ARIS SUMMARY SHEET

District Geologist, Victoria   Off Confidential: 89.05.26

ASSESSMENT REPORT 17692   MINING DIVISION: Nanaimo

PROPERTY: Bolt
LOCATION: LAT 49 42 00 LONG 124 29 00
UTM 10 5506113 393032
NTS 092F09W
CLAIM(S): Bolt 1-2
OPERATOR(S): Cukor, D.
AUTHOR(S): Cukor, D.
REPORT YEAR: 1988, 29 Pages

GEOLOGICAL SUMMARY: The property located on Texada Island has skarn developed in a contact zone of Upper Triassic Quatsino Formation limestone and Middle or Upper Jurassic Island Intrusives. The contact zone strikes northeast and contains massive magnetite, pyrite and chalcopyrite.

WORK DONE: Geophysical
EMGR 1.9 km;VLF
MAGG 1.9 km

RELATED REPORTS: 13912

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BOLT CLAIMS

Texada Island, British Columbia

Owner: D. Cukor

1. INTRODUCTION

The geophisical survey program outlined in this Report was conducted by D. Cukor, Geologist, the registered owner of the claims. The survey consisted of ground VLF-EM and magnetics, utilizing a Scintrex IGS-2 system.

This work is to be applied as assessment work on the property.

2. PROPERTY

The claims are located on the north portion of Texada Island, approximately 9 km southeast of Vananda, B.C., and approximately 2 km north of Gillies Bay. See Figures 1 and 2. The property is shown on NTS sheet 92-F/9W, in the Nanaimo Mining Division. It is centered at about north latitude 49 42' and west longitude 124 29'.

Access to the claims is provided via the paved Vananda-Gillies Bay highway, then by the gravel road that leads through a gravel pit and up to and past the claims.

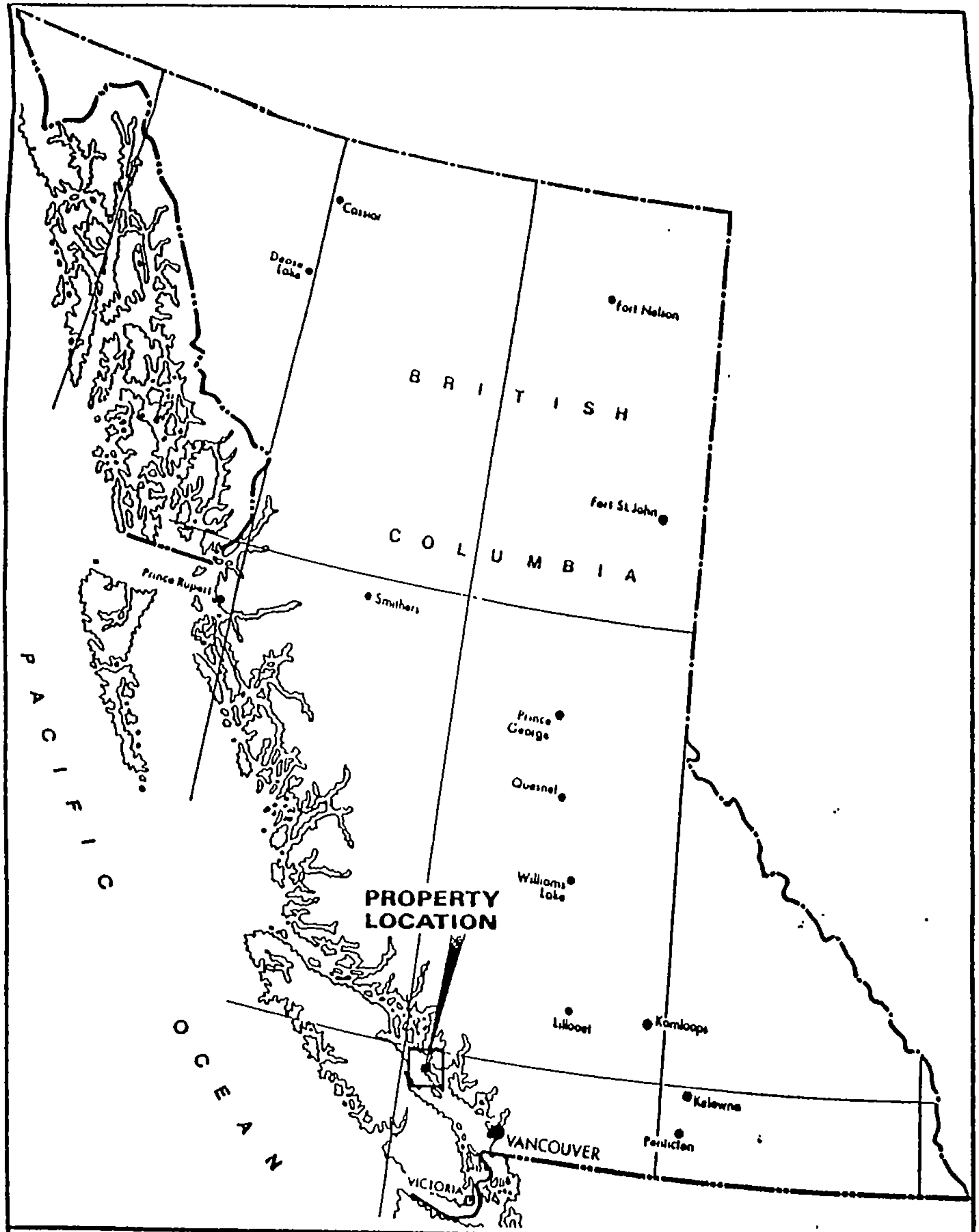
The nearest accomodation is in Vananda, and the nearest supply centre is Powell River. Texada Island is serviced by a regularly scheduled B.C. Ferry route from Powell River; access to Powell River is by a combination of road and B.C. Ferry up the Sunshine Coast or up Vancouver Island to Comox, then over to the mainland. Texada Island is also serviced by regularly scheduled air service.

