GEOLOGICAL, GEOCHEMICAL AND GEOPHYSICAL REPORT

ON THE

KING, KING #1 to KING #4, AND MO CLAIMS

AND

L1448, L1449 CROWN GRANTS

OSOYOOS MINING DIVISION, B.C.

82E - 4E, 5E

($49^{0}15'$N, $119^{o}41'$W)

FOR

DRC RESOURCES CORPORATION

AND

STRATA ENERGY CORPORATION

(OPERATORS)

BY

GRANT CROOKER, B.Sc., FGAC

GEOLOGIST

OWNER - GRANT CROOKER

NOVEMBER, 1984

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ILLUSTRATIONS

SUMMARY AND RECOMMENDATIONS

The Orofino Mountain property consists of the Mo, King, and King #1 through King #4 mineral claims covering 74 units in the Osoyoos Mining Division. Two Grown Grants, L 1448 and L 1449 are also included in the property. The property is located 20 kilometers south of Penticton, B.C.

Mineralization consists of quartz veins with related gold values. Significant gold values have been indicated at the Upper and Lower King Adits, Independence Adit, Orofino adit, adit at L-0 and 12+00W, and shaft at LO and 3+70 W. In addition, sampling of the Grandoro dump has indicated some of this material could possibly be processed profitably. From 1930 to 1940 the Grandoro and the King Property had been mined independently of one another. These two properties, for the first time held under option by one group of companies, has the potential of outlining a considerable amount of gold-silver ore from the workings and ore dumps.

The present program consisted of soil sampling, a VLF-EM survey and rock sampling. The soil sampling program outlined the known mineralized areas, and possible extensions of these zones. The VLF-EM survey indicated a number of conductors, some of which appear to be associated with the known mineralized zones.

Recommendations are as follows:

To continue the Phase I program, consisting of prospecting, rock sampling, soil sampling and VLF-EM surveying over areas of the property not previously investigated.

A Phase II program, consisting of rehabilitation of workings, and trenching and/or diamond drilling of mineralized zones, should be carried out simultaneously with the Phase I program.

Cost Estimates are as follows:

Phase I:

Establishment of Grid	$5,000.00
Geochemical Survey	4,000.00
Geochemical Analysis	8,000.00
Geophysical Survey (VLF-EM)	5,000.00
Engineering and Supervision	5,000.00
Total	27,000.00
Contingency	3,000.00
	$30,000.00

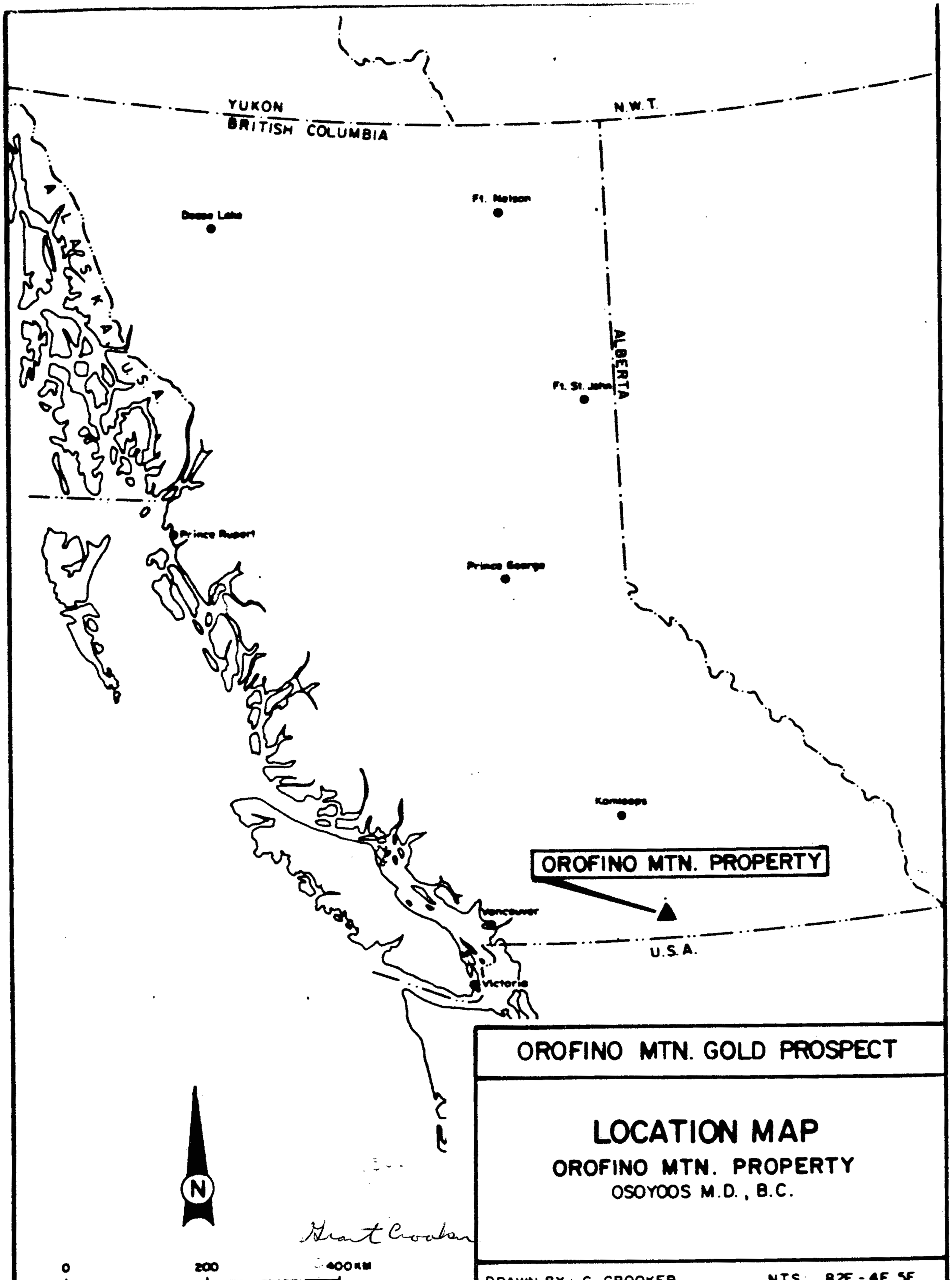
Phase II:

Rehabilitation of Workings	$12,000.00
Trenching and Sampling	12,000.00
Drilling and Sampling, 1,000 ft. @ $30.00 per foot	30,000.00
Supervision	10,000.00
Total	$64,000.00
Contingency	6,000.00
Total Phase II	$70,000.00

Respectfully submitted,

Grant Crooker

Grant Crooker, B.Sc., FGAC
Geologist



OROFINO MTN. GOLD PROSPECT

LOCATION MAP

OROFINO MTN. PROPERTY

OSOYOOS M.D., B.C.

DRAWN BY: G. CROOKER	NTS: 82E-4E,5E
DATE: Nov. 1984	FIGURE Nº. 1

INTRODUCTION

General

Field work was carried out on the property by the author and one field assistant from October 6 to October 19, 1984.

The orientation VLF-EM survey carried out in July of 1984 was continued on the property. As well soil sampling was carried out over the main showings. Some rock sampling was also carried out on old workings and dumps.

Location and Access

The property is located 7 kilometers southeast of Twin Lakes, on Orofino Mountain (figure 1) in southern B.C. The claims lie between 49°14' and 49°16' north latitude and 119°39' and 119°42' west longitude.

Access is via highway 3A turning onto a secondary road approximately 24 kilometers from Penticton. An all weather 2 wheel drive logging road leads to the claim area, with a network of logging roads and skid trails covering the entire claim area.

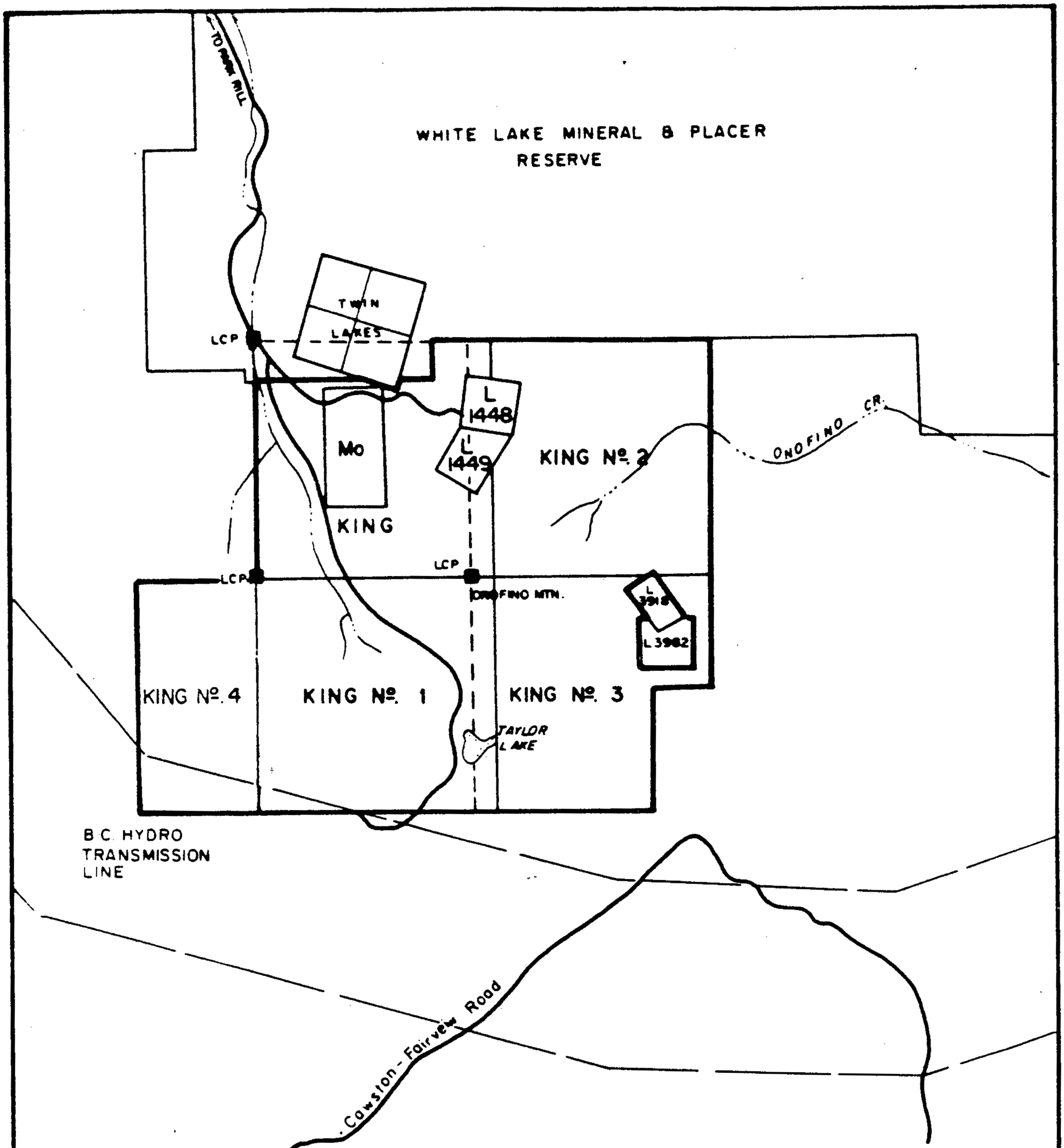
Physiography

The property is located in the Okanagan Highlands. Topography varies from rolling hills to steep slopes. Elevation varies from 1,000 meters to 1,600 meters above sea level.

Most areas are timbered with larch, spruce, fir, or pine. Bunch-grass and sagebrush cover the open areas.

Property and Claim Status

The Orofino Mountain Property consists of 6 mineral claims totalling 74 units and 2 Crown Grants (figure 2). The mineral claims are owned by Grant Crooker of Keremeos, B.C., with DRC Resources Corporation and Strata Energy Corporation, #1250-800 West Pender Street, Vancouver, B.C., V6C 2V6 having an option on the property. The Crown Grants are also under option to DRC Resources and Strata Energy.



OROFINO MTN. GOLD PROSPECT

CLAIM MAP

OROFINO MTN. PROPERTY
OSOYOOS M.D., B.C.

SCALE 1:50,000

DRAWN BY: G. CROOKER
NTS: 82 E - 4E, 5E

DATE: Nov. 1984
FIGURE Nº. 2

Claim	Units	Record Numbers	Expiry Date
MO	2	135	Oct. 15, 1989
King	16	1386	May 8, 1986
King #1	16	1398	June 5, 1985
King #2	16	1461	Aug. 31, 1985
King #3	16	1462	Aug. 31, 1985
King #4	8	1630	Nov. 12, 1987

Crown Grants	Lot Number
Orofino	1448
Independence	1449

History and Previous Work

The Orofino Mountain gold camp dates back to the late 1890's when the Fairview Camp was being developed. The Orofino Camp is only 7 kilometers from the Fairview Area, and has simiiliar geological conditions.

There are two properties covered by this report. These are the King and Grandoro (figure 3). Most of the activity in the camp was from 1930 to 1940.

At the Grandoro considerable underground development was carried out. This includes several adits, a tunnel, and a winze leading to a lower level. The workings are not accessable at this time. A limited amount of diamond drilling was carried out in the 1930's, but no records are available. Minister of Mines Reports indicate the following production from the Grandoro:

Year	Tonnage	Grade
1932	76	$20.00 per ton
1933	220	1.77 oz/ton gold
1935	10,000	0.50 oz/ton gold
1941	251	0.69 oz/ton gold

Examination of the BCMM annual reports gives a sketchy picture of the underground workings at the Grandoro (figure 3).

