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Seismic data from the Canadian Patrol Frigate Shock Trial CPF Trial Series #825

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A report on the seismic program accompanying the Canadian Patrol Frigate Shock Trial #825, November 18, 1994

A cooperative program between the Geological Survey of Canada and the Navy to acquire unique seismic data across tectonic elements of Canada's Atlantic margin.

The project was conceived, coordinated and sponsored by teams from:

The Canadian Navy, Department of National Defense
Geological Survey of Canada,
Department of Natural Resources Canada

The field program was executed with assistance from:

Nova Scotia Department of Natural Resources
New Brunswick Department of Natural Resources
Ministère des Ressources Naturelles du Québec

Seismic Data From The Canadian Patrol Frigate Shock Trial
CPF Trial Series # 825

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Geological Survey of Canada

Open File Report No. 3110

Summary

On November 18, 1994, a team of scientists from Natural Resources Canada, the provincial departments of Natural Resources in Nova Scotia, New Brunswick and Québec, Université du Québec à Québec and Dalhousie University, in co-operation with the Canadian Department of National Defence made unusual seismic recordings of a large underwater controlled source explosion along a long-range seismic refraction profile. The cost effective seismic survey - GSC field expenses of less than $20k -resulted from the successful collaboration between scientific teams from two Geological Survey divisions, between the federal departments of Natural Resources and National Defence with volunteer assistance from university students and provincial departments from Nova Scotia, New Brunswick and Quebec. The New Brunswick and Quebec Departments of Natural Resources also contributed transportation costs in the form of truck rentals or gas.

The acoustic source was provided by the DND's Naval Forces as the Canadian Patrol Frigate Trial Series number 825, approximately 300 km south-east of Halifax. The shot was detonated from HMCS Halifax by the Canadian Patrol Frigate Shock Trial Team to test the response of Canada's new class of patrol frigate to large shock levels. To satisfy seismic and shock trial requirements, a detonation schedule was arranged in collaboration with the shock trial team. In addition, a special, cooperatively designed hardware and software system was deployed on board HMCS Halifax to provide precise time and location of the shot.

The shot was recorded by 201 Portable Recording Seismographs (models PRS1 & PRS4) along a profile extending for about 600 km across Nova Scotia, New Brunswick and the Gaspé peninsula of Québec. Clear seismic records were obtained to a shot-receiver offset distance of 900 km and data quality exceeded expectations.

The shot was also recorded on stations of the Canadian National Seismograph Network between Halifax and Schefferville, and provided excellent calibration data to improve the capability of these stations to locate earthquakes in the Atlantic region with a known history of seismic activity.

This open file report provides a complete account of the recorded data. The data in industry standard SEGY format are available in `anonymous ftp` directory `/pub/lithosei/frigate` in domain `cg.emr.ca` until December 31, 1995.

Introduction

The Department of National Defence (DND) plan to conduct a shock trial as Canadian Patrol Frigate Trial Series #825 off the coast of Nova Scotia south of Halifax (Figure 1) provided a rare, efficient and economical opportunity for the Geological Survey of Canada (GSC) to collaborate with the Canadian Navy and acquire controlled source seismic data across Canada's Atlantic margin to the edge of the Canadian Shield. To acquire this kind of information in a conventional wide-angle survey would cost hundred's of thousands of dollars in addition to a major environmental assessment and is normally not feasible. DND conducted the environmental assessment for the shock trial.

The DND program included testing the response of HMCS Halifax, as representative of the new class of Patrol Frigate, to shock waves generated from a single 10,000 lb charge of HBX-1 explosive detonated at a short distance from the ship. A single source detonation of a charge of this size with no delays in the firing circuit also provides an ideal acoustic source for wide-angle seismic surveys.

The GSC's objective was to record the seismic waves generated by this single source on a long range refraction profile extending from Nova Scotia, through New Brunswick to the Gaspé peninsula of Québec to obtain information on the structure of the deep crust and mantle of the earth. Due to the cost, such surveys across continental margins are rare, particularly across Canada's extensive and complex continental margins.

The shot was also recorded on stations of the Canadian National Seismograph Network (CNSN) between Halifax and Schefferville, and provided excellent calibration data to improve the capability of these stations to locate earthquakes in maritime areas with a known history of seismic activity.

Geological Setting

The Grenville-Appalachian orogenic complex of southern Nova Scotia, New Brunswick, and south-eastern Quebec encompasses a geologically complicated region that has recorded opening of the Iapetus Ocean in Late Precambrian time, terrane accretion and continental collision during closure in the Paleozoic, and Mesozoic rifting that opened the modern Atlantic Ocean. Five upper crustal terranes (Meguma, Avalon, Gander, Dunnage and Humber) three lower crustal blocks (Avalon, Central, and Grenville) have been identified on the basis of geological and geophysical observations (Figure 1). Deep seismic reflection profiles across northern Maine and offshore Nova Scotia and Newfoundland have revealed significant differences in terrane structures. Linkages between these two regions, and information on the Nova Scotia to Québec segment in particular, is critical to understanding along-strike variations in the northern Appalachians.

Scientific Objectives

Topics that we hope to address with these new data include:

* evidence of anomalously high velocity upper mantle and upper mantle layering similar to that observed beneath central Newfoundland,
* variations in upper mantle velocities that characterise the Appalachian orogen and the Grenville-Appalachian orogenic front for comparison with earthquake and controlled source crustal studies in Maine and Quebec, and
* evidence of relict traces of subduction zones or and linkages between the major crustal blocks.

* documentation of seismic wave propagation from a given explosive source on the continental margin.
* The data also provide an initial contribution towards the Maritime-Applachian Transect proposed to Lithoprobe in 1992.

Field Program Overview

The field program consisted of the offshore shock trial component, the onshore seismic recording component and co-ordination of the two. The shock trial component was executed by the Canadian Patrol Frigate Shock Trial Team from DND's Canadian Patrol Frigate Project Management Offices in Ottawa and Halifax in collaboration with the crews aboard HMCS Halifax, HMCS Preserver, and CFAV Riverton. The recording component was co-ordinated by scientists from the Natural Resources Canada (GSC Ottawa and GSC Atlantic), in cooperation with provincial departments of Natural Resources in Nova Scotia, New Brunswick and Québec, Université du Québec and Dalhousie University. The list of participants is shown below.

Participant List

Department of National Defense

Cdr J.E.D. Byrtus*, Canadian Patrol Frigate Project Management Office, Ottawa
Cdr P. Hoes, Maritime Command Atlantic, Halifax
Cdr D. Sweeney, Commanding Officer, HMCS Halifax

The Canadian Patrol Frigate Shock Trial Team

LCdr S. Garon*, Trial Director

Lt(N) D. Spagnolo*, Deputy Trial Director

Lt(N) J. Ford, Public Affairs Officer

LCdr P. Hendry, Fleet Coordination Officer

LCdr R. Portolesy, Onsite Environmental Officer

J. Czaban, Shock Trial Coordinator at the Directorate General Marine Engineering and Maintenance Office

E. Kotecki, Deputy Shock Trial Coordinator at the Directorate General Marine Engineering and Maintenance Office

Geological Survey of Canada

Atlantic Geoscience Centre
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I. Asudeh*
R. Schieman
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Universities

Dalhousie University
Halifax, Nova Scotia

Université du Québec
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Participant List, continued

T. Schell
C. Anderson
S. Ellis

M. Belanger
M. Cloutier
J. Ortega
N. Fagnan

Provincial Departments

Nova Scotia Department of Natural Resources

S. King
K. MacLeod

M. Corey

New Brunswick Department of Natural Resources

R. Bouden
R. Phillips

M. O'Donald
C. St. Peter

Ministère des Ressources Naturelles du Québec

D. Lefebvre
P. Rivard

Field Program - details

The GSC's field data acquisition and processing system, LithoSEIS, was used in the seismic survey. LithoSEIS includes a comprehensive software package, 232 Portable Recording Seismographs (models PRS1 and PRS4[1]) with 2 Hz seismometers, laptop, luggable and desktop PC's, satellite clocks and peripherals. LithoSEIS is described in a user manual by Asudeh et al. (1993).

LithoSEIS uses Global Positioning System (GPS) satellite receivers to determine precise location of the recording stations and to provide accurate time to the seismographs. A GPS receiver was installed on the bridge of HMCS Halifax with assistance of the Canadian Patrol Frigate Shock Trial Team to obtain precise time and position of the trial shock.

GPS receivers manufactured by Trimble Navigation Ltd., model SVeeSix, were employed in the survey. These provide continuous time and position fixes once locked to at least 4 satellites. The precision in time is in the nanoseconds range. Precision in location fixes depends on Selective Availability and are quoted to be better than 100 meters. (Trimble Navigation, 1992).

All recording sites were selected and navigated using two SVeeSix GPS receivers in 'mobile' mode. The receivers were attached to a notebook PC in the deployment vehicles. Using a Trimble Navigation software package called 'Mobile', the deployment path was continuously logged to files at a rate of a position fix every 30 seconds.

The PRS units were deployed from headquarters established at Bedford Institute of Oceanography, Dartmouth, Nova Scotia and motels at Chipman and Campbelton in New Brunswick.

[1] The PRS1 seismographs record on a single data channel, PRS4's record three data and one time channels.

Offshore Component

An Ocean Bottom Seismometer (OBS) was installed on the bridge of HMCS Halifax to provide an analog backup record of shot time and near source waveform on tape in case the shock caused the digital systems to fail with attendant data loss. The OBS time channel was linked to the GPS clock and can therefore be rated with respect to true shot time. Figure 2a shows a sketch of the system interface on board HMCS Halifax. Figure 2b shows the detonation as recorded by the OBS on the bridge of HMCS Halifax. The OBS seismogram clearly shows the bubble pulse arrivals with a period of 0.54s following the first arrival from the detonation.

The Shock Trial Detonation

On November 18, 1994 the detonation of 10,000 lb of HBX-1 (ca. 15,000 lb TNT equivalent, detonation velocity 8180 m/s, ignition temperature 160-170 degrees C) by the Canadian Patrol Frigate Shock Trial Team (Figure 3) was successfully recorded by the land-based teams. The charge was suspended at a depth of 97m in a total water depth of 4077m. This was the largest of three charges detonated over a 5-day period to test the response of the HMCS Halifax as representative of the new class of patrol frigate to large shock levels.

Time and Location of the Trial Shock

In collaboration with personnel from the Canadian Patrol Frigate Shock Trial Team, special software code was developed by the GSC to obtain precise time and location of the Trial Shock using a GPS receiver installed on the bridge of HMCS Halifax and interfaced with the ship's detonation circuitry.

The software package included two modules running on a PC connected to a Trimble GPS receiver. The first software module re-programmed the PC's timer interrupt to 2000 Hz to increase timing resolution. The second software module forced a time and location reading from the GPS receiver upon detecting a TTL signal from the detonation circuitry.

Upon receiving each trigger TTL signal, the software modules created a visual output on the PC's screen as well as an ASCII output to a log file. The log file created up to the main trial shock is shown in Table 1 below. As shown in this table, the bridge of HMCS Halifax was located at 42° 01.113′ N, 61° 13.039′ W at 12:05:01.738 local Atlantic Standard Time on Wednesday November 18, 1994 . After correcting for charge deployment cable geometry, the detonation location is 42° 01.103′ N, 61° 12.889′ W.

Table 1: Segment of navigation log showing time and location of the Shock Trial #825 in bold.

```
94.11.18 10:12 DOWNLOAD  SHOT:0000  D GPS: doing position fixes
94.11.18 10:54 DOWNLOAD  SHOT:0000  D Shot @ 10:54:34.677 (Δ: 005 ms/min)
94.11.18 10:54 DOWNLOAD  SHOT:0000  D        Lat:    42  2.070 N
94.11.18 10:54 DOWNLOAD  SHOT:0000  D        Lon:    61 15.245 W
94.11.18 10:54 DOWNLOAD  SHOT:0000  D Shot @ 10:54:40.940 (Δ: 005 ms/min)
94.11.18 10:54 DOWNLOAD  SHOT:0000  D        Lat:    42  2.070 N
94.11.18 10:54 DOWNLOAD  SHOT:0000  D        Lon:    61 15.241 W
94.11.18 10:55 DOWNLOAD  SHOT:0000  D Shot @ 10:55:37.859 (Δ: 005 ms/min)
94.11.18 10:55 DOWNLOAD  SHOT:0000  D        Lat:    42  2.072 N
94.11.18 10:55 DOWNLOAD  SHOT:0000  D        Lon:    61 15.202 W
94.11.18 10:55 DOWNLOAD  SHOT:0000  D Shot @ 10:55:43.193 (Δ: 005 ms/min)
94.11.18 10:55 DOWNLOAD  SHOT:0000  D        Lat:    42  2.072 N
94.11.18 10:55 DOWNLOAD  SHOT:0000  D        Lon:    61 15.196 W
94.11.18 12:04 DOWNLOAD  SHOT:0000  D Shot @ 12:05:01.738 (Δ: 006 ms/min)
94.11.18 12:04 DOWNLOAD  SHOT:0000  D        Lat:    42  1.113 N
94.11.18 12:04 DOWNLOAD  SHOT:0000  D        Lon:    61 13.039 W
94.11.18 20:29 DOWNLOAD  SHOT:0000  D GPS: doing position fixes
```

Selection of the Recording Sites

After selection of the offshore shock trial site by DND and constrained by geological information and accessibility, the surprisingly linear network of road segments forming the profile shown in Figure 1 was scouted and access organized by the Planning and Coordination team from Atlantic Geoscience Center (AGC) (see Participant List). Initial site selection and preliminary navigation using Magellan hand-held receivers was coordinated by the AGC team.

A total of 201 seismic recording sites were navigated for the final profile extending from southern Nova Scotia, through New Brunswick to the Gaspe peninsula of Quebec (Figure 1).

Recording sites were selected and navigated using Trimble GPS SVeeSix receivers interfaced to notebook PC's in field vehicles. Navigational fixes were continuously written to a log file at a predetermined rate. At each selected recording site, a site number was added to the log files using a Trimble GPS software module called 'Mobile'. A log file sample is reproduced in Table 2, below.

All navigation log files were later merged and imported into LithoSEIS to create an accurate survey site database.

Table 2: Segment of navigation log created by 'Mobile' software during site selection. A typical site (number 0066) is shown in bold.

```
Time,Lat:Deg,Lat:Min,N-S,Lon:Deg,Lon:Min,E-W,Alt,COG,SOG,Mark
22:24:51,44,44.6964,N,064,4.8925,W,388.7,000.0,0.0,
22:25:01,44,44.6964,N,064,4.8924,W,388.8,000.0,0.0,0067,topmapsheet21/a9
22:25:51,44,44.6962,N,064,4.8921,W,388.6,000.0,0.0,
22:26:21,44,44.6635,N,064,4.8747,W,377.3,162.2,12.1,
22:26:51,44,44.5489,N,064,4.7875,W,320.1,151.5,20.0,
22:27:21,44,44.4652,N,064,4.7410,W,256.2,000.0,0.0,
22:27:51,44,44.4735,N,064,4.7444,W,252.7,000.0,0.0,
22:27:55,44,44.4735,N,064,4.7444,W,252.6,000.0,0.0,0066,2ndsitesouthonsheet21a/9
22:28:51,44,44.4734,N,064,4.7444,W,250.9,000.0,0.0,
```

LithoSEIS Deployments

Since the PRS instruments are designed for conventional seismic refraction surveys, Asudeh et al. (1992), and have limited recording capability, they were programmed to record at specific intervals or time windows. The schedule determined in collaboration with the DND shock trial team is listed in Table 3.

Table 3: Detonation schedule to match PRS-1 recording windows.

The final detonation schedule and recording windows shown below is detailed in Appendix A.

November 18, 1994		Programmed window parameters		
Start	End	Number	Duration (sec)	Interval (min)
11:00 AM	12:10 PM	15	128	5
12:10 PM	14:00 PM	11	128	10
14:15 PM	15:00 PM	4	128	15
15:00 PM	15:30 PM	1	128	30
16:00 PM	17:00 PM	2	128	60

These times were then pre-programmed into five LithoSEIS deployments. The deployments were designed to delay the start of recording from 0 to 70 seconds based on an estimated delay time of seismic arrivals according to the distance of recorders from the shot point (see Table B-1, Appendix B). The recording windows would thus start a few seconds before the expected arrival of P waves and continue to times beyond the arrival of the S waves as shown in Figure 4.

PRS Recordings

The PRS instruments were programmed prior to deployment at headquarters established at Bedford Institute of Oceanography, Dartmouth, Nova Scotia and motels at Chipman and Campbelton New Brunswick using previously tested and verified deployments codes prepared in LithoSEIS.

LithoSEIS shot database

From the information obtained from the GPS unit aboard HMCS Halifax (sample in Table 1, above), the LithoSEIS shot database was created. This database is listed in Table B-2, Appendix B, and was used in all subsequent LithoSEIS processing of the data. Note that in LithoSEIS, the shot time clock error is entered as part of the shot time and no further corrections are required in subsequent processing. The same does not apply to clock drifts of the PRS units as described below.

Data Retrieval

After recording the detonation, the PRS units were returned to the headquarters and the data were retrieved into single seismic trace files on hard disk of six Field Service Unit (FSU) PC computers. A complete list of recording parameters is shown in Table B-3, Appendix B. Note that recorder time correction (clock drift) shown in this table is the drift of the PRS clock for the duration of deployment. A portion of this correction is later calculated and stored in the header of the SEGY_IASPEI files. *This recorder clock correction is not applied to the data and users must apply the correction at processing stage.*

Recording Site Corrections

All recording sites were selected and navigated using GPS receivers in automated procedures. No correction to the satellite fixes were required. A complete list of all recording sites and the single Trial Shock location is given in Table B-4, Appendix B.

Processing Procedures

Creating SEGY Files

The LithoSEIS shot and sites databases were created and updated from navigational data from GPS receivers on board HMCS Halifax and in deployment vehicles. The LithoSEIS Catalog database was created with records for every seismic trace with all field parameters.

Using the SEGY_IASPEI format shown in Appendix C, five separate SEGY files were created. Table 4, below, shows the parameters of the SEGY files. All these files were created with a reduction velocity of 8 km/sec and reduction window of 0.0 to 120.0 seconds from the shot time. A single "Vertical Component Only" data file, *long.sgy* was created from the entire dataset. Other data files contain single horizontal component data from PRS4 instruments in various configurations. All data were stored with the recording sample rate of 120 samples per second.

Table 4: List of SEGY_IASPEI files created from the Shock Trial data.

File Name	Size, bytes	Start	End	Format	Records	Type
LONG .SGY	5,841,042	0.0	120.0	I*2	201	All Vertical
LONGNS.SGY	729,650	0.0	120.0	I*2	25	Horizontal NS
LONGEW.SGY	729,650	0.0	120.0	I*2	25	Horizontal EW
LONGV.SGY	729,650	0.0	120.0	I*2	25	PRS 4 Vertical
LONG3C. SGY	2,181,750	0.0	120.0	I*2	75	All PRS4 data

Data in all the above SEGY files are sorted by distance from the shot point. Examples of LithoSEIS Catalog listings for the two SEGY files long.sgy and longns.sgy are given in Tables B-5 and B-6 Appendix B.

The SEGY_IASPEI files are not corrected for the clock drifts of the PRS recorders. The clock drifts are stored in header bytes 217-218 of each trace header (see Appendix C) and need to applied to the data at the processing stage.

Location of the SEGY Files

The SEGY files listed above and all support documents are available on anonymous `ftp` directory `/pub/lithosei/frigate` in domain `cg.emr.ca` until December 31, 1995.

ITA Insight Processing

For presentation in this report, the SEGY_IASPEI files were converted to the ITA Insight format and processed using the Landmark Insight software package. The following processing steps were involved:

tape_read to convert SEGY_IASPEI to Insight format.

gsft and *shft* to apply static shifts to correct for the recorder clock drifts.

de-burst for energy scaling to remove high-frequency, high amplitude noise bursts.

band for band-pass filtering.

A special cross-wire file was created to convert data files from SEGY_IASPEI to Insight format. The listing of this file is shown in Appendix D.

Reading the data: tape_read

The *tape_read* process was used to read a window of 0.0 to 120.0 seconds from the SEGY_IASPEI files and write to an ITA Insight file.

A typical *tape_read* input response file is shown in Table 5, below.

Table 5: Example of *tape_read* input file. Cross-Wire file, iaspei_r.crs is listed in Appendix D.

```
driv 'long.sgy'
olis 'long.lst'
ohed 'long.hdr'
open 2 2 'long.dat'
ocrs 'iaspei_r.crs'
type 'SEGY'
form 3
tape 'tape 1' 1 2 1
chan 1 250 1
key  0
time 0.0 120.0 0.0
samp 0.00833
nrew
```

Applying static shift, gsft and shft

To correct the data for PRS1 and PRS4 recorder's internal clock drifts, the ITA Insight process shown in Table 6 below was applied. The output data are stored in 'record' format to permit ITA Insight processing of very long data traces.

Table 6 : Process to apply clock corrections.

```
open 1 1  'long.dat'
setf 1 1  0.0 120.0 0.008333
open 2 2  'long_r.dat'

getf 1 1 1 50 0.0 120.0
gsft 59
shft 1 58
putr 2 0 1 50 0.0 120.0

getf 1 51 1 50 0.0 120.0
gsft 59
shft 1 58
putr 2 0 1 50 0.0 120.0

getf 1 101 1 50 0.0 120.0
gsft 59
shft 1 58
putr 2 0 1 50 0.0 120.0

getf 1 151 1 50 0.0 120.0
gsft 59
shft 1 58
putr 2 0 1 50 0.0 120.0


getf 1 201 1 50 0.0 120.0
gsft 59
shft 1 58
putr 2 0 1 50 0.0 120.0


clos 1,1
clos 2,2
end
```

In the example above, ITA files long.dat and long_r.dat are input and output files. A maximum of 50 traces are read from input file and are written to output records after static shift process in *gsft* and *shft*.

Applying de_burst and band filters

The next two processing sequences involve removing the noise bursts and band-pass filtering of the data. The command sequence used for the *de_burst* process is shown in table 7.

Table 7 : Command sequence for *de_burst* process.

```
open 1 1  'long_r.dat'
setf 1 1  0.0 120.0 0.008333
open 2 2  'long_r_d.dat'


bsec 5
trak

getr 1 0
dbst 0.5 5 50
putr 2 0

esec

clos 1,1
clos 2,2
end
```

The *de_burst* data were then applied to a band-pass process shown in table 8, below.

Table 8: Band-Pass filter parameters.

```
open 1 1  'long_r_d.dat'
setf 1 1  0.0 120.0 0.008333
open 2 2  'long_r_d_b.dat'


bsec 5
trak

getr 1 0
band 1 5 10 20 'BUT' 90.0 10.0
putr 2 0

esec

clos 1,1
clos 2,2
end
```

Plotting the data

A local program called *plotita* was used for plotting the data files in Insight ITA format.

Examples from processing sequence

To show the effect of ITA's *de-burst* processing, the original and de-burst processed versions of the vertical component data from all PRS4 sites (longv.sgy, table 2, above) are plotted in Figures 5 and 6. The *de-burst* operator first calculates a median energy level over a specified trace time window and number of traces. It then scales the data to a threshold value which is set as a percentage of the median energy level. The trace time window of 0.5 seconds over five traces with threshold energy level of 50 percent was estimated by trial and error to provide a suitable seismogram.

Using the *band* command with corner frequencies of 1, 5, 10 and 20 Hz, the *de-burst* data shown in Figure 5 were bandpass filtered and results are shown in Figure 7.

The Shock Trial Data

The processing sequence listed above were applied to all data files listed in table 2, above. Figures 8 through 17 show vertical and horizontal component record sections of all the data.

Data From the Canadian National Seismograph Network

The detonation was also recorded on seismograph stations of the CNSN at Halifax, Guysborough, Deer lake, Moncton, La Malbaie and Schefferville. Three-component data with a high-pass filter of 4 Hz are shown in Figures 18 to 22. The data provide a valuable calibration source to improve the capability of these stations to accurately locate earthquakes in the east coast area with a history of damaging earth tremors. The CNSN data indicate that the seismic energy released by the detonation had an equivalent Richter magnitude of 2.7- 3.1. No induced earthquakes or unusual sea states were observed from the vicinity of the test site immediately following the detonation. Digital data are not directly available for Halifax and Guysborough. For comparison, the data from Moncton and Deer

Lake are merged with seismic refraction data within the same distance range in a profile segment shown on Figures 23 and 24.

Acknowledgments

As in all combined seaborne and land-based operations, preparation and near real time communication are key to effective coordination, execution and ultimately, successful seismic data acquisition. The land-based effort included deployment of 200 recording instruments along secondary and logging roads across the three provinces by a team of over 30 people composed of GSC scientists, members of the Natural Resources departments of the respective provinces, and university students and others registered with the GSC Volunteers Program. A. Tremblay, Institut National de Recherche Scientifique du Quebec, helped select routes in Quebec and coordinated and arranged transportation for teams from the Université du Québec. L. Fyffe and colleagues from the New Brunswick Department of Natural Resources helped route selection in New Brunswick. K. Louden, Dalhousie University, and B. Boehner, Nova Scotia Department of Natural Resources helped coordinate volunteers in Nova Scotia. F. Lombardo of the Canadian National Seismograph Network at Guysborough, Nova Scotia provided near real time information on the detonation. J. Adams and J. Drysdale have provided preliminary seismograms from the CNSN records. The seaborne operation was aided and made possible by the notable efforts of Cdr. D. Sweeney and crew of HMCS Halifax, Cdr P. Hoes at Maritime Command, Halifax, LCdr S. Garon, Lt(N) D. Spagnolo, Mr. J. Czaban and Mr. I. Kotecki of the CPF Shock Trial Team and Lt(N) J. Ford on HMCS Preserver. The last minute programming and system design done by D. Sharon and R. Schieman to capture the instant and position of the detonation worked without field trial and ensured the optimum seismic precision.

Access to deploy instruments along private roads and property was provided by Bowaters Mersey Paper Co. Ltd., Fraser Inc., and many unnamed and very hospitable private citizens. This cooperative effort between the various individuals and organisations was critical to the efficient and successful deployment and recovery of the instruments in a short time frame over such a vast territory and we gratefully acknowledge their assistance. This document was prepared by the Planning and Coordination team at the GSC and reviewed by LCdr S. Garon, Shock Trial Director, and by D. White and D. Boerner of the GSC.

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Trimble Navigation (1992) SVeeSix 6-Channel GPS Sensor, Specification and User's Manual.

Seismic Data - Record Sections

Part A, Field Seismic Refraction Data

The seismic sections shown in Figures 5 through 17 are all plotted with a reduced velocity of 8 km/second for the distance range of 330-910 km. The recovery of records with good signal to noise ratio to near 900 km is evident. Only the first 100 seconds from a maximum of 120 seconds of reduced record length are plotted. Figure 17 is an expanded view of same data in Figure 16. All data are trace-normalized and clipped at a maximum amplitude to better resolve adjacent records and reduce the remaining noise events.

On sections indicating the *de-burst* option (see Table 7), all data are processed using the *de-burst* operator with the same parameters of a 0.5 seconds window over 5 traces.

On sections indicating band-pass (see Table 8) , all data are filtered with corner frequencies of 1, 5, 10 and 20 (band-pass of 5-10 Hz).

The numbers appearing on the top of the plot sections are recording site numbers. Note that for site 3044 (for example, Figure 5) and some other sites, the recording data window ends before the end of the reduction velocity window used for plotting and the end of the trace is padded with zeros.

Part B, CNSN and Field Seismic Refraction data

In Figures 23 and 24 a shorter data window of only 30 seconds with a reduction velocity of 8 km/sec is used to plot records in the distance range from 340-900 km for comparison with records from CNSN stations at Moncton and Deer Lake in the same distance range. The similarity between the record from Moncton and the nearby PRS sites is evident while the considerably different travel path to the north beneath the Laurentian Channel and Newfoundland to Deer Lake has produced a different P wave coda from that recorded at PRS site 3023 in northern New Brunswick.

