ARIS SUMMARY SHEET

District Geologist, Victoria (OBSOLETE) Off Confidential: 92.09.03

ASSESSMENT REPORT 21898 MINING DIVISION: Victoria

PROPERTY:	Koksilah				
LOCATION:	LAT	48 36 00		LONG	123 51 00
	UTM	10	5383120	437330	
	NTS	092B12W			
CLAIM(S):	Koksilah				
OPERATOR(S):	Cukor, D.				
AUTHOR(S):	Cukor, V.				
REPORT YEAR:	1991, 27 Pages				
KEYWORDS:	Jurassic,Bonanza Group,Tuffs,Basalts				
WORK DONE:	Geophysical,Physical				
	EMGR	5.7 km;VLF ,REST			
	LINE	6.5 km			
RELATED REPORTS:	18848,20254				

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

ASSESSMENT REPORT TITLE PAGE AND SUMMARY

TYPE OF REPORT/SURVEY(S)	TOTAL COST
GEOPHYSICAL	$ 6,808.87

AUTHOR(S) VLADIMIR CUKOR, P. Eng. SIGNATURE(S) [signature]

DATE STATEMENT OF EXPLORATION AND DEVELOPMENT FILED Sept. 3. 91 YEAR OF WORK 1991

PROPERTY NAME(S) KOKSILAH

COMMODITIES PRESENT GOLD

B.C. MINERAL INVENTORY NUMBER(S), IF KNOWN

MINING DIVISION VICTORIA NTS 92 B-12 W

LATITUDE 48° 36′ LONGITUDE 123° 51′

NAMES and NUMBERS of all mineral tenures in good standing (when work was done) that form the property [Examples: TAX 1-4, FIRE 2 (12 units); PHOENIX (Lot 1706); Mineral Lease M 123; Mining or Certified Mining Lease ML 12 (claims involved)]:

KOKSILAH (20 UNITS)

OWNER(S)

(1) DAMIR CUKOR (2)

MAILING ADDRESS

6108 McKee Street
BURNABY, B.C.

OPERATOR(S) (that is, Company paying for the work)

(1) DAMIR CUKOR (2)

MAILING ADDRESS

6108 McKee Street
BURNABY, B.C.

SUMMARY GEOLOGY (lithology, age, structure, alteration, mineralization, size, and attitude):

The property is underlain by the Bonanza Group tuffs, volcanic breccia and basalt flows. Wide spread pyritization.

REFERENCES TO PREVIOUS WORK

(over)

TYPE OF WORK IN THIS REPORT	EXTENT OF WORK (IN METRIC UNITS)	ON WHICH CLAIMS	COST APPORTIONED
GEOLOGICAL (scale, area)			
Ground			
Photo			
GEOPHYSICAL (line-kilometres)			
Ground			
Magnetic			6,808.87
Electromagnetic			
Induced Polarization	5.7 kilometers	KOKSILAH	
Radiometric			
Seismic			
Other	Resistivity 5.7 kilometers	KOKSILAH	
Airborne			
GEOCHEMICAL (number of samples analysed for ....)			
Soil			
Silt			
Rock			
Other			
DRILLING (total metres; number of holes, size)			
Core			
Non-core			
RELATED TECHNICAL			
Sampling/assaying			
Petrographic			
Mineralogic			
Metallurgic			
PROSPECTING (scale, area)			
PREPARATORY/PHYSICAL			
Legal surveys (scale, area)			
Topographic (scale, area)			
Photogrammetric (scale, area)			
Line/grid (kilometres)	6.5 kilometers	KOKSILAH	
Road, local access (kilometres)			
Trench (metres)			
Underground (metres)			
		TOTAL COST	6,808.87

FOR MINISTRY USE ONLY	NAME OF PAC ACCOUNT	DEBIT	CREDIT	REMARKS:
Value work done (from report)				
Value of work approved				
Value claimed (from statement)				
Value credited to PAC account				
Value debited to PAC account				
Accepted .... Date	Rept. No.			Information Class

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GEOLOGICAL BRANCH
ASSESSMENT REPORT

21,898

1. INTRODUCTION

Assessment work, consisting of geophysical surveys, was conducted on the Koksilah claim during the month of August. V. Cukor, P.Eng. conducted the survey with the assistance of D. Cukor, geologist, owner of the claim and Z. Budrovich, geological engineer.

The area of the claim had been explored in 1988, and the grid cut at that time was rehabilitated as preparation for this year's survey. A great deal of effort was expended to re-establish the exact position of the 1988 survey stations, for purposes of data correlation. Where the grid is located in wooded areas, this task was accomplished fairly easily, since here flagging was well preserved and cut lines were clearly recognizable. In clear cut areas, flagging was generally broken off and blown away by the wind. In such areas it took considerable time and effort to re-establish old survey stations.

The geophysical work done within this program comprised a resistivity survey (VLF-EM E-field method) and a VLF-EM survey. Signals from Seattle, Washington, 24.8 kHz were utilized for both surveys. The VLF-EM survey, essentially repeating a part of the 1988 survey, was conducted in order to better correlate between VLF-EM and resistivity data.

