PR Onion Lake 81(1)B

# ONION LAKE PROJECT

1981

GEOPHYSICS ADDENDUM

Author:
A. Allison

PR-Onion Lake 81 (1)B

**Crows Nest Resources** LIMITED
Eau Claire Place, 525 - 3rd Avenue S.W., Calgary, Alberta (403) 232-4355
P.O. Box 2699, Station M, Calgary, Alberta T2P 2M7 Telex 03-822505

December 30, 1982



Ministry of Energy, Mines and
Petroleum Resources
525 Superior Street
Victoria, B.C.
V8V 1T7

Dear Sirs:

Enclosed please find our report on the results of the geophysical survey done at Onion Lake during the summer of 1981.

The results of this work were not available at the time of submission of the 1981 Onion Lake Geological Report, but are being filed now as an addendum to that Report. For reference purposes, the Coal Land Disposition, Index and Geological Compilation map from the 1981 Geological Report are included in this addendum as appendix II.

The geophysical survey work and the present addendum were conducted and prepared by Andrea Allison, an employee of Shell Canada Resources Limited, Minerals Division, for Crows Nest Resources Limited.

Ms. Allison received a B.Sc. in Physics from Loyola-Concordia University, Montreal in 1974 and an M.Sc. from U.B.C. in 1977. She worked as a geophysicist with Shell Canada Resources from 1977 to 1982.

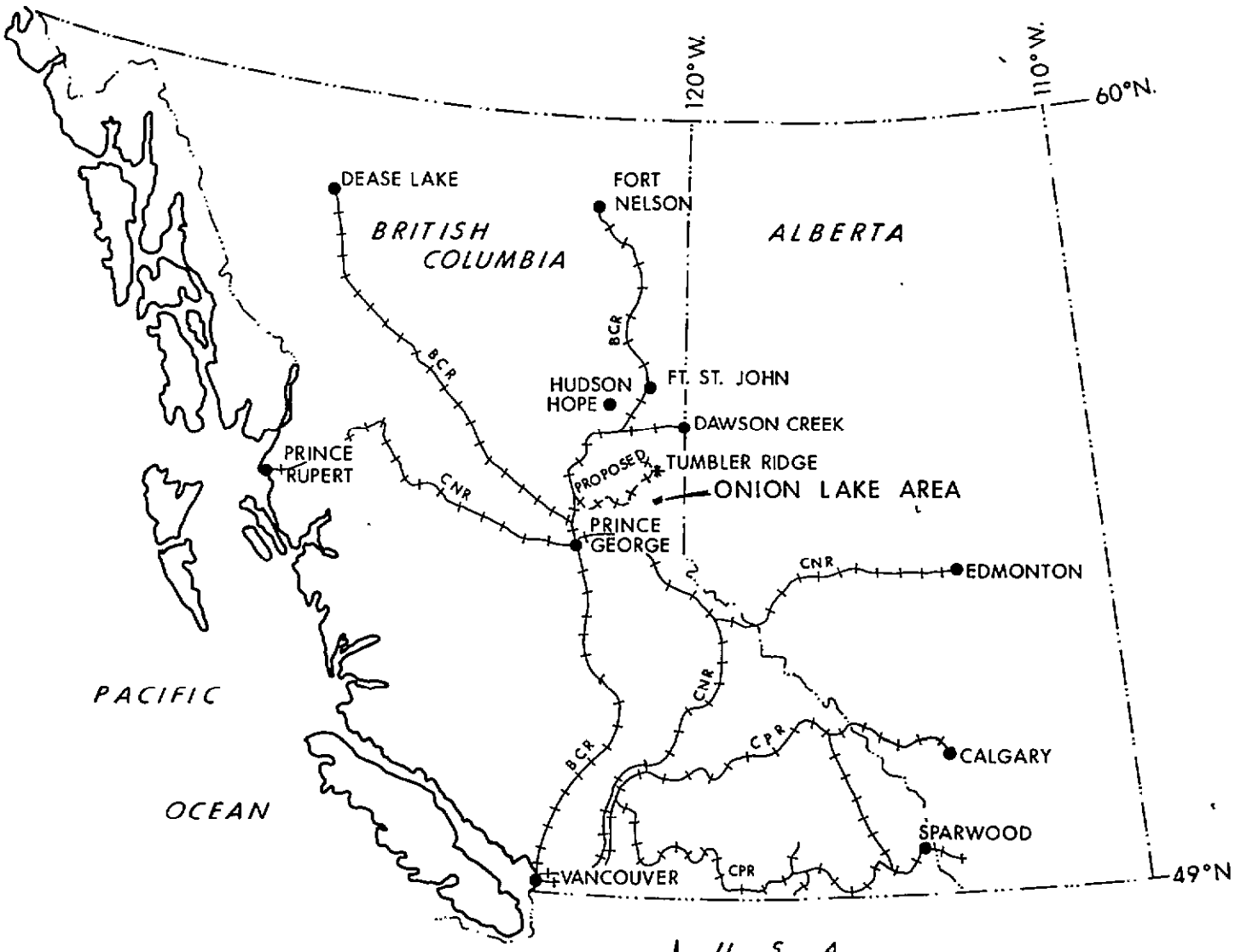
I consider the aforementioned person to be well qualified to undertake the responsibilities assigned on this project. I am satisfied that the attached report has been competently prepared and justly represents the information obtained from this project.

