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Acquisition of crustal reflection/refraction profiles across  
Vancouver Island

R.M. Ellis and R.M. Clowes

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## ABSTRACT

In August 1980, the CO-CRUST\* group conducted a large scale seismic program (VISP 80) in the Vancouver Island region to investigate the crust and upper mantle structure. In this study 25 refraction shots were detonated for observation at 38 land stations and a 10 km long deep reflection profile, typically with 1200% coverage, was recorded in the central section of the island.

This report summarizes the tectonic setting, the program objectives, field procedures, field parameters, and the digital tape contents and formats. The accompanying 10 digital tapes contain the preliminary refraction sections and both the raw and processed reflection data.

## RESUME

Pendant le mois d'Août 1980, le group CO-CRUST a mené à bien un programme séismique à grande échelle (VISP 80) dans la région de l'île de Vancouver afin de déterminer les structures de la croûte et du manteau supérieur. Lors de cette étude, 25 tirs de réfraction furent effectués et observés à 38 stations terrestres. De plus, un profil de réflexion profonde d'une longueur de 10 km, représentant une couverture de 1200%, fut enregistré dans la partie centrale de l'île.

Ce rapport résume le cadre tectonique, les objectifs du programme, les techniques de terrain, les paramètres de terrain et les contenus et formats des bandes digitales. Les 10 bandes digitales qui accompagnent ce rapport contiennent les sections préliminaires de réfraction et à la fois les données brutes et les données traitées de réflexion.

\* Consortium for Crustal Reconnaissance Using Seismic Techniques.

## VISP 80: THE VANCOUVER ISLAND SEISMIC PROJECT

### INTRODUCTION

The stated overall objective of this program is to explore the nature of the crust and upper mantle in the transition zone from the Pacific Ocean through Vancouver Island to the mainland of British Columbia by conducting a seismic refraction/reflection experiment. To place the data set acquired under this contract in perspective, the tectonic setting is briefly described and the previous seismic studies summarized.

#### Tectonic Setting

The essential features of the plate tectonic environment of the region are shown in Figure 1. To the northwest of Vancouver Island, the Pacific, America, and Explorer-Juan de Fuca plates meet at a triple junction of the transform fault-ridge-trench type. The right lateral Queen Charlotte transform fault extends to the northwest from this point; a series of spreading centres (Dellwood Knolls, Explorer Ridge, and Juan de Fuca Ridge) connected by transform fault zones lie in a southerly direction; and the inferred trench is near the base of the continental slope to the southeast. A line of volcanoes lies 150 km inland (Figure 1) and is approximately parallel to the coastline. These volcanoes are of the typical calc-alkaline type that is usually associated with subduction zones. The pattern of heat flow from the ocean basin to the interior mainland is also characteristic of a convergent boundary (Riddihough and Hyndman 1976). Earthquakes as large as  $M = 7.2$  have occurred beneath Vancouver Island with the most probable focal mechanisms' strike slip and compressive axes in the north-south direction (Rogers and Hasegawa, 1978). This mechanism is consistent with compression due to the northward movement of the previously subducted Explorer plate causing compression in the overlying section of the America plate. Two features of the system are particularly relevant to our program.

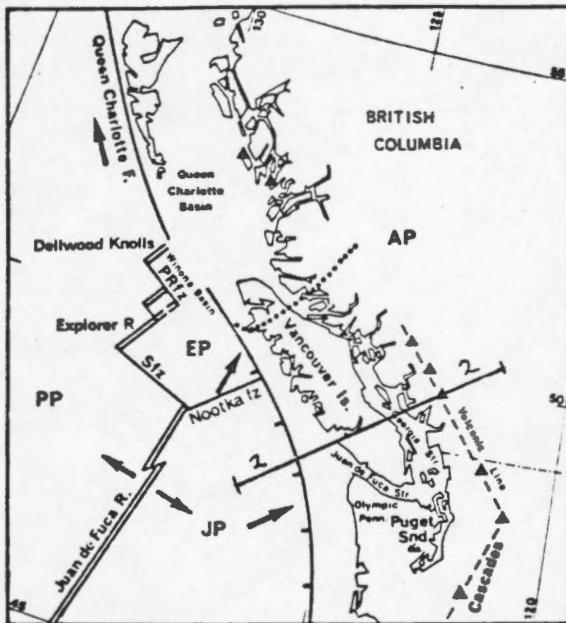


Fig. 1. Tectonic map of western Canada showing the main lithospheric plate boundaries and relative plate motions. The dotted line is the estimated northern edge of the Juan de Fuca plate. PRFz=Paul Revere fracture zone; Sfz=Sovanco fracture zone; PP=Pacific plate; EP=Explorer plate; JP=Juan de Fuca plate; AP=American plate. (modified from Keen and Hyndman, 1979)

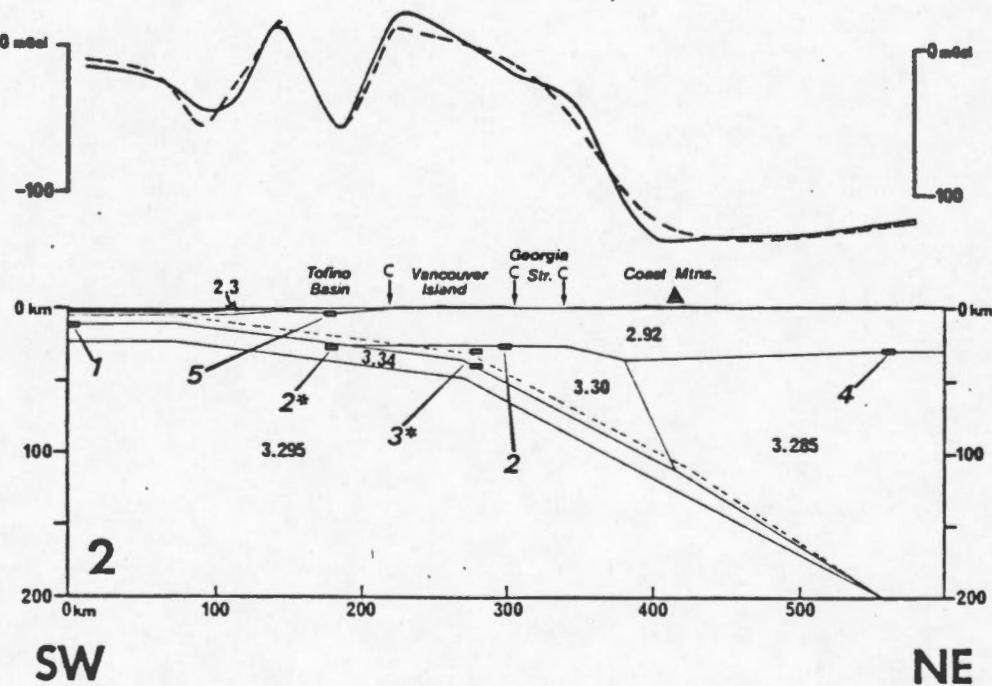


Fig. 2. Structural section along line 2 shown in Fig. 1. Gravity profiles are free air over sea and Bouguer over land; solid=observed, dashed=calculated. Densities in  $\text{g cm}^{-3}$ , no vertical exaggeration of scale. Bars are seismic control points, numbers are source; (1) Clowes and Malecek (1976), Keen and Barrett (1971); (2) Tseng (1968); (3) Wickens (1977); (4) White et al. (1968); and (5) Shouldice (1971). Stars indicate controls of particular uncertainty. Solid lines are density contrasts, dashed line is not, but is the upper boundary of oceanic crustal material (from Riddihough, 1979).

(i) Based on earthquake data, Barr and Chase (1974) suggested that a fault zone separates the main Juan de Fuca Plate from its northern extension. Subsequently Riddihough (1977) showed that the magnetic anomaly reversal pattern required relative motion between these plates, as indicated by the arrows in Figure 1, with recent subduction rates of about 1 cm/yr north of the fault boundary and 3 to 4 cm/yr to the south. Recent seismic reflection profiles, accurate earthquake locations, and analysis of gravity, magnetic and bathymetric data have accurately located the Nootka fault zone, an active region separating Explorer and Juan de Fuca plates (Hyndman et al., 1979). Moreover, the magnetic anomaly pattern and 'double or twin' spreading centres at the northern end of Juan de Fuca and Explorer ridges indicate that the triple junction has migrated along the coast and there have been significant rotation and changes in spreading direction of the plates over the past 10 my. This complexity and the relative youth of the subducting plates suggests that the oceanic/continental interaction may be different from other such areas that have been studied (e.g. off South America).

(ii) The trench is not characterized by a bathymetric deep although seismic data show that oceanic basement dips at 5° towards the margin. The lack of a deep is probably due to high sedimentation rates and a damming effect of the Juan de Fuca ridge. Further, few earthquakes are located along this zone. Thus underthrusting and compression must be predominantly aseismic or discontinuous over long periods. However in the Strait of Georgia region earthquakes at a depth of 50 to 60 km are consistent with a subduction zone dipping at about 10° to 15°

From an analysis of gravity data, Riddihough (1979) has developed detailed structural models which are consistent with the available seismic surveys. Figure 2 presents his model across southern Vancouver Island (Profile 2 of Figure 1). It is noted that the downgoing slab may have a significant change in dip approximately 100 km in front of the volcanic area. This proposed change is based on the seismic data and the requirement that beneath the volcanic arc the downgoing plate must be

at a depth near 100 km in order to be partially melted and supply the appropriate magma. The model derived by Riddihough (1979) is a good starting model, but one to which we expect to add significantly more detail.

For summaries and critical examination of the geophysical data in this region, the reader is referred to Keen and Hyndman (1979), Riddihough (1979), Riddihough (1978) and Riddihough and Hyndman (1976).

#### Previous Seismic Studies

In Figure 2, the seismic control points used by Riddihough (1979) are shown. The control data of Clowes and Malecek (1976) lie to the west in the Explorer Ridge region. The data of Davis et al. (1976) and the more recent work of Au and Clowes (1981) reflect complexities due to the Juan de Fuca Ridge and the Nootka Fault Zone. Thus, the only offshore data sets from relatively 'normal' regions are the Shouldice (1971) and Chevron Standard Ltd. reflection profiles, and the Clowes and Knize (1979) reflection/refraction profiles. Interpretations are shown in Figures 3 to 5. Unfortunately these studies do not reveal structure to upper mantle depths.

The structural interpretation of the Vancouver Island area is based on the refraction work of White and Savage (1965), the reassessment of this data by Tseng (1968), and the surface wave studies by Wickens (1977) for a travel path from Port Hardy near the northern end of the island to Victoria in the south. Berry and Forsyth (1975) have attempted to reconcile the data from their Nitinat Lake-Greenbush Lake profile with these earlier data. Their model is shown in Figure 6. It is noted that the early data is from paper records and some of it is of rather low quality. The section from Nitinat Lake eastward shows a low S/N ratio and lacks correlatable energy at times corresponding to the crustal guided phase. This is suggestive of a scattering zone.

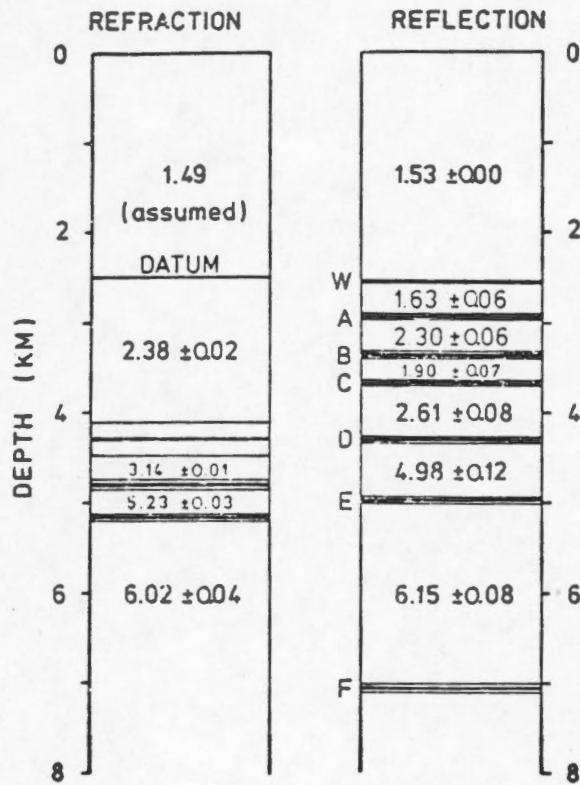


Fig. 3. Velocity-depth models from refraction and reflection data of profile 73-5 which lies near 75 km on Fig. 2. Shading shows error bars from thickness calculations (from Clowes and Knize, 1979).

Chevron 173H

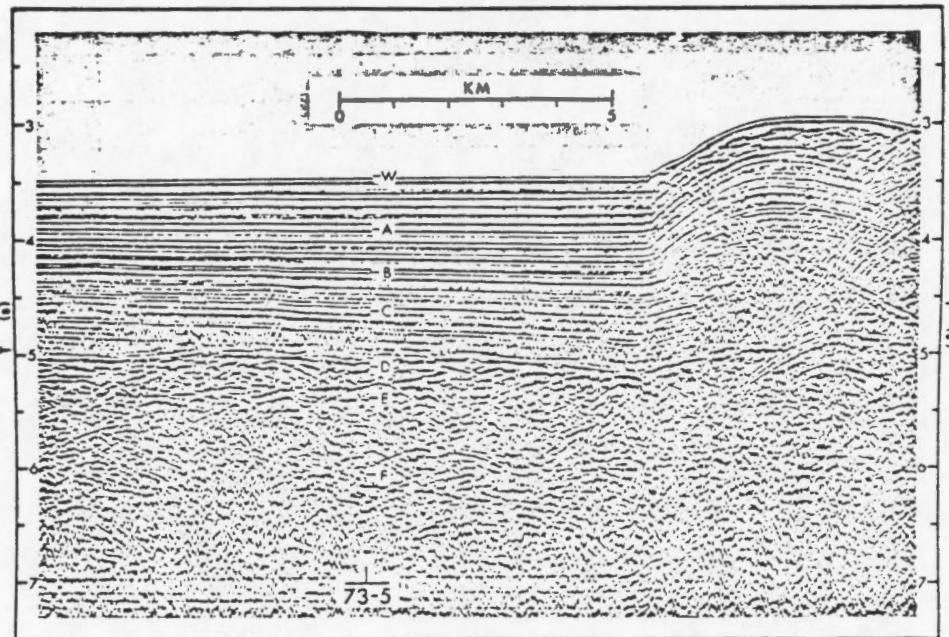


Fig. 4. Stacked record section of a 2400%, 24 channel seismic reflection profile crossing profile 73-5. Automatic gain control, 8-36 Hz bandpass filtering, and a standard deconvolution process have been applied to the data. Vertical incidence two-way traveltimes derived from the  $T^2-X^2$  plot of 73-5 reflection data are given at the approximate location of the crossing. A small time adjustment was required to account for different datum levels. Note the apparent arching of the basement and other horizons on the right side. This is partially the result of velocity 'pull-up' due to replacement of part of the water column with subbottom material (from Clowes and Knize, 1979).

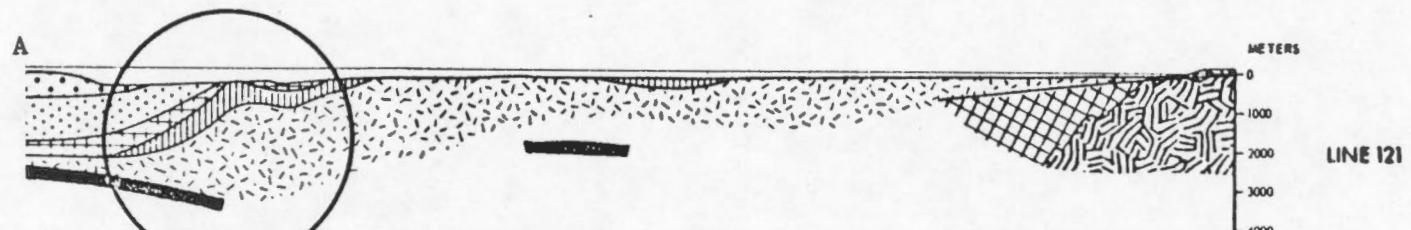
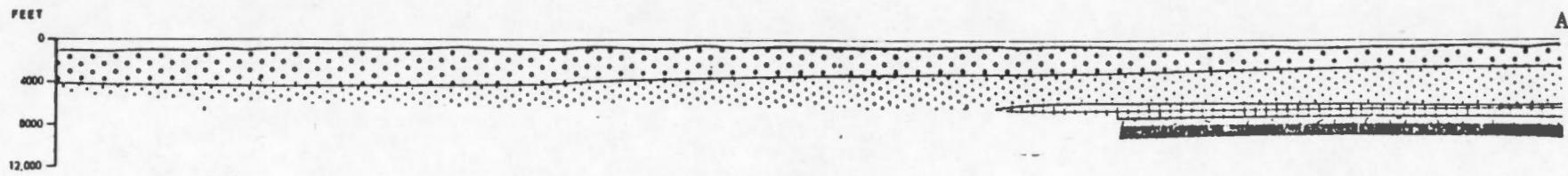


FIG.30

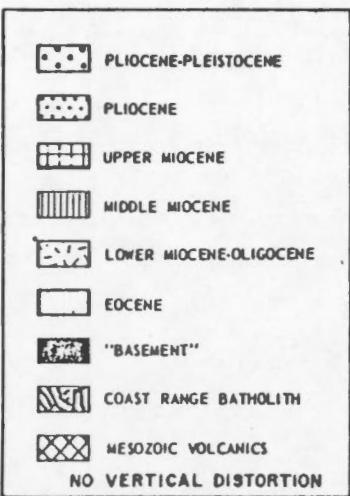
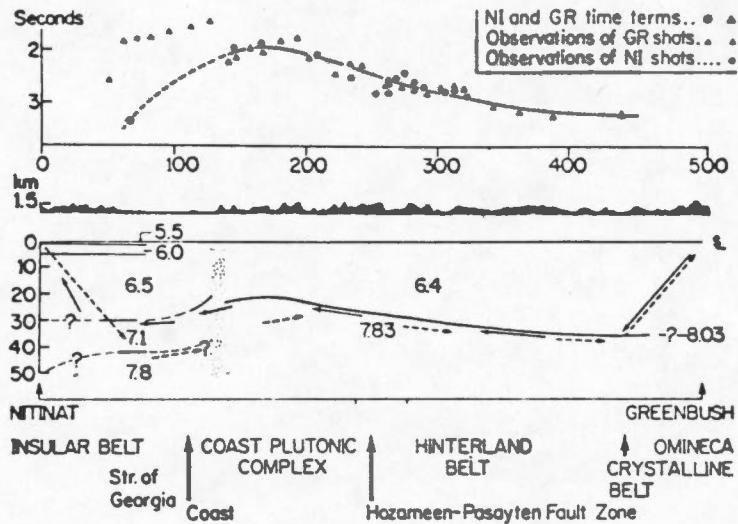


Fig. 5. Structural Section along Shell profile S-121 (control point 5, Fig. 2) based on seismic reflection data (from Shouldice, 1971).