2. REVIEW

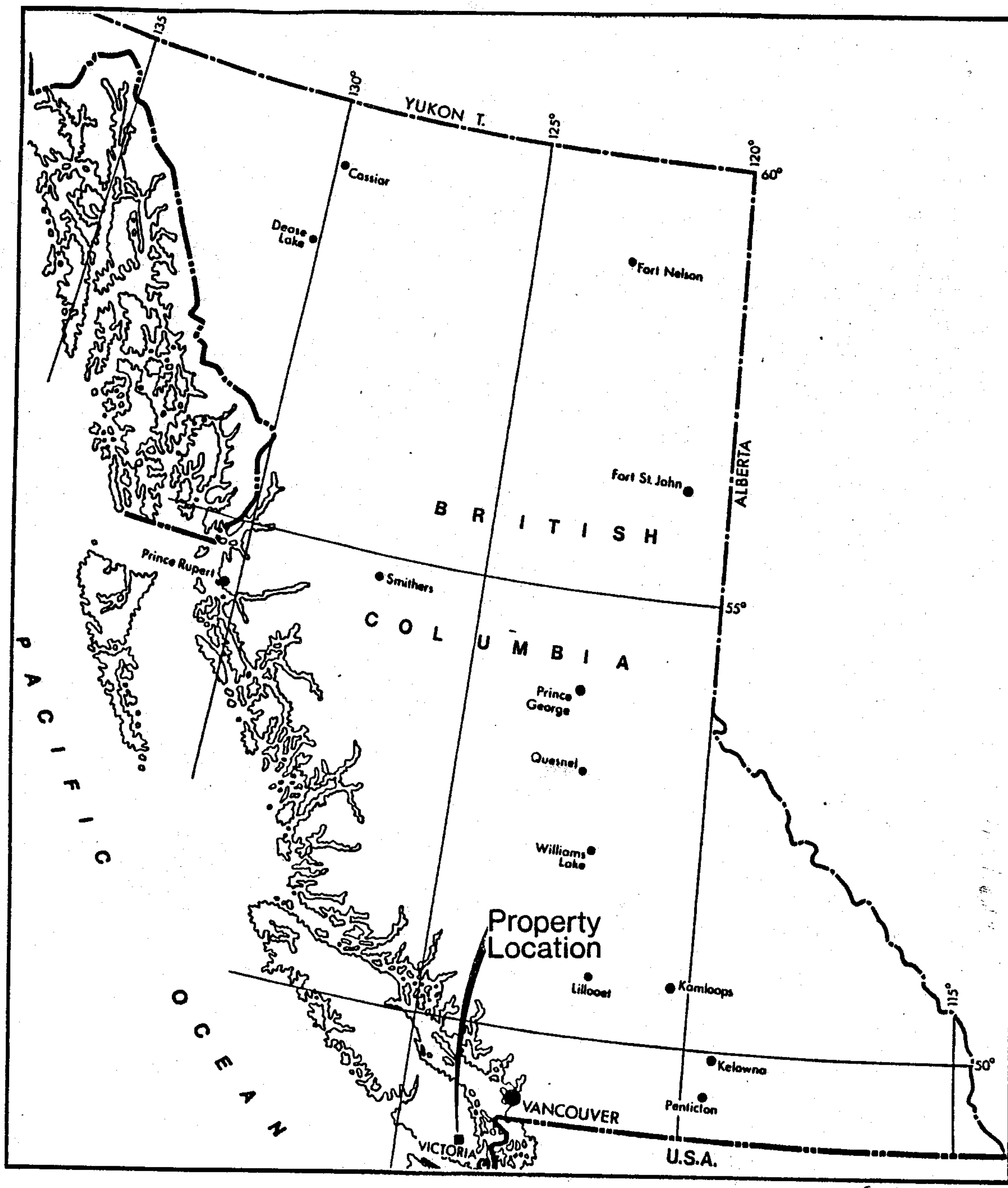
2.1 Summary and Conclusions

The greater part of the claim area is underlain by various volcanic rocks. Wide spread pyritization is conspicuous in most of the examined areas; pyrite content in sheared areas reaches up to 20%. Samples in such areas assayed up to 0.07 oz./ton Au and 0.2 oz./ton Ag.

The majority of the anomalous low resistivity readings are concentrated in the northeastern portion of the grid, where shearing and greater than average pyrite concentrations were observed in the scarce rock outcrops. The combination of VLF-EM and resistivity surveys appears to be a useful tool for outlining such target features in areas where overburden cover precludes direct visual observation.

2.2 Recommendations

The existing baseline should be extended eastward and the gridlines cut to the north over the entire length of the claim. Subsequently, this grid should be used for geological mapping, sampling and geophysical surveys. Selection of target areas for backhoe trenching would follow the completion of these surveys.