The property consists of the Bolt 1 and 2, contiguous 2-post mineral claims, (see Figure 2). Bolt 1 is recorded under number 1738 and , Bolt 2 under number 1739, both with an anniversary date of May 28th.

The topography is fairly flat over much of the property area. The major topographical features on the property are several gullies. Elevations on the property range from 300 to 350 m above sea level. The property is covered with timber.

The property region has a modified coastal climate; Texada Island is located in Vancouver Island's rain shadow. Summers are generally warm to hot and dry and winters mild with a moderate amount of atmospheric precipitation. The property is generally snow-free all year round.

Water and timber for exploration purposes are available on the property.



BOLT CLAIMS

Owner: D.Cukor

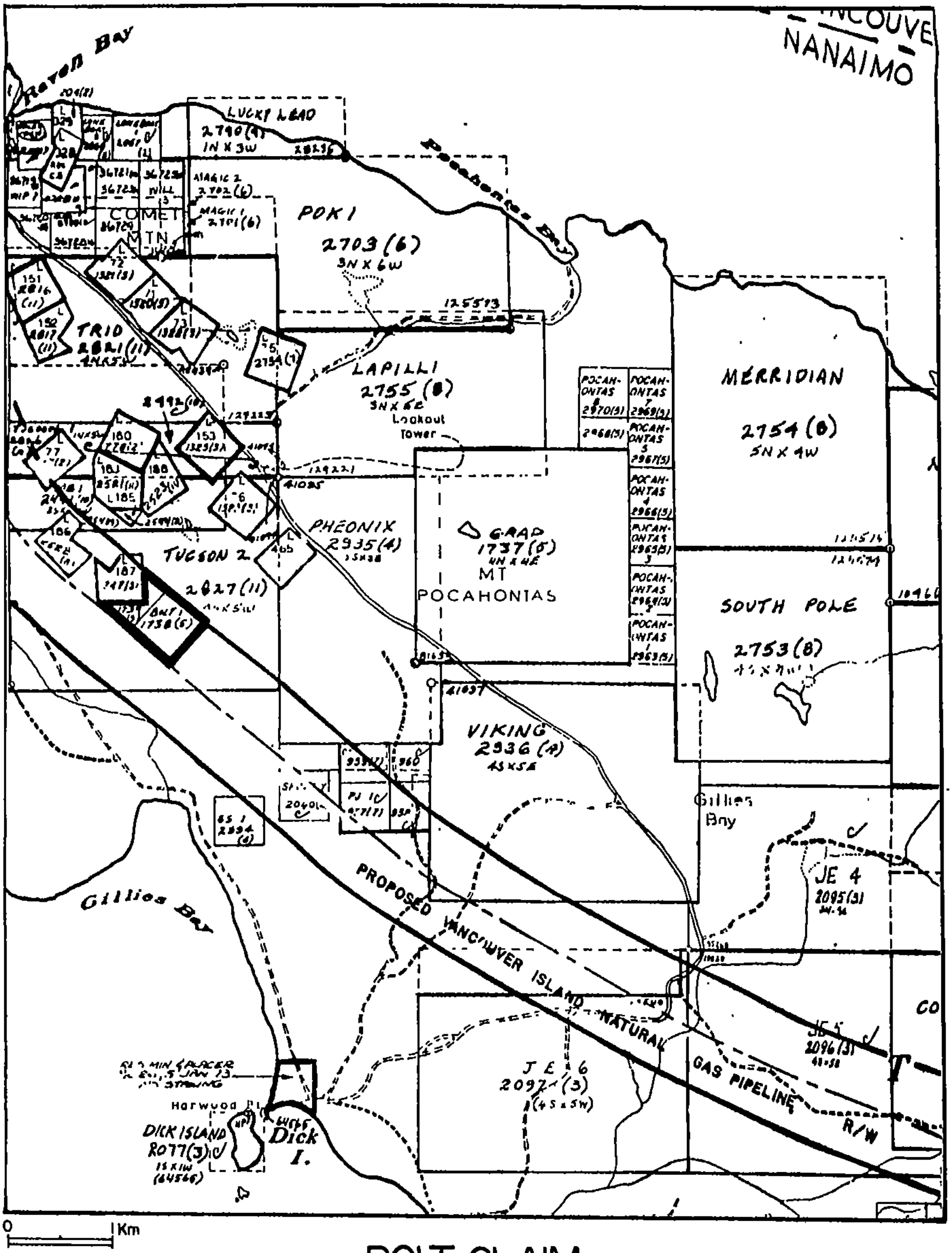
Location Map

Scale: 0 100 km

NTS 92 F/W

Date: May 1988

Figure: 1



BOLT CLAIM

Owner: D.Cukor

CLAIM MAP

NTS 92F/9W
May 1988

3. GEOPHISICAL SURVEYS

The geophisical surveys comprised of Ground Magnetic and VLF-EM methods. Both methods were run simultaneously, utilizing the Scintrex IGS-2 system.

3.1 Field Method

