MR-2

COMINCO LTD.

EXPLORATION
N.T.S. 82G/12
82F/9

SULLIVAN MINE

MYRTLE MTN HLEM AND MAGNETOMETER SURVEY

Latitude $49^{\circ}40'$N; Longitude $116^{\circ}00'$W

Work Performed: September 10, 11, 13, 14, 20, 21, and 22, 1979

Claims Covered: MOHAWK GROUP

Claim Owner and Operator: COMINCO Ltd.

MINERAL RESOURCES BRANCH
ASSESSMENT REPORT
NO. 8511

February 1980

Jules J. Lajoie

TABLE OF CONTENTS

COMINCO LTD.

EXPLORATION

SULLIVAN MINE

February, 1980

MYRTLE MTN HLEM AND

MAGNETOMETER SURVEY

LIST OF CLAIMS - MOHAWK GROUP

Claim Names	Record No.	Recorded	Work to	Apply	New Work to
Mohawk	*CGMC, Lot 13825				
Jumbo	CGMC, Lot 13824				
Bisbee	CGMC, Lot 13819				
Kitty	CGMC, Lot 13817				
Spring	CGMC, Lot 13826				
Jerry	CGMC, Lot 13818				
Annex FR	CGMC, Lot 13949				
Annie Fr	CGMC, Lot 14282				
Late 89	16934	April 22/71	1987	$ 600	1990
Late 77	16926	April 22/71	1987	$ 600	1990
Late 78	16927	April 22/71	1987	$ 600	1990
Late 76A	16925	April 22/71	1986	$ 800	1990
Late 85	16931	April 22/71	1987	$ 600	1990
Late 86	16932	April 22/71	1987	$ 600	1990
Late 87	16933.	April 22/71	1987	$ 600	1990
Late 3 FR	16939	April 22/71	1988	$ 400	1990
Jack Pot FR	17844	Dec. 29/71	1985	$1000	1990
Late 2 FR	16938	April 22/71	1987	200	1988
Late. 90	16935	April 22/71	1987	$ 200	1988
Late 80,	16929	April 22/71	1987	$ 200	1988
Late 63	16911	April 22/71	1987	$ 400	1989
Late 79	16928	April 22/71	1987	$ 400	1989
Late 61	16909	April 22/71	1987	$ 400	1989
Late 59	16907	April 22/71	1987	$ 400	1989
		TOTAL APPLIED		$8000	

*CGMC = Crown Grant Mineral Claim

/..2

PERSONNEL EMPLOYED

Personnel employed by Cominco Ltd. during the course of the survey were:

Name	DATES	Address
Dr. Jules J. Lajoie Geophysicist	Sept. 10, 11, 13, 14, 20, 21, and 22, 1979.	Cominco Ltd. 8th Floor 409 Granville St. Vancouver, B.C. V6C 1T2
Kevin Fennessey Assistant	Sept. 10, 11, 13, '14, 20, and 21, 1979.	Kootenay Exploration 2450 Cranbrook St. Cranbrook, B.C. V1L 3T4

INTRODUCTION

This report describes a HLEM survey in an area southeast of North Star . Hill and west of Kimberley. The area is outlined in Plate 164-79-1 which also shows two access roads. Note'that the mine grid coordinates are different from the geophysics grid coordinates.

The area was covered in the mid 1970's by airborne EM with both Aerodat and McPhar systems. The results suggested an airborne FM conductor at about mine grid 7000S and 5200E, at the center of the survey area described herein.

The survey area was also previously covered by ground EM: Turam on lines 2400' apart and EM-17 HLEM on lines 800' apart. The HLEM data was acquired with a.coil spacing of 400' and frequency of 1600 Hz, is shown in Plate 164-79-5, and will be further discussed later. The HLEM data indicated conductive zones, some of which were not substantiated by the Turam data and vice versa. It would have been premature to recommend drilling on the existing data and so it was decided to resurvey the area on a 400' line spacing with more modern HLEM equipment.

SURVEY LAYOUT AND GRID

A new survey grid was cut and superimposed on the old grid which had a line spacing of 800'. That is, the old lines were used when they could be found. Slope chaining was used to install the 'pickets.

This procedure simplifies the logistics of the HLEM surveying. Twelve lines were prepared at a spacing of 400' from 200S to 7400S extending from 600W to 2600E (geophysics grid coordinates, see Plate 164-79-l). Chainage and inclinometer data between the pickets were supplied by the linecutter. A T159 calculator was programmed to facilitate the computation of coil separation corrections and tilt angles so that, in the field, the coils would be exactly at the nominal coil separation and coplanar.

FIELD WORK

A max-Min II horizontal loop EM system was used with a coil separation (C.S.) of 150 metres. All five frequencies were used: 222Hz, 444Hz, 888Hz, 1777Hz, and 3555Hz. The basic station interval was 50 metres with some sections at 25 metres over anomalies.

Subsequently detail EM with a coil separation of 50m and station interval of 12.5m was done on four lines with anomalies of special interest: 2600S, 4355S, 4800S, and 5200S. For the detail survey the 12.5 meter stations had to be paced in. Coil separation and tilt angles had to be estimated as best as possible in the field.

Magnetometer surveying was also done on the above detail lines with a Geometries "Unimag" 10γ accuracy magnetometer. Drift was checked in the normal manner but no drift corrections were required.

The EM field work was performed by Dr. J. Lajoie with the assistance of K. Fennessey on the following dates: September 10, 11, 13, 14, 20, and 21, of 1979. The magnetometer work was performed by Dr. J. Lajoie on September 22, 1979.

DATA PRESENTATION

Plate 164-79-1 (in text)	Location map Scale 1"=800'
Plate 164-79-1a (in envelope).	Claim Map Scale 1"=2000'
Plate 164-79-2 (in envelope)	Myrtle Mtn HLEM (c.s. = 150m) Frequencies: 222, 444, 888,: 1777, & 3555 Hz Horizontal Scale: 1"= 400' Vertical Scale: : 1"= 40%
Plate 164-79-3 (inenvelope)	Myrtle Mtn detail HLEM (c.s. = 50m) Frequencies: 222, 444, 888, 1777, & 3555 Hz Horizontal Scale: 1" = 400' Vertical Scale: : 1" = 20%
Plate 164-79-4 (in envelope)	Myrtle Mtn detail HLEM (c.s. = 50m) 222 In-phase subtracted' Frequencies: 444, 888, 1777 & 3555 Hz' Horizontal Scale: 1" = 400' Vertical Scale : 1" = 20%

DATA PRESENTATION (continued)

Plate 164-79-5 (in envelope)	Myrtle Mtn HLEM (old data) (c.s. = 400') Frequency: 1600 Hz Horizontal Scale: 1" = 400' Vertical Scale : 1" = 40%
Plate 164-79-6 (in envelope)	Myrtle Mtn proton magnetometer data Horizontal Scale: 1" = 400' Vertical Scale : 1" = 200 gammas
Plate 164-79-7	Myrtle Mtn HLEM interpretation compilation Base: 888 Hz HLEM (c.s. = 150m) data Horizontal Scale: 1" = 400' Vertical Scale : 1" = 40%

NOTE: Slope chaining was us& in the field. For plotting, however, all station locations were corrected so that they.are plotted at the proper horizontal distance from the baseline. The coordinates (600W to 2100E) shown in the Plates are therefore true Imperial horizontal coordinates. Therefore, note that the horizontal coordinate of a conductor in the Plate will not correspond exactly with the picket coordinate in the field. Therefore; in the interpretation compilation in Plate 164-79-7, the field picket location of each conductor is identified (e.g. P418E).

INTERPRETATION

The five frequencies of HLEM (c.s. = 150m) data are shown in Plate 164-79-2. The data is judged to beef excellent quality with a noise level of about ±1% overall, lending support to the scheme for computing and applying coil corrections and tilt corrections. There are, however, two locations with rough topography where the in-phase data are somewhat suspicious because there appears to be little change with varying frequency:

a) In-phase anomaly at 950E *on* line 4000S

b) In-phase anomaly at 2350E on line 6000S

Interpretation of σt and depth was not done on either of these,

For the detail data shown in Plate 164-79-3, the coil separation and tilt correction procedure applied for the 150m data could not be applied because the picket interval was not tight enough. In the field, it was attempted as best as possible to achieve constant coil separation and coplanarity. Due to very rough topography, there is considerable in-phase noise on lines 4400S and 4800S.

In order to see through this noise, the data at frequencies 444 to 3555 Hz were replotted after subtracting the in-phase 222 Hz data, thus removing most of the topographic noise from the in-phase but also removing an unknown percentage of the in-phase anomaly. This data is shown in Plate 164-79-4. Fortunately, on both lines 4355S and 4800S the increase in the in-phase component from 222 Hz to 444 Hz is so small that the in-phase anomaly amplitude at 222 Hz is estimated to be near zero. Therefore, for the detail HLEM data, Plate 164-79-4 was used for interpreting the data on lines 4355S and 48005, while Plate 164-79-3 was used for interpreting the detail data on.lines 3600S and 5200S.

The interpretationis compiled on Plate 164-79-7 using the 888 Hz, c.s. = 150m data as a base. The conductive zones are shown by solid and dashed bars using both the 150m and 50m coil separation data. The' solid bars indicate conductor widthbased on the 888 Hz in-phase data, while dashed bars indicate conductor width based on the 888 Hz out-of-phase data. This helps to give some idea of the over-all conductor width and where, within it, the highest conductivity zone is located. One notes that the 50m c.s. anomalies are always on the western edge or somewhat to the west of the 150m c.s. anomalies. This suggests an easterly dip to the conductors. On the.other hand, a shallow easterly dip is notsupported by the anomaly shape because no anomaly shows a strong positive shoulder on the.east side.

The anomaly amplitudes at all frequencies for both reconnaissance and detail data were plottedon phasor diagrams. All show strong evidence of current channelling characterized by much stronger quadrature response with increasing frequency than ispredicted by free air modelling. This may well be caused by poorly conducting sulphides around the main conductors. A few examples of anomaly spectral- responses are shown in Figures 2a to 2e. All were studied to see if spectral signatures could be used to differentiate between the conductive zones. However, nothing concrete resulted. The σt and depth interpretations were based on the 222 Hz (or extrapolated 222 Hz data and are shown for both 150m c.s. data in Plate 164-79-7.

The conductive zones are labelled A to E. Conductor A has consistently high conductivities and strikes NW-SE across the survey area. On lines. 4355S and especially on line 4800S it widens considerably. Note that this may only'be an apparent thickening because of the steep slopes near here. On line 4800S the difference between the steep and long c.s. data indicates that the conductor increases in both width and conductivity with depth. The highest interpreted σt of the survey occurs on line 5200S where a σt of 180 mhos was obtained with, the short coil separation. 'When current channelling is occurring one expects a higher σt interpretation with a shorter coil separation if the conductor does not vary much with depth.

Conductors B and C are nearly parallel in strike direction which is more northerly than that for conductor A. Generally; their σt's are lower to the north and increase to 'the south. Conductor B-appears to merge with conductor A where the latter comes much thicker. Conductor B coincides' directly with a mapped contact between sedimentary rocks and a meta-gabbro sill on lines 3200S and 2600S. North of line 3200S conductor B strikes north whearas the contact appears to strike NW according to' outcrop on line 2200S. The increase in conductivity and decrease *in* depth to top with the shorter coil separation on line 3600S, for both conductors B and C, is as expected.

Conductor D has a rather high conductivity of 40 mhos. It also correlates very closely with the mapped contact between sediments and sill on line 6000S.

Conductor E appears isolated and there is no geological data available in its vicinity due to widespread overburden.

The magnetic data is shown in Plate 164-79-6 for the lines on which detail EM work was done. There is a direct coincidence of magnetic anomalies with conductor A on line 5200S and the two conductive zones (HLEM c.s. = 50m, Plate 164-79-4) on, line 4800S. On line 4355S, there is considerable magnetic activity directly over the conductive zone. On line 3600S the correlation of magnetics and EM is uncertain.

The old HLEM data *was* replotted by computer on Plate 164-79-5 in order to provide a direct comparison with the newer data. The only evidence that the coil separation used was 400' comes from outlines marked on old maps in the geology office in Kimberley. This data should be comparable with the 150m (492') 1777 Hz data of the new survey. The noise level of the old survey is much higher. The conductors as interpreted from the new data are shown superimposed. There is no clear and confident indication of the conductive zones in the old. data, as can be seen in. the new 'data; This is understandable however, when considering the equipment and procedures used at that time and that it was impractical to do better.