V. G.

Figure 1

KOKSILAH CLAIM

LOCATION MAP

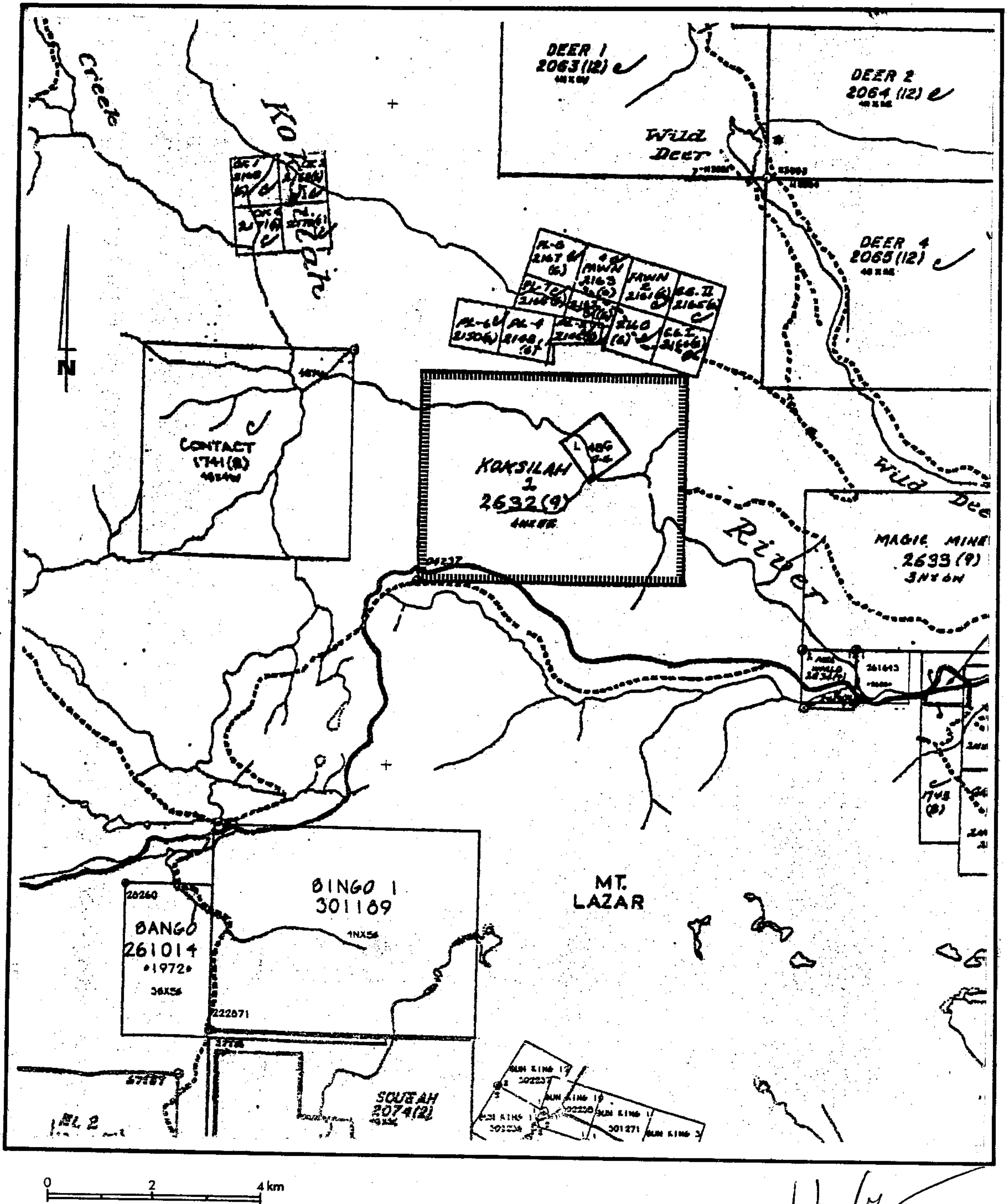


Figure 2

KOKSILAH CLAIM

CLAIM MAP

3. PROPERTY

3.1 Location and Access

The property is located on the southern part of Vancouver Island, about 15 kilometers west of the community of Shawnigan Lake. Its approximate coordinates are north latitude 48° 36' and west longitude 123° 51', on NTS sheet 92B-12W. The claim is in the Victoria Mining Division.

Access is provided from either Victoria or Nanaimo via Provincial Highway No. 1, then by a paved highway westward to Shawnigan Lake and to the property by the Shawnigan Lake - Port Renfrew Logging Mainline, a good quality gravel thoroughfare kept free of snow during the winter months. A good quality logging road provides access to the various parts of the claim area. Fig. 1 shows the general location of the claim.

3.2 Claim Description

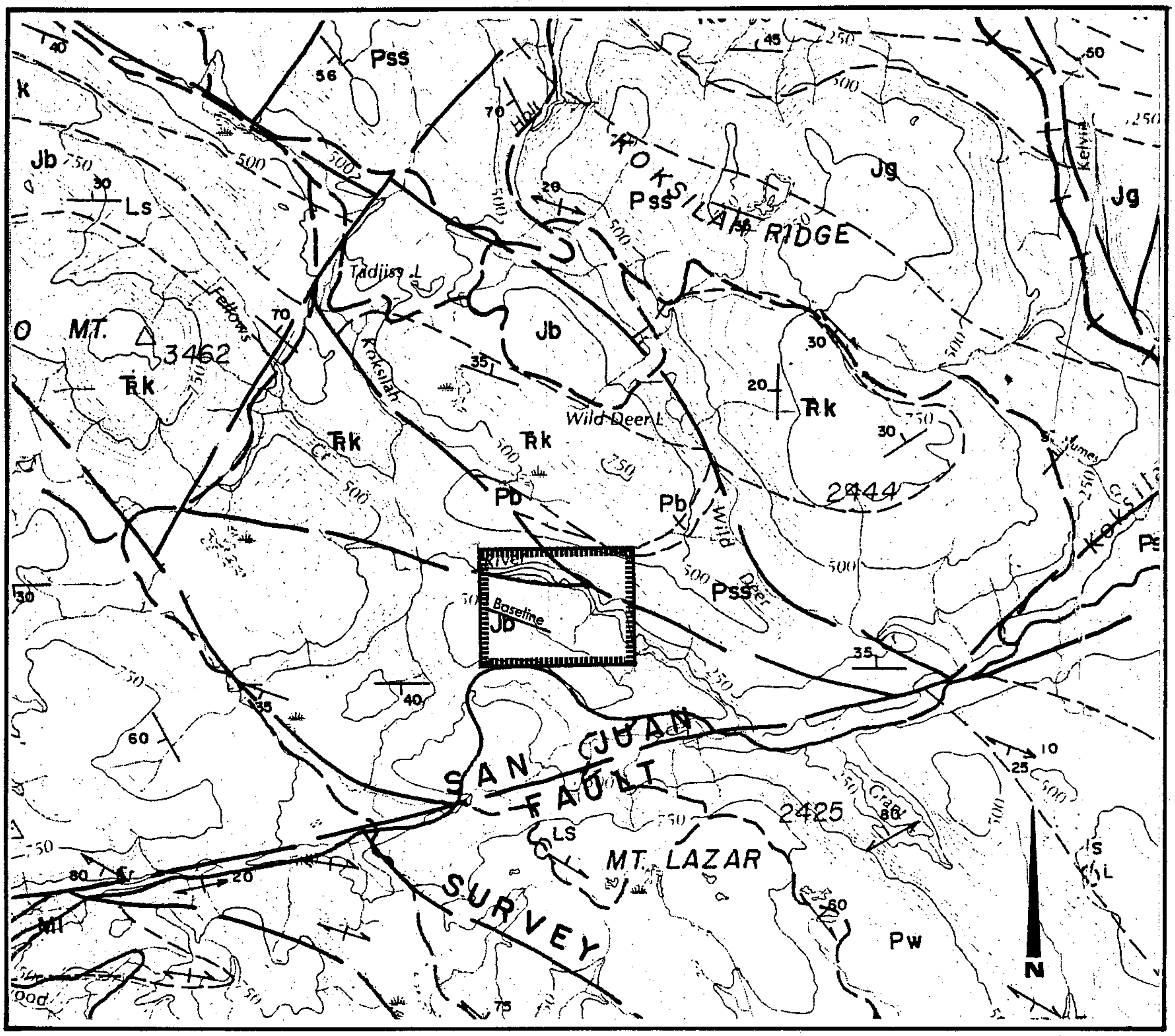
The property comprises KOKSILAH CLAIM, a 20 unit mineral claim, staked on the grid system. The claim's record number is 261667 and the anniversary date is September 12. The claim location is shown on the claim map, Fig. 2.

