CURRAGH RESOURCES INC.
BOREHOLE PULSE EM SURVEY
FARO NW PROJECT
WHITEHORSE MINING DIVISION
NTS: 105K/6W
LATITUDE: 62°14'N LONGITUDE: 133°39'W

AUTHORS: DOUGLAS M. HRYNYK
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CONSULTING GEOPHYSICIST

DATE OF WORK: 11 TO 16 SEPTEMBER, 1989
DATE OR REPORT: 16 OCTOBER, 1989

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INTRODUCTION:

On 11 to 16 September 1989, White Geophysical Inc. carried out a borehole Pulse EM survey for **Curragh Resources Inc.** on their **Faro NW Project**, near Faro in the Yukon Territory. Four drillholes, 89FX-01 through 89FX-04 inclusive, were surveyed.

Pulse EM was employed to detect any conductive mineralization not intersected by the drillholes.

SURVEY LOCATION AND ACCESS:

Faro is located in the Anvil Range lead-zinc-silver district, 200 km northeast of Whitehorse (Figure 1). The area lies in NTS 105K/6W. Road access is either from the west through Carmacks, or from the east through Ross River.

CRONE BOREHOLE PULSE EM SYSTEM

The Crone borehole pulse EM system is a time domain, downhole EM instrument capable of detecting conductive mineralization intersected by the drillhole or lying offhole. The borehole pulse EM system utilizes a special downhole receiver coil, 600 metre cable and winch, in conjunction with a standard PEM transmitter and receiver normally employed in surface surveys.

The primary field is produced by a square loop of wire laid on the surface and driven by a Pulse EM transmitter.

The time derivative of the secondary EM field is measured using an axial receiver coil lowered down the diamond drillhole. The minimum size of drillhole which can be accommodated is AQ (1 3/4" diameter). The receiver measures eight samples of the secondary field during the primary field off-time. Sample times range from 0.15 to 6.4 ms after primary field shut-off on a 10.8 ms transmitter time base.

CURRAGH RESOURCES INC.

FARO NW PROJECT

LOCATION MAP

N.T.S. 105K/6W

Scale in Miles: 50 0 50 100

Scale in Kilometers: 50 0 50 100

ONE INCH EQUALS APPROXIMATELY 63 MILES OR 101.3 KILOMETERS

FIG. 1

Multiple transmitter loops may be used to provide various loop to conductor coupling geometries in order to obtain conductor attitude and position information. A complete survey of a given borehole may entail logging the hole from five transmitter loop setups. One of these loops would be approximately centred over the area of interest with the remaining four loops away from and distributed around the borehole.

When an anomalous response is observed in a borehole log from a single transmitter loop, the nature of this anomaly allows the determination of the location of the conductive source relative to the drillhole. As shown by Woods and Crone (1980, Figs. 7 & 8), the response can indicate whether the borehole is intersecting the centre of the conductor, the margin of a conductor, with the bulk of conductive material away from the hole, or whether the conductor is entirely off-hole.

Model study curvos for various conductor to borehole geometries from Woods (1975) are employed in the interpretation. Quantitative analysis of the conductor's attitude, position and conductance is made using nomograms presented by Woods, et al. (1980). Computer plate modelling, using the reutines developed by Dyck, et al (1980), can be used to confirm the interpretation.

In the case of a dike-like or tabular conductor, the magnitude of an anomaly varies with the angle that the primary field cuts the conductor. Thus, the change in coupling between the conductor and the primary field from different transmitter loop setups, will provide information on the attitude and position of the conductive mineralization.

If the conductor tends towards a more spheroidal shape, the shape as well as the magnitude of the anomaly will change as the primary field direction is altered. This occurs because the eddy currents are not constrained to flow within a single plane but

rather tend to circulate perpendicular to the primary field direction. Thus, multiple transmitter loop coverage can also provide information about the shape of a conductive body.

In practice the responses observed in field situations are much more complex than those of simple models, but the results are sufficiently interpretable that the method has general acceptance and a number of discovery case histories exist.

SURVEY PROCEDURE:

An Ohm meter, applied to a grab smaple of the local ore, indicated that the ore is quite conductive. A sizable body of this ore would have a large conductivity-thickness, and would be detectable during a Pulse EM survey

A Crone 2000 Watt Pulse EM transmitter energized each of the nine wire loops laid out near the four drill collars (Figure 2). These loops were variously either 400m x 400m, 400m x 500m, or 500m x 500m as shown in figure 2. To ensure that no mineralization was present but undetected because of a lack of coupling, at least three different loops were tried with every drillhole. Drillholes 89FX-02, 89FX-03 and 89FX-04 are grouped closely enough that a given loop can be used for more than one drillhole. Loops A - F provided a sufficient variety of coupling geometries with any mineralization that might have been present in the drillholes. Drillhole 89FX-01 is west of the others, and loops G, H and I were laid out near its' collar.

DISCUSSION OF RESULTS:

The responses produced, in the drillholes, from each loop are displayed in Figures 3 - 15. The responses are flat indicating that there are no conductive bodies in the immeadiate vicinity of the drillholes.

Loops H and I coupled with a conductive body located beside drillhole 89FX-01, under Loop H, more than 580m below the collar. Since only a few data points are involved, it is not possible to derive any quantitative information about the conductive body.

CONCLUSIONS AND RECOMMENDATIONS:

Four drillholes, 89FX-01 to 89FX-04, with a combined length of 1366m, were surveyed with nine loops. Three or more loops were used with every drillhole assuring that a sufficient variety of coupling geometries were tried to have energized any conductive mineralization which might have been present. The only such mineralization indicated is beside the bottom of drillhole 89FX-01, below Loop H - no quantitative information about this mineralization was obtained. There is no indication that drillholes 89FX-02, 89FX-03, 89FX-04 pass through or near any conductive bodies.

The conductivity of the grab sample of ore suggests that a Pulse EM survey would readily detect an orebody of economic size. The lack of responses in drillholes 89FX-02, 89FX-03 and 89FX-04 does not mean that a strong response would not be found in other drill holes sited closer to an orebody. Borehole Pulse EM would greatly increase the effective search radius about a drillhole because it is not necessary to drill directly through an orebody to 'see' it with Pulse EM. Given a sufficient conductivity-thickness, an ore body can be detected as much as 100m away from a drillhole. Surveying more drillholes, located in favourable geology, with Pulse EM is recommended.

Respectfully submitted,

Douglas M. Hrynyk

Markus B. Seyward, B.Sc.
Consulting Geophysicist

REFERENCES:

Dyck, A.V., Bloore, M., and Valles, M.A., 1980: User manual for programs PLATE and SPHERE; Research in Applied Geophysics, 23, University of Toronto.

Woods, D.V., 1975: A model study of the Crone Borehole pulse electromagnetic (PEM) system; unpublished M.Sc. thesis, Queen's University, Kingston, Ontario.

Woods, D.V. and Crone, J.D. 1980: Scale model study of a borehole pulse electromagnetic system; C.I.M. Bulletin, vol.73, no. 817, pp.96-104.

Woods, D.V., Rainsford, D.R.B. and Fitzpatrick M.N. 1980: Analogue modelling and quantitative interpretation of borehole PEM measurements (abstract only); EOS Transactions of the American Geophysical Union, vol. 61, no. 17, pp. 414-415.

SPECIFICATIONS – CRONE BOREHOLE PULSE EM EQUIPMENT

PROBE:
- Measures dB/dt of axial-component of borehole
- Ferrite cored antenna with preamplifier and self contained power supply (Ni.-Cd. rechargeable)
- 30 hours continuous operation
- Weight: 3.6 Kg.
- Length: 1.63 M.
- Diameter: 2.9 cm (for "E" holes and larger)
- Pressure tested to 13.8 MPa (2000 PSI)

WINCH ASSEMBLY:
- 3 speed gear box, gear ratios 1:1, 2:1, 3:1
- Optional power winching for deep holes
- Borehole cable capacity of up to 2000 meters
- Portable

UNDERGROUND PUSHROD SYSTEM:
- For use in horizontal boreholes (‹ 45 degrees)
- Powered Pushrod assembly for holes › 500 meters

BATTERY SUPPLY:
±12 VDC, two internal, rechargeable, 12V gel type batteries

MEASURED QUANTITIES:
Primary shut-off voltage pulse (PP). Time derivative of the transient magnetic field by integrative sampling over eight, contiguous time gates (microseconds).

CH. NO.	WINDOW	WIDTH	MID PT.	REL. GAIN	WINDOW	WIDTH	MID PT.
PP	-100 to 0	100	-50	1.00	-200 to 0	200	-100
1	100 to 200	100	150	1.00	200 to 400	200	300
2	200 to 400	200	300	1.39	400 to 800	400	600
3	400 to 700	300	550	1.93	800 to 1400	600	1100
4	700 to 1100	400	900	2.68	1400 to 2200	800	1800
5	1100 to 1800	700	1450	3.73	2200 to 3600	1400	2900
6	1800 to 3000	1200	2400	5.18	3600 to 6000	2400	4800
7	3000 to 5000	2000	4000	7.20	6000 to 10K	4000	8000
8	5000 to 7800	2800	6400	10.00	10K to 15.6K	5600	12.8K
	10.8ms. Time Base				21.6ms. Time Base		

READOUT:
Readings are output on an analog meter (6V FSD), over three sensitivity ranges (X1, X10, X100). Data retrieval made by channel select switch.

TIMING:
A telemetry link ("sync.") is maintained by radio signal, or a back-up cable, between the transmitter and the receiver, and is meter monitored.

SENSITIVITY:
Adjustable through a ten turn, calibrated gain pot.

SAMPLING MODES:
"S & H" (Sample & Hold)
The receiver averages 512 (10.8 ms), or 256 (21.6ms), readings for all channels, and stores the results for display.
"CONT" (Continuous)
A running average for all channels is stored, enabling the operator to reject thunderstorm spikes and power line noise by visual inspection.

SPECIFICATIONS – PULSE EM TRANSMITTER EQUIPMENT

MOTOR GENERATOR:

4-1/2 H.P. Wisconsin, 4 cycle engine with belt drive to D.C. alternator; maximum output 120V, 30 amps; external gas tank; frame unit weight: 33 kg, shipping: 47 kg.

REGULATOR:

Controls and filters the alternator output; continuously variable between 24V and 120V D.C.; 20 amp maximum current; weight: 10 kg, shipping: 24 kg.

PEM WAVEFORM TRANSMITTER:

Controls bipolar, on-off waveform and linear current shut-off ramp time. Radio and cable time synchronization with housing for optional crystal clock sync system; on-off times for 60 Hz areas 8.33ms, 16.66ms, 33.33ms; for 50 Hz areas 10.0ms, 20.0ms, 40ms; for analog PEM operation 10.9ms, 21.8ms; linear controlled current shut-off ramp times of 0.5, 1.0 and 1.5ms; monitors for shut-off ramp operation, instrument temperature, Tx loop continuity, and overload output current; automatic shut-down for open Tx loop. Weight: 12.5 kg, shipping: 22 kg.