CONCLUSIONS

The horizontal loop EM and magnetometer work on the Myrtle Mtn grid outlined a number of interesting conductors. The direct correlation of conductors B and D with contacts betweensedimentary and meta gabbro rocks suggests a genetic relationship between the conductors and the intrusive. The anomaly shapes indicate steeply dipping vein-type conductors. Weak magnetic responsesover the best conductors indicate pyrrhotite as a possible, cause of the anomalies as it is known that the pyrrhotite in the Sullivan orebody is only weakly'magnetic.

Submitted by: Jules J. Lajoie

Jules J. Lajoie, Ph. D., P. Eng.
Geophysicist, Vancouver.

Approved for Release by-: John Hamilton

John M. Hamilton, P. Eng.
Chief Geologist, Kimberley.

n

Distribution:

Mining Recorder, Cranbrook (2)
Sullivan Mine (2)
Western District Expl. (1)
Expl. Admin. (1)
Tech. Support (1)

HLEM

PHASOR DIAGRAM

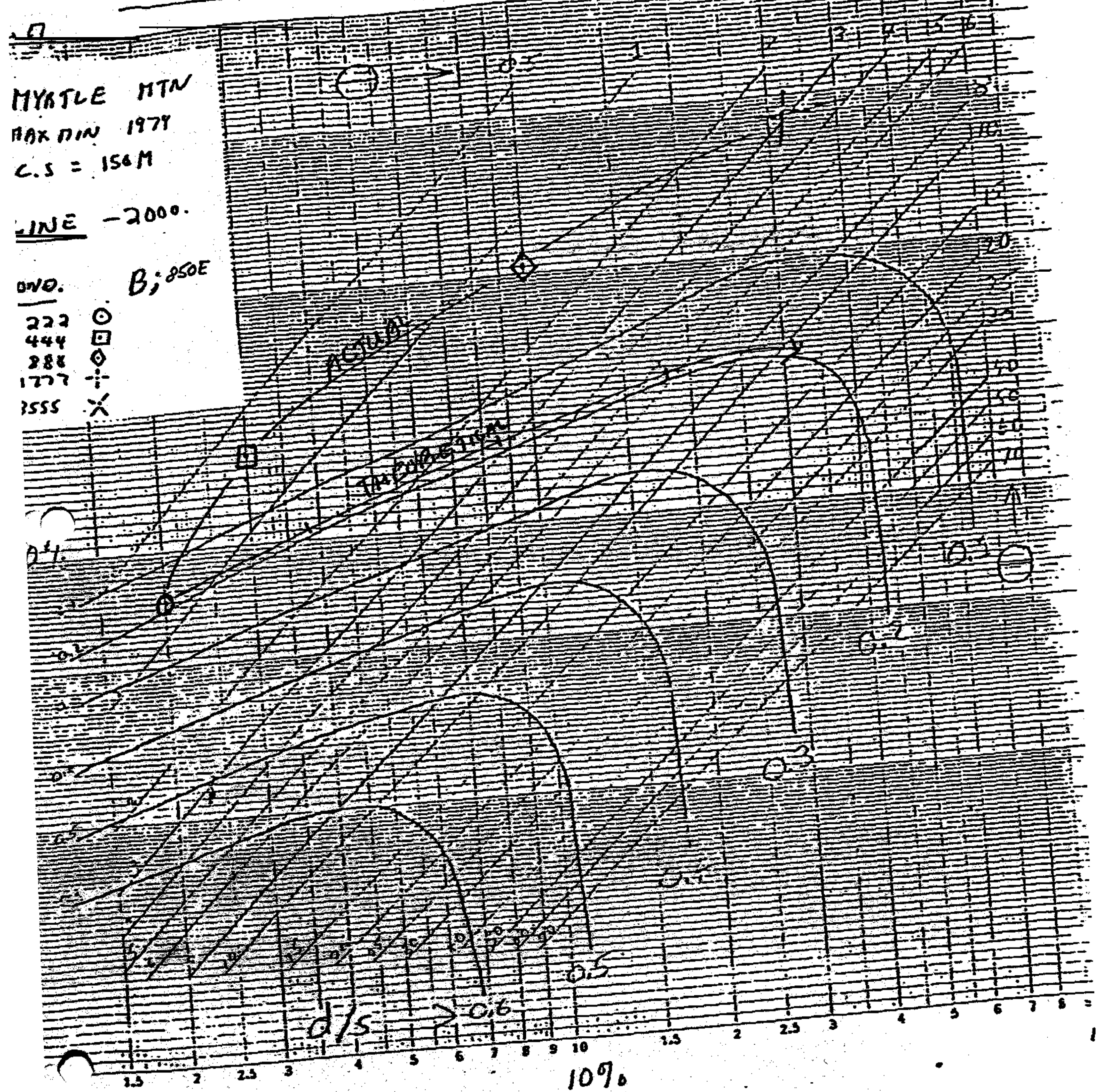
(AVERAGE PEAK TO PEAK AMPLITUDES)

VERTICAL THIN SHEET

$\theta = \mu_0 \cdot \omega \cdot S \cdot \sigma t$

S = COIL SEPARATION

d = depth to top



IN PHASE

DRAWN BY JJL

SOURCE: Jack Betz

Fig. 1a: Phasor diagram for conductor B, line 2000S, 850E.

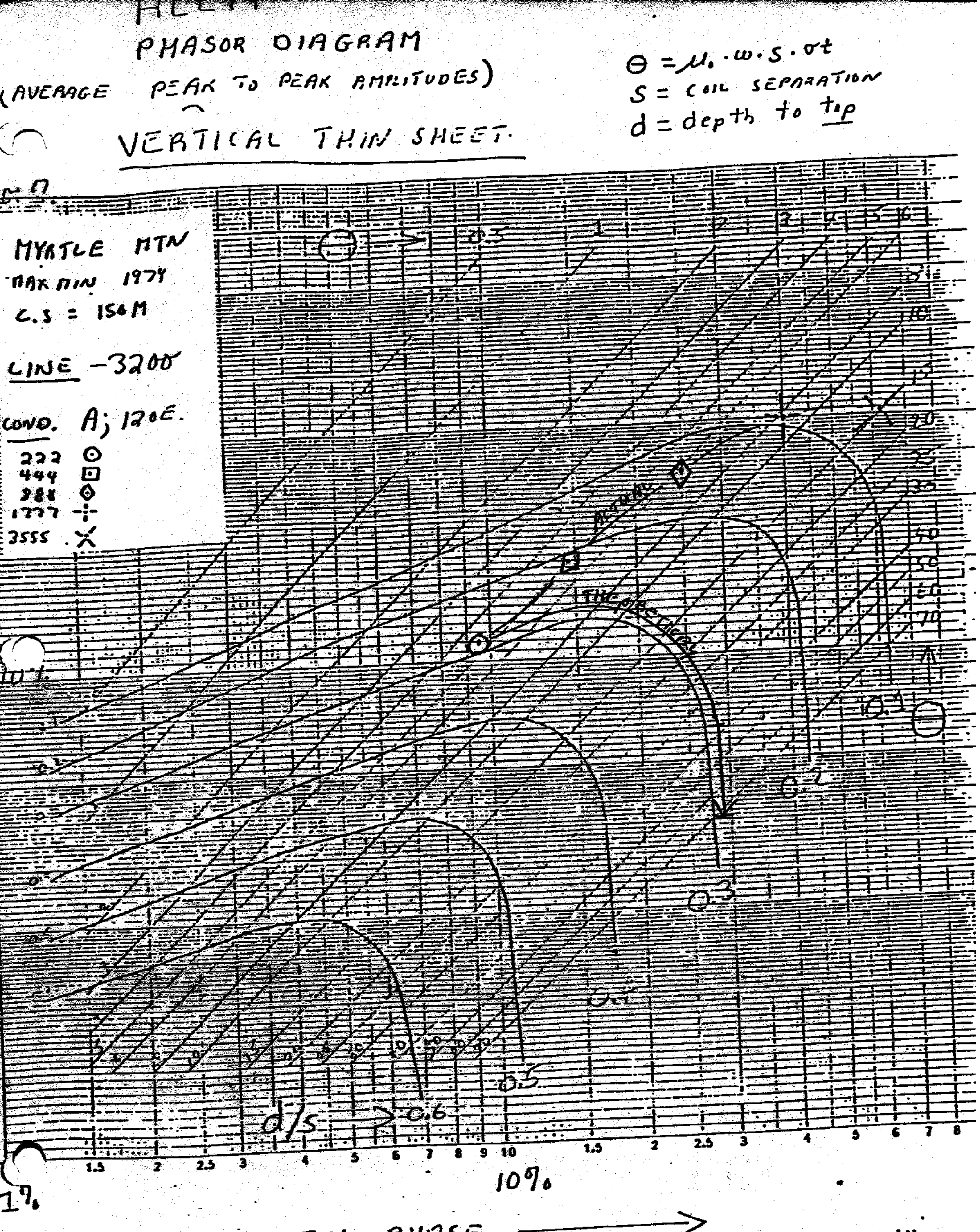


Fig. 1b: Phasor diagram for conductor A, line 3200S, 120E.

DRAWN BY JJL
SOURCE: Jack Betz

PHASOR DIAGRAM

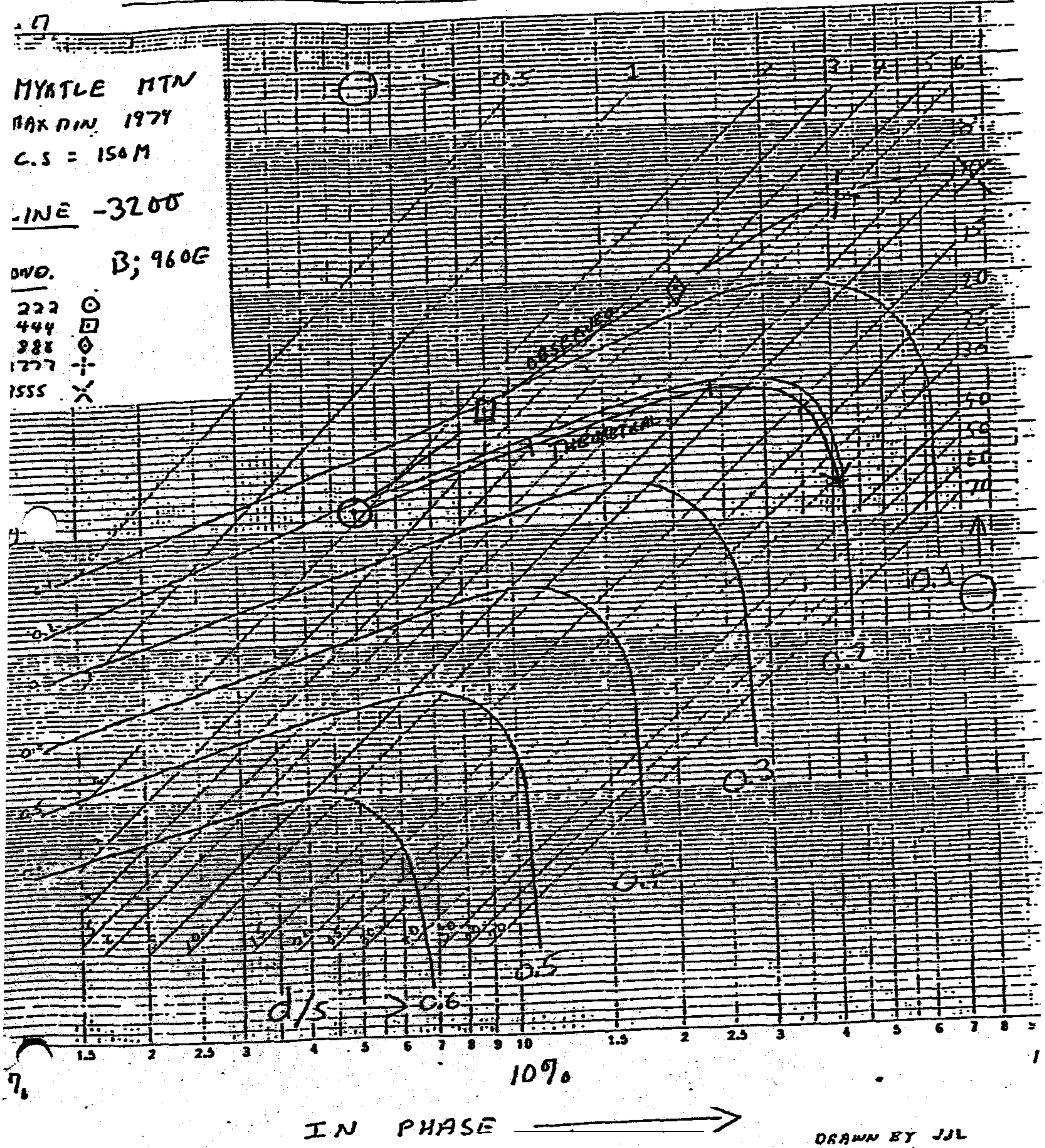
AVERAGE PEAK TO PEAK AMPLITUDES)

VERTICAL THIN SHEET

$\Theta = \mu_0 \cdot \omega \cdot S \cdot \sigma t$

S = COIL SEPARATION

d = depth to top



DRAWN BY JJL

SOURCE: Jock Betz

g. 1c: Phasor diagram for conductor B, line 3200S, 960E.