3.3 Topography and Climate

The property covers the area bounded to the south by the PORT RENFREW - SHAWNIGAN LAKE LOGGING MAINLINE and to the north it crosses the KOKSILAH RIVER; property elevations range between 220 and 550 meters above sea level. The north facing slope toward the Koksilah River valley is moderately steep to very steep. The ridge top is relatively flat.

Vegetation of the property area varies. There are several stands of mature trees, under active logging, while a portion of the claim is covered by thick second growth, and the rest is still clear following clear cut logging. Much of such areas are covered by logging slash.

The climate is fairly typical for the West Coast. Summers are hot and dry with most of atmospheric precipitation concentrated in fall and winter. Normally winters are moderately cold with variable amounts of snowfall year to year.



TRIASSIC TO CRETACEOUS

Ml	CHERT - ARGILLITE - VOLCANIC UNIT

JURASSIC

Jg	ISLAND INTRUSIONS: granodiorite, quartzdiorite
Jb	BONANZA GROUP: basaltic to rhyolitic tuff, breccia, flows, minor argillite

TRIASSIC

Ŧrk	VANCOUVER GROUP KARMUTSEN FORMATION: pillow basalt, breccia tuff, minor flows

PALEOZOIC SICKER GROUP:

Pb	limestone, greywacke, argillite
Pss	argillite, greywacke, chert, diabase sills

LOWER PALEOZOIC (or YOUNGER)

Pw	WARK GNEISS: massive and gneissic metadiorite, metagabro, amphibolite

0 1 2 3 4 5 km

Figure 3

KOKSILAH CLAIM

GEOLOGICAL MAP

GEOLOGY BY J.E.MULLER, 1979-1980 O.F. 701

4. GEOLOGY

General geology of the area is shown on Fig. 4. The most prominent geological feature is the San Juan Fault, a major structural lineament trending east-west from Mt. Todd to Cobble Hill. It separates Mesozoic rocks to the north from the Paleozoic Wark Gneiss.

The property lies north of the San Juan Fault and is mostly underlain by the Bonanza Group tuffs, volcanic breccias and basalt flows. At least one diorite sill is present on the property. Numerous generally east-west striking shear zones have been identified in the northern portion of the claim.