The "Orofino Adit" is actually a winze which was sunk to the 150 foot level. From here drifts were driven 250 feet east and 200 feet west, with crosscuts 50 feet each way from the west drift. The east drift is reported to follow the vein for its entire length, although some sections were low grade. In the west drift only a 50 foot length of vein is reported.

The "Independence Adit" is actually a tunnel having been driven through the mountain for approximately 250 meters. From the amount of material on the dump, the Independence Adit was the main working level, and probably intercepted the lower workings of the Orofino Adit.

At the King only a small amount of work has been carried out. Two adits were driven, along with a winze. In the lower King adit some stoping was carried out, with production estimated at 2,000 tons. The grade is not known.

During 1981, 1983 and 1984 geological and geophysical surveys were carried out on the property. This work included geological mapping, prospecting, sampling and geochemical surveying and VLF-EM surveying.

EXPLORATION PROCEDURE

The October 1984 program consisted of establishing 2 grids, geochemical soil sampling, rock sampling, and continuing the VLF-EM survey.

On the main grid, the baseline is north-south, with a length of 900 meters. The nine crosslines are 100 meters apart, and the lines are 900 meters long to the west and from 1,200 to 1,600 meters long to the east. Fifteen kilometers of line were added to the main grid.

At grid A, the baseline is north-south, with a length of 400 meters. The five crosslines are 100 meters apart and extend 300 meters to the east and west. Three kilometers of line were established at Grid A. Stations were established at 20 meter intervals on all lines.

Eighteen kilometers of VLF-EM surveying were carried out, with readings taken every 20 meters.

Grant Crooker, B.Sc. geologist carried out the survey using a Geonics EM-16 receiver. The VLF transmitter was NLK at 24.8 KHZ. This transmitter was used due to its good signal strength and orientation to the geological structures.

The EM-16 measures In-phase and Quadrature components of vertical magnetic field as a percentage of horizontal primary field. (That is tagent of the tiltangle and ellipticity.) Both values are given in percentages.

Field procedure requires to always face the same direction when taking readings. When approaching a conductor the readings will be positive, and when leaving a conductor the readings will be negative.

The EM-16 is rotated in the vertical plane until a minimum signal is obtained. This reading is the "In-phase" and gives the tiltangle in degrees and the tangent of the tiltangle expressed as percent. Once this minimum signal is obtained, the "Quadrature" knob is rotated until the signal minimum is obtained. This reading is approximately the ratio of the quadrature component of the vertical secondary field to the horizontal primary field.

The VLF-EM can pick up conductors caused by electrolyte-filled fault or shear zones and porous horizons, graphite, carbonaceous sediments, lithological boundaries as well as sulphide bodies.

The In-phase and Quad-phase raw data were plotted as percentages on figures 7 and 9 at a scale of 1:2500.

The Fraser filter method was then applied to the In-phase data, and the results plotted at a scale of 1:2500 of figures 8 and 10.

Geochemical soil sampling (194 samples) was carried out on the property. On the main grid, 5 lines were sampled, with samples taken at 40 meter spacings, increasing to 20 meter spacings over showings and conductors. The soil samples were generally taken at a depth of 10-15 centimeters in the brown "B" horizon. All samples were placed in soil geochemical bags for shipment to the laboratory.

The samples were all analyzed for copper, lead, silver and gold by Rossbacher Laboratory Ltd., Burnaby, B.C. Laboratory technique for analysis consists of preparing samples by drying at 75°C and sieving to minus 80 mesh. Copper, lead, and silver are analyzed by nitric perchloric digestion, while gold is analyzed by aqua-regia digestion. Concentrations of elements are determined by atomic absorption.

The geochemical data was plotted at a scale of 1:2500 on figures 4, 5 and 6.

Thirty-two rock samples were taken in mineralized areas and from dumps. The samples were assayed for gold and the results were plotted on figure 3 at a scale of 1:5000.

GEOLOGY

Regional Geology

The gold showings in the Orofino Mountain area occur in an area about 4 square miles in extent. The area is underlain by irregular, easterly trending belts of greenstone, sedimentary rocks, and highly altered rocks of uncertain origin.

These rocks are intruded by bodies of diorite, granodoirite and granite. The Oliver Granite extends into the Fairview area. On the north and west Tertiary volcanics of considerable thickness are faulted against older rocks.

Claim Geology

The oldest rock underlying the Orofino Mountain gold prospect are quartzites of the Kobau Quartzite (Unit 0, figure 3) of Carboniferous age. The quartzites are generally massive and vary from grey to blue-grey in color.

Triassic quartzites of the Shoemaker Formation (Unit 1, figure 3) form two relatively narrow bands which strike west and northwest across the King and King #2 claims. The quartzites vary from massive to thinly bedded and are light grey in color.

Unit 2 consists of altered rocks of uncertain origin. This rock type varies from massive coarse grained hornblende gabbro and biotite diorite to finer grained biotite schist.

Unit 3 is generally a pinkish, medium grained diorite containing hornblende and biotite. This unit is often difficult to distinguish from Unit 2.

The granite of unit 4 is generally light grey, porphyritic and coarse grained. Biotite and hornblende are the main mafic constituents.

Unit 5 is a light grey granitic dike.

Unit 6 is a medium grained, grey granodiorite with hornblende predominating over biotite.

Weathered vesicular basalt of the Marron Formation of Eocene or Oligocene age forms Unit 7. This unit is faulted against older rocks on the north and west sides of the claim block.

Mineralization

Mineralization on the Orofino Mountain Property consists of quartz veins in which pyrite, chalcopyrite, galena, and free gold occur. The mineralization is similiar to that which occurs in the Fairview gold camp to the south of the claim block.

The quartz veining appears to be associated with the granite which extends from Fairview to Orofino Mountain. Most veins in the area occur within one mile of the contact of the granite with older rocks. The quartz veins are associated with shear zones, and are up to 1.5 meters wide.

Rock samples were collected at a number of showings and dumps (figure 3) on the property with the following results:

Sample No.	Width (m)	Gold ppb	Gold oz/ton	Material
T-100	grab	-	0.001	quartz
T-101	grab	-	0.001	rusty shear
T-102	"	-	0.001	quartz, pyrite
T-103	"	-	0.003	quartz, pyrite
T-104	"	-	0.001	quartz
T-105	dump	-	0.367	quartz, pyrite
T-106	"	-	0.10	wallrock, pyrite
T-107	grab	-	0.078	quartz, vugs
T-108	"	-	1.75	quartz, vugs
T-109	float	-	0.001	quartz, vugs
T-110	"	-	1.127	quartz, vugs
01	dump	4,800	0.141	quartz, pyrite
02	"	30	-	wallrock
04	grab	46,200	1.35	vugs, quartz
84-k-001	grab	-	0.008	quartz
" " 002	"	-	0.082	wallrock, pyrite
" " 003	"	-	0.010	wallrock, pyrite
" " 004	"	-	0.014	quartz
" " 005	0.60	-	0.160	quartz, pyrite
" " 006	0.45	-	0.130	quartz, vugs
" " 007	0.45	-	0.122	quartz, vugs
" " 008	0.60	-	0.066	quartz, vugs
" " 009	0.60	-	0.006	white quartz
" " 010	0.60	-	0.010	white quartz
" " 011	0.80	-	0.146	quartz, pyrite
" " 012	1.0	-	0.012	quartz, pyrite
" " 013	dump	-	0.038	quartz, wallrock
" " 014	"	-	0.254	quartz, wallrock
" " 015	"	-	0.070	quartz, wallrock
" " 016	1.2	-	0.026	rusty quartz
" " 017	0.8	-	0.010	rusty quartz
" " 018	dump	-	0.126	quartz, pyrite

Samples T-100 to T-104 were taken from a series of shafts and trenches 200 meters southeast of the southeast corner of L 1449. The veins are sparsely mineralized and returned only trace amounts of gold.

Samples T-107 and T-108 were taken from an adit and trenches which have been mined, 100 to 200 meters north of the

MO claim and within the mineral reserve. Values of 0.078 and 1.75 oz. gold per ton were returned. The vein strikes S 53°E and dips 60° to 75° east, and although located off the property, there is an excellent possibility the vein extends onto the property.

Sample 04 (1.35 oz gold per ton) was a grab sample taken from high grade material located at the Lower King Adit. This assay confirms the high gold values from previous assays from this area.

Samples 84-K-001 to 84-K-004 were taken from a shaft located at 1-0+3+75E. The shaft is 5 meters deep, and exposes a vein 1.0 meter wide on the surface. Below the surface the vein narrows and becomes veinlets within a shear zone. The shear zone strikes N 42°E and is vertical. This orientation is almost exactly the same as a conductor indicated by the VLF-EM survey. The quartz is sparsely mineralized and returned only low (0.008 and 0.014 oz. gold per ton) values. The wallrock however, is strongly chloritized and contains up to 5% pyrite. One sample of this material assayed 0.082 oz. gold per ton, which is significant.

Samples 84-K-005 to 84-K-008 were taken from an adit located at L-1N+12+00E. The adit is approximately 17 meters long, and follows a quartz vein. The vein strikes N83°W and dips 23°S. It varies from 0.30 to 0.60 meters wide, is rusty and vuggy and contains massive pyrite. The samples assayed 0.160, 0.130, 0.122 and 0.066 oz. gold per ton respectively. These assays are significant, and the structure requires further investigation.

Two samples, 84-K-009 and 84-K-010 were taken from a trench located between L-5N and L-6N, at 5+20W. The vein is from 0.30 to 0.70 meters wide, strikes N66°W and is vertical. The samples gave only trace amounts of gold.

Samples 84-K-011 and 84-K-012 were taken at the portal of the Upper King Adit. One sample gave an assay of 0.146 oz.gold per ton.

Samples 84-K-016 and 84-K-017 were taken from the surface of the Orofino vein. Assay results were 0.026 and 0.010 oz. gold per ton respectively.

The following samples (T-105, T-106, 01, 02, 84-K-014, 015) were taken from the dump at the Independence Adit. Values ranged from a trace to 0.367 oz. gold per ton, with an average of 0.155 oz. gold per ton. In addition a sample taken from the Orofino dump (84-K-018) gave a value of 0.126 oz. gold per ton, and a sample taken from the Upper King dump (84-K-013) gave a value of 0.038 oz. gold per ton. The assay values indicate the material on the dumps may be of high enough grade to process profitably.

GEOCHEMISTRY

A total of 194 soil samples were taken and analyzed for copper, lead, silver and gold (figures 4, 5, 6). As chalcopyrite and galena are associated with the gold mineralization in the area, copper and lead were used a pathfinders for gold.

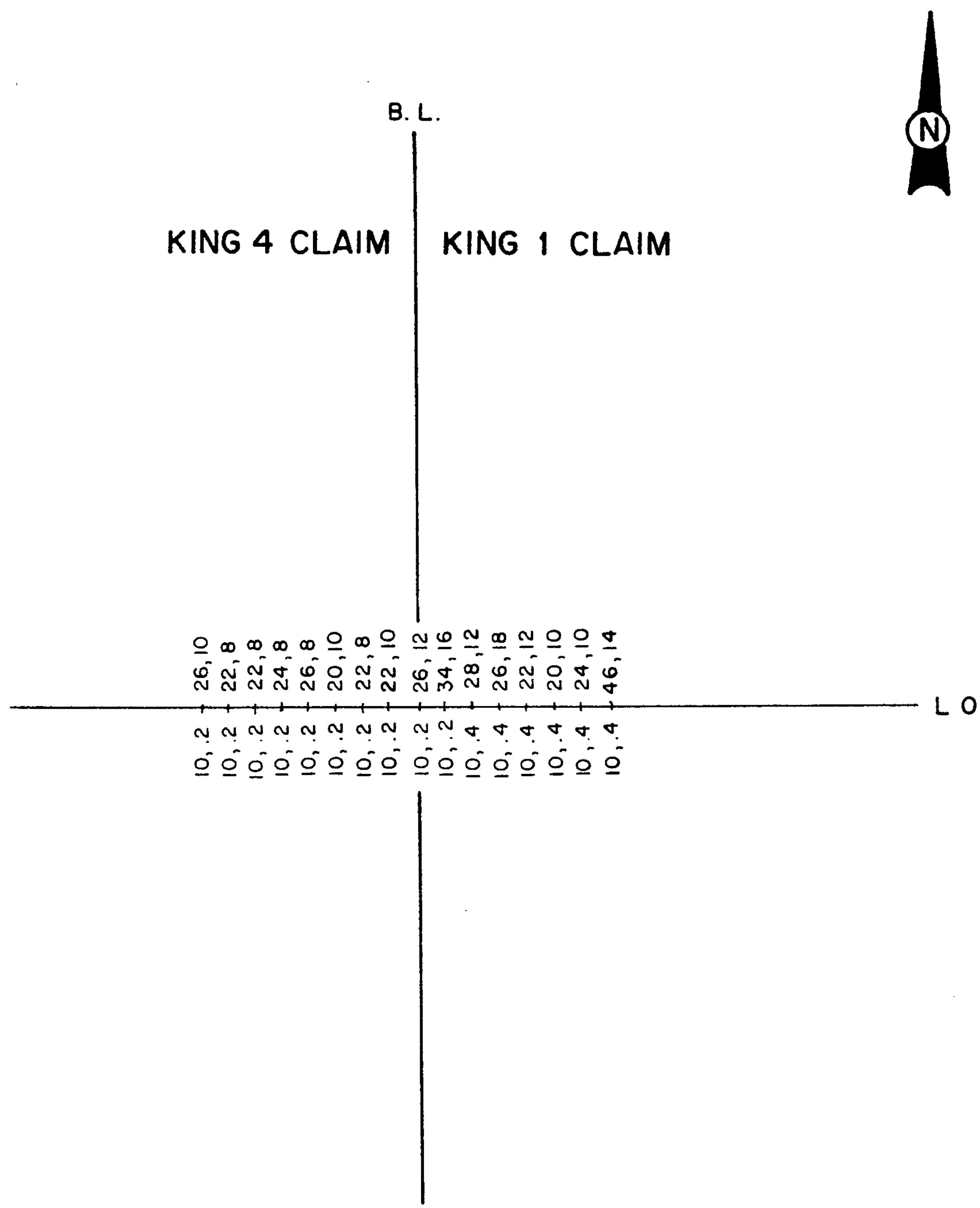
Gold

Background values for gold is 10 ppb, and values greater the 10 ppb were considered anomalous. Ten values were anomalous.