PHASOR DIAGRAM

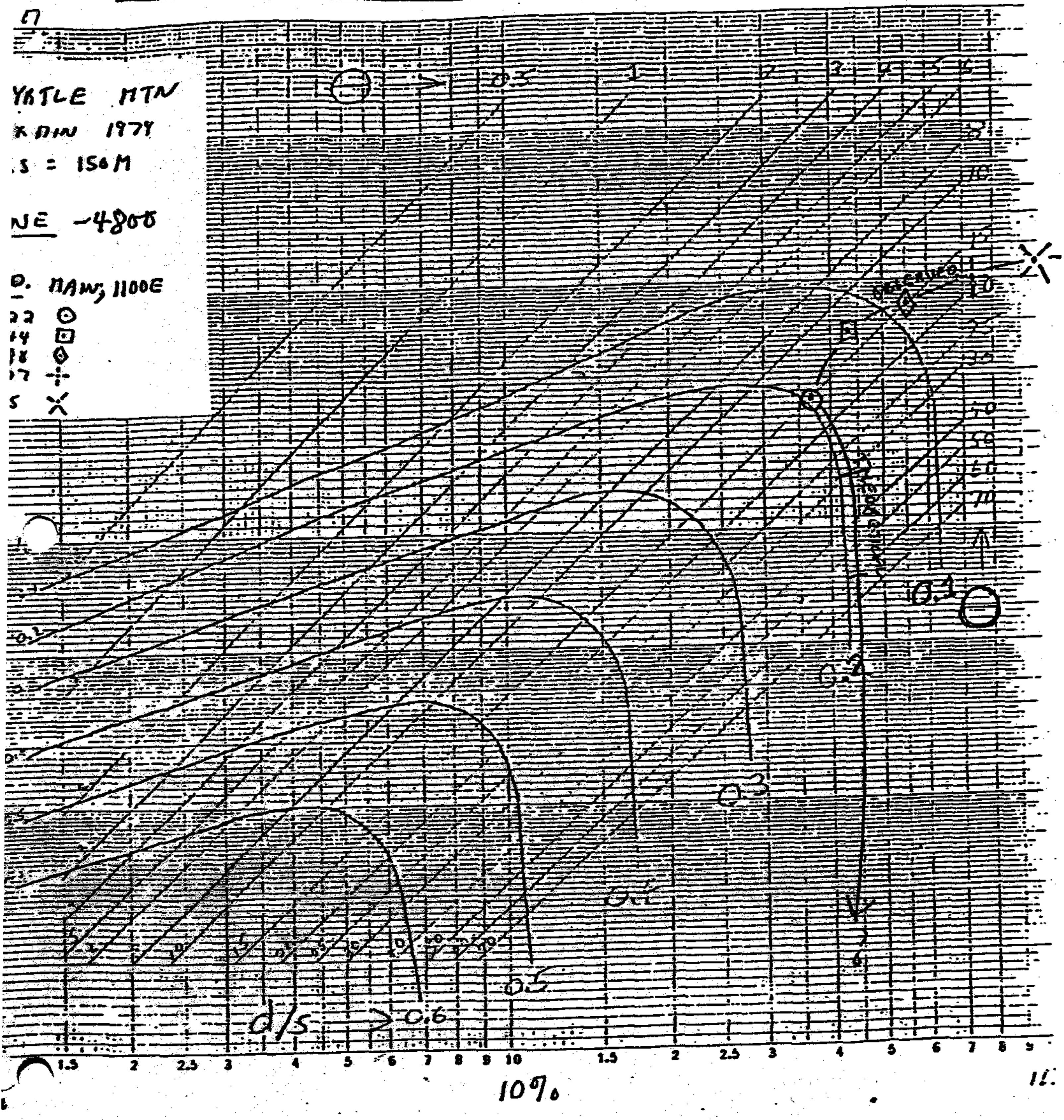
(AVERAGE PEAK TO PEAK AMPLITUDES)

VERTICAL THIN SHEET

$\Theta = \mu_0 \cdot \omega \cdot S \cdot \sigma t$

S = COIL SEPARATION

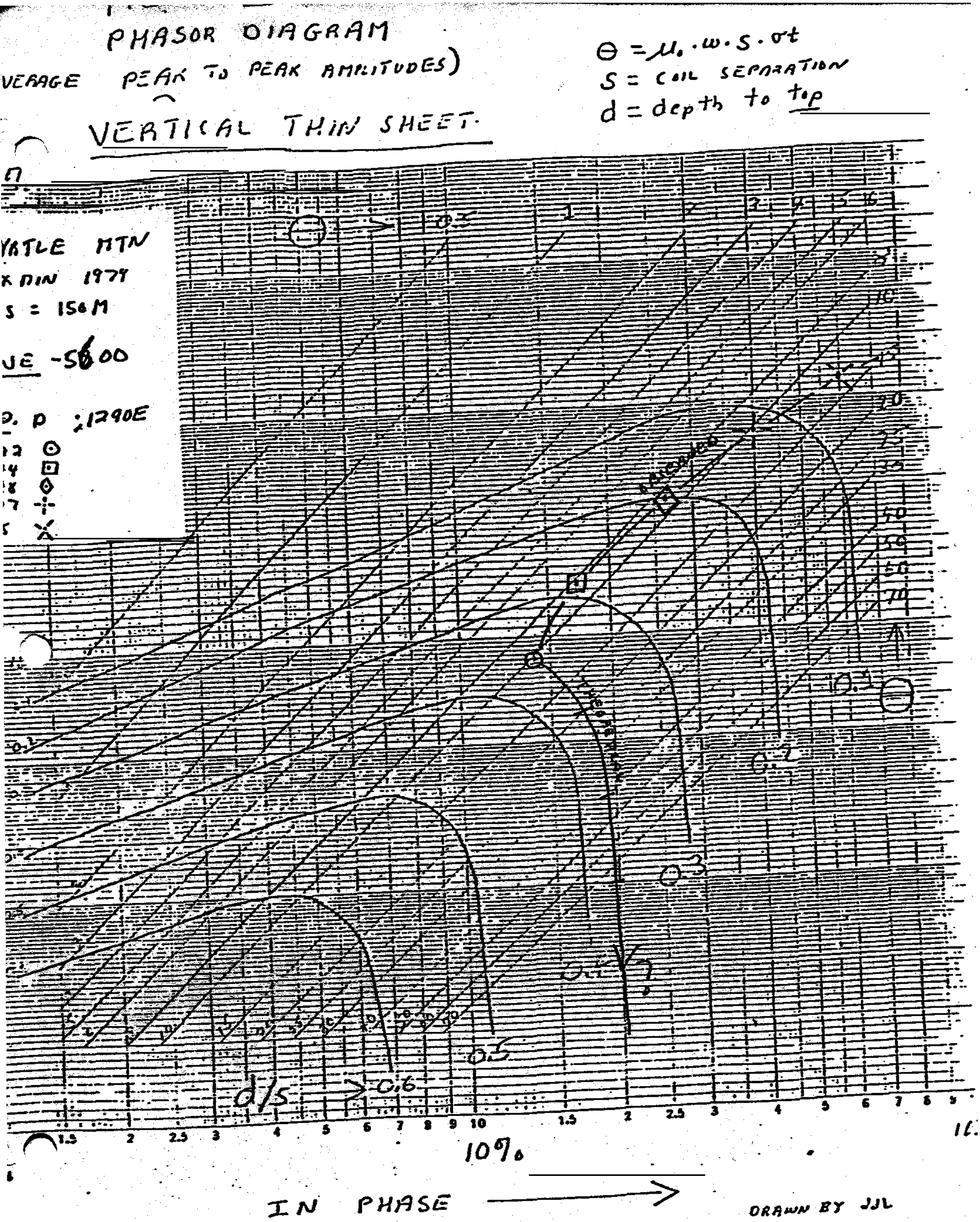
d = depth to top



DRAWN BY JJL

SOURCE: Jack Betz

Fig. 1d: Phasor diagram for conductor A, line 4800S, 1100E.



g. 1e: Phasor diagram for conductor D,
line 5600S, 1290E.

DRAWN BY JJL
SOURCE: Jack Betz

JULY 79

IN THE MATTER OF THE B.C. MINERAL ACT

AND IN THE MATTER OF A GEOPEYSICAL PROGRAMME

CARRIED'OUT ON MOHAWK CLAIM GROUP

LOCATED DIRECTLY WEST OF KIMBERLEY, B.C.

IN THE FORT STEELE MINING DIVISION OF THE

PROVINCE OF BRITISH COLUMBIA MORE PARTICULARLY

N.T.S. F/9, N.T.S. 82 G/12

S T A T E M E N T

I, Jules J. Lajoie of the City of West Vancouver in the Province of British Columbia, make oath and say:

1. That I am employed as a geophysicist by Cominco Ltd. and as such have a personal knowledge of the facts to which I hereinafter dispose;

2. That annexed hereto and marked as "Exhibit A", to this statement is a true copy of expenditures incurred on geophysical survey on the MOHAWK mineral claim group;

3. That the said expenditures were incurred on September 10, 11, 13, 14, 20, 21, and 22, 1979, for the purpose of mineral exploration of the above noted claims.

Jules J. Lajoie

Jules J. Lajoie, Ph.D., P. Eng.
Geophysicist, Cominco Ltd.

EXHIBIT 'A'

MOHAWK GROUP

STATEMENT OF EXPENDITURES

(Linecutting, Em and Magnetometer Survey)

Salaries

a) September 10, 11, 13, 14, 20, and 21, 1979:

Dr. J. J. Lajoie (geophysicist)	6 days @ $150/day	$ 900
K. Fennessey (assistant)	6 days @ $ 42/day	252

b) September 22, 1979:

Dr. J. J. Lajoie (geophysicist	1 day @ $150/day	150

c) Report preparation:

J. Snyder (draftsperson)	2 days @ $ 85/day	170

Miscellaneous

Room and Board: 1 man x $50/day x 7 days	350
Truck (4x4): 7 days x $25/day	175
Fuel and Oil: 7 days x $5/day	35
Operating Day Charge: 7 days x $175/day	1225
Geophysical Equipment Rental (Incl. travel)	
(EM) 11 days x $35/day	385
(Mag) 1 day x $10/day	10

Linecutting

Contractor: P. Xlewchuck, 3 - 436 Chapman Street
Kimberley, B.C.

8.78 miles @ 300/mile	2635
TOTAL	$6287

Jules J. Lajoie, Ph. D., P. Eng.
Geophysicist, Cominco Ltd.