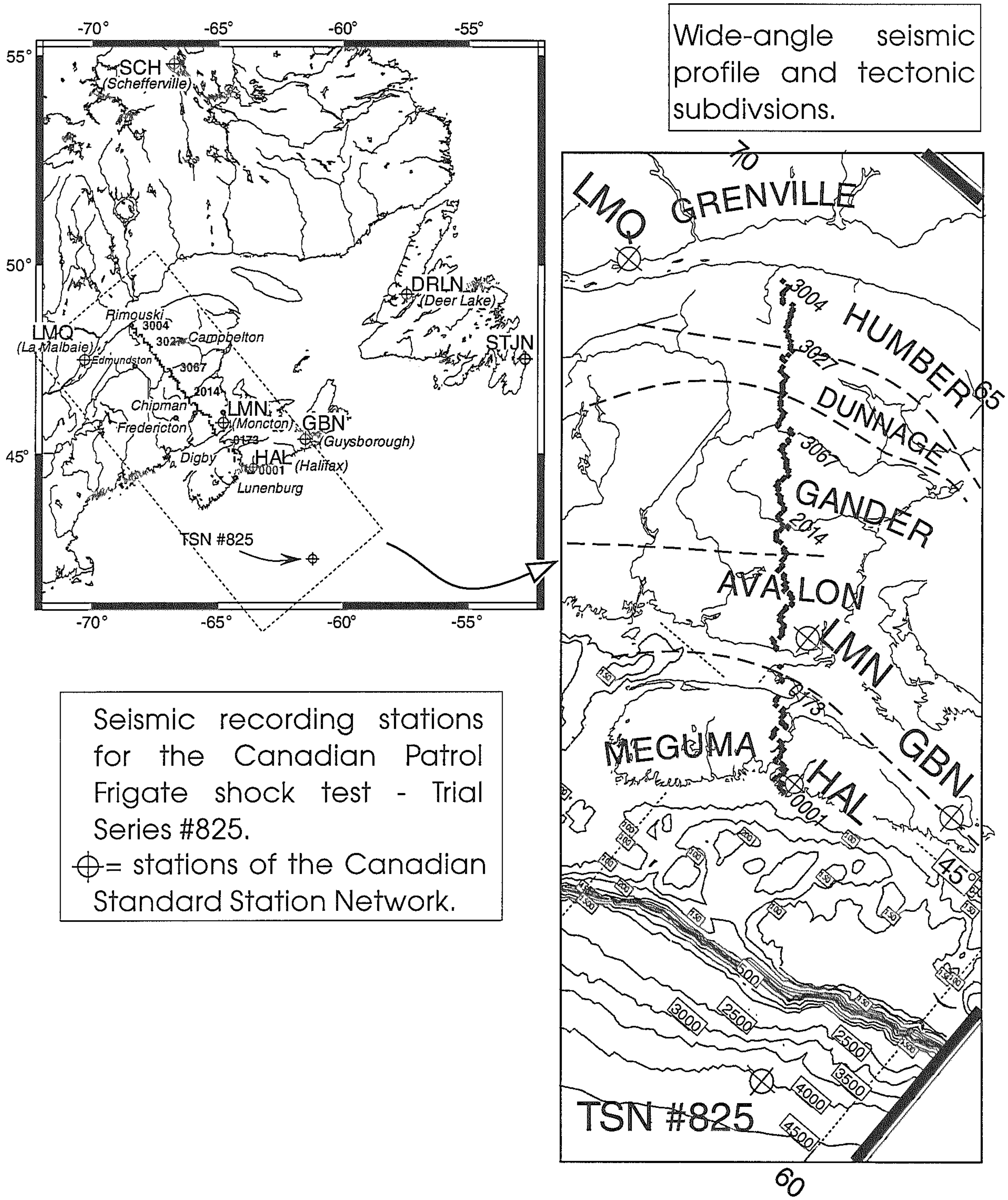

-70°
-65°
-60°
-55°
55°
50°
45°
SCH
(Schefferville)
DRLN
(Deer Lake)
STJN
LMQ
(La Malbaie)
Rimouski
3004
3027
Campbelton
Edmundston
3067
2014
Chipman
Fredericton
LMN
(Moncton)
GBN
(Guysborough)
0173
Digby
HAL
0001
(Halifax)
Lunenburg
TSN #825
Seismic recording stations for the Canadian Patrol Frigate shock test - Trial Series #825.
= stations of the Canadian Standard Station Network.
Wide-angle seismic profile and tectonic subdivsions.
70
LMQ
GRENVILLE
3004
HUMBER
3027
65
DUNNAGE
3067
GANDER
2014
AVALON
LMN
0173
GBN
MEGUMA
HAL
0001
45°
3000
2500
4000
3500
4500
TSN #825
60

Figure 1:

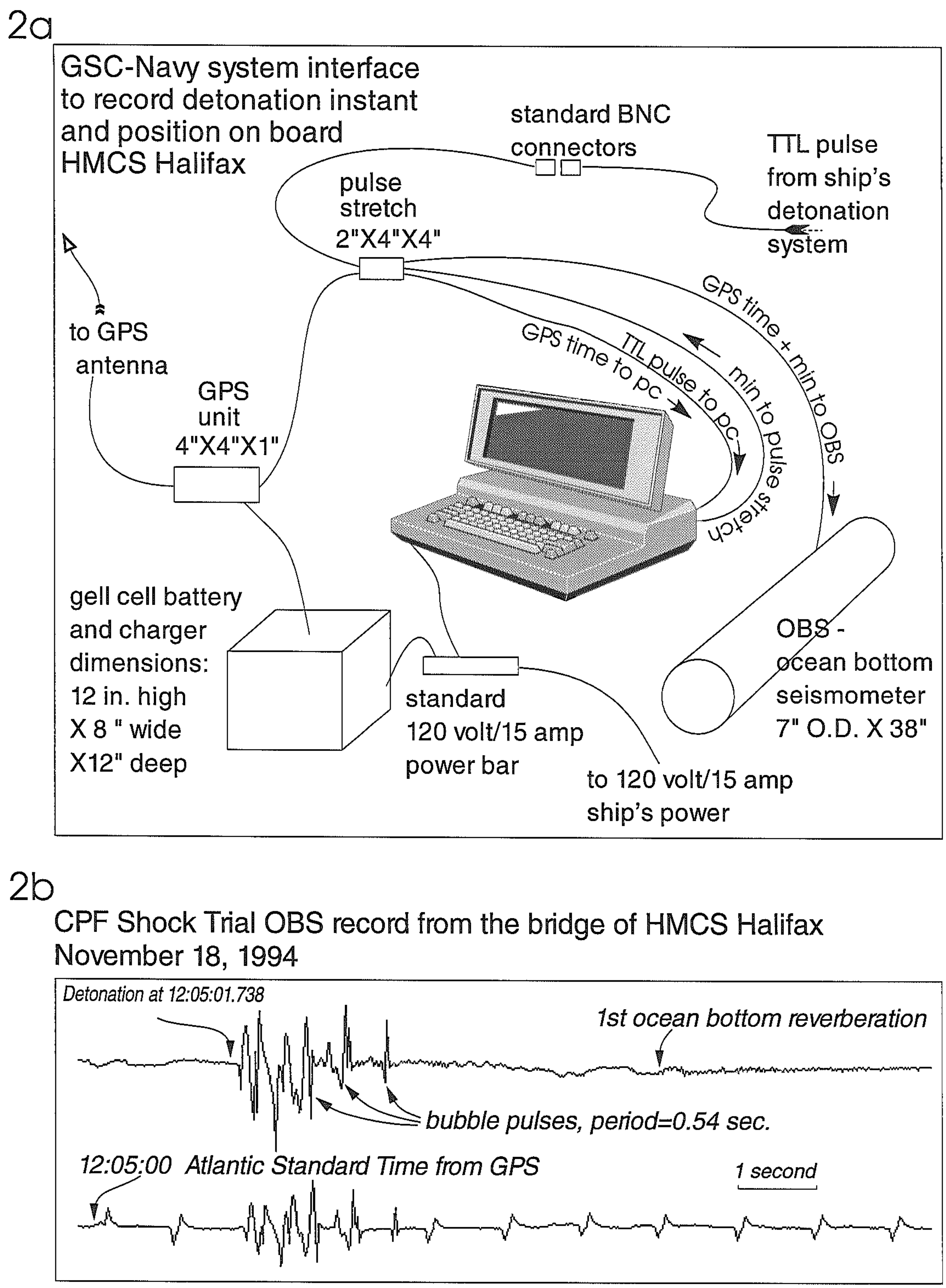

2a
GSC-Navy system interface to record detonation instant and position on board HMCS Halifax
standard BNC connectors
TTL pulse from ship's detonation system
pulse stretch 2"X4"X4"
GPS time + min to OBS
GPS time to pc
TTL pulse to pc
min to pulse stretch
to GPS antenna
GPS unit 4"X4"X1"
gell cell battery and charger dimensions: 12 in. high X 8 " wide X12" deep
standard 120 volt/15 amp power bar
to 120 volt/15 amp ship's power
OBS - ocean bottom seismometer 7" O.D. X 38"
2b
CPF Shock Trial OBS record from the bridge of HMCS Halifax November 18, 1994
Detonation at 12:05:01.738
1st ocean bottom reverberation
bubble pulses, period=0.54 sec.
12:05:00 Atlantic Standard Time from GPS
1 second

Figure 2:

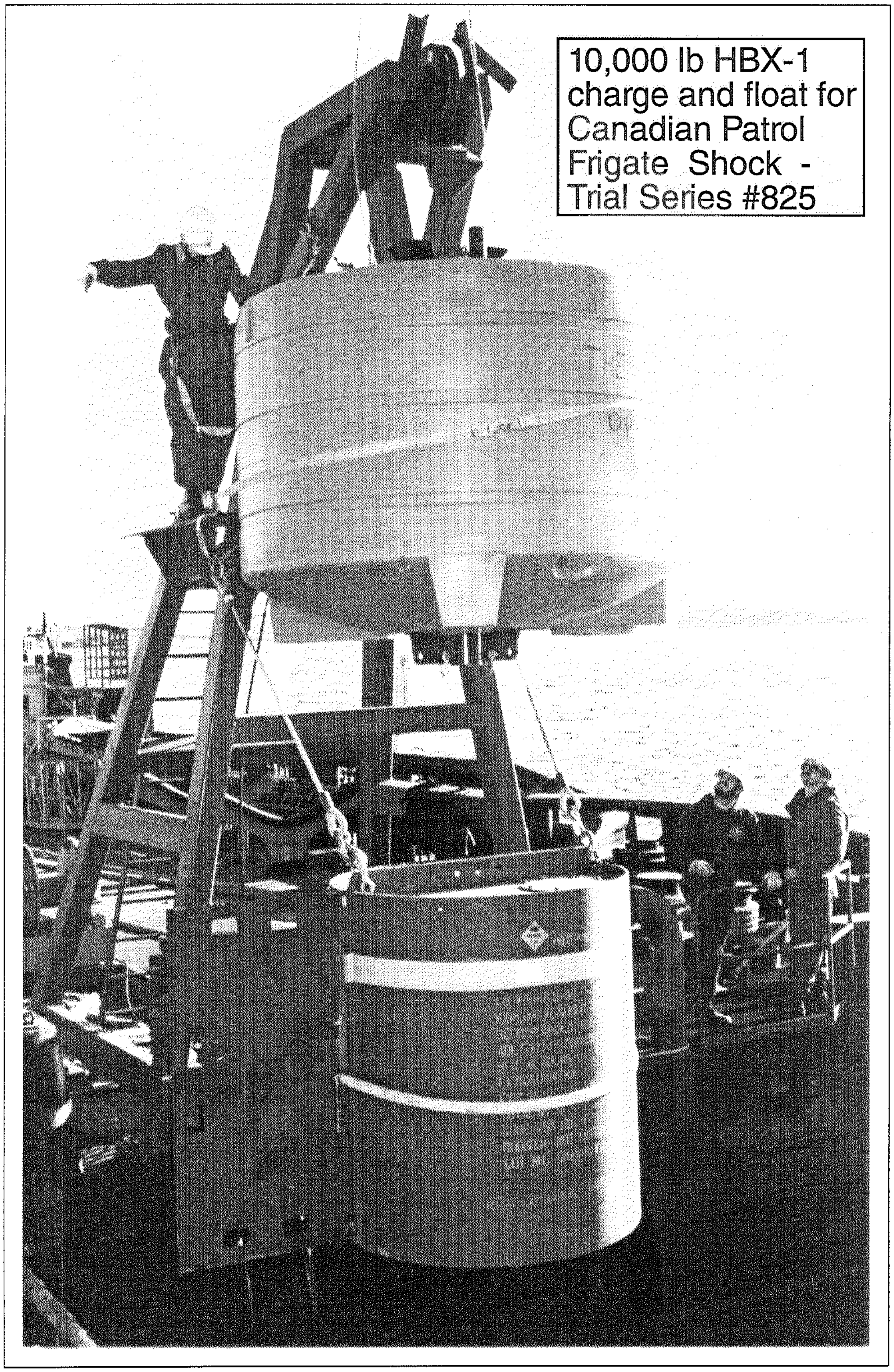

10,000 lb HBX-1
charge and float for
Canadian Patrol
Frigate Shock -
Trial Series #825

Figure 3:

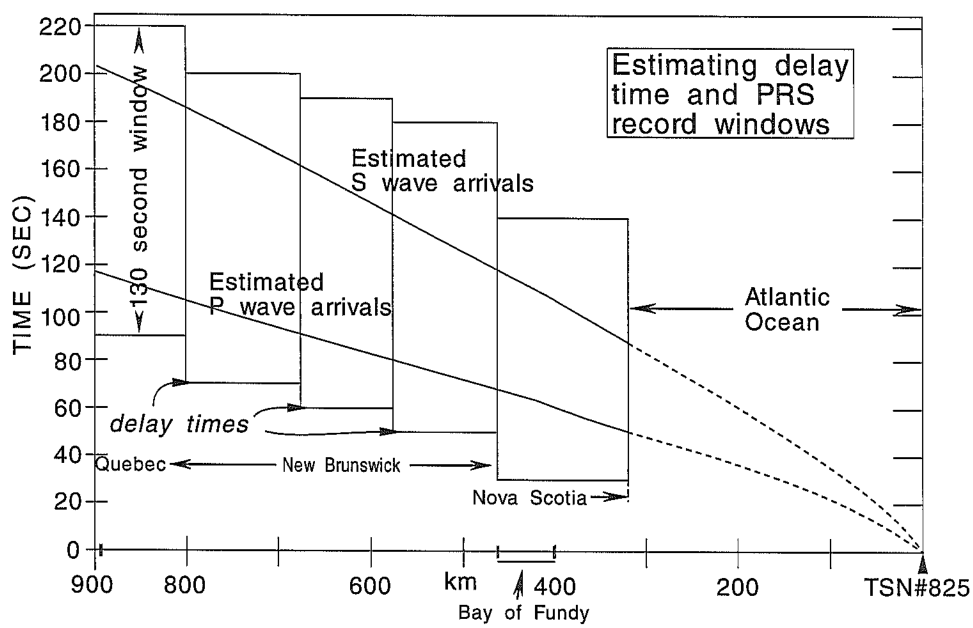

Estimating delay time and PRS record windows
TIME (SEC)
220
200
180
160
140
120
100
80
60
40
20
0
130 second window
Estimated S wave arrivals
Estimated P wave arrivals
delay times
Atlantic Ocean
Quebec
New Brunswick
Nova Scotia
900
800
600
km
400
200
TSN#825
Bay of Fundy

Figure 4:

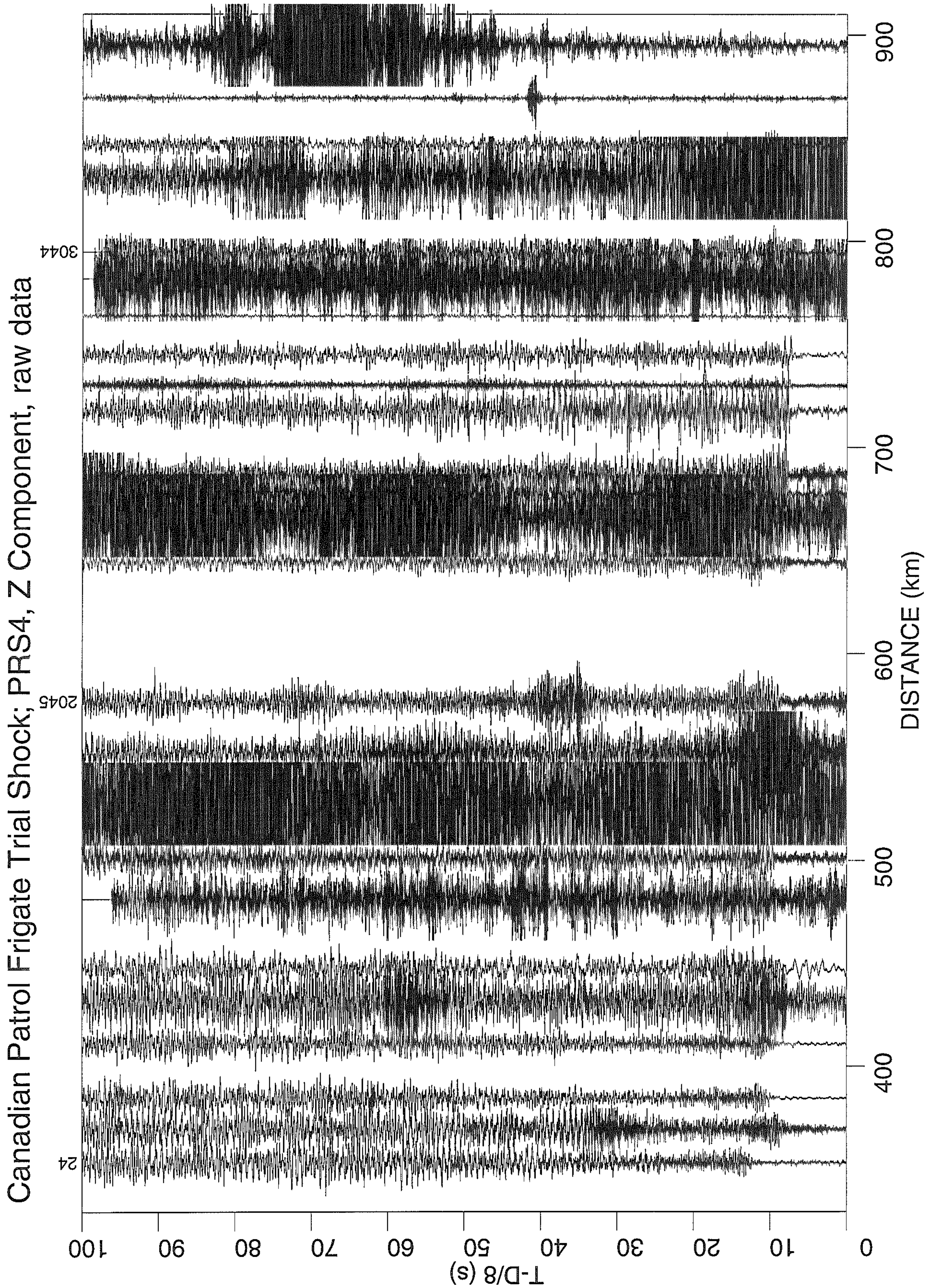

Canadian Patrol Frigate Trial Shock; PRS4, Z Component, raw data
24
2045
3044
DISTANCE (km)
400
500
600
700
800
900
T-D/8 (s)
0
10
20
30
40
50
60
70
80
90
100

Figure 5:

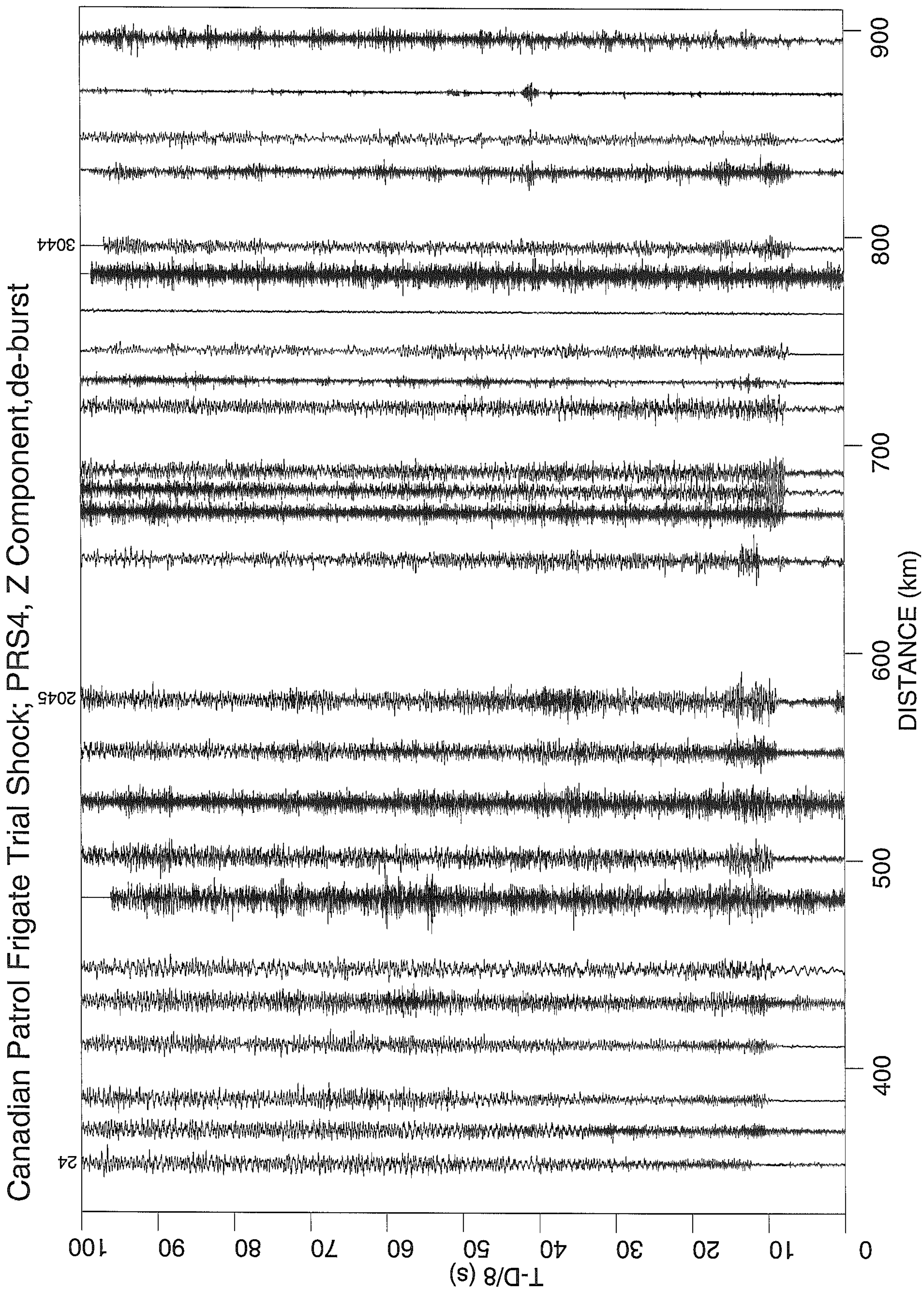

Canadian Patrol Frigate Trial Shock; PRS4, Z Component,de-burst
3044
2045
24
900
800
700
600
500
400
DISTANCE (km)
100
90
80
70
60
50
40
30
20
10
0
T-D/8 (s)

Figure 6:

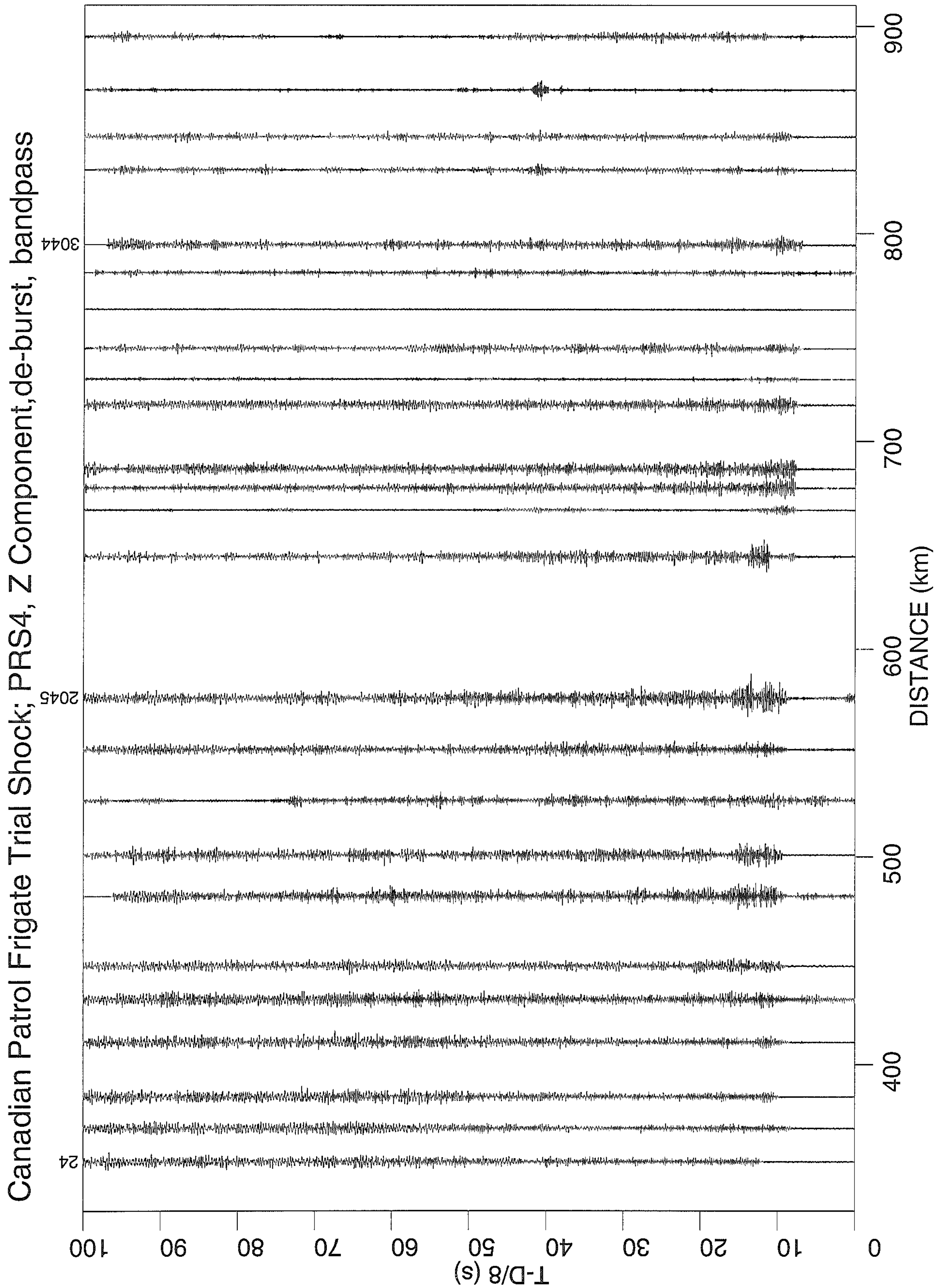

Canadian Patrol Frigate Trial Shock; PRS4, Z Component,de-burst, bandpass
3044
2045
24
DISTANCE (km)
400
500
600
700
800
900
T-D/8 (s)
0
10
20
30
40
50
60
70
80
90
100

Figure 7:

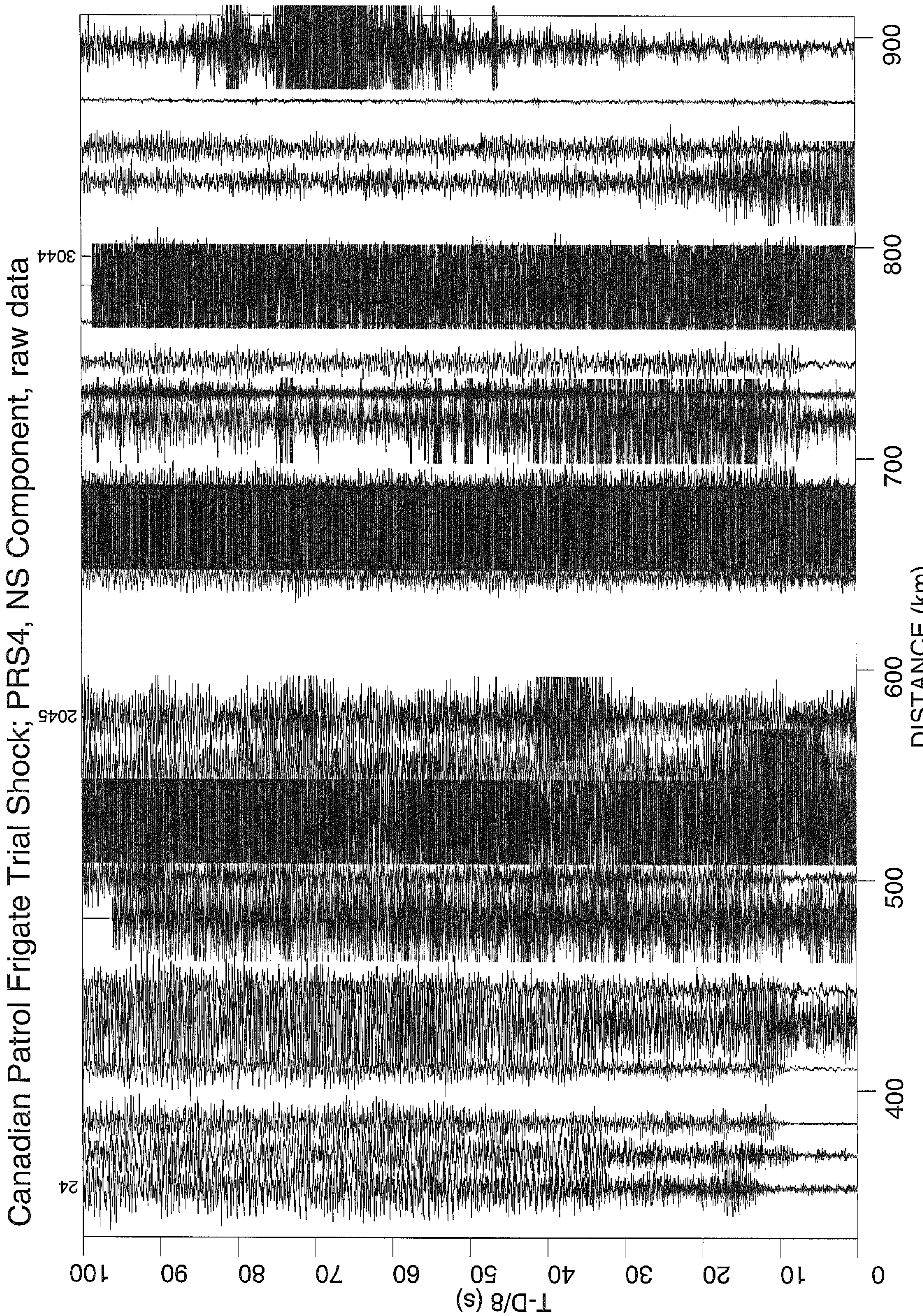

Canadian Patrol Frigate Trial Shock; PRS4, NS Component, raw data
DISTANCE (km)
T-D/8 (s)
0
10
20
30
40
50
60
70
80
90
100
400
500
600
700
800
900
24
2045
3044