At 1-0 and 0+80W (6,200 ppb) and 0+60W (3,900 ppb), two highly anomalous values were returned. Both of these values came from Lower King dump.

Four values along L-1S were anomalous (8+60E(100 ppb), 10+40E (9,400 ppb), 10+60E (30 ppb) and 10+80E (20 ppb)). The value at 8+60E is south of the Independence Adit, while the other 3 values are adjacent to the Orofino Adit.

At L-25 and 9+80E a value of 90 ppb was returned. This may indicate an extension of the Orofino vein. Along L-0+50S, 0+80W (20 ppb) and 0+40W (30 ppb) were anomalous. These samples were taken adjacent to the high grade trench at the Lower King Adit.



LEGEND

26,10	Pb (ppm)
	Cu (")
—+—	SOIL SAMPLE LOCATION
10,.2	Ag (ppm)
	Au (ppb)

OROFINO MTN. GOLD PROSPECT

GEOCHEMISTRY
Au, Ag, Cu, Pb
GRID A

OROFINO MTN. PROPERTY

OSOYOOS M.D., B.C.

SCALE 1:2500

0 50 100 150 Metres

Grant Crooker

DRAWN BY: G. CROOKER	N.T.S.: 82E-4E,5E
DATE: NOV. 1984	FIGURE Nº. 6

At L-6N and 1+80w, a value of 200 ppb was obtained. This may indicate a vein covered by overburden.

Silver

Background for silver was calculated to be 0.32 ppm, and values twice background (0.64 ppm) were considered anomalous.

Four values were anomalous, and in all but one instance coincident with the anomalous gold values. The coincidental values are at L-0 and 0+80W, 0+60W, and L-1S and 10+40E. Samples s-1 (1.4 ppm) is located below the trench between L-5N and L-6N, at 5+20W.

Lead

Background for lead was calculated to be 11.8 ppm, and values twice background (23.6 ppm) were considered anomalous. Only two values were anomalous, (L-1S and 9+00E (24 ppm) and 10+40E (284 ppm)), and these are coincident with anomalous gold values.

Copper

Background for copper was calculated to be 49 ppm, with values twice background (98 ppm) considered anomalous. Six values were anomalous, again generally coincidental with the anomalous gold values.

Anomalous values along L-0 and 9+40E (100 ppm) and 9+60E (116 ppm) possibly indicate an extention of the Independence Vein.

At L-1S and 2+60E a value of 214 ppm was obtained, and this highly anomalous value should be investigated.

The geochemical sampling at Grid A (figure 6) did not indicate any anomalous values.

VLF-EM SURVEY

The Fraser filter was applied to all In-phase readings to allow contouring of the data. The results were contoured at 10 percent intervals (figures 3,8 and 10).

A large number of conductors were found during the course of the survey. Some appear to be associated with known mineralized structures, while no explanation is obvious for others.

The highest readings of over 100% were obtained along L-5, at 1+20W and 0+40E. This anomaly occurs over a tailings pond, and would appear to be caused by sulphides in the tailings.

Conductor A occurs near the Lower King Adit and associated workings. The conductor is weak, but appears to sub parallel the vein. The conductor is probably caused by a shear zone associated with the veining. If this is the case, the shear zone extends to the north and south of the known extent of the shear zone.

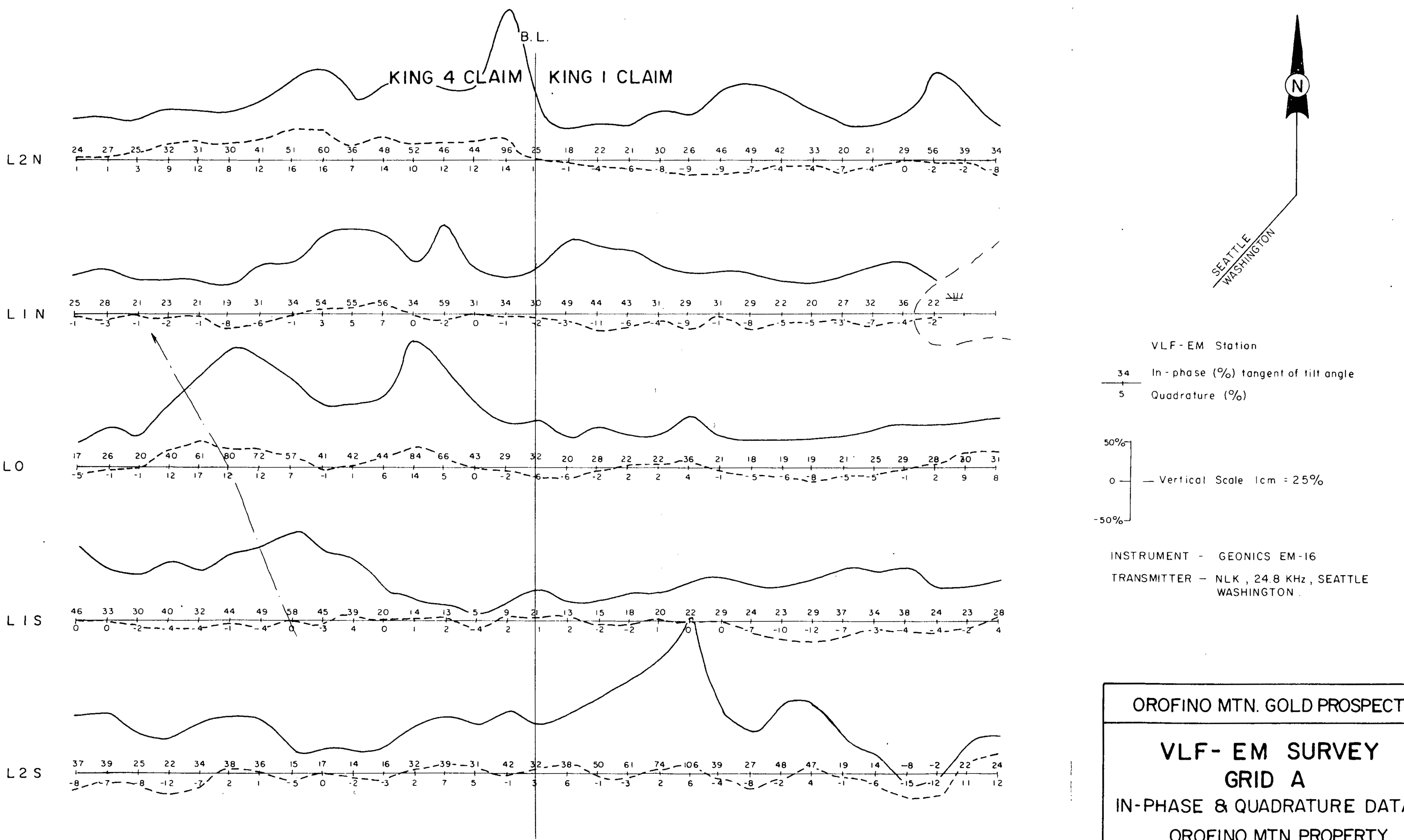
Conductor B occurs near the Upper King Adit, and the conductor is weak. However the conductor parallels the direction of shearing within the adit. The vein occurs within a shear zone with graphite. The conductor again extends north and south from the area of showing, and thus the vein and shearing may extend in both directions.

Conductors C occurs near a shaft located at L-O and 3+60E, and is weak. However the conductor parallels a shear zone, with associated veining and pyrite exposed in the shaft.

Conductor D is a broad, weak conductor near the Grandoro Showing. The conductor sub-parallels the northwest to southeast strike of the veins. The conductor may indicate shearing or faulting, associated with the quartz veining.

No obvious explanation is available for the other conductors.

Several conductors were indicated at Grid A (figure 10), but no explanation is obvious for the conductors. The conductors at L-0 and 0+50W passes through the area where gold bearing quartz float was found, but geochemical sampling did not indicate anomalous values.



Grant Crooker

OROFINO MTN. GOLD PROSPECT

VLF-EM SURVEY
GRID A

IN-PHASE & QUADRATURE DATA

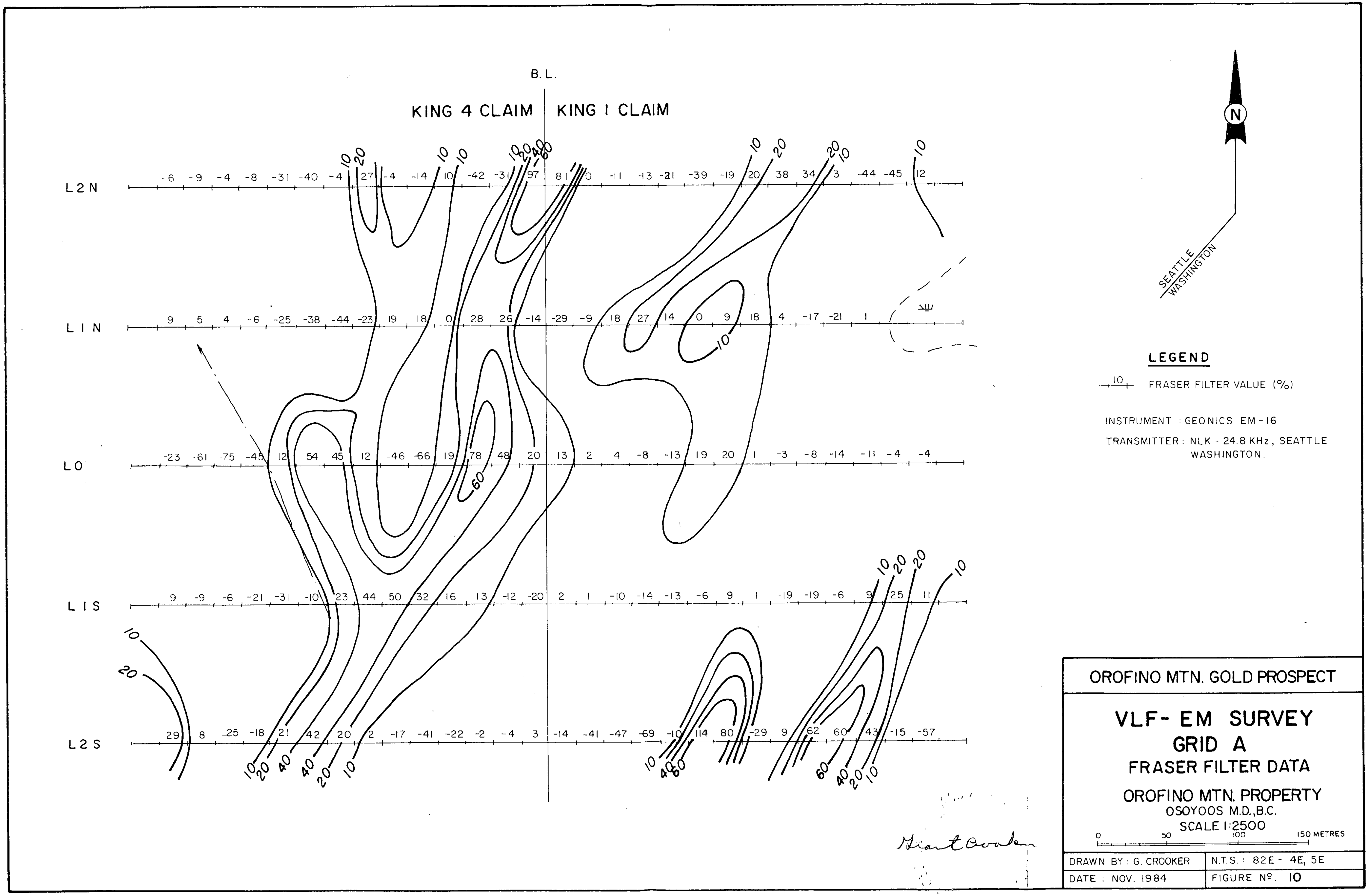
OROFINO MTN. PROPERTY

OSOYOOS M.D., B.C.

SCALE 1:2500

0 50 100 150 METRES

DRAWN BY: G. CROOKER	N.T.S.: 82E-4E, 5E
DATE: NOV. 1984	FIGURE Nº. 9


B.L.
KING 4 CLAIM
KING I CLAIM
L2N
L1N
L0
L1S
L2S
N
SEATTLE WASHINGTON
LEGEND
10 FRASER FILTER VALUE (%)
INSTRUMENT : GEONICS EM-16
TRANSMITTER : NLK - 24.8 KHz, SEATTLE WASHINGTON.
OROFINO MTN. GOLD PROSPECT
VLF- EM SURVEY
GRID A
FRASER FILTER DATA
OROFINO MTN. PROPERTY
OSOYOOS M.D., B.C.
SCALE 1:2500
0 50 100 150 METRES
DRAWN BY : G. CROOKER
N.T.S. : 82E - 4E, 5E
DATE : NOV. 1984
FIGURE Nº. 10

CONCLUSIONS AND RECOMMENDATIONS

The geochemical survey indicated the anomalous gold, silver, lead and copper values are generally coincidental, and successfully outlined the existing mineralized zones. At the Grandoro Showings the sampling also indicated extensions of the veins systems.