CERTIFICATION'

I; Jules J. Lajoie, of 5655 Keith goad, in the City of West Vancouver, in the Province of British Columbia, do hereby certify that:-

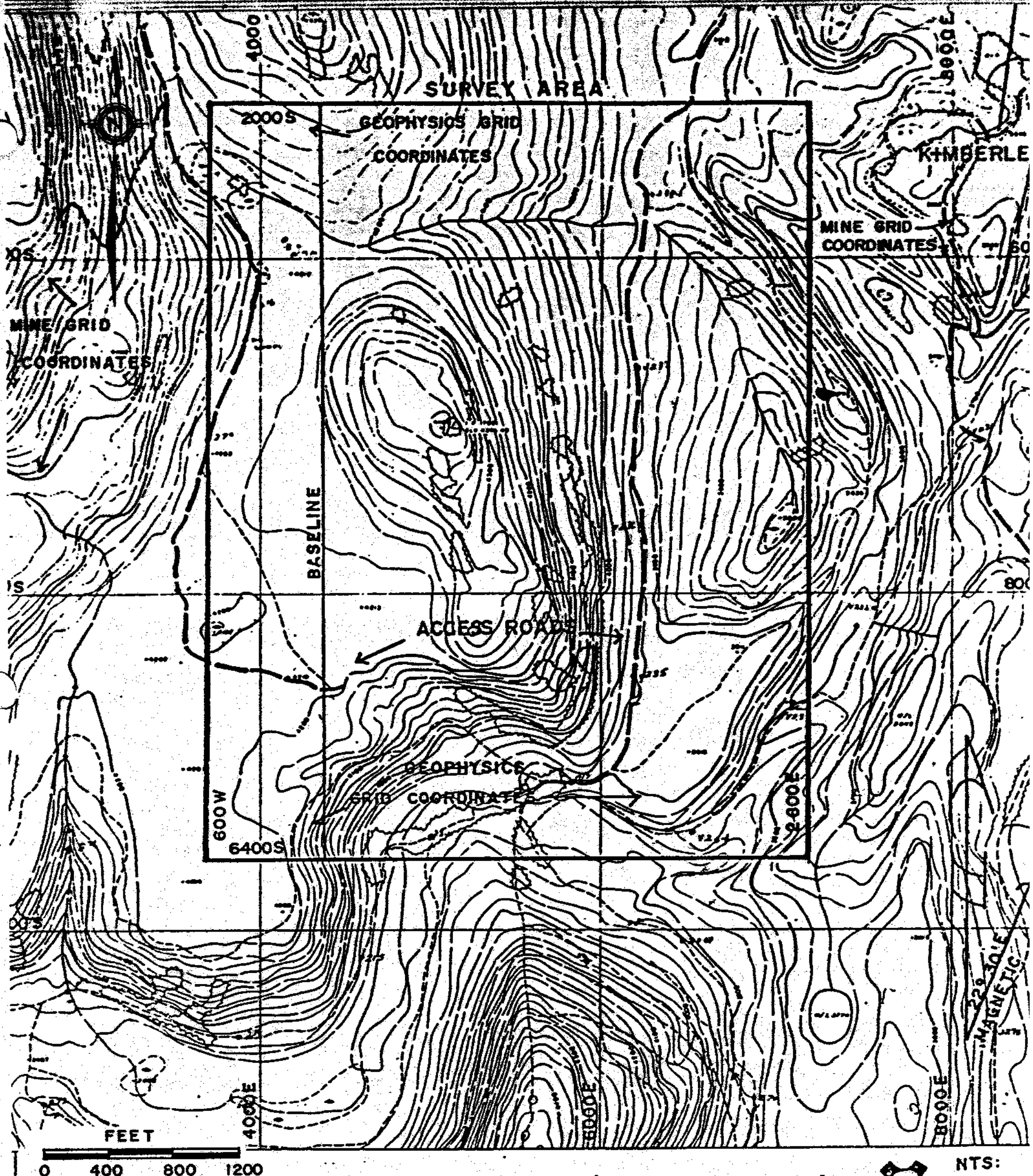
1. I graduated from the University of Ottawa in 1968 with an Honours B.Sc. in Physics, from the University of British Columbia in 1970 with a M.Sc. in Geophysics, and from the University of Toronto in 1973 with a Ph.D. in Geophysics.

2. I am a registered member of the Association of Professional Engineers of the Province of British Columbia, the Society of Exploration Geophysicists, and the British Columbia Geophysical Society.

3. I have been practicing my profession for the past seven years.

Jules Lajoie

Jules J. Lajoie, Ph.D., P. Eng.
Geophysicist



MYRTLE MTN. (SULLIVAN MINE)

Cominco

NTS:
82-G-12
82-F-9

Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

HORIZONTAL LOOP EM GRID

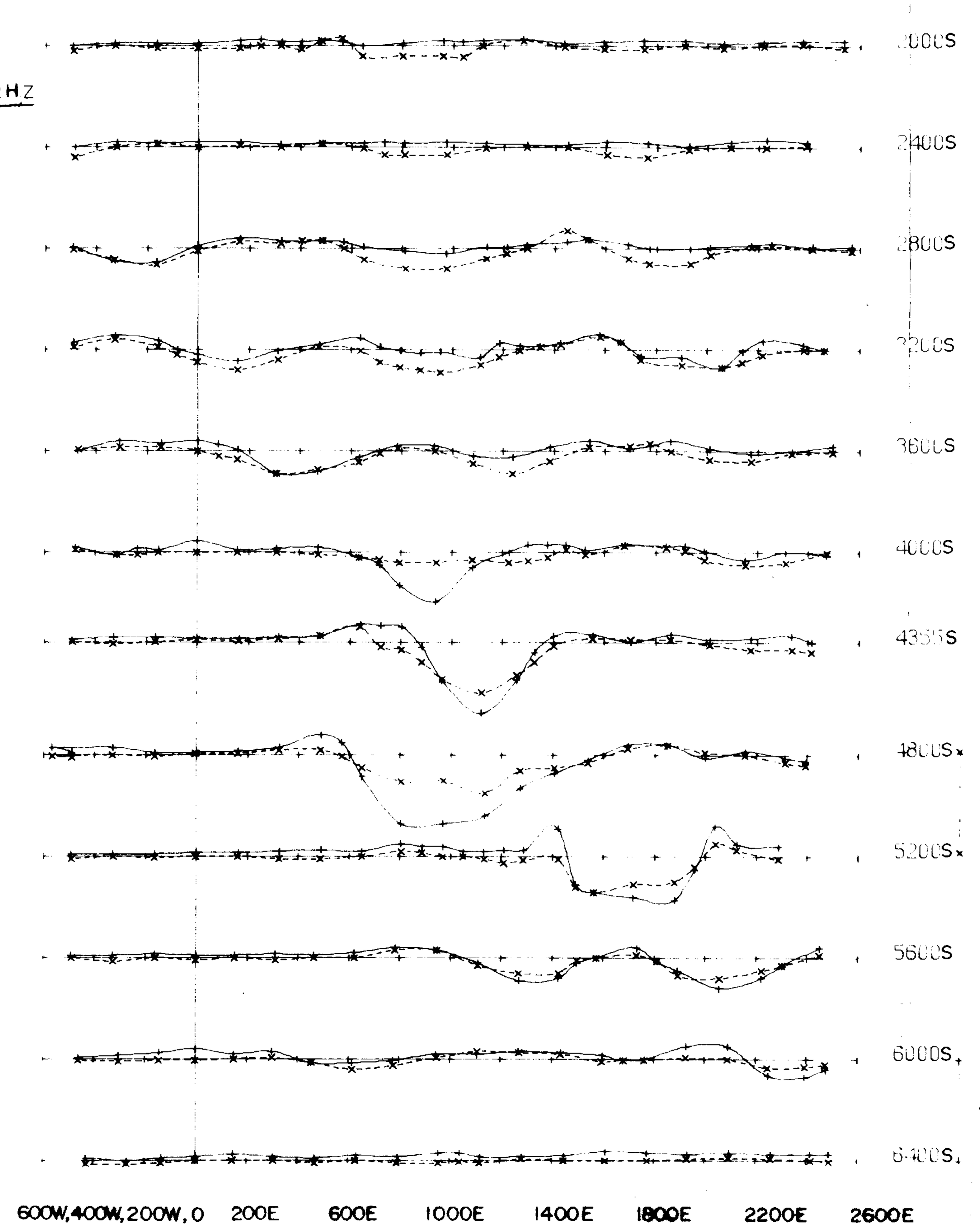
LOCATION MAP

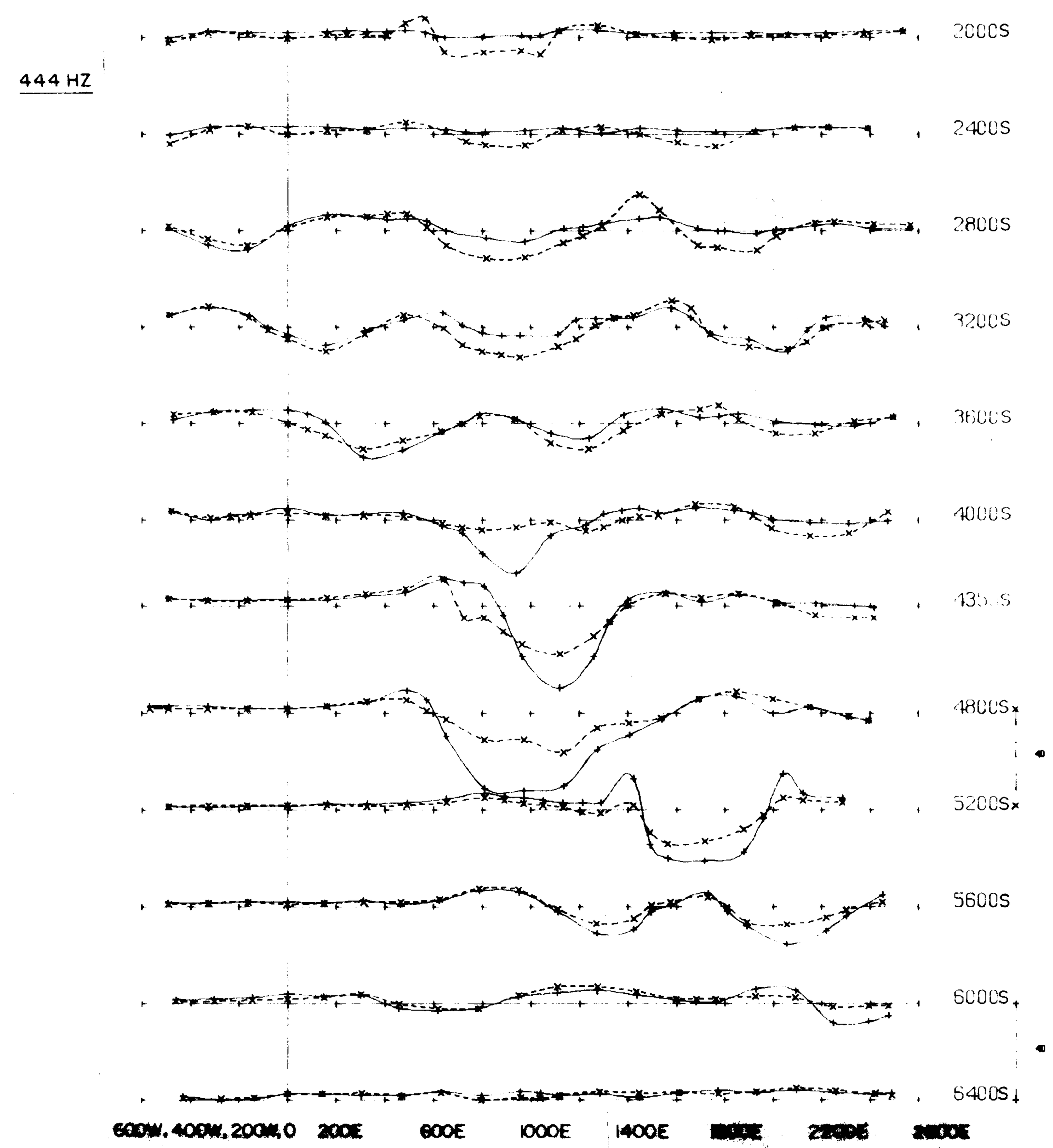
FORT STEELE M.D., B.C.