REMOTE RADIO, ANTENNA AND MAST:

Used for radio timing synchronization on large survey grids; range up to 2 km; radio has 12V rechargeable gell cell battery supply; antenna is fiberglass mounted on a 4 section aluminum mast each 2m long. Radio weight: 2.7 kg, shipping: 6.0 kg; mast and antenna shipped as bundle: 6.4 kg.

OPTIONAL CRYSTAL CLOCK TIMING LINK:

Installed in the Digital Rx and external tiox mounted to be plugged into PEM-Tx. Gel rechargeable power supply. Weight: 10 kg, shipping: 15 kg.

WIRE, SPOOLS AND WINDERS:

Transmitter wire is usually No. 10 or No. 12 AWG copper in 310m or 410m lengths, 1 length per spool; 2 spools in a shipping box; winder is mounted on a magnesium packframe.

MULTI-TURN MOVING COIL:

7 turn, 13.7 meter diameter Tx loop with plugs to break into 2 sections. Aluminum or copper wire and various coverings depending on area being used.

BATTERY POWER SUPPLY:

24V, 20 amp hour; rechargeable battery supply for use with PEM-Tx as power source rather than motor-generator-regulator. In aluminum case, with clamp connectors. Weight: 20.5 kg, shipping: 29 kg.

- Battery chargers supplied for all rechargeable battery units.
- All instruments and equipment operational from -40°C to +50°C.
- Shipping boxes are reusable plywood construction with closed cell foam shock protection.

STATEMENT OF QUALIFICATIONS

NAME:	HRYNYK, Douglas M.
PROFESSION:	Practicing Geophysicist
EDUCATION:	University of British Columbia - Geophysics undergraduate program
EXPERIENCE:	Eight years with White Geophysical Inc. Two years as Head of Data Processing, and six years as Crew Chief working in British Columbia, Saskatchewan, Northwest Territories, Quebec, Nova Scotia, Washington, and Nevada.

STATEMENT OF QUALIFICATIONS

NAME:	SEYWERD, Markus B., B.Sc.
PROFESSION:	Geophysicist
EDUCATION:	University of British Columbia - B.Sc., Mathematics
EXPERIENCE:	Three years of summer field work with Noranda Exploration Company Ltd. in British Columbia, Northwest Territories and Yukon Territories. Three years Geophysicist with White Geophysical Inc. with work in British Columbia, Saskatchewan and Yukon Territories.

COST BREAKDOWN:

A. Mobilization and demobilization ..... $ 3,500.00

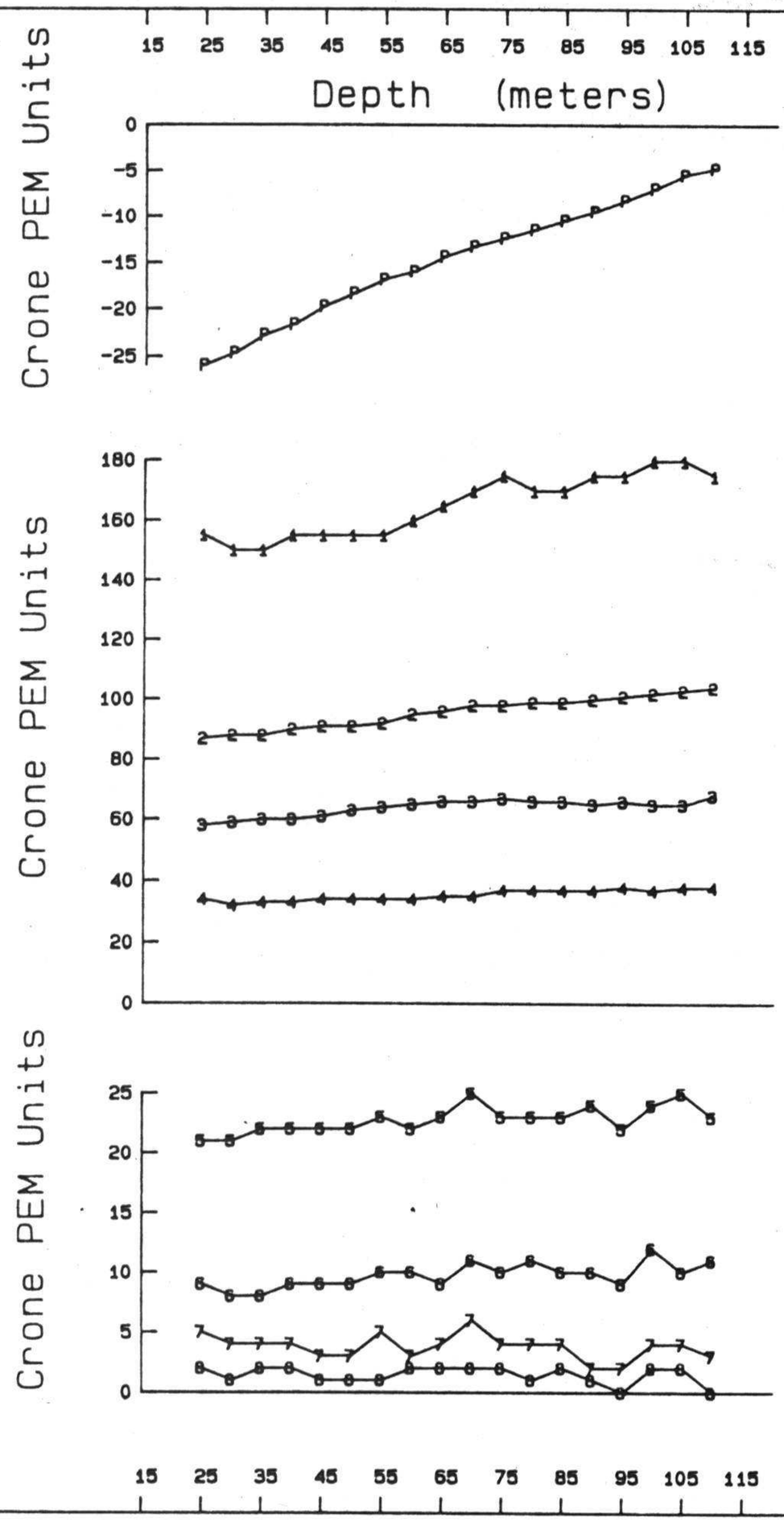
B. Daily rate for survey $1200 x 6 days (Sept. 10-17, 1989):

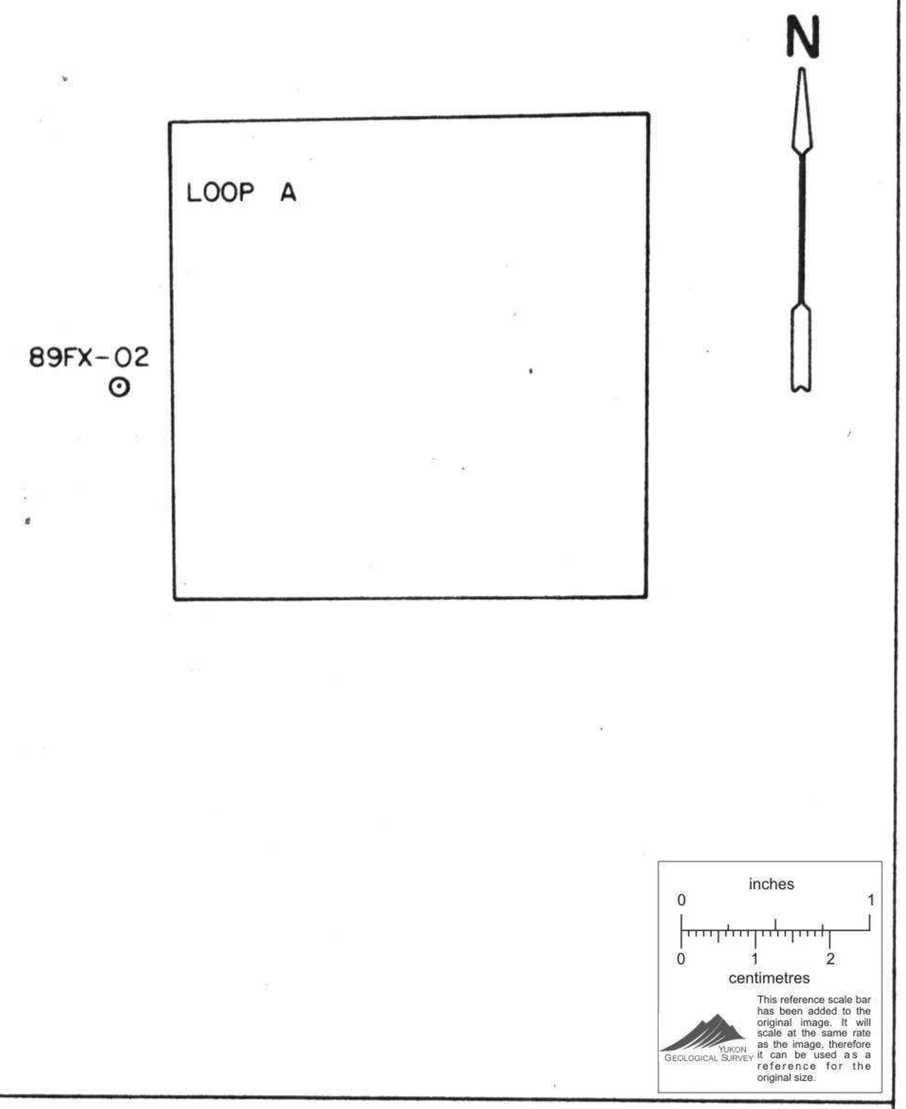
Borehole Pulse EM system	$450 x 6	$ 2,700.00
Brent Robertson	$450 x 6	2,700.00
Tim Kolchyski	$300 x 6	1,800.00

C. Room and board 744.90

D. Technical report 2,000.00

Total $13,444.90





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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-02 LOOP A