No broad geochemical anomalies were found, even over areas which have had significant gold production. This may be at least inpart due to the extremely arid conditions, which prevent broad dispersion of the elements.

Copper would appear to be the most useful element to use as a pathfinder, in conjunction with gold for geochemical surveys on the property.

The VLF-EM Survey indicated a number of conductors on the property. Conductors A, B, C and D appear to be associated with previously known mineralized quartz veins and shear zones. The conductors may indicate extensions of these zones.

The rock sampling, along with the previous exploration programs have shown a number of mineralized quartz veins exist on the property. These mineralized zones which contain significant gold values definitely warrant trenching and/or drilling. The Upper and Lower King Adits, Independence Adit, Orofino Adit, adit a L-0 and 12+00W, and shaft at L-0 and 3+70W all require further investigation.

Recommendations are as follows:

To continue the Phase I program, consisting of prospecting, rock sampling, soil sampling and VLF-EM surveying over areas of the property not previously investigated.

A Phase II program consisting of rehabilitation of working, and trenching and/or diamond drilling of mineralized zones should be carried out simultaneously with the Phase I program.

Cost estimates are as follows:

Phase I

Establishment of grid	$5,000.00
Geochemical Survey	4,000.00
Geochemical Analysis	8,000.00
Geophysical Survey (VLF-EM)	5,000.00
Engineering and Supervision	5,000.00
Total	$27,000.00
Contingency	3,000.00
Total Phase I	$30,000.00

Phase II

Rehabilitation of Workings	$12,000.00
Trenching and sampling	12,000.00
Drilling and Sampling, 1,000 Feet @ $30.00 per foot	30,000.00
Supervision	10,000.00
Total	$64,000.00
Contingency	6,000.00
Total Phase II	$70,000.00

Respectfully submitted,

Grant Crooker, B.Sc., FGAC
Geologist

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CERTIFICATE OF QUALIFICATIONS

I, Grant F. Crooker, B.Sc., Geology of Upper Bench Road, Keremeos, in the Province of British Columbia, hereby certify as follows:

1. That I graduated from the University of British Columbia in 1972 with a Bachelor of Science degree in Geology.

2. That I have prospected and actively pursued geology prior to my graduation and have practiced my profession since 1972.

3. That I am a member of the Canadian Insitute of Mining and Metallurgy.

4. That I am a Fellow of the Geological Association of Canada.

5. That I am the sole owner of the MO, King, King #1, King #2, King #3, and King #4 mineral claims.

Dated at Vancouver, British Columbia this 30the day of November, 1984.

Grant Crooker

Grant F. Crooker, B.Sc., FGAC
Geologist

EM16 SPECIFICATIONS

MEASURED QUANTITY	In-phase and quad-phase components of vertical magnetic field as a percentage of horizontal primary field. (i.e. tangent of the tilt angle and ellipticity).
SENSITIVITY	In-phase :±150% Quad-phase :± 40%
RESOLUTION	±1%
OUTPUT	Nulling by audio tone. In-phase indication from mechanical inclinometer and quad-phase from a graduated dial.
OPERATING FREQUENCY	15-25 kHz VLF Radio Band. Station selection done by means of plug-in units.
OPERATOR CONTROLS	On/Off switch, battery test push button, station selector switch, audio volume control, quadrature dial, inclinometer.
POWER SUPPLY	6 disposable 'AA' cells.
DIMENSIONS	42 x 14 x 9cm
WEIGHT	Instrument: 1.6 kg Shipping : 4.5 kg

NOTES ON VLF TRANSMISSIONS

	STATION	LOCATION	FREQUENCY (kHz)	CO-ORDINATES
N. AMERICA	NAA	Cutler, Maine	~~17.8~~ 24.0	67W17-44N39
	NLK	Seattle, Washington	~~18.6~~ 24.8	121W55-48N12
	NSS	Annapolis, Maryland	21.4	76W27-38N59
EUROPE	GBR	Rugby, England	16.0	01W11-52N22
	FUO	Bordeaux, France	15.1	00W48-44N65
	JXZ	Helgeland, Norway	16.4	13E01-66N25
	UMS	Moscow, U.S.S.R.	17.1	37E01-55N49
PACIFIC	NWC	North West Cape Australia	22.3	114E09-21S47
	NDT	Yosami, Japan	17.4	137E01-34N58
	NPM	Lualualei, Hawaii	23.4	158W09-21N25

FIELD PROCEDURE

Orientation & Taking a Reading

The direction of the survey lines should be selected approximately along the lines of the primary magnetic field, at right angles to the direction to the station being used. Before starting the survey, the instrument can be used to orient oneself in that respect. By turning the instrument sideways, the signal is minimum when the instrument is pointing towards the station, thus indicating that the magnetic field is at right angles to the receiving coil inside the handle.(Fig.11).

To take a reading, first orient the reference coil (in the lower end of the handle) along the magnetic lines.(Fig.12) Swing the instrument back and forth for minimum sound intensity in the speaker. Use the volume control to set the sound level for comfortable listening. Then use your left hand to adjust the quadrature component dial on the front left corner of the instrument to further minimize the sound. After finding the minimum signal strength on both adjustments, read the inclinometer by looking into the small lens. Also, mark down the quadrature reading.

While travelling to the next location you can, if you wish, keep the instrument in operating position. If fast changes in the readings occur, you might take extra stations to pinpoint accurately the details of anomaly.

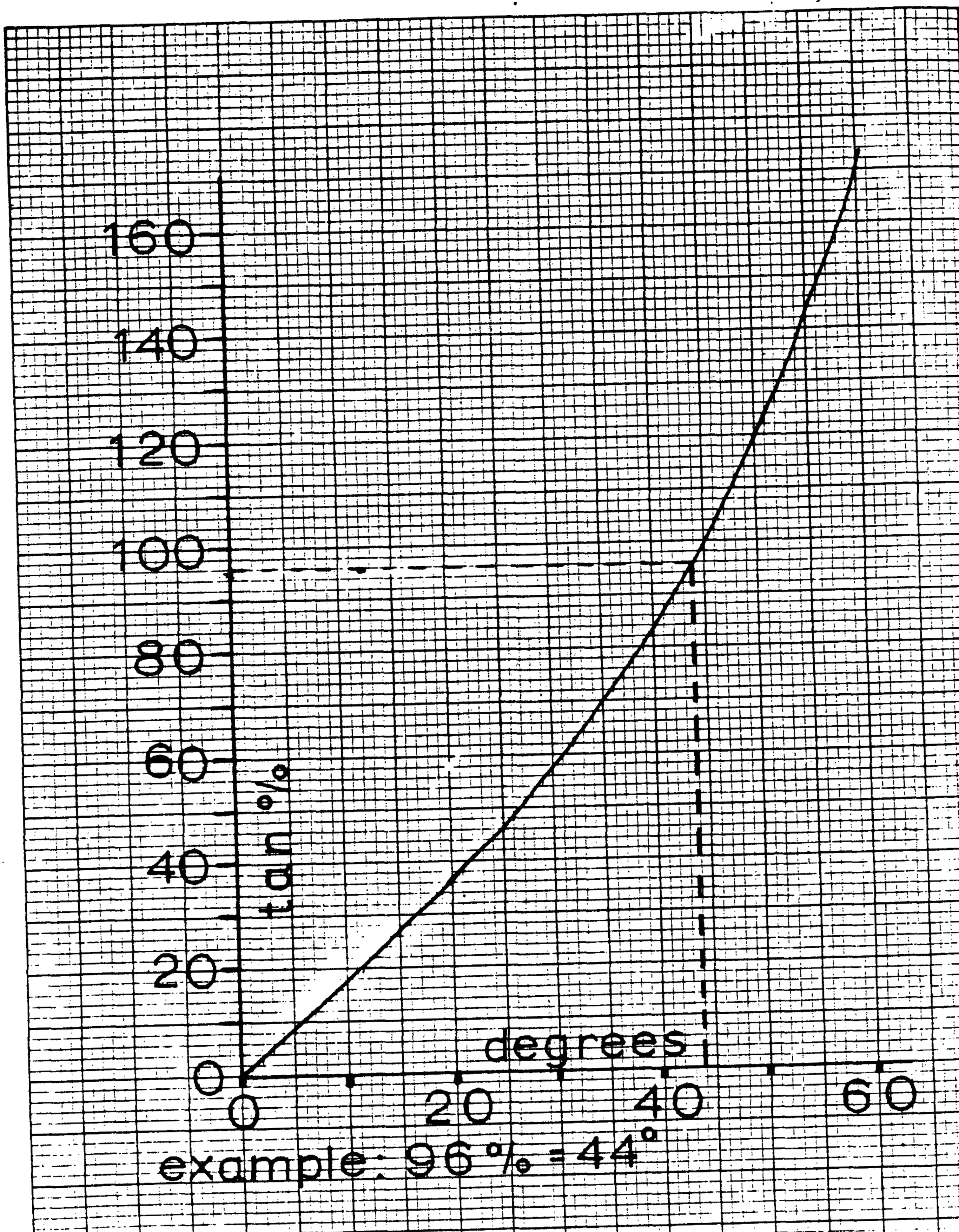
The dials inside the inclinometer are calibrated in positive and negative percentages. If the instrument is facing 180^{o} from the original direction of travel, the polarities of the readings will be reversed. Therefore, in the same area take the readings always facing in the same direction even when travelling in opposite way along the lines.

The lower end of the handle, will as a rule, point towards the conductor. (Figs.13 & 14) The instrument is so calibrated that when approaching the conductor, the angles are positive in the in-phase component. Turn always in the same direction for readings and mark all this on your notes, maps, etc.

THE INCLINOMETER DIALS

The right-hand scale is the in-phase percentage(ie.Hs/Hp as a percentage). This percentage is in fact the tangent of the dip angle. To compute the dip angle simply take the arctangent of the percentage reading divided by 100. See the conversion graph on the following page.

The left-hand scale is the secant of the slope of the ground surface. You can use it to "calculate" your distance to the next station along the slope of the terrain.



EM16 in-phase, % to degrees

(1) Open both eyes.

(2) Aim the hairline along the slope to the next station to about your eye level height above ground.

(3) Read on the left scale directly the distance necessary to measure along the slope to advance 100 (ft) horizontally.

We feel that this will make your reconnaissance work easier. The outside scale on the inclinometer is calibrated in degrees just in case you have use for it.

PLOTTING THE RESULTS

For easy interpretation of the results, it is good practice to plot the actual curves directly on the survey line map using suitable scales for the percentage readings. (Fig.15) The horizontal scale should be the same as your other maps on the area for convenience.

A more convenient form of this data is easily achieved by transforming the zero-crossings into peaks by means of a simple numerical filtering technique. This technique is described by D.C. Fraser in his paper "Contouring of VLF-EM Data", Geophysics, Vol. 34, No. 6. (December 1969)pp958-967. A reprint of this paper is included in this manual for the convenience of the user.

This simple data manipulation procedure which can be implemented in the field produces VLF-EM data which can be contoured and as such provides a significant advantage in the evaluation of this data.

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

CONTOURING OF VLF-EM DATA

By

D. C. Fraser

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GEOPHYSICS, VOL. 34, NO. 6 (DECEMBER 1969), P. 958-967, 6 FIGS., 1 TABLE

CONTOURING OF VLF-EM DATA†

D. C. FRASER*

Prospecting for conductive deposits with ground VLF-EM instruments has received considerable impetus with the recent development of lightweight receivers. The large geologic noise component, which results from the relatively high-transmitted frequency, has caused some critics to avoid use of the technique. Those who routinely perform surveys with a VLF-EM unit find that, in some areas, a 5-degree peak-to-peak anomaly can be significant, whereas anomalies having amplitudes in excess of 100 degrees may occur as well. Consequently, there is a dynamic range problem when presenting the results as profiles plotted on a field map.

A data manipulation procedure is described which transforms noisy noncontourable data into less noisy contourable data, thereby eliminating the dynamic range problem and reducing the noise problem. The manipulation is the result of the application of a difference operator to transform zero-crossings into peaks, and a low-pass smoothing operator to reduce noise. Experience has shown that field personnel can routinely perform the calculations which simply involve additions and subtractions.

INTRODUCTION

VLF-EM data can be exceedingly difficult to interpret because a large geologic noise component can result from the relatively high-transmitted frequency of about 20,000 Hz. Routine surveys can yield useless data unless special care is taken both in survey procedure and in data presentation.

The purpose of this paper is to describe the survey procedure and the method of data presentation in use by the Keevil Mining Group and to illustrate the advantages of this approach.

VLF-EM GROUND SURVEY PROCEDURE AND DATA TREATMENT

The primary field

VLF-EM transmitter stations are located at several points around the globe. They broadcast at frequencies close to 20,000 Hz, which is low compared to the normal broadcast band. The purpose of these stations is to allow governmental communication with submarines, and the low frequency allows some penetration of the conductive ocean water. Skin depth is approximately $3.6\sqrt{P}$ meters, where P is the resistivity of a homogeneous halfspace in ohm-m, on the assumption that the frequency is 20,000 Hz and that the halfspace is magnetically nonpolarizable. Consequently, depth of exploration is severely restricted for overburden resistivities less than 200 ohm-m.

Since the area to be prospected normally is of considerable distance from the transmitter stations, the primary field is uniform in the area, allowing rather simple mathematics to be used in anomaly prediction and analysis.