**Fig. 6:** A model of the seismic structure eastward from Nitinat Lake (NI) to Greenbush Lake (GR), (from Berry and Forsyth, 1975).

Thus the seismic data existing prior to this project do not define clearly the structural characteristics of the crust and upper mantle in this region where significant earthquake activity may be expected to recur and in which active petroleum exploration on the continental shelf is again being considered.

#### PROGRAM OBJECTIVES

The detailed program objectives were to:

- (a) obtain two reversed refraction profiles (i) the first of these was a profile across Vancouver Island from the volcanic arc to the deep ocean to provide the basic data for the interpretation of this structural section and thus test the model of Riddihough (1979). This required shot points in an inlet on the mainland and in the Pacific Ocean with receivers spread over approximately 175 km across Vancouver Island, to islands in the Strait of Georgia, and onto the mainland. (ii) the second profile was to be along the length of Vancouver Island and thus along strike. This would provide a basic structural section, possibly define differences between areas of Juan de Fuca and Explorer plate subduction and provide a control point on the cross profile. To provide additional data, a source was to be located at the mid-point of the profile as well as at both ends.
- (b) carry out a 5 to 10 km length near-vertical incidence reflection survey to test whether deep reflections could be obtained in this geological environment. To provide an adequate test, a minimum of 1200% coverage was required with recording station spacings of approximately 100 m, and at least 9 geophones per trace.

Appendix A contains the program specifications as detailed in the contract section entitled 'Statement of Work'.

The acquired data set was required to be presented as follows:

- (a) a complete set of edited data tapes in a format specified by the Earth Physics Branch, Energy, Mines and Resources;

- (b) record section presentations of the reflection and refraction data;
- (c) a complete set of maps, field reports, etc., sufficient to allow further data reduction and interpretation by other interested bodies.

#### FIELD PROGRAM

The field program was conducted during August 1980 with personnel and equipment contributions from the Pacific Geoscience Centre, University of British Columbia, University of Alberta, University of Calgary, University of Saskatchewan, University of Manitoba, University of Western Ontario, Earth Physics Branch (Ottawa), and the Atlantic Geoscience Centre. The initial phase of the experiment was refraction undertaken in the period August 9 to 21 followed by the reflection experiment from August 22-26.

#### REFRACTION EXPERIMENT

##### A. EXPERIMENT OUTLINE

The refraction program consisted of two profiles, Lines I and IV as shown in Figure 7.

Initially the 38 seismic systems were distributed along the 150 km section N-A of Line IV. Shots A1, N1, and F1 were then detonated at A, N and F respectively. (Shot point parameters are provided in Table 1). The seismographs were then relocated along the A-F section of Line IV for the observation of shots F2, A2 and N2.

In the second phase of the refraction experiment, the land seismic systems were located along Line I from J to the southwest on the British Columbia mainland, on islands in the Strait of Georgia, and on Vancouver Island. Two shots, separated by approximately 7 km, were detonated at J and a series of 19 shots fired in the Pacific Ocean (P1-P19). Figure 7 shows the locations of P1, P13, and P19, the

Fig. 7. Location map for VISP 80 program. Portable seismographs along Line IV recorded shots from N, A and F. Relocated along Line I, they then recorded two shots near J and a series detonated between P1 and P19 in the Pacific Ocean. Location of the 10 km reflection line is indicated by RL.

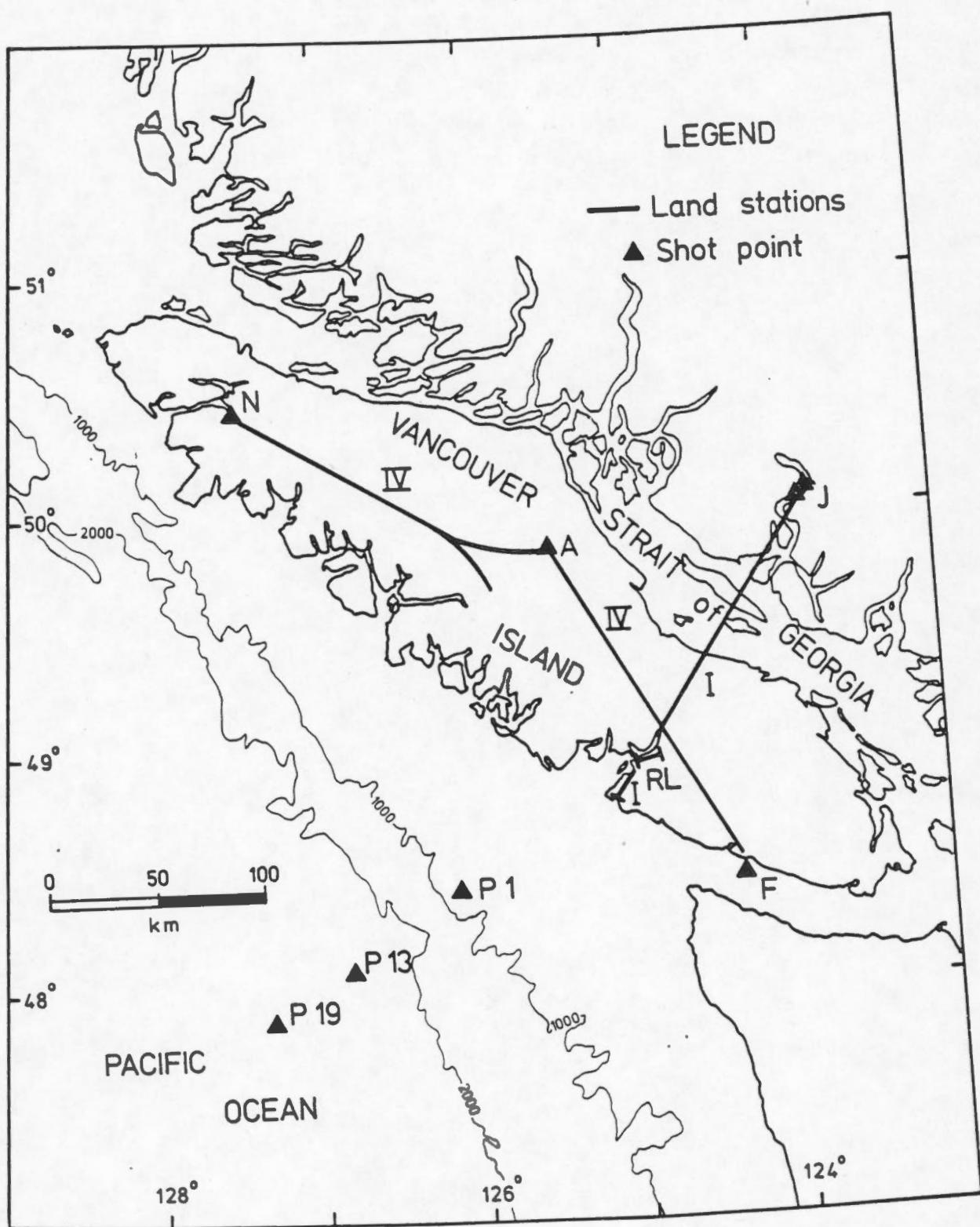


TABLE 1  
REFRACTION SHOT POINT PARAMETERS

LINE NO.	SHOT NAME	ORIGIN TIME (UT)						CHARGE SIZE (KG)	LOCATION	SURFACE ELEVATION (M)	SHOT DEPTH (M)	WATER DEPTH (±) (M)	SEDIMENT THICKNESS 2-WAY TRAVEL TIME S (±) QUALITY <sup>2</sup>	
		Y	D	H	M	S								
1	ARGO A1	80	223	02	00	00.039	900	49.8630	125.6252	503	25	25	0	G
2	NERO N1	80	223	03	00	00.070	900	50.4375	127.4972	0	60	60	10	
3	FUCA F1	80	225	13	59	57.587	1800	48.3850	124.2650	0	110	110		
4	FUCA F2	80	227	13	59	51.846	1200	48.4092	124.2492	0	110	110		
5	ARGO A2	80	228	01	00	00.018	900	49.8630	125.6252	503	25	25	0	G
6	NERO N2	80	228	03	00	00.090	1800	50.4717	127.5349	0	85	85	5	
7	JERV J1	80	233	12	59	52.358	825	50.0808	123.7952	0	159	530		
8	JERV J2	80	233	13	40	13.659	825	50.0385	123.8658	0	248	542		
9	P1 P1	80	234	15	00	23.993	825	48.3607	126.1446	0	207	525	2	
10	P2 P2	80	234	15	19	56.309	200	48.3313	126.1943	0	194	798	2	
11	P3 P3	80	234	15	39	58.906	200	48.2959	126.2379	0	210	1132	2	
12	P4 P4	80	234	16	00	07.150	200	48.2701	126.2937	0	245	1192	2	
13	P5 P5	80	234	16	20	01.852	200	48.2484	126.3526	0	227	1706	15	E
14	P6 P6	80	234	16	39	51.496	200	48.2278	126.4139	0	181	2108	4	E
15	P8 P8	80	234	17	19	56.059	200	48.1799	126.5479	0	163	2432	4	F
16	P9 P9	80	234	17	40	05.260	200	48.1568	126.6113	0	192	2514	4	F
17	P10 P10	80	234	17	59	56.837	200	48.1334	126.6731	0	178	2530	4	G
18	P12 P12	80	234	18	40	12.769	200	48.0875	126.8009	0	183	2508	4	F
19	P13 P13	80	234	19	00	04.890	825	48.0635	126.8694	0	153	2514	4	P
20	P14 P14	80	234	19	20	01.806	275	48.0394	126.9353	0	180	2523	4	F
21	P15 P15	80	234	19	40	04.791	275	48.0131	126.9958	0	211	2533	4	P
22	P16 P16	80	234	19	59	56.423	275	47.9904	127.0576	0	167	2542	4	F
23	P17 P17	80	234	20	20	03.495	275	47.9678	127.1224	0	191	2564	4	F
24	P18 P18	80	234	21	00	15.412	825	47.9235	127.2336	0	168	2596	4	F
25	P19 P19	80	234	21	39	52.377	825	47.8812	127.3454	0	115	2622	4	P

SHOTS P7 AND P11 WERE MISFIRES.

<sup>1</sup> THIS AND SUBSEQUENT WATER DEPTHS ARE DETERMINED FROM 2-WAY TRAVEL-TIME  
USING WATER VELOCITY OF 1490 M/S.

<sup>2</sup> QUALITY CODING : G = GOOD ; F = FAIR ; P = POOR ; E = ESTIMATE

largest offshore explosion (825 kg).

The explosive Nitropel was used for shots N1, N2, A1, and A2 and Hydromex for the J, F and P series.

#### B. REFRACTION DATA CHARACTERISTICS

The refraction records which are presented as time series on digital magnetic tape were recorded on 8 different types of systems, 5 digital and 3 analog, each with its own characteristic gain and frequency response. All data have been converted to a 60 Hz sampling rate with variations in analog tape speeds taken into account. To convert the data to a common ground velocity requires the application of a numerical factor to each time series. This factor, GAIN, is contained in the record header and is defined as follows:

GAIN - the number by which the time series data is to be divided to obtain units of  $10^{-8}$  m/s at a frequency of 5 Hz.

As different calibration procedures were used, the basis for computation of GAIN for the individual systems is sketched:

(i) EMR DIGITAL MK I (12 systems)

Units are  $10^{-8}$  m/s

GAIN = 1.0

(ii) UWO PORTABLE FM (9 systems)

Units are microvolts at amplifier input.

Effective transducer constant  $g = 102$  v/m/s

$$\text{GAIN} = \frac{102}{10^{-6}} \times 10^{-8} = 1.02$$

The velocity response of this system is shown in Figure 8.

(iii) UBC FM SYSTEM (5 systems)

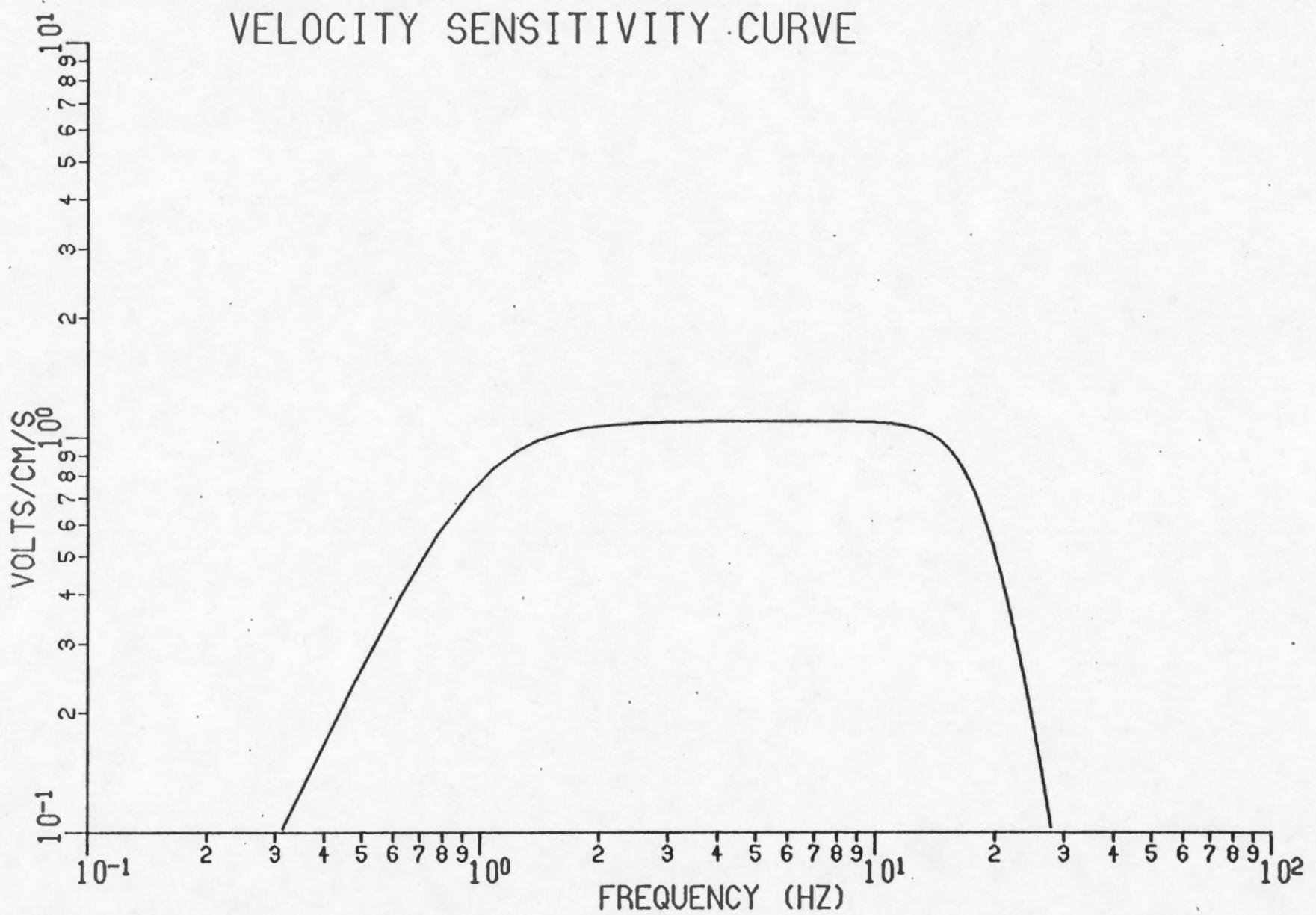
Units are volts at amplifier output.

$$g = 105 * \text{SEIS} \text{ v/m/s}$$

$$\begin{aligned} \text{GAIN} &= G * 105 * \text{SEIS} * 10^{-8} \\ &= 1.05 * 10^{-6} * G * \text{SEIS} \end{aligned}$$

Fig. 8. Velocity sensitivity curve of UWO PORTABLE FM  
with amplifier gain X1.

UNIVERSITY OF WESTERN ONTARIO SEISMIC SYSTEM  
VELOCITY SENSITIVITY CURVE



where  $SEIS = 1.0 \pm 10\%$  and accounts for variation in transducer constants

$G = \text{amplifier gain}$

The velocity response of this system is shown in Figure 9.