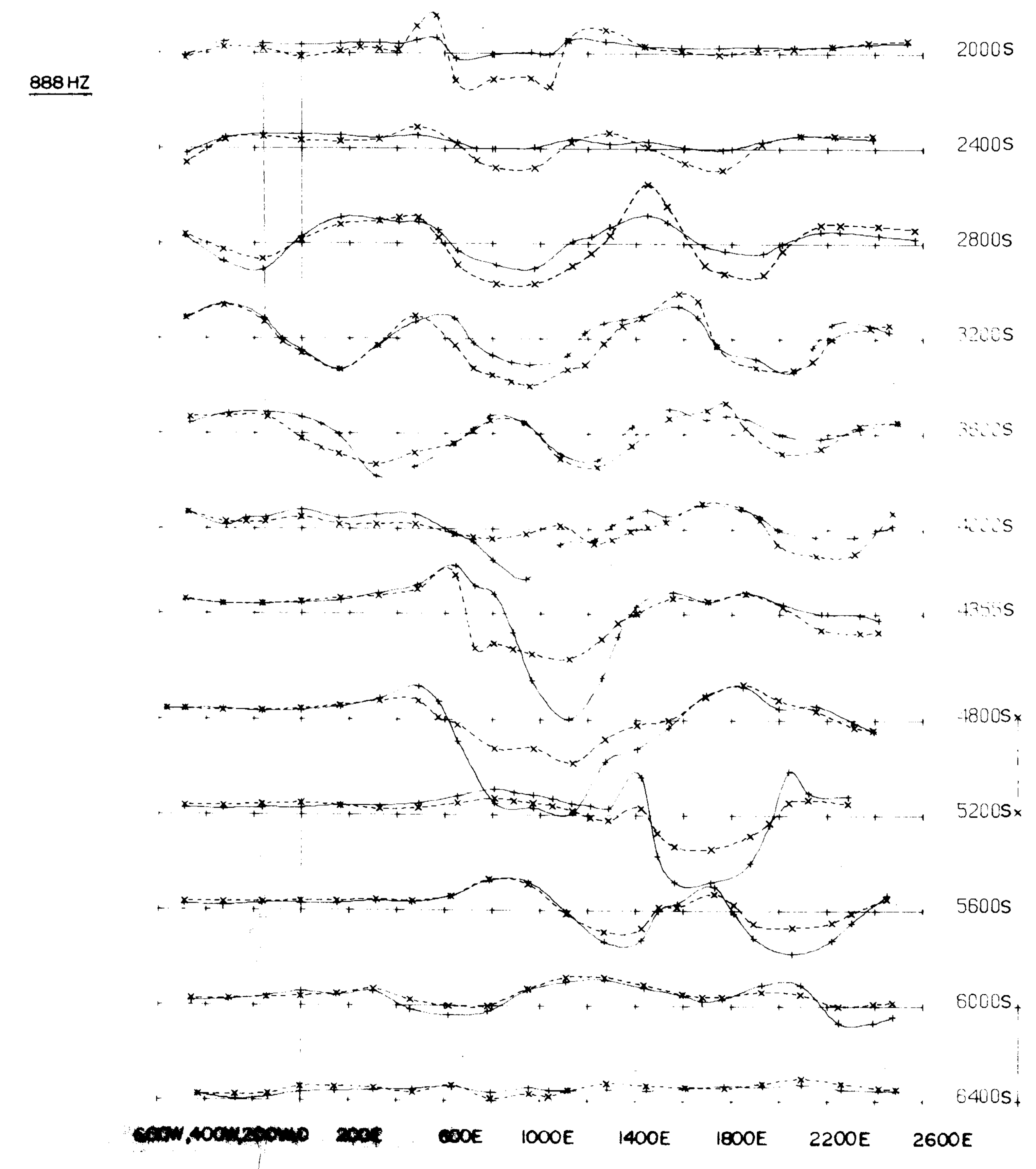
Scale: 1" = 800'

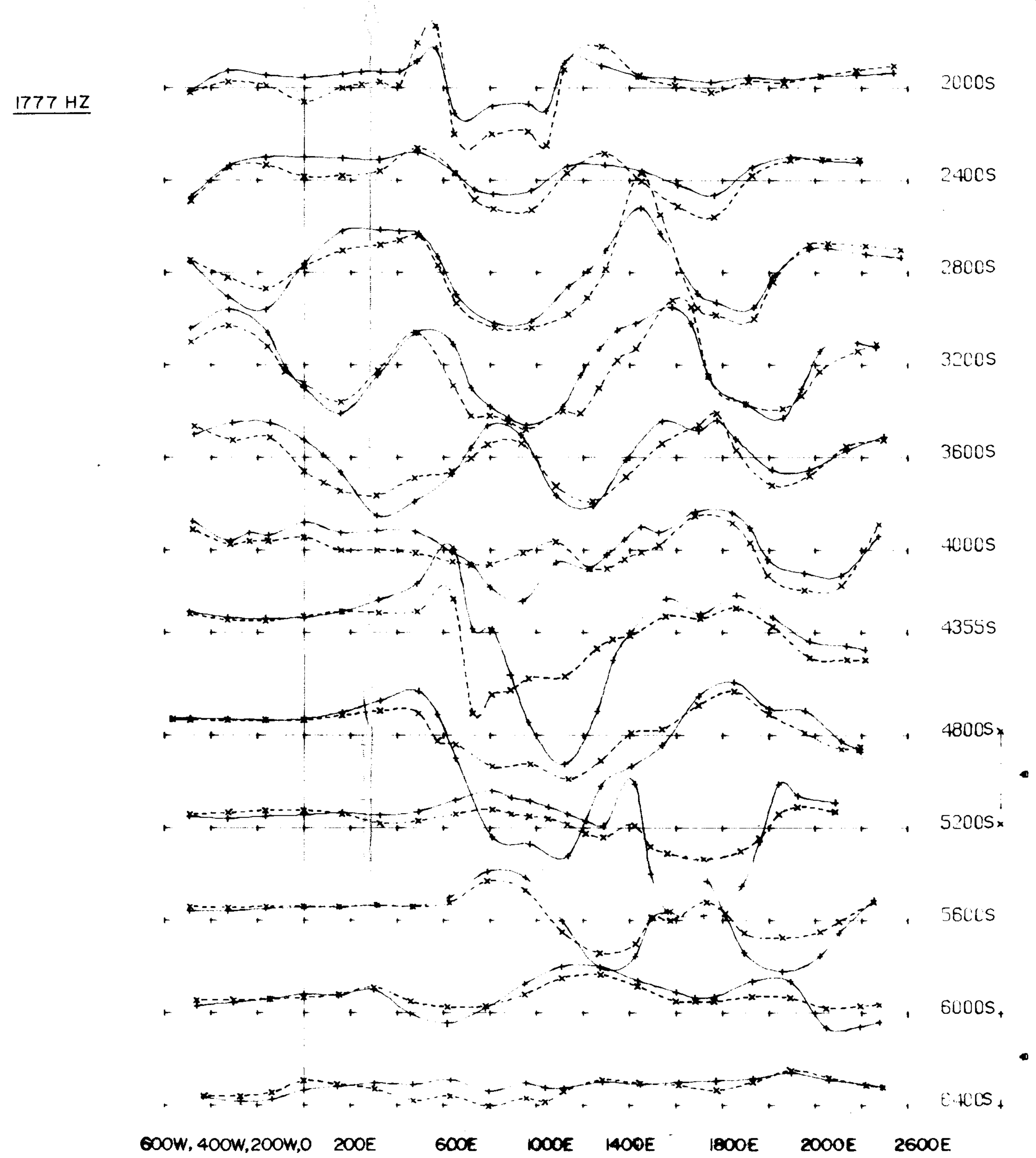
Date: JANUARY 1980

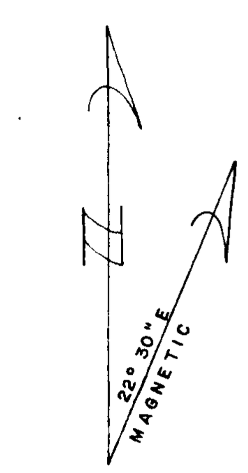
Plate: 164-79-

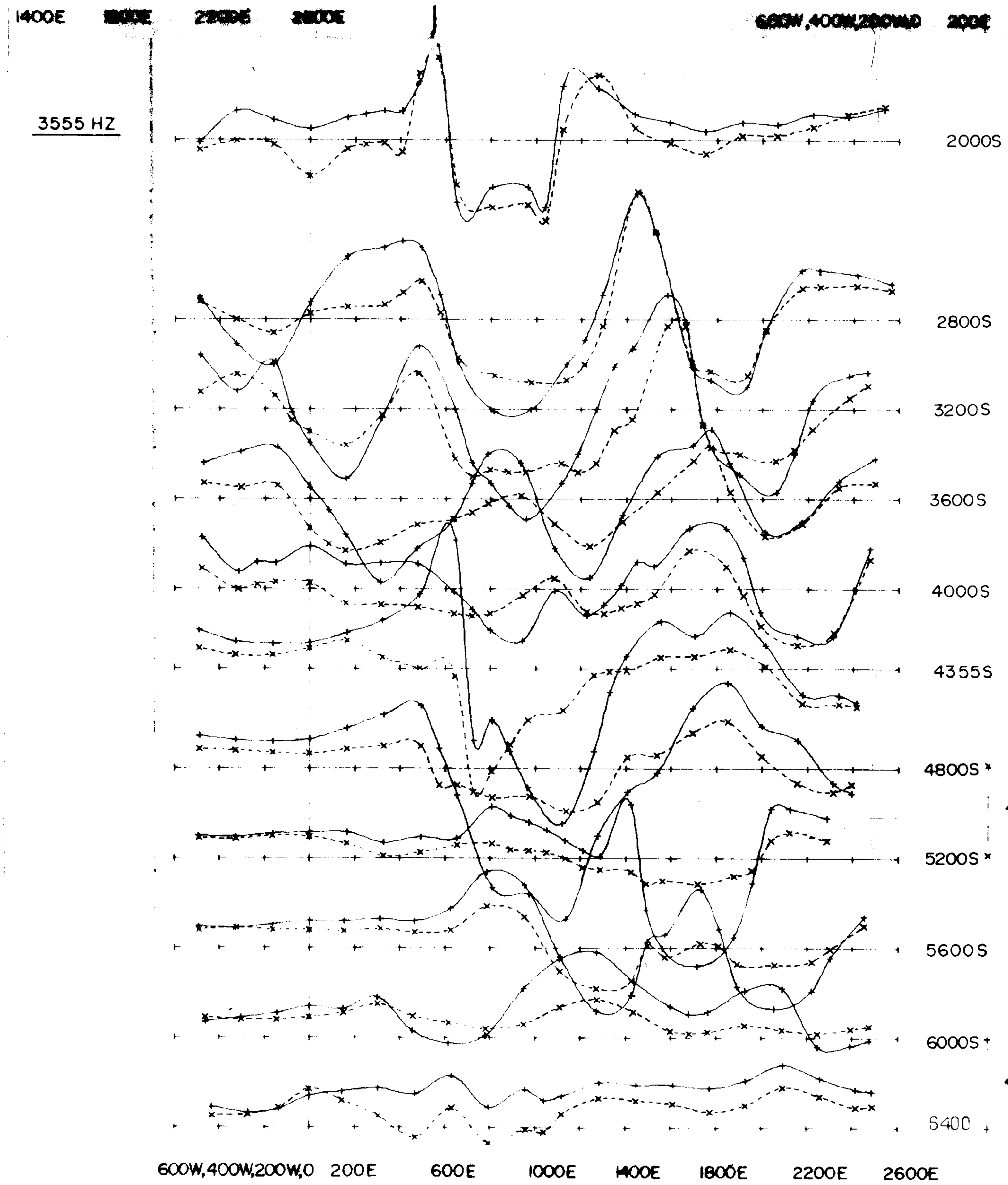












LEGEND

MYRTLE MTN. HORIZONTAL LOOP EM

MAX-MIN II

COIL SEPARATION = 150M (WITH PRE COMPUTED CORRECTIONS FOR DISTANCE AND TILT)

SCALE 1" = 400'