Survey procedure and data treatment

The survey procedure first consists of selecting a transmitter station which provides a field approximately parallel to the traverse direction, i.e., approximately perpendicular to the expected strike of a conductor. The following points relate to the method of data treatment.

1. Readings should be taken every 50 ft, as will be shown below.
2. Transmitter stations should not be changed

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* Keevil Mining Group Limited, Geophysical Engineering & Surveys Limited, Teck Corporation Limited, Toronto, Ontario, Canada.

for a given block of ground, to avoid distortion in the contour presentation. Hence, fill-in lines should be run with the same transmitter station as other lines in the block. The field direction of this station should be shown on the data map.

3. List the dip angle[1] data in tabular form, as follows:
   a) list in the direction of north (top of paper) to south, or from west to east;
   b) designate south or east dips as negative; and
   c) perform calculations as shown in Table 1.

   Thus, the filtered output or contourable quantity simply consists of the sum of the observations at two consecutive data stations subtracted from the sum at the next two consecutive data stations. The theoretical basis for this procedure will be described below.

4. The right-hand column (filtered data) is suitable for contouring. Normally, negative values are not contoured since, being caused by dip angle flanks, they do not aid interpretation but only confuse the picture. The positive values generally are contoured at 10-unit intervals, and the zero contour is shown only when it brackets an anomaly. In quiet areas, 5-unit contours may be meaningful.

[1] This paper assumes that data is recorded as for the Crone Radem which defines a north-dipping field as a south "dip" on the instrument. This convention was chosen because a south reading is interpreted as arising from a conductor to the south.

Example

Figure 1 presents dip-angle data, according to the Crone convention, in the vicinity of the Temagami mine of Copperfields Mining Corporation Limited in Ontario. This figure illustrates that several conductors are present yielding large dip angles. A complex pattern has resulted which requires some thought to interpret properly.

Figure 2 presents the filtered data in contoured form where only the 0, 20, and 40 contours are shown for simplicity. The conductor pattern is immediately apparent, even to exploration personnel untrained in VLF-EM interpretation. The three anomalies correlate with a zone of nearly massive pyrite and two brecciated fault zones. Depth to bedrock is 15 ft.

In practice, all the data of Figures 1 and 2 are

Table 1. Example of calculations

Location	Measured dips	Apply sign and form the moving sum of pairs of entries		Take first differences of alternate entries		
3+00S	6S	−6				
			(−6)+(−7)=	−13		
3+50S	7S	−7				
			(−7)+(−8)=	−15	(−23)−(−13)=	−10
4+00S	8S	−8				
				−23	(−39)−(−15)=	−24
4+50S	15S	−15				
				−39		+ 7
5+00S	24S	−24				
				−16		+57
5+50S	8N	+ 8				
				+18		+38
6+00S	10N	+10				
				+22		+ 8
6+50S	12N	+12				
				+26		+ 6
7+00S	14N	+14				
				+28	(+34)−(+26)=	+ 8
7+50S	14N	+14				
			(14)+(20)=	+34		
8+00S	20N	+20				

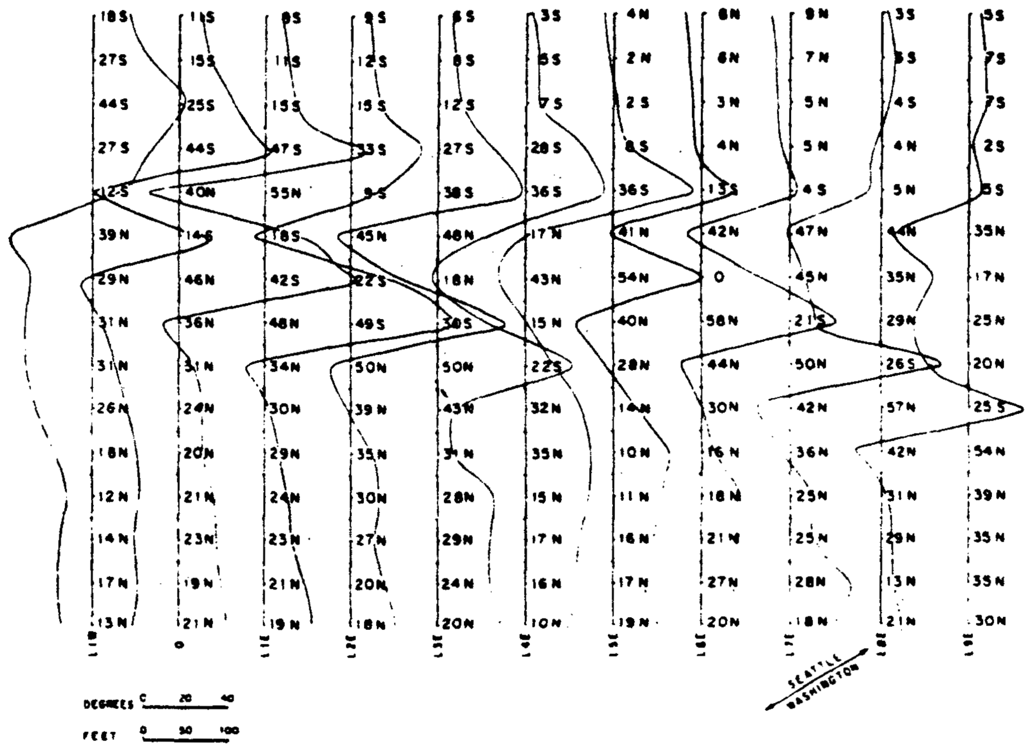

FIG. 1. Dip-angle data in the vicinity of the Temagami mine. The arrow defines the VLF-EM primary field direction from the transmitter at Seattle, Washington.

placed on a single map. The above example illustrates that this very simple one-dimensional filtering scheme yields a practical and effective approach to VLF-EM data handling.

The filter improves the resolution of anomalies, thereby making them easier to recognize. An inflection on the dip profile from a conductor subordinate to a larger one yields a positive peak, thereby emphasizing the presence of such a conductor. Figure 3 illustrates this effect where nine lines were run over an SP (self-potential) anomaly in the Temagami area. The dip-angle anomaly is very poorly resolved due to the regional south dips produced by an areally large conductor to the south of the map area. The contoured VLF-EM data yields a clearly defined anomaly which was located over the negative center of the SP.

THE FILTER AND ITS EFFECT ON ANOMALIES

The filter operator

The filter operator was designed to meet the following criteria:

1. It must phase shift the dip-angle data by 90 degrees so that crossovers and inflections will be transformed into peaks to yield contourable quantities.
2. It must completely remove dc and attenuate long spatial wavelengths to increase resolution of local anomalies.
3. It must not exaggerate the station-to-station random noise.
4. It must be simple to apply so that field personnel can make the calculations without difficulty.

The first two criteria are met by using a simple difference operator, i.e.

$$M_2 - M_1,$$

where M_1 and M_2 are any two consecutive data points.

The third criterion is met by applying a smoothing or low-pass operator to the differences, i.e.

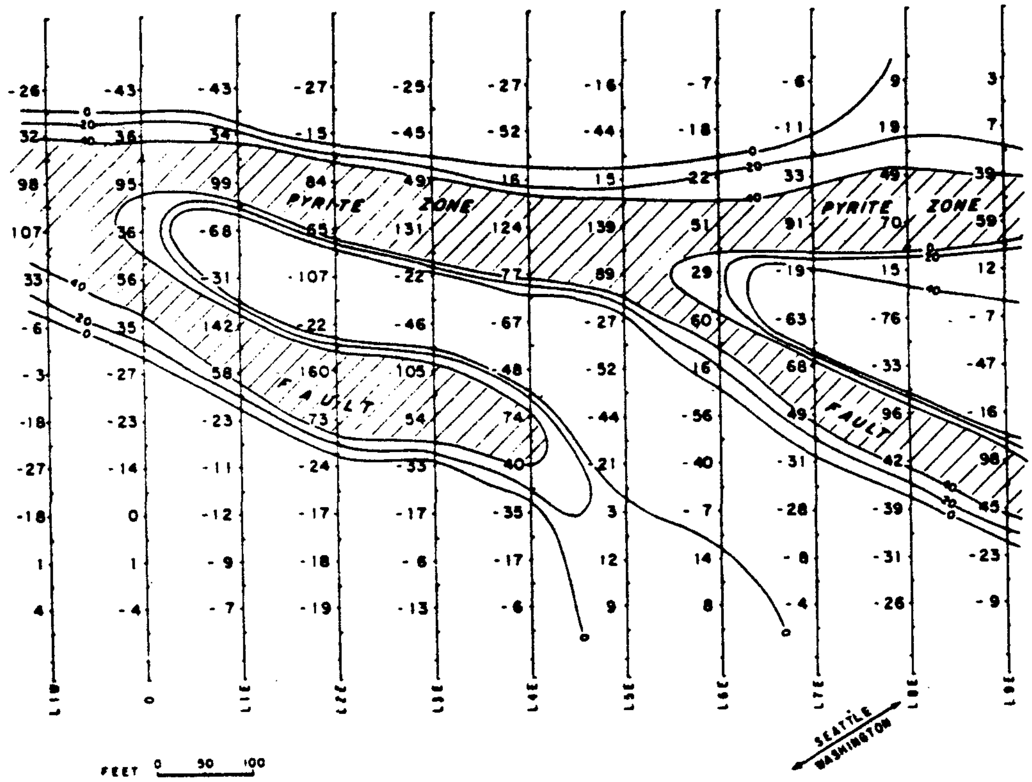

FIG. 2. Filtered data computed from the map of Figure 1.

$$\tfrac{1}{4}(M_2 - M_1) + \tfrac{1}{2}(M_3 - M_2) + \tfrac{1}{4}(M_4 - M_3),$$

where M_1, M_2, M_3, and M_4 are any four consecutive data points. The filtered output then is

$$\tfrac{1}{4}(M_2 - M_1) + \tfrac{1}{2}(M_3 - M_2) + \tfrac{1}{4}(M_4 - M_3) = \tfrac{1}{4}[M_3 + M_4 - M_1 - M_2].$$

The final criterion is enhanced by eliminating the constant, so that the plotted function becomes

$$f_{2,3} = (M_3 + M_4) - (M_1 + M_2),$$

which is plotted midway between the M_2 and M_3 dip-angle stations.

This filter has its frequency (wavenumber) response displayed in Figure 4, for a station spacing of 50 ft. Its characteristics are as follows:

1. All frequencies are shifted by 90 degrees.
2. Noise having a wavelength equal to the station spacing and dc bias are completely removed.
3. Maximum amplitude occurs for wavelengths of 250 ft, or five times the station spacing.

The frequency (wavenumber) response of the filter is shown for a station spacing of 50 ft, because this is the most suitable spacing for defining sulfide bodies within a few hundred feet of surface. This will be demonstrated below.

The dike model

A conducting dike in a VLF-EM field will produce a secondary induction field from eddy currents maintained in it by the primary field. These eddy currents will tend to flow in such a manner as to form line sources concentrated near the outer edges of the dike since the field is uniform (Figure 5a). This dike may be replaced by a loop of wire of dimensions traced out by the main current concentration in the dike. The secondary field geometry of the loop and dike then will be practically identical, as has been shown by Fraser (1966), Parry (1966), and Parry et al (1965). This

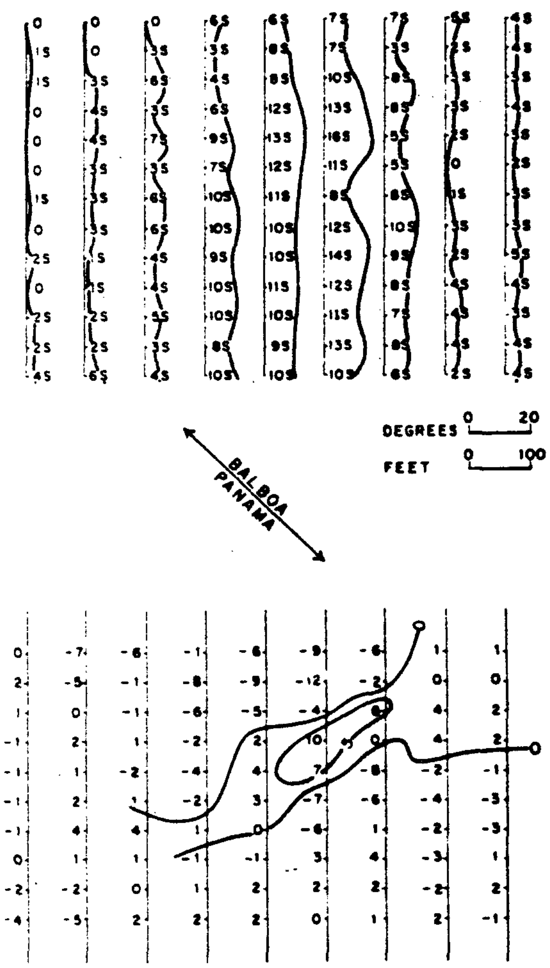

Fig. 3. Dip-angle (upper map) and filtered data (lower map) over a small grid in the Temagami area. The arrow defines the VLF-EM primary field direction from the transmitter at Balboa, Panama.

allows a mathematical model of a dike to be constructed because the field from a line source is known.

For brevity, only a dike which is large in depth extent and in length will be considered herein. Only the top line source of Figure 5a will contribute to the measured dip angles because the other current line sources are very far away.