Sincerely,

G. Rushton

Glenn Rushton
Vice-President, Exploration

2/FBi.1




**Crows Nest Resources Limited**

EXPLORATION

ONION LAKE

NE BC

# LOCATION MAP

| | | |
|---|---|---|
| AUTHOR R. GILCHRIST | SCALE AS SHOWN | ENCLOSURE No |
| DATE 82-12-12 | REVISED | DRAWING No AA-542 |
| To Accompany | | |

# ONION LAKE PROJECT

# 1981 GEOLOGICAL REPORT

# ADDENDUM

# GEOPHYSICS FOR COAL EXPLORATION

# EM & DC RESISTIVITY SURVEYS

Peace River Land District, British Columbia

B.C. Coal Licence Numbers: 4220-4223 inclusive and 4749

Group Number: 242

Owner: Shell Canada Resources Limited

Operator: Crows Nest Resources Limited

NTS 93I/10W (Wapiti Lake)

Longitude: 120° 48' West

Latitude: 57° 44' North

Exploration Period: June - August, 1981

Report Prepared by: Dennis Bell

Submitted: December, 1981

Addendum Prepared by Andrea Allison

Submitted: December, 1982

4/FBi.2

CONFIDENTIAL

TABLE OF CONTENTS

## INTRODUCTION

### Historical

In 1980 a study was undertaken of non-seismic geophysical methods applied to exploration for coal. A complete report of this research is in Jones, 1981. In particular, Jones studied the application of geophysical methods to solving the following fundamental problems in coal exploration.

1) The determination of the depth of overburden.
2) The determination of seam thickness.
3) The establishment of seam continuity.
4) The location of the seam edge.

The first part of the report was theoretical examination and literature search of the following methods: gravity, magnetics, resistivity, induced polarization (IP) and electromagnetics (EM).

As a second step, DC Resistivity surveys were conducted on three properties; Merritt, Lillyburt and Blackfoot. The operations report is given in Fudge, 1980 and an interpretation of the data is in Jones, 1981. The analysis of the data at Merritt showed limited success in determining the depth of the overburden. Frank Jones states that the resistivity technique was capable of the accurate determination of the depth of the overburden only if sufficient geophysical control (such as a focussed electric log) was available for calibration.

### Present Study

In 1981 this research was applied to coal exploration on two properties: Lillyburt in S.E. B.C. and Onion Lake in N.E. B.C. This report discusses results of the work at Onion Lake only. A separate report has been filed for the parallel study on Lillyburt property. Three techniques: DC Resistivity Electromagnetics (EM) and Induced Polarization (IP) were used to determine:

1) the depth of overburden.
2) fault contacts and/or basement lithology changes.

The DC Resistivity and Electromagnetics (EM) methods measure the Resistivity of the subsurface. The data is presented in the form of apparent resistivity values. Apparent resistivity is defined as the resistivity of a uniform earth which would have produced the observed voltage reading with the given signal current.

In order for these methods to succeed for the above purpose the "rocks" must possess certain physical characteristics. In order to determine the depth of overburden there must be a sufficient resistivity contrast between the overburden and the material below. Also, the resistivity must be constant throughout each individual layer. In order to be able to detect faults and/or lithology changes there must again be a sufficient resistivity contrast between the rocks on both sides of the contact.

A general description of the geophysical equipment and survey geometry will be given followed by a detailed discussion on data acquisition, data presentation and interpretation of the results.

## OPERATION

The EM method used was the magnetic induction method. Current flow is induced in the ground by the varying magnetic field of a vertical or horizontal magnetic dipole transmitter. A magnetic dipole transmitter consists of a loop antenna through which an alternating electric current is forced; similarly, a magnetic dipole receiver is a loop antenna in which an electromotive force is measured in the presence of a varying magnetic field.

The EM equipment used was the Geonics EM 34-3 and EM 31. Appendix I gives a list of the instrument specifications.

In this method the exploration depth is mainly increased by increasing the distance between transmitter and receiver dipoles. The EM 31 was used to sample the very shallow overburden. The EM 34-3 was used to sample increasing depths by increasing the cable length from 10 to 20 to 40 meters.

The depth of overburden was thought to be less than approximately 30 m. Therefore, measurements with the 40 m cable separation should be sampling the basement material.

DC Resistivity and IP measurements were taken using the Dipole-Dipole array. A schematic diagram of the array geometry is in Figure #1. Current is injected through the current electrodes and the resulting potential difference between the voltage electrodes is measured. For our survey an electrode separation of 25 m (a = 25 m) was used.

DC Resistivity measurements were also taken by means of Schlumberger soundings. A schematic diagram of the array geometry is in Figure #2. When the current electrodes are close together (i.e. AB/2 = L small) shallow layers only contribute to the resistivity profile. With increasing L the apparent resistivity has a contribution from greater depths.