The part of the system dedicated to the magnetic survey utilizes two console units, one set up as the base station, the other as the portable unit, and two similar proton precession sensors measuring total magnetic field. The base station and field units are time synchronized so that the background field, diurnal variations and micropulsations can be filtered out from the data. The base station in this survey was programmed to measure the field and record the field at five second intervals. The sensitivity of the instrument is 0.1 Gamma. For more information on the IGS-2, see the appendix.

The VLF unit was programmed to receive signals from NLK Seattle, Washington, 24.8 kHz, measuring the horizontal field strength and the inphase and out-of-phase or quadrature components of the vertical field. the instrument uses a three coil system, one horizontal and two vertical coils, all at 90° angles to each other. The system is set to automatically adjust for topographical shadowing of field strength.

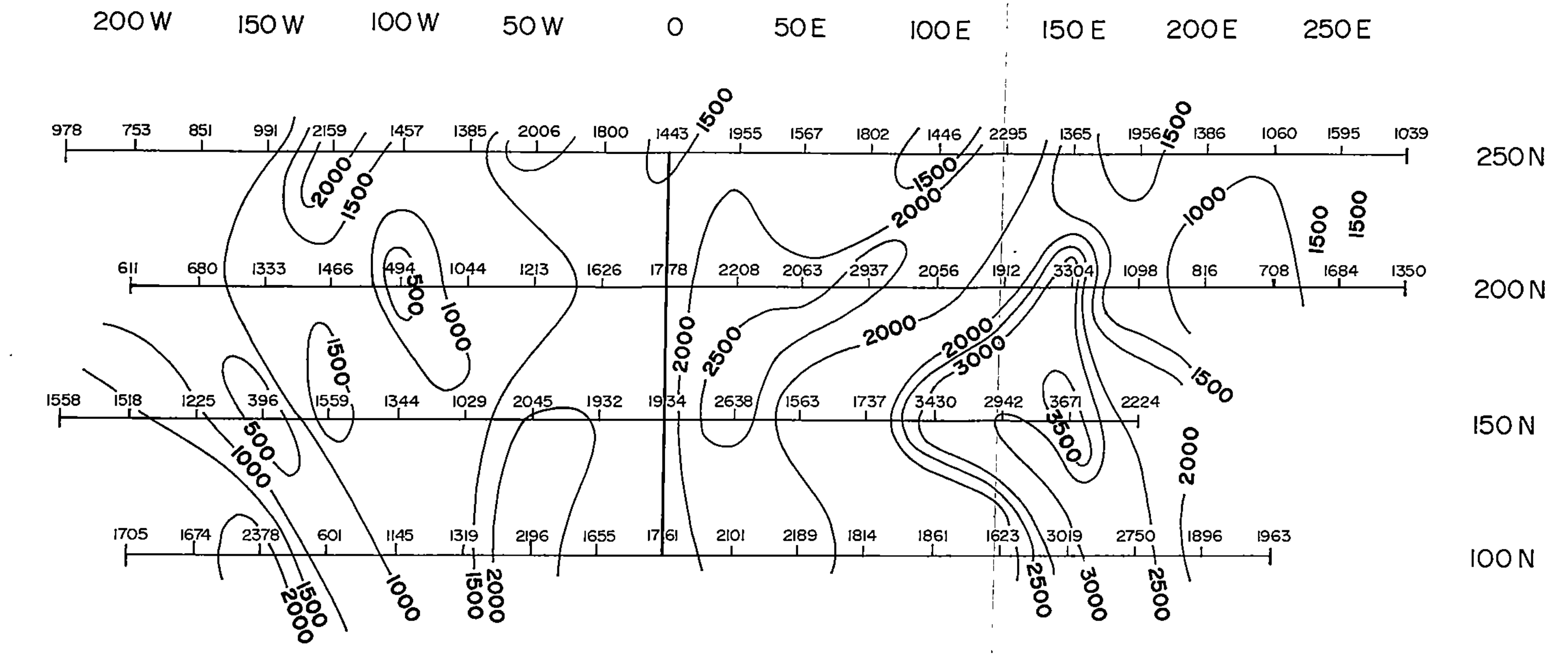
3.2 Magnetic Survey

The survey was performed along flagged lines, set 100 meters apart, with stations every 25 meters. All readings are shown on the 1:2000 Magnetic survey Plan (Figure 3). The plan was contoured at 500 Gamma intervals. Relative readings were arrived at by deducting 50,000 Gammas from the corrected total magnetic field value and then rounding off to the nearest 1 Gamma value.