The horizontal Hs_x and vertical Hs_z secondary fields are (Figure 5b)

$$Hs_x = kH_0 \frac{z}{x^2 + z^2}$$

$$Hs_z = kH_0 \frac{x}{x^2 + z^2},$$

where k is a positive constant having the dimension of length and is related to the conductivity and dimensions of the dike, and where H_0 is the primary VLF-EM strength at the dike. The measured dip angle is

$$\alpha = \tan^{-1}\left[\frac{H_{s_z}}{Hs_x + H_0}\right]$$

$$= \tan^{-1}\left[\frac{kx}{kz + x^2 + z^2}\right]$$

Model dip profiles can be computed for various depths z only by assuming a value for k.

As a means of testing the effect of the filter operator, a single k value was chosen to yield a

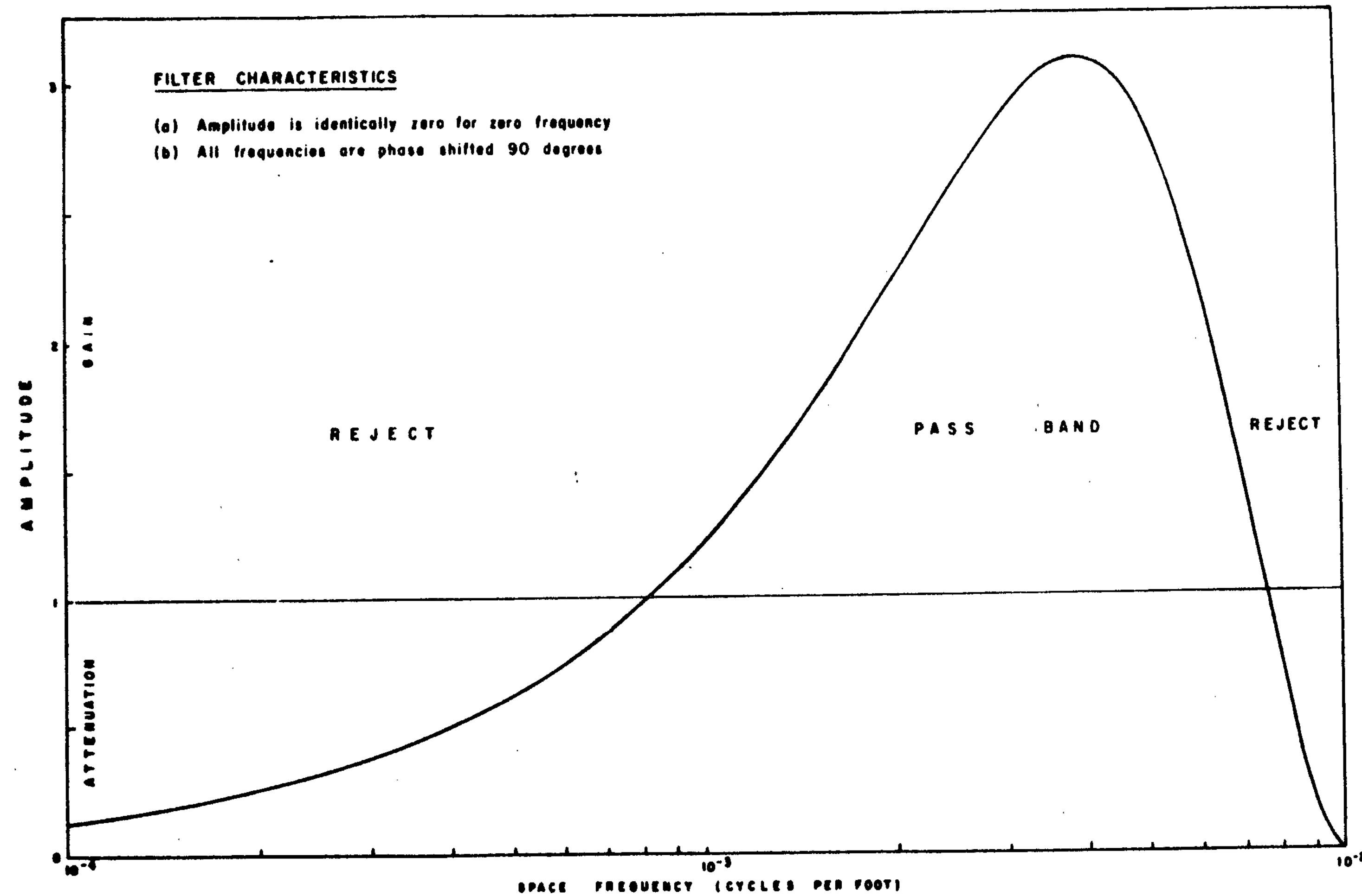

FIG. 4. Frequency response of filter operator for station spacing of 50 ft.

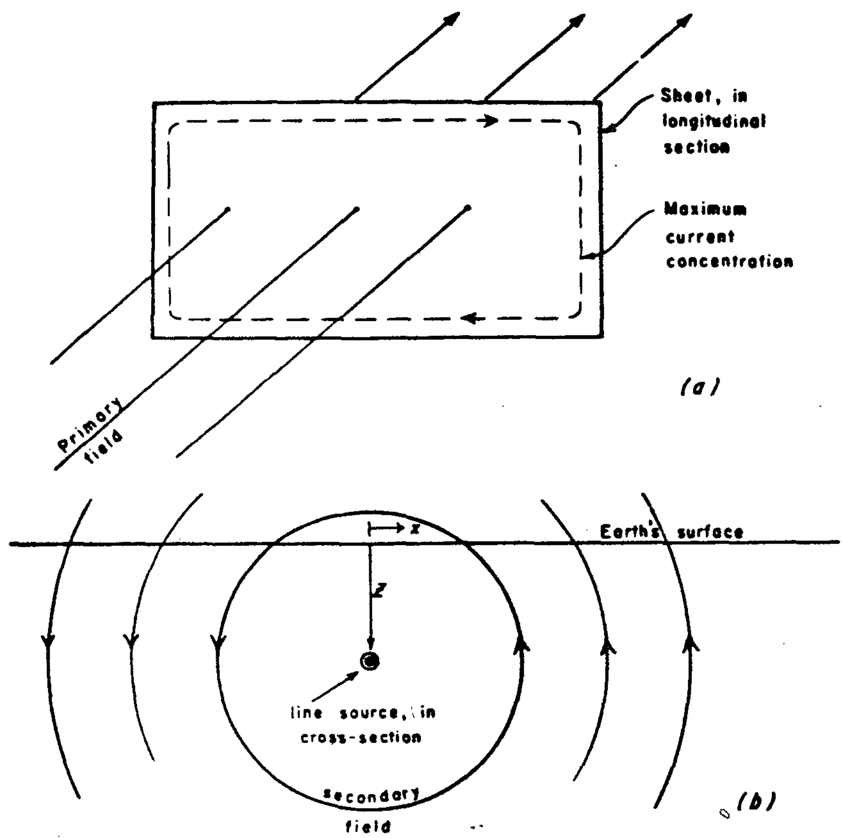

FIG. 5. (a) A sheet in a uniform primary field will have maximum current concentrated near its edges. (b) A line source, corresponding to the upper current concentration in (a), yields a secondary magnetic field of cylindrical shape.

maximum dip angle of 35 degrees when depth z to top of dike (or line source) was 100 ft. Figure 6 illustrates the dip angle and filtered profiles for this case for a station spacing of 50 ft and for several depth values.

The following are the main characteristics of these dike and filtered anomalies:

1. Peak-to-peak angles vary from 93 degrees for $z=50$ ft to 25 degrees for $z=500$ ft. Filtered peaks vary from 118 degrees for $z=50$ ft to 8 degrees for $z=500$ ft. Thus, the filter amplifies near-surface anomalies and attenuates deep-source anomalies. There is neither amplification nor attenuation when z is 100 ft.
2. On the basis of anomaly resolution and usual noise levels, dip angle data can detect dike-like conductors in a resistive medium to a depth of 500 ft, while filtered data can detect such bodies to a depth of 300 ft. Conductors in the upper 200 ft generally will be more easily recognized on the filtered data.

VLF-EM data commonly is measured at 100-ft intervals in Canada. A change in the sample interval from the 50 ft recommended herein to 100 ft causes the passband curve of Figure 4 to shift to the left, such that the peak is at 2×10^{-3} cpf rather than 4×10^{-3} cpf. Similarly, the anomaly curves of Figure 6 remain correct in shape provided all distance dimensions are doubled. Consequently, detection of conductors to a depth of 500 ft, when utilizing the filter operator, might appear facilitated by use of a 100-ft station interval rather than a 50-ft interval. However, anomalies from near-surface conductors will have poorly defined waveforms for a 100-ft

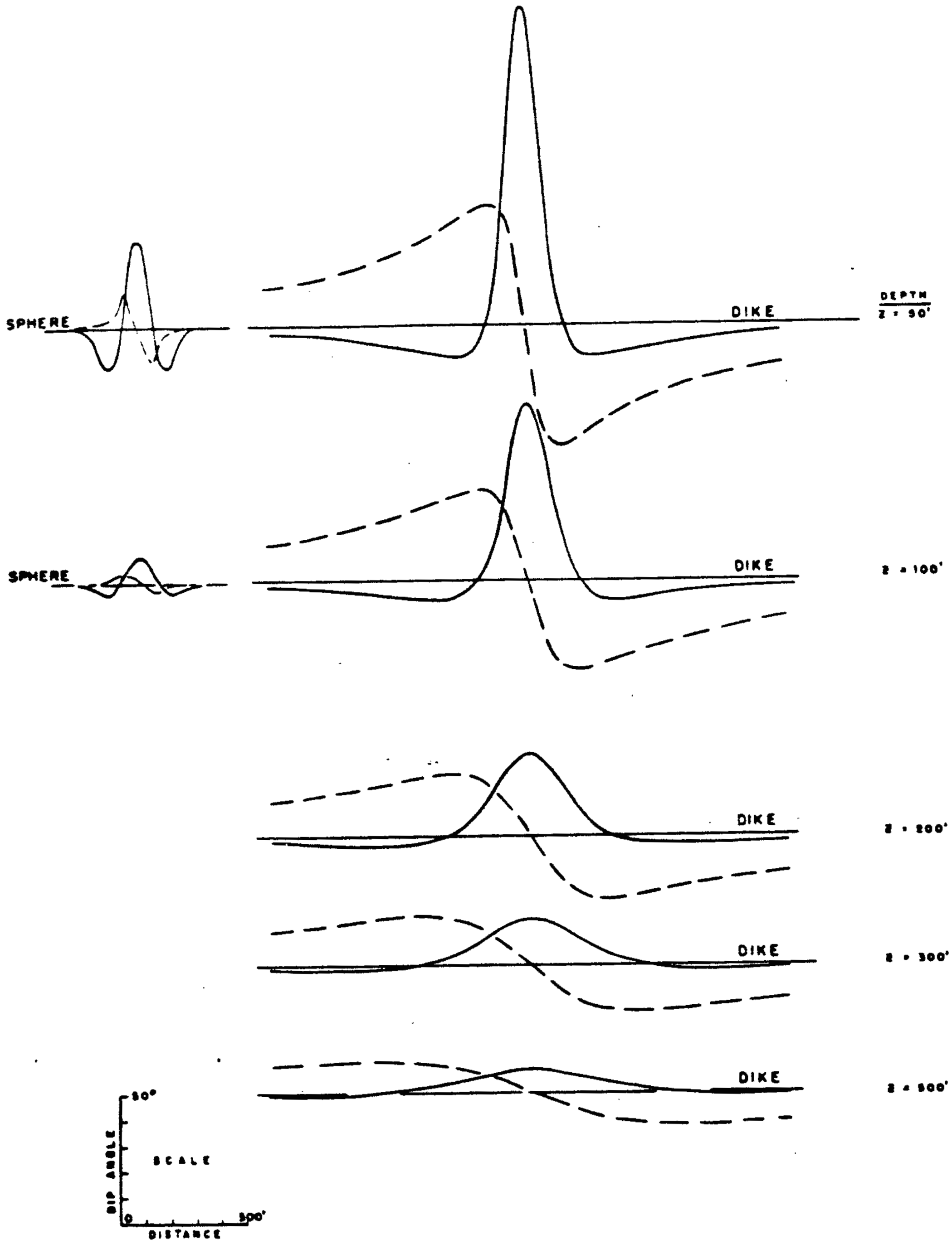

FIG. 6. Dip-angle (dashed) and filtered (solid) curves for model dike and sphere for several depths of burial, where z is depth to top of dike and to center of sphere.

data station interval, and will alias as deeper conductors. This "geologic noise" will somewhat confuse the contoured output. Generally, a comparison of the 50-ft data station dip angle profiles with the contoured filtered output suffices to indicate approximate depth to source and to allow recognition of sources deeper than 300 ft.

As an aside, some geophysicists have claimed that a reasonable dike model depth estimate can be obtained directly as half the distance between dip angle peaks, because the vertical field Hs_z peaks at $x = \pm z$. However, this formula is not applicable to dip-angle data, as can be seen by the dike curves of Figure 6. For this example, the formula provides erroneous depth estimates of 150, 200, 325, 425, and 625 for true depths of 50, 100, 200, 300, and 500 ft.

The sphere model

A conducting sphere in a VLF-EM field will produce an anomaly according to equations in Ward (1967). For a traverse directly over a sphere having its center at depth z, and run in the direction of the primary field H_0, the anomaly is,

$$Hs_x = kH_0 \frac{(2x^2 - z^2)}{(x^2 + z^2)^{5/2}}$$

$$Hs_z = kH_0 \frac{3xz}{(x^2 + z^2)^{5/2}},$$

where k is a positive constant which saturates at $R^3/2$, where R is the sphere radius, and where quadrature is ignored. The measured dip angle as a function of station location x is (where x is zero directly over the sphere center),

$$\alpha = \tan^{-1}\left(\frac{Hs_z}{Hs_x + H_0}\right)$$

$$= \tan^{-1}\left[\frac{3kxz}{k(2x^2 - z^2) + (x^2 + z^2)^{5/2}}\right].$$

Model dip profiles can be computed for various depths z only by assuming a value for k. The sphere curves of Figure 6 assume a saturated k-value for a sphere radius of 50 ft. Obviously, a sphere having its center at a depth of greater than twice its radius generally will not be detectable. However, the filter operator aids in the recognition of a spherical conductor because it amplifies the anomaly, for the small sphere sizes usually encountered in nature, assuming data spacing is 50 ft.

