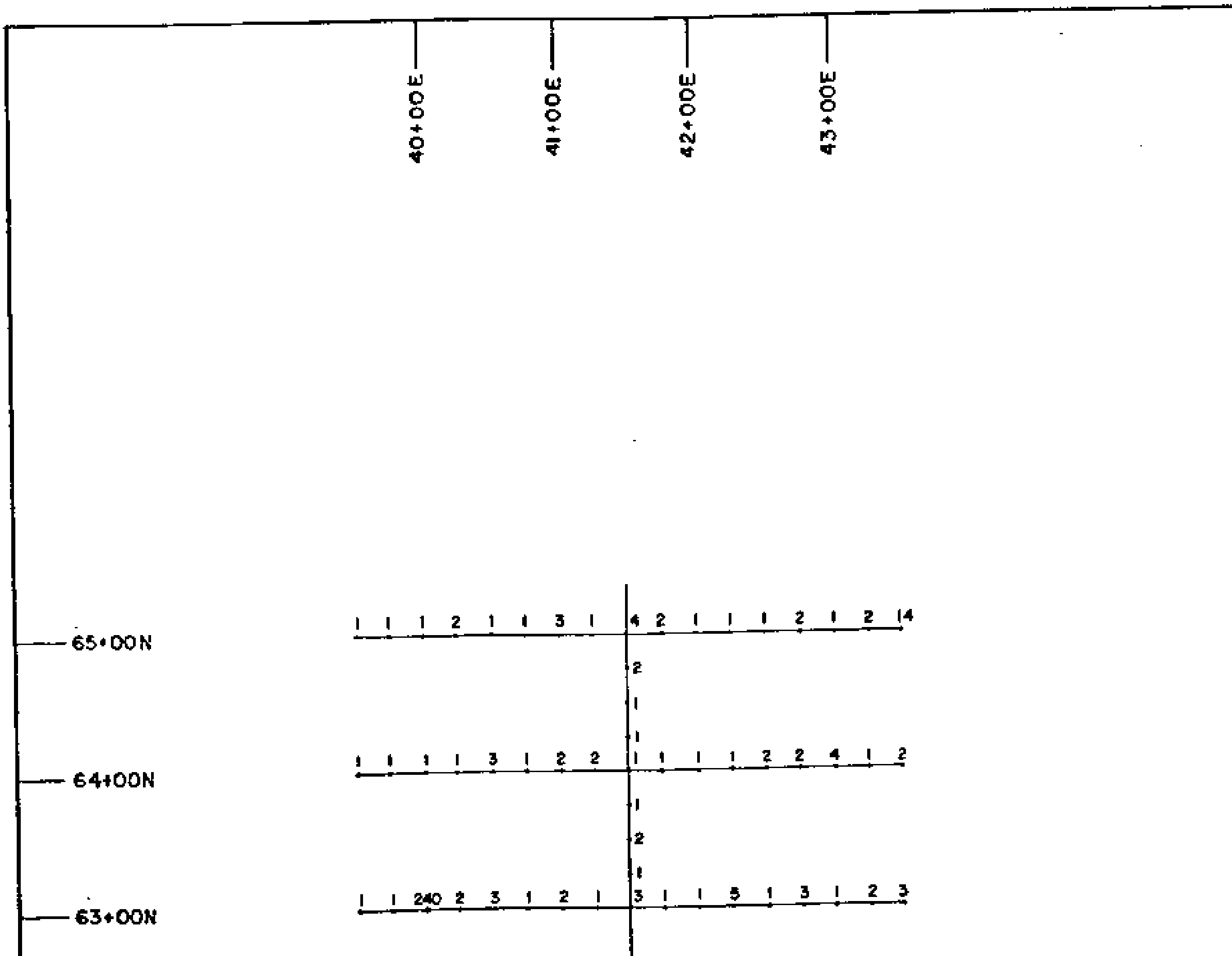
LOON CLAIMS
ARSENIC GEOCHEM

93F/12 | OMINECA M.D.