Moderate magnetic relief is shown on the Magnetic Survey Plan. The high value is 3,671 and the low is 396, for a total relief of 3,275 Gammas. The plan displays a high at 150N 150E and a dipole structure between lines 200N and 250N. Both the dipole and the magnetic high coincide with VLF-EM conductors.

3.3 VLF-EM Survey

The ground electromagnetic readings were taken simultaneously with magnetic readings. The data was plotted in the form of stacked profiles, Figure 4. Three conductors were detected; the two more pronounced ones coincide with magnetic structures.



GEOLOGICAL BRANCH
ASSESSMENT REPORT

17,692

All values in gammas

Contour interval: 500 gammas

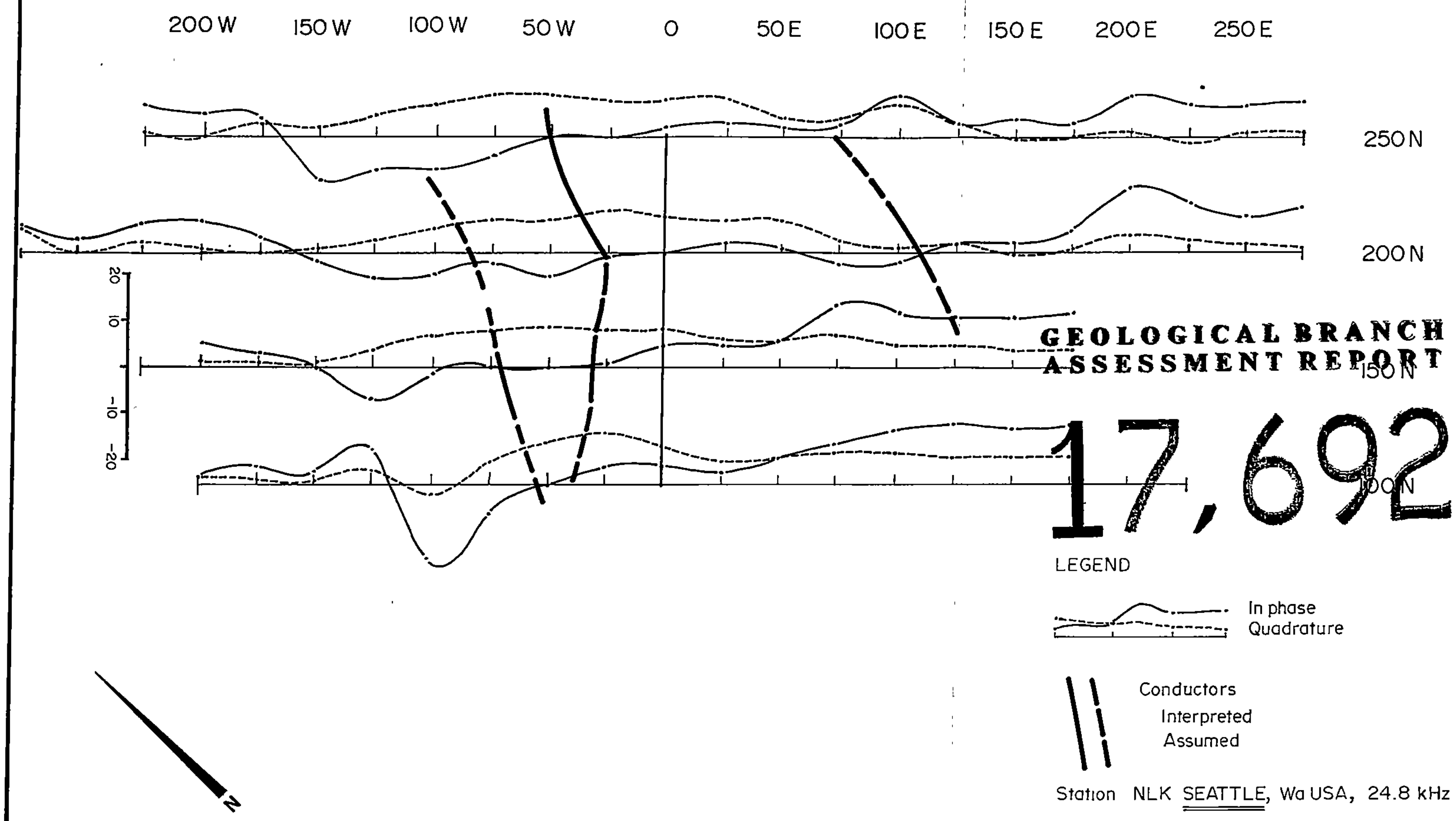
BOLT CLAIM

GROUND MAGNETIC SURVEY PLAN

NANAIMO M.D., B.C. NTS 92 F 9 W

D. CUKOR, B.Sc. NVC ENGINEERING Ltd. VANCOUVER, B.C.

DATE: May 1988 SCALE: 0 25 50m FIG. 3



BOLT CLAIM

GROUND VLF-EM SURVEY PLAN

NANAIMO M.D., B.C. NTS 92 F 9 W

D. CUKOR, B.Sc. NVC ENGINEERING Ltd. VANCOUVER, B.C.

DATE: May 1988 SCALE: 0 25 50m FIG. 4

4. CONCLUSIONS AND RECOMMENDATIONS

The results of the surveys are interesting in several aspects. Firstly, the magnetic relief was found to be relatively high for such a small geographic area. High magnetic relief may be of high significance in an area with skarn deposits and an established link between magnetite and gold occurrence. Secondly, the VLF-EM conductors are coincident with the magnetic structures. Also the conductors run off the grid area.

The conductive areas should be examined for signs of mineralization, as should be the magnetic structures. The grid should be expanded over the greater property area, especially in the directions of the possible extensions of the VLF-EM conductors.

Respectfully submitted,

D. Cukor
Geologist
NVC ENGINEERING LTD.

May 1988

COSTS OF THE WORK PROGRAM

Field Work

D. Cukor, Geologist 1.5 days @ $200/day	$	300.00
Helper, 1.5 days @ $120/day		180.00
Instrument rental, 1.5 days @ $600/day		900.00
Truck rental, 1.5 days @ 80/day		120.00

Field Expenses

Gasoline		20.00
meals, field supplies		30.00

Report

D. Cukor, 0.5 day @ $200/day		100.00
Drafting		50.00
Typing, printing		80.00

TOTAL Costs	$	1780.00

D. Cukor

CERTIFICATE

I, DAMIR CUKOR, of 6108 McKee Street, Burnaby, British Columbia, DO HEREBY CERTIFY that:

1. I graduated from the University of British Columbia in 1984 as a Bachelor of Science in Geology;
2. Since 1983 I have been employed as a geologist with NVC Engineering Ltd.;
3. I have worked in the field of exploration geology and geophysics for 12 seasons and have held positions of responsibility since 1982;
4. I have performed and/or supervised the work as documented in this Report.

May 1988

D. Cukor, B. Sc.
NVC ENGINEERING LTD.