Data Acquisition

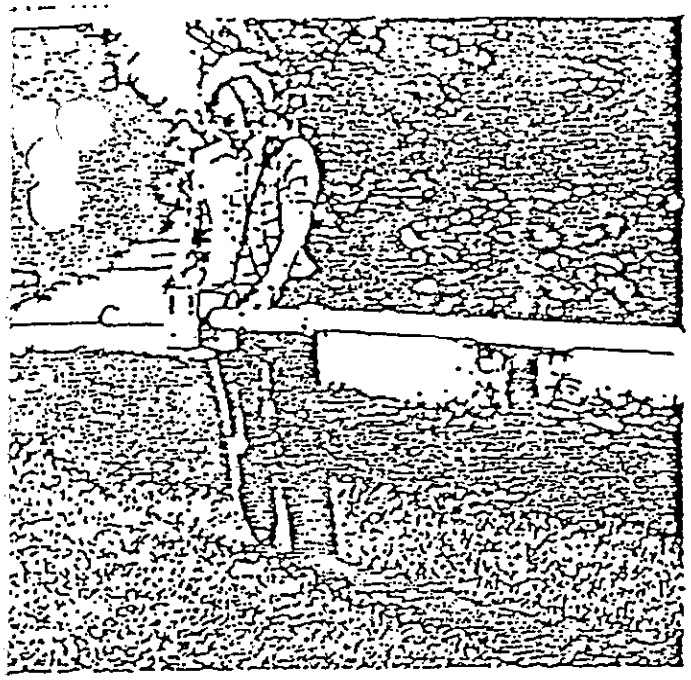
At Onion Lake one line of 1.4 km was surveyed. Figure 3 shows the location of the line.

Figure 4 shows the EM 31 and EM 34 profiles. Figure 5 shows the Schlumberger soundings. Figure 6 shows the dipole-dipole array DC Resistivity and IP pseudo-section.

Interpretation

Consider Figure 4. The primary purpose at Onion Lake was to determine overburden depth. At 6+00W the EM 31 gave an apparent resistivity of 300 ohm-meters. The EM 34-3 also gave an apparent resistivity of 300 ohm-meters for both 20 and 40 m coil separations. There does not seem to be any resistivity contrast between overburden and the material beneath.

There is some variation along the line as seen in Figure 5, but looking at the schlumberger sounding for 1+00W there again appears to be little resistivity contrast.



## M31

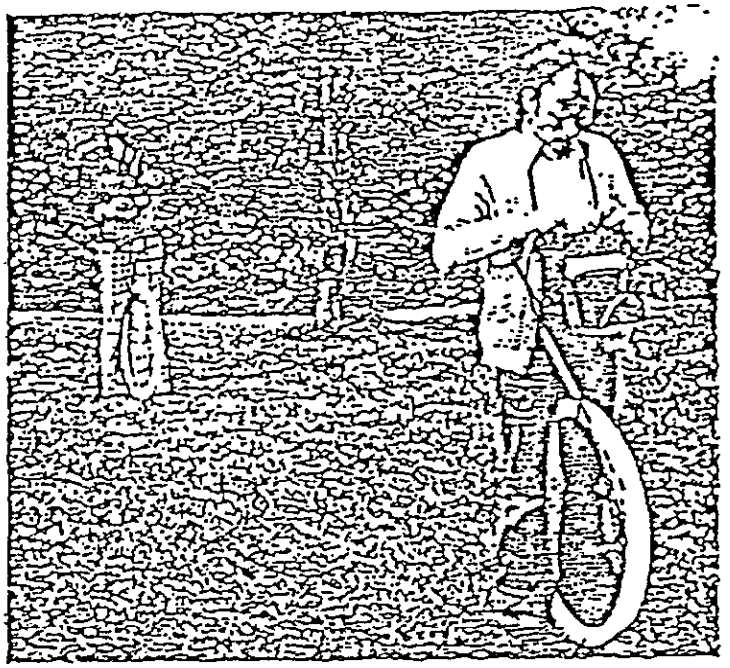
Geonics EM31 provides a measurement of terrain conductivity without contac- the ground using a patented inductive electromagnetic technique. The in- ment is direct reading in millimhos per meter and surveys are carried out simply raversing the ground.

effective depth of exploration is approximately six meters making it ideal for ophysics. By eliminating ground contact, measurements are easily regions of high resistivity such as gravel, permafrost and bedrock. m half space the EM31 reads identically with conventional resistivity esurement is analogous to a conventional galvanic resistivity survey a fixed array spacing. Interpretation curves supplied with each instrument n permit an estimate of a layered earth.

e advantages of the EM31 are the speed with which surveys can be carried out, ability to precisely measure small changes in conductivity, and the continuous dout which provides a previously unobtainable lateral resolution.

## Specifications

| | |
|---|---|
| EASURED QUANTITY | Apparent conductivity of the ground in millimhos per meter. |
| IMARY FIELD SOURCE | Self-contained dipole transmitter |
| NSOR | Self-contained dipole receiver |
| TERCOIL SPACING | 3.66 meters |
| ERATING FREQUENCY | 9.8 kHz |
| WER SUPPLY | 8 disposable alkaline "C" cells (approx. 20 hrs life continuous use) |
| NDUCTIVITY RANGES | 3, 10, 30, 100, 300, 1000 mmhos/meter |
| EASUREMENT PRECISION | ±2% of full scale |
| EASUREMENT ACCURACY | ±5% at 20 millimhos per meter |
| ISE LEVEL | <0.1 millimhos per meter |
| ERATOR CONTROLS | • Mode Switch<br>• Conductivity Range Switch<br>• Phasing Potentiometer<br>• Coarse Inphase Compensation<br>• Fine Inphase Compensation |
| ME | Boom : 4.0 meters extended<br>1.4 meters stored<br>Console : 24 x 20 x 18 cm<br>Shipping Crate : 155 x 42 x 28 cm |
| EIGHT | Instrument Weight : 9 kgm<br>Shipping Weight : 23 kgm |



## EM34-3

Operating on the same principles as the EM31, the EM34-3 is designed to achieve a substantially increased depth of exploration and a readily available vertical conductivity profile.