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 3

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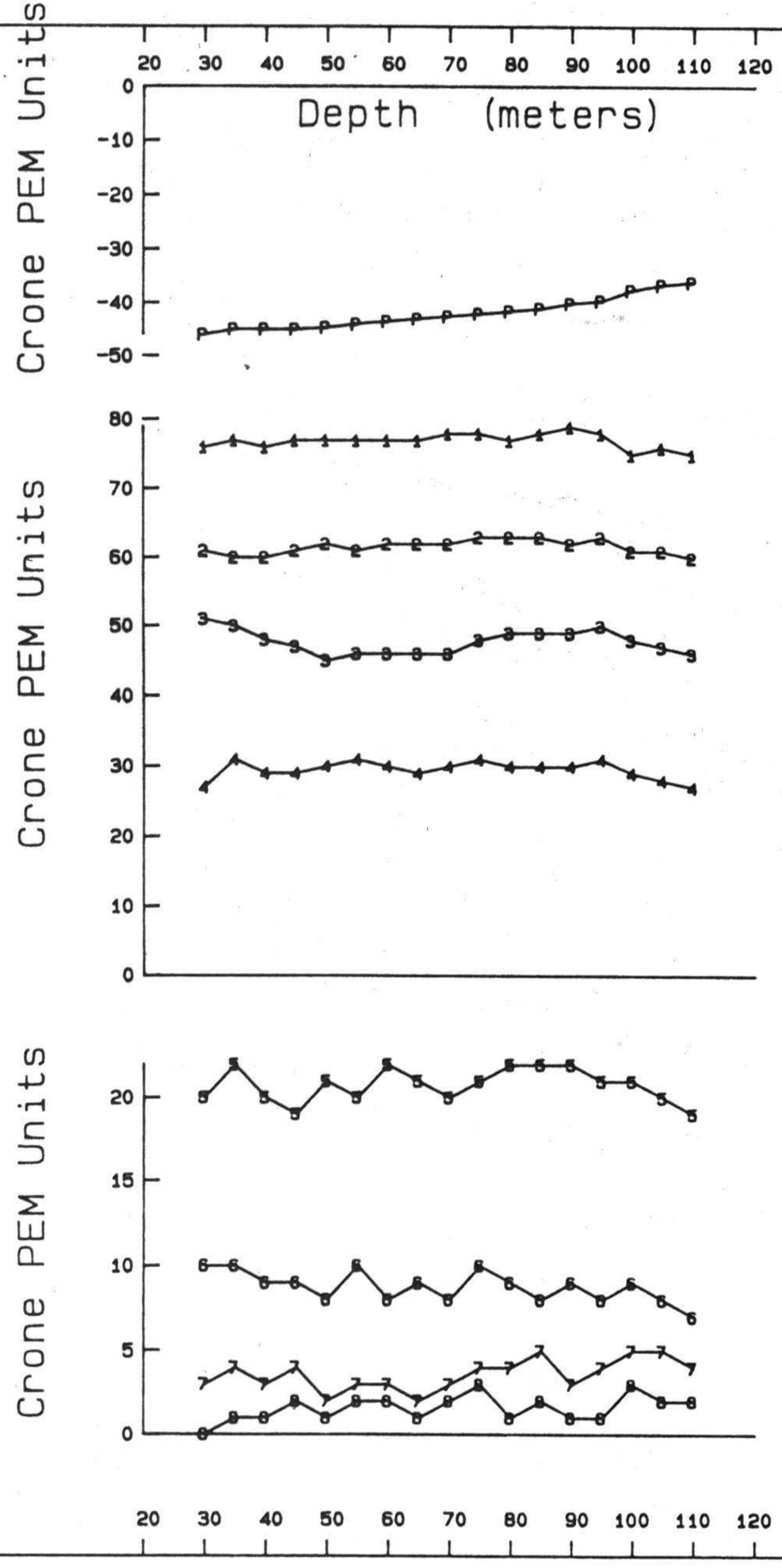

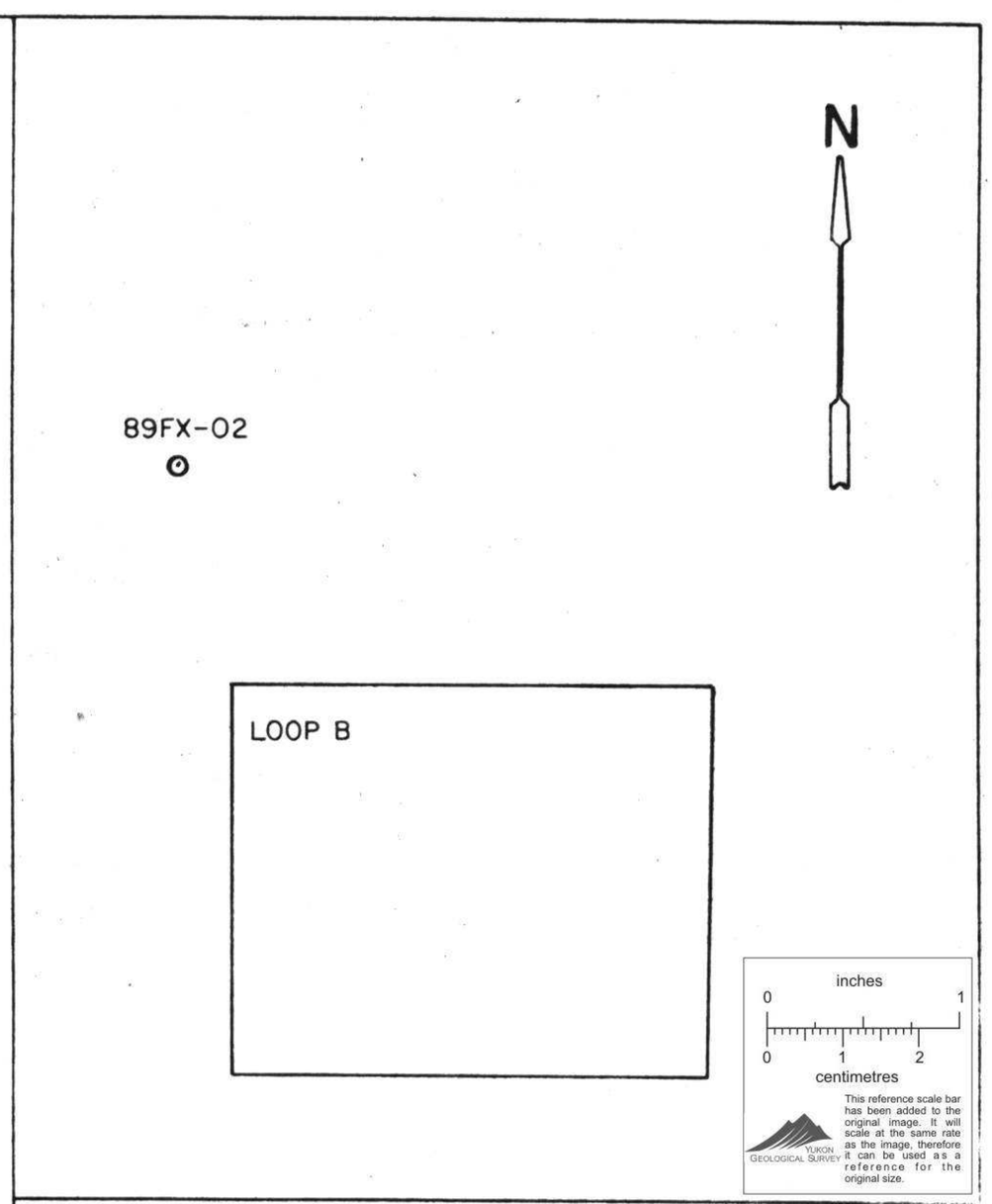

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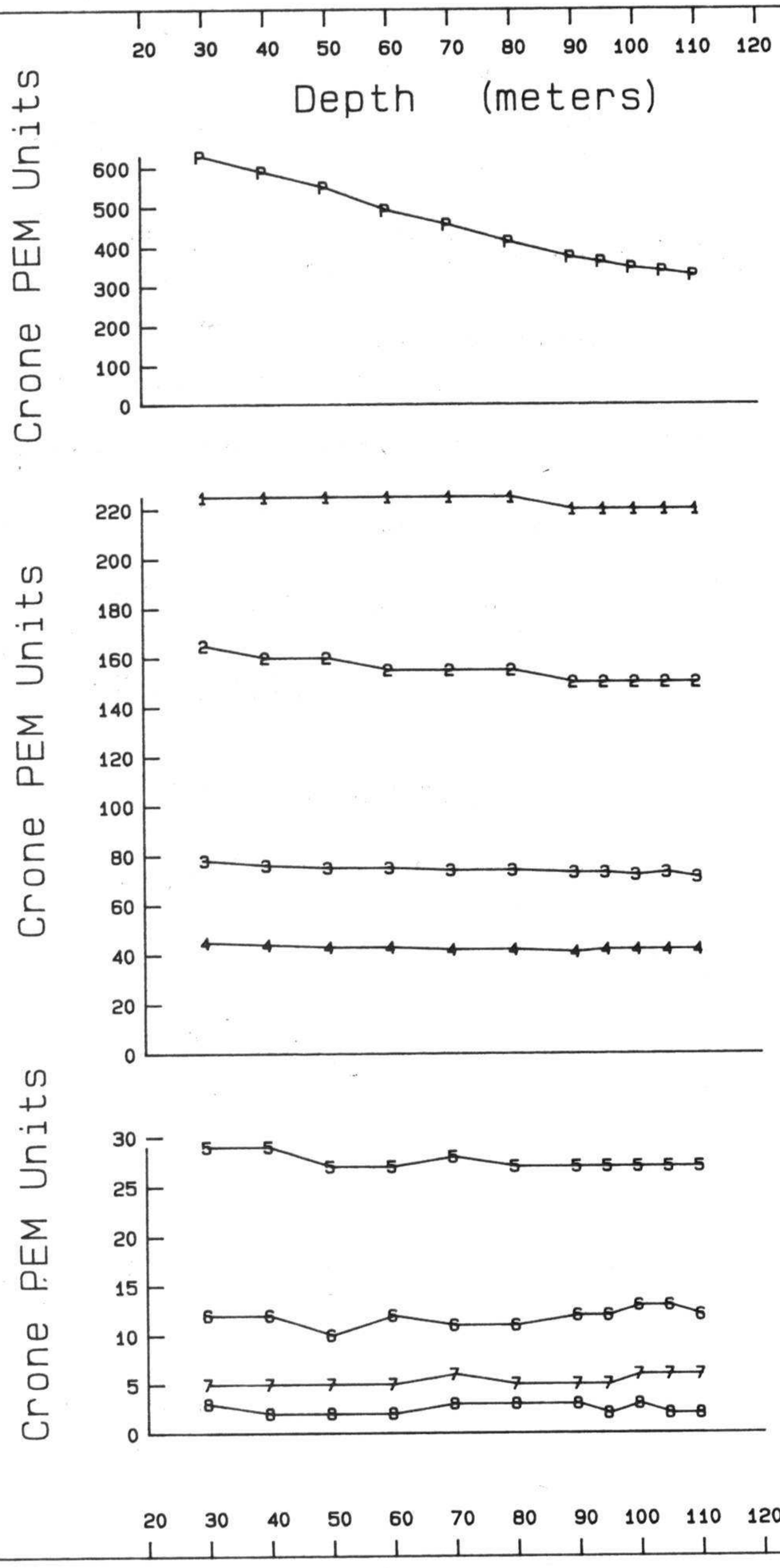
BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-02 LOOP B