(iv) UBC GEOTECH MCR 600 (7 systems)

Units are  $408.6 * (\text{volts at amplifier output})$

$g = 102 \text{ v/m/s}$

$$\text{GAIN} = G * 408.6 * 102 * 10^{-8}$$

$$= 4.17 * 10^{-4} * G$$

Note: For one system a Willmore MK I seismometer was used rather than a Mark Products L4C. In this case  $g = 105 * SEIS \text{ v/m/s}$ .

The velocity response of the standard system is shown in Figure 10.

(v) UA SPRENGNETH DR100 (1 system)

Units are  $0.44 \times 10^{-8} \text{ m/s}$  at 66 db (= 1995)

$$\text{GAIN} = G / (0.448 * 1995)$$

$$= 0.00112 * G$$

(vi) UA DIGITAL ARRAY (1 system)

Units are  $3276.8 * (\text{volts at amplifier output})$

$g = 240 \text{ v/m/s}$

$$\text{GAIN} = G (78 \text{ db}) * 3276.8 * 240 * 10^{-8}$$

$$= 62.434$$

The velocity response of this system is shown in Figure 11.

(vii) UA DIGITAL RCA 1800 (3 systems)

Units are  $1.17 \times 10^{-8} \text{ m/s}$

$$\text{GAIN} = 1. / (1.17) = 0.8547$$

(viii) UBC HYDROPHONE (1 system)

For the single trace recorded with this system, GAIN was chosen to equalize amplitude with that of adjacent traces.

## C. TAPE CHARACTERISTICS FOR VISP 80 REFRACTION DATA

### I. General Specifications:

(i) IBM floating point format

(ii) no label

(iii) logical record length 80 bytes

(iv) block size 4800 bytes

(v) 1600 BPI

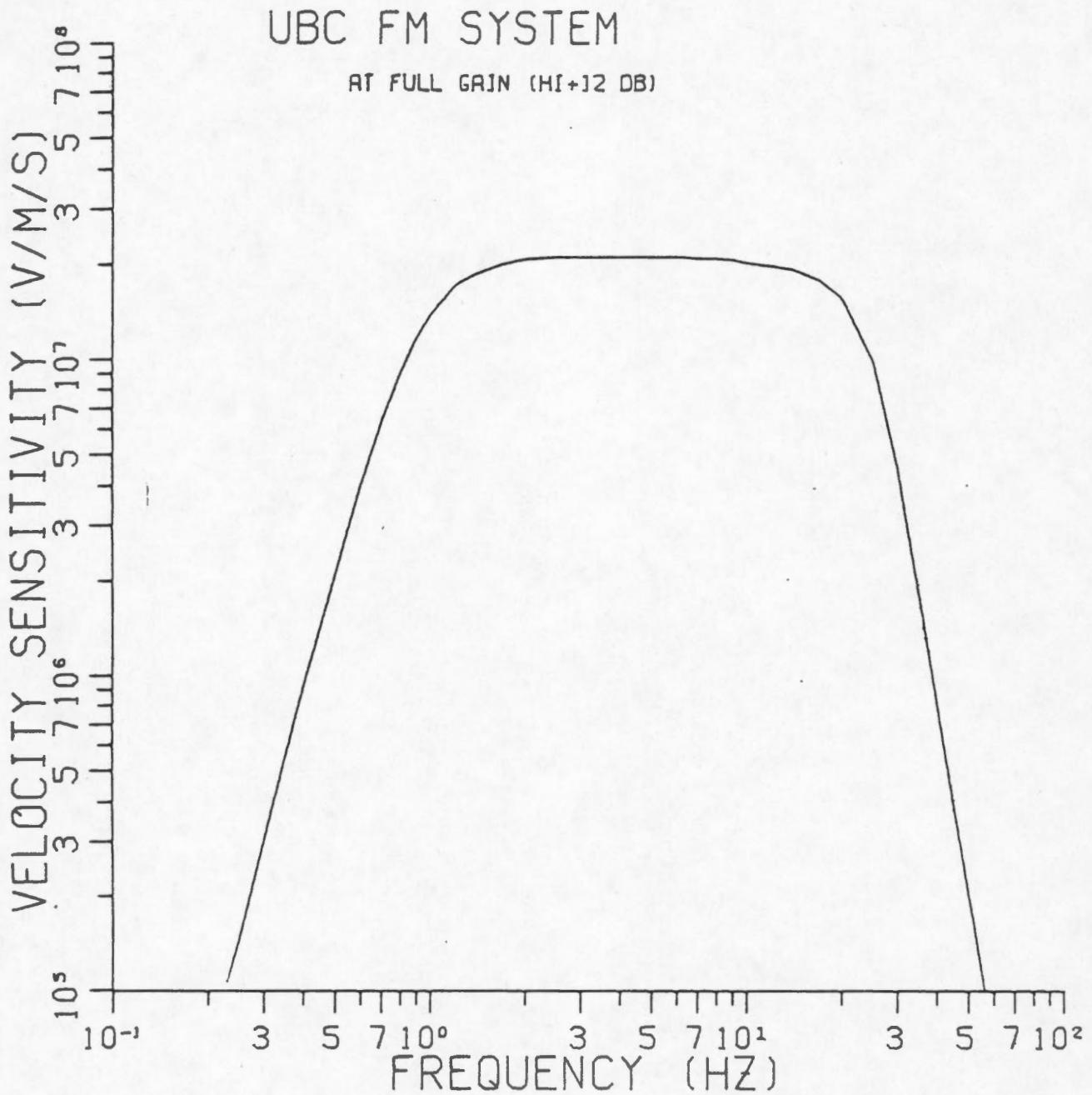


Fig. 9. Velocity sensitivity of UBC FM SYSTEM at amplifier gain of 106 db (i.e. HI=94 db) and SEIS=1.03.

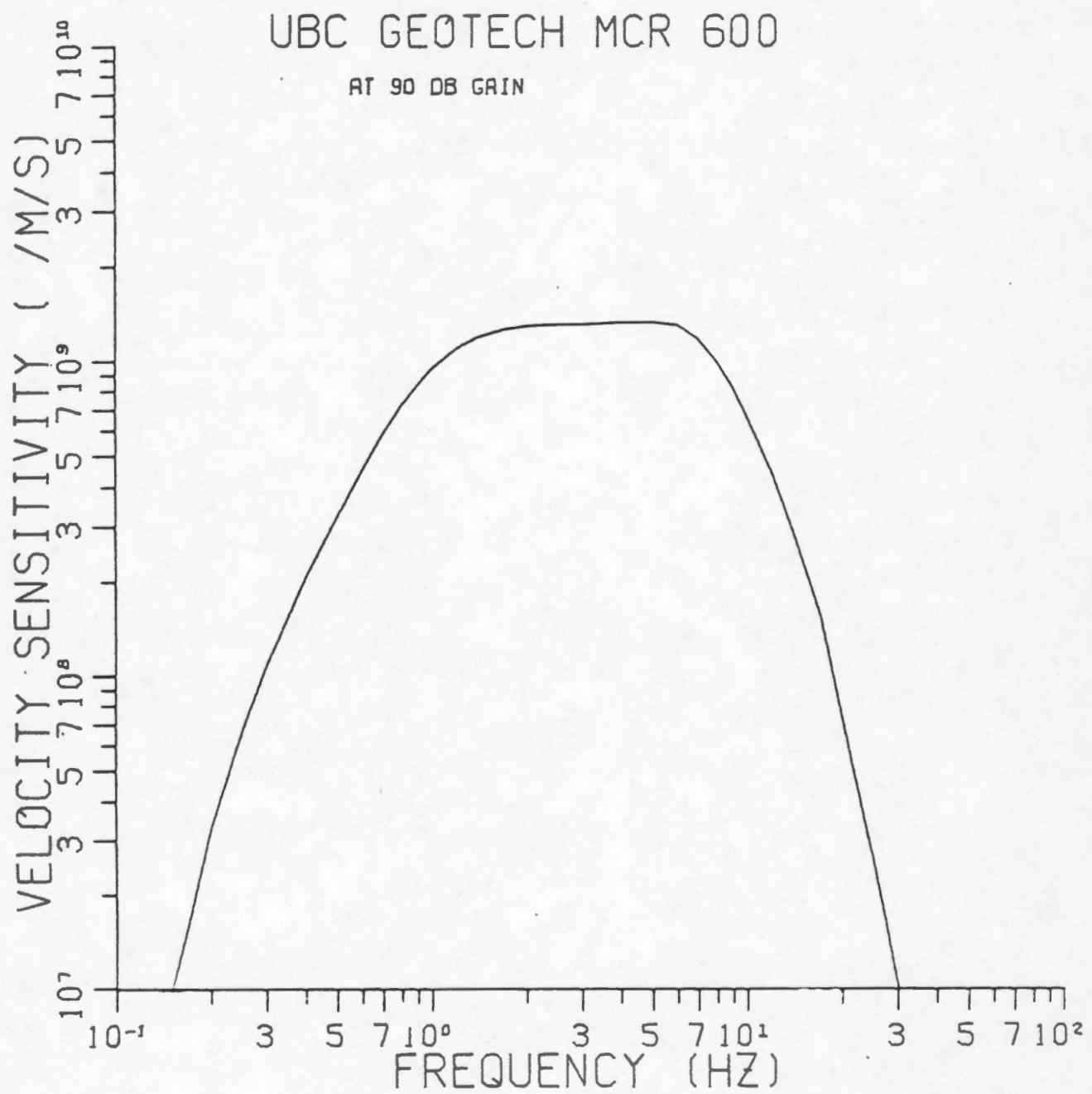


Fig. 10. Velocity sensitivity of UBC GEOTECH MCR 600 at 90 db gain and with Mark Products L4-C seismometer.

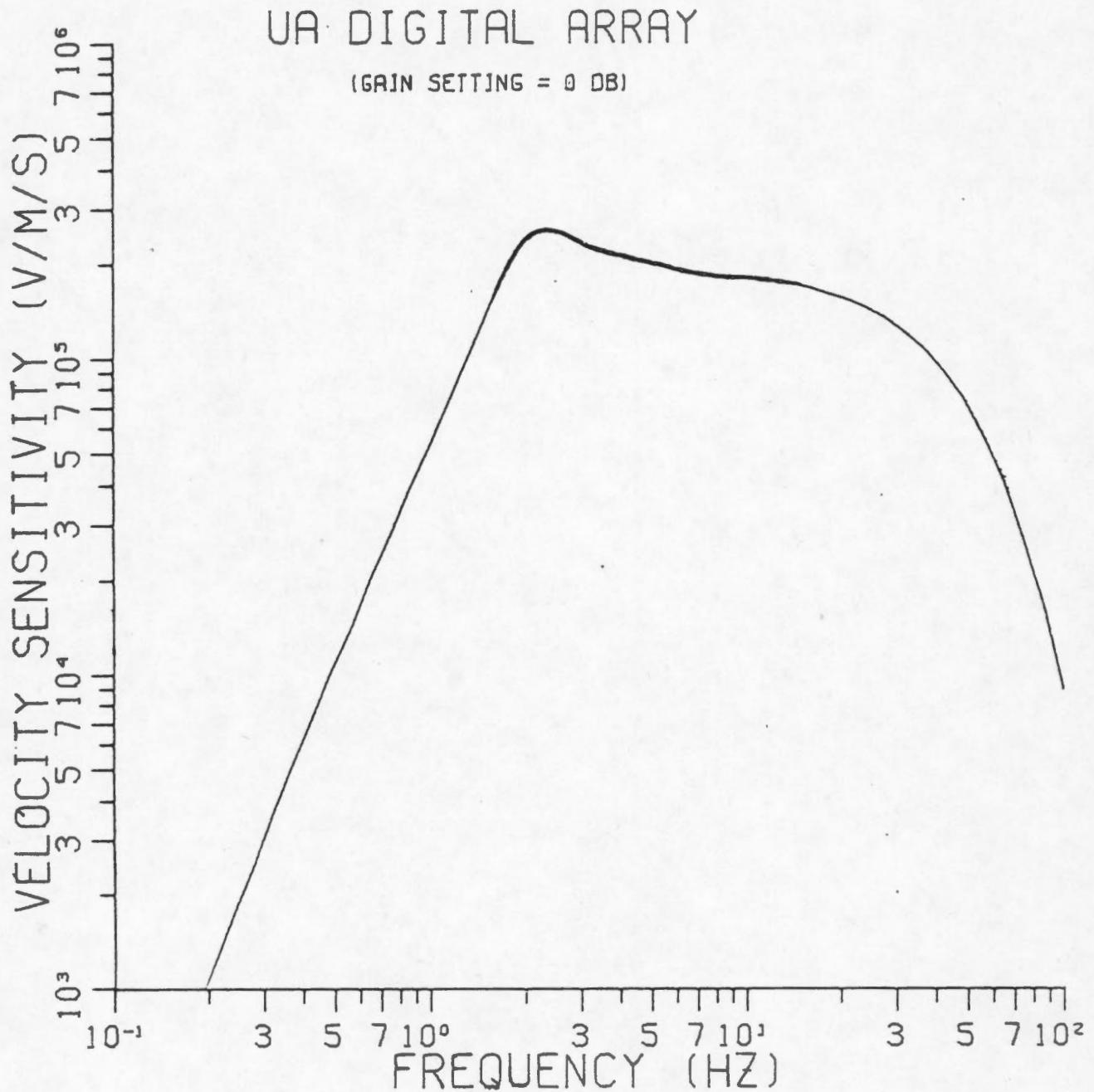


Fig. 11. Velocity sensitivity of UA DIGITAL ARRAY with gain setting 0 db (i.e. amplifier gain 58 db). To convert to digital units multiply by 3276.8.

## II. Record Header Description:

10 card images/header

Card 1. title of experiment

2. line, date, shot time, shot size

3. shot location, shot number, shot latitude and longitude

4. shot elevation, shot depth, receiver elevation

5. coded receiver number, receiver latitude and longitude

6. seismometer type, peak frequency, and seismometer orientation. The orientation may be either VERT, NHOR, EHOR.

7. recorder type, sampling frequency, gain

8. coded receiver number, shot and orientation e.g. 330113

receiver number 330 (field receiver number 33 multiplied by 10 to allow for intermediate receivers; in particular, the UA array fell in between two receiver locations).

shot number 11

orientation 3 - N/S horizontal

Orientation coding: 1 - vertical, 3 - N/S horizontal, 4 - E/W horizontal

9. shot/receiver distance and time after the shot of the first data sample.

10. time of first data sample (UT)

The subroutine WRITIT used to produce the 10 card headers and an example of a header from the VISP 80 experiment is shown in Table 2.

## III. Data Tape Characteristics

(i) Sampling frequency is 60 Hz

(ii) Data plus 3 word header is 7200 samples (~120 s)

3 word header - 1st word receiver number (330)

2nd word shot number (11)

3rd word orientation (3)

(iii) Data is written in format (5E16.6)

One event is thus 1440 records or 24 blocks

The arrangement of the data sets on tape is shown in Table 3.