DATA SCALE 1" = 40%

MINERAL RESOURCES BRANCH
ASSESSMENT REPORT
NO. 8511

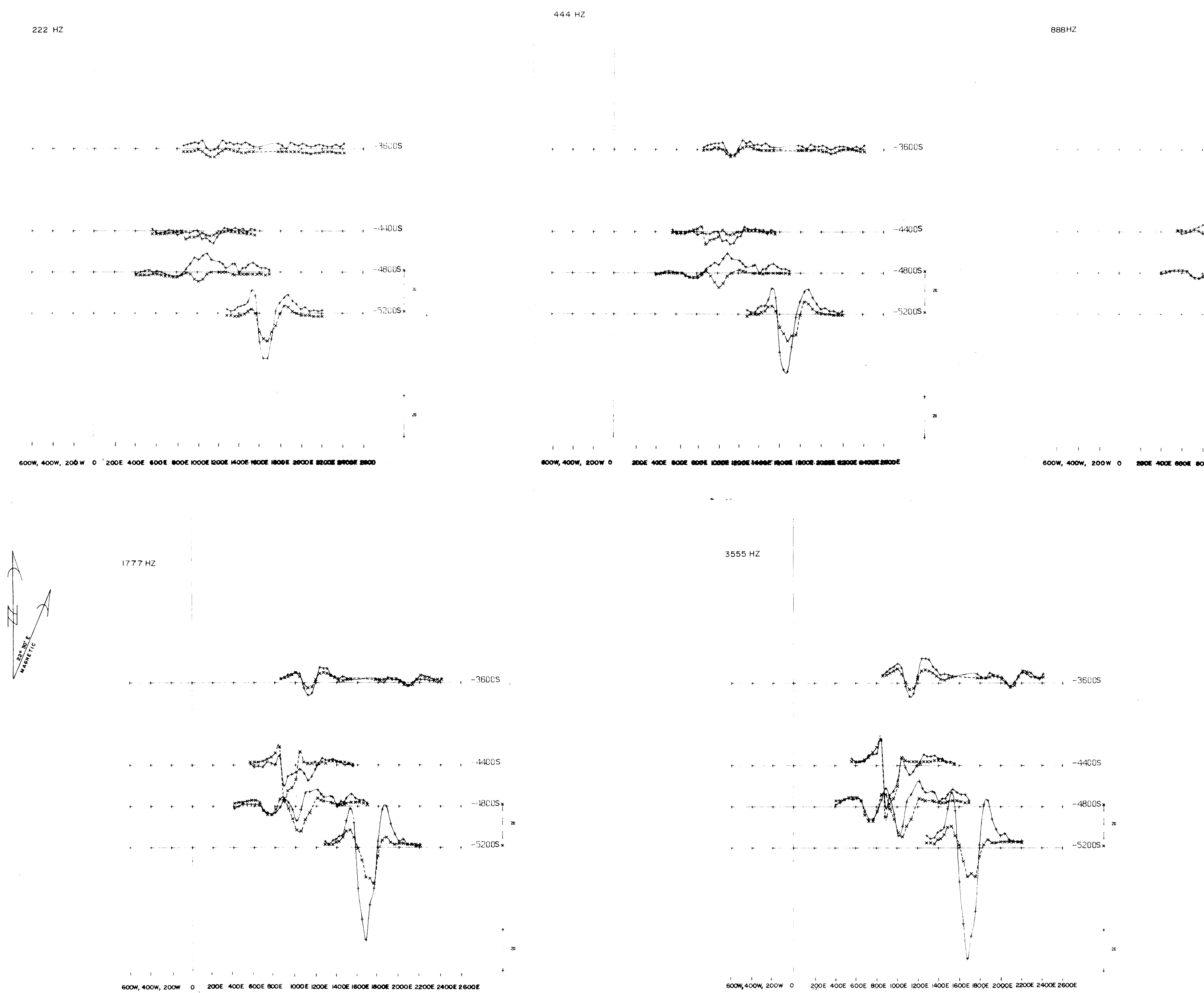
FEET
0 200 400 600 800 1000

METRES
0 100 200 300

TO ACCOMPANY A REPORT BY J. LAJOIE PhD P Eng

MYRTLE MOUNTAIN (SULLIVAN MINE)		NTS- 82-G-12 82-F-9
Drawn by: / Traced by:	MYRTLE MTN. HORIZONTAL LOOP EM FORT STEELE M.D., B.C.	
	Scale: 1" = 400'	Date: JANUARY 1980 — Plate: 164-79-2

FORM 210 0870



LEGEND

MYRTLE MTN. DETAIL HLEM
MAX-MIN II
COIL SEPARATION = 50M (FIELD ESTIMATED)
SCALE = 1" = 400'
DATA SCALE 1" = 20%

FEET
0 200 400 600 800 1000

METRES
0 100 200 300

MINERAL RESOURCES BRANCH
ASSESSMENT REPORT
NO. 8511

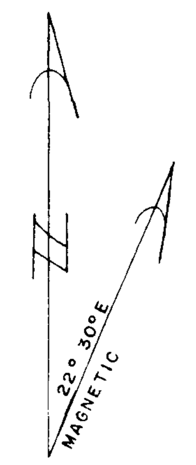
TO ACCOMPANY A REPORT BY J. LAJOIE Ph D P Eng

MYRTLE MOUNTAIN (SULLIVAN MINE)

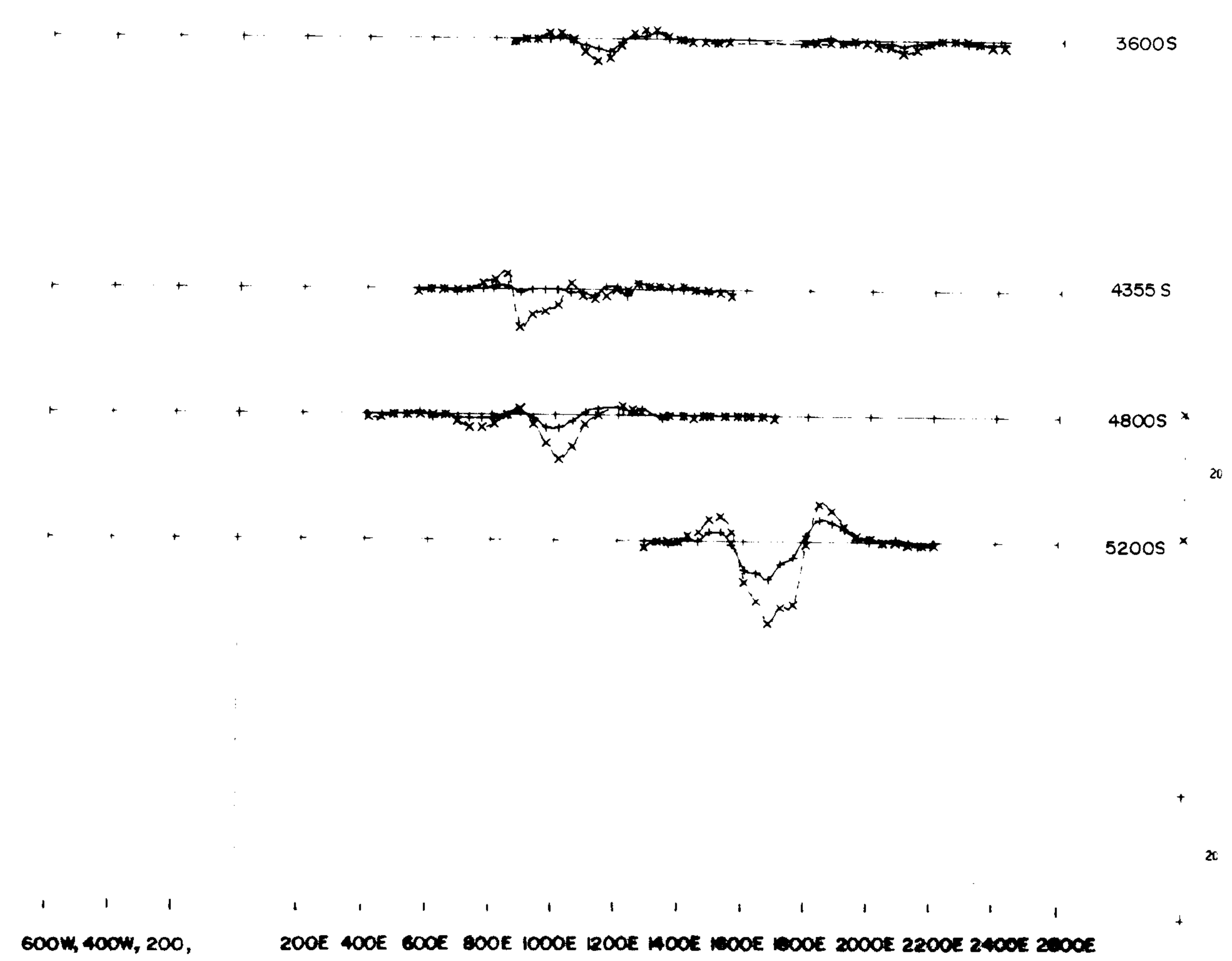
NTS 82-G-12 82-F-9

Drawn by:		Traced by:		
Revised by	Date	Revised by	Date	MYRTLE MOUNTAIN DETAIL HLEM FORT STEELE M.D., B.C.
Scale: 1" = 400'		Date: JANUARY 1980		Plate: 164-79-3