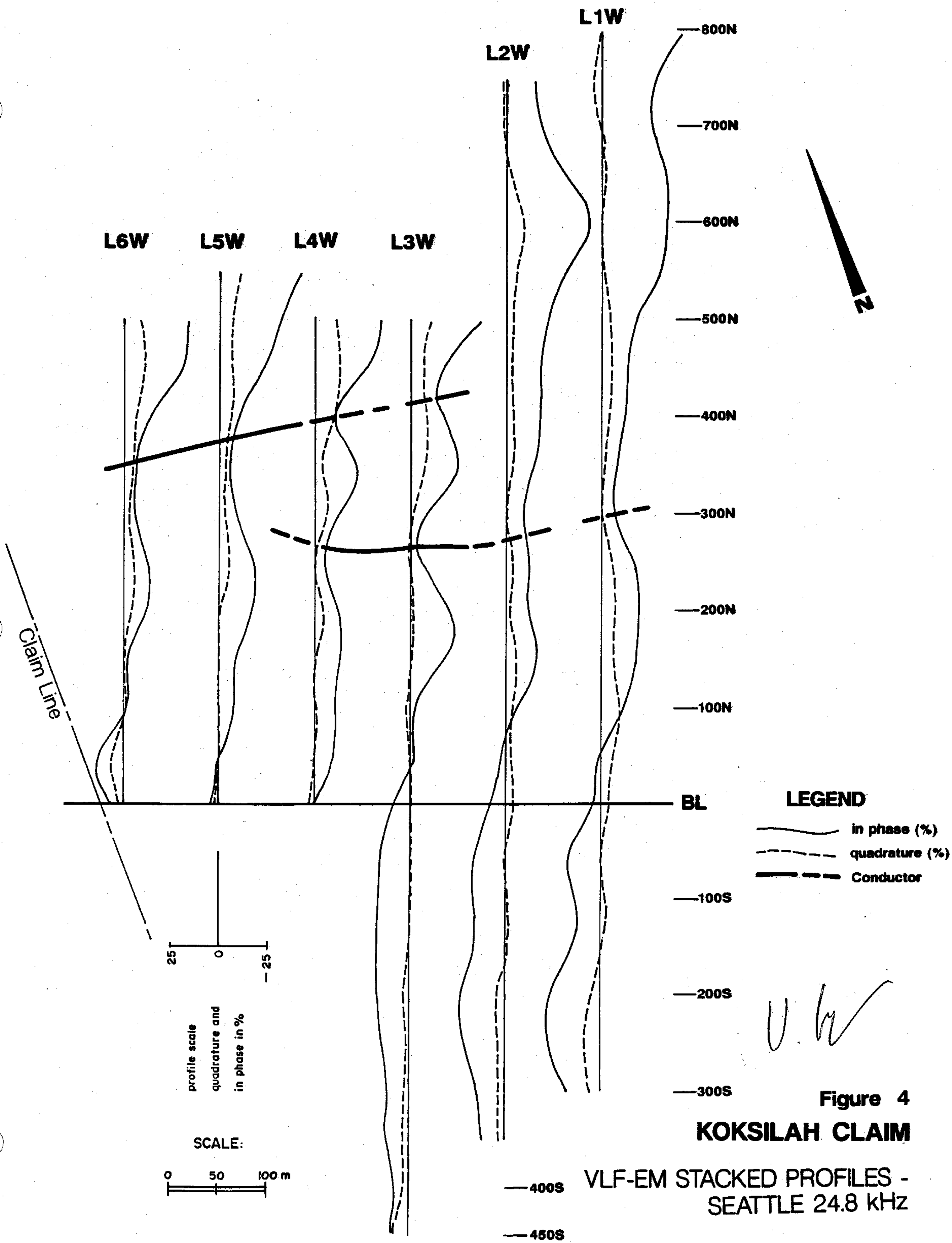


Figure 4

KOKSILAH CLAIM

VLF-EM STACKED PROFILES - SEATTLE 24.8 kHz

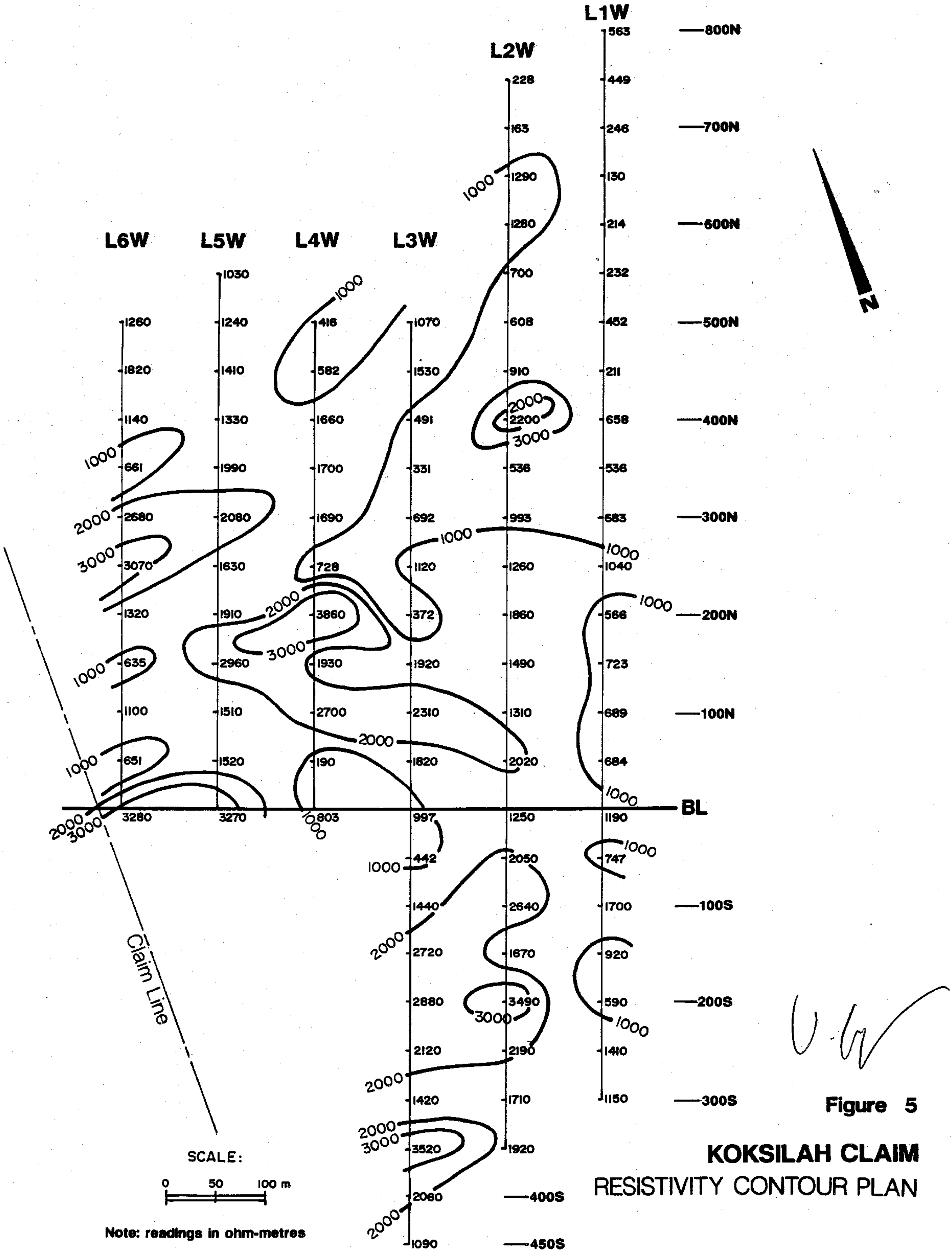


Figure 5

KOKSILAH CLAIM

RESISTIVITY CONTOUR PLAN

5. GEOPHYSICAL SURVEY

The surveys were taken at 50 meter station separation, along 100 meter spaced lines. The instrument used was a Scintrex IGS-2; signals from VLF station NLK Seattle, Washington, 24.8 kHz were utilized for both surveys. A total of 5.7 line kilometers of survey was conducted.

5.1 VLF-EM Survey

The survey data was processed and then plotted on Fig. 4, in the form of stacked profiles.