## D. SEISMIC SECTIONS

For all the large shots ( $\geq$  825 kg) except J1, preliminary seismic sections are plotted. In addition, the section for one 200 kg offshore shot, P8, is shown for comparison. The data sets have been digitally filtered with passband 1 to 20 Hz but no corrections have been applied for shot or receiver elevation, water depth, sediment

TABLE 2

SUBROUTINE WRITIT USED TO PRODUCE HEADERS  
AND EXAMPLE OF VISP 80 HEADER

```
SUBROUTINE WRITIT(ISHOT,IRCVR,JHR,JMIN,TFS,DIST,STIME,RGAIN,IUNIT)
INTEGER*4 ILINE(25),IDAY(25),IYEAR(25),IHOUR(25),IMIN(25),
1           ISIZE(25),ILOC(25),INUMB(25),ISE(25),ISD(25),
2           IRE(200),JTRACE(200),NHOR/'NHOR'/,EHOR/'EHOR'/,
3           IORIEN,JJJ,SNAME(5),RNAME(6),VERT/'VERT'/
REAL*8 DIST
REAL*4 FLDNAM(200),SEC(25),ALAT(200),ALONG(200),BLAT(200),
1           BLONG(200)
COMMON /COM1/ SEC,FLDNAM
COMMON /COM2/ ILINE,IDAY,IHOUR,IMIN,ISIZE,INUMB,ISE,ISD
COMMON /COM3/ IRE,JTRACE,IYEAR,ILOC,SNAME,RNAME
COMMON /COM4/ ALAT,ALONG,BLAT,BLONG
COMMON /COM5/ JJJ,IORIEN
IORIEN=VERT
IF(JJJ.EQ.3)IORIEN=NHOR
IF(JJJ.EQ.4)IORIEN=EHOR
WRITE(IUNIT,800)
     WRITE(IUNIT,801)ILINE(ISHOT),IDAY(ISHOT),IYEAR(ISHOT),
1IHOUR(ISHOT),IMIN(ISHOT),SEC(ISHOT),ISIZE(ISHOT)
     WRITE(IUNIT,802)ILOC(ISHOT),ISHOT,ALAT(ISHOT),ALONG(ISHOT)
     WRITE(IUNIT,803)ISE(ISHOT),ISD(ISHOT),IRE(IRCVR)
     WRITE(IUNIT,804)JTRACE(IRCVR),BLAT(IRCVR),BLONG(IRCVR)
     WRITE(IUNIT,805)(SNAME(K),K=1,5),IORIEN
     WRITE(IUNIT,806)(RNAME(K),K=1,6),RGAIN
     WRITE(IUNIT,807)JTRACE(IRCVR),ISHOT,JJJ
     WRITE(IUNIT,808)DIST,STIME
     WRITE(IUNIT,809)JHR,JMIN,TFS
C
800 FORMAT(' TITLE - VANCOUVER ISLAND SEISMIC PROJECT 1980      ')
801 FORMAT(' LINE - ',A4, ' DATE - ',I3,'D ',I2,'Y SHOT TIME - ',
1I2,'HR ',I2,'MIN ',F6.3,'S SIZE - ',I4,'KG')
802 FORMAT(' SHOT LOCATION - ',A4,' SHOT NUMB - ',I2,' LAT - ',
1F8.4,'DEG LONG - ',F8.4,'DEG')
803 FORMAT(' SHOT ELEVATION - ',I4,'M SHOT DEPTH - ',I3,
1'M RECEIVER ELEVATION - ',I4,'M')
804 FORMAT(' RECEIVER LOCATION - NUMB ',I3,' LAT - ',F8.4,'DEG ',
1'LONG - ',F8.4,'DEG')
805 FORMAT(' SEISMOMETER TYPE - ',5A4,' FREQUENCY',
1' - 1HZ ORIENT - ',A4)
806 FORMAT(' RECORDER TYPE - ',6A4,' SAMPLING FREQ.',
1' 60HZ GAIN',F11.5)
807 FORMAT(' ',I3,I2,I1)
808 FORMAT(' UBC CALCULATED: SHOT/RECEIVER DIST - ',F8.3,
1' START TIME AFTER SHOT : ',F7.3,'S')
809 FORMAT(' TIME OF DATA FIRST SAMPLE ',I2,'HR ',I2,'MIN ',
1F6.3,'S')
RETURN
END
TITLE - VANCOUVER ISLAND SEISMIC PROJECT 1980
LINE - P3 DATE - 234D 80Y SHOT TIME - 15HR 39MIN 58.906S SIZE - 200KG
SHOT LOCATION - P3 SHOT NUMB - 11 LAT - 48.2959DEG LONG - 126.2379DEG
SHOT ELEVATION - OM SHOT DEPTH - 210M RECEIVER ELEVATION - OM
RECEIVER LOCATION - NUMB 330 LAT - 49.6002DEG LONG - 124.2441DEG
SEISMOMETER TYPE - WILLMORE MKII FREQUENCY - 1HZ ORIENT - VERT
RECORDER TYPE - UBC FM SYSTEM (PI) SAMPLING FREQ. 60HZ GAIN 0.05342
330111
UBC CALCULATED: SHOT/RECEIVER DIST - 205.823 START TIME AFTER SHOT : 2.7645
TIME OF DATA FIRST SAMPLE 15HR 40MIN 1.670S
```

Table 3  
ARRANGEMENT OF REFRACTION DATA ON TAPES

	File No.	Line No.*	No. of Events	File Length (meters)
TAPE 1	1	1	60	133.64
	2	2	60	133.64
	3	3	60	133.64
	4	4	59	131.42
TAPE 2	1	5	56	124.74
	2	6	58	129.19
	3	7	52	115.84
	4	8	56	124.74
	5	9	49	109.16
TAPE 3	1	10	46	102.48
	2	11	48	106.93
	3	12	47	104.71
	4	13	47	104.71
	5	14	35	78.00
	6	15	48	106.93
TAPE 4	1	16	48	106.93
	2	17	48	106.93
	3	18	49	109.16
	4	19	47	104.71
	5	20	49	109.16
TAPE 5	1	21	50	111.39
	2	22	50	111.39
	3	23	50	111.39
	4	24	50	111.39
	5	25	49	109.16
6-30		1-25	record headers	

\*

See Table 1 for Line No. - Shot Name relation.

thickness, or shot size. Figures 12 to 17 show these seismic sections with a reducing velocity of 8 km/s. Where first arrival picks have been made, these are indicated by solid arrowheads. Normally, individual traces are scaled to a common amplitude level for plotting.

#### E. ADDITIONAL REFRACTION NOTES

- (i) Time was not available for records, 440011, 440013, 440021, and 440023. For these records, start times have been chosen for alignment with adjacent traces.
- (ii) The water depth at the hydrophone location (record 290081) is  $351 \pm 10$  m.
- (iii) Due to equipment malfunctions, amplitudes are incorrect by up to an order of magnitude or more for the following records:

Receiver	Shots
430	1-3
360	1-3
50	4-6
90	4-6
80	8

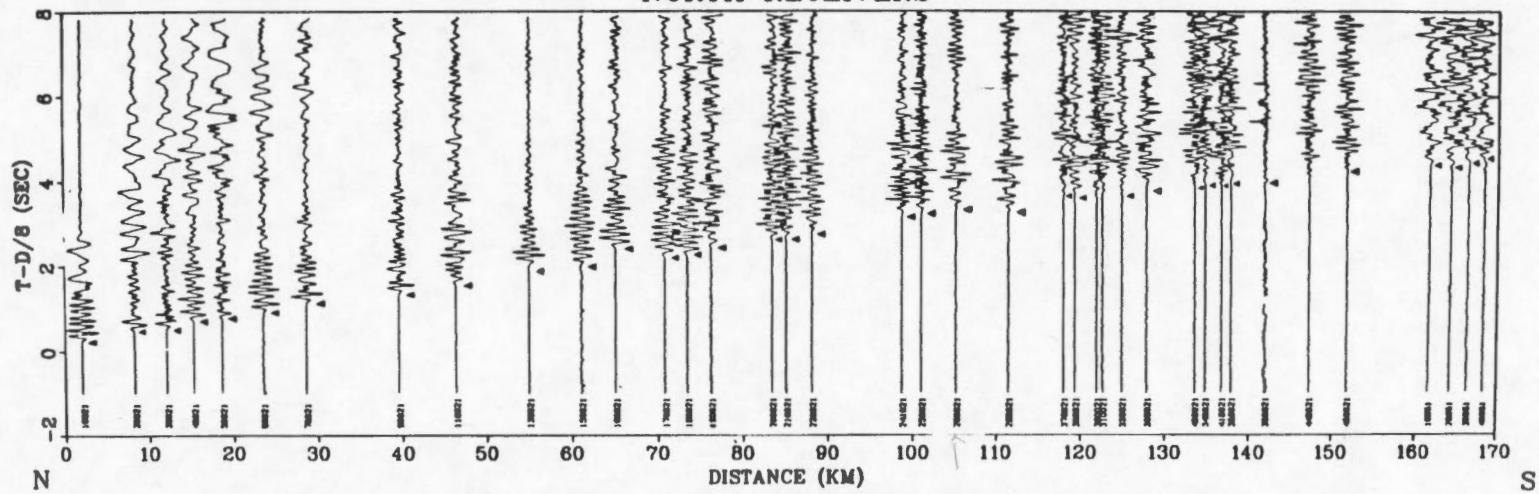
Some of these events should be rejected, while others contain signal and should be retained.

- (iv) On the UA DIGITAL ARRAY the following records were found to be dead or otherwise unuseable:

111041, 114041, 120041, 111061, 120061, 262081, 265081; and Receiver 261, component 1, for shots 7 to 25 (i.e. 261071, 261081, --- , 261251).

## NEROUTSOS SHOTS

### NORTH RECEIVERS



### SOUTH RECEIVERS

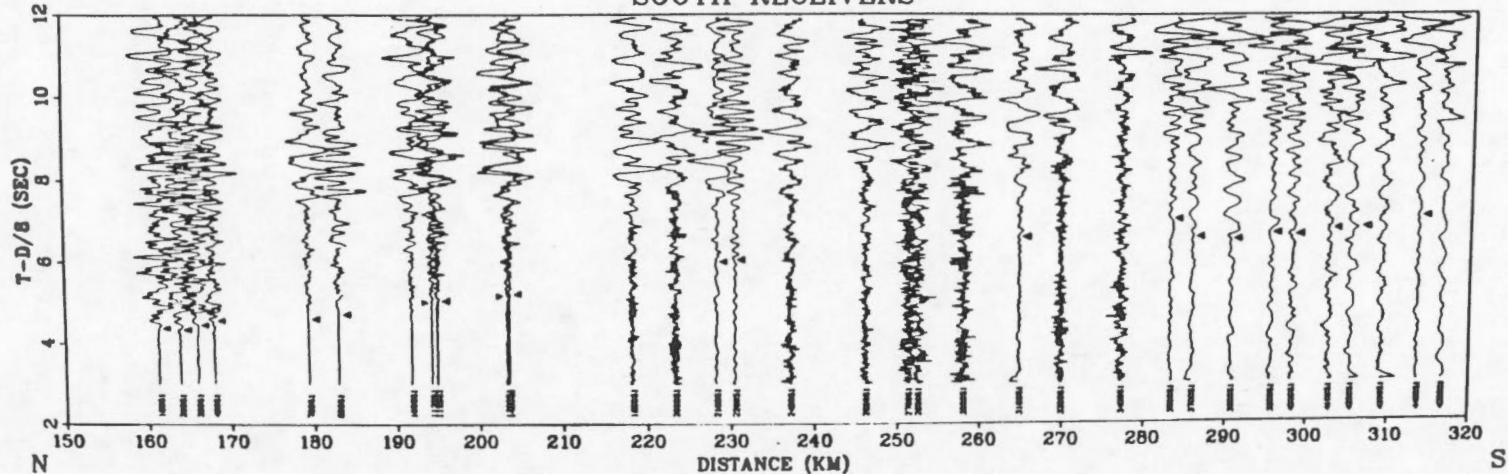


Fig. 12. Preliminary record sections for shots N1 and N2 recorded southward along Line IV. Solid arrowheads indicate first arrivals.

## JUAN DE FUCA SHOTS

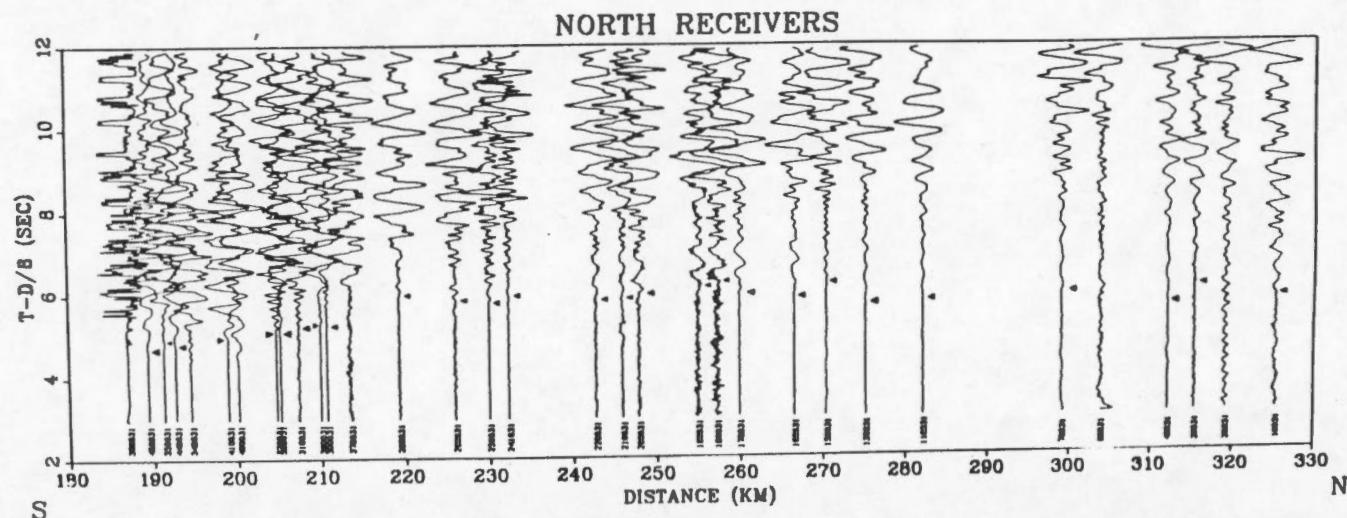
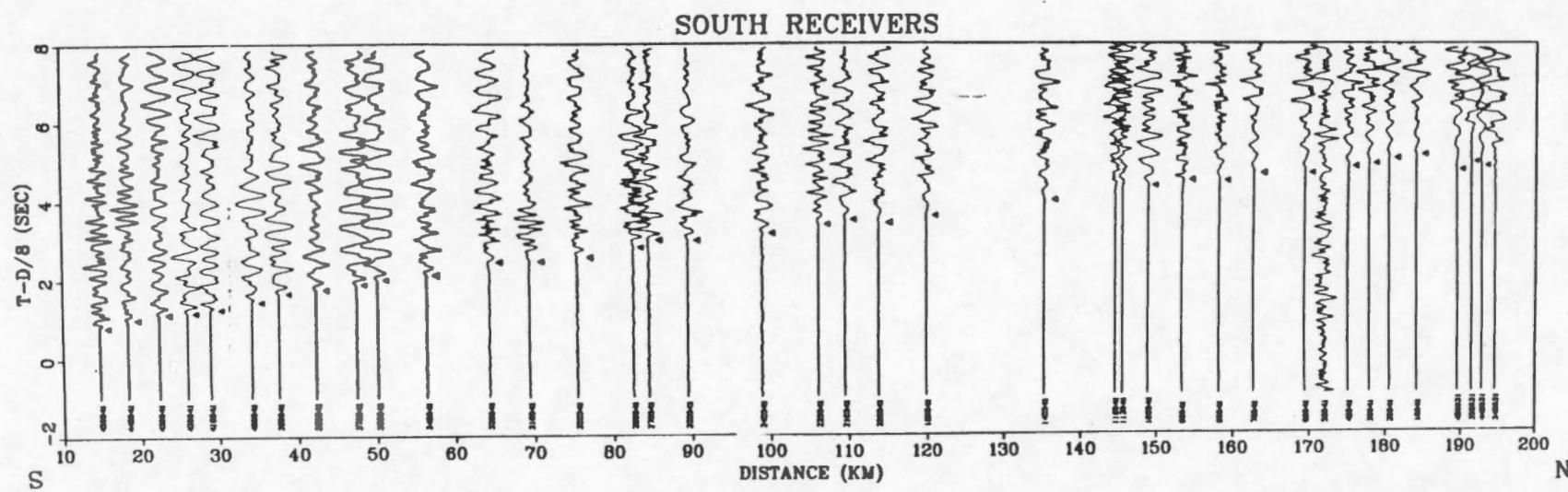


Fig. 13. Preliminary record sections for shots F1 and F2 recorded northward along Line IV.

## ARGONAUT SHOTS

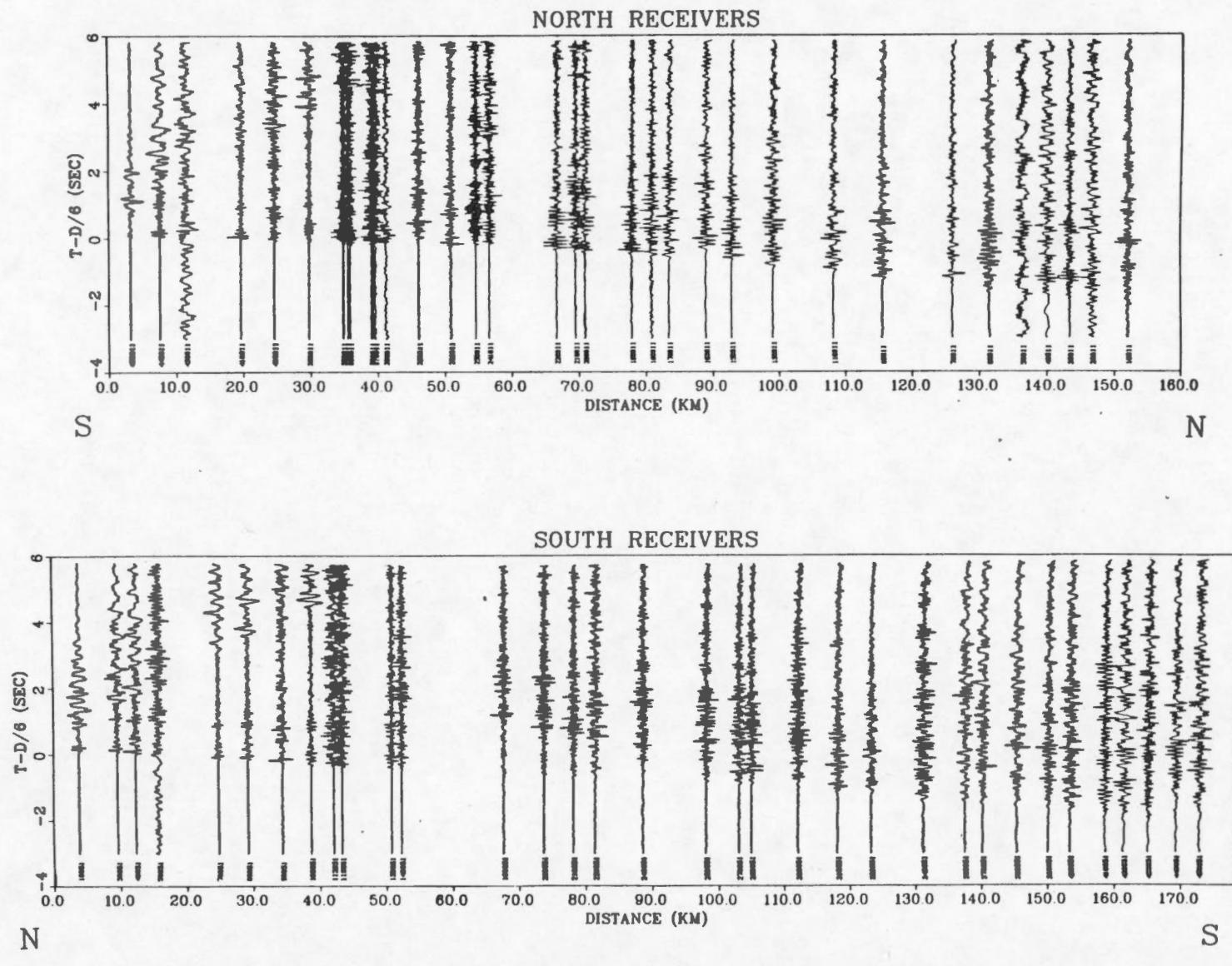


Fig. 14. Preliminary record sections for shots A1 and A2 recorded northward and southward along Line IV.