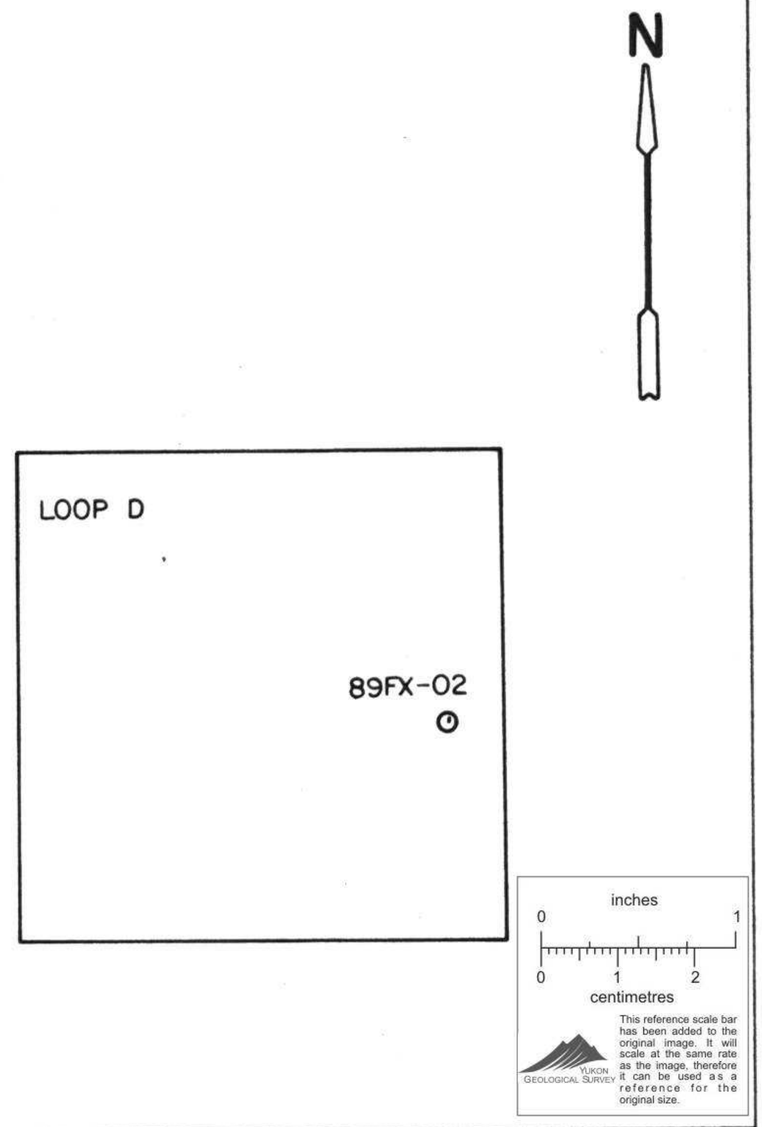
Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 4

WHITE GEOPHYSICAL INC.





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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-02 LOOP D

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 5

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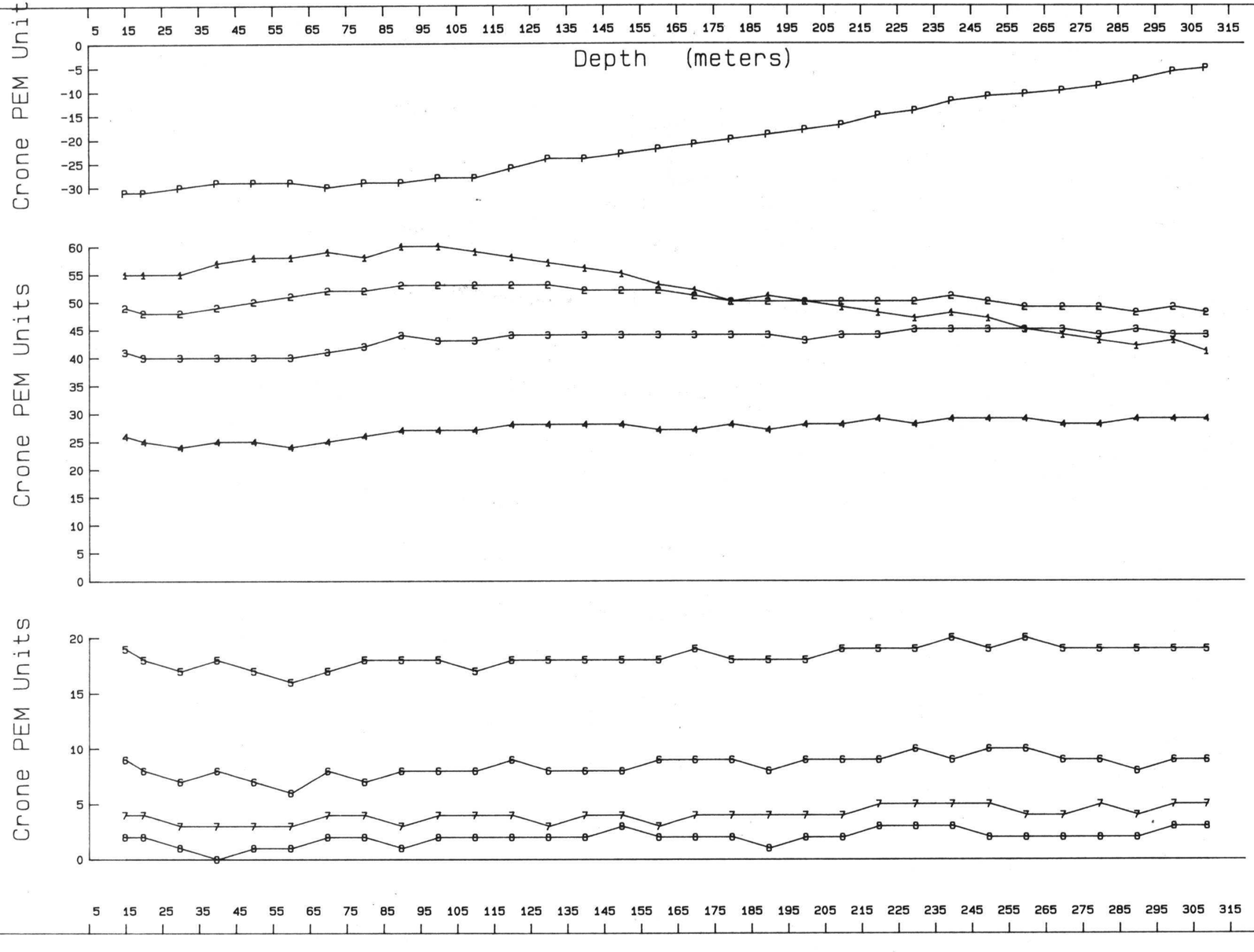

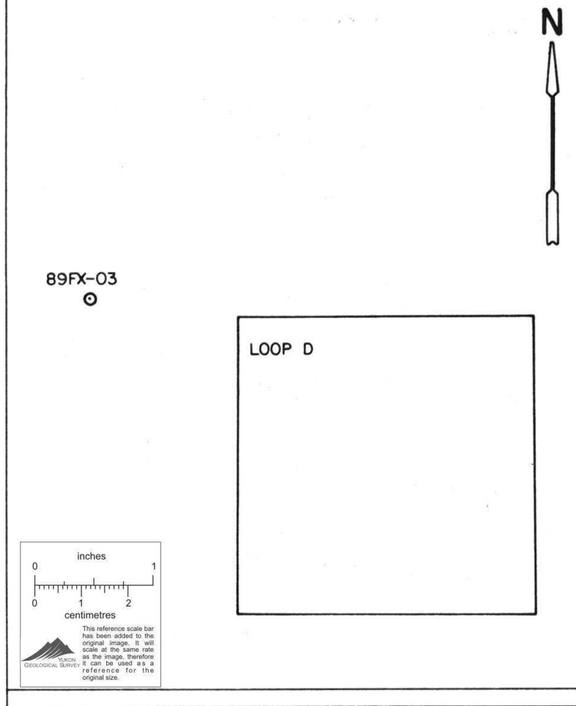

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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-03 LOOP D

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 6

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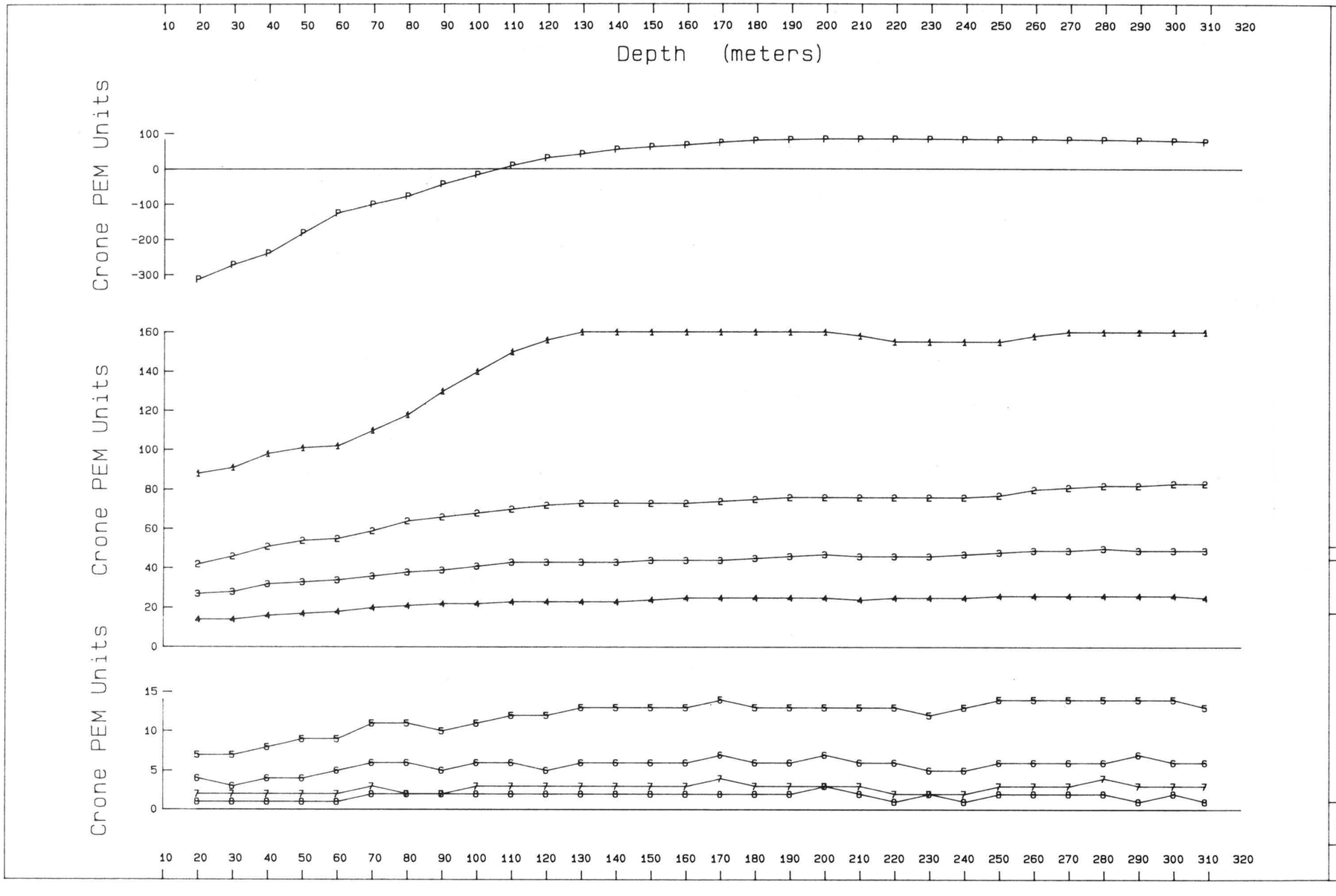