THE IGS-2 SYSTEM

1.0 INTRODUCTION

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 sensor options, the IGS-2 System Control Console becomes a method-specific instrument according to the sensor 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.

The IGS-2 may appear complex because of the new microprocessor-based technology employed in its design. However, it does not perform any operation that is, in principle, unfamiliar to an experienced operator. Only the procedures have changed. For instance, data can now be recorded in the memory of the IGS-2 by a

Figure IGS:1
The IGS-2 as Worn by an Operator

series of simple keystrokes, rather than recording measurements by hand in a notebook. Likewise, an error spotted in the records, which would be corrected or erased by hand, is now corrected by means of the Edit function which allows the error to be removed from memory, corrected, and then refiled, or erased altogether.

1.2 Product Updates

At Scintrex we are continually working in improve our line of products. You may be notified as important changes occur to either the software or hardware of our products. We would appreciate hearing from you if you are interested in our latest developments. We would also value hearing from you about any successes, or problems you may have encountered so that we may advise you.

THE MP-3/4 MAGNETOMETER

1.0 INTRODUCTION

1.1 General Outline

This section of the manual describes in detail the proton magnetometer method.

A theoretical explanation of the magnetic method is given first. Then the table MAG SETUP MENUS is presented for reference. After this, the following topics are dealt with in detail:

1) method enabling procedures,
2) measuring procedures,
3) warning messages,
4) equipment setup procedures,
5) troubleshooting information,
6) specifications and
7) parts list.

1.2 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.

1.2 Theory of Operation

The Very Low Frequency (VLF) Electromagnetic Method measures variations in the components of the electromagnetic fields, set up by communication stations operating in the 15 to 30 kHz frequency range. These stations, located around the world, generate signals for the purposes of navigation and communication with submarines.

In far field, above uniform earth, the groundwave of the vertically polarized VLF radiowave has three field components:

1) a radial, horizontal electrical field,
2) a vertical electrical field, and
3) a tangential, horizontal magnetic field.

When these three fields meet conductive bodies in the ground, eddy currents are induced causing secondary fields to radiate outwards from these conductors. In the Magnetic Field mode, the IGS-2/ VLF-4 measures the horizontal field and two components of the