*The underlying principle of operation of this patented non-contacting method of* measuring terrain conductivity is that the depth of penetration is independent of terrain conductivity and is determined solely by the instrument geometry i.e. the intercoil spacing and coil orientation. The EM34-3 can be used at three fixed spacings of 10, 20, or 40 meters and in the vertical coplanar (as shown) or horizontal coplanar mode. In the vertical coplanar mode, the instrument senses to approx. 0.75 of the intercoil spacing. In the horizontal coplanar mode, the instrument can sense to 1.5 times the intercoil spacing. For the horizontal coplanar mode, however, coil misalignment errors are more serious than in the vertical mode so greater care must be exercised to achieve the maximum 60 meter depth.

Simple operation, survey speed and straight forward data interpretation makes the EM34-3 a versatile and cost effective tool for the engineering geophysicist.

## Specifications

| | |
|---|---|
| MEASURED QUANTITY | Apparent conductivity of the ground in millimhos per meter |
| PRIMARY FIELD SOURCE | Self-contained dipole transmitter |
| SENSOR | Self-contained dipole receiver |
| REFERENCE CABLE | Lightweight, 2 wire shielded cable |
| INTERCOIL SPACING & OPERATING FREQUENCY | • 10 meters at 6.4 kHz<br>• 20 meters at 1.6 kHz<br>• 40 meters at 0.4 kHz |
| POWER SUPPLY | Transmitter : 8 disposable "D" cells<br>Receiver : 8 disposable "C" cells |
| CONDUCTIVITY RANGES | 3, 10, 30, 100, 300 mmhos/meter |
| MEASUREMENT PRECISION | ±2% of full scale deflection |
| MEASUREMENT ACCURACY | ±5% at 20 millimhos per meter |
| NOISE LEVEL | < 0.2 millimhos per meter |
| DIMENSIONS | Receiver Console : 19.5 x 13.5 x 26cm<br>Transmitter Console : 15 x 8 x 26cm<br>Coils : 63cm diameter |
| WEIGHTS | Receiver Console : 3.1 kg<br>Receiver Coil : 3.2 kg<br>Transmitter Console : 3.0 kg<br>Transmitter Coil : 6.0 kg<br>Shipping Weight : 41. kg |

GEO-PHYSICON CO. LTD.
155 - 6712 FISHER STREET S.E.
CALGARY, ALBERTA T2H 2A7

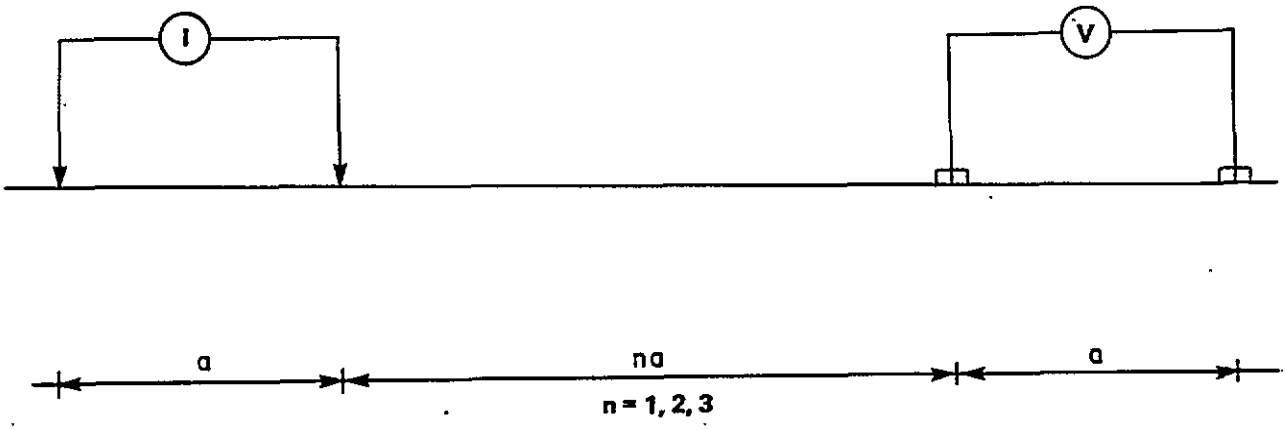



FIGURE NO. 1

Crows Nest Resources Limited
EXPLORATION

SCHEMATIC DIAGRAM OF

THE DIPOLE – DIPOLE ARRAY

| | | |
|---|---|---|
| AUTHOR: A.ALLISON | SCALE: | ENCLOSURE No: |
| DATE: | REVISED: | DRAWING No: HF-101E |
| To Accompany | | |