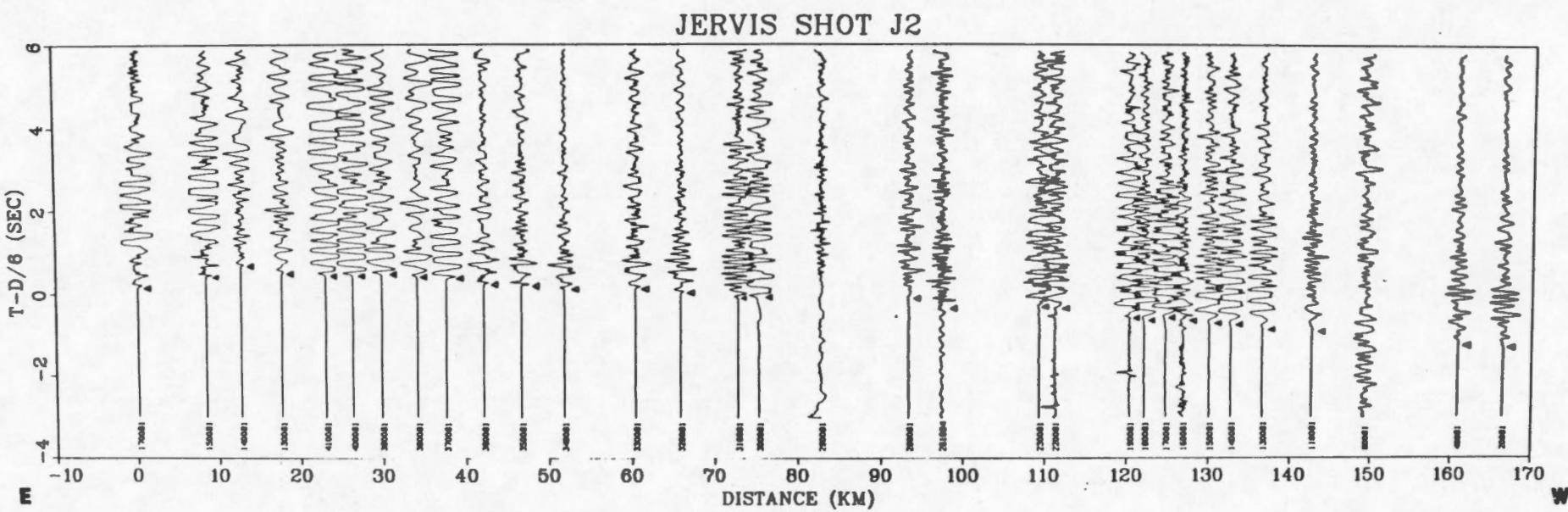


Fig. 15. Preliminary record section for shot J2 recorded westward along Line I.

## PACIFIC SHOTS

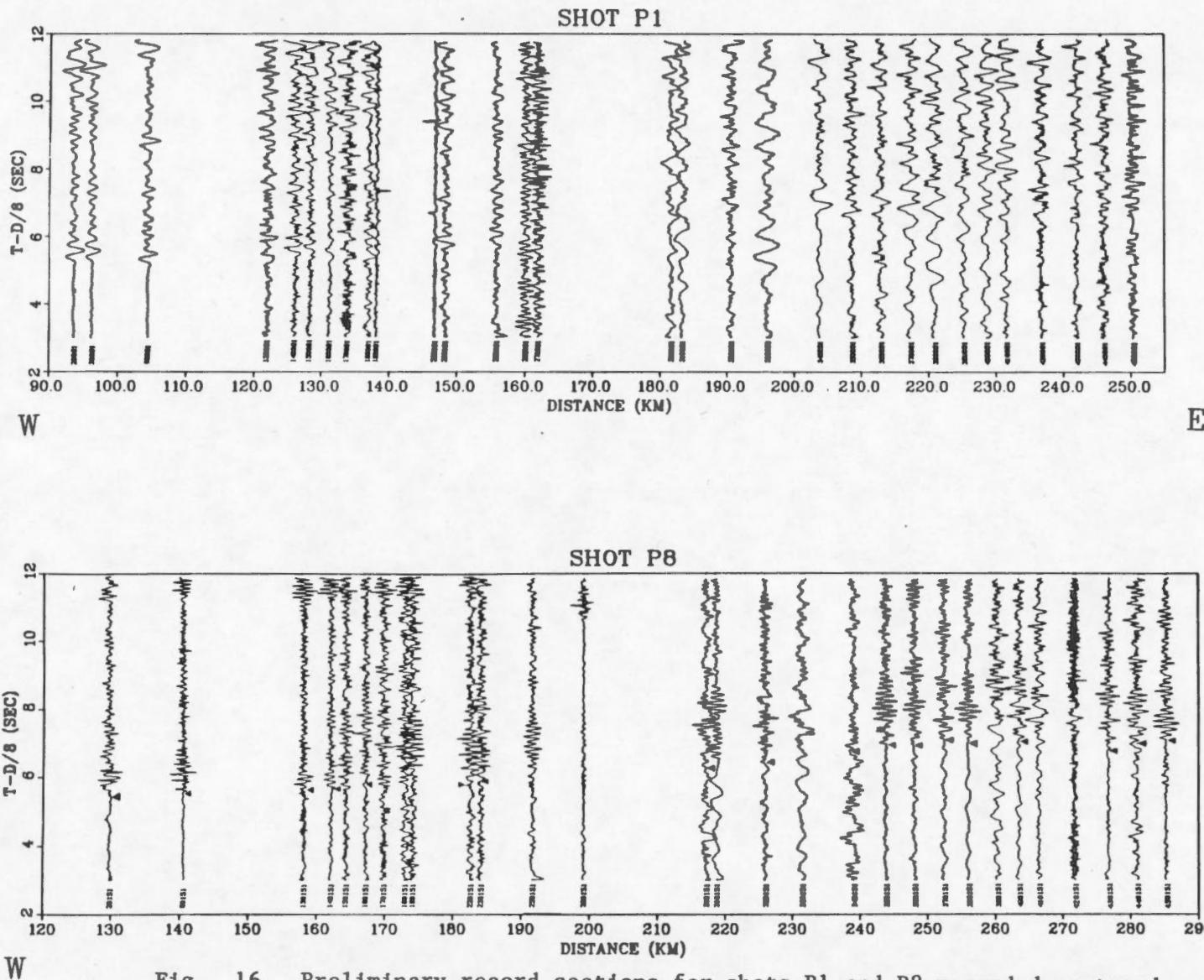


Fig. 16. Preliminary record sections for shots P1 and P8 recorded eastward on Line I. Note the comparatively low quality record section for P1 (825 kg) compared to P8 (200 kg). This is attributed to the complicated tectonics and thicker sediments beneath P1 on the

E

# PACIFIC SHOTS

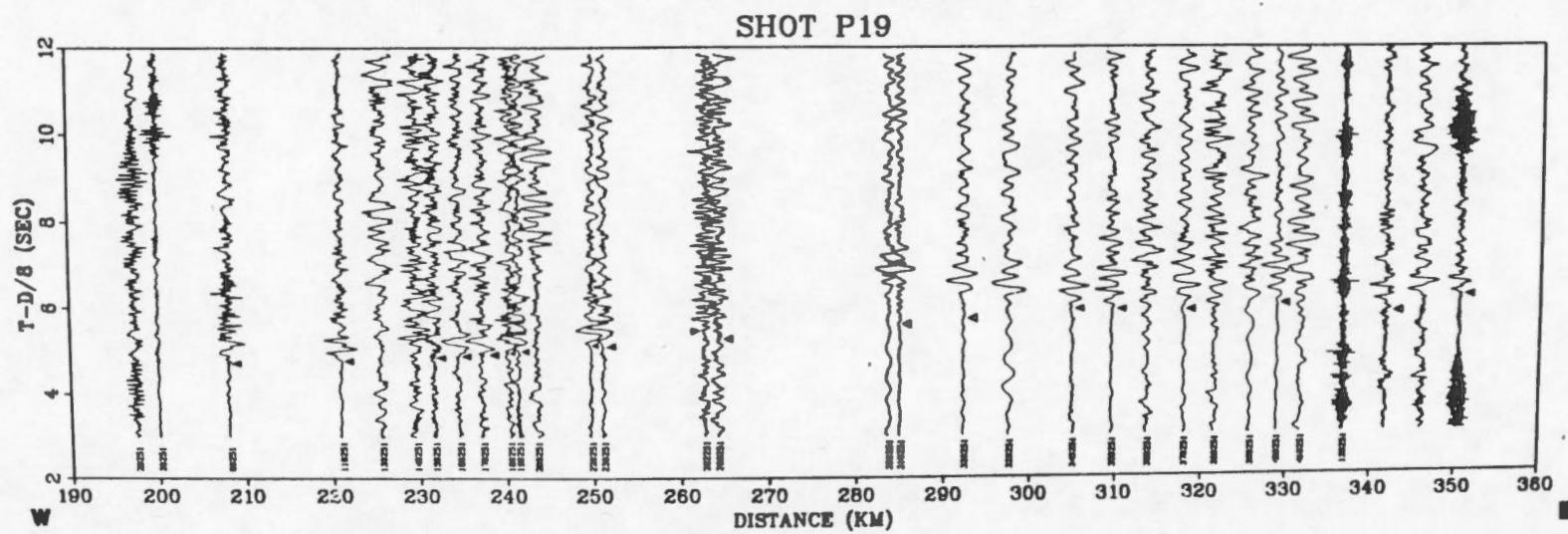
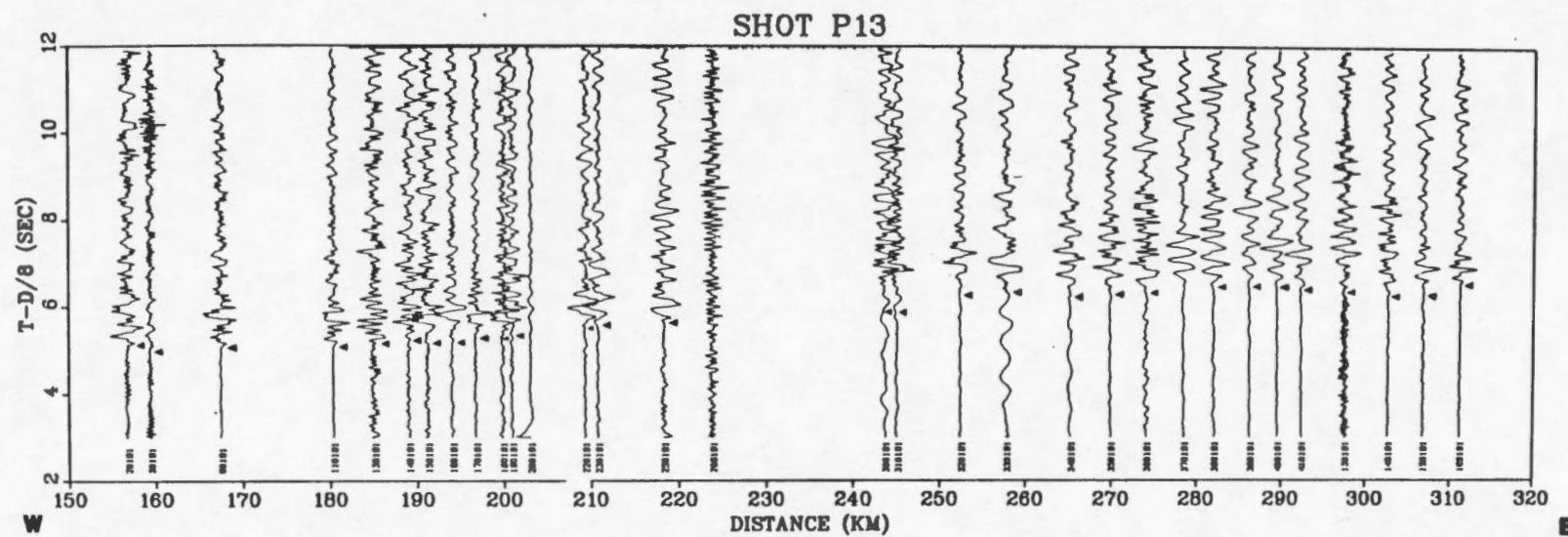


Fig. 17. Preliminary record section for shots P13 and P19 recorded eastward on Line I.

## REFLECTION EXPERIMENT

### A. EXPERIMENT OUTLINE

The 10 km profile lies along the south side of Alberni Inlet on central Vancouver Island (RL in Figure 7). The line is entered by the Spencer Main Line (Spencer ML) off the Port Alberni - Bamfield road (Figure 18) and extends eastward from San Mateo Bay along Ritherdon Road, northwest along Spencer Main Line, and then eastward on Spencer Creek 4 (S.C. 4). The surveyed shot and geophone locations are given in Plate I (accompanying folder) and the elevations provided in Table 4. To provide a more linear profile shots 9 to 17 were offset from the geophone line.

The operational procedure was briefly as follows. The geophones were laid out at positions 1 through 48 and shots 1 to 18 detonated. Subsequently, as the shot location was increased by one position, the geophones were moved by 2 geophone locations i.e. a nominal 500 m offset was maintained between the shot and the nearest geophone position.

### B. FIELD PROCEDURES AND PARAMETERS

#### I. Instrumentation and Shooting Procedures

The data were recorded with a Texas Instruments model DFS III 48 trace seismic system. Record length was 40 seconds; sampling rate was 2 msec. This recording system is equipped with binary gain ranging amplifiers with fifteen 2 to 1 gain steps, providing a 90 db dynamic range and giving a total range of 32,768:1.

The shooting procedure was conducted with an Input/Output Incorporated Model DEC 200 FM decoding system. The FM pulse, generated remotely by the shooter, triggered the entire recording system thus providing an accurate zero time as well as transmitting the uphole time to the recording truck.

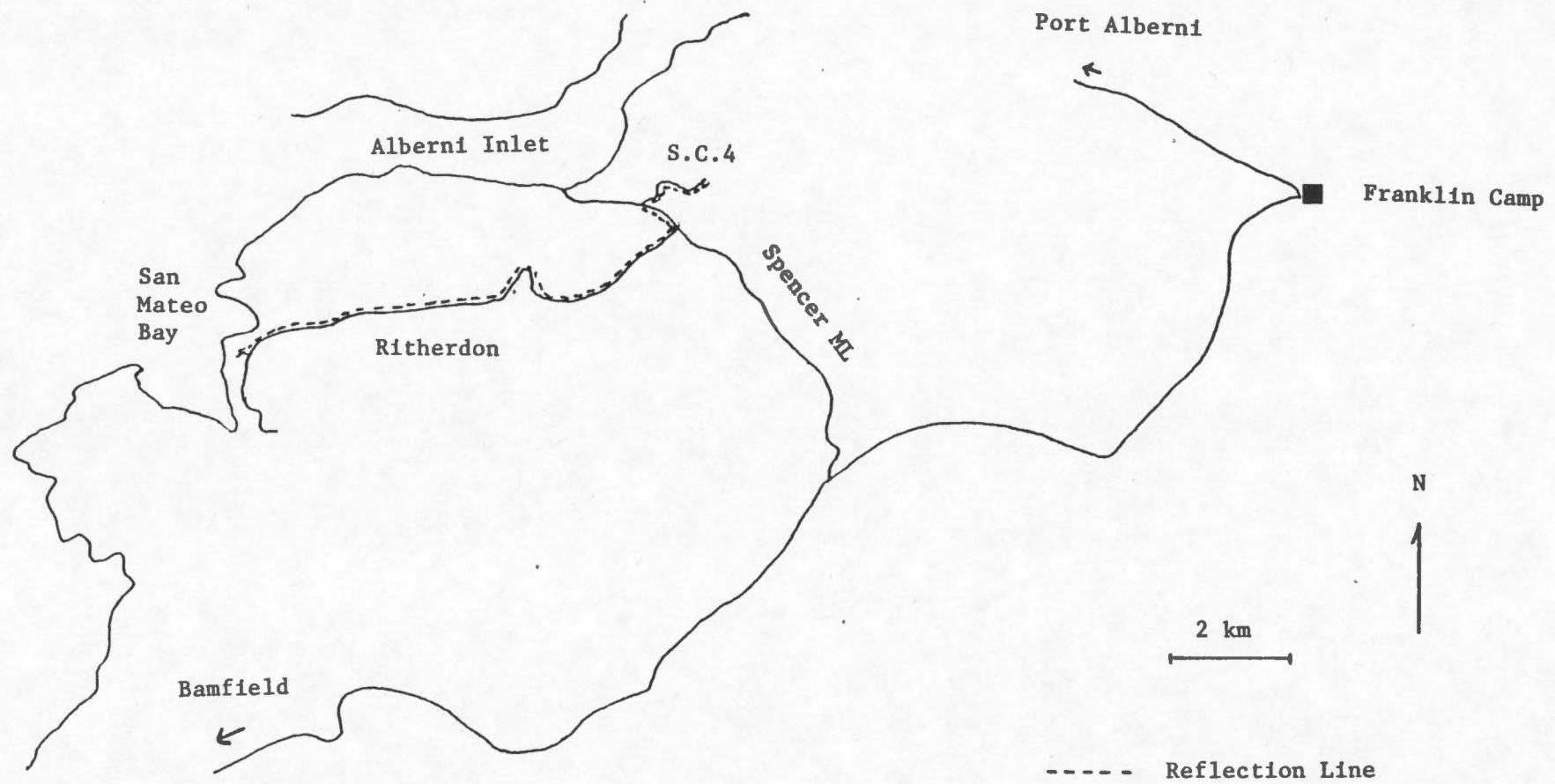


Fig. 18. Location map for reflection line.