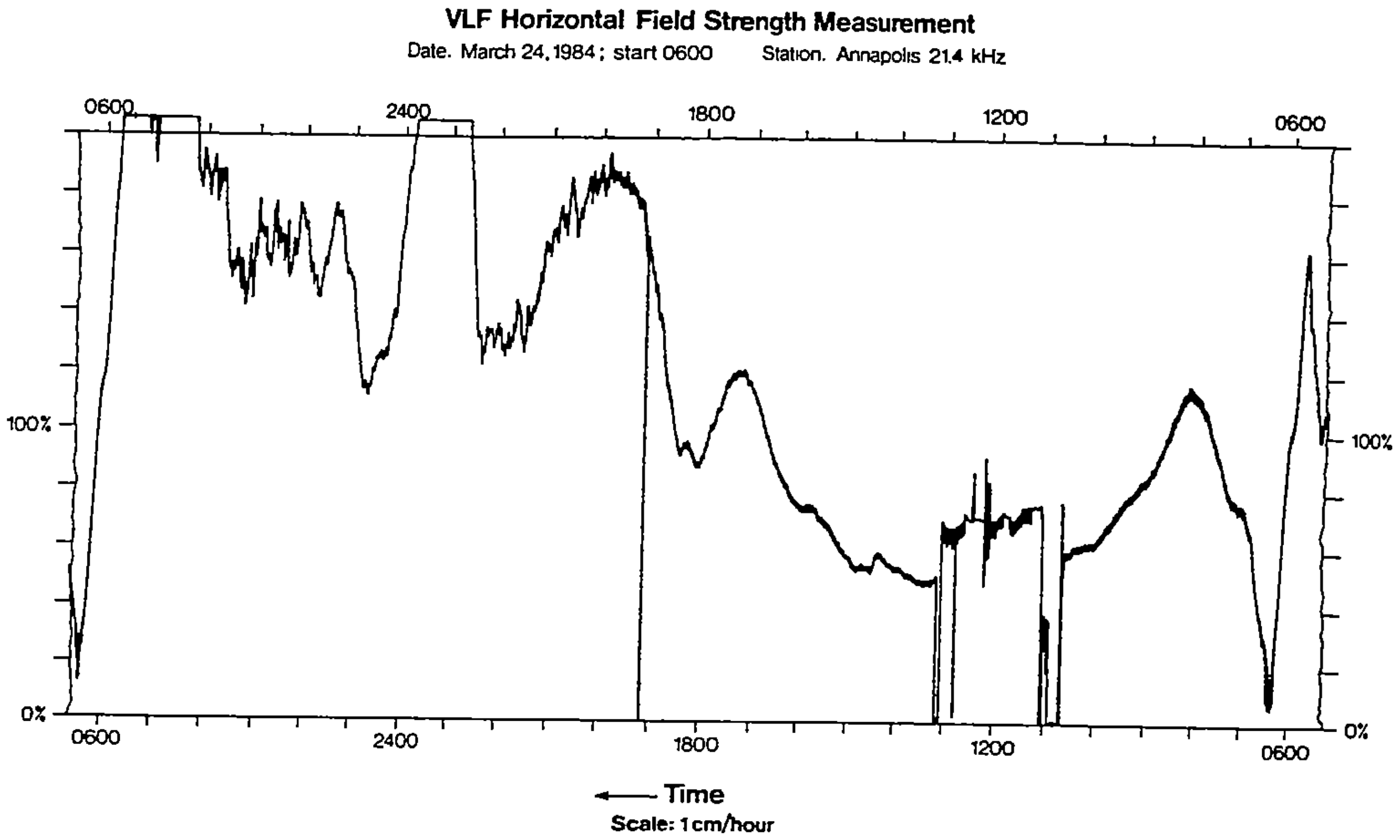


Figure VLF:1
Chart Recording of Primary Field Changing with Time

vertical field, normalized by the horizontal field measurement. In the Electrical Field mode, it measures the horizontal magnetic and electrical fields.

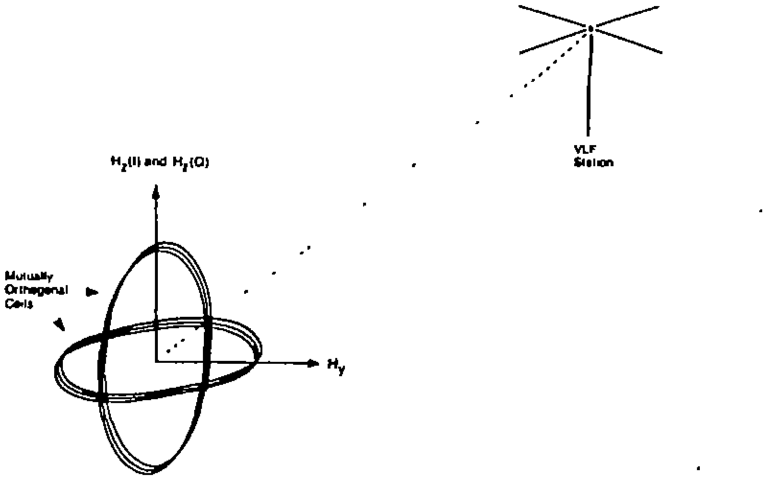
1.3 What the IGS-2/VLF-4 Measures

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.