Figure 8:

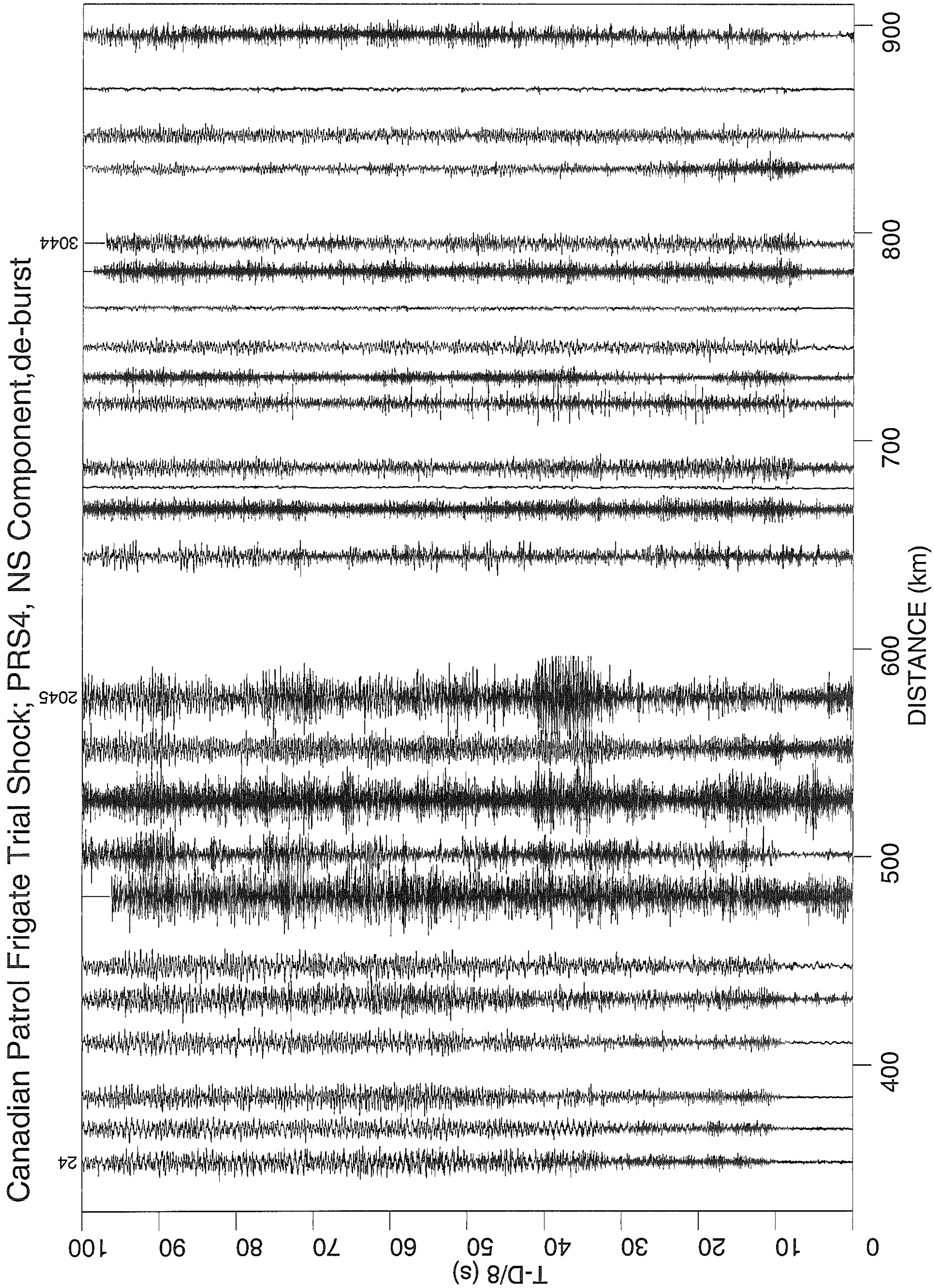

Canadian Patrol Frigate Trial Shock; PRS4, NS Component,de-burst
3044
2045
24
900
800
700
600
500
400
DISTANCE (km)
100
90
80
70
60
50
40
30
20
10
0
T-D/8 (s)

Figure 9:

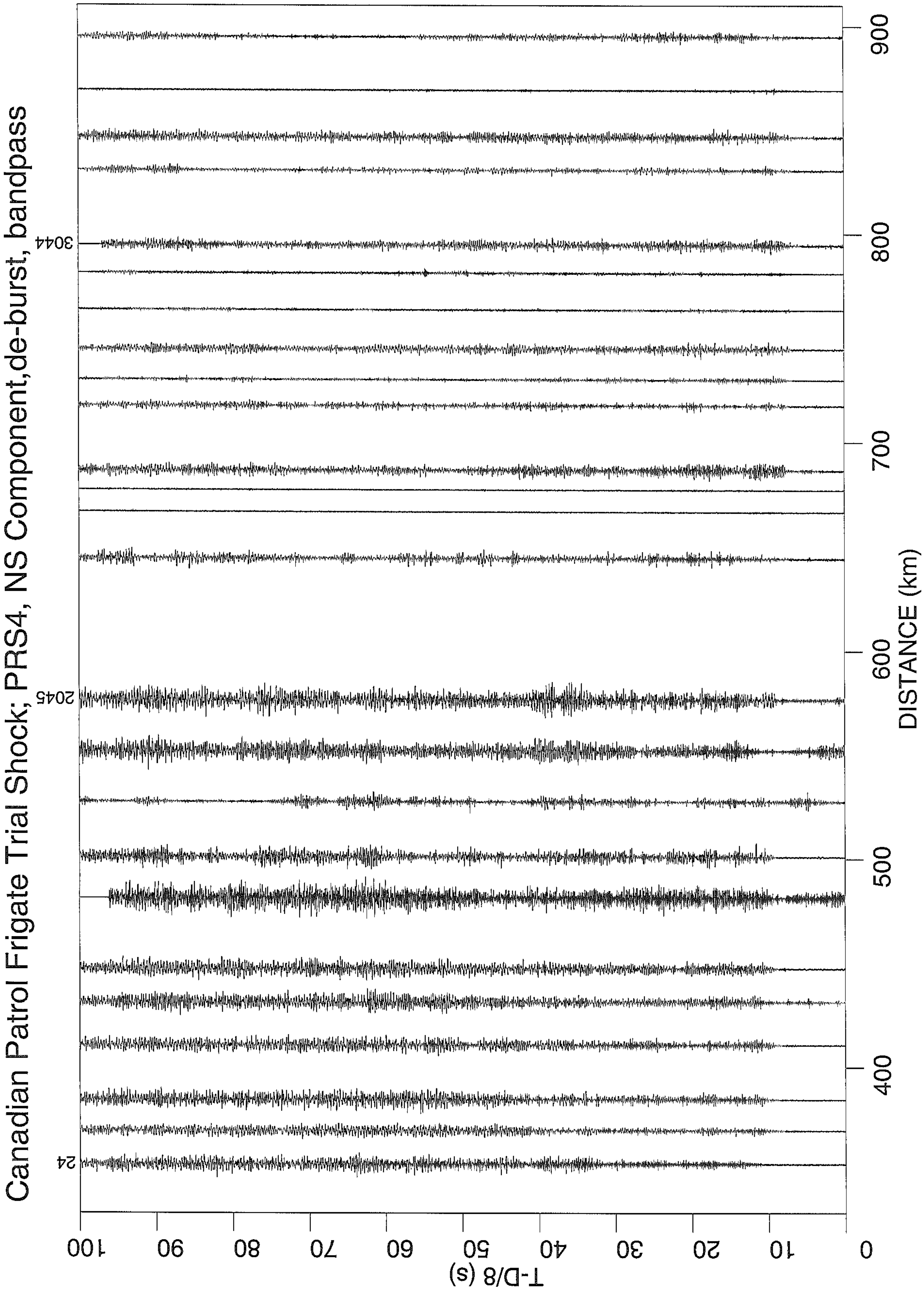

Canadian Patrol Frigate Trial Shock; PRS4, NS Component,de-burst, bandpass
3044
2045
24
900
800
700
600
500
400
DISTANCE (km)
100
90
80
70
60
50
40
30
20
10
0
T-D/8 (s)

Figure 10:

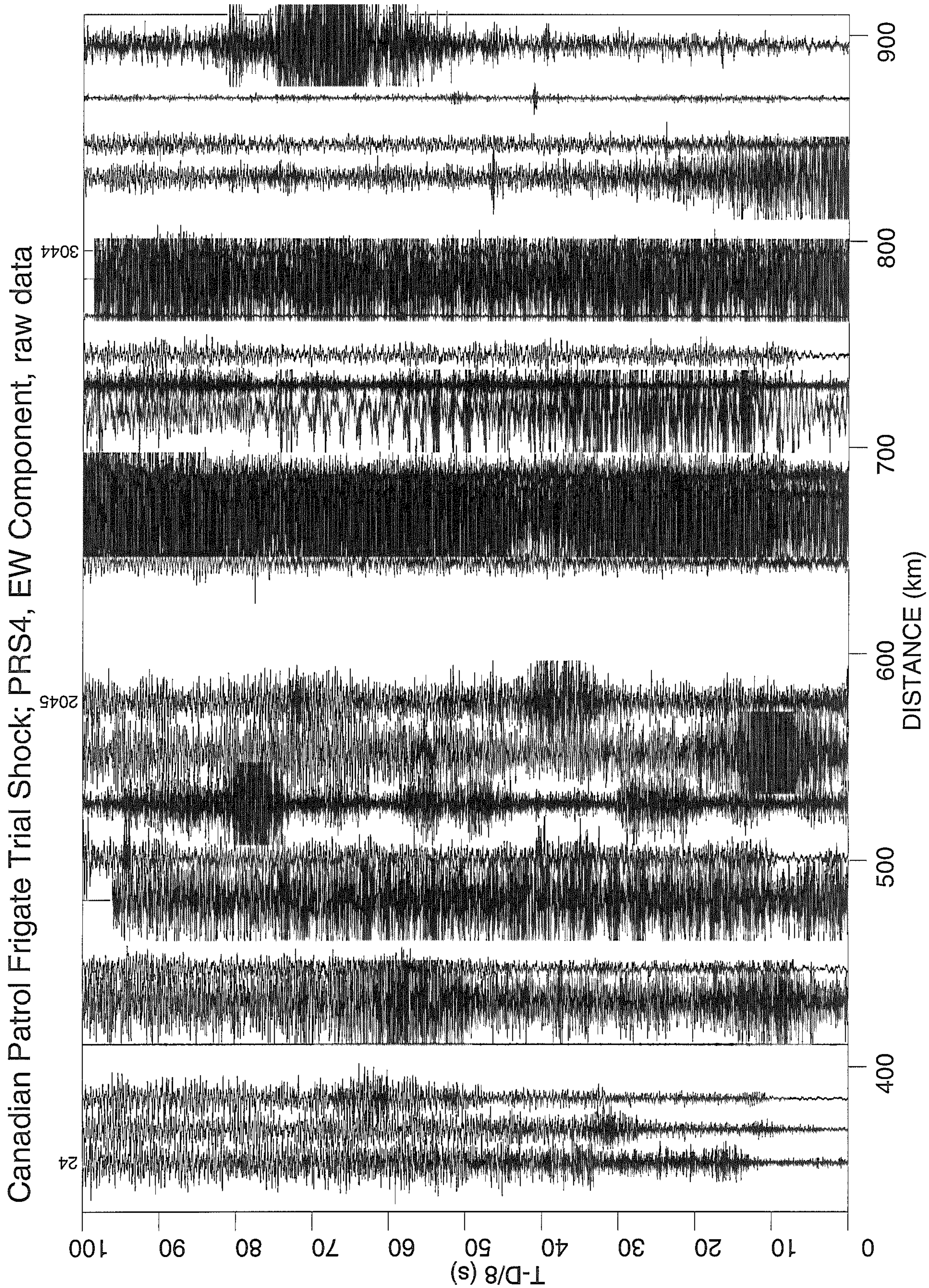

Canadian Patrol Frigate Trial Shock; PRS4, EW Component, raw data
24
2045
3044
DISTANCE (km)
400
500
600
700
800
900
T-D/8 (s)
0
10
20
30
40
50
60
70
80
90
100

Figure 11:

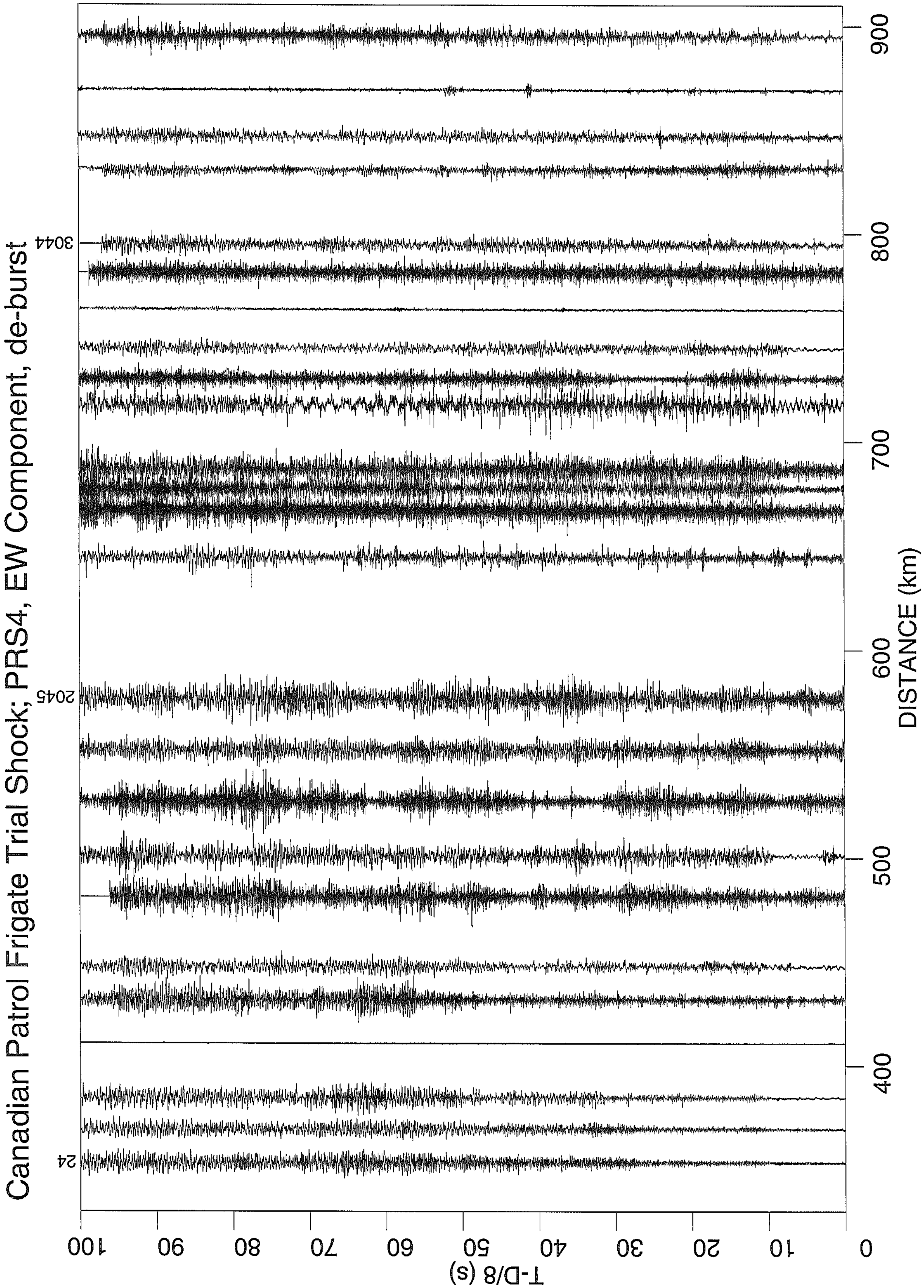

Canadian Patrol Frigate Trial Shock; PRS4, EW Component, de-burst
3044
2045
24
DISTANCE (km)
900
800
700
600
500
400
T-D/8 (s)
100
90
80
70
60
50
40
30
20
10
0

Figure 12:

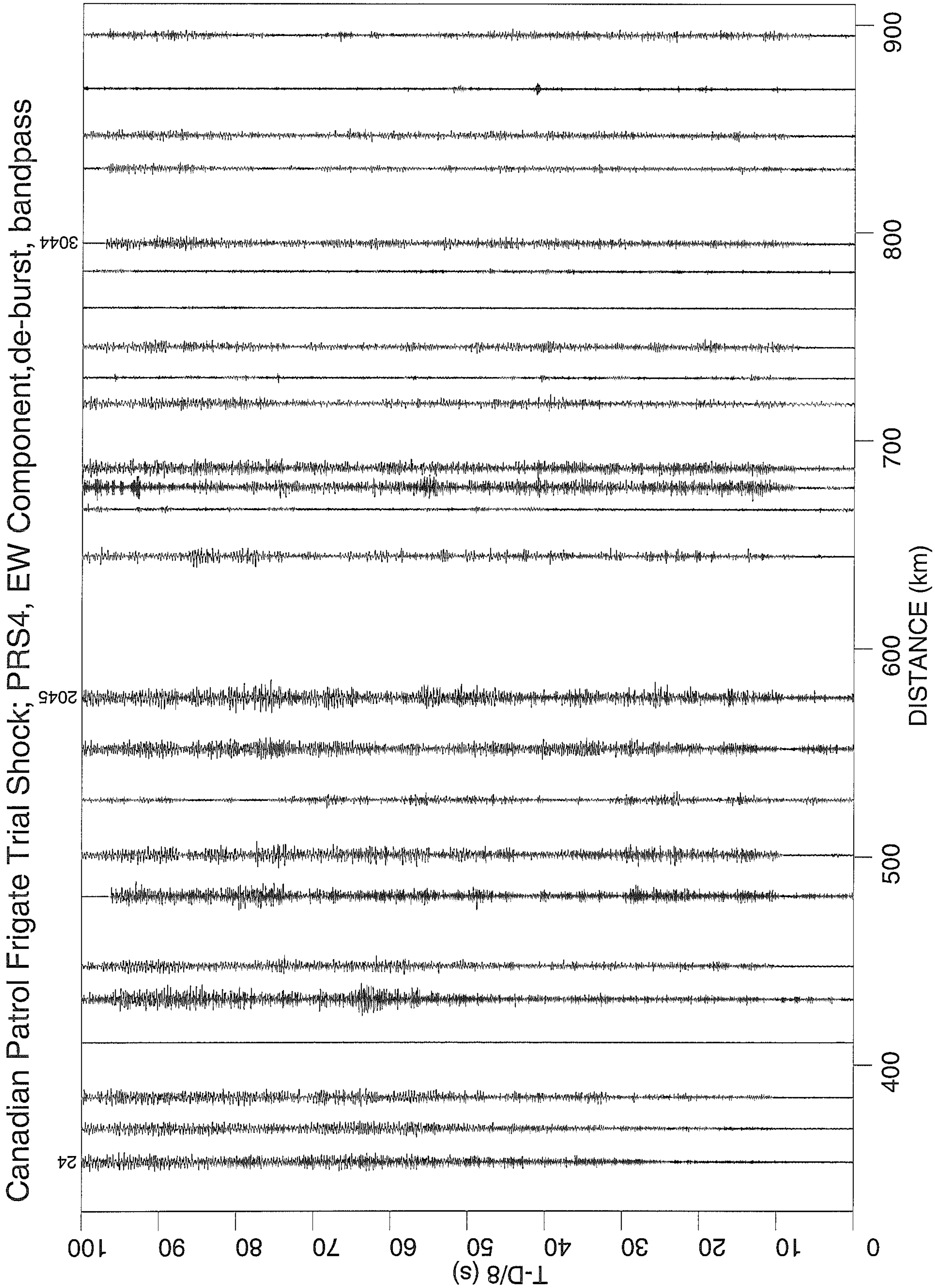

Canadian Patrol Frigate Trial Shock; PRS4, EW Component,de-burst, bandpass
3044
2045
24
900
800
700
600
500
400
DISTANCE (km)
100
90
80
70
60
50
40
30
20
10
0
T-D/8 (s)

Figure 13:

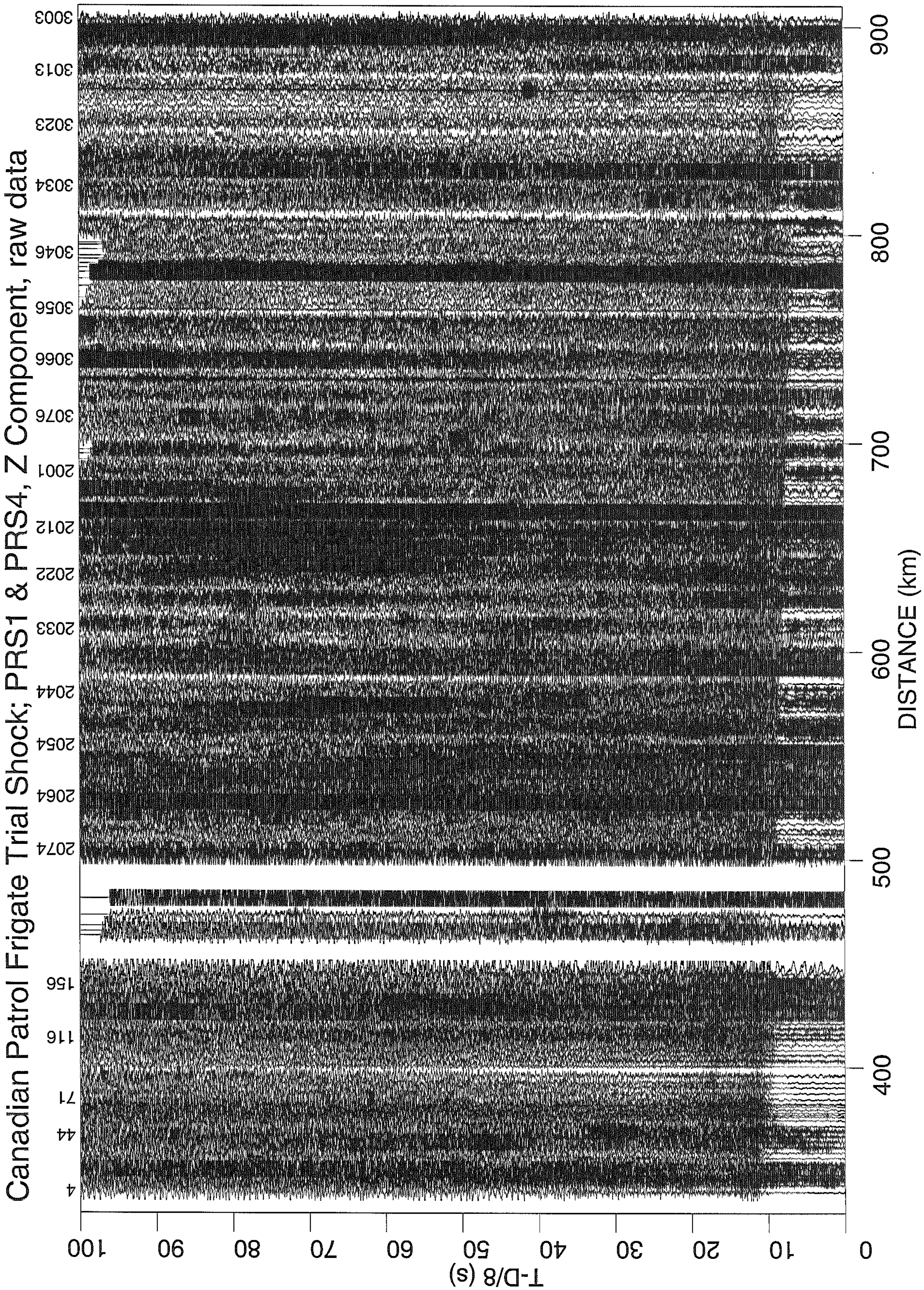

Canadian Patrol Frigate Trial Shock; PRS1 & PRS4, Z Component, raw data
3003
3013
3023
3034
3046
3056
3066
3076
2001
2012
2022
2033
2044
2054
2064
2074
156
116
71
44
4
900
800
700
600
500
400
DISTANCE (km)
100
90
80
70
60
50
40
30
20
10
0
T-D/8 (s)

Figure 14:

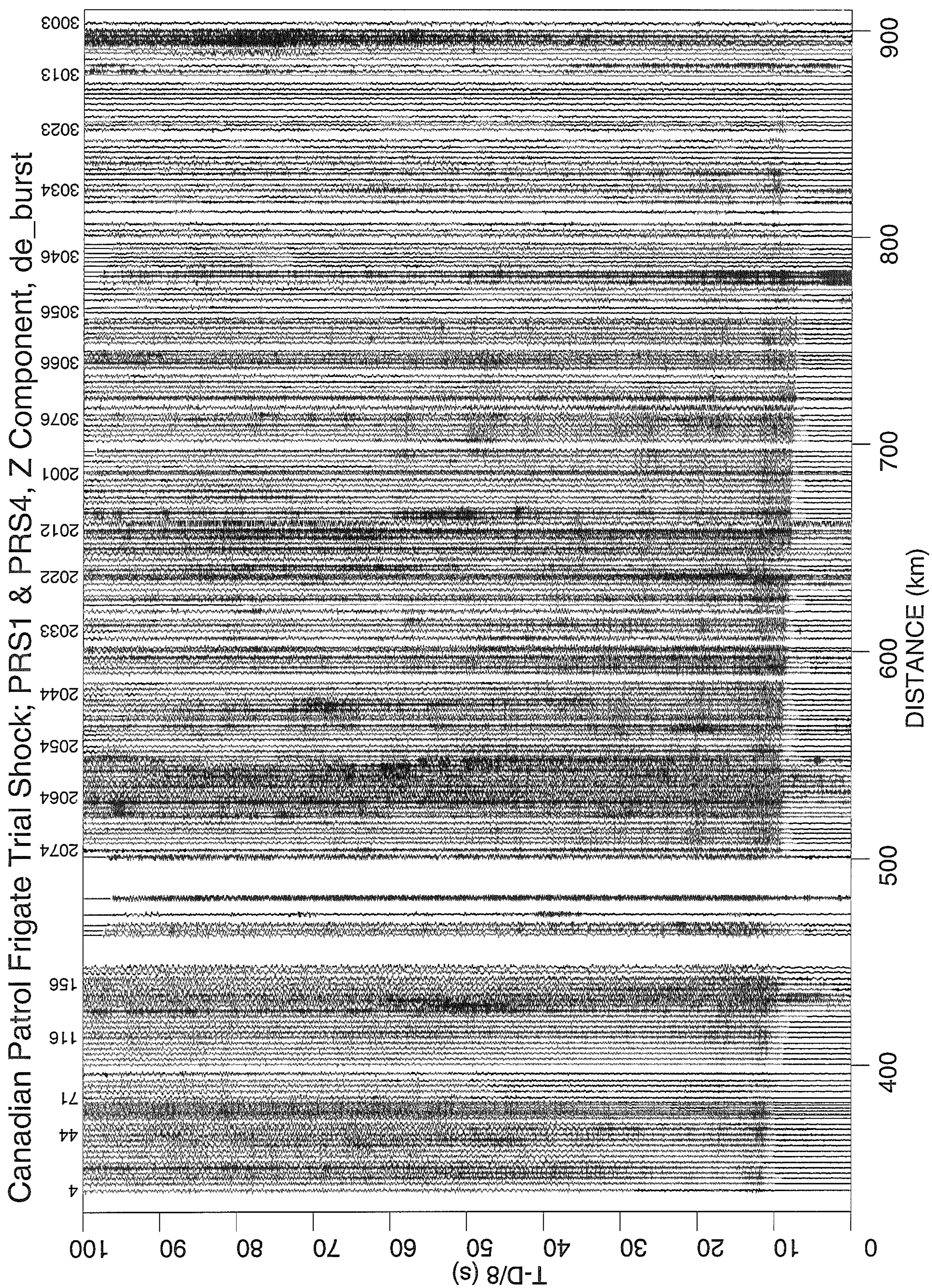

Canadian Patrol Frigate Trial Shock; PRS1 & PRS4, Z Component, de_burst
T-D/8 (s)
DISTANCE (km)
0
10
20
30
40
50
60
70
80
90
100
400
500
600
700
800
900
4
44
71
116
156
2074
2064
2054
2044
2033
2022
2012
2001
3076
3066
3056
3046
3034
3023
3013
3003

Figure 15:

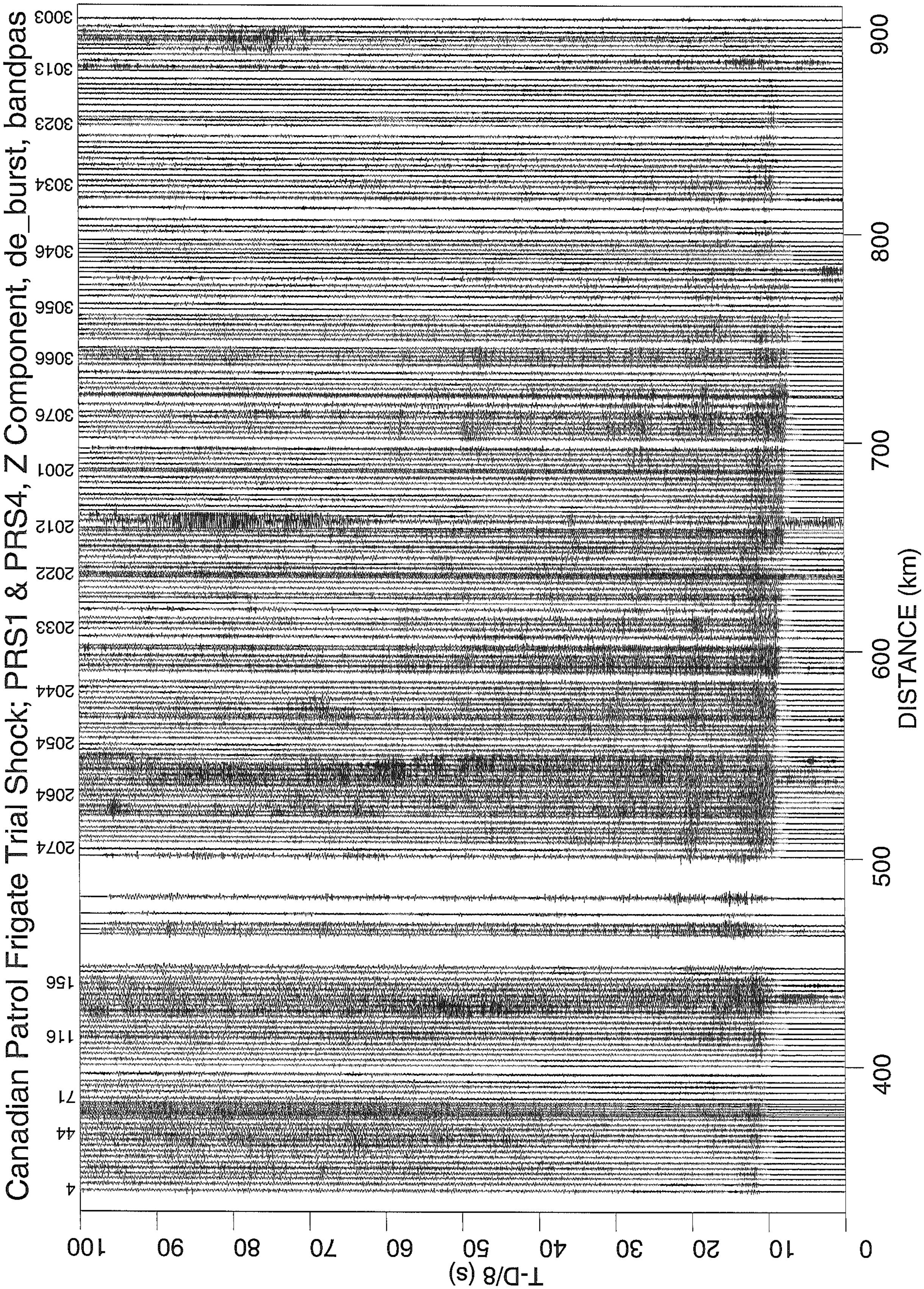
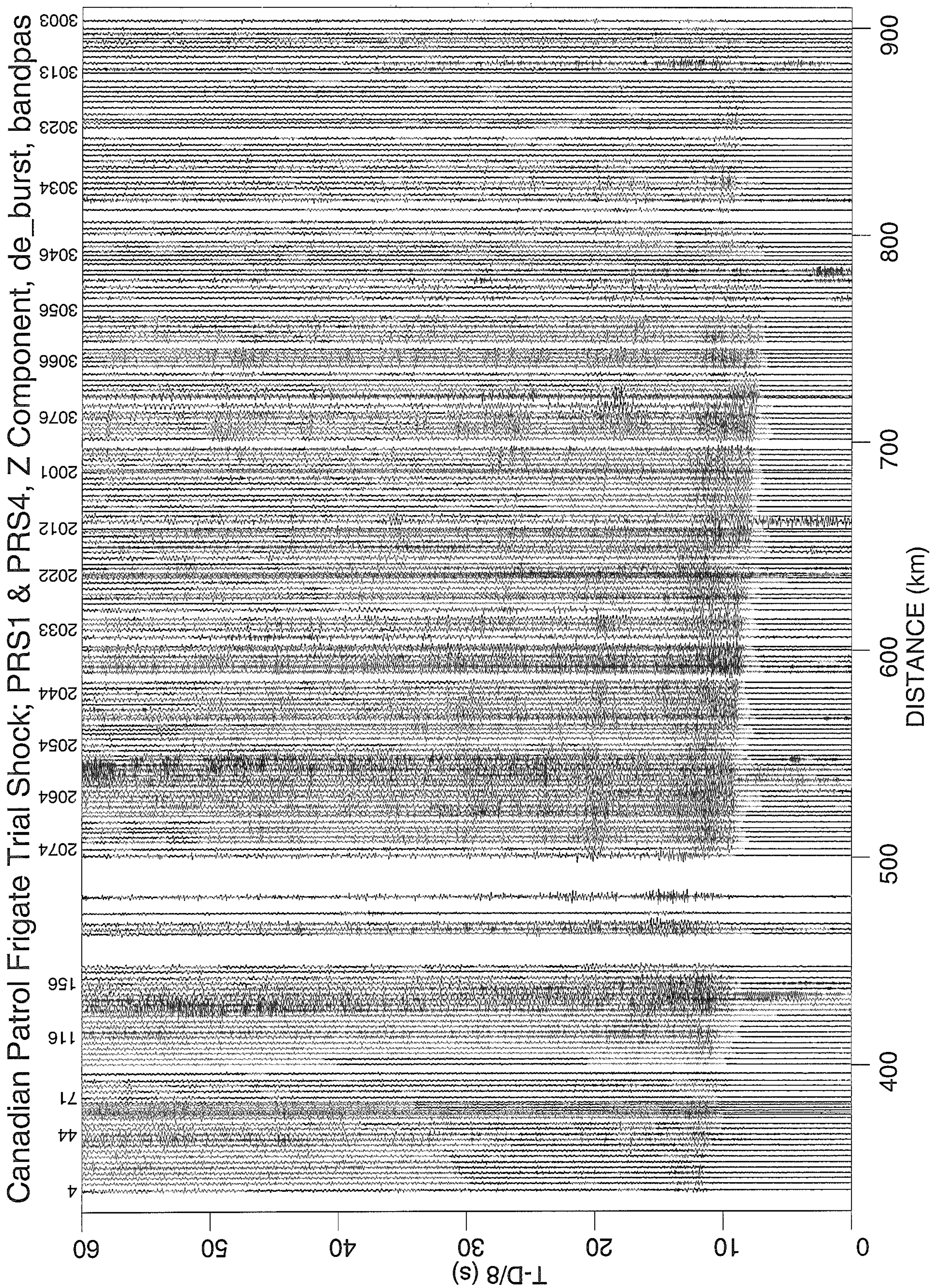

Canadian Patrol Frigate Trial Shock; PRS1 & PRS4, Z Component, de_burst, bandpas
3003
3013
3023
3034
3046
3056
3066
3076
2001
2012
2022
2033
2044
2054
2064
2074
156
116
71
44
4
900
800
700
600
500
400
DISTANCE (km)
100
90
80
70
60
50
40
30
20
10
0
T-D/8 (s)

Figure 16:



Canadian Patrol Frigate Trial Shock; PRS1 & PRS4, Z Component, de_burst, bandpas
DISTANCE (km)
T-D/8 (s)

Figure 17:

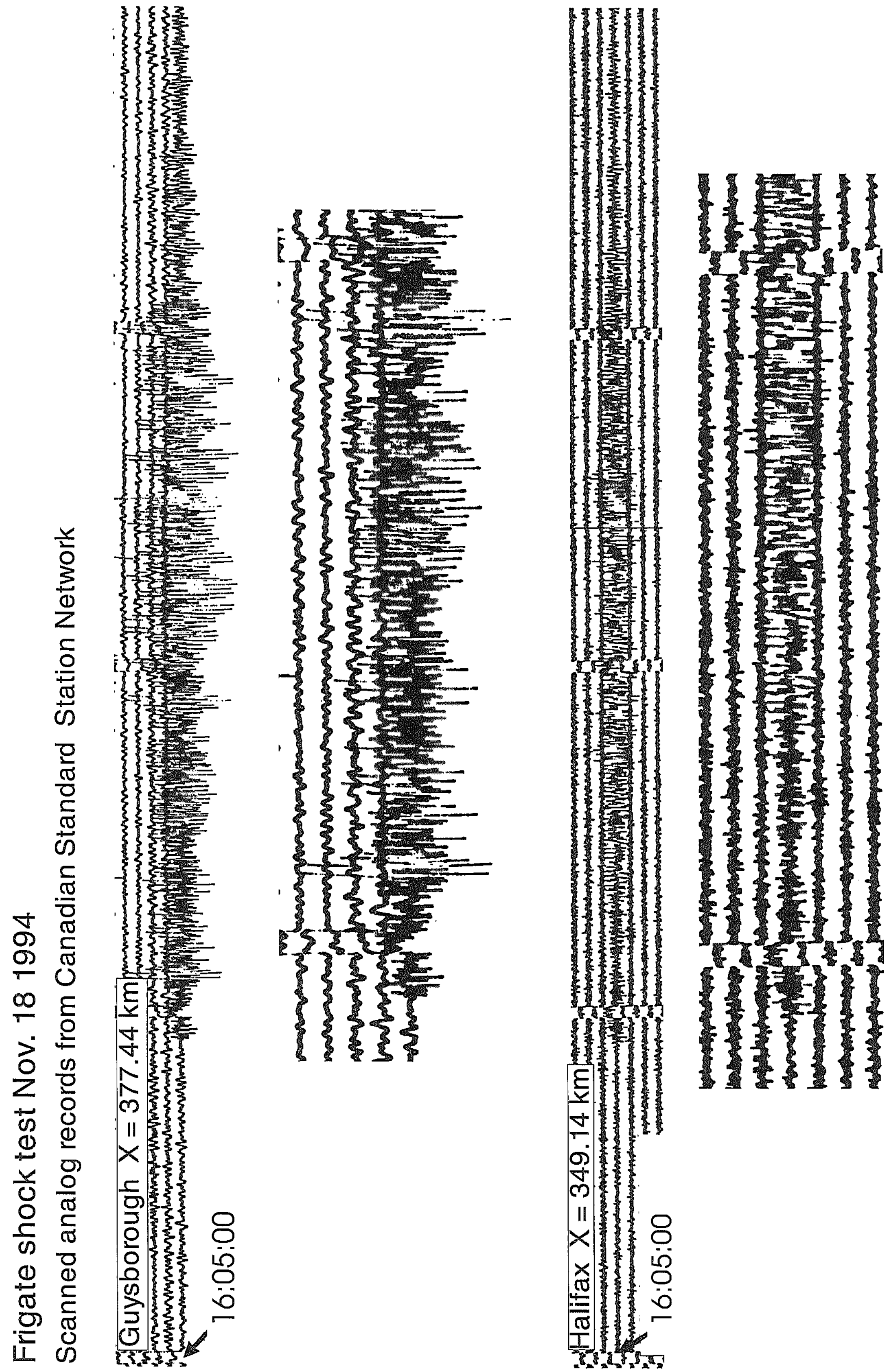

Frigate shock test Nov. 18 1994
Scanned analog records from Canadian Standard Station Network
Guysborough X = 377.44 km
16:05:00
Halifax X = 349.14 km
16:05:00

Figure 18:

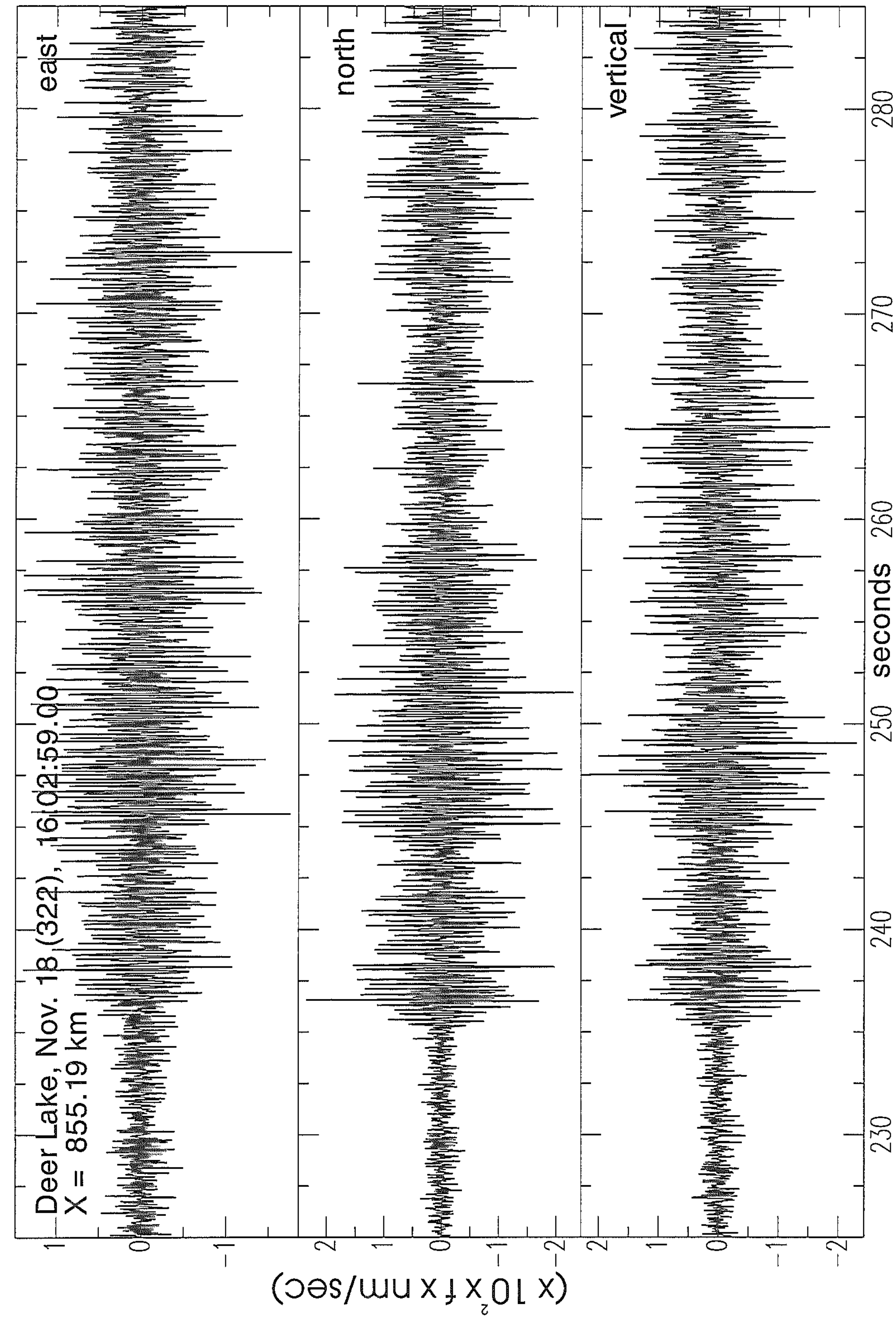

Deer Lake, Nov. 18 (322), 16:02:59.00
X = 855.19 km
east
north
vertical
seconds
230
240
250
260
270
280
(x 10² x f x nm/sec)

Figure 19:

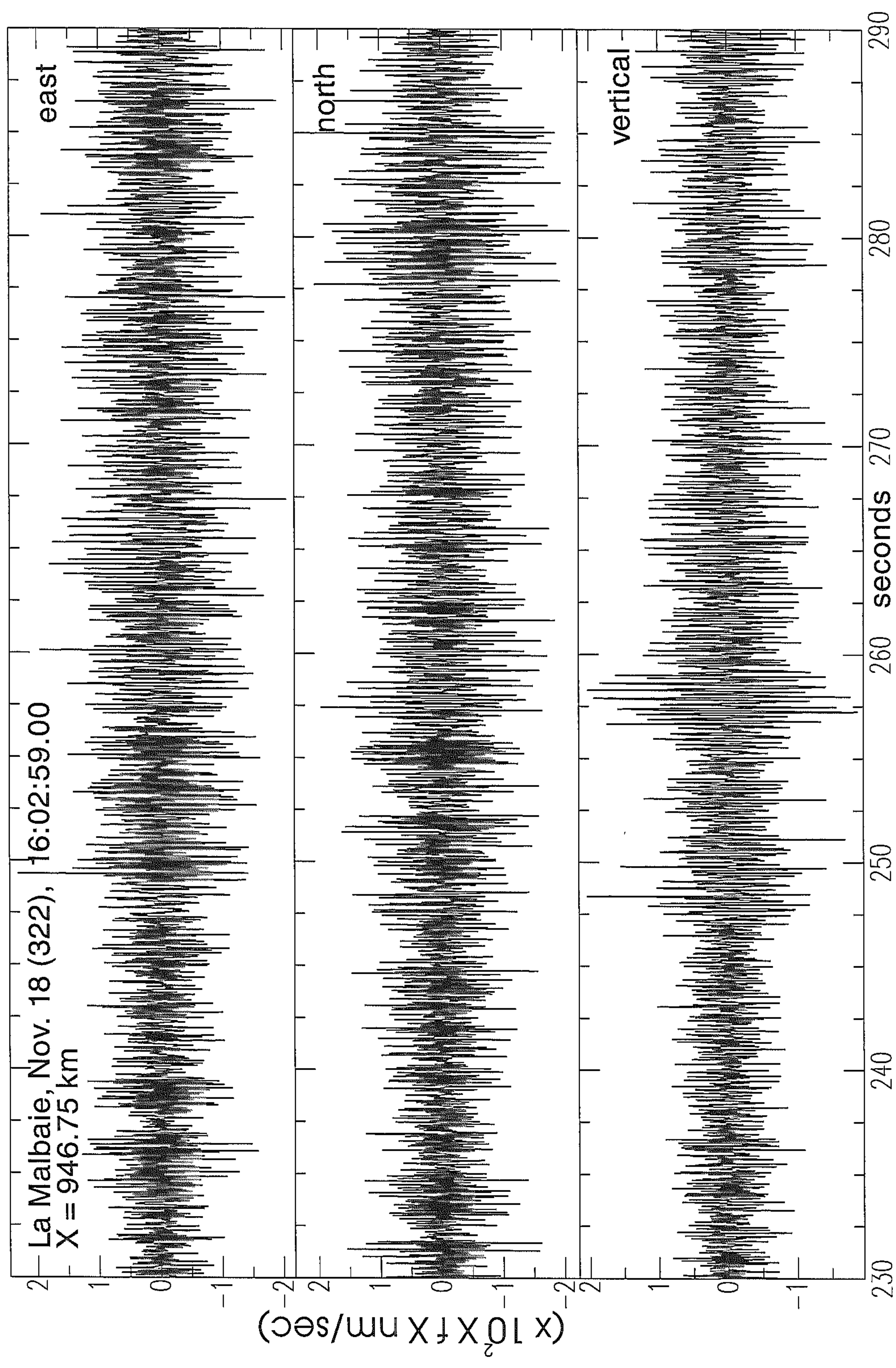

La Malbaie, Nov. 18 (322), 16:02:59.00
X = 946.75 km
east
north
vertical
seconds
230
240
250
260
270
280
290
2
1
0
-1
-2
(x 10^2 X f X nm/sec)

Figure 20:

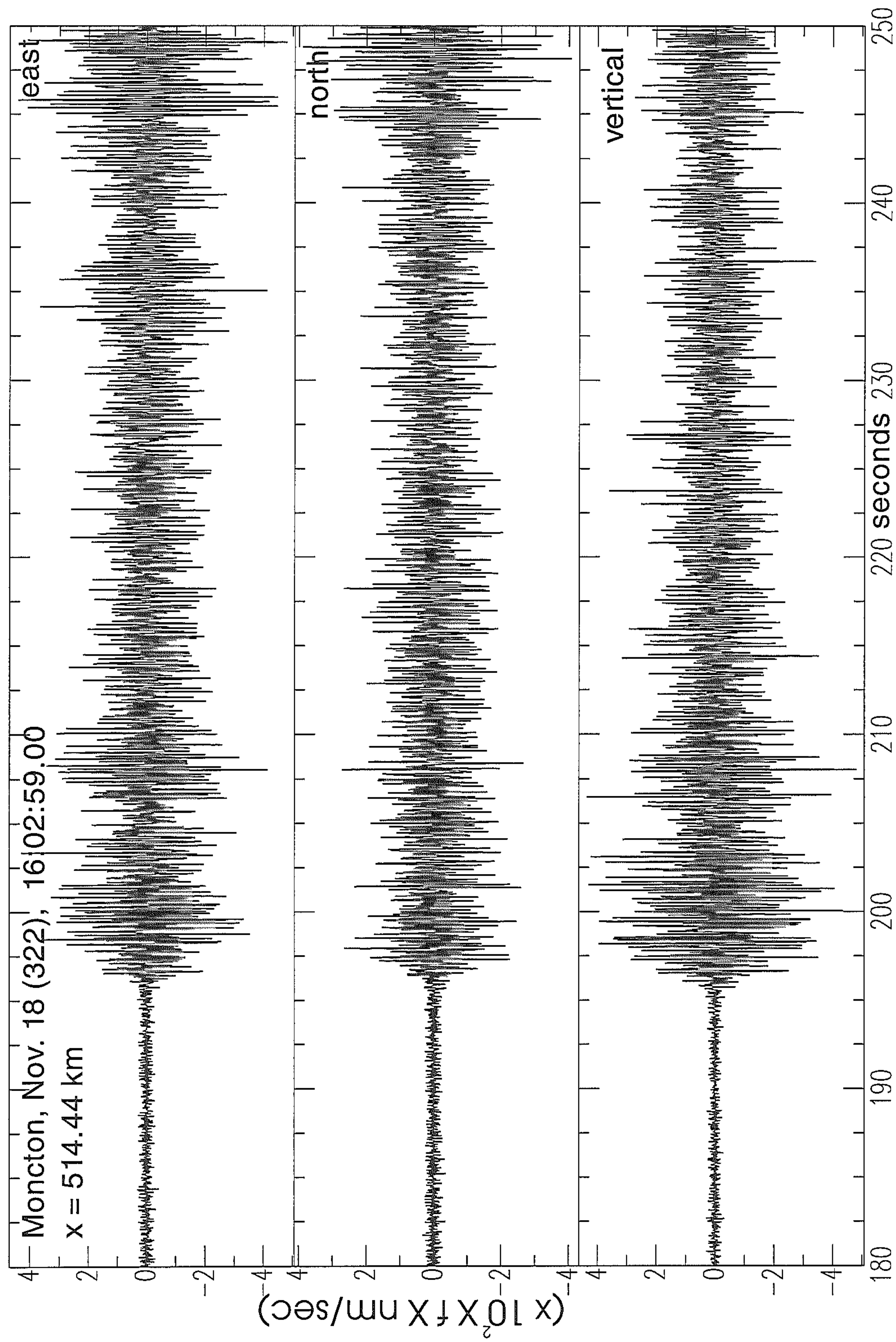

Moncton, Nov. 18 (322), 16:02:59.00
x = 514.44 km
east
north
vertical
seconds
(x 10² X f X nm/sec)
180
190
200
210
220
230
240
250
4
2
0
-2
-4

Figure 21:

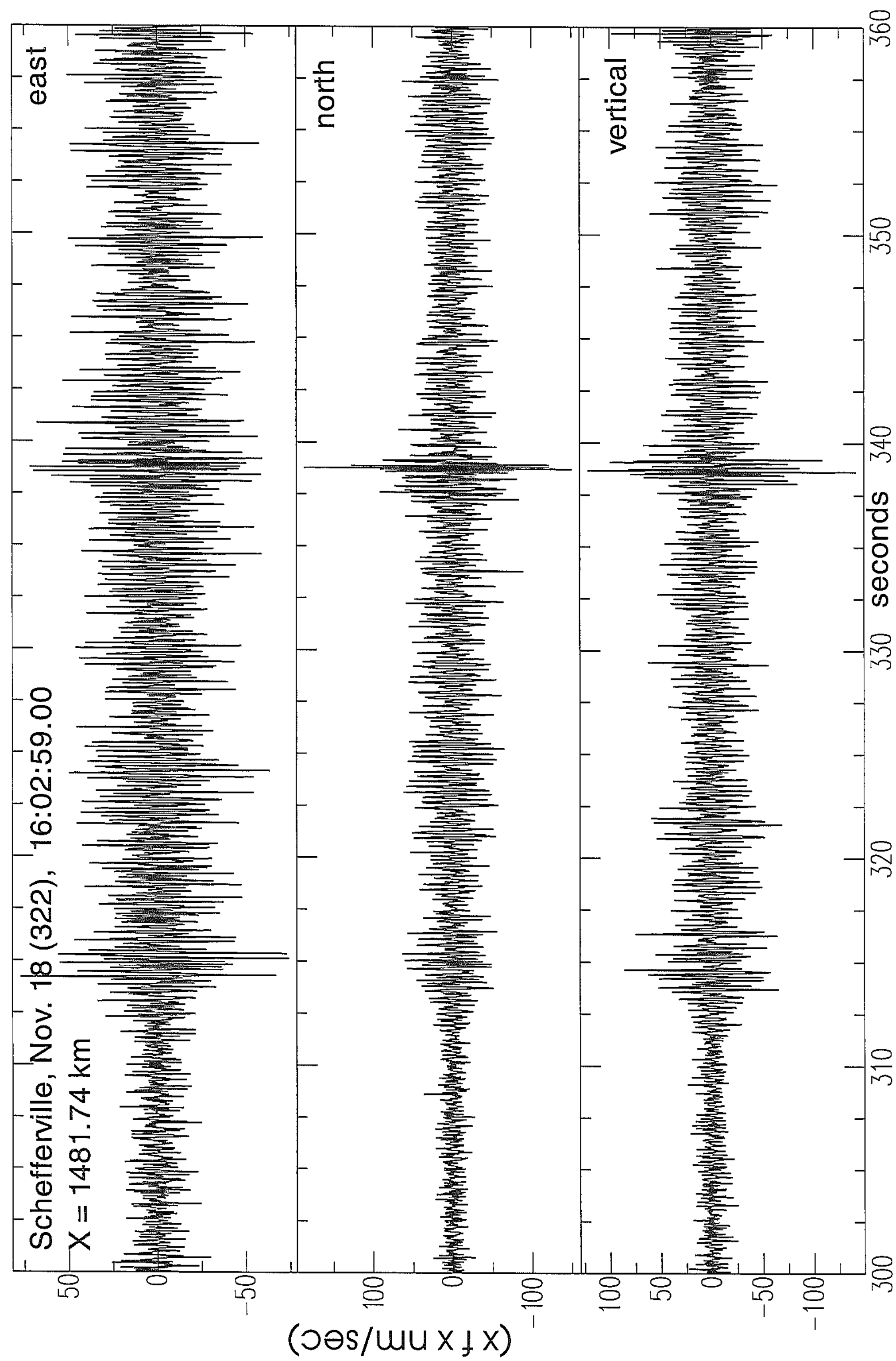

Schefferville, Nov. 18 (322), 16:02:59.00
X = 1481.74 km
east
north
vertical
seconds
(X f x nm/sec)
300
310
320
330
340
350
360
50
0
-50
100
0
-100
100
50
0
-50
-100

Figure 22:

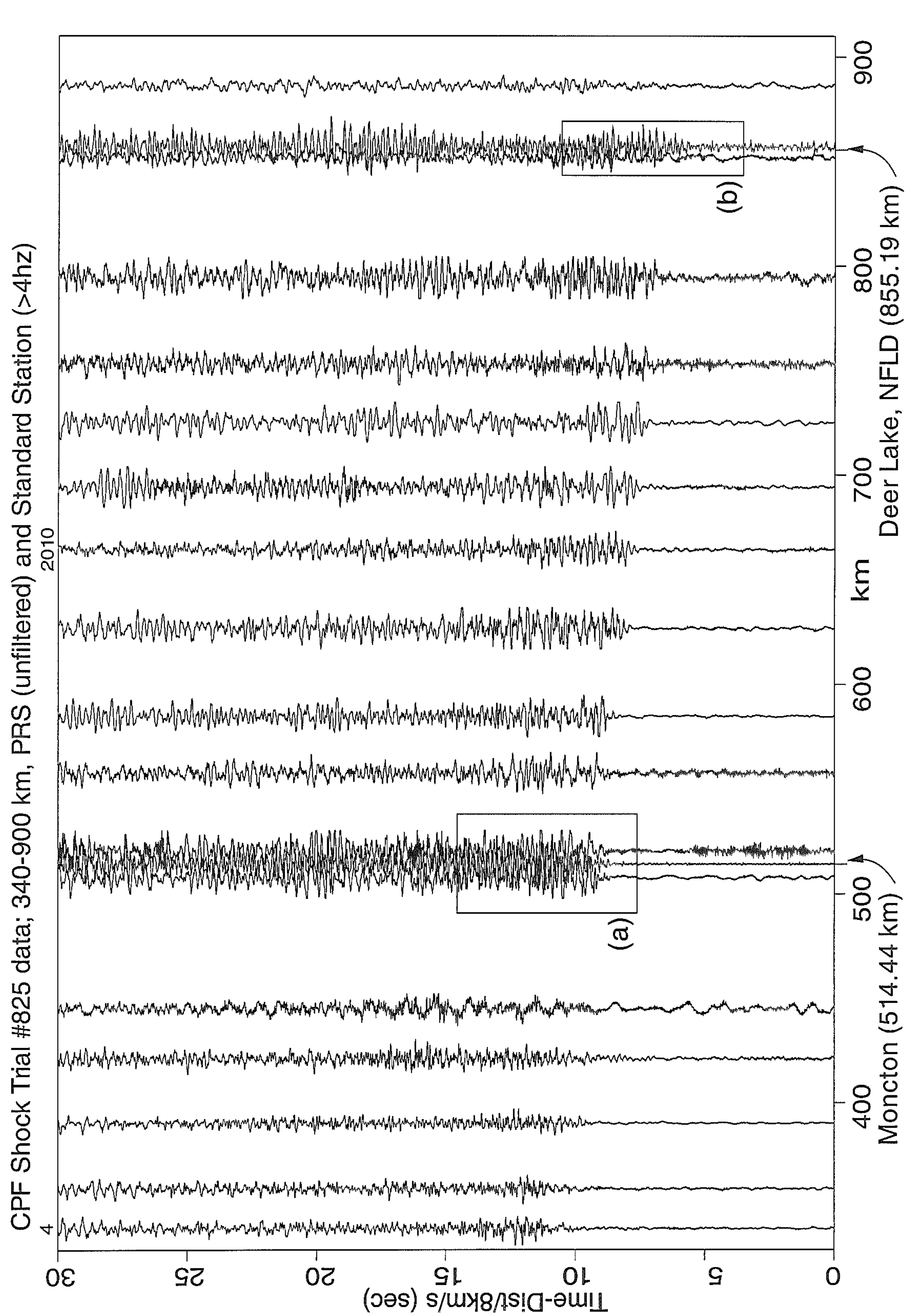

CPF Shock Trial #825 data; 340-900 km, PRS (unfiltered) and Standard Station (>4hz)
Time-Dist/8km/s (sec)
km
Moncton (514.44 km)
Deer Lake, NFLD (855.19 km)
(a)
(b)
4
2010
0
5
10
15
20
25
30
400
500
600
700
800
900