M, N – CURRENT ELECTRODES

A, B – CURRENT ELECTRODES

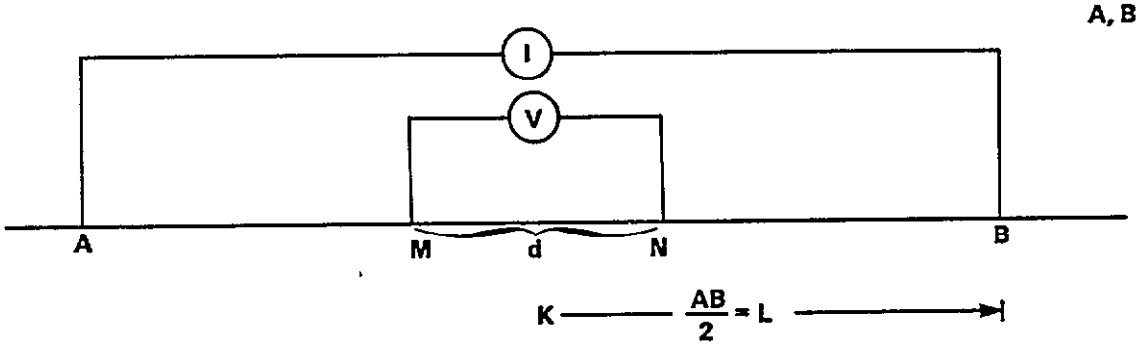
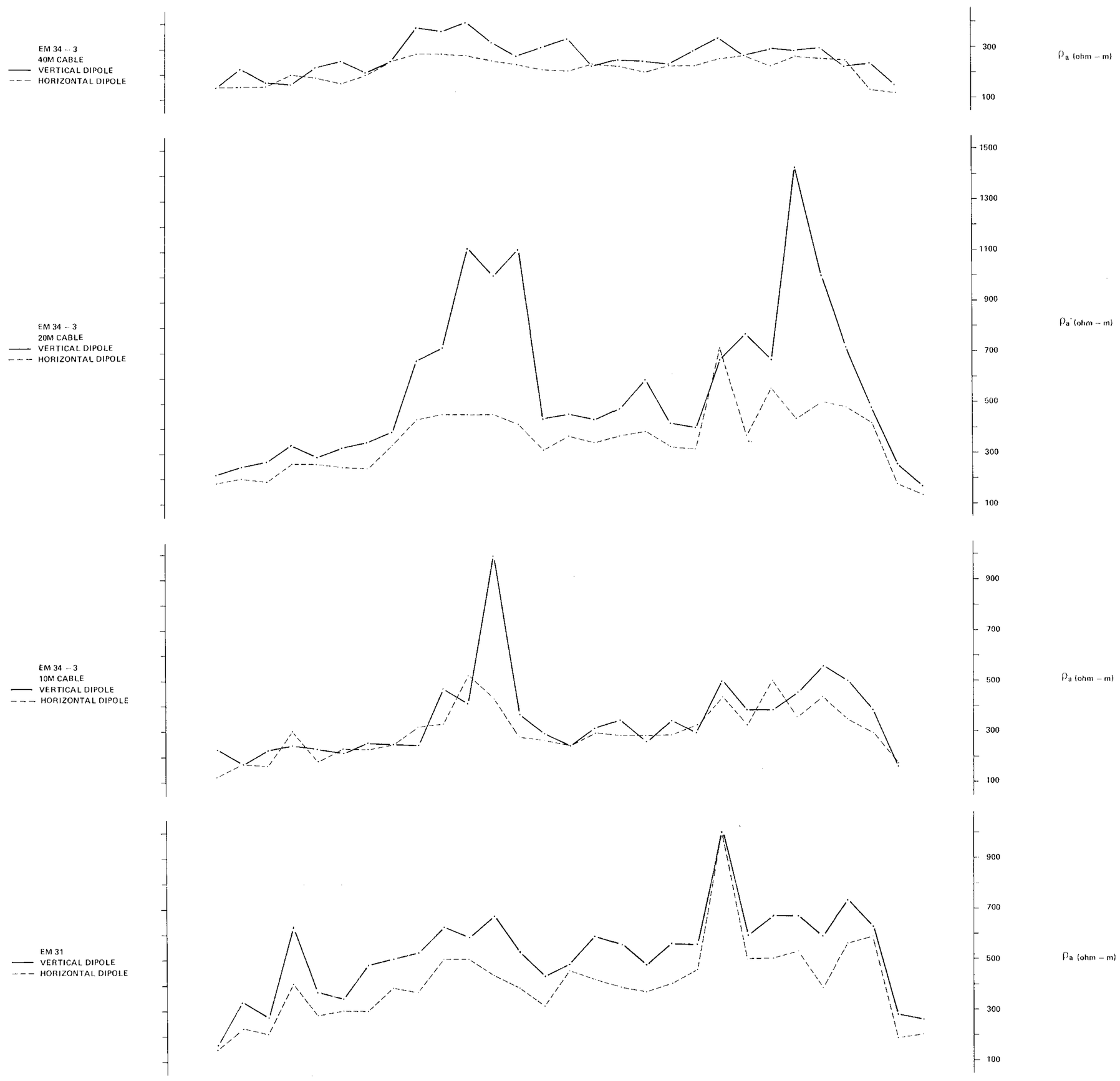



FIGURE NO. 2

Crows Nest Resources Limited
EXPLORATION

DC RESISTIVITY
SCHLUMBERGER SOUNDINGS
GEOMETRY

| | | |
|---|---|---|
| AUTHOR: A. ALLISON | SCALE: | ENCLOSURE No: |
| DATE: | REVISED: | DRAWING No: HF-1010 |
| To Accompany | | |




PR-Onion Lake 81(2*)A * (1)

FIGURE NO. 4

**Crows Nest Resources Limited**
EXPLORATION

ONION LAKE
EM 34 AND EM 31
SURVEY PROFILES OF APPARENT RESISTIVITY
VS STATION NUMBER

| | | |
|---|---|---|
| AUTHOR: A ALLISON | SCALE: 1:5000 | ENCLOSURE No: |
| DATE: | REVISED: | DRAWING No: HC-101D |
| To Accompany | | |