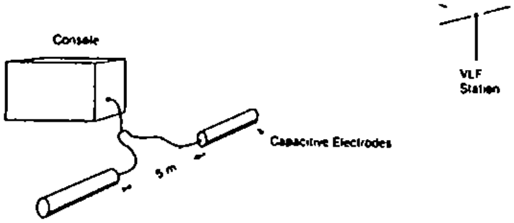
The primary field from a VLF station can in fact, vary considerably. Figure VLF:1 is a recording of the horizontal field strength from the Annapolis VLF station made in Toronto, Canada. For the most part, the field fluctuates moderately during the course of the day due to changes in atmospheric conditions. There are, however, more dramatic changes indicated on the recording. 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.

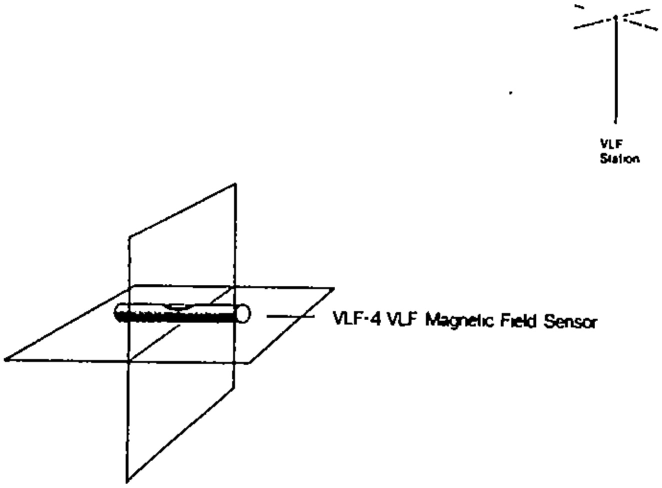
To permit measurement of the VLF-electric field, a dipole consisting of two cylindrical electrodes and 5 meters of wire is used. When this dipole is correctly laid out, the IGS-2/VLF-4 measures the in-phase and quadrature components of the horizontal electric field in the direction of the line joining the operator and the transmitter station. The phase reference is the horizontal magnetic field.



The VLF-magnetic field measurement comprises: 1) horizontal amplitude H_y, 2) the amplitude of $H_z(I)$ (the vertical field component which is in-phase with H_y) and 3) the amplitude of $H_z(Q)$ (the vertical field component which is 90° out-of-phase with H_y.



The VLF-4 is used to measure the in-phase $E_x(I)$, and quadrature $E_x(Q)$, components of the horizontal electric field, E_x, in the line joining the operator and the transmitter station. The phase is referenced to that of the horizontal magnetic field H_y. These components are not recorded but are used in the calculations of resistivity and phase made by the VLF-4.



An electronic level sensor on the axis of the horizontal vector receiver coil provides automatic side-to-side tilt compensation. The error in the vertical in-phase component is less than 1% for tilts up to 15° provided that the operator is facing the VLF station directly. Tilts in any other direction of up to 10° produce no significant error (1%) in the other components and, therefore, require no compensation.

Figure VLF:2
What the VLF-4 Measures

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 degrees. 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 in ohm-meters
E_x = horizontal electric amplitude, calculated
$E_x = (E_x(I)^2 + E_x(Q)^2)^{\frac{1}{2}}$
H_y = horizontal magnetic amplitude, measured
f = VLF station frequency in Hertz
μ_o = permeability of the ground in Henries/meter, a constant

The resistivity calculation has a range of 1 to 100,000 ohm-meters with a resolution of 1 ohm-meter.

Phase Angle Calculation

The phase angle ϕ is expressed as:

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

where:

$E_x(Q)$ = horizontal quadrature VLF electric field.
$E_x(I)$ = horizontal in-phase VLF electric field, phase rferenced 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.

9.0 SPECIFICATIONS

9.1 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, ±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.

9.2 Battery Pack Options

Battery Pack lifetime depends on which Battery Pack is selected, sensor(s) used, reading time and ambient temperature. Life expectancy would be 1 to 10, eight hour survey days.

Non-Rechargeable Battery Pack	Includes battery holder and 10 disposable 'C' cell batteries for installation on console. Used in low sensitivity total field magnetometry or VLF in temperatures above 0°C. Weight is 0.9 kg.
Rechargeable Battery Pack and Charger	Includes battery holder, 6 rechargeable, non-magnetic, sealed lead-acid batteries and charger for installation on console. Best for high sensitivity total field measurements, all gradient measurements and operation below 0°C. Pack weighs 1.3 kg. Charger specifications are: 140 x 95 x 65 mm, 115/230 V AC, 50/60 Hz, 20 VA, overload protected.

8.0 SPECIFICATIONS

8.1 Magnetometry 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.

9.0 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 Hz. 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 2^{16} 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°.

APPENDIX 2

VLF THEORY

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

$$Hp = A \sin wt; \quad Hs = B \cos (wt-\phi) \qquad (1.0)$$

where: Hp = primary signal

A = amplitude of primary signal

Hs = secondary (phase laged) signal

w = frequency

B = amplitude of secondary signal

t = time

ϕ = phase lag

These two received signals combine giving an ellipse, which has two axis corresponding to the maximum length and minimum width of the ellipse.

i.e. $$\frac{Hp^2}{A^2} + \frac{Hs^2}{B^2} - \frac{2\ HpHs \sin \phi}{AB} = \cos^2 \phi \quad (2.0)$$

By measuring the angle from horizontal of the long axis of the ellipse, a conductor is located when this tilt angle is zero.