Figure 23:

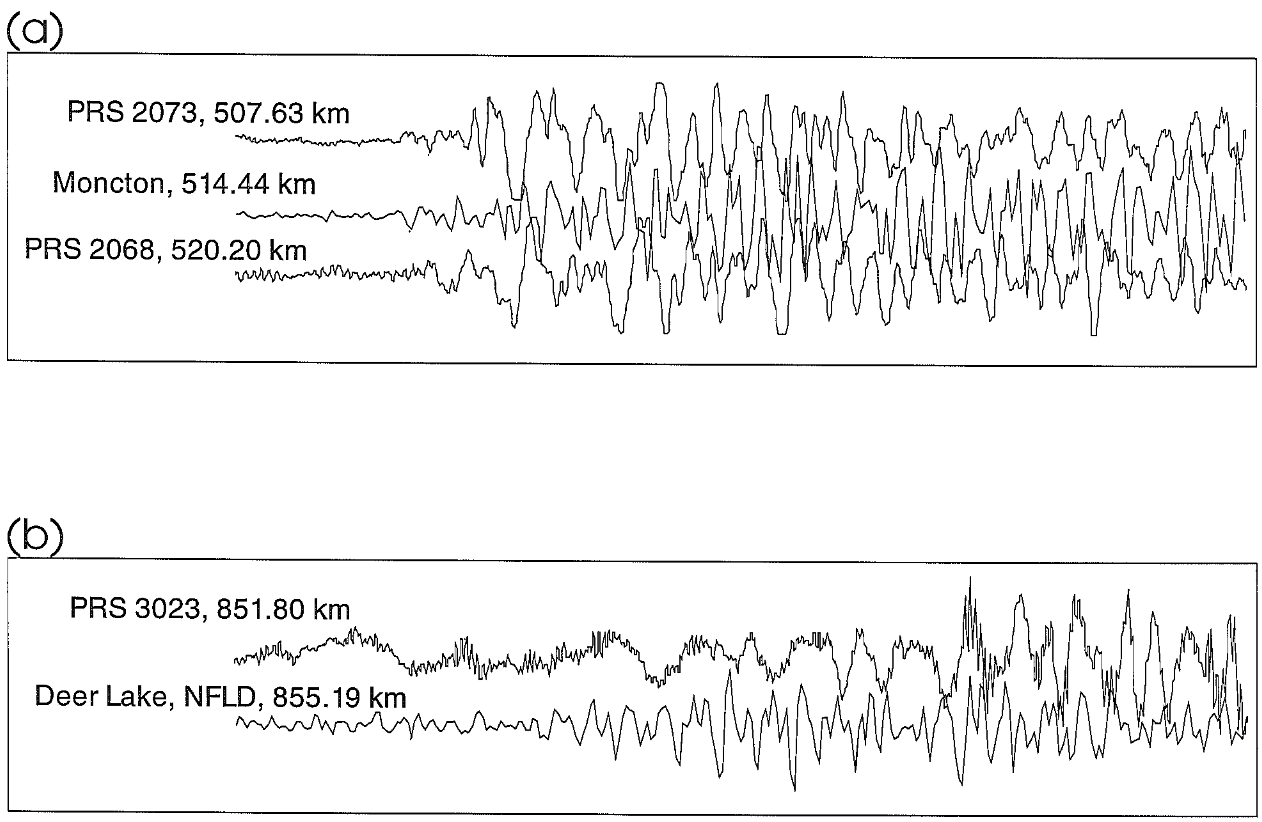

(a)
PRS 2073, 507.63 km
Moncton, 514.44 km
PRS 2068, 520.20 km
(b)
PRS 3023, 851.80 km
Deer Lake, NFLD, 855.19 km

Figure 24:

Appendix A: Detailed Recording Windows

Detonation and recording window options were agreed upon by the land-based recording team and the Shock Trial team prior to each of the test shots. To avoid misfires, the firing was executed by activating two keys to initiate a two minute sequence of electrical checks preceding detonation. The 33 windows of 130 second duration represent 71.5 minutes of the 72 minutes total recording capacity of the PRS-1 instrument. Option B below details the final options for the Nov. 18 detonation.

Large shot Detonation Schedule - 33 windows, 130 sec duration
Option A - Windows Starting 10:30 - ALL TIMES ATLANTIC LOCAL

Window		Key Time		Window Time
1		10:28		10:30
2		10:33		10:35
3		10:38		10:40
4		10:43		10:45
5		10:48		10:50
6		10:53		10:55
7		10:58		11:00
8		11:03		11:05
9		11:08		11:10
10		11:13		11:15
11		11:18		11:20
12		11:23		11:25
13		11:28		11:30
14		11:33		11:35
15		11:38		11:40
16		11:43		11:45
17		11:48		11:50
18		11:53		11:55
19		11:58		12:00
20		12:03		12:05
21	---------	12:08	every 10 minutes	12:10
22		12:18		12:20
23		12:28		12:30
24		12:38		12:40
25		12:48		12:50
26	---------	12:58	every 15 minutes	13:00
27		13:13		13:15
28		13:28		13:30
29		13:43		13:45
30	---------	13:58	30 minutes	14:00
31		14:28		14:30
32	---------	14:58	60 minutes	15:00
33		15:58		16:00

Large shot Detonation Schedule - 33 windows, 130 sec duration
Option B - Windows Starting 11:00 - ALL TIMES ATLANTIC LOCAL

Window		Key Time		Window Time
1		10:58		11:00
2		11:03		11:05
3		11:08		11:10
4		11:13		11:15
5		11:18		11:20
6		11:23		11:25
7		11:28		11:30
8		11:33		11:35
9		11:38		11:40
10		11:43		11:45
11		11:48		11:50
12		11:53		11:55
13		11:58		12:00
14		12:03		12:05
15	---------	12:08	every 10 minutes	12:10
16		12:18		12:20
17		12:28		12:30
18		12:38		12:40
19		12:48		12:50
20		12:58		13:00
21		12:08		13:10
22		12:18		13:20
23		12:28		13:30
24		12:38		13:40
25		13:48		13:50
26	---------	13:58	every 15 minutes	14:00
27		14:13		14:15
28		14:28		14:30
29		14:43		14:45
30	---------	14:58	30 minutes	15:00
31		15:28		15:30
32	---------	15:58	60 minutes	16:00
33		16:58		17:00

Appendix B Tables Generated by LithoSEIS

Note that in all tables generated by LithoSEIS, times are listed in Universal Time.

Table B- 1: Five LithoSEIS deployments 18Z1-18Z5 shown in bold were used for segments of the profile from south to north.

Page No. 1 Frigate Survey
94.12.30

List of LithoSEIS Deployments
With Time In Both UT and Local Format

Dep Code	Number of PRS Plan	Down	Up	Deployment Start Time jjj:hh:mm:ss	Win Dur. (s)	# of Win	Win Int. (s)	Ver	Deployment Start Date and Local Time
NV14	0	0	0	318:14:59:58	108	31	300	No	Mon 14 Nov 1994 14:59:58
NV15	0	2	0	320:14:59:58	108	31	300	Yes	Wed 16 Nov 1994 14:59:58
TEST	0	0	0	322:12:19:00	128	15	300	Yes	Fri 18 Nov 1994 12:19:00
18Z1	**0**	**0**	**0**	**322:15:00:30**	**128**	**15**	**300**	**No**	**Fri 18 Nov 1994 15:00:30**
18Z2	**0**	**6**	**4**	**322:15:00:50**	**128**	**15**	**300**	**Yes**	**Fri 18 Nov 1994 15:00:50**
18Z3	**0**	**6**	**4**	**322:15:01:00**	**128**	**15**	**300**	**Yes**	**Fri 18 Nov 1994 15:01:00**
18Z4	**0**	**4**	**1**	**322:15:01:10**	**128**	**15**	**300**	**Yes**	**Fri 18 Nov 1994 15:01:10**
18Z5	**0**	**0**	**0**	**322:15:01:30**	**128**	**15**	**300**	**Yes**	**Fri 18 Nov 1994 15:01:30**

Table B- 2: LithoSEIS shot database showing time of the Trial Shock in Universal Time.

Page No. 1 Frigate Survey
94.12.30

List of LithoSEIS Survey Shots

Dep Code	Shot ID	Shot Site	Shot Name	Shot Dept (m)	Shot Weight (kg)	Shot Julian Time jjj:hh:mm:ss	Shot Date & Local Time	Shot Corr. (s)
** FSU Code: ZINC								
18Z1	0825	0825		100	0.0	322:16:05:01	Fri 18 Nov 1994 16:05:01	0.738

Table B- 3: Listing from LithoSEIS record database. PRS instruments were deployed for more than 2 days. Clock time corrections were mostly a few milliseconds, with a few exceptions of few tens of milliseconds.

Page No. 1 Frigate Survey
95.04.19

List of LithoSEIS Recordings
With Upload and Download Times

Dep Code	Site ID	PRS Ser. Num.	Download Time jjj:hh:mm:ss	Upload Time jjj:hh:mm:ss	Record Span (hr)	Time Corr. (s)	Down Volts	Up Volts	Level One ?
** FSU Code: DUST									
18Z1	0004	A180	320:23:06:27	323:12:40:16	61.6	0.035	11.68	11.40	
18Z1	0008	A179	320:20:18:40	323:12:41:26	64.4	-0.011	12.03	11.64	
18Z1	0012	A181	320:23:03:11	323:12:39:13	61.6	-0.025	11.53	11.20	
18Z1	0016	A182	320:23:04:53	323:12:38:08	61.6	0.011	11.44	11.13	
18Z1	0020	A187	320:23:14:36	323:12:30:42	61.3	-0.014	11.43	11.07	
18Z1	0024	0252	320:20:17:08	323:12:49:12	64.5	0.103	10.40	10.20	
18Z1	0028	A188	320:23:16:46	323:12:29:21	61.2	0.039	11.47	11.10	
18Z1	0032	A189	320:23:24:35	323:12:27:56	61.1	0.007	11.74	11.62	
18Z1	0036	A185	320:23:13:03	323:12:34:36	61.4	-0.012	11.44	11.09	
18Z1	0040	A186	320:23:11:00	323:12:33:20	61.4	-0.004	11.40	11.03	
18Z1	0044	A184	320:23:09:37	323:12:35:59	61.4	-0.016	11.52	11.15	
18Z1	0048	0254	320:20:22:12	322:09:19:39	37.0	0.000	10.25	13.60	
18Z1	0052	A183	320:23:08:11	323:12:37:06	61.5	0.048	11.47	11.10	
18Z1	0056	A166	320:23:34:31	323:03:01:55	51.5	0.017	11.18	10.82	
18Z1	0058	A142	321:00:28:40	323:03:13:30	50.7	-0.032	10.87	10.37	
18Z1	0060	A171	320:23:43:41	323:02:52:18	51.1	-0.012	11.79	11.54	
18Z1	0062	A143	321:00:24:13	323:03:11:45	50.8	-0.017	10.77	10.23	
18Z1	0064	A170	320:23:41:22	323:02:53:39	51.2	0.003	11.34	10.94	
18Z1	0066	A144	321:00:26:19	323:03:09:04	50.7	-0.008	10.97	10.57	
18Z1	0068	A169	320:23:38:45	323:02:55:22	51.3	-0.009	11.42	11.04	
18Z1	0071	0075	320:23:52:25	323:02:30:23	50.6	-0.005	10.20	14.10	
18Z1	0076	A168	320:23:37:19	323:02:56:36	51.3	-0.017	11.45	11.12	
18Z1	0080	A174	320:23:48:11	323:02:49:38	51.0	0.013	11.60	11.05	
18Z1	0084	A175	320:23:49:51	323:02:44:55	50.9	-0.009	11.27	10.87	
18Z1	0090	A177	320:23:51:35	323:02:42:24	50.8	-0.021	11.44	11.07	
18Z1	0096	A172	320:23:45:02	323:02:50:58	51.1	0.005	11.58	11.24	
18Z1	0100	A163	320:23:26:37	323:03:07:37	51.7	-0.004	11.38	11.04	
18Z1	0104	A164	320:23:28:41	323:03:06:12	51.6	0.009	11.38	10.99	
18Z1	0108	A165	320:23:30:48	323:03:04:31	51.6	0.001	11.43	11.12	
18Z1	0112	0218	320:23:54:49	323:02:28:02	50.6	0.018	10.20	13.60	
18Z1	0116	A149	321:00:03:24	323:16:11:46	64.1	-0.006	10.54	9.84	
18Z1	0120	A150	321:00:04:44	323:16:10:30	64.1	-0.005	10.94	10.53	
18Z1	0124	A151	321:00:06:57	323:16:09:00	64.0	-0.013	10.89	10.40	
18Z1	0128	A152	321:00:09:11	323:16:07:35	64.0	-0.047	10.97	10.50	
18Z1	0132	A161	321:00:14:40	323:16:01:09	63.8	0.011	11.67	11.43	
18Z1	0136	A155	321:00:13:17	323:16:03:23	63.8	-0.086	11.13	10.63	
18Z1	0140	A154	321:00:11:54	323:16:04:55	63.9	0.009	10.87	10.43	
18Z1	0144	0277	321:00:17:07	323:16:23:23	64.1	-0.027	11.15	10.35	
18Z1	0148	A153	321:00:10:32	323:16:06:18	63.9	-0.039	10.94	10.39	
18Z1	0152	A145	320:23:57:41	323:16:17:05	64.3	-0.029	10.83	10.28	
18Z1	0160	A147	321:00:00:44	323:16:14:41	64.2	-0.028	10.84	10.37	
18Z1	0165	A148	321:00:02:04	323:16:13:09	64.2	-0.039	10.79	10.24	
18Z1	0168	0286	321:00:15:30	323:16:21:46	64.1	-0.049	10.55	10.00	

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18Z1	0173	A134	321:00:30:09	323:23:59:43	71.5	0.020	11.59	11.37	
18Z1	0176	A133	321:00:31:31	323:23:58:12	71.4	0.000	11.74	11.49	
18Z1	0180	A132	321:00:33:04	323:23:55:34	71.4	0.024	11.55	11.20	
18Z1	0188	A131	321:00:40:11	323:23:53:26	71.2	0.007	11.60	11.33	
18Z1	0200	0288	321:00:27:08	324:00:02:15	71.6	-0.048	11.70	13.70	
** FSU Code: MOON									
18Z2	2036	A100	321:10:48:22	323:18:43:38	55.9	0.083	11.49	11.37	
18Z2	2037	A101	321:10:47:01	322:17:20:27	30.6	-0.016	11.54	11.18	
18Z2	2038	A105	321:10:41:38	323:18:39:08	56.0	0.020	11.73	11.49	
18Z2	2039	A104	321:10:42:56	323:18:40:02	56.0	0.043	11.72	11.49	
18Z2	2040	A122	321:10:34:26	323:18:45:26	56.2	-0.010	11.57	11.37	
18Z2	2041	A119	321:10:29:56	323:18:30:55	56.0	-0.020	11.67	11.44	
18Z2	2042	A108	321:10:37:14	323:18:44:35	56.1	0.028	11.75	11.60	
18Z2	2043	A109	321:10:35:58	323:18:30:02	55.9	0.019	11.68	11.58	
18Z2	2044	A106	321:10:40:19	323:18:29:08	55.8	0.022	11.68	11.49	
** FSU Code: ZINC									
18Z2	2045	0273	321:11:11:12	323:18:19:46	55.1	-0.007	10.40	9.95	
** FSU Code: MOON									
18Z2	2046	A116	321:10:24:45	323:18:38:11	56.2	0.015	11.63	11.43	
18Z2	2047	A117	321:10:26:16	323:18:34:10	56.1	-0.031	11.64	11.43	
18Z2	2048	A120	321:10:31:51	323:18:40:59	56.2	0.007	11.62	11.38	
18Z2	2049	A121	321:10:33:09	323:18:41:51	56.1	-0.015	11.54	11.32	
18Z2	2050	A103	321:10:44:22	323:18:37:20	55.9	0.061	11.72	11.49	
18Z2	2051	A107	321:10:38:33	323:18:25:17	55.8	0.006	11.69	11.54	
18Z2	2052	A102	321:10:45:40	323:18:19:47	55.6	0.024	11.63	11.45	
18Z2	2053	A118	321:10:28:35	323:18:42:46	56.2	0.041	11.78	11.63	
18Z2	2054	A115	321:10:23:26	323:18:36:20	56.2	0.026	11.63	11.43	
** FSU Code: ZINC									
18Z2	2055	0274	321:11:12:05	323:18:18:28	55.1	-0.022	10.60	10.05	
** FSU Code: MOON									
18Z2	2056	A110	321:10:15:50	323:18:03:52	55.8	0.015	11.63	11.49	
18Z2	2057	A136	321:10:06:32	323:18:04:39	56.0	0.005	11.69	11.53	
18Z2	2058	A127	321:09:57:11	323:18:09:17	56.2	0.027	11.59	11.35	
18Z2	2059	A128	321:09:55:46	323:18:05:37	56.2	-0.008	11.54	11.30	
18Z2	2060	A123	321:09:41:21	323:18:08:26	56.5	0.024	11.68	11.43	
18Z2	2061	A112	321:10:18:46	323:18:06:31	55.8	0.005	11.68	11.48	
18Z2	2062	A125	321:10:14:26	323:18:07:25	55.9	0.050	11.60	11.39	
18Z2	2063	A135	321:10:04:41	323:18:12:52	56.1	0.004	11.77	11.58	
18Z2	2064	A139	321:10:10:48	323:18:14:44	56.1	0.042	11.64	11.48	

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** FSU Code: ZINC									
18Z2	2065	0258	321:11:08:35	323:17:55:28	54.8	-0.042	10.60	10.10	
** FSU Code: MOON									
18Z2	2066	A113	321:10:20:07	323:18:16:43	55.9	0.013	11.69	11.49	
18Z2	2067	A124	321:09:48:45	323:18:02:11	56.2	0.004	11.57	11.32	
18Z2	2068	A126	321:09:51:56	323:18:10:06	56.3	-0.002	11.60	11.34	
18Z2	2069	A130	321:10:03:13	323:18:12:02	56.1	0.014	11.54	11.30	
18Z2	2070	A137	321:10:07:54	323:18:15:41	56.1	0.010	11.69	11.49	
18Z2	2071	A129	321:10:12:50	323:18:13:54	56.0	0.003	11.49	11.30	
18Z2	2072	A114	321:10:21:42	323:18:03:04	55.7	-0.006	11.63	11.44	
18Z2	2073	A138	321:10:09:22	323:18:10:59	56.0	0.002	11.73	11.54	
18Z2	2074	A111	321:10:17:28	323:18:17:36	56.0	-0.002	11.77	11.58	
** FSU Code: ZINC									
18Z2	2075	0271	321:11:10:11	323:17:58:52	54.8	-0.074	10.55	10.15	
** FSU Code: MARS									
18Z3	2001	A087	321:10:36:14	323:00:31:02	37.9	-0.001	11.73	11.53	
18Z3	2003	A086	321:10:40:30	323:00:29:12	37.8	0.010	11.73	11.54	
18Z3	2004	A091	321:10:11:31	323:00:30:02	38.3	-0.009	11.64	11.49	
** FSU Code: ZINC									
18Z3	2005	0278	321:11:21:31	323:00:51:07	37.5	-0.015	11.55	13.60	
** FSU Code: MARS									
18Z3	2006	A067	321:11:06:38	323:00:21:51	37.3	-0.001	11.63	11.38	
18Z3	2007	A090	321:10:09:27	323:00:25:55	38.3	0.009	11.64	11.45	
18Z3	2008	A140	321:10:26:02	323:00:25:02	38.0	0.009	11.73	11.54	
** FSU Code: ZINC									
18Z3	2009	0280	321:11:13:08	322:22:59:25	35.8	-0.024	10.85	10.40	
** FSU Code: MARS									
18Z3	2010	A077	321:10:44:29	322:23:45:43	37.0	0.000	11.62	11.38	
18Z3	2011	A064	321:11:00:56	322:23:49:16	36.8	0.002	11.68	11.49	
18Z3	2012	A078	321:10:43:10	322:23:47:31	37.1	0.010	11.67	11.44	
18Z3	2013	A079	321:10:41:52	322:23:46:38	37.1	-0.007	11.57	11.34	
18Z3	2014	A063	321:11:02:18	322:23:48:25	36.8	-0.008	11.67	11.49	
18Z3	2015	A065	321:11:03:46	322:23:50:12	36.8	0.011	11.75	11.62	
18Z3	2016	A076	321:10:46:12	322:23:44:41	37.0	0.025	11.73	11.55	
18Z3	2017	A075	321:10:59:31	322:23:43:43	36.7	0.004	11.49	11.30	
** FSU Code: ZINC									

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18Z3	2018	0281	321:11:14:10	322:22:56:58	35.7	-0.027	10.95	10.65	
** FSU Code: MARS									
18Z3	2019	A089	321:10:39:10	322:23:34:50	36.9	-0.021	11.74	11.58	
18Z3	2020	A082	321:10:29:18	322:23:28:05	37.0	0.022	11.63	11.40	
18Z3	2021	A073	321:10:53:02	322:23:41:54	36.8	0.008	11.47	11.24	
18Z3	2022	A074	321:10:49:36	322:23:42:48	36.9	-0.005	11.63	11.48	
18Z3	2023	A083	321:10:34:13	322:23:31:07	36.9	-0.007	11.55	11.37	
18Z3	2024	A071	321:10:56:04	322:23:40:05	36.7	0.015	11.79	11.64	
18Z3	2025	A088	321:10:37:51	322:23:33:54	36.9	0.055	11.23	10.94	
18Z3	2026	A072	321:10:54:24	322:23:41:01	36.8	-0.004	11.73	11.59	
18Z3	2027	A070	321:10:57:25	322:23:39:07	36.7	0.006	11.58	11.44	
18Z3	2028	A080	321:10:27:48	322:23:26:56	37.0	0.015	11.64	11.44	
18Z3	2029	A094	321:10:16:25	322:23:32:03	37.3	-0.008	11.73	11.58	
18Z3	2031	A095	321:10:17:59	322:23:32:53	37.2	-0.018	11.68	11.54	
18Z3	2032	A098	321:10:23:08	322:23:38:03	37.2	0.006	11.65	11.59	
18Z3	2033	A096	321:10:19:35	322:23:36:02	37.3	0.019	11.69	11.54	
18Z3	2034	A097	321:10:21:11	322:23:37:11	37.3	0.013	11.63	11.49	
18Z3	3082	A084	321:10:31:33	323:00:27:00	37.9	0.007	11.68	11.49	
18Z3	3083	A066	321:11:05:10	323:00:27:52	37.4	-0.014	11.74	11.58	
18Z3	3084	A085	321:10:32:56	323:00:23:56	37.9	0.005	11.60	11.43	
18Z3	3085	A099	321:10:24:32	323:00:22:54	38.0	0.018	11.64	11.49	
** FSU Code: ZINC									
18Z3	3086	0285	321:11:15:47	323:00:52:19	37.6	-0.014	10.60	10.30	
** FSU Code: CLAY									
18Z4	3043	A046	321:11:03:35	323:20:24:59	57.4	0.018	11.62	11.38	
** FSU Code: MINE									
18Z4	3044	0304	321:10:19:19	323:19:53:38	57.6	-0.030	11.20	10.75	
** FSU Code: CLAY									
18Z4	3045	A045	321:11:04:57	323:20:26:32	57.4	-0.006	11.73	11.49	
18Z4	3046	A001	321:11:00:28	323:20:27:15	57.4	-0.023	11.68	11.42	
18Z4	3047	A002	321:11:02:07	323:20:16:24	57.2	0.031	11.63	11.40	
18Z4	3048	A060	321:10:47:07	323:20:17:06	57.5	0.041	11.69	11.47	
18Z4	3049	A059	321:10:48:41	323:20:25:43	57.6	0.001	11.72	11.49	
** FSU Code: MINE									
18Z4	3050	0305	321:10:29:01	323:19:52:58	57.4	-0.099	10.90	10.20	
** FSU Code: CLAY									
18Z4	3051	A062	321:10:49:57	323:20:17:49	57.5	0.004	11.69	11.48	
18Z4	3052	A061	321:10:51:12	323:20:14:58	57.4	0.024	11.74	11.49	

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18Z4	3053	A057	321:10:56:22	323:20:15:42	57.3	-0.023	11.64	11.44	
18Z4	3054	A058	321:10:54:49	323:20:24:15	57.5	-0.007	11.77	11.55	
18Z4	3055	A056	321:10:57:40	323:20:23:32	57.4	0.023	11.77	11.57	
** FSU Code: MINE									
18Z4	3056	0309	321:10:20:01	323:19:52:19	57.5	-0.097	11.20	10.80	
** FSU Code: CLAY									
18Z4	3057	A055	321:10:59:05	323:20:21:32	57.4	0.089	11.73	11.49	
18Z4	3058	A037	321:11:13:54	323:20:18:32	57.1	-0.007	11.68	11.44	
18Z4	3059	A010	321:11:10:41	323:20:22:47	57.2	-0.009	11.20	10.79	
18Z4	3060	A009	321:11:09:09	323:20:20:43	57.2	0.015	11.59	11.37	
18Z4	3061	A004	321:11:06:24	323:20:19:59	57.2	0.032	11.74	11.49	
18Z4	3062	A003	321:11:07:46	323:20:19:15	57.2	0.016	11.69	11.49	
** FSU Code: MINE									
18Z4	3063	0225	321:10:25:17	323:21:28:17	59.1	-0.003	11.60	10.00	
** FSU Code: CLAY									
18Z4	3064	A012	321:11:15:34	323:21:20:32	58.1	0.004	11.68	11.44	
18Z4	3065	A011	321:11:16:56	323:21:19:38	58.0	0.010	11.63	11.33	
18Z4	3066	A038	321:11:12:22	323:21:18:51	58.1	-0.002	11.79	11.58	
18Z4	3067	A041	321:11:26:22	323:21:22:03	57.9	0.006	11.75	11.54	
18Z4	3068	A042	321:11:24:54	323:21:21:16	57.9	0.010	11.77	11.53	
** FSU Code: MINE									
18Z4	3069	0307	321:10:17:13	323:21:29:08	59.2	-0.082	11.20	10.80	
** FSU Code: CLAY									
18Z4	3070	A021	321:11:20:34	323:21:22:49	58.0	-0.054	11.69	11.44	
18Z4	3071	A017	321:11:23:25	323:21:23:36	58.0	0.017	11.67	11.43	
18Z4	3072	A020	321:11:21:58	323:21:17:21	57.9	-0.004	11.64	11.43	
18Z4	3073	A022	321:11:18:49	323:21:18:07	58.0	0.011	11.63	11.39	
** FSU Code: ZINC									
18Z4	3074	0306	321:11:16:53	323:00:53:54	37.6	-0.069	11.25	11.00	
** FSU Code: MOON									
18Z4	3075	A141	321:10:58:55	323:00:38:32	37.7	0.039	11.74	11.59	
18Z4	3076	A068	321:11:03:45	323:00:39:27	37.6	-0.017	11.77	11.62	
18Z4	3077	A069	321:11:05:16	323:00:37:16	37.5	-0.011	11.67	11.49	
18Z4	3078	A160	321:11:00:28	323:00:40:30	37.7	0.001	11.33	10.98	
18Z4	3079	A092	321:13:39:53	323:00:33:07	34.9	-0.002	11.63	11.44	
18Z4	3080	A093	321:13:38:22	323:00:41:25	35.1	0.009	11.69	11.54	

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** FSU Code: CLAY									
18Z5	3003	A043	321:11:04:53	323:02:03:05	39.0	-0.004	11.77	11.60	
18Z5	3004	A023	321:11:13:50	323:15:05:21	51.9	-0.024	11.80	11.58	
18Z5	3005	A031	321:11:15:29	323:15:06:10	51.8	0.044	11.63	11.38	
** FSU Code: MINE									
18Z5	3006	0257	321:10:39:52	323:15:32:22	52.9	-0.042	10.45	10.10	
** FSU Code: CLAY									
18Z5	3007	A032	321:11:16:51	323:15:04:29	51.8	0.008	11.59	11.34	
18Z5	3008	A024	321:11:12:20	323:14:54:48	51.7	0.010	11.63	11.37	
18Z5	3009	A028	321:11:29:08	323:14:59:56	51.5	0.012	11.60	11.38	
18Z5	3010	A027	321:11:27:46	323:14:53:56	51.4	0.027	11.29	10.94	
18Z5	3011	A033	321:11:24:50	323:14:58:17	51.6	-0.019	11.30	11.07	
18Z5	3012	A034	321:11:26:18	323:14:45:50	51.3	-0.029	11.63	11.44	
18Z5	3013	A054	321:11:21:54	323:14:46:41	51.4	0.000	11.72	11.54	
18Z5	3014	A053	321:11:23:21	323:14:49:25	51.4	0.008	11.74	11.49	
18Z5	3015	A029	321:11:18:44	323:14:50:17	51.5	0.010	11.59	11.34	
** FSU Code: MINE									
18Z5	3016	0308	321:10:33:34	323:15:31:36	53.0	-0.065	10.90	10.75	
** FSU Code: CLAY									
18Z5	3017	A030	321:11:20:29	323:14:53:05	51.5	0.014	11.68	11.44	
18Z5	3018	A049	321:11:32:04	323:14:51:28	51.3	-0.029	11.72	11.53	
18Z5	3019	A050	321:11:30:35	323:14:52:16	51.4	-0.004	11.84	11.64	
18Z5	3020	A047	321:11:33:22	323:15:00:49	51.5	-0.014	11.63	11.43	
18Z5	3021	A048	321:11:34:42	323:15:01:39	51.4	0.009	11.72	11.54	
18Z5	3022	A052	321:11:38:53	323:15:02:38	51.4	0.002	11.67	11.47	
18Z5	3023	A051	321:11:36:07	323:15:03:27	51.5	0.009	11.34	11.03	
** FSU Code: MINE									
18Z5	3025	0275	321:10:32:09	324:01:57:54	63.4	-0.056	10.60	10.05	
** FSU Code: CLAY									
18Z5	3026	A007	321:10:50:53	324:01:48:13	63.0	-0.004	11.64	11.35	
18Z5	3027	A039	321:10:49:39	324:01:48:58	63.0	-0.010	11.82	11.58	
18Z5	3028	A040	321:10:48:19	324:01:49:44	63.0	-0.049	11.78	11.54	
18Z5	3029	A006	321:10:56:48	324:01:50:31	62.9	0.042	11.73	11.45	
18Z5	3030	A016	321:10:58:02	324:01:45:07	62.8	-0.022	11.59	11.30	
** FSU Code: MINE									
18Z5	3031	0263	321:10:40:42	324:01:58:38	63.3	-0.065	11.40	10.05	

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List of LithoSEIS Recordings
With Upload and Download Times

Dep Code	Site ID	PRS Ser. Num.	Download Time jjj:hh:mm:ss	Upload Time jjj:hh:mm:ss	Record Span (hr)	Time Corr. (s)	Down Volts	Up Volts	Level One ?
** FSU Code: CLAY									
18Z5	3032	A008	321:10:54:21	324:01:45:52	62.9	0.047	11.67	11.39	
18Z5	3033	A005	321:10:55:34	324:01:46:39	62.9	0.001	11.74	11.49	
18Z5	3034	A015	321:10:59:17	324:01:47:24	62.8	0.018	11.73	11.47	
18Z5	3035	A013	321:11:00:36	324:01:44:22	62.7	-0.011	11.64	11.38	
18Z5	3036	A044	321:11:03:30	324:01:43:36	62.7	0.004	11.77	11.53	
18Z5	3038	A014	321:11:02:13	324:01:41:58	62.7	0.016	11.67	11.39	
18Z5	3040	A036	321:11:06:20	324:01:42:46	62.6	0.003	11.68	11.43	
18Z5	3041	A026	321:11:10:37	324:01:40:25	62.5	0.041	11.64	11.35	
18Z5	3042	A025	321:11:09:06	324:01:41:13	62.5	0.001	11.57	11.23	

Table B- 4: Location of survey recording sites and the Trial Shock. All these locations were automatically recorded using GPS receivers. Site Elevations are for the for the geoid used in the GPS software and are not corrected. The Trial Shock is given a site number of 0825 and is shown on the next page in bold.