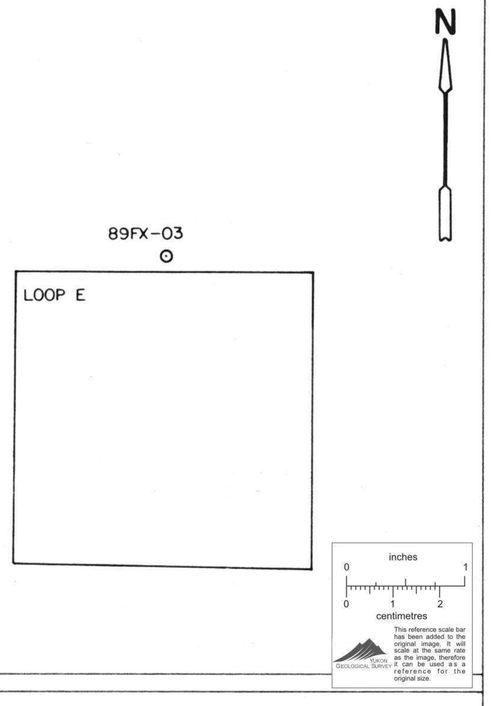

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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-03 LOOP E

Scale 1: 1000.0

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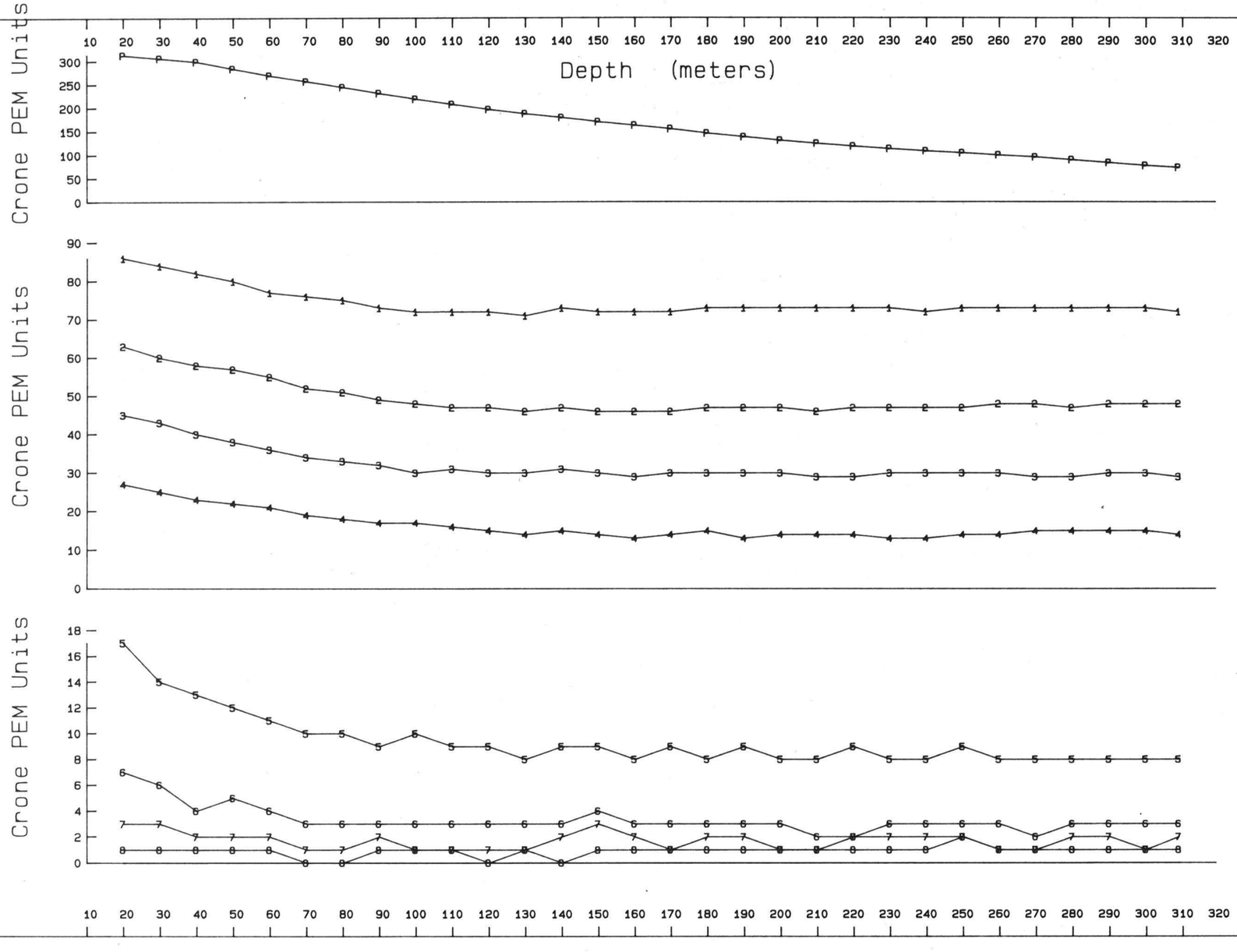
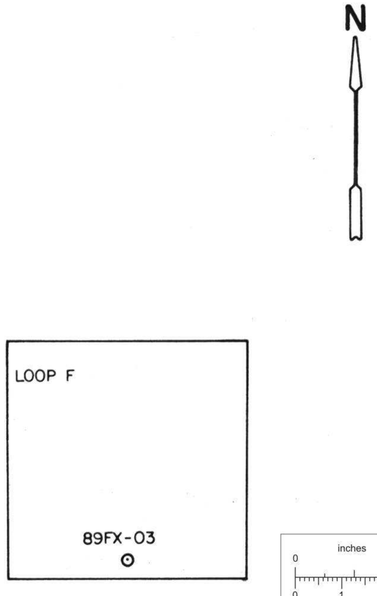
Date: Sept 1989	Survey: Sept 1989	Figure: 7 .

WHITE GEOPHYSICAL INC.





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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-03 LOOP F

Scale 1: 1000.0

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Date: Sept 1989	Survey: Sept 1989	Figure: 8

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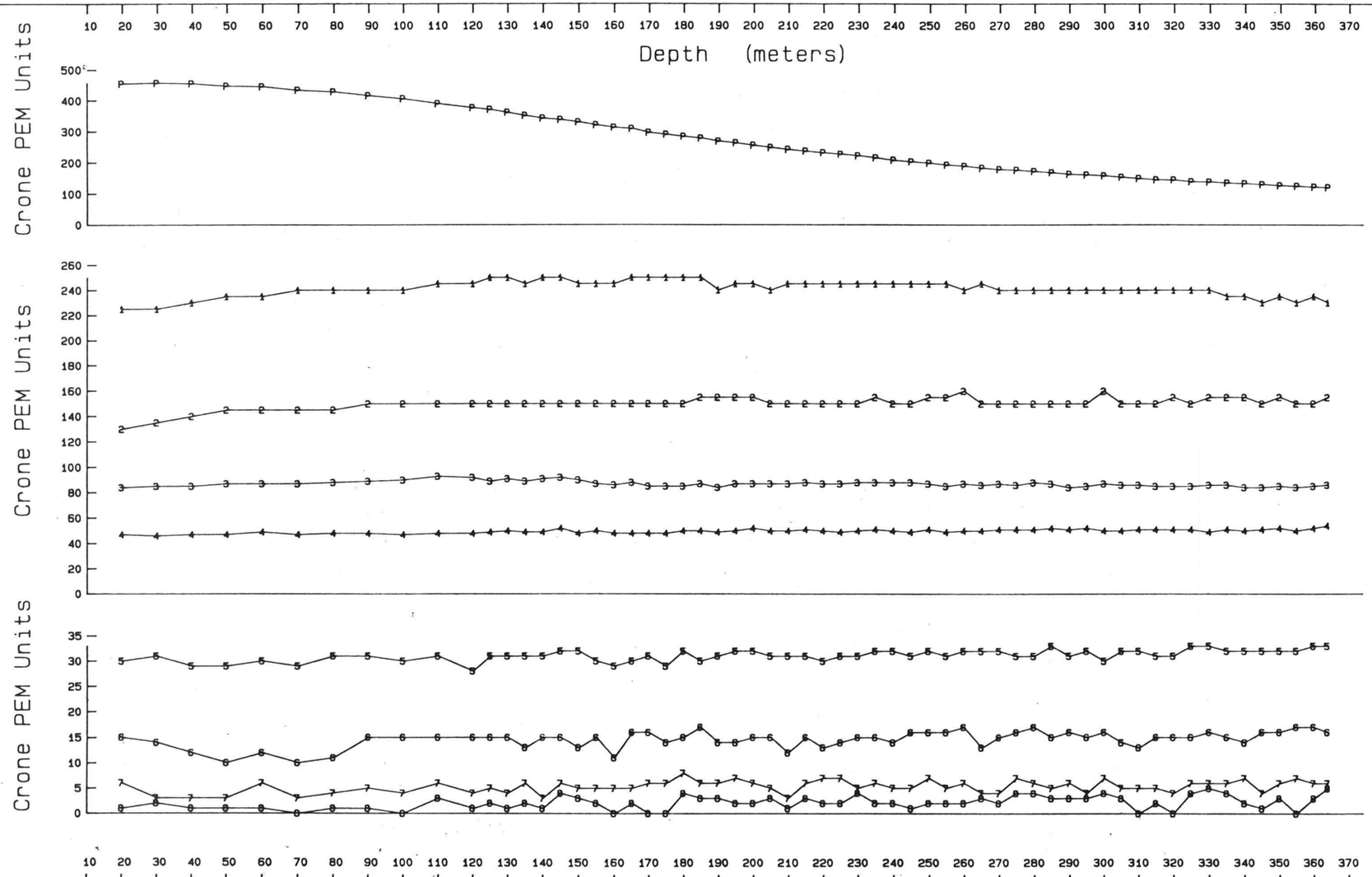