TOPOGRAPHIC EFFECT

Whittles (1969) recently described a topographic effect which may arise when surveying with VLF-EM in mountainous regions. The spatial wavelengths which result from the phenomenon he describes are greatly attenuated by the filter and generally do not appear on the contoured maps. Whittles advocates the use of first derivatives to remove the topographic effect. The filter operator described herein uses the first difference (i.e., the discrete first derivative) as one of its components.

ADDITIONAL APPLICATIONS

The simplicity of the calculations allows practical application of the filter to any form of ground geophysical data which yields zero-crossings over tragets, such as vertical loop EM and Afmag. However, it is difficult to justify the use of the filter on vertical loop EM data because neither dynamic range of anomalies nor geologic noise is large. In Afmag, utilization of the filter is not recommended because of the varying direction of the primary field.

Airborne VLF-EM systems, which measure parameters yielding zero-crossings over targets, are being marketed. If the data were collected on magnetic tape, a computer could be used to apply the filter, thereby allowing contouring of the data. However, in this situation more sophisticated filter operators should be employed.

If the filter is to be applied to data other than ground VLF-EM, the sample interval should be selected to ensure that the passband of the filter is correct relative to the frequency components of the anomalies sought.

CONCLUSIONS

A consideration of geologic noise and conductor shapes illustrates that VLF-EM data should be collected at 50-ft intervals, and that the described filter operator should be employed. The filtered data, when contoured, provides a data presentation which simplifies interpretation. The filter also amplifies anomalies from near-surface, highly conducting ore pods which is an important feature in several mining districts such as at Tribag and Temagami, both in Ontario, and in Louvicourt Township of Quebec.

Chemex Labs Ltd.

212 Brooksbank Ave.
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Sample description	Prep code	Au FA oz/T					
84K001	214	0.008	--	--	--	--	--
84K002	214	0.082	--	--	--	--	--
84K003	214	0.010	--	--	--	--	--
84K004	214	0.014	--	--	--	--	--
84K005	214	0.160	--	--	--	--	--
84K006	214	0.130	--	--	--	--	--
84K007	214	0.122	--	--	--	--	--
84K008	214	0.066	--	--	--	--	--
84K009	214	0.006	--	--	--	--	--
84K010	214	0.010	--	--	--	--	--
84K011	214	0.146	--	--	--	--	--
84K012	214	0.012	--	--	--	--	--
84K013	214	0.038	--	--	--	--	--
84K014	214	0.254	--	--	--	--	--
84K015	214	0.070	--	--	--	--	--
84K016	214	0.026	--	--	--	--	--
84K017	214	0.010	--	--	--	--	--
84K018	214	0.126	--	--	--	--	--
84P001	214	0.014	--	--	--	--	--
84P002	214	0.024	--	--	--	--	--
84P003	214	0.006	--	--	--	--	--
84P004	214	0.008	--	--	--	--	--
84P005	214	0.016	--	--	--	--	--
84P006	214	0.010	--	--	--	--	--

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CERTIFICATE No.: 84485 - 1
INVOICE No.: 5064
DATE ANALYSED: NOV.5,1984
FILE NAME: GC485

PRE FIX	SAMPLE NAME	PPM Cu	PPM Ag	PPM Pb	PPB Au
S	LO - 3+60 W	30	0.2	10	10
S	2+60 W	28	0.2	8	10
S	2+20 W	30	0.2	12	10
S	1+80 W	28	0.2	14	10
S	1+40 W	38	0.2	8	10
S	1+00 W	28	0.2	8	10
S	0+80 W	174	3.8	8	6200
S	0+60 W	640	7.6	10	3900
S	0+40 W	36	0.4	6	10
S	0+20 W	32	0.2	8	10
S	LO - 0+BL	32	0.2	10	10
S	0+20 E	22	0.2	8	10
S	0+40 E	24	0.2	8	10
S	0+60 E	32	0.2	8	10
S	0+80 E	36	0.2	8	10
S	1+00 E	28	0.2	8	10
S	1+20 E	20	0.2	8	10
S	1+40 E	16	0.2	8	10
S	1+80 E	14	0.2	8	10
S	2+20 E	18	0.2	6	10
S	LO - 2+60 E	18	0.2	8	10
S	2+80 E	18	0.2	6	10
S	3+20 E	30	0.2	10	10
S	3+40 E	22	0.2	6	10
S	3+60 E	36	0.2	8	10
S	3+80 E	30	0.2	10	10
S	4+00 E	42	0.2	8	10
S	4+20 E	30	0.2	8	10
S	4+60 E	38	0.2	10	10
S	5+00 E	36	0.2	10	10
S	LO - 5+20 E	28	0.2	10	10
S	5+60 E	32	0.2	12	10
S	6+00 E	30	0.2	10	10
S	6+40 E	68	0.2	8	10
S	6+80 E	56	0.2	10	10
S	7+20 E	78	0.2	8	10
S	7+60 E	42	0.4	10	10
S	8+00 E	72	0.4	10	10
	8+20 E	68	0.4	10	10

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CERTIFICATE No.: 84485 - 2
INVOICE No.: 5064
DATE ANALYSED: NOV.5,1984
FILE NAME: GC485

PRE FIX	SAMPLE NAME	PPM Cu	PPM Ag	PPM Pb	PPB Au
S	L0 - 8+40 E	50	0.2	10	10
S	8+60 E	50	0.2	12	10
S	8+80 E	66	0.2	8	10
S	9+00 E	36	0.2	8	10
S	9+20 E	32	0.2	10	10
S	9+40 E	100	0.2	10	10
S	9+60 E	116	0.2	8	10
S	10+00 E	56	0.2	10	10
S	10+40 E	72	0.2	10	10
S	10+60 E	30	0.2	12	10
S	L0 -10+80 E	36	0.2	10	10
S	11+00 E	36	0.2	12	10
S	11+20 E	38	0.2	12	10
S	11+60 E	20	0.2	12	10
S	12+00 E	20	0.2	10	10
S	L1S- 3+00 W	24	0.2	8	10
S	2+60 W	32	0.2	10	10
S	2+20 W	26	0.2	10	10
S	1+80 W	20	0.2	8	10
S	1+40 W	28	0.2	10	10
S	L1S- 1+00 W	34	0.2	10	10
S	0+80 W	56	0.2	10	10
S	0+60 W	50	0.2	8	10
S	0+40 W	44	0.2	12	10
S	0+20 W	60	0.2	14	10
	0+00	MISSING			
S	0+20 E	48	0.2	8	10
S	0+40 E	46	0.2	10	10
S	0+60 E	22	0.2	10	10
S	0+80 E	26	0.2	10	10
S	L1S- 1+00 E	34	0.2	16	10
S	1+40 E	28	0.2	12	10
S	1+80 E	32	0.2	10	10
S	2+20 E	30	0.2	10	10
S	2+60 E	214	0.4	6	10
S	3+00 E	32	0.2	8	10
S	3+20 E	36	0.2	8	10
S	3+40 E	58	0.4	6	10
S	3+60 E	86	0.4	8	10

CERTIFIED BY : F. Rossbacher

ROSSBACHER LABORATORY LTD.

2225 S. SPRINGER AVENUE
BURNABY, B.C. V5B 3N1
TEL : (604) 299 - 6910

CERTIFICATE OF ANALYSIS

TO : DRC RESOURCES LTD.
1250-800 W.PENDER ST.
VANCOUVER,B.C.
PROJECT No.: G. CROOKER

CERTIFICATE No.: 84485 - 3
INVOICE No.: 5064
DATE ANALYSED: NOV.5,1984
FILE NAME: GC485

PRE FIX	SAMPLE NAME	PPM Cu	PPM Ag	PPM Pb	PPB Au
S	L1S- 3+80 E	48	0.2	14	10
S	4+20 E	44	0.2	16	10
S	4+60 E	58	0.4	8	10
S	5+00 E	38	0.2	8	10
S	5+40 E	52	0.2	10	10
S	5+80 E	64	0.2	10	10
S	6+20 E	40	0.2	10	10
S	6+60 E	40	0.2	10	10
S	7+00 E	46	0.2	10	10
S	7+40 E	42	0.2	12	10
S	L1S- 7+80 E	54	0.4	8	10
S	8+20 E	42	0.4	10	10
S	8+60 E	50	0.4	8	100
S	9+00 E	44	0.2	24	10
S	9+20 E	90	0.4	14	10
S	9+40 E	50	0.2	12	10
S	9+60 E	40	0.2	12	10
S	9+80 E	38	0.2	14	10
S	10+00 E	38	0.2	12	10
S	10+20 E	88	0.4	16	10
S	L1S-10+40 E	110	2.0	284	9400
S	10+60 E	102	0.2	18	30
S	10+80 E	60	0.4	12	20
S	11+20 E	38	0.2	10	10
S	L2S- 3+00 W	36	0.6	12	10
S	2+60 W	42	0.4	12	10
S	2+20 W	44	0.2	14	10
S	1+80 W	24	0.4	18	10
	1+60 W	MISSING			
S	1+40 W	26	0.2	10	10
S	L2S- 1+20 W	38	0.2	12	10
S	1+00 W	44	0.2	12	10
S	0+80 W	60	0.2	18	10
S	0+60 W	74	0.2	10	10
S	0+40 W	50	0.2	10	10
S	0+20 W	46	0.2	12	10
	0+00	MISSING			
S	0+20 E	32	0.2	14	10
S	0+40 E	48	0.2	10	10

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ROSSBACHER LABORATORY LTD.

2225 S. SPRINGER AVENUE
BURNABY, B.C. V5B 3N1
TEL : (604) 299 - 6910

CERTIFICATE OF ANALYSIS

TO : DRC RESOURCES LTD.
1250-800 W.PENDER ST.
VANCOUVER,B.C.
PROJECT No.: G. CROOKER

CERTIFICATE No.: 84485 - 4
INVOICE No.: 5064
DATE ANALYSED: NOV.5.1984
FILE NAME: GC485

PRE FIX	SAMPLE NAME	PPM Cu	PPM Ag	PPM Pb	PPB Au
S	L2S- 0+60 E	46	0.2	16	10
S	0+80 E	54	0.2	14	10
S	1+20 E	24	0.2	8	10
S	1+60 E	32	0.4	8	10
S	2+00 E	30	0.6	8	10
S	2+40 E	30	0.6	6	10
S	2+80 E	20	0.4	6	10
S	3+00 E	88	0.4	4	10
S	3+20 E	66	0.2	4	10
S	3+40 E	30	0.2	6	10
S	L2S- 3+60 E	28	0.2	6	10
S	4+00 E	32	0.2	8	10
S	4+40 E	32	0.2	8	10
	4+80 E	34	0.4	8	10
	5+20 E	48	0.2	10	10
S	5+60 E	52	0.2	8	10
S	6+00 E	34	0.2	8	10
S	6+40 E	58	0.2	10	10
S	6+80 E	66	0.2	10	10
S	7+20 E	48	0.2	8	10
S	L2S- 7+60 E	58	0.4	6	10
S	8+00 E	54	0.2	10	10
S	8+40 E	52	0.2	10	10
S	8+80 E	52	0.2	14	10
S	9+00 E	50	0.2	14	10
	9+20 E	MISSING			
S	9+40 E	54	0.4	12	10
S	9+60 E	40	0.4	14	10
S	9+80 E	56	0.2	14	90
S	10+00 E	42	0.2	12	10
S	L2S-10+40 E	34	0.2	10	10
S	10+80 E	30	0.2	10	10
S	11+20 E	36	0.2	8	10
S	L50S- 1+00 W	38	0.2	10	10
S	0+80 W	38	0.4	10	20
S	0+60 W	42	0.2	10	10
S	0+40 W	48	0.2	14	30
S	0+20 W	50	0.4	10	10
	0+00	32	0.4	10	10

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MOSSBACHER LABORATORY LTD.

2225 S. SPRINGER AVENUE
BURNABY, B.C. V5B 3N1
TEL : (604) 299 - 6910

CERTIFICATE OF ANALYSIS

TO : DRC RESOURCES LTD.
1250-800 W.PENDER ST.
VANCOUVER,B.C.
PROJECT No.: G. CROOKER

CERTIFICATE No.: 84485 - 5
INVOICE No.: 5064
DATE ANALYSED: NOV.5,1984
FILE NAME: GC485

PRE FIX	SAMPLE NAME	PPM Cu	PPM Ag	PPM Pb	PPB Au
S	L50S- 0+20 E	40	0.4	14	10
S	0+40 E	26	0.2	10	10
S	0+60 E	24	0.2	8	10
S	0+80 E	34	0.2	8	10
S	1+00 E	36	0.2	6	10
S	L6N- 1+00 W	50	0.2	10	10
S	1+20 W	64	0.2	8	10
S	1+40 W	60	0.2	8	10
S	1+60 W	74	0.2	6	10
S	1+80 W	96	0.4	6	200
S	L6N- 2+00 W	80	0.2	6	10
S	2+20 W	62	0.2	6	10
S	2+40 W	54	0.2	10	10
	2+60 W	78	0.2	8	10
	2+80 W	MISSING			
S	3+00 W	56	0.2	10	10
S	3+20 W	44	0.2	10	10
S	3+40 W	44	0.2	14	10
S	3+60 W	44	0.2	14	10
S	3+80 W	44	0.2	14	10
S	L6N- 4+00 W	44	0.2	12	10
S	4+20 W	36	0.2	10	10
S	4+40 W	40	0.2	12	10
S	4+60 W	40	0.2	10	10
S	4+80 W	48	0.2	10	10
S	5+00 W	52	0.2	12	10
	5+20 W	MISSING			
	5+60 W	MISSING			
	6+00 W	MISSING			
S	LA - 0+80 W	26	0.2	10	10
S	0+70 W	22	0.2	8	10
S	0+60 W	22	0.2	8	10
S	0+50 W	24	0.2	8	10
S	0+40 W	26	0.2	8	10
S	0+30 W	20	0.2	10	10
S	0+20 W	22	0.2	8	10
S	0+10 W	22	0.2	10	10
S	0+00	26	0.2	12	10
	0+10 E	34	0.2	16	10

CERTIFIED BY : [signature]

ROSSBACHER LABORATORY LTD.