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List of LithoSEIS Survey Sites
Standard Report Form

Site ID	Line ID	Lat.	Long.	Site Elev. m	Northing	Easting	UTM Zone
** FSU Code: BORT							
0001		044:27:04.09N	063:43:36.23W	****.*	4922022	442177	20
0004		044:28:16.52N	063:43:22.58W	452.0	4924254	442498	20
0008		044:28:14.98N	063:47:29.50W	-508.0	4924257	437042	20
0012		044:29:38.47N	063:48:12.69W	1254.0	4926842	436113	20
0016		044:31:51.61N	063:47:04.39W	-269.0	4930935	437661	20
0020		044:31:48.78N	063:50:22.69W	612.0	4930892	433283	20
0024		044:30:24.17N	063:55:53.00W	-455.0	4928360	425963	20
0028		044:32:13.38N	063:56:15.46W	-223.0	4931735	425506	20
0032		044:34:44.34N	063:55:00.27W	-10.0	4936374	427217	20
** FSU Code: ZINC							
0036		044:37:54.56N	063:52:39.66W	606.0	4942210	430381	20
0040		044:38:18.14N	063:55:05.68W	521.0	4942973	427172	20
0044		044:40:52.06N	063:53:36.81W	1149.0	4947700	429182	20
0048		044:40:28.91N	063:57:41.73W	-946.0	4947047	423782	20
0052		044:41:36.32N	063:58:29.94W	243.0	4949140	422746	20
** FSU Code: BORT							
0056		044:39:47.37N	064:05:06.46W	-602.0	4945888	413973	20
0058		044:40:36.90N	064:05:39.22W	1110.0	4947427	413272	20
0060		044:42:24.35N	064:03:35.25W	488.0	4950706	416045	20
0062		044:43:03.08N	064:03:46.05W	311.0	4951904	415823	20
0064		044:43:37.39N	064:04:27.10W	694.0	4952974	414933	20
0066		044:44:28.41N	064:04:44.66W	828.0	4954554	414568	20
0068		044:45:04.10N	064:05:04.57W	1886.0	4955661	414145	20
0071		044:46:14.82N	064:05:51.91W	897.0	4957857	413133	20
0076		044:48:37.94N	064:05:18.27W	312.0	4962263	413932	20
0080		044:48:24.27N	064:09:00.98W	485.0	4961909	409034	20
0084		044:49:28.11N	064:10:01.25W	694.0	4963897	407738	20
0090		044:50:34.33N	064:12:15.80W	2528.0	4965984	404814	20
0096		044:48:48.92N	064:20:35.61W	2181.0	4962903	393787	20
0100		044:50:43.47N	064:20:23.85W	1415.0	4966434	394104	20
0104		044:52:06.62N	064:21:12.49W	1804.0	4969017	393079	20
0108		044:53:18.78N	064:22:02.69W	1326.0	4971262	392015	20
0112		044:54:38.43N	064:22:56.13W	1827.0	4973740	390885	20
** FSU Code: ZINC							
0116		045:00:13.65N	064:16:32.02W	2371.0	4983946	399470	20
0120		045:00:36.56N	064:18:41.77W	2439.0	4984698	396641	20
0124		045:00:47.30N	064:21:40.51W	2439.0	4985094	392734	20
0128		045:01:43.70N	064:23:02.90W	835.0	4986865	390960	20
0132		045:02:52.85N	064:24:20.87W	642.0	4989028	389291	20
0136		045:04:49.61N	064:23:58.78W	-409.0	4992623	389836	20

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List of LithoSEIS Survey Sites
Standard Report Form

Site ID	Line ID	Lat.	Long.	Site Elev. m	Northing	Easting	UTM Zone
0140		045:05:42.13N	064:25:37.99W	966.0	4994281	387696	20
0144		045:06:07.33N	064:27:55.81W	203.0	4995113	384698	20
0148		045:07:16.17N	064:28:55.68W	108.0	4997261	383428	20
0152		045:05:46.17N	064:34:58.00W	914.0	4994634	375458	20
0156		045:06:58.62N	064:35:57.12W	-779.0	4996895	374210	20
0160		045:08:02.35N	064:37:18.32W	1611.0	4998897	372475	20
0165		045:09:32.88N	064:38:29.22W	390.0	5001721	370983	20
0168		045:10:42.47N	064:39:19.43W	1588.0	5003892	369931	20
0173		045:17:52.91N	064:46:04.20W	77.0	5017361	361388	20
0176		045:19:38.27N	064:45:27.73W	14.0	5020595	362253	20
0180		045:20:44.71N	064:46:45.02W	-524.0	5022683	360616	20
0188		045:22:33.51N	064:49:50.00W	1866.0	5026130	356667	20
0200		045:25:54.97N	064:53:33.48W	-98.0	5032460	351953	20
** FSU Code: FRIG							
0825		**042:01:06.78N**	**061:13:02.34W**	**0.0**	**4653160**	**647601**	**20**
** FSU Code: ZINC							
2001		046:49:05.52N	066:37:46.62W	283.0	5187471	680822	19
2003		046:47:28.14N	066:37:05.52W	438.0	5184492	681784	19
2004		046:46:27.84N	066:35:45.60W	319.0	5182682	683536	19
2005		046:45:37.02N	066:33:54.06W	213.0	5181187	685950	19
2006		046:44:52.74N	066:31:27.36W	321.0	5179917	689105	19
2007		046:44:18.72N	066:29:42.78W	274.0	5178937	691357	19
2008		046:43:00.42N	066:28:12.84W	270.0	5176582	693343	19
2009		046:42:26.28N	066:26:33.42W	247.0	5175596	695488	19
2010		046:41:32.40N	066:25:10.62W	211.0	5173991	697301	19
2011		046:41:02.28N	066:22:51.90W	285.0	5173158	700278	19
2012		046:40:25.98N	066:19:37.86W	213.0	5172177	704438	19
2013		046:39:37.74N	066:19:22.32W	226.0	5170699	704818	19
2014		046:37:47.58N	066:19:57.00W	130.0	5167274	704197	19
2015		046:36:18.06N	066:19:11.46W	477.0	5164544	705259	19
2016		046:34:44.46N	066:18:47.70W	328.0	5161672	705863	19
2017		046:33:37.92N	066:18:00.72W	95.0	5159653	706933	19
2018		046:33:03.66N	066:15:22.86W	111.0	5158711	710331	19
2019		046:32:23.46N	066:12:55.80W	193.0	5157580	713506	19
2020		046:34:04.02N	066:07:32.94W	51.0	5160931	720269	19
2021		046:32:43.74N	066:06:53.64W	47.0	5158483	721196	19
2022		046:29:58.20N	066:10:29.40W	77.0	5153208	716785	19
2023		046:28:51.36N	066:11:04.08W	342.0	5151119	716119	19
2024		046:27:01.62N	066:11:25.02W	190.0	5147716	715793	19
2025		046:25:10.20N	066:11:04.74W	101.0	5144292	716348	19
2026		046:24:00.60N	066:09:40.32W	96.0	5142209	718227	19
2027		046:23:13.92N	066:08:44.94W	7.0	5140811	719462	19
2028		046:22:04.62N	066:07:42.18W	153.0	5138720	720880	19

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List of LithoSEIS Survey Sites
Standard Report Form

Site ID	Line ID	Lat.	Long.	Site Elev. m	Northing	Easting	UTM Zone
** FSU Code: BORT							
2029		046:22:33.00N	066:03:09.00W	0.0	5139811	726684	19
** FSU Code: ZINC							
2031		046:22:48.84N	065:57:22.62W	60.0	5140325	272659	20
2032		046:21:50.70N	065:56:11.46W	32.0	5138474	274112	20
2033		046:21:10.62N	065:54:04.50W	0.0	5137137	276780	20
2034		046:19:34.14N	065:52:29.94W	137.0	5134085	278692	20
2036		046:17:19.26N	065:50:48.90W	98.0	5129845	280703	20
2037		046:15:51.06N	065:51:34.44W	40.0	5127158	279631	20
2038		046:14:12.84N	065:50:27.66W	11.0	5124075	280951	20
2039		046:12:58.68N	065:49:41.64W	35.0	5121751	281855	20
2040		046:11:04.74N	065:49:58.86W	0.0	5118248	281361	20
2041		046:09:42.96N	065:49:15.90W	74.0	5115691	282192	20
2042		046:10:02.28N	065:42:31.68W	5.0	5115985	290881	20
2043		046:08:46.86N	065:41:24.84W	0.0	5113609	292236	20
2044		046:08:07.68N	065:39:26.04W	20.0	5112314	294744	20
2045		046:07:38.22N	065:36:48.84W	267.0	5111293	298087	20
** FSU Code: BORT							
2046		046:05:28.32N	065:37:43.44W	0.0	5107322	296782	20
** FSU Code: ZINC							
2047		046:05:08.34N	065:35:06.84W	124.0	5106595	300125	20
2048		046:04:05.40N	065:33:47.40W	44.0	5104598	301768	20
2049		046:03:22.02N	065:32:56.22W	90.0	5103223	302825	20
2050		046:03:45.18N	065:28:17.82W	12.0	5103749	308829	20
2051		046:03:05.16N	065:27:02.70W	93.0	5102464	310405	20
2052		046:02:30.30N	065:25:32.94W	4.0	5101329	312301	20
2053		046:01:56.82N	065:23:24.66W	140.0	5100213	315027	20
2054		046:00:24.54N	065:22:19.50W	254.0	5097323	316343	20
2055		045:59:36.84N	065:20:41.94W	140.0	5095788	318398	20
2056		045:56:01.32N	065:23:57.72W	75.0	5089263	313986	20
2057		045:55:02.46N	065:23:16.98W	26.0	5087420	314809	20
2058		045:53:28.68N	065:22:53.16W	63.0	5084510	315235	20
2059		045:51:55.92N	065:22:43.38W	136.0	5081641	315361	20
2060		045:49:33.84N	065:23:32.04W	39.0	5077288	314180	20
2061		045:49:24.48N	065:20:55.14W	650.0	5076898	317557	20
2062		045:47:51.60N	065:20:39.66W	221.0	5074022	317807	20
2063		045:46:42.60N	065:19:16.68W	32.0	5071841	319536	20
2064		045:46:55.26N	065:15:57.00W	358.0	5072107	323859	20
2065		045:46:01.50N	065:14:35.34W	392.0	5070399	325576	20
2066		045:44:22.20N	065:14:18.48W	262.0	5067324	325855	20
2067		045:43:06.36N	065:13:22.50W	289.0	5064950	326999	20

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Site ID	Line ID	Lat.	Long.	Site Elev. m	Northing	Easting	UTM Zone
2068		045:42:12.18N	065:12:43.38W	351.0	5063254	327799	20
2069		045:40:58.08N	065:11:08.40W	470.0	5060911	329790	20
2070		045:39:24.60N	065:10:24.18W	283.0	5058000	330668	20
2071		045:36:02.28N	065:13:50.58W	293.0	5051879	326028	20
2072		045:35:00.78N	065:12:29.34W	16.0	5049933	327735	20
2073		045:34:34.20N	065:10:39.48W	164.0	5049047	330094	20
2074		045:33:52.62N	065:07:36.48W	375.0	5047658	334026	20
2075		045:32:08.04N	065:06:45.48W	244.0	5044401	335046	20
** FSU Code: FRIG							
3003		048:21:16.22N	068:26:07.18W	1552.0	5355638	541834	19
3004		048:21:42.97N	068:20:37.40W	3075.0	5356518	548613	19
3005		048:20:58.48N	068:18:48.87W	2554.0	5355164	550859	19
3006		048:18:47.87N	068:19:48.70W	3569.0	5351121	549663	19
3007		048:17:13.62N	068:20:28.79W	3379.0	5348204	548862	19
3008		048:16:08.73N	068:19:18.24W	3779.0	5346213	550334	19
3009		048:15:09.56N	068:18:37.81W	2924.0	5344393	551183	19
3010		048:14:04.01N	068:17:06.43W	3605.0	5342387	553086	19
3011		048:12:59.99N	068:15:08.39W	3792.0	5340433	555540	19
3012		048:11:16.22N	068:14:31.86W	3166.0	5337237	556326	19
3013		048:14:08.85N	068:07:20.65W	3428.0	5342662	565168	19
3014		048:12:36.89N	068:05:01.22W	4509.0	5339856	568078	19
3015		048:11:35.21N	068:03:23.52W	3346.0	5337976	570117	19
3016		048:10:13.32N	068:02:58.45W	3022.0	5335454	570666	19
3017		048:09:19.03N	068:01:49.07W	1991.0	5333796	572120	19
3018		048:07:53.45N	068:01:06.66W	4227.0	5331165	573030	19
3019		048:06:13.05N	068:00:20.09W	3058.0	5328077	574033	19
3020		048:04:32.59N	067:59:17.17W	4165.0	5324993	575374	19
3021		048:03:09.10N	067:58:33.75W	3232.0	5322427	576307	19
3022		048:02:07.12N	067:58:31.92W	2541.0	5320514	576371	19
3023		048:01:09.24N	067:57:18.32W	1690.0	5318747	577919	19
3025		047:59:57.26N	067:52:52.11W	3838.0	5316603	583465	19
3026		047:58:55.30N	067:50:43.70W	3818.0	5314729	586155	19
3027		047:57:55.69N	067:49:28.44W	3831.0	5312912	587743	19
3028		047:56:51.24N	067:48:05.75W	3831.0	5310949	589488	19
3029		047:55:55.64N	067:46:19.91W	3824.0	5309267	591711	19
3030		047:54:49.61N	067:44:37.35W	1349.0	5307262	593872	19
3031		047:54:17.58N	067:42:58.72W	3310.0	5306307	595936	19
3032		047:53:21.63N	067:41:02.96W	2993.0	5304620	598368	19
3033		047:50:36.05N	067:42:30.21W	2996.0	5299478	596642	19
3034		047:47:47.69N	067:44:16.36W	1261.0	5294244	594520	19
3035		047:46:32.08N	067:42:36.72W	222.0	5291944	596632	19
3036		047:45:39.09N	067:41:04.93W	3415.0	5290340	598570	19
3038		047:43:30.49N	067:38:55.29W	2580.0	5286416	601338	19
3040		047:40:11.20N	067:37:25.21W	1172.0	5280297	603324	19

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Site ID	Line ID	Lat.	Long.	Site Elev. m	Northing	Easting	UTM Zone
3041		047:39:59.28N	067:33:54.80W	2613.0	5280009	607718	19
3042		047:39:47.53N	067:31:24.58W	2233.0	5279705	610858	19
3043		047:37:20.89N	067:30:31.38W	2263.0	5275199	612054	19
3044		047:36:11.53N	067:29:51.59W	2266.0	5273074	612927	19
3045		047:35:08.72N	067:28:40.78W	2263.0	5271164	614443	19
3046		047:34:17.40N	067:27:55.41W	2240.0	5269598	615422	19
3047		047:33:19.87N	067:26:56.28W	2243.0	5267847	616693	19
3048		047:32:38.34N	067:25:38.61W	2240.0	5266597	618342	19
3049		047:31:41.22N	067:23:36.23W	2210.0	5264887	620937	19
3050		047:30:42.19N	067:22:49.74W	3084.0	5263085	621947	19
3051		047:28:12.28N	067:23:36.59W	2973.0	5258436	621062	19
3052		047:26:45.09N	067:22:06.18W	3802.0	5255784	623011	19
3053		047:25:43.13N	067:20:48.68W	4165.0	5253906	624675	19
3054		047:24:49.78N	067:18:56.43W	3821.0	5252309	627062	19
3055		047:23:28.18N	067:16:46.13W	2096.0	5249850	629848	19
3056		047:22:55.09N	067:14:46.76W	1519.0	5248885	632374	19
3057		047:22:03.58N	067:12:22.85W	2796.0	5247363	635428	19
3058		047:21:13.66N	067:11:33.03W	2213.0	5245847	636508	19
3059		047:19:48.06N	067:10:54.01W	2243.0	5243223	637389	19
3060		047:18:19.84N	067:10:09.62W	2970.0	5240522	638384	19
3061		047:16:45.24N	067:10:11.60W	1582.0	5237601	638411	19
3062		047:15:25.55N	067:09:42.96W	1428.0	5235155	639071	19
3063		047:18:09.59N	067:00:02.35W	2538.0	5240519	651143	19
3064		047:17:32.24N	066:58:56.92W	3615.0	5239401	652547	19
3065		047:17:02.92N	066:57:14.13W	3196.0	5238553	654730	19
3066		047:16:25.44N	066:56:01.69W	3009.0	5237436	656282	19
3067		047:15:57.60N	066:54:00.00W	0.0	5236645	658862	19
3068		047:13:06.00N	066:54:23.40W	0.0	5231334	658512	19
3069		047:11:12.00N	066:54:04.80W	0.0	5227826	658998	19
3070		047:08:55.20N	066:54:56.40W	0.0	5223574	658025	19
3071		047:07:12.00N	066:55:07.20W	0.0	5220383	657882	19
3072		047:05:53.40N	066:54:06.60W	0.0	5217991	659224	19
3073		047:04:51.60N	066:54:54.00W	0.0	5216056	658276	19
** FSU Code: ZINC							
3074		047:05:21.54N	066:48:56.88W	530.0	5217186	665780	19
3075		047:03:26.16N	066:47:56.22W	518.0	5213660	667159	19
3076		047:02:56.94N	066:46:06.06W	440.0	5212824	669509	19
3077		047:01:50.70N	066:44:32.58W	414.0	5210836	671540	19
3078		047:00:57.72N	066:43:09.54W	429.0	5209252	673341	19
3079		046:59:49.26N	066:42:18.30W	335.0	5207170	674484	19
3080		046:59:05.28N	066:40:21.54W	398.0	5205885	676990	19
3081		046:58:20.64N	066:38:16.92W	307.0	5204586	679664	19
3082		046:57:40.08N	066:36:34.68W	132.0	5203400	681863	19
3083		046:56:32.88N	066:35:39.72W	328.0	5201361	683088	19

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Site ID	Line ID	Lat.	Long.	Site Elev. m	Northing	Easting	UTM Zone
3084		046:53:56.94N	066:36:57.00W	406.0	5196498	681601	19
3085		046:51:44.70N	066:37:39.42W	645.0	5192389	680827	19
3086		046:50:07.98N	066:37:25.68W	392.0	5189413	681208	19
** FSU Code: BORT							
8000		042:05:00.00N	061:20:00.00W	0.0	4660159	637855	20
LODG		044:16:00.00N	065:51:12.00W	0.0	4905235	272254	20
WARE		044:41:08.72N	063:36:46.30W	-602.0	4948008	451433	20

Table B- 5: Listing from LithoSEIS catalog showing parameters for all vertical component data used to create the SEGY-IASPEI file called *long.sgy* (Table 4).

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List of LithoSEIS Catalog
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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z1A180.Z0E	DUST	18Z1		0004	0825	0825	A180	322:16:05:30	127	120
18Z1A179.Z0E	DUST	18Z1		0008	0825	0825	A179	322:16:05:30	127	120
18Z1A181.Z0E	DUST	18Z1		0012	0825	0825	A181	322:16:05:30	127	120
18Z1A182.Z0E	DUST	18Z1		0016	0825	0825	A182	322:16:05:30	127	120
18Z1A187.Z0E	DUST	18Z1		0020	0825	0825	A187	322:16:05:30	127	120
18Z10252.10E	DUST	18Z1		0024	0825	0825	0252	322:16:05:30	128	120
18Z1A188.Z0E	DUST	18Z1		0028	0825	0825	A188	322:16:05:30	127	120
18Z1A189.Z0E	DUST	18Z1		0032	0825	0825	A189	322:16:05:30	127	120
18Z1A185.Z0E	DUST	18Z1		0036	0825	0825	A185	322:16:05:30	127	120
18Z1A186.Z0E	DUST	18Z1		0040	0825	0825	A186	322:16:05:30	127	120
18Z1A184.Z0E	DUST	18Z1		0044	0825	0825	A184	322:16:05:30	127	120
18Z10254.10E	DUST	18Z1		0048	0825	0825	0254	322:16:05:30	128	120
18Z1A183.Z0E	DUST	18Z1		0052	0825	0825	A183	322:16:05:30	127	120
18Z1A166.Z0E	DUST	18Z1		0056	0825	0825	A166	322:16:05:30	127	120
18Z1A142.Z0E	DUST	18Z1		0058	0825	0825	A142	322:16:05:30	127	120
18Z1A171.Z0E	DUST	18Z1		0060	0825	0825	A171	322:16:05:30	127	120
18Z1A143.Z0E	DUST	18Z1		0062	0825	0825	A143	322:16:05:30	127	120
18Z1A170.Z0E	DUST	18Z1		0064	0825	0825	A170	322:16:05:30	127	120
18Z1A144.Z0F	DUST	18Z1		0066	0825	0825	A144	322:16:05:30	127	120
18Z1A169.Z0E	DUST	18Z1		0068	0825	0825	A169	322:16:05:30	127	120
18Z10075.10E	DUST	18Z1		0071	0825	0825	0075	322:16:05:30	128	120
18Z1A168.Z0E	DUST	18Z1		0076	0825	0825	A168	322:16:05:30	127	120
18Z1A174.Z0E	DUST	18Z1		0080	0825	0825	A174	322:16:05:30	127	120
18Z1A175.Z0E	DUST	18Z1		0084	0825	0825	A175	322:16:05:30	127	120
18Z1A177.Z0E	DUST	18Z1		0090	0825	0825	A177	322:16:05:30	127	120
18Z1A172.Z0E	DUST	18Z1		0096	0825	0825	A172	322:16:05:30	127	120
18Z1A163.Z0E	DUST	18Z1		0100	0825	0825	A163	322:16:05:30	127	120
18Z1A164.Z0E	DUST	18Z1		0104	0825	0825	A164	322:16:05:30	127	120
18Z1A165.Z0E	DUST	18Z1		0108	0825	0825	A165	322:16:05:30	127	120
18Z10218.10E	DUST	18Z1		0112	0825	0825	0218	322:16:05:30	128	120
18Z1A149.Z0E	DUST	18Z1		0116	0825	0825	A149	322:16:05:30	127	120
18Z1A150.Z0E	DUST	18Z1		0120	0825	0825	A150	322:16:05:30	127	120
18Z1A151.Z0E	DUST	18Z1		0124	0825	0825	A151	322:16:05:30	127	120
18Z1A152.Z0E	DUST	18Z1		0128	0825	0825	A152	322:16:05:30	127	120
18Z1A161.Z0E	DUST	18Z1		0132	0825	0825	A161	322:16:05:30	127	120
18Z1A155.Z0E	DUST	18Z1		0136	0825	0825	A155	322:16:05:30	127	120
18Z1A154.Z0E	DUST	18Z1		0140	0825	0825	A154	322:16:05:30	127	120
18Z10277.10E	DUST	18Z1		0144	0825	0825	0277	322:16:05:30	128	120
18Z1A153.Z0E	DUST	18Z1		0148	0825	0825	A153	322:16:05:30	127	120
18Z1A145.Z0E	DUST	18Z1		0152	0825	0825	A145	322:16:05:30	127	120
18Z1A146.Z0E	DUST	18Z1		0156	0825	0825	A146	322:16:05:30	127	120
18Z1A147.Z0E	DUST	18Z1		0160	0825	0825	A147	322:16:05:30	127	120
18Z1A148.Z0E	DUST	18Z1		0165	0825	0825	A148	322:16:05:30	127	120
18Z10286.10E	DUST	18Z1		0168	0825	0825	0286	322:16:05:30	128	120
18Z1A134.Z0E	DUST	18Z1		0173	0825	0825	A134	322:16:05:30	127	120