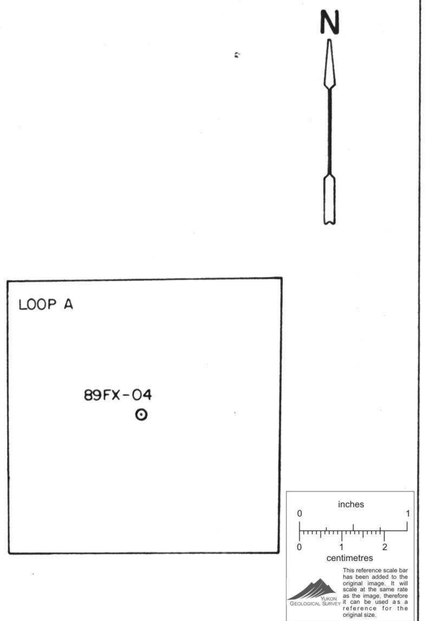

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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-04 LOOP A

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 9

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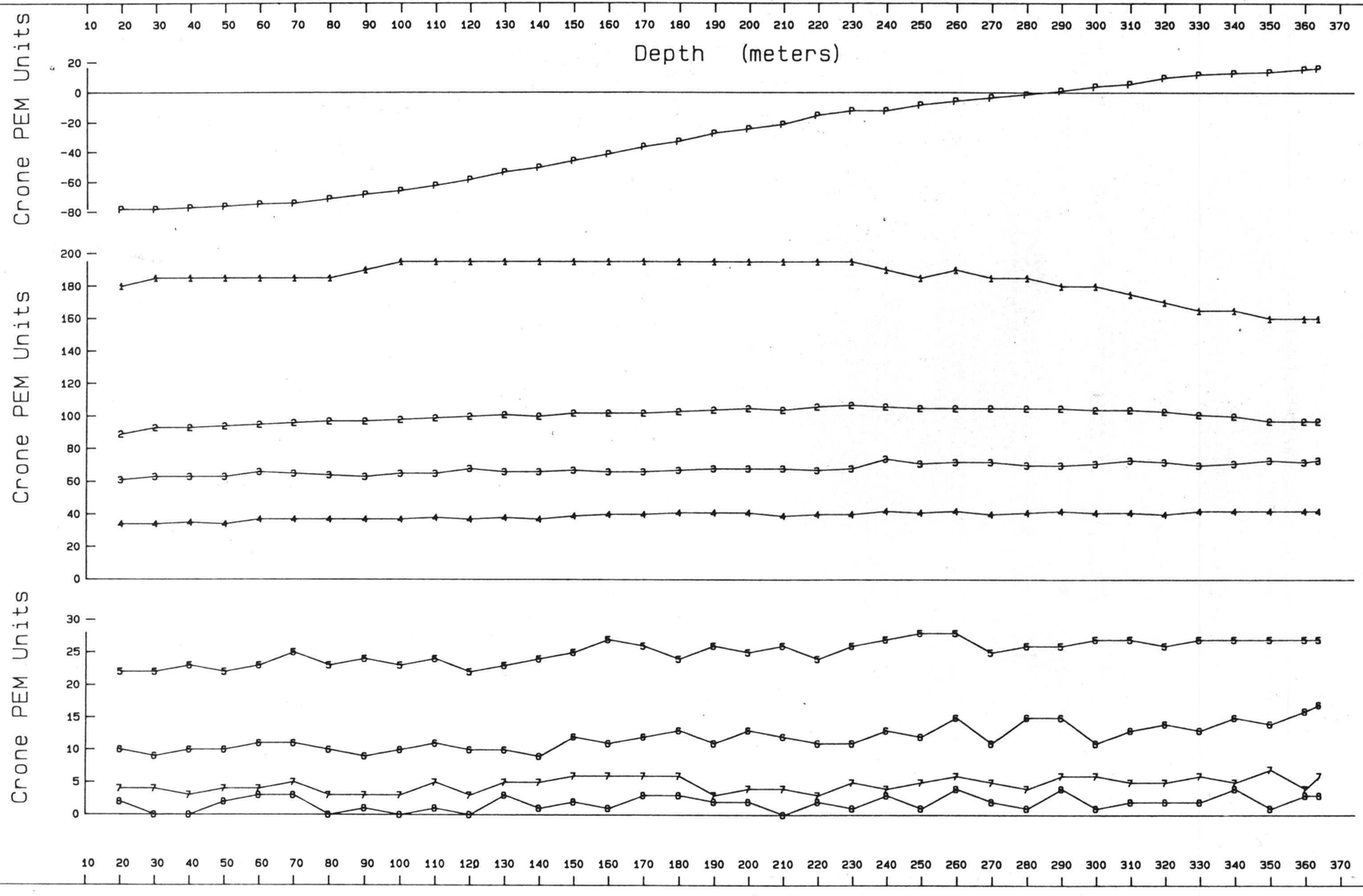

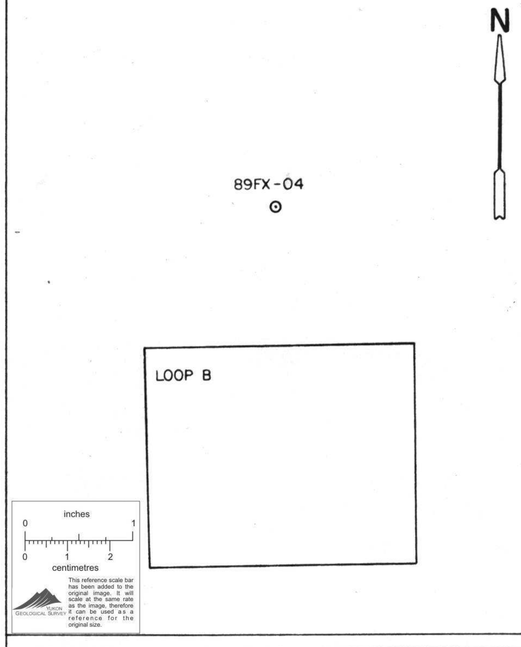

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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-04 LOOP B

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 10 .

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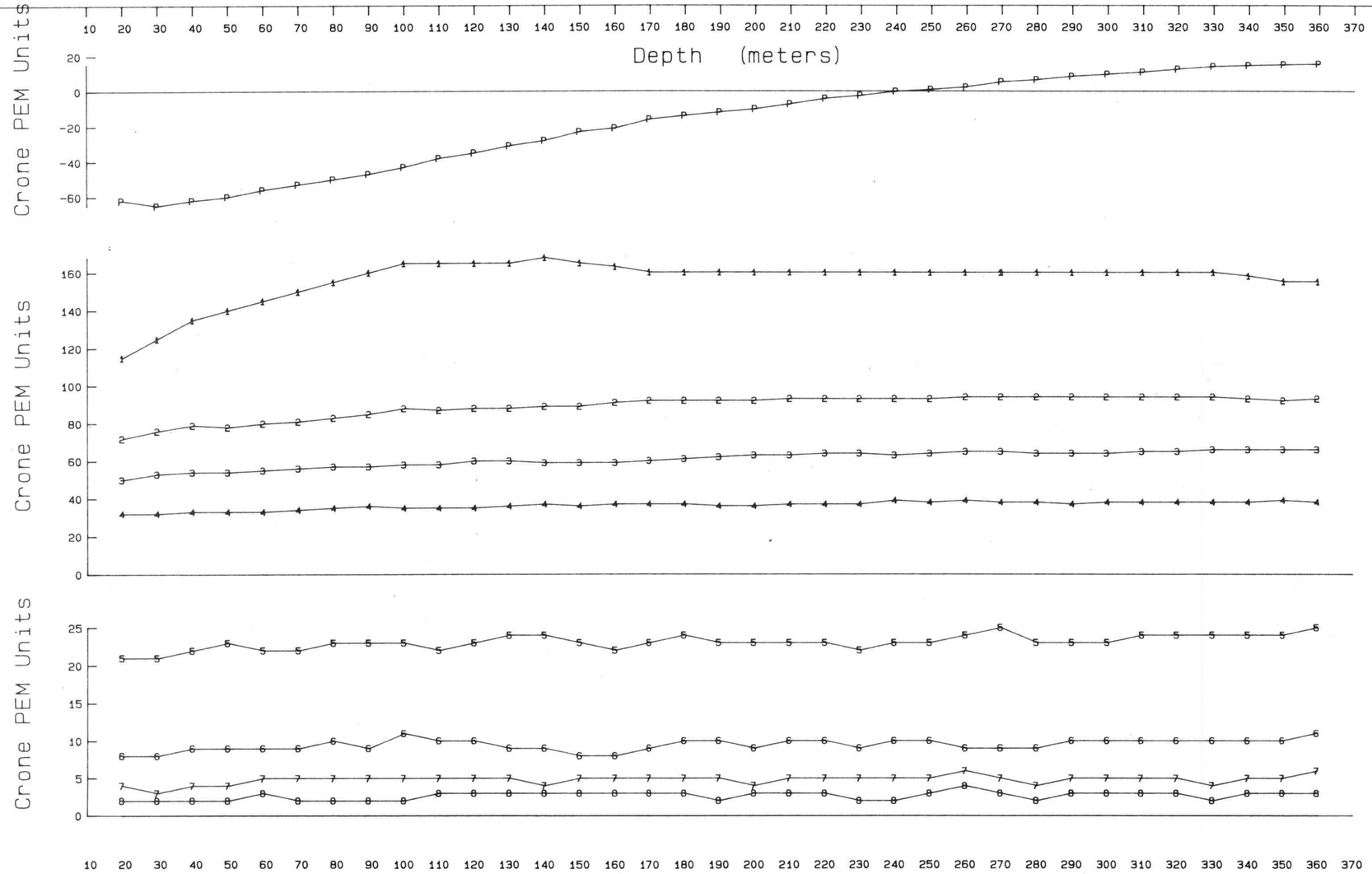

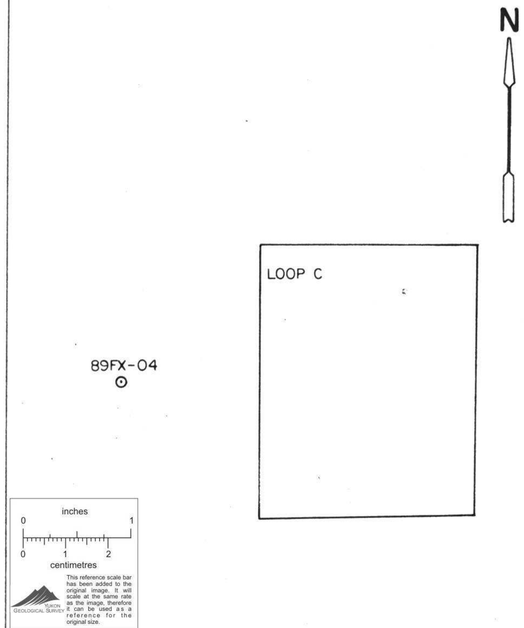

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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-04 LOOP C

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 11 .