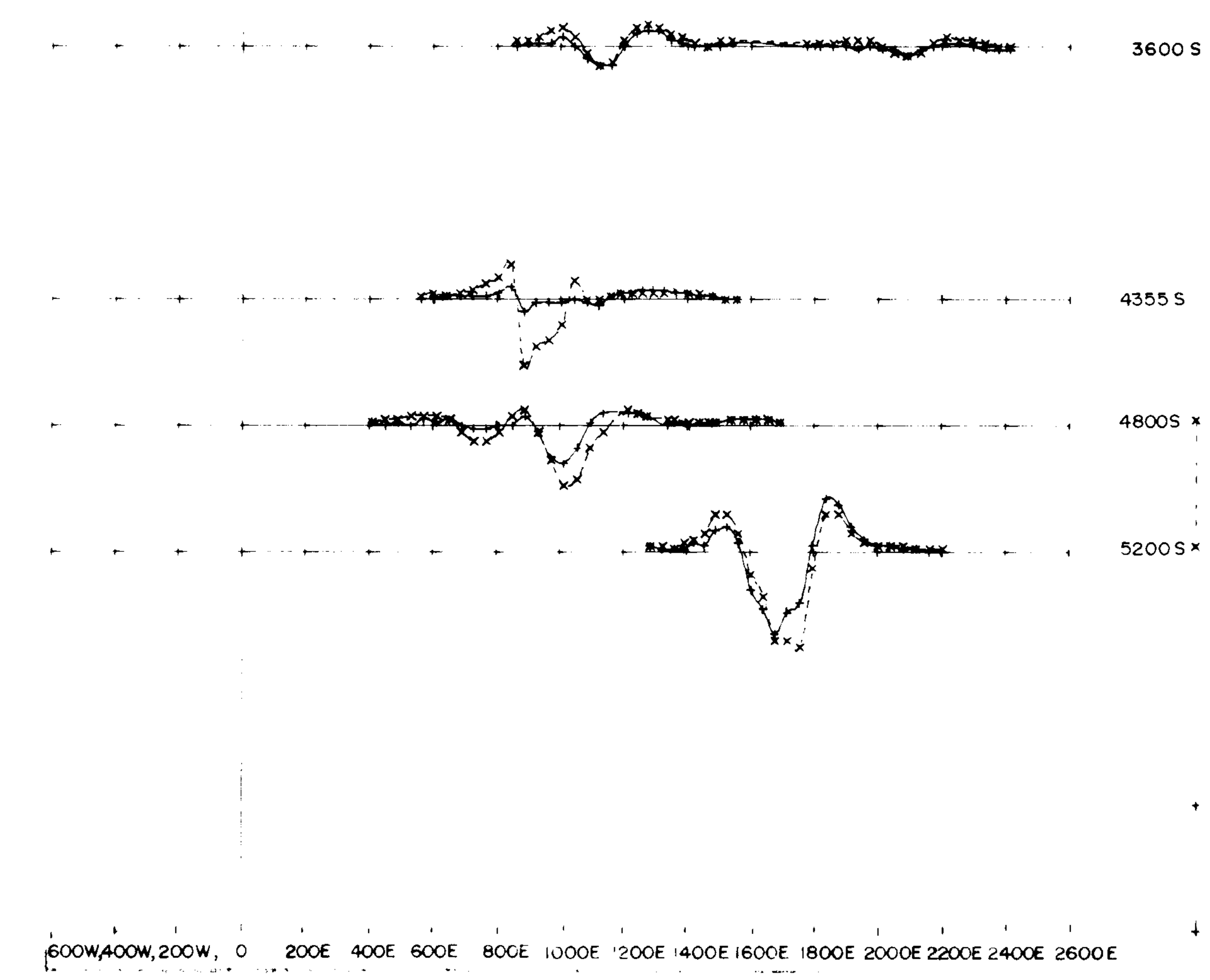
FORM 210 0670



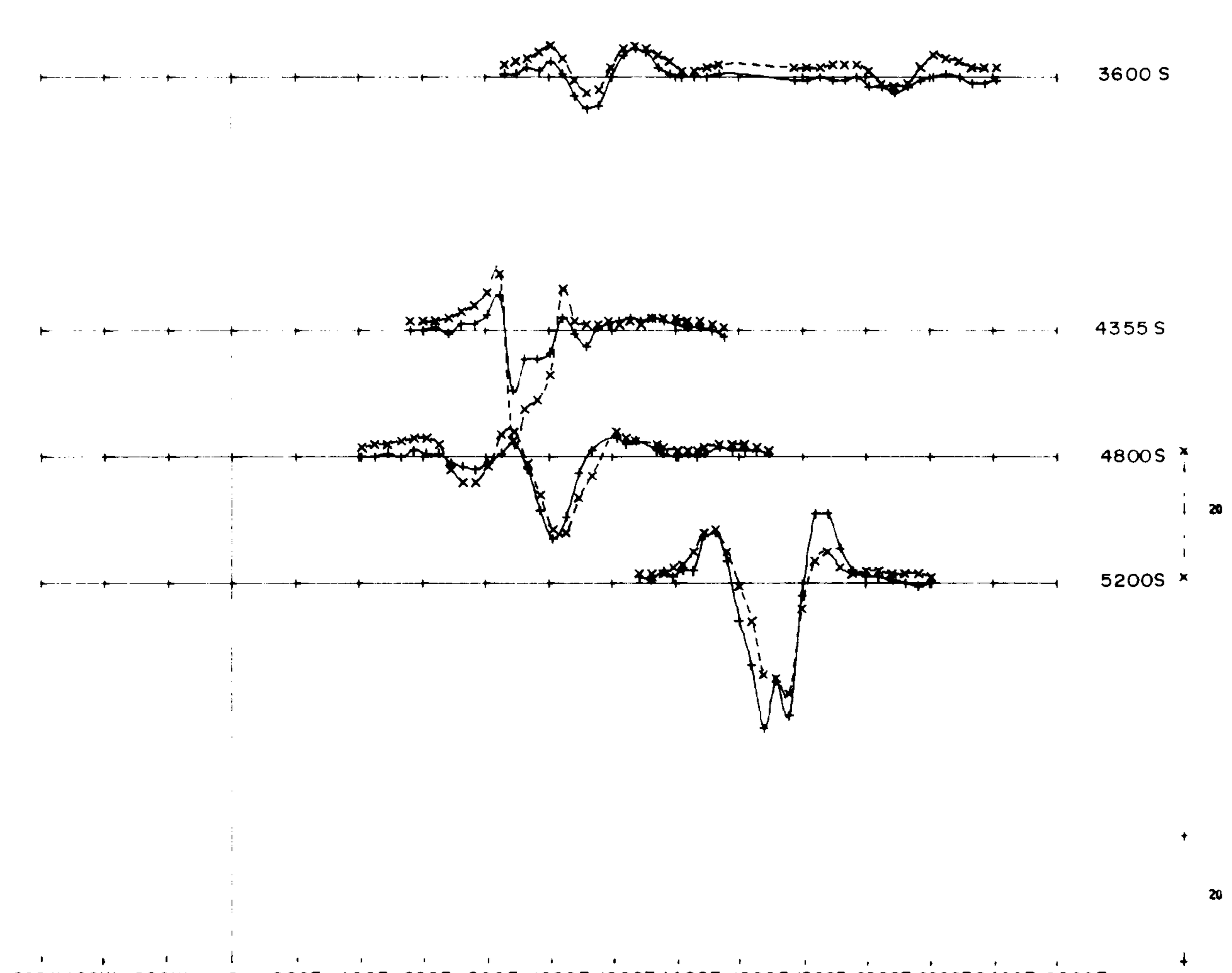
444 HZ



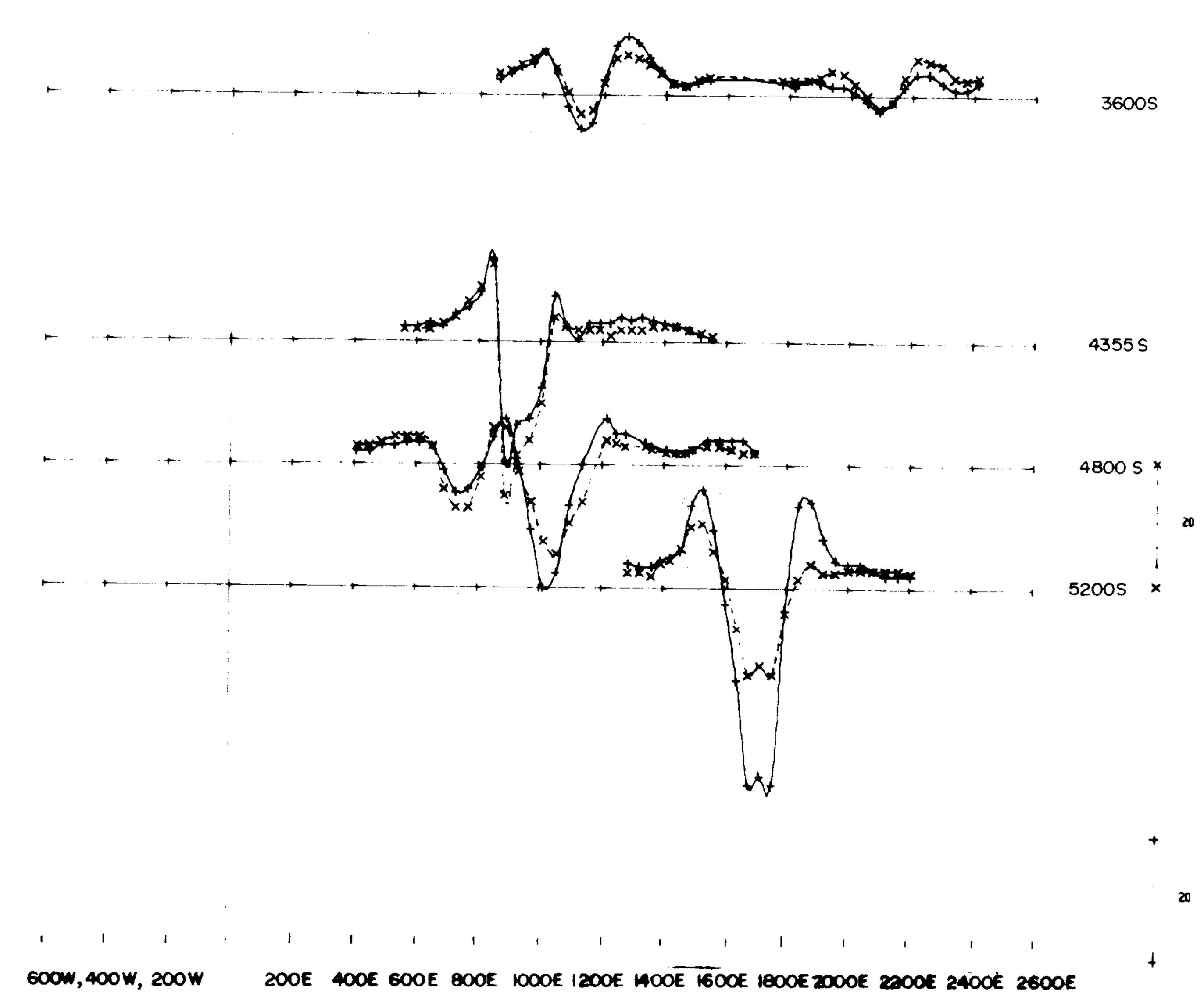
888 HZ



1777 HZ



3555 HZ



LEGEND

MYRTLE MTN DETAIL HLEM

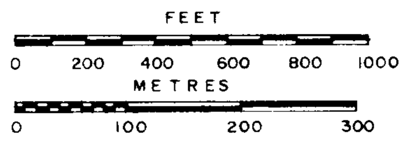
MAX-MIN II

THE 222 HZ IN PHASE DATA IS SUBTRACTED

COIL SEPARATION = 50 M

SCALE 1" = 400'

DATA SCALE 1" = 20%



SURVEYED SEPT 1979

TO ACCOMPANY A REPORT BY J. LAJOIE Ph D P Eng.

MYRTLE MOUNTAIN (SULLIVAN MINE)

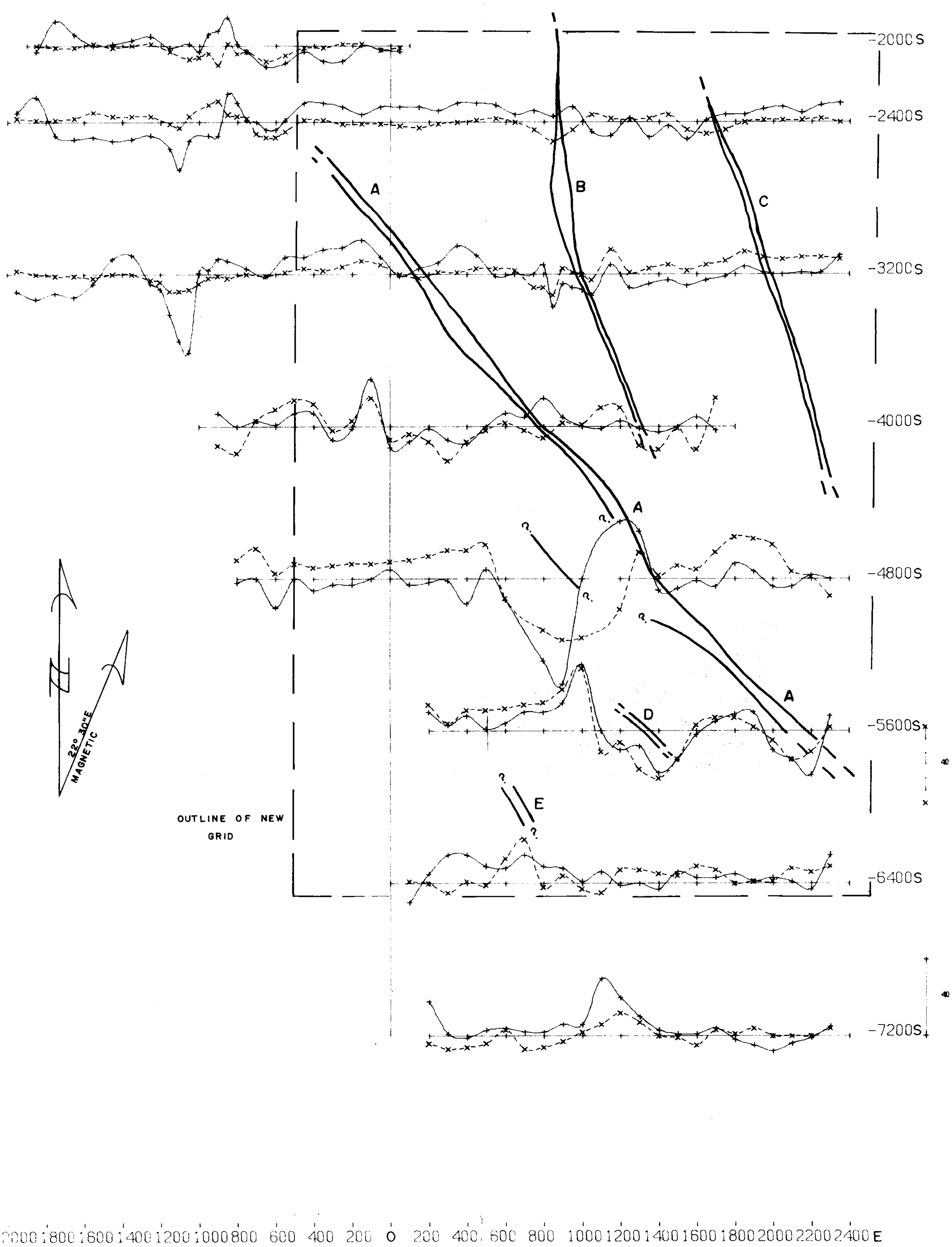
NTS: 82-G-12 82-F-9

Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

MYRTLE MTN. DETAIL HLEM
222 HZ IN PHASE SUBTRACTED
FORT STEELE M.D., B.C.