The Scintrex IGS VLF measures the primary vertical (in phase) Hp and the secondary (quadrature) Hs to obtain a conductor's location (from Hp) and the conductor's quality using both Hp and Hs.

i.e. $$o = \tfrac{1}{2} \tan^{-1} (2\ Hp/100\ (1 - e^2))$$

where o = tilt angle (degrees)

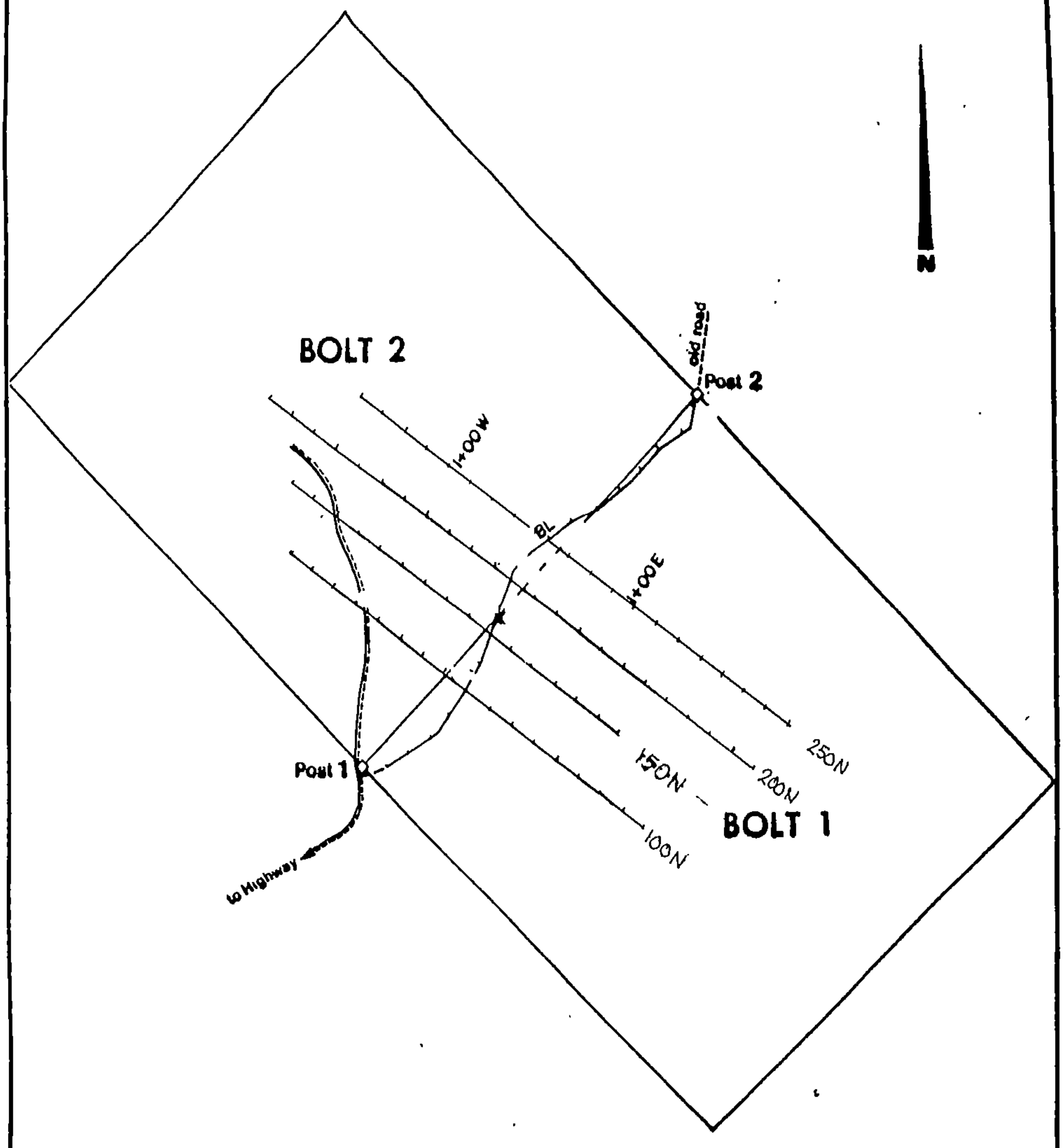
Hp = vertical in phase, expressed as a o/o

$\phi = \tan^{-1} \left(\frac{Hp}{Hs}\right)$

VLF THEORY (Continued)

where ϕ = phase lag (degrees)
Hp = vertical in phase (any units)
Hs = vertical quadrature (same units as Hp)

Since the quadrature readings require a magnetic field phase reference, using unpublished means, the phase lag value is untested and should be considered qualatative only, but it is likely reasonably precise (the readings are repeatable), but may or may not be accurate (the correct value).



BOLT GRID LOCATION

Scale: 0 50 100m

NTS 92 F/W

Date: May 1987

Figure: 5