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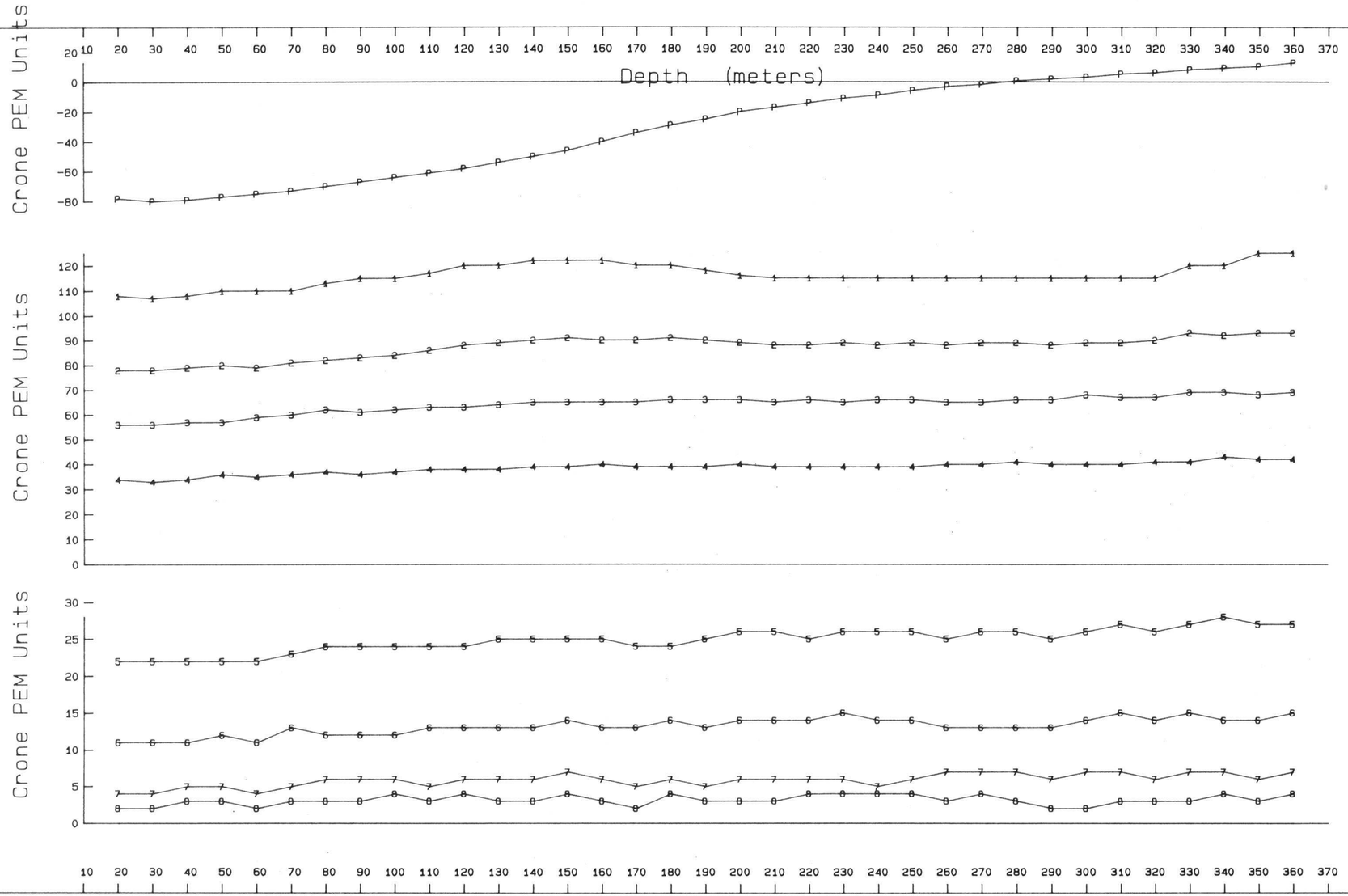

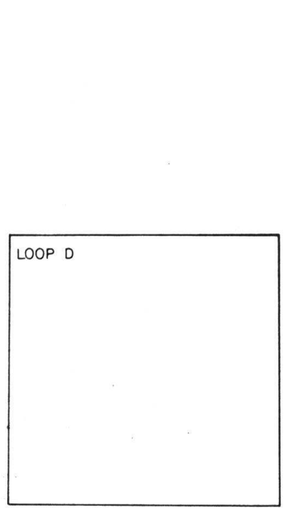

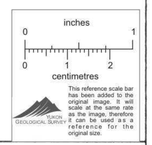

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BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-04 LOOP D

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 12

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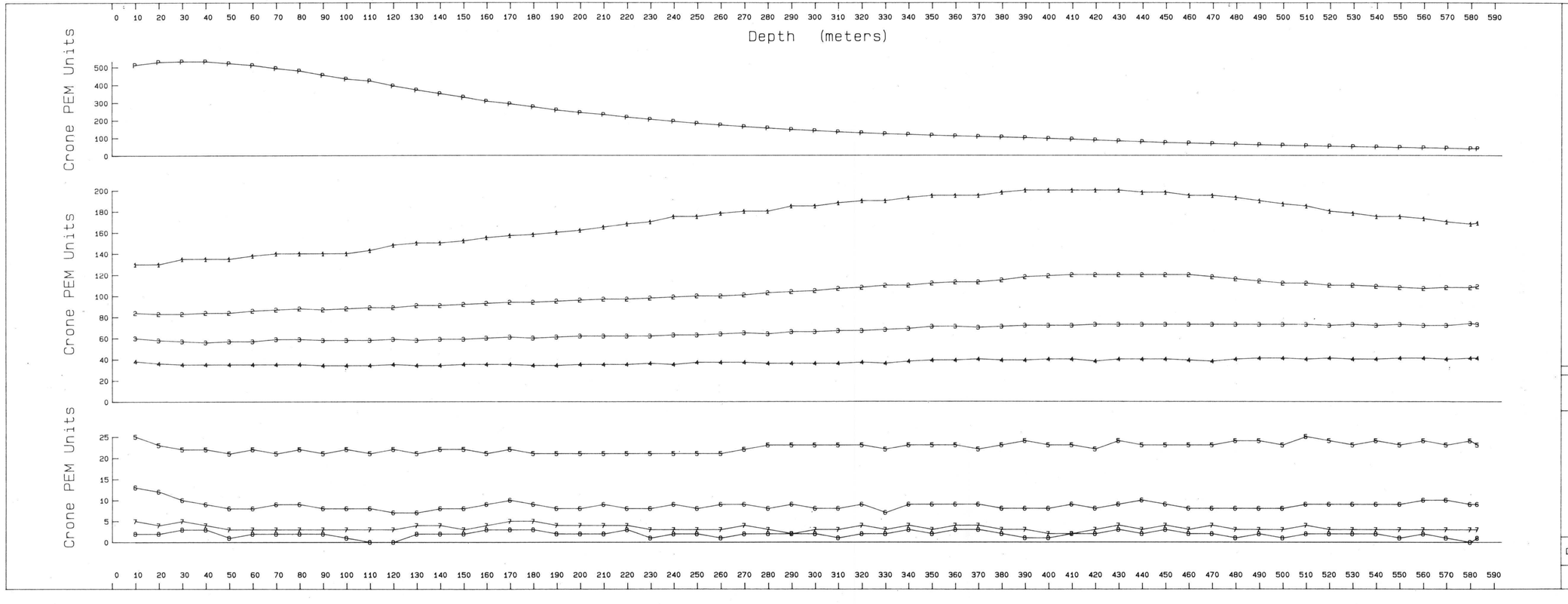
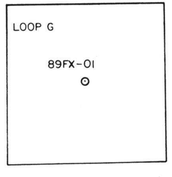
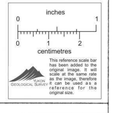






CURRAGH RESOURCES INC.

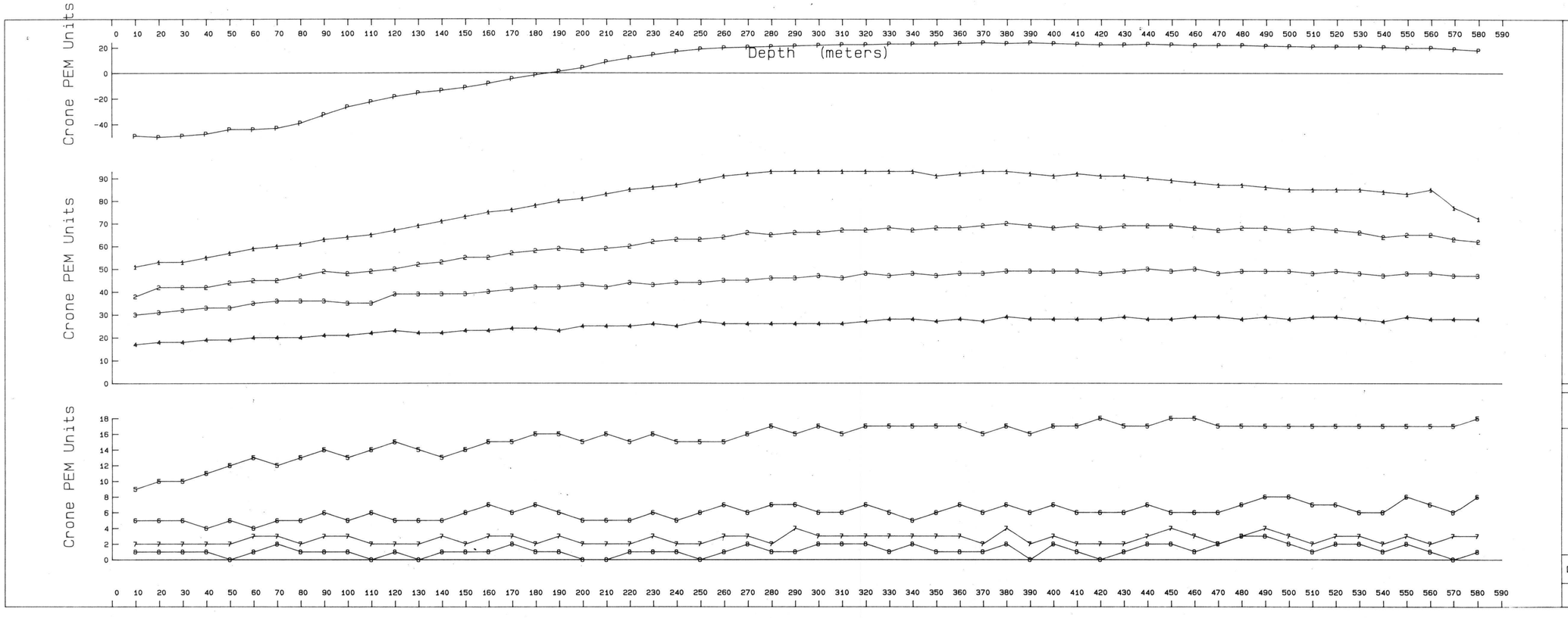
BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-01 LOOP G

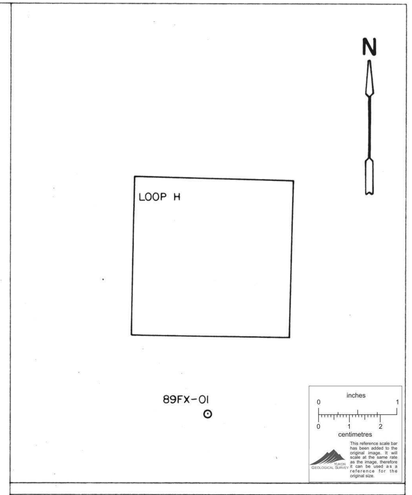
Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 13 .