Scale: 1" = 400' | Date: JANUARY 1980 | Plate: 164-79-4

FORM 210 0670



MYRTLE MTN HLEM C.S.=400FT F=1600HZ 1''=400' 1''=40% OLD 1970(?) DATA

NOTE: CONDUCTORS A TO E ARE FROM DATA ON PLATE 164-79-7

FEET
0 200 400 600 800 1000
METRES
0 100 200 300

TO ACCOMPANY A REPORT BY J. LAJOIE Ph D P Eng

MYRTLE MOUNTAIN (SULLIVAN MINE)

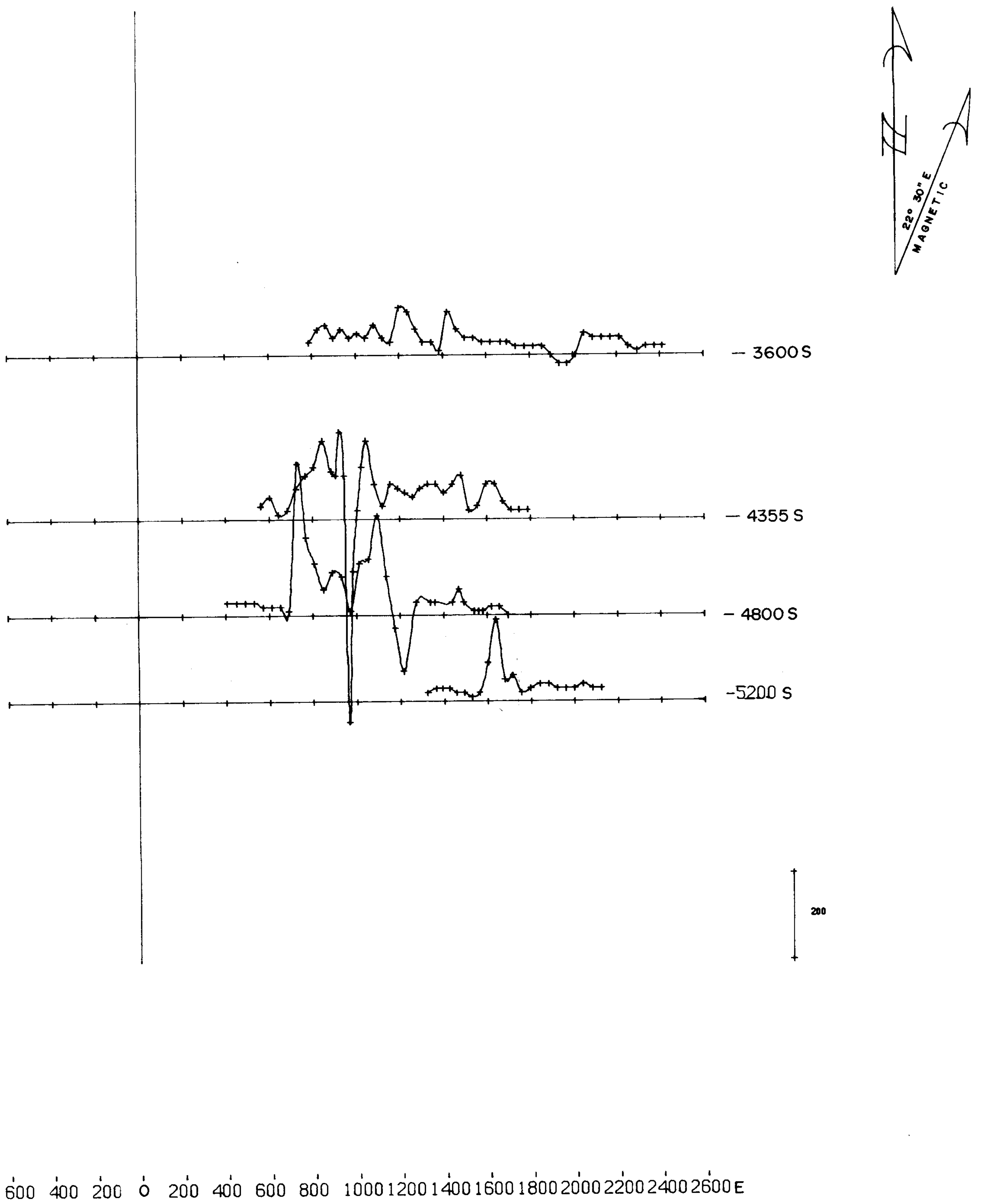
NTS: 82-G-12, 82-F-9

Drawn by:		Traced by:	
Revised by	Date	Revised by	Date

MYRTLE MOUNTAIN HLEM (1970)

FORT STEELE M.D., B.C.

Scale: 1" = 400' | Date: JANUARY 1980 | Plate: 164-79-5



MYRTLE MTN PROTON MAG DATA (UNIMAG); GAMMAS (LESS 58150); 1''=400'; 1''=200GAMMAS

MINERAL RESOURCES BRANCH
ASSESSMENT REPORT
NO. 8511

INSTRUMENT :
GEOMETRICS UNIMAG PROTON MAGNETOMETER

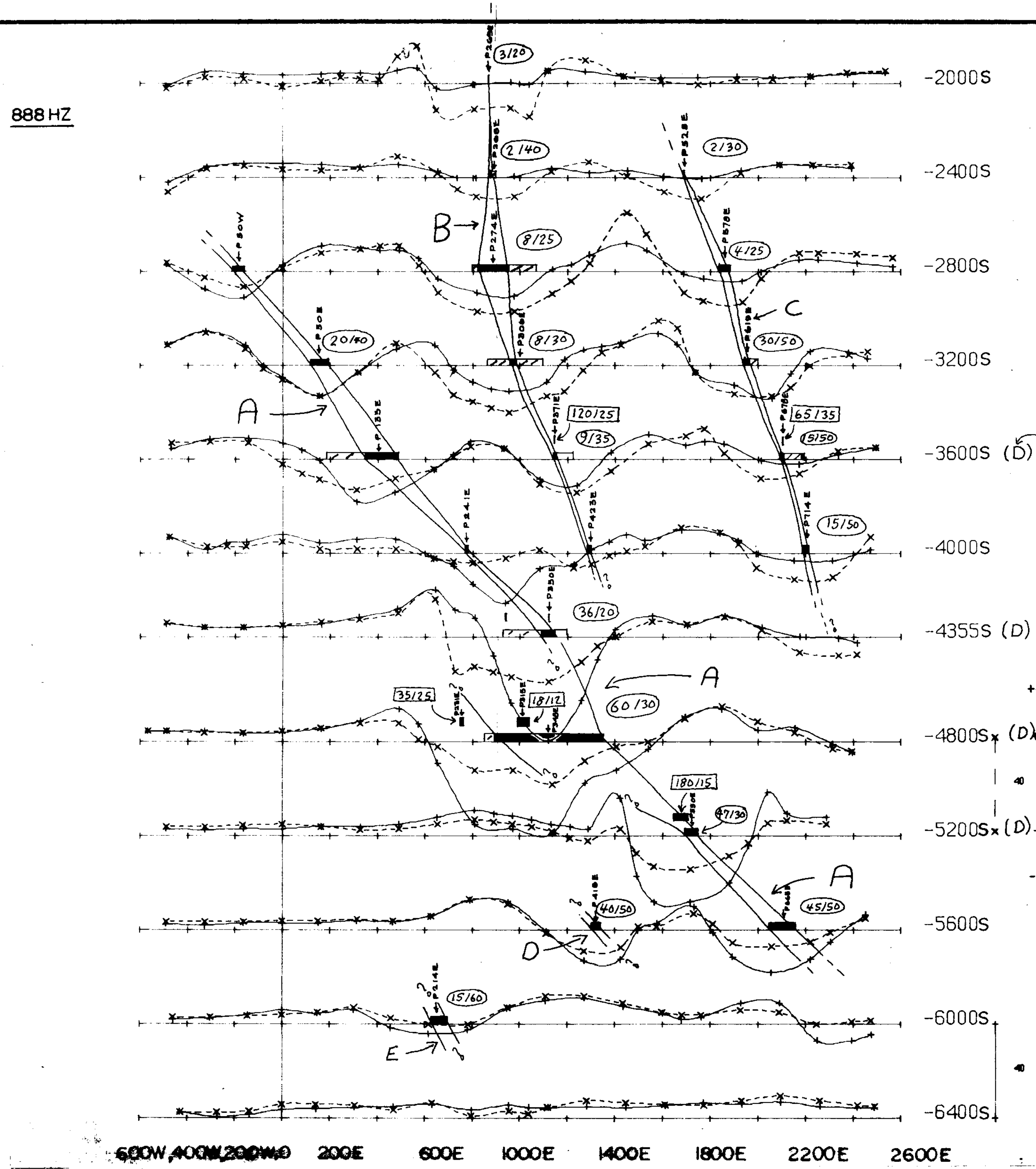
FEET
0 200 400 600 800 1000
METRES
0 100 200 300

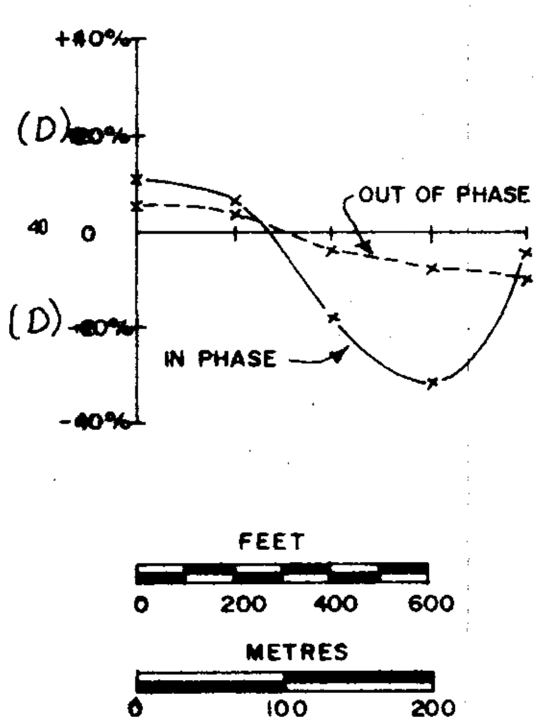
SURVEYED SEPT 1979

TO ACCOMPANY A REPORT BY J. LAJOIE PhD P.Eng. Jules Lajoie

MYRTLE MOUNTAIN (SULLIVAN MINE)			NTS: 82-G-12 82-F-9
Drawn by:	Traced by:	PROTON MAG DATA	
Revised by / Date	Revised by / Date	FORT STEELE M.D., B.C.	
		Scale: 1" = 400'	Date: JANUARY 1980
		Plate: 164-79-6	

NCI - 229 - C.L.





LEGEND

MYRTLE MTN. HORIZONTAL LOOP EM

MAX-MIN II

COIL SEPARATION = 150M (WITH PRE-COMPUTED CORRECTIONS FOR DISTANCE AND TILT)

888 Hz

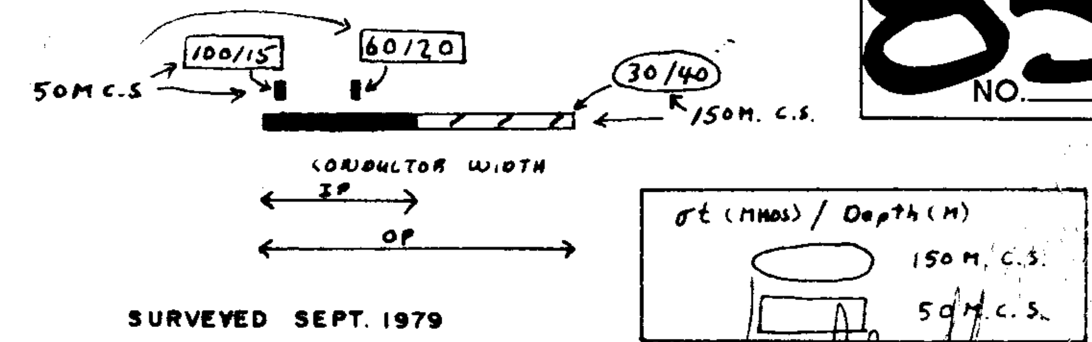
P214E PICKET LOCATION (METRIC) IN FIELD OF THE CENTRE OF THE HIGHEST CONDUCTIVITY.

SCALE 1" = 400'

DATA SCALE 1" = 40%

x——x IN PHASE

x- - -x OUT OF PHASE



MINERAL RESOURCES BRANCH
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SURVEYED SEPT. 1979

TO ACCOMPANY A REPORT BY J. LAJOIE Ph D PEng

MYRTLE MOUNTAIN (SULLIVAN MINE)

NTS: 82-G-12 82-F-9

Drawn by:		Traced by:	
Revised by	Date	Revised by	Date
		J.P.S.	3/17/80

HORIZONTAL LOOP EM INTERPRETATION

FORT STEELE M.D., B.C.

Scale: 1" = 400' | Date: JANUARY 1980 | Plate: 164-79-7

NCI-114-CL

#210-0640