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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z1A133.Z0E	DUST	18Z1		0176	0825	0825	A133	322:16:05:30	127	120
18Z1A132.Z0E	DUST	18Z1		0180	0825	0825	A132	322:16:05:30	127	120
18Z1A131.Z0E	DUST	18Z1		0188	0825	0825	A131	322:16:05:30	127	120
18Z10288.10E	DUST	18Z1		0200	0825	0825	0288	322:16:05:30	128	120
18Z3A087.Z0E	MARS	18Z3		2001	0825	0825	A087	322:16:06:00	127	120
18Z3A086.Z0E	MARS	18Z3		2003	0825	0825	A086	322:16:06:00	127	120
18Z3A091.Z0E	MARS	18Z3		2004	0825	0825	A091	322:16:06:00	127	120
18Z30278.10E	ZINC	18Z3		2005	0825	0825	0278	322:16:06:00	128	120
18Z3A067.Z0E	MARS	18Z3		2006	0825	0825	A067	322:16:06:00	127	120
18Z3A090.Z0E	MARS	18Z3		2007	0825	0825	A090	322:16:06:00	127	120
18Z3A140.Z0E	MARS	18Z3		2008	0825	0825	A140	322:16:06:00	127	120
18Z30280.10E	ZINC	18Z3		2009	0825	0825	0280	322:16:06:00	128	120
18Z3A077.Z0E	MARS	18Z3		2010	0825	0825	A077	322:16:06:00	127	120
18Z3A064.Z0E	MARS	18Z3		2011	0825	0825	A064	322:16:06:00	127	120
18Z3A078.Z0E	MARS	18Z3		2012	0825	0825	A078	322:16:06:00	127	120
18Z3A079.Z0E	MARS	18Z3		2013	0825	0825	A079	322:16:06:00	127	120
18Z3A063.Z0E	MARS	18Z3		2014	0825	0825	A063	322:16:06:00	127	120
18Z3A065.Z0E	MARS	18Z3		2015	0825	0825	A065	322:16:06:00	127	120
18Z3A076.Z0E	MARS	18Z3		2016	0825	0825	A076	322:16:06:00	127	120
18Z3A075.Z0E	MARS	18Z3		2017	0825	0825	A075	322:16:06:00	127	120
18Z30281.10E	ZINC	18Z3		2018	0825	0825	0281	322:16:06:00	128	120
18Z3A089.Z0E	MARS	18Z3		2019	0825	0825	A089	322:16:06:00	127	120
18Z3A082.Z0E	MARS	18Z3		2020	0825	0825	A082	322:16:06:00	127	120
18Z3A073.Z0E	MARS	18Z3		2021	0825	0825	A073	322:16:06:00	127	120
18Z3A074.Z0E	MARS	18Z3		2022	0825	0825	A074	322:16:06:00	127	120
18Z3A083.Z0E	MARS	18Z3		2023	0825	0825	A083	322:16:06:00	127	120
18Z3A071.Z0E	MARS	18Z3		2024	0825	0825	A071	322:16:06:00	127	120
18Z3A088.Z0E	MARS	18Z3		2025	0825	0825	A088	322:16:06:00	127	120
18Z3A072.Z0E	MARS	18Z3		2026	0825	0825	A072	322:16:06:00	127	120
18Z3A070.Z0E	MARS	18Z3		2027	0825	0825	A070	322:16:06:00	127	120
18Z3A080.Z0E	MARS	18Z3		2028	0825	0825	A080	322:16:06:00	127	120
18Z3A094.Z0E	MARS	18Z3		2029	0825	0825	A094	322:16:06:00	127	120
18Z3A095.Z0E	MARS	18Z3		2031	0825	0825	A095	322:16:06:00	127	120
18Z3A098.Z0E	MARS	18Z3		2032	0825	0825	A098	322:16:06:00	127	120
18Z3A096.Z0E	MARS	18Z3		2033	0825	0825	A096	322:16:06:00	127	120
18Z3A097.Z0E	MARS	18Z3		2034	0825	0825	A097	322:16:06:00	127	120
18Z2A100.Z0E	MOON	18Z2		2036	0825	0825	A100	322:16:05:50	127	120
18Z2A101.Z0E	MOON	18Z2		2037	0825	0825	A101	322:16:05:50	127	120
18Z2A105.Z0E	MOON	18Z2		2038	0825	0825	A105	322:16:05:50	127	120
18Z2A104.Z0E	MOON	18Z2		2039	0825	0825	A104	322:16:05:50	127	120
18Z2A122.Z0E	MOON	18Z2		2040	0825	0825	A122	322:16:05:50	127	120
18Z2A119.Z0E	MOON	18Z2		2041	0825	0825	A119	322:16:05:50	127	120
18Z2A108.Z0E	MOON	18Z2		2042	0825	0825	A108	322:16:05:50	127	120
18Z2A109.Z0E	MOON	18Z2		2043	0825	0825	A109	322:16:05:50	127	120
18Z2A106.Z0E	MOON	18Z2		2044	0825	0825	A106	322:16:05:50	127	120

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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z20273.10E	ZINC	18Z2		2045	0825	0825	0273	322:16:05:50	128	120
18Z2A116.Z0E	MOON	18Z2		2046	0825	0825	A116	322:16:05:50	127	120
18Z2A117.Z0E	MOON	18Z2		2047	0825	0825	A117	322:16:05:50	127	120
18Z2A120.Z0E	MOON	18Z2		2048	0825	0825	A120	322:16:05:50	127	120
18Z2A121.Z0E	MOON	18Z2		2049	0825	0825	A121	322:16:05:50	127	120
18Z2A103.Z0E	MOON	18Z2		2050	0825	0825	A103	322:16:05:50	127	120
18Z2A107.Z0E	MOON	18Z2		2051	0825	0825	A107	322:16:05:50	127	120
18Z2A102.Z0E	MOON	18Z2		2052	0825	0825	A102	322:16:05:50	127	120
18Z2A118.Z0E	MOON	18Z2		2053	0825	0825	A118	322:16:05:50	127	120
18Z2A115.Z0E	MOON	18Z2		2054	0825	0825	A115	322:16:05:50	127	120
18Z20274.10E	ZINC	18Z2		2055	0825	0825	0274	322:16:05:50	128	120
18Z2A110.Z0E	MOON	18Z2		2056	0825	0825	A110	322:16:05:50	127	120
18Z2A136.Z0E	MOON	18Z2		2057	0825	0825	A136	322:16:05:50	127	120
18Z2A127.Z0E	MOON	18Z2		2058	0825	0825	A127	322:16:05:50	127	120
18Z2A128.Z0E	MOON	18Z2		2059	0825	0825	A128	322:16:05:50	127	120
18Z2A123.Z0E	MOON	18Z2		2060	0825	0825	A123	322:16:05:50	127	120
18Z2A112.Z0E	MOON	18Z2		2061	0825	0825	A112	322:16:05:50	127	120
18Z2A125.Z0E	MOON	18Z2		2062	0825	0825	A125	322:16:05:50	127	120
18Z2A135.Z0E	MOON	18Z2		2063	0825	0825	A135	322:16:05:50	127	120
18Z2A139.Z0E	MOON	18Z2		2064	0825	0825	A139	322:16:05:50	127	120
18Z20258.10E	ZINC	18Z2		2065	0825	0825	0258	322:16:05:50	128	120
18Z2A113.Z0E	MOON	18Z2		2066	0825	0825	A113	322:16:05:50	127	120
18Z2A124.Z0E	MOON	18Z2		2067	0825	0825	A124	322:16:05:50	127	120
18Z2A126.Z0E	MOON	18Z2		2068	0825	0825	A126	322:16:05:50	127	120
18Z2A130.Z0E	MOON	18Z2		2069	0825	0825	A130	322:16:05:50	127	120
18Z2A137.Z0E	MOON	18Z2		2070	0825	0825	A137	322:16:05:50	127	120
18Z2A129.Z0E	MOON	18Z2		2071	0825	0825	A129	322:16:05:50	127	120
18Z2A114.Z0E	MOON	18Z2		2072	0825	0825	A114	322:16:05:50	127	120
18Z2A138.Z0E	MOON	18Z2		2073	0825	0825	A138	322:16:05:50	127	120
18Z2A111.Z0E	MOON	18Z2		2074	0825	0825	A111	322:16:05:50	127	120
18Z20271.10E	ZINC	18Z2		2075	0825	0825	0271	322:16:05:50	128	120
18Z5A043.Z0E	CLAY	18Z5		3003	0825	0825	A043	322:16:06:30	127	120
18Z5A023.Z0E	CLAY	18Z5		3004	0825	0825	A023	322:16:06:30	127	120
18Z5A031.Z0E	CLAY	18Z5		3005	0825	0825	A031	322:16:06:30	127	120
18Z50257.10E	MINE	18Z5		3006	0825	0825	0257	322:16:06:30	128	120
18Z5A032.Z0E	CLAY	18Z5		3007	0825	0825	A032	322:16:06:30	127	120
18Z5A024.Z0E	CLAY	18Z5		3008	0825	0825	A024	322:16:06:30	127	120
18Z5A028.Z0E	CLAY	18Z5		3009	0825	0825	A028	322:16:06:30	127	120
18Z5A027.Z0E	CLAY	18Z5		3010	0825	0825	A027	322:16:06:30	127	120
18Z5A033.Z0E	CLAY	18Z5		3011	0825	0825	A033	322:16:06:30	127	120
18Z5A034.Z0F	CLAY	18Z5		3012	0825	0825	A034	322:16:06:30	127	120
18Z5A054.Z0E	CLAY	18Z5		3013	0825	0825	A054	322:16:06:30	127	120
18Z5A053.Z0E	CLAY	18Z5		3014	0825	0825	A053	322:16:06:30	127	120
18Z5A029.Z0E	CLAY	18Z5		3015	0825	0825	A029	322:16:06:30	127	120
18Z50308.10E	MINE	18Z5		3016	0825	0825	0308	322:16:06:30	128	120

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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z5A030.Z0E	CLAY	18Z5		3017	0825	0825	A030	322:16:06:30	127	120
18Z5A049.Z0E	CLAY	18Z5		3018	0825	0825	A049	322:16:06:30	127	120
18Z5A050.Z0E	CLAY	18Z5		3019	0825	0825	A050	322:16:06:30	127	120
18Z5A047.Z0E	CLAY	18Z5		3020	0825	0825	A047	322:16:06:30	127	120
18Z5A048.Z0E	CLAY	18Z5		3021	0825	0825	A048	322:16:06:30	127	120
18Z5A052.Z0E	CLAY	18Z5		3022	0825	0825	A052	322:16:06:30	127	120
18Z5A051.Z0E	CLAY	18Z5		3023	0825	0825	A051	322:16:06:30	127	120
18Z50275.10E	MINE	18Z5		3025	0825	0825	0275	322:16:06:30	128	120
18Z5A007.Z0E	CLAY	18Z5		3026	0825	0825	A007	322:16:06:30	127	120
18Z5A039.Z0E	CLAY	18Z5		3027	0825	0825	A039	322:16:06:30	127	120
18Z5A040.Z0E	CLAY	18Z5		3028	0825	0825	A040	322:16:06:30	127	120
18Z5A006.Z0E	CLAY	18Z5		3029	0825	0825	A006	322:16:06:30	127	120
18Z5A016.Z0E	CLAY	18Z5		3030	0825	0825	A016	322:16:06:30	127	120
18Z50263.10E	MINE	18Z5		3031	0825	0825	0263	322:16:06:30	128	120
18Z5A008.Z0E	CLAY	18Z5		3032	0825	0825	A008	322:16:06:30	127	120
18Z5A005.Z0E	CLAY	18Z5		3033	0825	0825	A005	322:16:06:30	127	120
18Z5A015.Z0E	CLAY	18Z5		3034	0825	0825	A015	322:16:06:30	127	120
18Z5A013.Z0E	CLAY	18Z5		3035	0825	0825	A013	322:16:06:30	127	120
18Z5A044.Z0E	CLAY	18Z5		3036	0825	0825	A044	322:16:06:30	127	120
18Z5A014.Z0E	CLAY	18Z5		3038	0825	0825	A014	322:16:06:30	127	120
18Z5A036.Z0E	CLAY	18Z5		3040	0825	0825	A036	322:16:06:30	127	120
18Z5A026.Z0E	CLAY	18Z5		3041	0825	0825	A026	322:16:06:30	127	120
18Z5A025.Z0E	CLAY	18Z5		3042	0825	0825	A025	322:16:06:30	127	120
18Z4A046.Z0E	CLAY	18Z4		3043	0825	0825	A046	322:16:06:10	127	120
18Z40304.10E	MINE	18Z4		3044	0825	0825	0304	322:16:06:10	128	120
18Z4A045.Z0E	CLAY	18Z4		3045	0825	0825	A045	322:16:06:10	127	120
18Z4A001.Z0E	CLAY	18Z4		3046	0825	0825	A001	322:16:06:10	127	120
18Z4A002.Z0E	CLAY	18Z4		3047	0825	0825	A002	322:16:06:10	127	120
18Z4A060.Z0E	CLAY	18Z4		3048	0825	0825	A060	322:16:06:10	127	120
18Z4A059.Z0E	CLAY	18Z4		3049	0825	0825	A059	322:16:06:10	127	120
18Z40305.10E	MINE	18Z4		3050	0825	0825	0305	322:16:06:10	128	120
18Z4A062.Z0E	CLAY	18Z4		3051	0825	0825	A062	322:16:06:10	127	120
18Z4A061.Z0E	CLAY	18Z4		3052	0825	0825	A061	322:16:06:10	127	120
18Z4A057.Z0E	CLAY	18Z4		3053	0825	0825	A057	322:16:06:10	127	120
18Z4A058.Z0E	CLAY	18Z4		3054	0825	0825	A058	322:16:06:10	127	120
18Z4A056.Z0E	CLAY	18Z4		3055	0825	0825	A056	322:16:06:10	127	120
18Z40309.10E	MINE	18Z4		3056	0825	0825	0309	322:16:06:10	128	120
18Z4A055.Z0E	CLAY	18Z4		3057	0825	0825	A055	322:16:06:10	127	120
18Z4A037.Z0E	CLAY	18Z4		3058	0825	0825	A037	322:16:06:10	127	120
18Z4A010.Z0E	CLAY	18Z4		3059	0825	0825	A010	322:16:06:10	127	120
18Z4A009.Z0E	CLAY	18Z4		3060	0825	0825	A009	322:16:06:10	127	120
18Z4A004.Z0E	CLAY	18Z4		3061	0825	0825	A004	322:16:06:10	127	120
18Z4A003.Z0E	CLAY	18Z4		3062	0825	0825	A003	322:16:06:10	127	120
18Z40225.10E	MINE	18Z4		3063	0825	0825	0225	322:16:06:10	128	120
18Z4A012.Z0E	CLAY	18Z4		3064	0825	0825	A012	322:16:06:10	127	120

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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z4A011.Z0F	CLAY	18Z4		3065	0825	0825	A011	322:16:06:10	127	120
18Z4A038.Z0E	CLAY	18Z4		3066	0825	0825	A038	322:16:06:10	127	120
18Z4A041.Z0E	CLAY	18Z4		3067	0825	0825	A041	322:16:06:10	127	120
18Z4A042.Z0E	CLAY	18Z4		3068	0825	0825	A042	322:16:06:10	127	120
18Z40307.10E	MINE	18Z4		3069	0825	0825	0307	322:16:06:10	128	120
18Z4A021.Z0E	CLAY	18Z4		3070	0825	0825	A021	322:16:06:10	127	120
18Z4A017.Z0E	CLAY	18Z4		3071	0825	0825	A017	322:16:06:10	127	120
18Z4A020.Z0E	CLAY	18Z4		3072	0825	0825	A020	322:16:06:10	127	120
18Z4A022.Z0E	CLAY	18Z4		3073	0825	0825	A022	322:16:06:10	127	120
18Z40306.10E	ZINC	18Z4		3074	0825	0825	0306	322:16:06:10	128	120
18Z4A141.Z0E	MOON	18Z4		3075	0825	0825	A141	322:16:06:10	127	120
18Z4A068.Z0E	MOON	18Z4		3076	0825	0825	A068	322:16:06:10	127	120
18Z4A069.Z0E	MOON	18Z4		3077	0825	0825	A069	322:16:06:10	127	120
18Z4A160.Z0E	MOON	18Z4		3078	0825	0825	A160	322:16:06:10	127	120
18Z4A092.Z0E	MOON	18Z4		3079	0825	0825	A092	322:16:06:10	127	120
18Z4A093.Z0E	MOON	18Z4		3080	0825	0825	A093	322:16:06:10	127	120
18Z3A084.Z0E	MARS	18Z3		3082	0825	0825	A084	322:16:06:00	127	120
18Z3A066.Z0E	MARS	18Z3		3083	0825	0825	A066	322:16:06:00	127	120
18Z3A085.Z0E	MARS	18Z3		3084	0825	0825	A085	322:16:06:00	127	120
18Z3A099.Z0E	MARS	18Z3		3085	0825	0825	A099	322:16:06:00	127	120
18Z30285.10E	ZINC	18Z3		3086	0825	0825	0285	322:16:06:00	128	120

Table B- 6: Listing from LithoSEIS catalog showing parameters for all three component data used to create the SEGY-IASPEI files called *longv.sgy, longns.sgy, longew.sgy and long3c.sgy* (Table 4).

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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z10252.10E	DUST	18Z1		0024	0825	0825	0252	322:16:05:30	128	120
18Z10252.20E	DUST	18Z1		0024	0825	0825	0252	322:16:05:30	128	120
18Z10252.30E	DUST	18Z1		0024	0825	0825	0252	322:16:05:30	128	120
18Z10254.10E	DUST	18Z1		0048	0825	0825	0254	322:16:05:30	128	120
18Z10254.20E	DUST	18Z1		0048	0825	0825	0254	322:16:05:30	128	120
18Z10254.30E	DUST	18Z1		0048	0825	0825	0254	322:16:05:30	128	120
18Z10075.10E	DUST	18Z1		0071	0825	0825	0075	322:16:05:30	128	120
18Z10075.20E	DUST	18Z1		0071	0825	0825	0075	322:16:05:30	128	120
18Z10075.30E	DUST	18Z1		0071	0825	0825	0075	322:16:05:30	128	120
18Z10218.10E	DUST	18Z1		0112	0825	0825	0218	322:16:05:30	128	120
18Z10218.20E	DUST	18Z1		0112	0825	0825	0218	322:16:05:30	128	120
18Z10218.30E	DUST	18Z1		0112	0825	0825	0218	322:16:05:30	128	120
18Z10277.10E	DUST	18Z1		0144	0825	0825	0277	322:16:05:30	128	120
18Z10277.20E	DUST	18Z1		0144	0825	0825	0277	322:16:05:30	128	120
18Z10277.30E	DUST	18Z1		0144	0825	0825	0277	322:16:05:30	128	120
18Z10286.10E	DUST	18Z1		0168	0825	0825	0286	322:16:05:30	128	120
18Z10286.20E	DUST	18Z1		0168	0825	0825	0286	322:16:05:30	128	120
18Z10286.30E	DUST	18Z1		0168	0825	0825	0286	322:16:05:30	128	120
18Z10288.10E	DUST	18Z1		0200	0825	0825	0288	322:16:05:30	128	120
18Z10288.20E	DUST	18Z1		0200	0825	0825	0288	322:16:05:30	128	120
18Z10288.30E	DUST	18Z1		0200	0825	0825	0288	322:16:05:30	128	120
18Z30278.10E	ZINC	18Z3		2005	0825	0825	0278	322:16:06:00	128	120
18Z30278.20E	ZINC	18Z3		2005	0825	0825	0278	322:16:06:00	128	120
18Z30278.30E	ZINC	18Z3		2005	0825	0825	0278	322:16:06:00	128	120
18Z30280.10E	ZINC	18Z3		2009	0825	0825	0280	322:16:06:00	128	120
18Z30280.20E	ZINC	18Z3		2009	0825	0825	0280	322:16:06:00	128	120
18Z30280.30E	ZINC	18Z3		2009	0825	0825	0280	322:16:06:00	128	120
18Z30281.10E	ZINC	18Z3		2018	0825	0825	0281	322:16:06:00	128	120
18Z30281.20E	ZINC	18Z3		2018	0825	0825	0281	322:16:06:00	128	120
18Z30281.30E	ZINC	18Z3		2018	0825	0825	0281	322:16:06:00	128	120
18Z20273.10E	ZINC	18Z2		2045	0825	0825	0273	322:16:05:50	128	120
18Z20273.20E	ZINC	18Z2		2045	0825	0825	0273	322:16:05:50	128	120
18Z20273.30E	ZINC	18Z2		2045	0825	0825	0273	322:16:05:50	128	120
18Z20274.10E	ZINC	18Z2		2055	0825	0825	0274	322:16:05:50	128	120
18Z20274.20E	ZINC	18Z2		2055	0825	0825	0274	322:16:05:50	128	120
18Z20274.30E	ZINC	18Z2		2055	0825	0825	0274	322:16:05:50	128	120
18Z20258.10E	ZINC	18Z2		2065	0825	0825	0258	322:16:05:50	128	120
18Z20258.20E	ZINC	18Z2		2065	0825	0825	0258	322:16:05:50	128	120
18Z20258.30E	ZINC	18Z2		2065	0825	0825	0258	322:16:05:50	128	120
18Z20271.10E	ZINC	18Z2		2075	0825	0825	0271	322:16:05:50	128	120
18Z20271.20E	ZINC	18Z2		2075	0825	0825	0271	322:16:05:50	128	120
18Z20271.30E	ZINC	18Z2		2075	0825	0825	0271	322:16:05:50	128	120
18Z50257.10E	MINE	18Z5		3006	0825	0825	0257	322:16:06:30	128	120
18Z50257.20E	MINE	18Z5		3006	0825	0825	0257	322:16:06:30	128	120
18Z50257.30E	MINE	18Z5		3006	0825	0825	0257	322:16:06:30	128	120

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Trace File Name	FSU Code	Dep Code	Line ID	Site ID	Shot ID	Shot Site	PRS Ser. Num.	Trace Time jjj:hh:mm:ss	Win. Len. s	Sam. Rate /s
18Z50308.10E	MINE	18Z5		3016	0825	0825	0308	322:16:06:30	128	120
18Z50308.20E	MINE	18Z5		3016	0825	0825	0308	322:16:06:30	128	120
18Z50308.30E	MINE	18Z5		3016	0825	0825	0308	322:16:06:30	128	120
18Z50275.10E	MINE	18Z5		3025	0825	0825	0275	322:16:06:30	128	120
18Z50275.20E	MINE	18Z5		3025	0825	0825	0275	322:16:06:30	128	120
18Z50275.30E	MINE	18Z5		3025	0825	0825	0275	322:16:06:30	128	120
18Z50263.10E	MINE	18Z5		3031	0825	0825	0263	322:16:06:30	128	120
18Z50263.20E	MINE	18Z5		3031	0825	0825	0263	322:16:06:30	128	120
18Z50263.30E	MINE	18Z5		3031	0825	0825	0263	322:16:06:30	128	120
18Z40304.10E	MINE	18Z4		3044	0825	0825	0304	322:16:06:10	128	120
18Z40304.20E	MINE	18Z4		3044	0825	0825	0304	322:16:06:10	128	120
18Z40304.30E	MINE	18Z4		3044	0825	0825	0304	322:16:06:10	128	120
18Z40305.10E	MINE	18Z4		3050	0825	0825	0305	322:16:06:10	128	120
18Z40305.20E	MINE	18Z4		3050	0825	0825	0305	322:16:06:10	128	120
18Z40305.30E	MINE	18Z4		3050	0825	0825	0305	322:16:06:10	128	120
18Z40309.10E	MINE	18Z4		3056	0825	0825	0309	322:16:06:10	128	120
18Z40309.20E	MINE	18Z4		3056	0825	0825	0309	322:16:06:10	128	120
18Z40309.30E	MINE	18Z4		3056	0825	0825	0309	322:16:06:10	128	120
18Z40225.10E	MINE	18Z4		3063	0825	0825	0225	322:16:06:10	128	120
18Z40225.20E	MINE	18Z4		3063	0825	0825	0225	322:16:06:10	128	120
18Z40225.30E	MINE	18Z4		3063	0825	0825	0225	322:16:06:10	128	120
18Z40307.10E	MINE	18Z4		3069	0825	0825	0307	322:16:06:10	128	120
18Z40307.20E	MINE	18Z4		3069	0825	0825	0307	322:16:06:10	128	120
18Z40307.30E	MINE	18Z4		3069	0825	0825	0307	322:16:06:10	128	120
18Z40306.10E	ZINC	18Z4		3074	0825	0825	0306	322:16:06:10	128	120
18Z40306.20E	ZINC	18Z4		3074	0825	0825	0306	322:16:06:10	128	120
18Z40306.30E	ZINC	18Z4		3074	0825	0825	0306	322:16:06:10	128	120
18Z30285.10E	ZINC	18Z3		3086	0825	0825	0285	322:16:06:00	128	120
18Z30285.20E	ZINC	18Z3		3086	0825	0825	0285	322:16:06:00	128	120
18Z30285.30E	ZINC	18Z3		3086	0825	0825	0285	322:16:06:00	128	120