Two weak conductors appear in the surveyed area, one running from L4W, 2+75N to L1W, 3+00N, and running off the surveyed area; the second one from L6W, 3+50N to L3W, 4+25N. Both conductors coincide in position and strike direction with earlier identified shear zones.

5.2 Resistivity Survey

A total relief of 3649 Ohmmeters is shown on the Resistivity Contour Plan, Fig. 5. Although some sporadic lows are found in most parts of the grid, the largest concentration of low values occurs in the northeastern portion of the grid, coincidental with the shear zone locations and the interpreted conductors. However the trends that appear on the Survey Plan do not coincide very well with the general strike of the structural elements. Nevertheless, a wider survey, covering most of the north half of the claim area should be completed.

Respectfully Submitted,

V. Cukor, P.Eng.

6. COSTS OF THE PROGRAM AND PERSONNEL INVOLVED

Field Work

V. Cukor, P.Eng., 5 days @ $400.00	$ 2,000.00
Z. Budrovich, Geological Eng., 4 days @ $200.00	800.00
D. Cukor, Geologist, 3 days @ $200.00	600.00
Instrument rental, 3 days @ $500.00	1,500.00
Truck and camper rental, 5 days @ $80.00	400.00

Other Field Expenses

B.C. Ferries	$70.00	
Meals (Restaurant)	42.35	
Food (in camp)	171.35	
Gasoline	75.17	
	358.87	358.87

Report:

V. Cukor, P.Eng, 2 days @ $400.00	800.00
Drafting (N. Cukor), 10 hrs. @ $20	200.00
Typing, printing, binding	150.00

Total Expenditure $ 6,808.87

Of this total program expenditure, a sum of $4,000.00 is to apply for two years of assessment work.

V. Cukor, P.Eng.

<u>**CERTIFICATE**</u>

I, VLADIMIR CUKOR, of 6108 McKee Street in the Municipality of Burnaby, Province of British Columbia, DO HEREBY CERTIFY that:

1. I am a Consulting Geological Engineer with NVC Engineering Ltd., with business address as above;

2. I graduated from the University of Zagreb, Yugoslavia in 1963 as a Graduated Geological Engineer;

3. I am a Registered Professional Engineer in the Geological Section of the Association of Professional Engineers in the Province of British Columbia, Registration No. 7444;

4. I have practiced my profession as a Geological Engineer for the past twenty-nine years in Europe, North America and South America in engineering geology, hydrogeology and exploration for base metals and precious metals.

5. I have personally supervised the work described in this Report and reviewed all available information on the property.

November 5, 1991

V. Cukor, P.Eng
NVC Engineering

APPENDIX

INSTRUMENT SPECIFICATIONS

1. THE IGS-2 SYSTEM

1.1 General Information

The IGS-2 Integrated Geophysical System is a portable microprocessor-based instrument which allows more than one type of survey measurement to be performed by a single operator during a survey.

The IGS-2 is a modular system which can easily be configured to suit different and changing survey requirements. Reconfiguring the system is easy and offers both operational flexibility and minimal redundancy with a minimum number of spare consoles and/or modules.

When configured with any of the available senor options, the IGS-2 System Control Console becomes a method-specific instrument according to the senor option(s) utilized. In addition, the IGS-2 Console is an electronic notebook into which geophysical, geological or other data may be manually entered and digitally stored.

Data is stored in the IGS-2 in an expandable, solid state memory and can be output in the field by connecting the instrument to a printer, tape recorder, modem or microcomputer.

The 32 character digital display uses full words in most cases, ensuring clear communication. Both present and previous data are displayed simultaneously, allowing comparisons to be made at a glance during a survey.

The IGS-2 records header information, data values, station number, line number, grid number and the time of each observation in its internal memory. Data are first sorted by grid number, then in order of increasing line number and, within each line, by increasing station number. In this way, the data are organized logically regardless of the sequence in which they were taken. Ancillary data can also be manually entered and recorded at a given station, along with the survey parameters.

1.2 Standard Console Specifications

Digital Display	32 character, 2 line LCD display
Keyboard Input	14 keys for entering all commands, coordinates, header and ancillary information
Languages	English plus French is standard
Standard Memory	16K RAM. More than sufficient for a day's data in most applications
Clock	Real time clock with day, month, year, hour, minute and second. One second resolution, $\pm$ 1 second stability over 12 hours. Needs keyboard initialization only after battery replacement
Digital Data Output	RS-232C serial interface for digital printer, modem, microcomputer or cassette tape recorder. Data outputs in 7 bit ASCII, no parity format. Baud rate is keyboard selectable at 110, 300, 600 and 1200 baud. Carriage return delay is keyboard selectable in increments of one from 0 through 999. Handshaking is done through X-ON/X-OFF protocol. Allows IGS-2 to act as a master for other instrumentation.

Analog Output	For a strip chart recorder. 0 to 999 mV full scale with keyboard selectable sensitivities of 10, 100 or 1000 units full scale.
Console Dimensions	240 x 90 x 240 mm includes mounted battery pack.
Weights	Console; 2.2 kg. Console with Non-rechargeable Battery Pack; 3.2 kg. Console with Rechargeable Battery Pack; 3.6 kg.
Operating Temperature Range	-40°C to +50°C provided optional Display Heater is used below -20°C.
Power Requirements	Can be powered by external 12 V DC or one of the Battery Pack Options listed below.

2. IGS-2/MP MAGNETOMETER

2.1 The Magnetic Method

The magnetic method consists of measuring the magnetic field of the earth as influenced by rock formations having different magnetic properties and configurations. The measured field is the vector sum of induced and remanent magnetic effects. Thus, there are three factors, excluding geometrical factors, which determine the magnetic field. These are the strength of the earth's magnetic field, the magnetic susceptibilities of the rocks present and their remanent magnetism.