Table 4  
REFLECTION PROFILE - STATION ELEVATIONS

Station	Elevation (m)	Station	Elevation (m)	Station	Elevation (m)
01-01	139.0	G-25	212.4	G-49	155.9
G-02	145.2	G-26	211.1	G-50	154.8
3-02	140.1	G-27	221.2	G-51	151.3
G-04	135.7	G-28	222.6	G-52	141.7
5-03	135.1	G-29	223.8	G-53	142.3
G-06	134.0	G-30	216.1	G-54	144.4
7-04	132.3	G-31	212.2	55-19	146.6
G-08	127.0	G-32	208.0	SP-09	235.4
9-05	122.5	G-33	203.8	SP-10	226.9
G-10	119.1	G-34	201.0	SP-11	208.8
11-06	118.8	G-35	201.7	SP-12	223.9
G-12	116.3	G-36	191.5	SP-13	255.7
13-07	114.2	G-37	196.1	SP-14	249.7
G-14	117.0	G-38	200.5	SP-15	189.3
15-08	121.5	G-39	200.0	SP-16	171.9
G-16	123.8	G-40	199.3	SP-17	153.2
G-17	144.2	G-41	191.2	SP-18	145.5
G-18	148.6	G-42	195.8	G-56	146.8
G-19	155.6	G-43	196.0	57-20	146.8
G-20	170.9	G-44	195.7	G-58	145.4
G-21	181.3	G-45	194.1	59-21	143.0
G-22	189.6	G-46	186.2	G-60	143.4
G-23	202.4	G-47	174.4	61-22	125.6
G-24	209.9	G-48	163.8	G-62	112.9
63-23	109.6	87-35	65.2	111-47	88.5
G-64	108.7	G-88	67.7	G-112	80.0
65-24	111.6	89-36	66.3	113-48	78.9
G-66	109.1	G-90	66.9	G-114	76.1
67-25	114.7	91-37	67.4	115-49	75.8
G-68	116.8	G-92	64.2	G-116	78.7
69-26	123.0	93-38	59.9	117-50	82.9
G-70	120.8	G-94	55.4	G-118	81.2
71-27	119.5	95-39	61.6	119-51	78.3
G-72	116.4	G-96	70.7		
73-28	110.9	97-40	78.3		
G-74	104.0	G-98	72.6		
75-29	96.4	99-41	68.8		
G-76	91.1	G-100	62.8		
77-30	84.2	101-42	64.7		
G-78	78.5	G-102	66.2		
79-31	74.5	103-43	71.0		
G-80	72.4	G-104	75.0		
81-32	71.4	105-44	74.0		
G-82	69.8	G-106	71.3		

Table 4 (Continued)

Station	Elevation (m)	Station	Elevation (m)	Station	Elevation (m)
83-33	68.3	107-45	64.8		
G-84	67.4	G-108	65.0		
85-34	65.9	109-46	69.0		
G-86	64.6	G-110	81.2		

Note: For the paired nos. (e.g. 63-23), the first is the geophone location no. and the second is the shot location no. G-geophone SP-shot point

## II. Field Parameters

The principal parameters are as follows:

### (a) Seismic Line

Seismometer group spacing	100 m
No. of geophone groups/shot	48
Geophone interval	5.5 m
No. of geophones/station	18
Geophone type	Mark Products L-15
Geophone frequency	8 Hz
Total no. of receiver locations	114
Group layout	linear

### (b) Shot Point

Shot point spacing	200 m
Total no. of shots	51
Explosives (15 kg Nitropel, 12 kg Powerfrac)	27 kg
Shot hold depth	15.2 m
No. of holes/shot	1

## III. Drilling

Shot holes were normally drilled in the roadside ditch or where this was not possible in the edge of the roadbed. The drilling sub-contractor, TRI-K Drilling Ltd. of Victoria, found poor drilling conditions at 5 sites which necessitated movement of the drill holes from the surveyed locations. These shot skids are given in Table 5.

## IV. Principal Field Personnel

Supervisor - E.R. Kanasewich  
Observer - J. Arnold  
Shooter - B. Reilkoff

## V. Additional Note

The shot at shot location 33 was not recorded due to a malfunction in the recording system.

### C. DATA PROCESSING

The non-linear character of the reflection profile required 'crooked line' processing procedures. In particular, it was required that the CDP offset for each shot-geophone station pair be determined from the survey map (Plate I) for summing the appropriate traces. These CDP offsets are provided in Appendix B.

For processing designations, the unrecorded shot has not been included. Therefore the processing shot nos. 1, 2, --- 32 are the same as the shot location nos. (Plate I and Table 4) but processing shot nos. 33, 34, -- 50 are one less than the shot location no.

#### I. Corrections

Static corrections were computed to effectively place all shots and receivers at a common datum of 100 m above sea level. A replacement velocity of 3,079 km/s was used.

Normal moveout corrections were made using constant velocity stacks. The velocity function used is given in Table 6.

The corrected section is shown in Plate II (accompanying folder) and shows prominent bands of reflected energy near 4.3, 7.2 and 9.5 s 2-way travel time. It is anticipated that improved sections can be obtained by the application of more realistic stacking velocities based on the refraction results.

#### II. Specialized Processing

In addition to the normal stack procedures, two specialized processes developed by Sefel Associates were also applied

##### (a) Coherency Filter - Sono

Takes the traces of a Common Depth Point (CDP) gather. These traces are summed assuming a sequence of dips. A resultant trace is obtained after each dip summation. These resultant traces are summed to generate a pilot trace. This pilot trace is summed back to the CDP gather in a percentage portion.

Table 5

SHOT SKIDS

Shot Location No.	Skid (m)	Direction
23	55	W
41	20	E
42	15	W
43	45	W
46	45	W

Table 6  
STACKING VELOCITIES

Depth (km)	Velocity <sup>1</sup> (km/s)
0.0	3.729
1.9	4.641
6.0	5.553
30.0	6.100

<sup>1</sup>A constant velocity was used in the upper 2 layers and a linear velocity gradient in the lower layer.

(b) Wavelet Processing - Deconvolution

An average wavelet is designed from several input traces assuming minimum phase for the wavelet. This average wavelet is then used to calculate the output trace using principles of inverse filtering. The wavelets are averaged over a running window to secure the most likely wavelet in the different time intervals.

The record sections with the 'coherency filter' and with both the 'coherency filter' and 'wavelet processing' applied are presented in Plates III and IV respectively.

D. TAPE CONTENTS-VISP 80 REFLECTION DATA

The data submitted on magnetic tape are as follows:

- (i) demultiplexed, shot sorted data
- (ii) CDP trace gathers before stack
- (iii) normal stack
- (iv) coherency filter stack
- (v) wavelet processing stack
- (vi) coherency filter and wavelet processing stack.

For both the raw and processed reflection data, the trace lengths are 20 s with sampling interval 4 ms. The submitted tapes contain the data as follows:

- (i) J6830 - Demultiplexed, shot sorted data
  - ID # 1-46
  - Filter: 8-30 Hz
- (ii) J6841 - Demultiplexed, shot sorted data
  - ID # 47-50
  - Filter: 8-30 Hz
- (iii) J6770 - CDP trace gathers before stack
  - ID # 1-91
- (iv) J6780 - CDP trace gathers before stack
  - ID # 92-100

(v) J6604 - Stacked data

ID # 1-10 Normal stack  
11-20 Coherency filter stack  
21-30 Wavelet processing stack  
31-40 Coherency filter and wavelet processing stack.

#### E. TAPE CHARACTERISTICS

1. Tape density: 1600 BPI
2. Labelling: unlabelled
3. Format: tapes are written in 'Sefel IBM Trace Sequential Format'

#### Tape header record

One 40 byte tape header record is written at the beginning of each reel.

Bytes 0-9 - set to zero  
10-11 - number of traces/shot point  
12-13 - input sample interval  
14-15 - number of input samples/trace  
16-17 - output sample interval  
18-19 - number of output samples/trace  
20-39 - set to zero

#### Trace record

Data is written in 32 bit floating point (IBM short) with the first 8 bytes of data overwritten with

Bytes 0-1 - record ID  
2-3 - trace number  
4-5 - zero (0)  
6-7 - one (1)

4. Record length = Block size = 20000 Bytes
5. Trace header and record may be read by

REAL TRACE (5000)

READ (10, 20) (TRACE (I), I = 1,5000)

20 FORMAT (5000 A4)

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## APPENDIX A

### Program Specifications as Detailed in Contract 'Statement of Work'

#### A. Refraction Survey

1. A N-S profile along Vancouver Island will be recorded in two segments, each of approximately 150 km length. Two shots, with recording site offsets from 10 to 150 km, and one shot with offsets of 150 to 300 km will be recorded for each segment. The more distant shots will be 1800 kg, in charge size, the nearer shots 900 kg. (7200 kg total). These shots will be detonated in deep water.
2. Two 900 kg shots are required near the centre of the profile which may be detonated in deep water or in several holes drilled to properly contain these charges.
3. The E-W profile, about 200 km in length, will record shots detonated in the Pacific Ocean and Jervis Inlet using recording sites located on Vancouver Island, islands in the Strait of Georgia and on the Mainland.
4. Recorder spacing should not exceed 10 km except where road access is not available.
5. Instrumentation capable of recording these shots over a passband from 1 to 20 Hz will be required.
6. At least 60 seconds of data, after first arrivals, are to be recorded.
7. Field recording may be digital, AM or FM tape but must finally be available on 9 track,  $\frac{1}{2}$ " magnetic tape, 10 millisecond digital sampling and in a standardized format (to be supplied by Earth Physics Branch).
8. Timing of the shot and recording channels must be accurate to within 10 milliseconds. Accurate chronometers synchronized with WWV/WWVB time signals appear to be the only way to achieve this over the distances involved; however, other suggestions will be examined.

#### B. Reflection Survey

This project is to serve as a trial of the near-vertical, multifold, seismic reflection technique for crustal studies on Vancouver Island.

1. A profile of 5 to 10 km in length with recording site spacings of approximately 100 m is required.
2. Relative timing of shot and recording channels must be accurate to within 2 milliseconds for explosions and to within 4 milliseconds for the airgun.
3. Multiple geophones in a linear array over 100 meters for each trace are required. Geophones should be 10 Hz or lower in resonant frequency and at least 9 of these used per trace.

4. Instrumentation capable of recording over a passband of 8-50 Hz will be required.
5. At least 20 seconds of data, after first arrivals are to be recorded.
6. Some form of amplifier gain control is mandatory and must be recoverable.
7. Final field recording output to be available on 9 track  $\frac{1}{2}$ " magnetic tape, 4 millisecond digital sampling and in a standardized format.
8. Relative timing of shot and recording channels must be accurate to within 2 milliseconds.
9. After-shot inspection, clean-up, repair of damage and settlement of damage claims are the contractors responsibility.

#### C. Horizontal and Vertical Control

1. Refraction Surveys - Horizontal and vertical control of shot-points and recording sites, to within 50 and 15 meter accuracy respectively is to be obtained, except for off-shore shots where the horizontal accuracy may be 250 meters. Horizontal positioning to be stated in terms of latitude and longitude. Earth curvature and ellipticity corrections to be applied when forming time - distance sections.
2. Reflection Surveys - Horizontal and vertical control of shot-points and recording sites, to within a 3 meter accuracy, is to be obtained.

APPENDIX B

COMMON DEPTH POINT OFFSET DISTANCES

- Note: (i) For shot nos. 1, 2, -- 32, shot no. is the same as shot location no. in Plate I and Table 4.
- (ii) For shot nos. 33, 34, -- 50, shot no. is one less than shot location no. in Plate I and Table 4.

1

2

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
1	1	0	3	1	192
2	2	96	4	2	96
3	3	192	5	3	0
4	4	245	6	4	98
5	5	320	7	5	197
6	6	406	8	6	295
7	7	496	9	7	394
8	8	590	10	8	487
9	9	695	11	9	579
10	10	772	12	10	645
11	11	810	13	11	664
12	12	766	14	12	610
13	13	795	15	13	625
14	14	891	16	14	715
15	15	984	17	15	812
16	16	1059	18	16	889
17	17	1043	19	17	865
18	18	990	20	18	806
19	19	903	21	19	716
20	20	868	22	20	677
21	21	846	23	21	654
22	22	732	24	22	540
23	23	671	25	23	481
24	24	726	26	24	540
25	25	818	27	25	636
26	26	840	28	26	670
27	27	934	29	27	760
28	28	1028	30	28	852
29	29	1122	31	29	944
30	30	1217	32	30	1038
31	31	1281	33	31	1104
32	32	1348	34	32	1167
33	33	1420	35	33	1235
34	34	1494	36	34	1308
35	35	1572	37	35	1384
36	36	1666	38	36	1478
37	37	1760	39	37	1572
38	38	1853	40	38	1666
39	39	1934	41	39	1745
40	40	2016	42	40	1827
41	41	2108	43	41	1918
42	42	2199	44	42	2009
43	43	2297	45	43	2107
44	44	2396	46	44	2206
45	45	2494	47	45	2305
46	46	2593	48	46	2404
47	47	2654	49	47	2464
48	48	2710	50	48	2520

3

4

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
5	1	320	7	1	496
6	2	252	8	2	437
7	3	208	9	3	394
8	4	110	10	4	295
9	5	20	11	5	197
10	6	90	12	6	98
11	7	187	13	7	0
12	8	282	14	8	94
13	9	380	15	9	200
14	10	453	16	10	280
15	11	491	17	11	341
16	12	451	18	12	324
17	13	492	19	13	395
18	14	594	20	14	502
19	15	681	21	15	572
20	16	752	22	16	632
21	17	746	23	17	646
22	18	707	24	18	630
23	19	632	25	19	576
24	20	623	26	20	600
25	21	629	27	21	633
26	22	523	28	22	545
27	23	502	29	23	560
28	24	584	30	24	651
29	25	686	31	25	750
30	26	752	32	26	837
31	27	829	33	27	901
32	28	911	34	28	970
33	29	995	35	29	1044
34	30	1081	36	30	1121
35	31	1155	37	31	1199
36	32	1203	38	32	1231
37	33	1257	39	33	1274
38	34	1317	40	34	1321
39	35	1382	41	35	1374
40	36	1477	42	36	1469
41	37	1573	43	37	1565
42	38	1668	44	38	1660
43	39	1740	45	39	1724
44	40	1814	46	40	1791
45	41	1903	47	41	1876
46	42	1992	48	42	1962
47	43	2092	49	43	2063
48	44	2193	50	44	2165
49	45	2293	51	45	2266
50	46	2394	52	46	2368
51	47	2449	53	47	2419
52	48	2497	54	48	2459

5

6

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
9	1	695	11	1	810
10	2	633	12	2	735
11	3	579	13	3	664
12	4	482	14	4	575
13	5	386	15	5	490
14	6	291	16	6	411
15	7	200	17	7	341
16	8	111	18	8	274
17	9	0	19	9	176
18	10	85	20	10	107
19	11	176	21	11	0
20	12	202	22	12	78
21	13	300	23	13	164
22	14	393	24	14	233
23	15	436	25	15	260
24	16	480	26	16	304
25	17	516	27	17	341
26	18	528	28	18	364
27	19	504	29	19	360
28	20	561	30	20	437
29	21	620	31	21	512
30	22	562	32	22	483
31	23	610	33	23	556
32	24	702	34	24	640
33	25	791	35	25	715
34	26	895	36	26	830
35	27	941	37	27	860
36	28	995	38	28	899
37	29	1055	39	29	947
38	30	1120	40	30	1002
39	31	1201	41	31	1083
40	32	1218	42	32	1089
41	33	1244	43	33	1105
42	34	1277	44	34	1130
43	35	1317	45	35	1162
44	36	1410	46	36	1254
45	37	1503	47	37	1346
46	38	1597	48	38	1438
47	39	1652	49	39	1489
48	40	1710	50	40	1545
49	41	1791	51	41	1624
50	42	1873	52	42	1704
51	43	1975	53	43	1806
52	44	2077	54	44	1908
53	45	2179	55	45	2009
54	46	2280	56	46	2111
55	47	2326	57	47	2155
56	48	2359	58	48	2187