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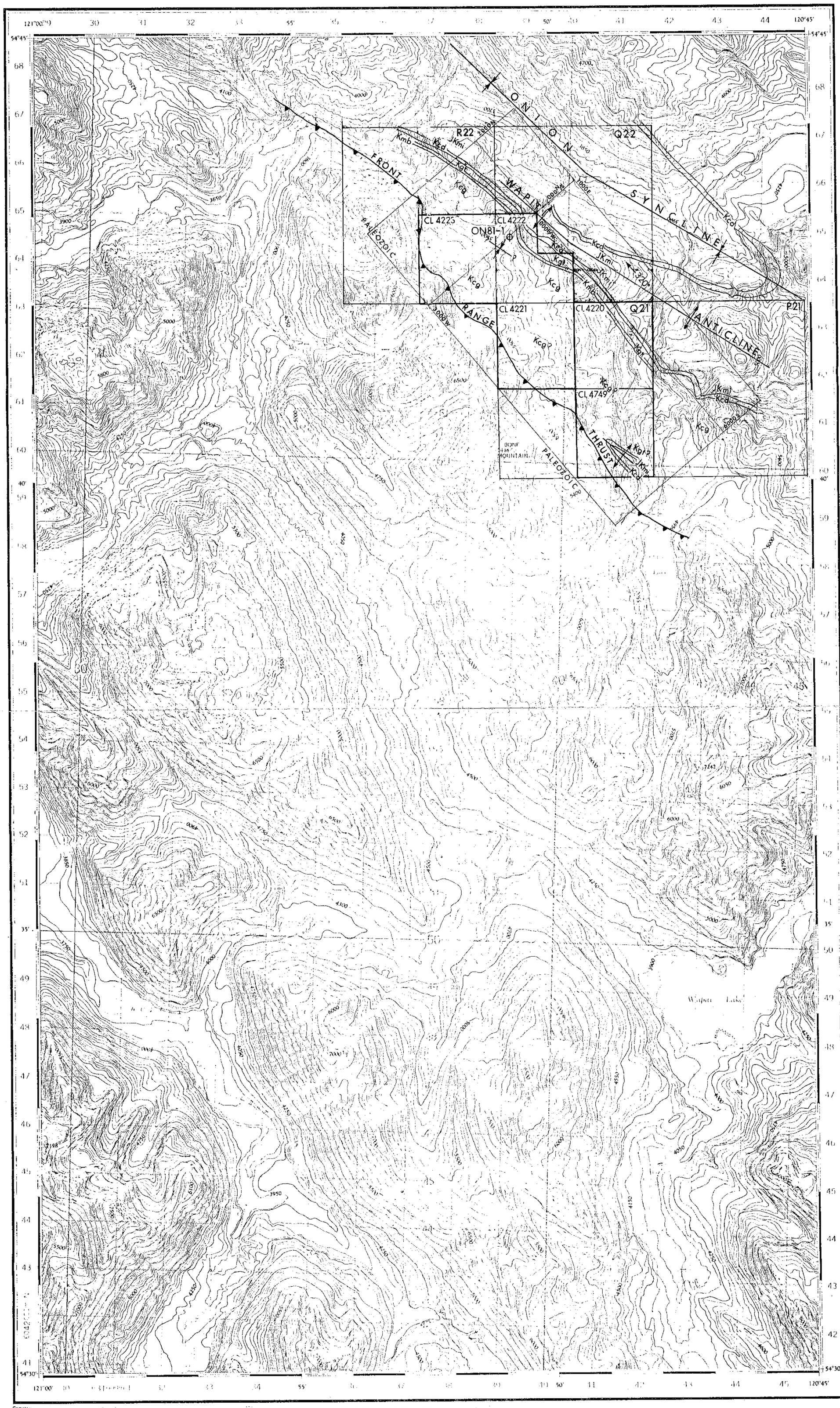