2225 S. SPRINGER AVENUE
BURNABY, B.C. V5B 3N1
TEL : (604) 299 - 6910

CERTIFICATE OF ANALYSIS

TO : DRC RESOURCES LTD.
1250-800 W.PENDER ST.
VANCOUVER,B.C.
PROJECT No.: G. CROOKER

CERTIFICATE No.: 84485 - 6
INVOICE No.: 5064
DATE ANALYSED: NOV.5,1984
FILE NAME: GC485

PRE FIX	SAMPLE NAME	PPM Cu	PPM Ag	PPM Pb	PPB Au
S	LA - 0+20 E	28	0.4	12	10
S	0+30 E	26	0.4	18	10
S	0+40 E	22	0.4	12	10
S	0+50 E	20	0.4	10	10
S	0+60 E	24	0.4	10	10
S	LA - 0+70 E	46	0.4	14	10
S	S - 001	114	1.4	18	10
S	S - 002	72	0.4	16	10
S	2N + 2+80 W	74	0.6	12	10
S	BL + 1+00 S	82	0.6	10	10
S	BL + 2+00 S	36	0.4	12	10
A	01	46	2.6	86	4800
A	02	14	0.6	18	30
	03	10	1.4	20	6400
	04	14	29.0	20	46200

CERTIFIED BY : [signature]

DETAILED COST STATEMENT

WAGES

1 Geologist, G. Crooker 16½ days @ $300.00 per day Oct. 6-10, 12-17, 18-½day, Nov. 1, 2, 5, 8, 21, 1984	$4,950.00
1 Geologist, J. Kruzick 5 days @ $300.00 per day Oct. 6-10, 1984	1,500.00
1 Field Assistant, Cal Green 5 days @ $150.00 per day Oct. 12-16, 1984	750.00

ACCOMMODATIONS

1 Geologist 17 days @ $30.00 per day Oct. 6-10, 12-18, 1984 Nov. 1, 2,5,8, 21, 1984	510.00
1 Geologist, 5 days @ $30.00 per day Oct. 6-10, 1984	150.00
1 Field Assistant 5 days @ $30.00 per day Oct. 12-16, 1984	150.00

MEALS

1 Geologist 17 days @ $30.00 per day Oct. 6-10 12-18, 1984 Nov. 1, 2, 5, 8, 21, 1984	510.00
1 Geologist 5 days at $30.00 per day Oct. 6-10, 1984	150.00
1 Field Assistant 5 days @ $30.00 per day Oct. 12-16, 1984	150.00

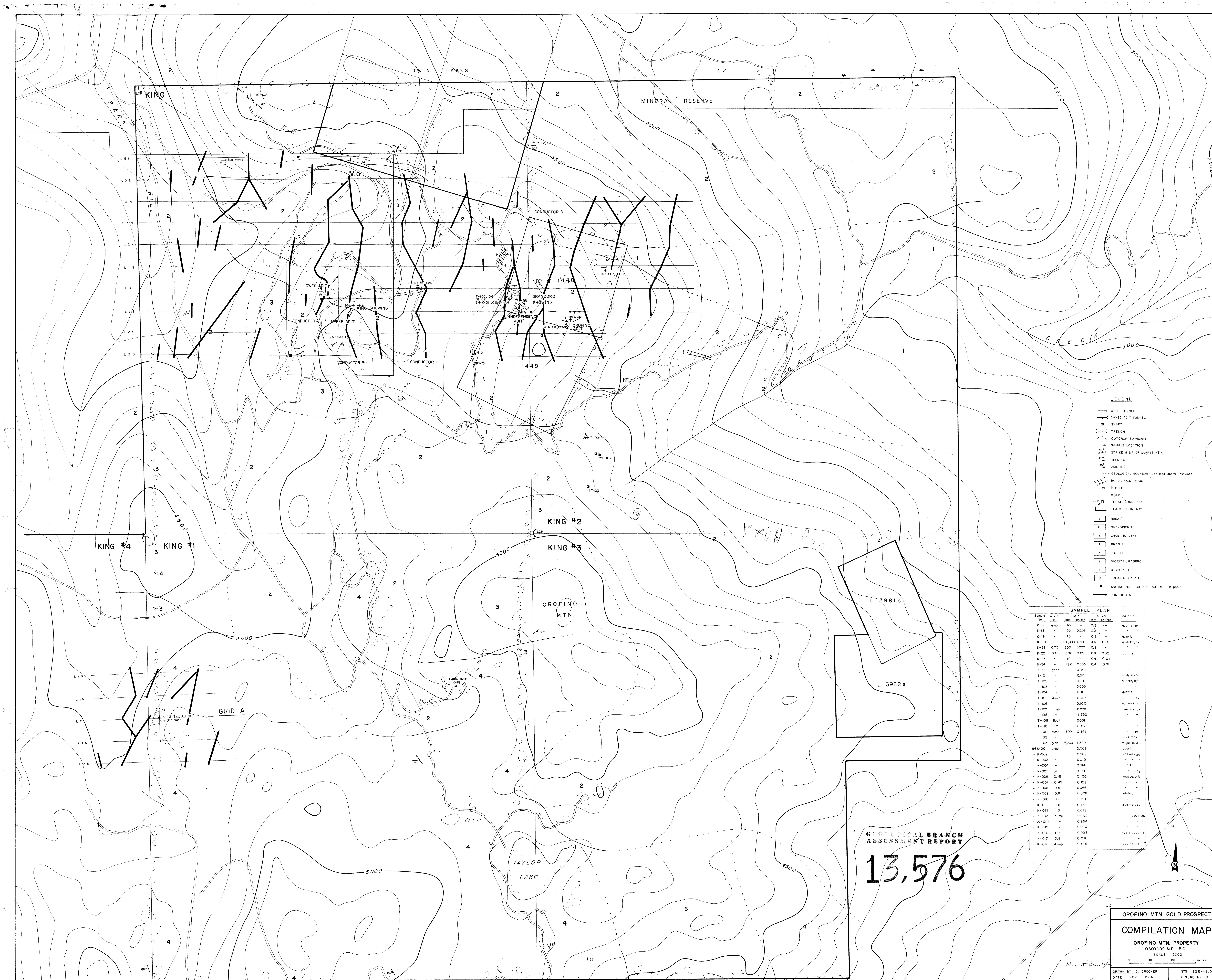
TRANSPORTATION

Vehicle Rental (Ford 3/4 ton 4X4) 12 days @ $48.00 per day Oct. 6-10, 12-18, 1984	576.00
Gasoline	276.50

INSTRUMENT RENTAL	
EM-16 17 days @ $22.00 per day Oct. 2-18, 1984	375.00
SUPPLIES	
Hipchain thread, flagging, geochem bags, etc.	155.51
FREIGHT	20.00
ANALYSIS	
202 soil samples (Au, Ag, Pb, Cu) @ $7.30 per sample	1,474.60
24 rock samples (Au) @ $10,50 per sample	252.00
PREPARATION OF REPORT	
Secretarial, draughting, reproduction, Research, etc.	2,500.00
TOTAL	$14,469.61


LEGEND
VLF-EM STATIONS
ADIT
TRENCH
SHAFT
LEGAL CORNER POST
CLAIM BOUNDARY
FAULT OR SHEAR ZONE
FRASER FILTER VALUE, %
QUARTZ VEIN
INSTRUMENT - GEONICS EM-16
TRANSMITTER - NLK-24.8 KHz, SEATTLE, WASHINGTON.
5+00W
BASELINE
5+00E
10+00E
L 6 N
L 5 N
L 4 N
L 3 N
L 2 N
L 1 N
L 0
L 1 S
L 2 S
L 3 S
L.C.P. MO
TAILING POND
MO CLAIM
KING CLAIM
KING 2 CLAIM
Lower Adit
KING SHOWING
Upper Adit
GRANDORO SHOWING
CONDUCTOR A
CONDUCTOR B
CONDUCTOR C
CONDUCTOR D
Seattle Washington
GEOLOGICAL BRANCH ASSESSMENT REPORT
13,576
OROFINO MTN. GOLD PROSPECT
VLF - EM SURVEY
FRASER FILTER DATA
OROFINO MTN. PROPERTY
OSOYOOS M.D., B.C.
SCALE 1:2500
0 50 100 200 METRES
DRAWN BY G. CROOKER
N.T.S. : 82E-4E,5E
DATE : 1984
FIGURE Nº. : 8


5+00W
BASELINE
5+00E
10+00E
LEGEND
VLF-EM STATIONS
ADIT
TRENCH
SHAFT
LEGAL CORNER POST
CLAIM BOUNDARY
35 IN-PHASE (%), TANGENT OF TILT ANGLE
-4 QUADRATURE (%)
50%
0
-50%
VERTICAL SCALE
1cm = 25%
L6N
L5N
L4N
L3N
L2N
L1N
L0
L1S
L2S
L3S
L.C.P. MO
KING CLAIM
KING 2 CLAIM
MO CLAIM
Lower Adit
KING SHOWING
Upper Adit
GRANDORO SHOWING
GEOLOGICAL BRANCH
ASSESSMENT REPORT
13,576
INSTRUMENT - GEONICS EM-16
TRANSMITTER - NLK-24.8 KHz, SEATTLE, WASHINGTON.
N
Seattle Washington
OROFINO MTN. GOLD PROSPECT
VLF-EM SURVEY
IN-PHASE & QUADRATURE RAW DATA
OROFINO MTN. PROPERTY
OSOYOOS M.D., B.C.
SCALE 1:2500
0 50 100 200 METRES
DRAWN BY G. CROOKER
N.T.S. : 82E-4E, 5E
DATE : NOV. 1984
FIGURE Nº. : 7



SAMPLE PLAN

Sample No	Width m.	Gold ppb	Gold oz/ton	Silver ppm	Silver oz/ton	Material
K-17	grab	10	–	0.2	–	quartz, py
K-18	"	150	0.004	0.2	–	" "
K-19	"	10	–	0.2	–	quartz
K-20	"	>20,000	0.560	4.6	0.14	quartz, py
K-21	0.75	250	0.007	0.2	–	" "
K-22	0.4	1600	0.05	0.8	0.02	quartz
K-23	"	10	–	0.4	0.01	"
K-24	"	180	0.005	0.4	0.01	"
T-100	grab		0.001			"
T-101	"		0.001			rusty shear
T-102	"		0.001			quartz, py
T-103	"		0.003			" "
T-104	"		0.001			quartz
T-105	dump		0.367			" , py
T-106	"		0.100			wall rock, "
T-107	grab		0.078			quartz, vugs
T-108	"		1.750			" "
T-109	float		0.001			" "
T-110	"		1.127			" "
01	dump	4800	0.141			" , py
02	"	30	–			wall rock
03	grab	46,200	1.350			vugsy, quartz
84 K-001	grab		0.008			quartz
" K-002	"		0.082			wall rock, py
" K-003	"		0.010			" " "
" K-004	"		0.014			quartz
" K-005	0.6		0.160			" , py
" K-006	0.45		0.130			vugs, quartz
" K-007	0.45		0.122			" "
" K-008	0.6		0.066			" "
" K-009	0.6		0.006			white, "
" K-010	0.6		0.010			" "
" K-011	0.8		0.146			quartz, py
" K-012	1.0		0.012			" "
" K-013	dump		0.038			" , wallrock
" K-014	"		0.254			" " "
" K-015	"		0.070			" " "
" K-016	1.2		0.026			rusty, quartz
" K-017	0.8		0.010			" "
" K-018	dump		0.126			quartz, py

GEOLOGICAL BRANCH
ASSESSMENT REPORT

13,576


B.L.
L 6 N
LCP Mo
Mo CLAIM
KING CLAIM
KING 2 CLAIM
L O S
L 1 S
L 2 S
LEGEND
10 Pb , ppm
SOIL SAMPLE LOCATION
50 Cu , ppm
ANOMALOUS VALUE – Cu >98 ppm , Pb >23 ppm
QUARTZ VEIN
TRENCH
SHAFT
ADIT
CREEK
GEOCHEM. ANOMALY – COPPER
GEOLOGICAL BRANCH
ASSESSMENT REPORT
13,576
OROFINO MTN. GOLD PROSPECT
GEOCHEMISTRY
Cu , Pb
OROFINO MTN. PROPERTY
OSOYOOS M.D., B.C.
SCALE 1:2500
0 50 100 200 METRES
DRAWN BY G. CROOKER
DATE : NOV. 1984
N.T.S. : 82E-4E, 5E
FIGURE No. : 5