7

8

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
13	1	795	15	1	984
14	2	708	16	2	897
15	3	625	17	3	812
16	4	550	18	4	739
17	5	484	19	5	674
18	6	431	20	6	617
19	7	395	21	7	572
20	8	363	22	8	523
21	9	300	23	9	436
22	10	260	24	10	367
23	11	164	25	11	260
24	12	100	26	12	248
25	13	0	27	13	189
26	14	106	28	14	100
27	15	189	29	15	0
28	16	264	30	16	80
29	17	255	31	17	80
30	18	236	32	18	136
31	19	203	33	19	197
32	20	272	34	20	304
33	21	347	35	21	396
34	22	328	36	22	429
35	23	410	37	23	528
36	24	489	38	24	588
37	25	557	39	25	631
38	26	674	40	26	751
39	27	698	41	27	752
40	28	735	42	28	765
41	29	782	43	29	790
42	30	838	44	30	826
43	31	919	45	31	904
44	32	927	46	32	892
45	33	947	47	33	891
46	34	977	48	34	902
47	35	1016	49	35	924
48	36	1109	50	36	1012
49	37	1202	51	37	1102
50	38	1296	52	38	1192
51	39	1352	53	39	1238
52	40	1413	54	40	1290
53	41	1495	55	41	1367
54	42	1579	56	42	1446
55	43	1681	57	43	1548
56	44	1782	58	44	1649
57	45	1884	59	45	1751
58	46	1986	60	46	1853
59	47	2034	61	47	1896
60	48	2071	62	48	1926

Shot  
Number

9

Shot  
Number

10

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
35	1	1480	35	1	1670
36	2	1386	36	2	1575
37	3	1292	37	3	1481
38	4	1240	38	4	1433
39	5	1195	39	5	1390
40	6	1156	40	6	1353
41	7	1124	41	7	1322
42	8	1083	42	8	1280
43	9	996	43	9	1193
44	10	924	44	10	1120
45	11	820	45	11	1016
46	12	806	46	12	1004
47	13	729	47	13	926
48	14	622	48	14	820
49	15	560	49	15	758
50	16	521	50	16	716
51	17	481	51	17	679
52	18	500	52	18	696
53	19	578	53	19	771
54	20	620	54	20	804
55	21	669	55	21	845
56	22	774	56	22	954
57	23	865	57	23	1040
58	24	868	58	24	1033
59	25	840	59	25	992
60	26	931	60	26	1072
61	27	872	61	27	1002
62	28	819	62	28	936
63	29	775	63	29	877
64	30	742	64	30	824
65	31	790	65	31	857
66	32	718	66	32	769
67	33	654	67	33	686
68	34	600	68	34	608
69	35	559	69	35	539
70	36	615	70	36	565
71	37	680	71	37	605
72	38	751	72	38	657
73	39	765	73	39	649
74	40	792	74	40	654
75	41	855	75	41	705
76	42	924	76	42	763
77	43	1022	77	43	858
78	44	1122	78	44	954
79	45	1221	79	45	1051
80	46	1321	80	46	1149
81	47	1357	81	47	1180
82	48	1379	82	48	1195

Shot  
Number

11

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
43	1	2311	42	1	2165
44	2	2215	43	2	2069
45	3	2119	44	3	1973
46	4	2090	45	4	1942
47	5	2065	46	5	1916
48	6	2044	47	6	1895
49	7	2028	48	7	1878
50	8	1998	49	8	1848
51	9	1919	50	9	1769
52	10	1850	51	10	1701
53	11	1744	52	11	1585
54	12	1722	53	12	1572
55	13	1639	54	13	1486
56	14	1532	55	14	1382
57	15	1484	56	15	1334
58	16	1451	57	16	1302
59	17	1403	58	17	1253
60	18	1400	59	18	1250
61	19	1454	60	19	1304
62	20	1456	61	20	1308
63	21	1465	62	21	1318
64	22	1579	63	22	1432
65	23	1642	64	23	1498
66	24	1604	65	24	1461
67	25	1531	66	25	1390
68	26	1566	67	26	1431
69	27	1473	68	27	1339
70	28	1381	69	28	1249
71	29	1290	70	29	1160
72	30	1200	71	30	1072
73	31	1179	72	31	1057
74	32	1080	73	32	956
75	33	980	74	33	855
76	34	881	75	34	755
77	35	782	76	35	654
78	36	702	77	36	587
79	37	637	78	37	528
80	38	575	79	38	481
81	39	478	80	39	390
82	40	381	81	40	303
83	41	306	82	41	259
84	42	243	83	42	244
85	43	249	84	43	304
86	44	292	85	44	382
87	45	360	86	45	470
88	46	441	87	46	562
89	47	451	88	47	584
90	48	453	89	48	597

Shot  
Number

13

Shot  
Number

14

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
40	1	1970	40	1	1952
41	2	1874	41	2	1856
42	3	1778	42	3	1761
43	4	1742	43	4	1720
44	5	1712	44	5	1683
45	6	1686	45	6	1652
46	7	1667	46	7	1626
47	8	1634	47	8	1587
48	9	1553	48	9	1502
49	10	1484	49	10	1430
50	11	1378	50	11	1326
51	12	1358	51	12	1311
52	13	1272	52	13	1230
53	14	1168	53	14	1124
54	15	1117	54	15	1066
55	16	1084	55	16	1026
56	17	1037	56	17	987
57	18	1037	57	18	997
58	19	1096	58	19	1064
59	20	1106	59	20	1084
60	21	1124	60	21	1111
61	22	1238	61	22	1224
62	23	1309	62	23	1301
63	24	1280	63	24	1280
64	25	1216	64	25	1224
65	26	1268	65	26	1285
66	27	1181	66	27	1203
67	28	1096	67	28	1122
68	29	1013	68	29	1045
69	30	933	69	30	971
70	31	933	70	31	980
71	32	832	71	32	880
72	33	731	72	33	781
73	34	630	73	34	683
74	35	530	74	35	586
75	36	488	75	36	560
76	37	463	76	37	550
77	38	457	77	38	556
78	39	396	78	39	502
79	40	352	79	40	463
80	41	366	80	41	478
81	42	403	81	42	509
82	43	490	82	43	592
83	44	581	83	44	680
84	45	676	84	45	771
85	46	772	85	46	864
86	47	800	86	47	885
87	48	816	87	48	892

15

16

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
45	1	2479	55	6	2387
46	2	2383	56	7	2366
47	3	2287	57	8	2331
48	4	2259	58	9	2248
49	5	2235	59	10	2176
50	6	2214	60	11	2072
51	7	2198	61	12	2055
52	8	2168	62	13	1971
53	9	2088	63	14	1866
54	10	2019	64	15	1812
55	11	1913	65	16	1772
56	12	1892	66	17	1732
57	13	1806	67	18	1736
58	14	1702	68	19	1796
59	15	1653	69	20	1804
60	16	1618	70	21	1816
61	17	1572	71	22	1930
62	18	1570	72	23	1996
63	19	1624	73	24	1958
64	20	1626	74	25	1886
65	21	1634	75	26	1921
66	22	1748	76	27	1828
67	23	1810	77	28	1735
68	24	1770	78	29	1643
69	25	1694	79	30	1552
70	26	1726	80	31	1528
71	27	1633	81	32	1429
72	28	1539	82	33	1331
73	29	1447	83	34	1233
74	30	1355	84	35	1136
75	31	1330	85	36	1057
76	32	1231	86	37	982
77	33	1133	87	38	910
78	34	1036	88	39	812
79	35	940	89	40	714
80	36	860	90	41	627
81	37	783	91	42	541
82	38	711	92	43	482
83	39	613	93	44	440
84	40	515	94	45	419
85	41	428	95	46	422
86	42	343	96	47	367
87	43	295	97	48	286
88	44	277	98	49	226
89	45	295	99	50	206
90	46	344	100	51	219
91	47	327	101	52	292
92	48	301	102	53	376

Shot  
Number

17

Shot  
Number

18

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
57	7	2524	55	3	2812
58	8	2485	56	4	2776
59	9	2398	57	5	2748
60	10	2323	58	6	2713
61	11	2221	59	7	2687
62	12	2209	60	8	2645
63	13	2128	61	9	2556
64	14	2023	62	10	2481
65	15	1963	63	11	2380
66	16	1919	64	12	2369
67	17	1884	65	13	2291
68	18	1895	66	14	2184
69	19	1957	67	15	2123
70	20	1973	68	16	2077
71	21	1990	69	17	2044
72	22	2104	70	18	2057
73	23	2172	71	19	2124
74	24	2138	72	20	2139
75	25	2068	73	21	2158
76	26	2107	74	22	2272
77	27	2014	75	23	2341
78	28	1923	76	24	2307
79	29	1831	77	25	2238
80	30	1741	78	26	2277
81	31	1719	79	27	2184
82	32	1620	80	28	2092
83	33	1521	81	29	2001
84	34	1422	82	30	1910
85	35	1324	83	31	1888
86	36	1247	84	32	1789
87	37	1174	85	33	1690
88	38	1104	86	34	1592
89	39	1006	87	35	1494
90	40	908	88	36	1417
91	41	1821	89	37	1342
92	42	735	90	38	1271
93	43	675	91	39	1173
94	44	625	92	40	1075
95	45	589	93	41	987
96	46	570	94	42	899
97	47	500	95	43	834
98	48	400	96	44	776
99	49	302	97	45	728
100	50	212	98	46	692
101	51	126	99	47	616
102	52	128	100	48	510
103	53	190	101	49	405
104	54	237	102	50	300

Shot  
Number

19

Shot  
Number

20

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
59	5	2909	63	7	2887
60	6	2875	64	8	2837
61	7	2845	65	9	2741
62	8	2800	66	10	2661
63	9	2708	67	11	2565
64	10	2631	68	12	2564
65	11	2531	69	13	2494
66	12	2525	70	14	2388
67	13	2449	71	15	2316
68	14	2343	72	16	2261
69	15	2277	73	17	2241
70	16	2227	74	18	2268
71	17	2200	75	19	2343
72	18	2219	76	20	2372
73	19	2289	77	21	2401
74	20	2310	78	22	2514
75	21	2332	79	23	2591
76	22	2446	80	24	2567
77	23	2518	81	25	2505
78	24	2488	82	26	2555
79	25	2421	83	27	2466
80	26	2464	84	28	2378
81	27	2372	85	29	2290
82	28	2282	86	30	2204
83	29	2191	87	31	2189
84	30	2102	88	32	2088
85	31	2082	89	33	1988
86	32	1982	90	34	1887
87	33	1882	91	35	1789
88	34	1783	92	36	1717
89	35	1684	93	37	1651
90	36	1610	94	38	1588
91	37	1537	95	39	1490
92	38	1468	96	40	1392
93	39	1370	97	41	1309
94	40	1272	98	42	1228
95	41	1184	99	43	1173
96	42	1098	100	44	1125
97	43	1034	101	45	1085
98	44	977	102	46	1053
99	45	927	103	47	977
100	46	886	104	48	872
101	47	808	105	49	767
102	48	703	106	50	662
103	49	598	107	51	555
104	50	493	108	52	459
105	51	390	109	53	365
106	52	292	110	54	272

Shot  
Number

21

Shot  
Number

22

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
67	9	2644	71	11	2360
68	10	2562	72	12	2370
69	11	2470	73	13	2310
70	12	2474	74	14	2206
71	13	2410	75	15	2124
72	14	2304	76	16	2061
73	15	2227	77	17	2055
74	16	2168	78	18	2097
75	17	2155	79	19	2182
76	18	2190	80	20	2226
77	19	2271	81	21	2269
78	20	2307	82	22	2378
79	21	2344	83	23	2464
80	22	2455	84	24	2453
81	23	2537	85	25	2405
82	24	2520	86	26	2471
83	25	2464	87	27	2389
84	26	2523	88	28	2309
85	27	2438	89	29	2230
86	28	2353	90	30	2152
87	29	2270	91	31	2152
88	30	2187	92	32	2051
89	31	2180	93	33	1949
90	32	2079	94	34	1848
91	33	1977	95	35	1747
92	34	1876	96	36	1695
93	35	1774	97	37	1646
94	36	1714	98	38	1602
95	37	1656	99	39	1509
96	38	1603	100	40	1416
97	39	1506	101	41	1349
98	40	1410	102	42	1284
99	41	1335	103	43	1259
100	42	1261	104	44	1241
101	43	1221	105	45	1232
102	44	1189	106	46	1231
103	45	1165	107	47	1168
104	46	1149	108	48	1070
105	47	1079	109	49	974
106	48	976	110	50	880
107	49	875	111	51	778
108	50	774	112	52	705
109	51	667	113	53	639
110	52	581	114	54	581
111	53	500	115	55	534
112	54	426	116	56	459
113	55	363	117	57	392
114	56	279	118	58	293

Shot  
Number

23

Shot  
Number

24

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
75	13	2367	79	15	2364
76	14	2263	80	16	2299
77	15	2180	81	17	2295
78	16	2116	82	18	2398
79	17	2111	83	19	2424
80	18	2155	84	20	2469
81	19	2241	85	21	2512
82	20	2287	86	22	2622
83	21	2331	87	23	2708
84	22	2440	88	24	2697
85	23	2527	89	25	2648
86	24	2517	90	26	2714
87	25	2469	91	27	2631
88	26	2537	92	28	2550
89	27	2456	93	29	2470
90	28	2376	94	30	2392
91	29	2297	95	31	2390
92	30	2220	96	32	2288
93	31	2220	97	33	2187
94	32	2119	98	34	2085
95	33	2018	99	35	1984
96	34	1917	100	36	1929
97	35	1816	101	37	1878
98	36	1764	102	38	1830
99	37	1716	103	39	1735
100	38	1672	104	40	1641
101	39	1879	105	41	1569
102	40	1487	106	42	1499
103	41	1419	107	43	1465
104	42	1355	108	44	1438
105	43	1329	109	45	1417
106	44	1311	110	46	1403
107	45	1300	111	47	1334
108	46	1297	112	48	1231
109	47	1233	113	49	1129
110	48	1134	114	50	1028
111	49	1037	115	51	921
112	50	942	116	52	834
113	51	838	117	53	750
114	52	762	118	54	669
115	53	690	119	55	539
116	54	626	120	56	502
117	55	572	121	57	411
118	56	491	122	58	332
119	57	414	123	59	267
120	58	316	124	60	228
121	59	219	125	61	229
122	60	125	126	62	269

Shot  
Number

25

Shot  
Number

26

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
83	17	2485	87	19	2753
84	18	2527	88	20	2790
85	19	2611	89	21	2826
86	20	2654	90	22	2938
87	21	2694	91	23	3020
88	22	2804	92	24	3001
89	23	2889	93	25	2945
90	24	2875	94	26	3001
91	25	2823	95	27	2914
92	26	2886	96	28	2828
93	27	2801	97	29	2743
94	28	2718	98	30	2659
95	29	2636	99	31	2648
96	30	2555	100	32	2547
97	31	2550	101	33	2446
98	32	2448	102	34	2344
99	33	2346	103	35	2243
100	34	2245	104	36	2178
101	35	2143	105	37	2115
102	36	2084	106	38	2055
103	37	2027	107	39	1957
104	38	1974	108	40	1859
105	39	1877	109	41	1778
106	40	1781	110	42	1697
107	41	1705	111	43	1643
108	42	1630	112	44	1595
109	43	1587	113	45	1551
110	44	1549	114	46	1513
111	45	1517	115	47	1435
112	46	1491	116	48	1330
113	47	1417	117	49	1225
114	48	1312	118	50	1120
115	49	1208	119	51	1015
116	50	1103	120	52	918
117	51	996	121	53	821
118	52	902	122	54	723
119	53	808	123	55	626
120	54	716	124	56	546
121	55	626	125	57	470
122	56	534	126	58	471
123	57	443	127	59	491
124	58	402	128	60	530
125	59	382	129	61	584
126	60	388	130	62	648
127	61	417	131	63	553
128	62	466	132	64	461
129	63	378	133	65	370
130	64	283	134	66	281

Shot  
Number

27

CDP	Station Number	OFFSET (m)
91	21	3005
92	22	3117
93	23	3197
94	24	3178
95	25	3119
96	26	3174
97	27	3086
98	28	2999
99	29	2913
100	30	2827
101	31	2814
102	32	2713
103	33	2612
104	34	2511
105	35	2410
106	36	2343
107	37	2277
108	38	2214
109	39	2116
110	40	2018
111	41	1934
112	42	1851
113	43	1792
114	44	1737
115	45	1687
116	46	1641
117	47	1562
118	48	1458
119	49	1358
120	50	1250
121	51	1150
122	52	1052
123	53	955
124	54	857
125	55	760
126	56	690
127	57	625
128	58	641
129	59	672
130	60	710
131	61	768
132	62	829
133	63	735
134	64	642
135	65	550
136	66	459
137	67	368
138	68	274

Shot  
Number

28

CDP	Station Number	OFFSET (m)
95	23	3366
96	24	3350
97	25	3294
98	26	3352
99	27	3265
100	28	3180
101	29	3095
102	30	3010
103	31	3000
104	32	2898
105	33	2797
106	34	2696
107	35	2595
108	36	2529
109	37	2466
110	38	2405
111	39	2307
112	40	2209
113	41	2126
114	42	2045
115	43	1988
116	44	1936
117	45	1887
118	46	1843
119	47	1764
120	48	1659
121	49	1555
122	50	1451
123	51	1350
124	52	1252
125	53	1155
126	54	1057
127	55	959
128	56	886
129	57	817
130	58	822
131	59	839
132	60	867
133	61	905
134	62	952
135	63	866
136	64	771
137	65	677
138	66	582
	67	488
	68	410
	69	341
	70	290