DRAWN BY: K.T.	DATE: MAY 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:5,000

0 50 100 200 m.

PLATE NO. 8



GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,123

LEGEND

STATIONS
OUTCROP
SWAMP
TRENCH
GOLD (PPB) IN SOIL

MINGOLD RESOURCES INC.

VANCOUVER OFFICE

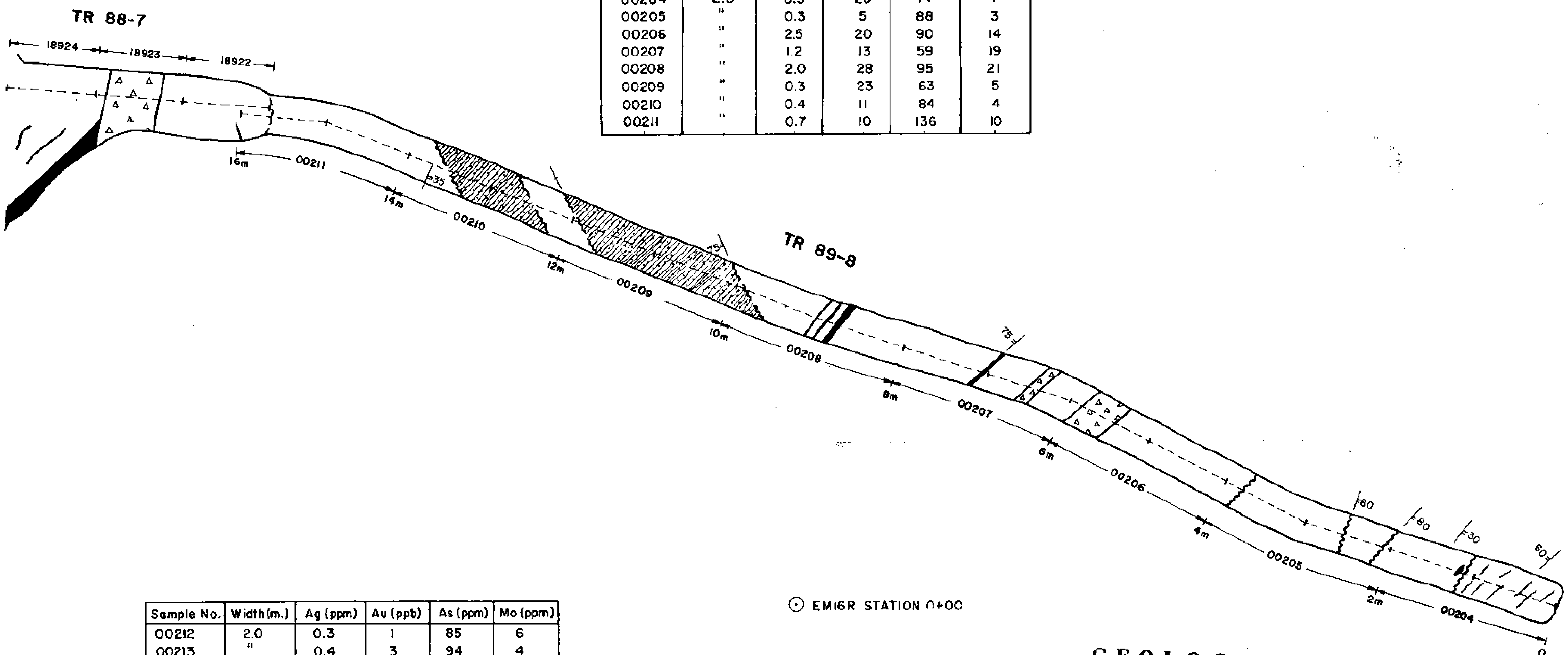
LOON CLAIMS
GOLD GEOCHEM

93F/12

OMINECA M.D.