The earth's magnetic field is similar in form to that of a bar magnet's. The flux lines of the geomagnetic field are vertical at the north and south magnetic poles where the strength is approximately 60,000 nT. In the equatorial region, the field is horizontal and its strength is approximately 30,000 nT.

The primary geomagnetic field is, for the purposes of normal mineral exploration surveys, constant in space and time. Magnetic field measurements may, however, vary considerably due to short term external magnetic influences. The magnitude of these variations is unpredictable. In the case of sudden magnetic storms, it may reach several hundred gammas over a few minutes. It may be necessary, therefore, to take continuous readings of the geomagnetic field with a base station magnetometer while the magnetic survey is being done. An alternative field procedure is to make periodic repeat measurements at convenient traverse points, although this is a very unreliable method during active magnetic storms when it is important to have proper reference data.

The intensity of magnetization induced in rocks by the geomagnetic field F is given by:

$$I = kF$$

where I is the induced magnetization
k is the volume magnetic susceptibility
F is the strength of the geomagnetic field

For most materials, k is very much less than 1. If k is negative, the body is said to be diamagnetic. Examples are quartz, marble, graphite and rock salt. If k is a small positive value, the body is said to be paramagnetic, examples of which are gneiss (k =

0.002), pegmatite, dolomite and syenite. If k is a large positive value, the body is strongly magnetic and it is said to be ferromagnetic, for example, magnetite (k = 0.3), ilmenite and pyrrhotite.

The susceptibilities of rocks are determined primarily by their magnetite content since this mineral is so strongly magnetic and so widely distributed in the various rock types. (Of considerable importance, as well, is the pyrrhotite content.)

The remanent magnetization of rocks depends both on their composition and their previous history. Whereas the induced magnetization is nearly always parallel to the direction of the geomagnetic field, the natural remanent magnetization may bear no relation to the present direction and intensity of the earth's field. The remanent magnetization is related to the direction of the earth's field at the time the rocks were last magnetized. Movement of the body through folding, etc., and the chemical history since the previous magnetization are additional factors which affect the magnitude and direction of the remanent magnetic vector.

Thus, the resultant magnetization M of a rock is given by:

$$M - M_n + kF$$

where M_n is the natural remanent magnetization, and F is a vector which can be completely specified by its horizontal (H) and vertical (Z) components and by the declination (D) from true north. Similarly, M_n is specified when its magnitude and direction are known. Thus, considerable simplification results if $M_n = 0$, whereupon M merely reduces to kF. In the early days of magnetic prospecting, it was usually assumed that there was no remanent magnetization. However, it has now been established that both igneous and sedimentary rocks possess remanent magnetization, and that the phenomenon is a widespread one.

2.2 Magnetometer Specifications

Total Field Operating Range	20,000 to 100,000 nT (1 nT = 1 gamma)
Gradient Tolerance For Total Field	±5000 nT/m

Total Field Absolute Accuracy	±1 nT at 50,000 nT ±2 nT over total field operating and temperature range.
Resolution	0.1 nT
Tuning	Fully solid-state. Manual or automatic mode is keyboard selectable.
Reading Time	2 seconds. For portable readings this is the time taken from the push of a button to the display of the measured value.
Continuous Cycle Times	Keyboard selectable in 1 second increments upwards from 2 seconds to 999 seconds.

3. IGS/VLF-4 ELECTROMAGNETIC RECEIVER

3.1 VLF Theory

VLF stations (total of 12 stations located around the world) radiate electromagnetic waves on the VLF band in the range between 15 to 29 kHz. The signals are transmitted for purposes of navigation and ommunication with submarines. The VLF Electromagnetic Receiver picks up the magnetic and electric fields of these signals to provide information about the electrical properties of the earth.

The signal transmitted by the VLF station is recorded by the vertical coils as:

$$H_p = A \sin w \; ; \; H_s = B \cos (w - \phi) \quad (1.0)$$

where H_p = primary signal

A = amplitude of primary signal

H_s = secondary (phase laged) signal

B = amplitude of secondary signal

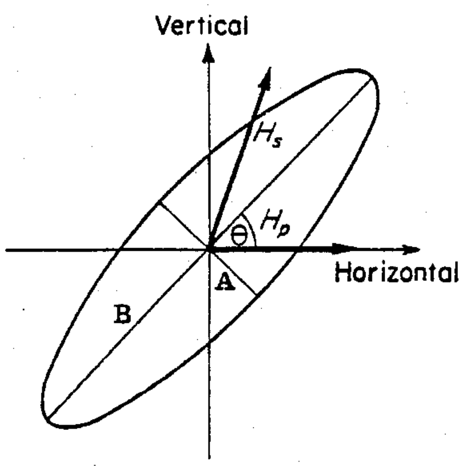
w = frequency

t = time

ϕ = phase lag

These two received signals combine giving an ellipse (see fig. A), which two axis correspond to the length and width of the ellipse.

i.e. $$\frac{H_p^2}{A^2} + \frac{H_s^2}{B^2} - \frac{2 H_p H_s \sin \phi}{AB} = \cos^2 \phi$$



By measuring the angle from the horizontal to the longaxis of the ellipse (θ), a conductor is located when this tilt angle is zero.

As its primary measurement, the IGS-2/VLF-4 employs two mutually orthogonal receive coils to determine three parameters of the VLF magnetic field. These are: 1) the horizontal amplitude vector in a direction perpendicular to a line joining the operator to the station; 2) the amplitude of the component of the vertical field vector which is in phase with the horizontal vector; and 3) the amplitude of the component of the vertical field vector which is 90° out of phase with the horizontal vector. These three parameters, for the given VLF transmitter, are recorded simultaneously. Since the vertical components are expressed as a percentage of the horizontal vector, they are automatically normalized for any changes in the amplitude of the transmitted primary field.