WHITE GEOPHYSICAL INC.





CURRAGH RESOURCES INC.

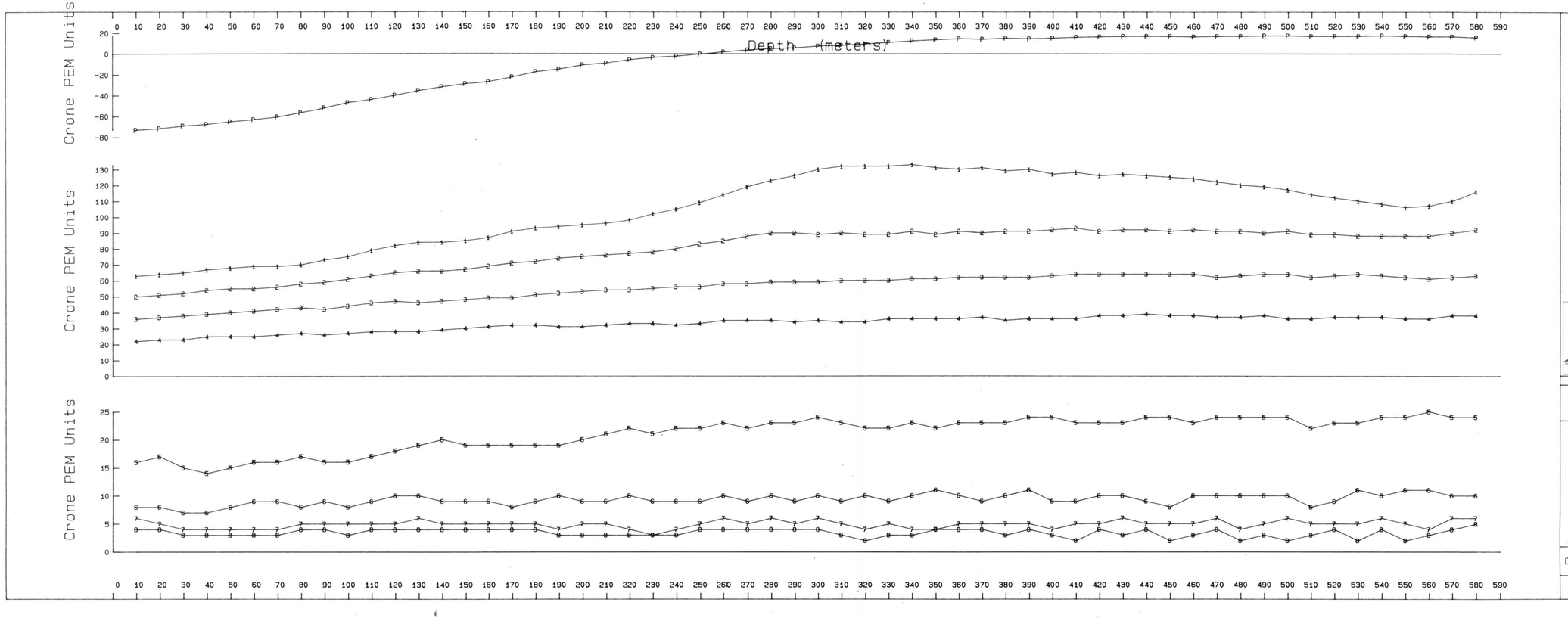
BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-01 LOOP H

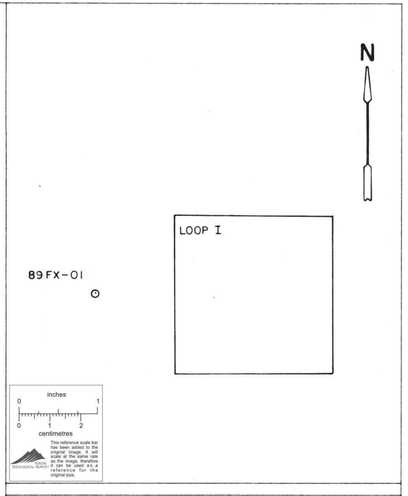
Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 14

WHITE GEOPHYSICAL INC.





CURRAGH RESOURCES INC.

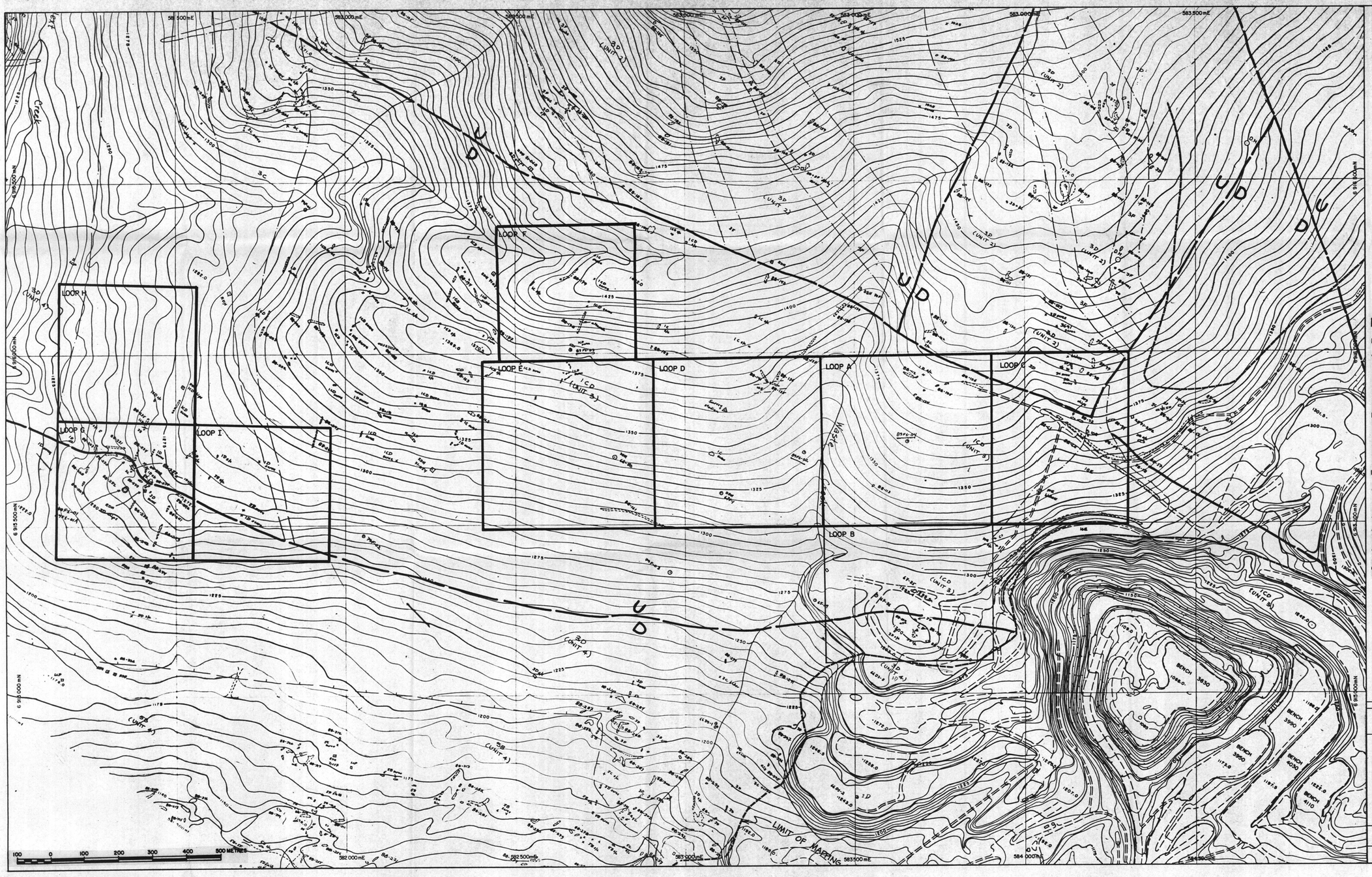
BOREHOLE PEM SURVEY
FARO NW PROJECT
BOREHOLE 89FX-01 LOOP I

Scale 1: 1000.0

0 20 40 60 80 100 M

Date: Sept 1989	Survey: Sept 1989	Figure: 15 .

WHITE GEOPHYSICAL INC.



LEGEND :

ROCK TYPES

VANGORDA FORMATION

3D (UNIT 4)	BIOTITE CALC-SILICATE
3F	MARBLE
5B	CALCAREOUS BIOTITE PHYLLITE
$5C_A$	AMPHIBOLITE (METABASITE)
$5C_P$	PYROXENITE

MT. MYE FORMATION

ICD	NONCALCAREOUS BIOTITE SCHIST
3C	AMPHIBOLITE (METABASITE)
3D (UNIT 2)	BIOTITE CALC-SILICATE
3F	MARBLE
3G	NONCALCAREOUS PHYLLITE

INTRUSIONS

$IOAB_M$	MEGACRYSTIC GRANITE (ANVIL BATHOLITH)
IOE	HORNBLENDE-BIOTITE PORPHYRY
	LITHOLOGIC CONTACT
U D	FAULT
CALC-SILICATE / CALCAREOUS PHYLLITE	METAMORPHIC "ISOGRAD"

inches 0 1 2
0 1 2 3 4 5 centimetres

YUKON GEOLOGICAL SURVEY

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

CURRAGH RESOURCES INC.

BOREHOLE PULSE EM SURVEY

FARO NW PROJECT

LOOP LOCATION MAP

DATE: SEPT. /89		FIG. 2

WHITE GEOPHYSICAL INC.