DRAWN BY: K.T.	DATE: MAY 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:5,000
	0 50 100 200 m.	PLATE NO. 6

Sample No.	Width(m.)	Ag (ppm)	Au (ppb)	As (ppm)	Mo (ppm)
18922	1.0	2.0	54	706	18
18923	"	8.0	117	170	102
18924	"	12.7	345	305	78
00204	2.0	0.3	23	74	7
00205	"	0.3	5	88	3
00206	"	2.5	20	90	14
00207	"	1.2	13	59	19
00208	"	2.0	28	95	21
00209	"	0.3	23	63	5
00210	"	0.4	11	84	4
00211	"	0.7	10	136	10



Sample No.	Width(m.)	Ag (ppm)	Au (ppb)	As (ppm)	Mo (ppm)
00212	2.0	0.3	1	85	6
00213	"	0.4	3	94	4
00214	"	0.5	3	63	5
00215	"	4.5	200	89	29
00216	"	0.7	12	74	6
00217	"	0.7	15	82	8
00218	"	2.5	44	98	27
00219	"	1.7	25	138	22
00220	1.0	0.7	2	80	5

GEOLOGICAL BRANCH
ASSESSMENT REPORT

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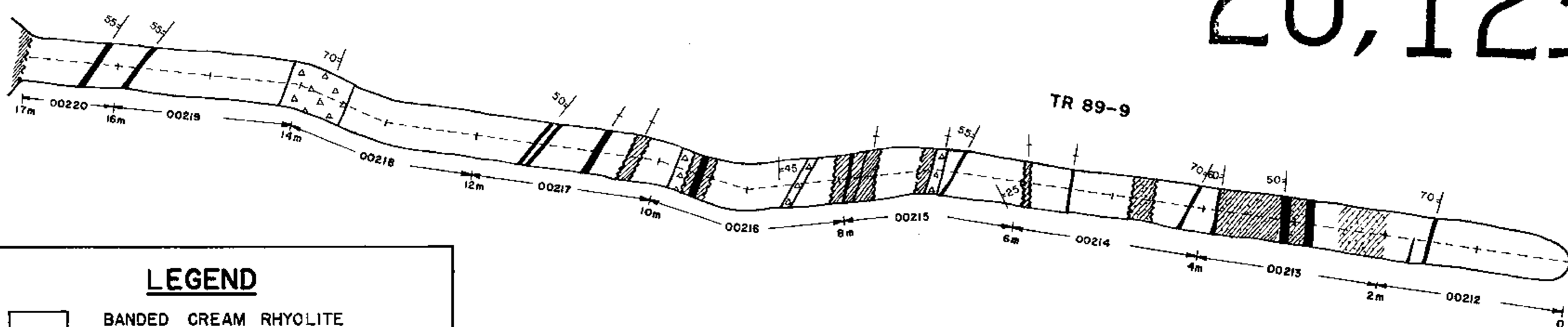


LEGEND

- BANDED CREAM RHYOLITE
- AMORPHOUS SILICA VEIN
- AMORPHOUS SILICA BRECCIA
- INTENSE ARGILLIC ALTERATION
- SHEAR/FAULT ZONE (attitude unknown)
- SHEAR/FAULT ZONE (attitude known)
- 60 STRIKE/DIP OF STRUCTURE