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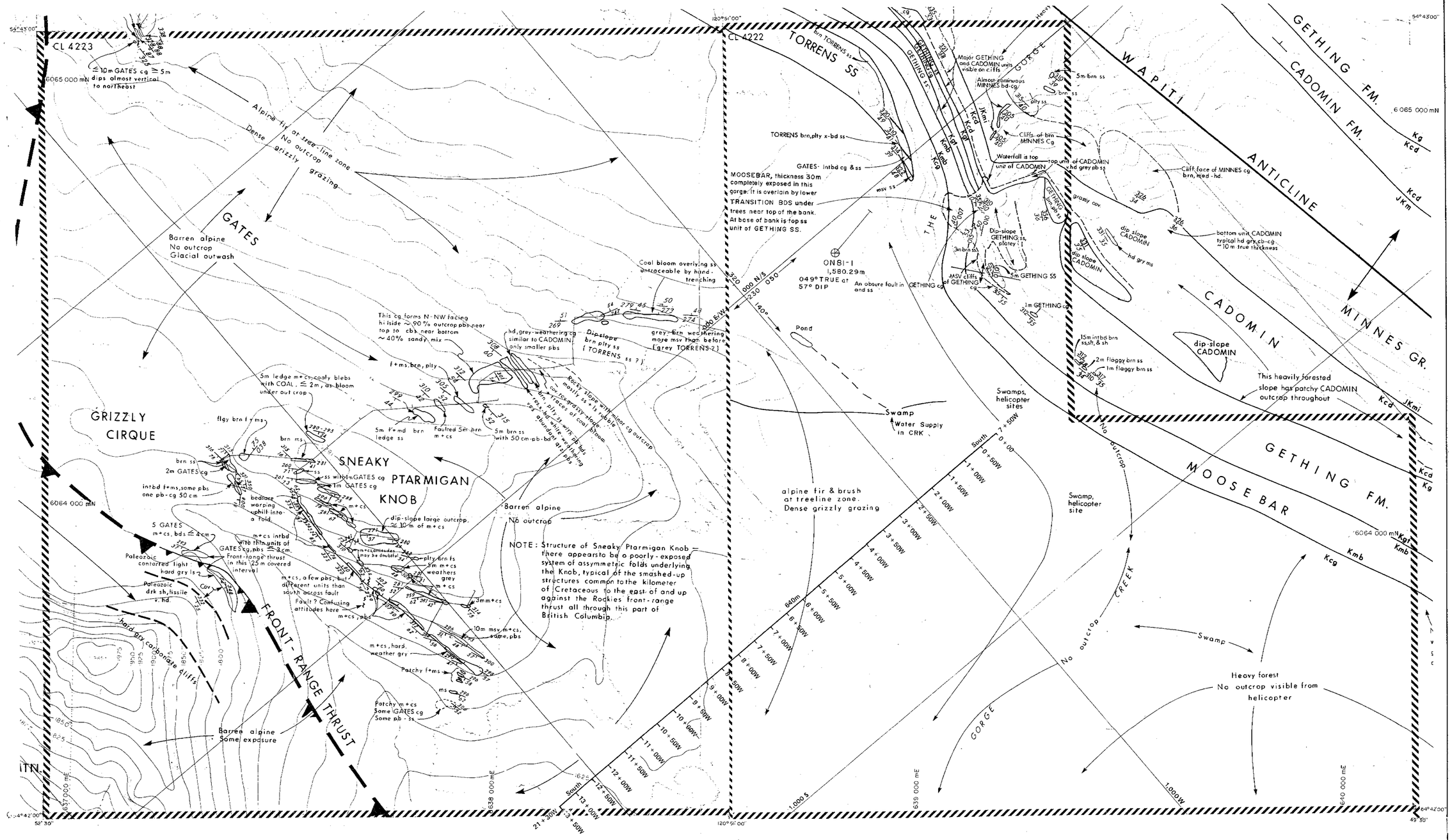
PR-Onion lake 81(A*)A *(1)
Figure 3A




LOWER CRETACEOUS
- Ksh Shaftesbury
- Kcb Boulder Creek
- Kcg Gates (includes overlying Transition Beds & Torrens Sandstone)
- Kmb Moosebar
- Kgt Gething
- Kcd Cadomin

JURASSIC - CRETACEOUS
- JKmi Minnes Group (undivided)

Thrust fault, position exposed

Thrust fault, position approximate

Fault other than thrust

Anticline

Syncline

Isolated outcrop, sketched to extent and size:

Strike & dip where strike line of symbol touches outcrop outline

Strike & dip where strike & dip lines of symbols intersect

Patchy, indeterminate outcrop

Outcrop with exposed contact

Chain-and-compass line (tick marks are stations) with outcrop sketched to size and limits along chained line; strike & dip where strike line of symbol touches chained line

Chain & compass line: attitudes refer to strike & dip at nearest tick (chain station)

NOTE: See Report for Legend of Abbreviations

TN. GRID NORTH

Scale 1:5000

Metres 100 0 100 200 300 400 500 Metres

ONSI-1 SURVEY CO-ORDINATES

| | |
|---|---|
| UTM NORTHING: | 6,064,643.44 |
| UTM EASTING: | 638,777.06 |
| ELEVATION: | 1,580.29 |

566

PR-Onion Lake 81(2)A #(1)