The primary field from a VLF station can, in fact, vary considerably. For the most part, the field fluctuates moderately during the course of the day due to changes in atmospheric conditions. There are, however, more dramatic changes. Towards evening there is a large upwards swing in the field strength, and at several points during the day, both partial and total drops in the field amplitude can be observed. In the light of these irregularities, the horizontal field data should always be considered with reservation as it is difficult to know whether changes are caused by conductors or by variations in the station's signal.

If the primary field strength is constant, changes in the amplitude of the horizontal magnetic field mainly reflect variations in the conductivity of the earth. Normally, there will be no vertical magnetic field. However, near a conductor, a vertical field will be observed. The relative amplitudes of the in-phase and quadrature components may be used to interpret the conductivity-size characteristics of the conductor.

3.2 IGS/VLF-4 Specifications

Frequency Tuning	Automatic digital tuning. Can be tuned to any frequency in the range 15.0 to 29.0 kHz with a bandwidth of 150 kHz.

	Up to three frequencies can be chosen by keyboard entry for sequential measurements.
Field Strength Range	Fields as low as 100 mA/m can be received. In practice, background noise may require fields up to 5-10 times this level. Maximum received field is 2 mA/metre. These values are specified for 20 kHz. For any other frequency, calculate the above limits by multiplying by the station frequency in kHz and dividing by 20.
Signal Filtering	Narrow bandpass, low pass and sharp cut-off high pass filters.
Measuring Time	0.5 seconds sample interval. As many as 216 samples can be stacked to improve measurement accuracy.
VLF-Magnetic Field Components Measured	1) Horizontal amplitude, 2) vertical in-phase component, and 3) vertical quadrature components. Vertical components are displayed as a percentage of horizontal component and are related in phase to the horizontal component. Their range is ±120%; reading resolution 1%.
VLF-Magnetic Field Sensor	Two air-cored coils in a backpack mounted housing with an electronic level for automatic tilt compensation. The error in the vertical in-phase component is less than 1% for tilts up to ±15°.

3.3 Fraser Filtering

This technique for filtering VLF-EM data was proposed by Dr. D. C. Fraser in 1969. The reason for applying this filter is that there is a dynamic range problem when presenting the data as profiles. In the same area that a 5° peak to peak anomaly may be significant, anomalies of 100° may also occur. This filtering operation transforms the zero cross-overs into peaks and noise is reduced by application of a low-pass filter. The data may be presented as profiles or the positive values may be contoured.

This filter was originally applied to dip angle data as collected by VLF receivers such as the Radem by Crone Geophysics. It is equally applicable to vertical in-phase and quadrature data.

The filter phase-shifts the data by 90° so that zero cross overs and inflections are transformed into peaks. It removes dc and attenuates long spatial wavelengths to increase resolution of local anomalies.

These requirements are met by the difference operator (R(n+1)-R(n)), where R(n) and R(n+1) are any two consecutive readings.

The filter does not exaggerate the random noise. This is achieved by applying a low-pass operator to the differences as follows:

0.25(R(n+1)-R(n)+0.50(R(n+2)-R(n+1)+0.25(R(n+3)-r(n+2)).

The filtered output is then 0.25(R(n+2)+R(n+3)-R(n)-R(n+1)).

As this filtering process was originally designed to be simple so it could be applied by field personnel with limited facilities, the constant is eliminated.

The plotted function then becomes F(n+1,n+2)=(R(n+2)+R(n+3)-(R(n)+R(n+1)).

The interpretation of filter plots is qualitative. Since the filter retains relative amplitudes, large responses can be equated with large and/or highly conductive zones. Very sharp responses indicate shallow sources, and, conversely, broader anomalies indicate progressively deeper sources. The contouring connects responses from line to line and serves to delineate the trend of conductive zones.

An additional interpretive tool is a pseudo-section of the filter outputs. This is produced by processing a given data profile with filters of various lengths or spans. As the length of the filter increases, responses from increasing depths are successively emphasized. Therefore, if these outputs are arranged on a section such that greater depths correspond to longer filters, then the section should approximately resemble the current pattern in the ground. However, it must be emphasized that this is only an approximation to the section (i.e. pseudo-section). Construction of the section follows a number of steps.

3.4 Resistivity

To permit measurement of the VLF-electric field, a dipole consisting of two cylindrical electrodes and five metres of wire is used. When this dipole is correctly laid out, the IGS-2/VLF-4 measures the in-phase and quadrature components of the horizontal electric field in the direction of the line joining the operator and the transmitter station. The phase reference is the horizontal magnetic field.

The IGS-2/VLF-4 uses the magnetic and electric field measurements to automatically calculate the apparent resistivity of the earth as well as the phase angle between the magnetic and electric field components. If the earth is uniform (not layered) within the depth of the VLF measurement, the phase angle between the horizontal magnetic and electric VLF fields will be 45°. A non-uniform earth will give rise to other phase angles.

The following formulae are used for resistivity and phase calculations:

Apparent Resistivity Calculation:

$$\rho = \frac{1}{2\pi f \mu_o} \left| \frac{E_x}{H_y} \right|^2$$

where:

ρ = apparent resistivity on ohm metres

E_x = horizontal electric amplitude, calculated

$$E_x = (E_x(I)^2 + E_x(Q)^2)1/2$$

H_y = horizontal magnetic amplitude, measured

f = VLF station frequency in Hertz

μ_o = permeability of the ground in Henries/metre, a constant

The resistivity calculation has a range of 1 to 100,000 ohm metres with a resolution of 1 ohm metre.

Phase Angle Calculation:

The phase angle ϕ is expressed as:

$$\phi = \arc\tan \frac{E_x(Q)}{E_x(I)}$$

where:

$E_x(Q)$ = horizontal quadrature VLF electric field

$E_x(I)$ = horizontal in-phase VLF electric field, phase referenced to the horizontal magnetic field, Hy.

The phase angle calculation has a range of -180° to +180° with a resolution of 1°. By definition, the angle is positive when the electrical field leads the magnetic field.