Shot  
Number

29

Shot  
Number

30

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
99	25	3477	103	27	3648
100	26	3535	104	28	3563
101	27	3449	105	29	3476
102	28	3363	106	30	3894
103	29	3279	107	31	3383
104	30	3195	108	32	3282
105	31	3184	109	33	3180
106	32	3083	110	34	3079
107	33	2982	111	35	2978
108	34	2880	112	36	2913
109	35	2779	113	37	2849
110	36	2714	114	38	2787
111	37	2650	115	39	2689
112	38	2589	116	40	2591
113	39	2491	117	41	2507
114	40	2393	118	42	2425
115	41	2310	119	43	2366
116	42	2228	120	44	2311
117	43	2171	121	45	2258
118	44	2117	122	46	2210
119	45	2067	123	47	2130
120	46	2021	124	48	2026
121	47	1941	125	49	1923
122	48	1837	126	50	1820
123	49	1733	127	51	1721
124	50	1630	128	52	1624
125	51	1530	129	53	1527
126	52	1432	130	54	1430
127	53	1335	131	55	1333
128	54	1237	132	56	1264
129	55	1140	133	57	1198
130	56	1069	134	58	1205
131	57	1001	135	59	1221
132	58	1007	136	60	1244
133	59	1022	137	61	1275
134	60	1046	138	62	1312
135	61	1079	139	63	1231
136	62	1120	140	64	1138
137	63	1037	141	65	1044
138	64	943	142	66	951
139	65	849	143	67	858
140	66	755	144	68	788
141	67	662	145	69	724
142	68	590	146	70	669
143	69	525	147	71	574
144	70	472	148	72	477
145	71	380	149	73	383
146	72	281	150	74	287

Shot  
Number

31

Shot  
Number

32

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
107	29	3611	111	31	3726
108	30	3528	112	32	3624
109	31	3520	113	33	3523
110	32	3419	114	34	3421
111	33	3317	115	35	3320
112	34	3216	116	36	3258
113	35	3115	117	37	2198
114	36	3052	118	38	3139
115	37	2991	119	39	3042
116	38	2931	120	40	2944
117	39	2834	121	41	2863
118	40	2736	122	42	2783
119	41	2654	123	43	2728
120	42	2574	124	44	2676
121	43	2518	125	45	2627
122	44	2466	126	46	2481
123	45	2417	127	47	2501
124	46	2371	128	48	2398
125	47	2292	129	49	2294
126	48	2188	130	50	2190
127	49	2084	131	51	2089
128	50	1980	132	52	1992
129	51	1880	133	53	1895
130	52	1782	134	54	1797
131	53	1685	135	55	1700
132	54	1587	136	56	1626
133	55	1490	137	57	1555
134	56	1416	138	58	1552
135	57	1346	139	59	1556
136	58	1345	140	60	1566
137	59	1351	141	61	1582
138	60	1365	142	62	1604
139	61	1386	143	63	1534
140	62	1413	144	64	1444
141	63	1339	145	65	1355
142	64	1247	146	66	1266
143	65	1156	147	67	1178
144	66	1066	148	68	1123
145	67	977	149	69	1073
146	68	917	150	70	1030
147	69	865	151	71	940
148	70	820	152	72	840
149	71	730	153	73	740
150	72	630	154	74	640
151	73	530	155	75	550
152	74	430	156	76	465
153	75	340	157	77	378
154	76	259	158	78	292

CDP	Shot Number	Station Number	OFFSET (m)	CDP	Shot Number	Station Number	OFFSET (m)
	33				34		
119	35	3712		123	37	3774	
120	36	3652		124	38	3717	
121	37	3593		125	39	3620	
122	38	3536		126	40	3522	
123	39	3438		127	41	3442	
124	40	3341		128	42	3362	
125	41	3261		129	43	3308	
126	42	3181		130	44	3256	
127	43	3127		131	45	3207	
128	44	3076		132	46	3160	
129	45	3027		133	47	3081	
130	46	3981		134	48	2977	
131	47	3901		135	49	2873	
132	48	3797		136	50	2770	
133	49	2694		137	51	2670	
134	50	2590		138	52	2572	
135	51	2489		139	53	2475	
136	52	2392		140	54	2377	
137	53	2295		141	55	2280	
138	54	2197		142	56	2207	
139	55	2100		143	57	2135	
140	56	2026		144	58	2130	
141	57	1954		145	59	2130	
142	58	1949		146	60	2134	
143	59	1949		147	61	2143	
144	60	1954		148	62	2157	
145	61	1964		149	63	2093	
146	62	1979		150	64	2006	
147	63	1914		151	65	1919	
148	64	1827		152	66	1834	
149	65	1740		153	67	1749	
150	66	1654		154	68	1698	
151	67	1568		155	69	1652	
152	68	1517		156	70	1610	
153	69	1471		157	71	1520	
154	70	1430		158	72	1420	
155	71	1340		159	73	1320	
156	72	1240		160	74	1220	
157	73	1140		161	75	1130	
158	74	1040		162	76	1041	
159	75	950		163	77	951	
160	76	862		164	78	870	
161	77	774		165	79	790	
162	78	691		166	80	686	
163	79	609		167	81	583	
164	80	506		168	82	480	
165	81	403		169	83	380	
166	82	300		170	84	282	

Shot  
Number

35

Shot  
Number

36

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
127	39	3753	131	41	3771
128	40	3655	132	42	3690
129	41	3574	133	43	3634
130	42	3492	134	44	3581
131	43	3436	135	45	3520
132	44	3382	136	46	3480
133	45	3330	137	47	3400
134	46	3280	138	48	3296
135	47	3200	139	49	3193
136	48	3097	140	50	3091
137	49	2994	141	51	2992
138	50	2891	142	52	2895
139	51	2793	143	53	2798
140	52	2695	144	54	2700
141	53	2598	145	55	2603
142	54	2501	146	56	2532
143	55	2404	147	57	2462
144	56	2334	148	58	2460
145	57	2264	149	59	2462
146	58	2264	150	60	2468
147	59	2268	151	61	2478
148	60	2276	152	62	2492
149	61	2288	153	63	2428
150	62	2305	154	64	2341
151	63	2239	155	65	2254
152	64	2151	156	66	2168
153	65	2063	157	67	2082
154	66	1976	158	68	2030
155	67	1889	159	69	1981
156	68	1835	160	70	1935
157	69	1784	161	71	1843
158	70	1737	162	72	1744
159	71	1644	163	73	1645
160	72	1545	164	74	1546
161	73	1447	165	75	1453
162	74	1348	166	76	1360
163	75	1254	167	77	1270
164	76	1161	168	78	1192
165	77	1071	169	79	1116
166	78	994	170	80	1013
167	79	919	171	81	910
168	80	816	172	82	807
169	81	714	173	83	711
170	82	611	174	84	616
171	83	517	175	85	522
172	84	427	176	86	429
173	85	334	177	87	335
174	86	241	178	88	263

Shot Number		Shot Number			
37		38			
CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
135	43	3834	139	45	3929
136	44	3780	140	46	3880
137	45	3729	141	47	3800
138	46	3680	142	48	3696
139	47	3600	143	49	3493
140	48	3496	144	50	3490
141	49	3393	145	51	3391
142	50	3290	146	52	3294
143	51	3192	147	53	3197
144	52	3095	148	54	3100
145	53	2997	149	55	3002
146	54	2900	150	56	2930
147	55	2803	151	57	2860
148	56	2731	152	58	2856
149	57	2661	153	59	2855
150	58	2658	154	60	2858
151	59	2659	155	61	2864
152	60	2664	156	62	2874
153	61	2672	157	63	2813
154	62	2684	158	64	2727
155	63	2621	159	65	2642
156	64	2535	160	66	2558
157	65	2449	161	67	2474
158	66	2363	162	68	2424
159	67	2279	163	69	2377
160	68	2227	164	70	2334
161	69	2179	165	71	2242
162	70	2135	166	72	2143
163	71	2042	167	73	2044
164	72	1944	168	74	1944
165	73	1845	169	75	1851
166	74	1745	170	76	1760
167	75	1652	171	77	1670
168	76	1560	172	78	1591
169	77	1470	173	79	1514
170	78	1392	174	80	1410
171	79	1315	175	81	1307
172	80	1212	176	82	1204
173	81	1109	177	83	1105
174	82	1006	178	84	1008
175	83	908	179	85	916
176	84	812	180	86	823
177	85	719	181	87	725
178	86	626	182	88	660
179	87	529	183	89	600
180	88	462	184	90	500
181	89	400	185	91	400
182	90	300	186	92	300

	Shot Number			Shot Number	
CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
143	47	4000	147	49	3983
144	48	3886	148	50	3881
145	49	3793	149	51	3782
146	50	3690	150	52	3684
147	51	3590	151	53	3587
148	52	3493	152	54	3490
149	53	3395	153	55	3393
150	54	3298	154	56	3321
151	55	3201	155	57	3250
152	56	3128	156	58	3245
153	57	3056	157	59	3244
154	58	3050	158	60	3245
155	59	3047	159	61	3250
156	60	3049	160	62	3257
157	61	3051	161	63	3198
158	62	3058	162	64	3113
159	63	3000	163	65	3029
160	64	2915	164	66	2945
161	65	2831	165	67	2862
162	66	2748	166	68	2813
163	67	2665	167	69	2767
164	68	2618	168	70	2724
165	69	2573	169	71	2632
166	70	2531	170	72	2533
167	71	2440	171	73	2434
168	72	2341	172	74	2334
169	73	2241	173	75	2242
170	74	2141	174	76	2150
171	75	2050	175	77	2060
172	76	1959	176	78	1982
173	77	1870	177	79	1904
174	78	1790	178	80	1801
175	79	1711	179	81	1697
176	80	1608	180	82	1594
177	81	1504	181	83	1496
178	82	1401	182	84	1398
179	83	1302	183	85	1305
180	84	1203	184	86	1214
181	85	1111	185	87	1115
182	86	1020	186	88	1051
183	87	921	187	89	989
184	88	860	188	90	890
185	89	802	189	91	790
186	90	702	190	92	690
187	91	602	191	93	590
188	92	500	192	94	489
189	93	402	193	95	391
190	94	305	194	96	296

Shot  
Number

41

Shot  
Number

42

CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
151	51	3911	155	53	3911
152	52	3814	156	54	3815
153	53	3717	157	55	3718
154	54	3621	158	56	3649
155	55	3524	159	57	3582
156	56	3455	160	58	3582
157	57	3387	161	59	3586
158	58	3387	162	60	3592
159	59	3390	163	61	3601
160	60	3396	164	62	3612
161	61	3404	165	63	3550
162	62	3416	166	64	3464
163	63	3354	167	65	3377
164	64	3267	168	66	3291
165	65	3181	169	67	3206
166	66	3095	170	68	3153
167	67	3010	171	69	3102
168	68	2957	172	70	3053
169	69	2907	173	71	2959
170	70	2859	174	72	2862
171	71	2765	175	73	2764
172	72	2667	176	74	2665
173	73	2569	177	75	2570
174	74	2470	178	76	2475
175	75	2375	179	77	2385
176	76	2281	180	78	2310
177	77	2191	181	79	2237
178	78	2116	182	80	2134
179	79	2042	183	81	2032
180	80	1939	184	82	1930
181	81	1836	185	83	1834
182	82	1734	186	84	1739
183	83	1638	187	85	1646
184	84	1543	188	86	1553
185	85	1450	189	87	1457
186	86	1357	190	88	1387
187	87	1261	191	89	1318
188	88	1191	192	90	1220
189	89	1122	193	91	1123
190	90	1025	194	92	1030
191	91	927	195	93	930
192	92	834	196	94	829
193	93	733	197	95	743
194	94	633	198	96	662
195	95	547	199	97	573
196	96	470	200	98	475
197	97	386	201	99	380
198	98	293	202	100	284

	Shot Number		Shot Number		
CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
159	55	3913	161	55	4066
160	56	3843	162	56	3997
161	57	3774	163	57	3929
162	58	3773	164	58	3928
163	59	3774	165	59	3930
164	60	3778	166	60	3934
165	61	3784	167	61	3941
166	62	3793	168	62	3950
167	63	3733	169	63	3890
168	64	3647	170	64	3804
169	65	3562	171	65	3719
170	66	3477	172	66	3634
171	67	3393	173	67	3550
172	68	3342	174	68	3498
173	69	3293	175	69	3448
174	70	3246	176	70	3401
175	71	3153	177	71	3307
176	72	3055	178	72	3209
177	73	2957	179	73	3112
178	74	2857	180	74	3012
179	75	2763	181	75	2918
180	76	2669	182	76	2823
181	77	2579	183	77	2733
182	78	2503	184	78	2658
183	79	2428	185	79	2583
184	80	2325	186	80	2481
185	81	2222	187	81	2378
186	82	2119	188	82	2275
187	83	2023	189	83	2179
188	84	1926	190	84	2083
189	85	1833	191	85	1990
190	86	1741	192	86	1897
191	87	1644	193	87	1800
192	88	1576	194	88	1731
193	89	1505	195	89	1664
194	90	1410	196	90	1566
195	91	1312	197	91	1468
196	92	1216	198	92	1373
197	93	1115	199	93	1271
198	94	1014	200	94	1170
199	95	921	201	95	1079
200	96	832	202	96	990
201	97	736	203	97	894
202	98	637	204	98	795
203	99	537	205	99	695
204	100	457	206	100	614
205	101	390	207	101	542
206	102	296	208	102	445

	Shot Number		Shot Number		
	45		46		
CDP	Station Number	OFFSET (m)	CDP	Station Number	OFFSET (m)
167	59	4183	171	61	4336
168	60	4139	172	62	4346
169	61	4147	173	63	4285
170	62	4157	174	64	4199
171	63	4096	175	65	4114
172	64	4010	176	66	4028
173	65	3924	177	67	3943
174	66	3838	178	68	3891
175	67	3753	179	69	3840
176	68	3700	180	70	3791
177	69	3649	181	71	3697
178	70	3600	182	72	3600
179	71	3506	183	73	3503
180	72	3409	184	74	3404
181	73	3312	185	75	3308
182	74	3213	186	76	3213
183	75	3117	187	77	3123
184	76	3022	188	78	3049
185	77	2932	189	79	2975
186	78	2858	190	80	2873
187	79	2784	191	81	2770
188	80	2682	192	82	2668
189	81	2579	193	83	2572
190	82	2477	194	84	2476
191	83	2381	195	85	2383
192	84	2286	196	86	2290
193	85	2193	197	87	2194
194	86	2100	198	88	2125
195	87	2004	199	89	2056
196	88	1934	200	90	1958
197	89	1865	201	91	1861
198	90	1768	202	92	1767
199	91	1670	203	93	1666
200	92	1577	204	94	1565
201	93	1476	205	95	1474
202	94	1375	206	96	1386
203	95	1285	207	97	1290
204	96	1198	208	98	1190
205	97	1103	209	99	1091
206	98	1004	210	100	1010
207	99	904	211	101	933
208	100	821	212	102	835
209	101	743	213	103	738
210	102	645	214	104	653
211	103	547	215	105	570
212	104	463	216	106	490
213	105	382	217	107	388
214	106	308	218	108	288

CDP	Shot Number	Station Number	OFFSET (m)	CDP	Shot Number	Station Number	OFFSET (m)
175	63	4475	179	65		4484	
176	64	4309	180	66		4398	
177	65	4304	181	67		4312	
178	66	4218	182	68		4259	
179	67	4134	183	69		4207	
180	68	4082	184	70		4156	
181	69	4031	185	71		4061	
182	70	3982	186	72		3964	
183	71	3888	187	73		3868	
184	72	3791	188	74		3769	
185	73	3693	189	75		3673	
186	74	3594	190	76		3577	
187	75	3499	191	77		3487	
188	76	3404	192	78		3414	
189	77	3314	193	79		3342	
190	78	3240	194	80		3240	
191	79	3166	195	81		3138	
192	80	3063	196	82		3035	
193	81	2961	197	83		2940	
194	82	2858	198	84		2846	
195	83	2762	199	85		2752	
196	84	2667	200	86		2659	
197	85	2574	201	87		2564	
198	86	2481	202	88		2493	
199	87	2384	203	89		2424	
200	88	2315	204	90		2326	
201	89	2247	205	91		2230	
202	90	2149	206	92		2136	
203	91	2051	207	93		2036	
204	92	1957	208	94		1935	
205	93	1856	209	95		1846	
206	94	1755	210	96		1758	
207	95	1663	211	97		1663	
208	96	1574	212	98		1563	
209	97	1478	213	99		1464	
210	98	1378	214	100		1381	
211	99	1278	215	101		1302	
212	100	1199	216	102		1204	
213	101	1124	217	103		1106	
214	102	1026	218	104		1023	
215	103	929	219	105		942	
216	104	843	220	106		863	
217	105	759	221	107		762	
218	106	677	222	108		660	
219	107	577	223	109		560	
220	108	478	224	110		468	
221	109	382	225	111		379	
222	110	284	226	112		291	

Shot Number		Shot Number	
49		50	
CDP	Station Number	CDP	Station Number
			OFFSET (m)
183	67	4402	187
184	68	4345	188
185	69	4289	189
186	70	4236	190
187	71	4140	191
188	72	4044	192
189	73	3949	193
190	74	3851	194
191	75	3754	195
192	76	3657	196
193	77	3567	197
194	78	3497	198
195	79	3427	199
196	80	3326	200
197	81	3224	201
198	82	3123	202
199	83	3030	203
200	84	2938	204
201	85	2844	205
202	86	2751	206
203	87	2658	207
204	88	2584	208
205	89	2512	209
206	90	2417	210
207	91	2322	211
208	92	2232	212
209	93	2133	213
210	94	2033	214
211	95	1948	215
212	96	1866	216
213	97	1773	217
214	98	1674	218
215	99	1575	219
216	100	1487	220
217	101	1401	221
218	102	1303	222
219	103	1205	223
220	104	1129	224
221	105	1055	225
222	106	984	226
223	107	881	227
224	108	778	228
225	109	676	229
226	110	596	230
227	111	513	231
228	112	431	232
229	113	358	233
230	114	268	234