FIGURE No. 3

**Crows Nest Resources Limited**

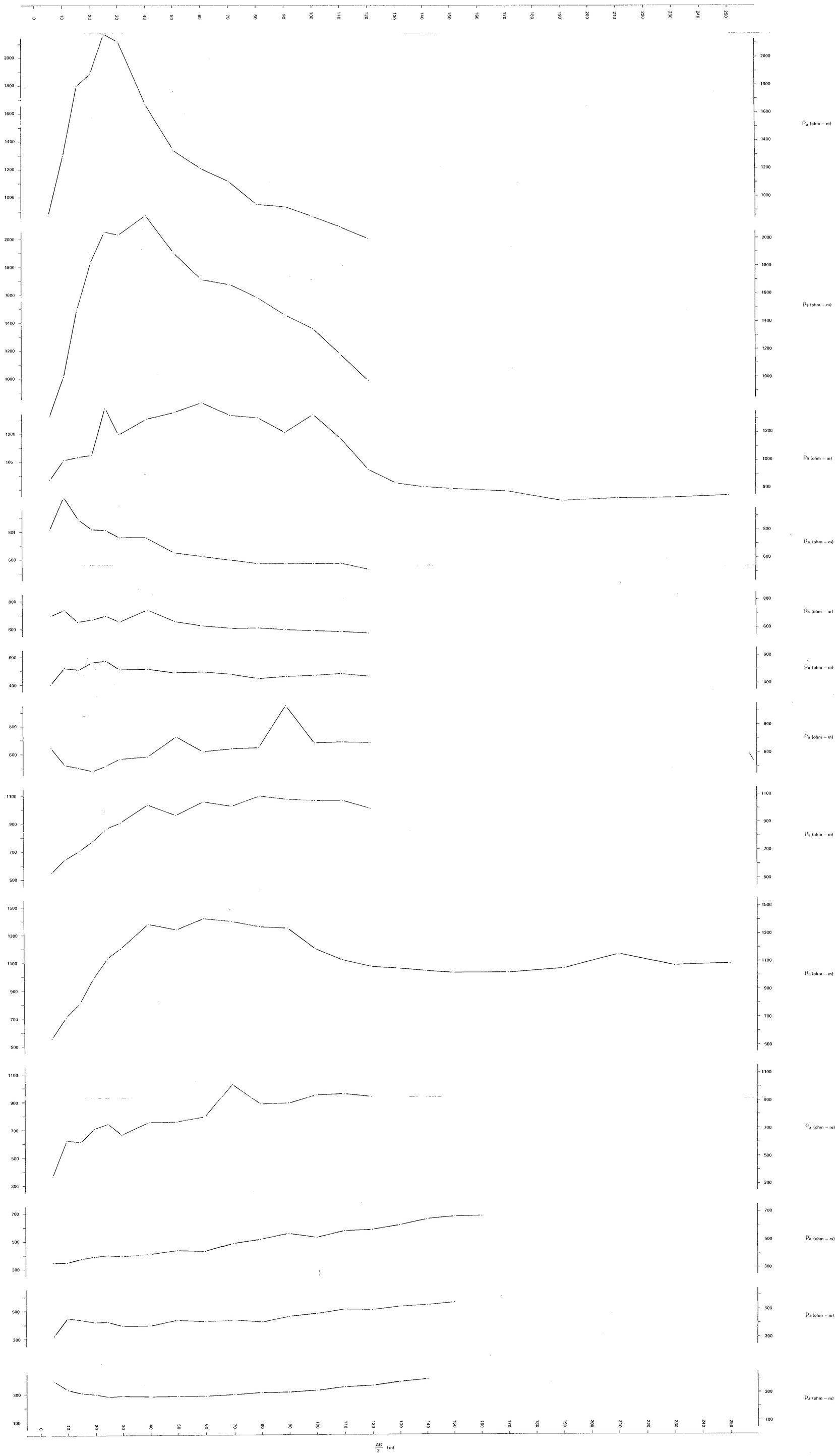
EXPLORATION

ONION LAKE
NE. BRITISH COLUMBIA

# GEOLOGY MAP

N.T.S. 93 I/10 — U.T.M. ZONE 10

| | | |
|---|---|---|
| AUTHOR A. ALLISON | SCALE 1:5000 | ENCLOSURE No |
| DATE MAR/82 | REVISED NOV., 1982 | DRAWING No HC-101 |
| To Accompany | | |




566 PR-Onion Lake 81(24)B.3(1)

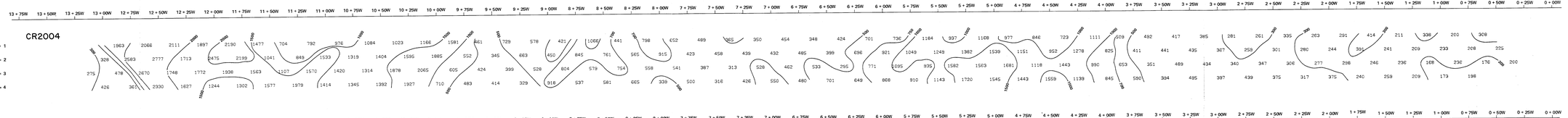
FIGURE NO. 5

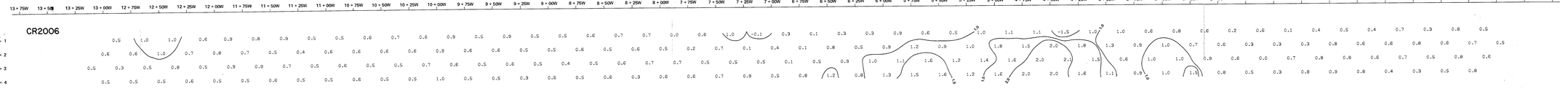
**Crows Nest Resources Limited**
EXPLORATION

ONION LAKE
SCHLUMBERGER SOUNDINGS

PROFILES OF APPARENT RESISTIVITY
VS DISTANCE $\left(\frac{AB}{2} = L\right)$
– EXPANSIONS ARE E–W ALONG THE LINE d = 5M

| | | |
|---|---|---|
| AUTHOR: A. ALLISON | SCALE: 1:5000 | ENCLOSURE No: |
| DATE: | REVISED: | |
| To Accompany | | DRAWING No: HC-101E |




566 PR-Onion Lake 81G-10-W1 FIGURE NO. 6

**Crows Nest Resources Limited**
EXPLORATION

ONION LAKE
RESISTIVITY AND IP PSEUDO SECTION
DIPOLE – DIPOLE ARRAY
FREQ – 0.25 HZ AND 2.0 HZ
a = 25 METRES

| | | |
|---|---|---|
| AUTHOR: A. ALLISON | SCALE: 1:5000 | ENCLOSURE No: |
| DATE: | REVISED: | DRAWING No. HC – 101 C |
| To Accompany | | |