N

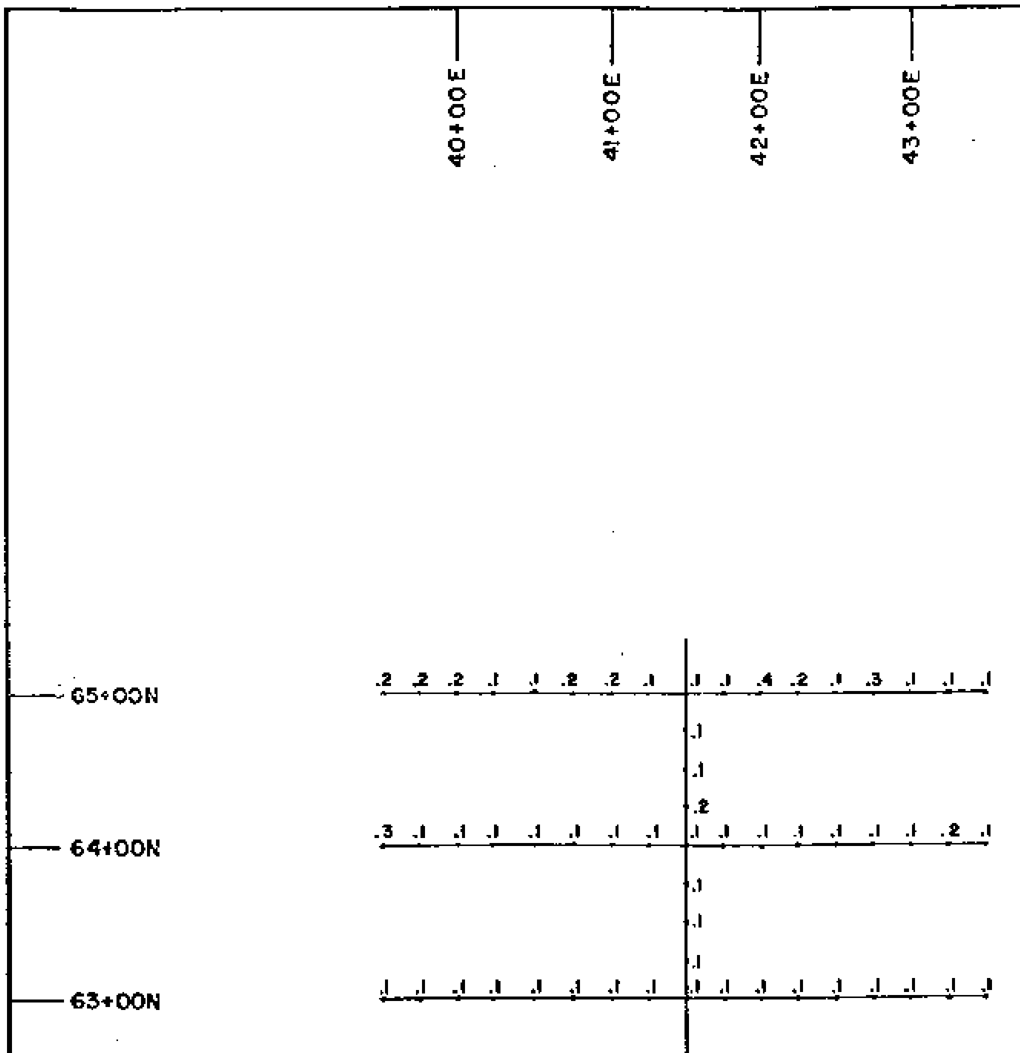
MINGOLD RESOURCES INC.
VANCOUVER OFFICE

LOON CLAIMS
TR 88-7, TR 89-8 & TR 89-9

93F/12 OMINECA M.D.

DRAWN BY: K.T.	DATE: MAR. 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:50

0 1 2 m. PLATE NO. 10



GEOLOGICAL BRANCH
ASSESSMENT REPORT

20,123

LEGEND

STATIONS
OUTCROP
SWAMP
TRENCH
SILVER (PPM) IN SOIL

MINGOLD RESOURCES INC.

VANCOUVER OFFICE

LOON CLAIMS
SILVER GEOCHEM

93F/12		OMINECA M.D.
DRAWN BY: K.T.	DATE: MAY 1990	APPROVED BY:
REVISED BY:	DATE:	SCALE: 1:5,000
	0 50 100 200 m.	PLATE NO. 7