Appendix C: The Segy_IASPEI Listing

The following include file was used in creation of all SEGY_IASPEI files in this report. Note that the *'cor'* field, bytes 217-218 of the binary trace header - shown in **bold** below, is used to store the recorder time correction that needs to be applied to the data at processing stage.

```
c- Start of FINAL segy.inc version 3.00 (IASPEI), January 25, 1993 ----
c
c Isa Asudeh, Geological Survey of Canada
c             1 Observatory Crescent
c             Ottawa, Ontario
c             Canada K1A 0Y3
c             Tel. 613-996-5757
c             Fax. 613-992-8836
c             e.mail asudeh@cg.emr.ca
c
c This file is an implicit definition of the SEGY format with additions
c for refraction work. It is based on the SEGY standard of Barry et al,
c Geophysics (1975) with extensions labelled SEGY_IASPEI
c for refraction work. This version has been checked and verified by
c the U.S. Geological Survey and the IRIS/PASSCAL Consortium and will
c be used for data exchange in North America.
c
c This format is primarily for the EXCHANGE of data between processing
c centers. All information that we consider to be  essential for the
c successful exchange of data are marked with a "R" in column 70:     R
c Items considered desirable are marked with a "D" in column 70:      D
c
c Some items have been added to facilitate disk
c storage in a SEGY type file.
c Items purely for tape use are labelled TAPE                 TAPE
c in column 62 items purely for disk user are
c labelled DISK, otherwise this field                         DISK
c is left blank.
c
c-Units:
c  Refraction ground velocities are
c  in nanometers/sec. We adopt the convention:
c    (tape data word)*(10**gc) = nanometers/sec;
c  where tape data word is the value in the trace
c  data block and gc is a two byte gain constant word
c  beginning in byte 121 of the trace header.
c
c-Dimensions:
c These may vary from system to system.
c SEGY allows no more than 32767
c samples per trace. Maximum number of bytes needed to
c hold a single trace and its header is:
c 131308 = (32767 samples)*(4 bytes per sample) + 240 bytes header.
c For TAPE we recommend that
c no more than 32767 bytes per trace be used (including
c 240 bytes for a header). This leaves space for
c 16728 two byte samples or 8139 4 byte samples per trace.

c
c start of Declarations:
c
c Parameter Statements:
c

c      maximum number of bytes per trace
       integer MAXLEN
       parameter (MAXLEN = 131308)
```

```
c       maximum number of samples per trace
        integer MAXSAM
        parameter (MAXSAM = 32767)

c       EBCDIC/ASCII header length (bytes)
        integer EBCDIC
        parameter (EBCDIC = 3200)

c       Reel Header Length (bytes)
        integer RHLEN
        parameter (RHLEN = 400)

c       Trace Header Length (bytes)
        integer THLEN
        parameter (THLEN = 240)
c
c Dimension Statements:
c

c       SEGY reel identification header part 1
        character*1  segy1a(EBCDIC)

c       SEGY reel identification header part 2
        character*1  segy1b(RHLEN)

c       SEGY trace data block
        character*1  segydb(MAXLEN)

c       SEGY trace header
        character*1 thead(THLEN)
        equivalence (segydb(1),thead(1))

c       real and integer data arrays
        integer*2    idata(MAXSAM)
        real*4       rdata(MAXSAM)
        equivalence (segydb(241),idata(1),rdata(1))
c
c end of Declarations.
c

c
c--------------------------------------------------------------------+
c Reel Identification Header (total 400 bytes)    Starts here        |
c--------------------------------------------------------------------+
c

c Job identification number                    SEGY_STANDARD
        integer*4    jobid
        equivalence  (segy1b(1),jobid)

c Line number                                  SEGY_STANDARD         R
        integer*4    lineno
        equivalence  (segy1b(5),lineno)

c Reel number                                  SEGY_STANDARD  TAPE   R
        integer*4    reelno
        equivalence  (segy1b(9),reelno)

c Number of data traces per record             SEGY_STANDARD         R
c By "record" we mean gather
        integer*2    ntrace
        equivalence  (segy1b(13),ntrace)

c Number of auxilliary traces per record       SEGY_STANDARD         R
        integer*2    nauxt
        equivalence  (segy1b(15),nauxt)
```

```
c Sample interval in microseconds (this data),  SEGY_STANDARD          R
c See override for this value (sinto, bytes 117-120) for
c more precise presentation.
       integer*2    sint
       equivalence  (segy1b(17),sint)

c Sample interval in microseconds (in field)    SEGY_STANDARD
c See override for this value (sint2o, bytes 121-124) for
c more precise presentation.
      integer*2    sint2
      equivalence  (segy1b(19),sint2)

c No of samples per trace this data             SEGY_STANDARD          R
c The total number of samples per trace is also
c stored with each trace, so this word is not
c essential. It can be used to calculate
c record length for disk files.
c If number of sample per trace varies
c from trace to trace leave this as 0.
      integer*2    nsam
      equivalence  (segy1b(21),nsam)

c No of samples per trace in the field          SEGY_STANDARD
      integer*2 nsamf
      equivalence  (segy1b(23),nsamf)

c Data sample format code                       SEGY_STANDARD          R
c  1   IBM 370 floating point (4 bytes)         SEGY_STANDARD          R
c  2   Fixed point            (4 bytes)         SEGY_STANDARD          R
c  3   Fixed point            (2 bytes)         SEGY_STANDARD          R
c  4   Fixed point with gain  (4 bytes)         SEGY_STANDARD          R
c
       integer*2    icode
       equivalence  (segy1b(25),icode)

c No of traces per  CDP ensemble                SEGY_STANDARD
       integer*2    ncdp
       equivalence  (segy1b(27),ncdp)

c Trace sorting code                            SEGY_STANDARD          R
c      itsort=1     Shot Gathers                SEGY_STANDARD
c      itsort=2     CDP ensemble                SEGY_STANDARD
c      itsort=3     Single fold continuous      SEGY_STANDARD
c      itsort=4     Horizontal stack            SEGY_STANDARD
c      itsort=5     Receiver Gather             SEGY_IASPEI
c      itsort=6     Gathers Sorted By Distance  SEGY_IASPEI
c      itsort=7     Gathers Sorted By Azimuth   SEGY_IASPEI
c      itsort=0     No sort.                    SEGY_IASPEI
       integer*2    itsort
       equivalence  (segy1b(29),itsort)

c  Vertical sum code                            SEGY_STANDARD
c  vcode = n sum on n traces                    SEGY_STANDARD
       integer*2    vcode
       equivalence  (segy1b(31),vcode)

c Start sweep frequency (HZ)                    SEGY_STANDARD
       integer*2    ssweep
       equivalence  (segy1b(33),ssweep)

c End sweep frequency (HZ)                      SEGY_STANDARD
       integer*2    esweep
       equivalence  (segy1b(35),esweep)

c Sweep length in milliseconds                  SEGY_STANDARD
       integer*2    sleng
       equivalence  (segy1b(37),sleng)
```

```
c Sweep type                                        SEGY_STANDARD
c      stype=1  linear                              SEGY_STANDARD
c      stype=2  parabolic                           SEGY_STANDARD
c      stype=3  exponential                         SEGY_STANDARD
c      stype=4  other                               SEGY_STANDARD
c      stype=5  borehole explosive source           SEGY_IASPEI
c      stype=6  water explosive source              SEGY_IASPEI
c      stype=7  airgun source                       SEGY_IASPEI
c      stype=8  earthquake                          SEGY_IASPEI
c      stype=9  quarry_blast                        SEGY_IASPEI
       integer*2    stype
       equivalence  (segy1b(39),stype)

c Trace no of sweep channel                         SEGY_STANDARD
       integer*2    nts
       equivalence  (segy1b(41),nts)

c Sweep trace taper in milliseconds at start        SEGY_STANDARD
       integer*2    stts
       equivalence  (segy1b(43),stts)

c Sweep trace taper  in milliseconds at end         SEGY_STANDARD
       integer*2    stte
       equivalence  (segy1b(45),stte)

c Taper type                                        SEGY_STANDARD
c      ttype=1 linrst                               SEGY_STANDARD
c      ttype=2 cos**2                               SEGY_STANDARD
c      ttype=3 other                                SEGY_STANDARD
       integer*2    ttype
       equivalence  (segy1b(47),ttype)

c Correlated data traces                            SEGY_STANDARD
c      cort=1 no, 2=yes
       integer*2    cort
       equivalence  (segy1b(49),cort)

c Binary Gain recovered                             SEGY_STANDARD
c      bgr=1 yes, 2=no
       integer*2    bgr
       equivalence  (segy1b(51),bgr)

c Amplitude recovery methods                        SEGY_STANDARD
c      arm=1 none, 2=spherical, 3=AGC, 4=other
       integer*2    arm
       equivalence  (segy1b(53),arm)

c Measurement system                                SEGY_STANDARD          R
c      1=meters, 2=feet                             SEGY_STANDARD
       integer*2    isys
       equivalence  (segy1b(55),isys)

c Polarity                                          SEGY_STANDARD
c    ipol=1 upward case movement gives negative     SEGY_STANDARD
c    ipol=2 upward case movement gives positive     SEGY_STANDARD
       integer*2    ipol
       equivalence  (segy1b(57),ipol)

c Vibrator polarity code                            SEGY_STANDARD
       integer*2    vpc
       equivalence  (segy1b(59),vpc)

c      number of traces in the tape/file            SEGY_IASPEI
       integer*2 notif
       equivalence (segy1b(61),notif)

c attribute information
c attri=0    velocity data nanometers/s             SEGY_IASPEI
```

```
c attri=1    instantaneous velocity nanometers/sSEGY_IASPEI
c attri=2    instantaneous frequency milliHz    SEGY_IASPEI
c attri=3    instantaneous phase  degrees       SEGY_IASPEI
c attri=4    slowness (m/ms)                    SEGY_IASPEI
c attri=5    semblance (0-1000)                 SEGY_IASPEI
c attri=6    displacement nanometers            SEGY_IASPEI
      integer*2 attri
      equivalence (segy1b(63),attri)

c Mean amplitude of all samples in all          SEGY_IASPEI
c     traces in the file.
      real*4 meanas
      equivalence (segy1b(65),meanas)

c Domain of data                                SEGY_IASPEI
c      domain=0 time/distance
c            =1 fk
c            =2 tau-p
      integer*2 domain
      equivalence (segy1b(69),domain)

c Not in use from version 3.00.
c Set to 1 for compatibility.
      integer*2 msexp
      equivalence (segy1b(71),msexp)


c Reduction velocity in meter(feet)/sec         SEGY_IASPEI          R
      integer*4   vred
      equivalence (segy1b(73),vred)

c Seconds of window start time                  SEGY_IASPEI          R
      real*4 wstart
      equivalence (segy1b(77),wstart)

c Seconds of window end time                    SEGY_IASPEI          R
      real*4 wend
      equivalence (segy1b(81),wend)

c Minimum of all samples in the file.           SEGY_IASPEI
      real*4    minass
      equivalence (segy1b(85),minass)

c Maximum of all traces in the file             SEGY_IASPEI
      real*4     maxass
      equivalence (segy1b(89),maxass)

c Recording instrument type                     SEGY_IASPEI          R
c If instrument types in reel header and trace
c header are different, then the trace header value
c must be used.
c
c      =0 Not specified.
c      =1 EDA (Scintrex) PRS1
c      =2 USGS cassette
c      =3 GEOS
c      =4 Springnether
c      =5 Teledyne
c      =6 Kinemetrics
c      =7 SGR
c      =8 TERATEK
c      =9 EDA (Scintrex) PRS4
c      =10 MARS 88
c      =11 MARS 66
c      =12 PCM 5800
c      =13 REFTEK
c      =14 GEOSTORE
c      =100 Mixed data
```

```
      integer*2 iinstr
      equivalence(segy1b(93),iinstr)

c File creation date - Year                   SEGY_IASPEI           R
      integer*2 cryear
      equivalence(segy1b(95),cryear)

c File creation date - Month                  SEGY_IASPEI           R
      integer*2 crmnth
      equivalence(segy1b(97),crmnth)

c File creation date - Day                    SEGY_IASPEI           R
      integer*2 crday
      equivalence(segy1b(99),crday)

c Disk File format                                         DISK
c   pad first header record past 3600 to data length
c   =0 Reel Header is 3600 bytes, data has
c      variable length records.
c   =1 Reel Header is 3600 bytes,
c      data is padded to nnb bytes.
c   =2 Reel Header and data are padded to nnb bytes.
c      All data have the same length.
      integer*2 padtyp
      equivalence (segy1b(101),padtyp)

c Character code. Must use EBCDIC for tape exchange.
c        =1 EBCDIC                            SEGY_IASPEI   TAPE   R
c        =2 ASCII                                         DISK
      integer*2 ccode
      equivalence(segy1b(103),ccode)

c File record length in bytes,                             DISK
c    data are padded to nnb bytes.
c  if padtyp=1,
c       then nnb should be >= trhlen+data length in bytes)
c  if padtyp=2, t
c       then nnb should be >= max(3600,trhlen+data length in bytes)
      integer*4 nnb
      equivalence (segy1b(105),nnb)

c Byte order within words                                  DISK
c     1   ='00 01'x Most  Signicant Byte first.
c     2   ='02 00'x Least Significant Byte first.
c Default for tape is MSB. Default for disk depends on machine.
      integer*2 bord
      equivalence(segy1b(109),bord)

c Trace header length                                      DISK
c   traces on disk are stored with header length
      integer*2 trhlen
      equivalence(segy1b(111),trhlen)

c Max number of channels per seismograph       SEGY_IASPEI           D
      integer*2 nchps
      equivalence(segy1b(113),nchps)
c
c n.b. bytes 115-116 of Binary Reel ID are empty.
c

c Override for sample interval(this data; sint) SEGY_IASPEI          D
c This variable is related to variable sint bytes (17-18).
c If this variable is set to non-zero, it holds a more
c precise value than sint.
c
c This is the status table for the value of this variable:
c      Variable Name  Overrides  Value        Result
c      sinto          sint       0            No action
```

```
c       sinto           sint        < 0         Sample rate in samples per second
c       sinto           sint        > 0         Sample interval in Nanoseconds
c
        integer*4 sinto
        equivalence(segy1b(117),sinto)

c Override for sample interval(in field; sint2) SEGY_IASPEI           D
c This variable is related to variable sint2 bytes (19-20).
c If this variable is set to non-zero, it holds a more
c precise value than sint2
c
c This is the status table for the value of this variable:
c       Variable Name   Overrides   Value       Result
c       sint2o          sint2       0           No action
c       sint2o          sint2       < 0         Sample rate in samples per second
c       sint2o          sint2       > 0         Sample interval in Nanoseconds
c
        integer*4 sint2o
        equivalence(segy1b(121),sint2o)

c       Distance-Azimuth Calculation Algorithm   SEGY_IASPEI
c       0 = Not specified
c       1 = Sodano algorithm. The program utilizes the
c           Sodano and Robinson (1963) direct solution
c           of geodesics (Army Map Service, Tech Rep #7,
c           section IV).
        integer*2 daca
        equivalence(segy1b(125),daca)

c       Earth Dimension Code                     SEGY_IASPEI
c       0 = Not specified
c       1 = Fisher 1960
c       2 = Clark 1866
c       3 = Ref ellipsoid 1967
c       4 = Hayford Internationl 1910
c       5 = World Geodetic Survey 1972
c       6 = Bessel 1841
c       7 = Everest 1841
c       8 = Airy 1936
c       9 = Hough 1960
c       10= Fischer 1968
c       11= Clarke 1880
        integer*2 edc
        equivalence(segy1b(127),edc)

c
c n.b. bytes 129-398 of Binary Reel ID are empty.
c

c Format version number times 100             SEGY_IASPEI           R
c          =99 Version .99
c          =100 Version 1.0
c          =200 version 2.0
c          =300 version 3.0
        integer*2 fvn
        equivalence (segy1b(399),fvn)

c
c---------------------------------------------------------------------+
c Reel Identification Header (total 400 bytes)    Ends here           |
c---------------------------------------------------------------------+
c

c
c---------------------------------------------------------------------+
c Trace Identification Header (total of 240 bytes) Starts here        |
c---------------------------------------------------------------------+
c
```

```
c Trace sequence number within line              SEGY_STANDARD          R
       integer*4 tsnl
       equivalence (thead(1),tsnl)

c Trace sequence number within tape              SEGY_STANDARD          R
       integer*4 tsnt
       equivalence (thead(5),tsnt)

c Original field record number                   SEGY_STANDARD          D
c Sequential Shot Number                         SEGY_IASPEI
       integer*4 ofrn
       equivalence (thead(9),ofrn)

c Trace number withint original field record     SEGY_STANDARD          R
c Receiver Site Number                           SEGY_IASPEI
       integer*4 tnofr
       equivalence (thead(13),tnofr)

c Energy source point number                     SEGY_STANDARD          R
c Shot Site Number                               SEGY_IASPEI
       integer*4 espn
       equivalence (thead(17),espn)

c CDP number                                     SEGY_STANDARD
       integer*4 cdp
       equivalence (thead(21),cdp)

c Trace number within CDP                        SEGY_STANDARD          R
       integer*4 tncdp
       equivalence (thead(25),tncdp)

c Trace identifications code                     SEGY_STANDARD          R
c     tic=1 seismic data                         SEGY_STANDARD
c     tic=2 dead                                 SEGY_STANDARD
c     tic=3 dummy                                SEGY_STANDARD
c     tic=4 time break                           SEGY_STANDARD
c     tic=5 uphole                               SEGY_STANDARD
c     tic=6 sweep                                SEGY_STANDARD
c     tic=7 timing                               SEGY_STANDARD
c     tic=8 water break                          SEGY_STANDARD
c     tic=11 --> tic=20 component number + 10
c                        for multi-compnent data SEGY_IASPEI
c     e.g. tic=11 (vertical component, horizontals following);
c          tic=12 (North-South component of 3 component);
c          tic=13 (East-West component of 3 component).
c     tic=100 calibration pulse                  SEGY_IASPEI
c     tic=101 calibration Frequency              SEGY_IASPEI
c              /Amplitude/Phase triplets
c
       integer*2 tic
       equivalence (thead(29),tic)

c Number of vertically summed traces             SEGY_STANDARD
c yeilding this trace
       integer*2 nvs
       equivalence (thead(31),nvs)

c Number of horizontally stacked traces          SEGY_STANDARD
c  yeilding this trace
       integer*2 nhs
       equivalence (thead(33),nhs)

c Data use   (1=productions, 2=test)             SEGY_STANDARD
       integer*2 duse
       equivalence (thead(35),duse)

c Distance from source to receiver (meters)      SEGY_STANDARD
```

```
      integer*4 idist
      equivalence (thead(37),idist)

c Receiver group elevation                          SEGY_STANDARD
      integer*4 irel
      equivalence (thead(41),irel)

c Surface elevation of source                       SEGY_STANDARD
      integer*4 ishe
      equivalence (thead(45),ishe)

c Source depth                                      SEGY_STANDARD
      integer*4 ishd
      equivalence (thead(49),ishd)

c Datum elevation at receiver                       SEGY_STANDARD
      integer*4 delr
      equivalence (thead(53),delr)

c Datum elevation at source                         SEGY_STANDARD
      integer*4 dels
      equivalence (thead(57),dels)

c Water depth at source                             SEGY_STANDARD
      integer*4 wds
      equivalence (thead(61),wds)

c Water depth at receiver                           SEGY_STANDARD
      integer*4 wdr
      equivalence (thead(65),wdr)

c Scalar multiplier/divisor(+/-)for bytes 41-68 SEGY_STANDARD
      integer*2 smul1
      equivalence (thead(69),smul1)

c Scalar multiplier/diviso(+/-)for bytes 73-88  SEGY_STANDARD
      integer*2 smul2
      equivalence (thead(71),smul2)

c Source coordinate X or Longitude
c (East positive)                                   SEGY_STANDARD
      integer*4 ishlo
      equivalence (thead(73),ishlo)

c Source coordinate Y or Latitude
c (North positive)                                  SEGY_STANDARD
      integer*4 ishla
      equivalence (thead(77),ishla)

c Group coordinate X or Longitude
c (East positive)                                   SEGY_STANDARD
      integer*4 irlo
      equivalence (thead(81),irlo)

c Group coordinate Y or Latitude
c (North positive)                                  SEGY_STANDARD
      integer*4 irla
      equivalence (thead(85),irla)

c Ccoordinate units (1 : meters/feet,               SEGY_STANDARD
c                    2 : seconds of arc
c                        (smul2 holds multiplier)
c                   -N : mod 100 = TX UTM zone
c                        div 100 = RX UTM zone
      integer*2 cunits
      equivalence (thead(89),cunits)

c Weathering velocity (meters(feet)/sec)            SEGY_STANDARD
```

```
      integer*2 wvel
      equivalence (thead(91),wvel)

c Subweathering velocity (meters(feet)/sec)     SEGY_STANDARD
      integer*2 swvel
      equivalence (thead(93),swvel)

c Uphole time at source                         SEGY_STANDARD
      integer*2 utimes
      equivalence (thead(95),utimes)

c Uphole time at group                          SEGY_STANDARD
      integer*2 utimeg
      equivalence (thead(97),utimeg)

c Source static correction                      SEGY_STANDARD
      integer*2 sstati
      equivalence (thead(99),sstati)

c Group static                                  SEGY_STANDARD
      integer*2 gstati
      equivalence (thead(101),gstati)

c Total static                                  SEGY_STANDARD
      integer*2 tstati
      equivalence (thead(103),tstati)

c Lag time A                                    SEGY_STANDARD
      integer*2 istime
      equivalence (thead(105),istime)

c Lag time B                                    SEGY_STANDARD
      integer*2 ibtime
      equivalence (thead(107),ibtime)

c Delay recording time                          SEGY_STANDARD
      integer*2 ictime
      equivalence (thead(109),ictime)

c The above times as defined for SEGY are not
c adequate for refraction data because they
c are limited to 32s. Use cor and tstart later on.

c Mute time start                               SEGY_STANDARD
      integer*2 mtimes
      equivalence (thead(111),mtimes)

c Mute time end                                 SEGY_STANDARD
      integer*2 mtimee
      equivalence (thead(113),mtimee)

c No of samples in this trace                   SEGY_STANDARD         R
      integer*2 length
      equivalence (thead(115),length)

c Sample interval in microseconds               SEGY_STANDARD         R
c See override for this value (isin, bytes 201-204) for
c more precise presentation.
      integer*2 isi
      equivalence (thead(117),isi)

c Gain type  (1=fixed, 2=binary, 3=floating)    SEGY_STANDARD
      integer*2 gaint
      equivalence (thead(119),gaint)

c Gain constant                                 SEGY_STANDARD         D
c data in nanometers/sec = (tape data)*(10**gc) SEGY_IASPEI
      integer*2  gc
```

```
      equivalence (thead(121),gc)

c Instrument or initial gain in dB                  SEGY_STANDARD
      integer*2 gidb
      equivalence (thead(123),gidb)

c Correlated 1=no, 2=yes                            SEGY_STANDARD
      integer*2  tcorr
      equivalence (thead(125),tcorr)

c Start sweep frequency (HZ)                        SEGY_STANDARD
      integer*2    tsswee
      equivalence  (thead(127),tsswee)

c End sweep frequency (HZ)                          SEGY_STANDARD
      integer*2    teswee
      equivalence  (thead(129),teswee)

c Sweep Length in milliseconds                      SEGY_STANDARD
      integer*2    tsleng
      equivalence  (thead(131),tsleng)

c Sweep type                                        SEGY_STANDARD       D
c     tstype=1  linear                              SEGY_STANDARD
c     tstype=2  parabolic                           SEGY_STANDARD
c     tstype=3  exponential                         SEGY_STANDARD
c     tstype=4  other                               SEGY_STANDARD
c     tstype=5  borehole source                     SEGY_IASPEI
c     tstype=6  water explosive source              SEGY_IASPEI
c     tstype=7  airgun source                       SEGY_IASPEI
c     tstype=8  earthquake                          SEGY_IASPEI
c     tstype=9  quarry-blast                        SEGY_IASPEI
c
      integer*2    tstype
      equivalence  (thead(133),tstype)

c Sweep trace taper in milliseconds at start        SEGY_STANDARD
      integer*2    tstts
      equivalence  (thead(135),tstts)
c
c Sweep trace taper in milliseconds at end          SEGY_STANDARD
      integer*2    tstte
      equivalence  (thead(137),tstte)

c Taper type                                        SEGY_STANDARD
c     ttype=1 linear
c     ttype=2 cos**2
c     ttype=3 other
      integer*2    tttype
      equivalence  (thead(139),tttype)

c Anti alias filter frequency                       SEGY_STANDARD
      integer*2    aif
      equivalence  (thead(141),aif)

c Alias filter slope                                SEGY_STANDARD
      integer*2    ais
      equivalence  (thead(143),ais)

c Notch filter frequency                            SEGY_STANDARD
      integer*2  nif
      equivalence (thead(145),nif)

c Notch filter slope                                SEGY_STANDARD
      integer*2    nis
      equivalence  (thead(147),nis)

c Low cut frequncy                                  SEGY_STANDARD
```

```
      integer*2    flc
      equivalence  (thead(149),flc)

c High cut frequncy                               SEGY_STANDARD
      integer*2    fhc
      equivalence  (thead(151),fhc)

c Low cut slope                                   SEGY_STANDARD
      integer*2    slc
      equivalence  (thead(153),slc)

c High cut slope                                  SEGY_STANDARD
      integer*2    shc
      equivalence  (thead(155),shc)

c Year of start of trace                          SEGY_STANDARD         R
      integer*2    tyear
      equivalence  (thead(157),tyear)

c Julian day of start of trace                    SEGY_STANDARD         R
      integer*2    tday
      equivalence  (thead(159),tday)

c Hour of start of trace                          SEGY_STANDARD         R
      integer*2    thour
      equivalence  (thead(161),thour)

c Minute of start of trace                        SEGY_STANDARD         R
      integer*2    tmin
      equivalence  (thead(163),tmin)

c Second of start of trace                        SEGY_STANDARD         R
      integer*2    tsec
      equivalence  (thead(165),tsec)

c Time basis code  1=local, 2=gmt                 SEGY_STANDARD         R
      integer*2    tbcode
      equivalence  (thead(167),tbcode)

c Trace weighting factor                          SEGY_STANDARD
      integer*2    twf
      equivalence  (thead(169),twf)

c Geophone group no on roll switch                SEGY_STANDARD
c first position
      integer*2    ggrp1
      equivalence  (thead(171),ggrp1)

c Geophone group no trace position 1 on rec       SEGY_STANDARD
      integer*2    ggtp
      equivalence  (thead(173),ggtp)

c Geophone group no on last trace of filed rec    SEGY_STANDARD
c     Or institution use
      integer*2    gglp
      equivalence  (thead(175),gglp)

c Gap size                                        SEGY_STANDARD
c     Or institution use
      integer*2    gapsz
      equivalence  (thead(177),gapsz)

c Field LINE number                               SEGY_IASPEI           D
      integer*2    overt
      equivalence  (thead(179),overt)

c Microseconds of trace start time                SEGY_IASPEI           R
      integer*4   mst
```

```
      equivalence (thead(181),mst)

c Charge size in kg or airgun size in litres     SEGY_IASPEI          R
      integer*2   charge
      equivalence (thead (185),charge)

c Shot or triger time - year                     SEGY_IASPEI          R
      integer*2 syear
      equivalence (thead(187),syear)

c Shot or triger time - Julian day               SEGY_IASPEI          R
      integer*2 sday
      equivalence (thead(189),sday)

c Shot or triger time - hour                     SEGY_IASPEI          R
      integer*2 shour
      equivalence (thead(191),shour)

c Shot or triger time - minute                   SEGY_IASPEI          R
     integer*2 smin
     equivalence (thead(193),smin)

c Shot or triger time - second                   SEGY_IASPEI          R
      integer*2 sseco
      equivalence (thead(195),sseco)

c Shot or triger time - microsecond              SEGY_IASPEI          R
      integer*4 ssmic
      equivalence (thead(197),ssmic)

c Override for sample interval.                  SEGY_IASPEI          D
c This variable is related to variable isi bytes (117-118).
c If this variable is set to non-zero, it holds a more
c precise value than isi.
c
c This is the status table for the value of this variable:
c     Variable Name  Overrides  Value      Result
c     isin           isi        0          No action
c     isin           isi        < 0        Sample rate in samples per second
c     isin           isi        > 0        Sample interval in Nanoseconds
c
      integer*4 isin
      equivalence (thead(201),isin)

c Azimuth of geophone orientation axis with      SEGY_IASPEI          D
c respect to true north in minutes of arc
      integer*2 geoazi
      equivalence (thead(205),geoazi)

c Angle between geophone orientation axis and    SEGY_IASPEI          D
c vertical in minutes of arc
      integer*2 geover
      equivalence (thead(207),geover)

c Static correction                              SEGY_IASPEI          D
c time to be added to recorded trace time to
c get actual trace start
c time. To be used when data has been reduced
      integer*4   ttrace
      equivalence (thead (209),ttrace)

c Flag to signal that ttrace has been used to    SEGY_IASPEI          D
c modify trace start time
c  tapply=0   static ttrace has been used to
c             reduce the data
c             and trace start time updated
c  tapply=1   static ttrace has beed has been
c             used to reduce the data but trace
```

```
c              start time has not been corrected
c
       integer*2   tapply
       equivalence (thead(213),tapply)

c Recording instrument type                        SEGY_IASPEI           R
c If instrument types in reel header and trace
c header are different, then the trace header value
c must be used.
c
c        =0 Not specified.
c        =1 EDA (Scintrex) PRS1
c        =2 USGS cassette
c        =3 GEOS
c        =4 Springnether
c        =5 Teledyne
c        =6 Kinemetrics
c        =7 SGR
c        =8 TERATEK
c        =9 EDA (Scintrex) PRS4
c        =10 MARS 88
c        =11 MARS 66
c        =12 PCM 5800
c        =13 REFTEK
c        =14 GEOSTORE
       integer*2 instru
       equivalence(thead(215),instru)

c Millisecond of timing correction                 SEGY_IASPEI           R
c to be added to reported times to get true
c local or gmt times.
c This should be the sum of all timing
c corrections such as master clock and
c seismograph drifts.
       integer*2   cor
       equivalence (thead(217),cor)

c Azimuth of receiver                              SEGY_IASPEI           D
c from shot in minutes of arc
       integer*2 azimut
       equivalence (thead(219),azimut)

c
c---------------------------------------------------------------------+
c Binary part of Trace Identification Header Ends here                |
c---------------------------------------------------------------------+

c Character information.

c Recording instrument name
       character*4   scrs
       equivalence (thead (221),scrs)

c Shotpoint name
       character*4 spname
       equivalence (thead(225),spname)

c Receiver site name
       character*4 rstnam
       equivalence (thead(229),rstnam)

c Shot site name
       character*4 shotid
       equivalence (thead(233),shotid)

c Geophone mnemonic
c for example L4-Z, L4-N
c use reel header to explain the mnemonics
```

```
c used on a tape.
      character*4 geopin
      equivalence (thead (237),geopin)
c
c--------------------------------------------------------------------+
c Trace Identification Header (total of 240 bytes) Ends    here      |
c--------------------------------------------------------------------+
c
c- End   of FINAL segy.inc version 3.00 (IASPEI), January 25, 1993 ----
```

Appendix D ITA-Insight to SEGY_IASPEI Cross-Wire File

Note the trace time correction (bytes 217-218 of SEGY_IASPEI trace header, Appendix C) is cross-wired to ITA word 59. An ITA process outlined in Table 5 is used to apply this correction to the data.

```
! modification history:
! Nov. 92, ita word 59, converted to sec on read.
! Nov. 92, ita word 28 is now a new flag.
! Jan. 93, ITA word 28 is x-wired to segy 179 which holds line number
! iaspei_r.crs    iaspei_read.crs
! identical to iaspei_w.crs except for SEGY header words 17 and 37.
! Crosswire file allowing ITA formated files to be read from tapes in SEG-Y
! format using the new SEGY_IASPEI standard.
!
! Isa Asudeh, June 9, 1992.
!
! all lines marked with IASPEI match LithoSEIS SEGY_IASPEI format.
! all lines marked with DUMMY are undefined and their variables get dummied.
! all other lines are original segy or ita.
!
! Words 7,8,10,12, and 13 are set automatically

head   1   'i*4'   1.0    0.0    1   'i*4' !original trace sequential #
head   5   'i*4'   1.0    0.0    2   'i*4' !file #
head  21   'i*4'   1.0    0.0    3   'i*4' !cdp #
head   9   'i*4'   1.0    0.0    4   'i*4' !shot name IASPEI
head  17   'i*4'   1.0    0.0    5   'i*4' !shotsite or sorting word IASPEI
head  29   'i*2'   1.0    0.0    6   'i*4' !trace type flag
!                                7         !# of points per trace
!                                8         !sampling interval (microsecs)
!                                9         !trace start time (ms)
!                                10        !trace end time (ms)
!                                11        !scratch word used in getdat
!                                12        !disk record fold
!                                13        !disk trace in record position
!                  0.0    0.0    14  'i*4' !horizon bit mask, ita use for later
!                  0.0    0.0    15  'r*4' !horizon 1 pick time, zeroed on read
!                  0.0    0.0    16  'r*4' !horizon 2 pick time, zeroed on read
!                  0.0    0.0    17  'r*4' !horizon 3 pick time, zeroed on read
!                  0.0    0.0    18  'r*4' !horizon 4 pick time, zeroed on read
!                  0.0    0.0    19  'r*4' !horizon 5 pick time, zeroed on read
!                  0.0    0.0    20  'r*4' !horizon 6 pick time IASPEI
!                  0.0    0.0    21  'r*4' !horizon 7 pick time IASPEI
!                  0.0    0.0    22  'r*4' !horizon 8 pick time IASPEI
!                  0.0    0.0    23  'r*4' !horizon 9 pick time IASPEI
!                  0.0    0.0    24  'r*4' !horizon 10 pick time IASPEI
head  71   'i*2'   1.0    0.0    25  'r*4' !multiplier segy bytes 73-88 IASPEI
head  17   'i*4'   1.0    0.0    26  'i*4' !shot site number IASPEI
head  13   'i*4'   1.0    0.0    27  'i*4' !receiver site number IASPEI
head 179   'i*2'   1.0    0.0    28  'i*4' !line number IASPEI
head  77   'i*4'   0.01   0.0    29  'r*8' !source y coordinate
head  73   'i*4'   0.01   0.0    31  'r*8' !source x coordinate
head  45   'i*4'   1.0    0.0    33  'r*8' !source elevation
head  85   'i*4'   0.01   0.0    35  'r*8' !rcvr y coordinate
head  81   'i*4'   0.01   0.0    37  'r*8' !rcvr x coordinate
head  41   'i*4'   1.0    0.0    39  'r*8' !receiver elevation
head 189   'i*2'   1.0    0.0    41  'r*8' !shot time day IASPEI
head 191   'i*2'   1.0    0.0    43  'r*8' !shot time hour IASPEI
head 193   'i*2'   1.0    0.0    45  'r*8' !shot time min IASPEI
head 195   'i*2'   1.0    0.0    47  'r*8' !shot time seconds IASPEI
head 197   'i*2'   1.0    0.0    49  'r*8' !shot time microseconds IASPEI
head  89   'i*2'   1.0    0.0    51  'r*4' !coordinate unit IASPEI
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head 219   'i*2'   1.0    0.0    52  'r*4' !azimuth in min of arc
head  37   'i*4'   1.0    0.0    53  'r*4' !offset in feet or meters
!
head 159   'i*2'   1.0    0.0    54  'r*4' !day of start of trace  IASPEI
head 161   'i*2'   1.0    0.0    55  'r*4' !hour of start of trace IASPEI
head 163   'i*2'   1.0    0.0    56  'r*4' !min of start of trace IASPEI
head 165   'i*2'   1.0    0.0    57  'r*4' !sec of start of trace IASPEI
head 181   'i*4'   1.0    0.0    58  'r*4' !microseconds of start of trace IASPEI
!
head 217   'i*2'  0.001   0.0    59  'r*4' !seconds of trace time correction
IASPEI
head 209   'i*4'   1.0    0.0    60  'i*4' !actual trace time correction-
microsec (ttrace) IASPEI
!
head 213   'i*2'   1.0    0.0    61  'r*4' ! ttrace application flag IASPEI
head 215   'i*2'   1.0    0.0    62  'r*4' ! recording instrument type IASPEI
head  69   'i*2'   0.0    1.0    63  'r*4' !scaler factor of 1 for bytes 41-48
IASPEI
head 167   'i*2'   0.0    2.0    64  'r*4' !time basis code of 2 IASPEI
end
```