APPENDIX 3. ProMAX 5.1 INPUT AND PROCESSING PARAMETERS

This appendix contains all the information used to load the Chukchi wide-angle seismic data into ProMAX 5.1, manipulate the ProMAX database, filter the data, and produce plots. The appendix is divided into three sections. The first describes the structure of the flows used, the second then lists the input parameters for all the ProMAX tools used in the flows. The third describes how we manipulated the database. Substantial revision of these flows may be necessary for ProMAX 6.0.

1.0 FLOWS

1.1 INPUT FROM TAPE TO DISK

SEG-Y Input
Disk Data Output

1.2 PROCESS AND PLOT ADJACENT SHOTS

This flow was used to realise our first objective, to simply plot the data for a 'first look'. Thus no velocity reduction was applied and all traces were plotted with equal spacing.

Disk Data Input
Trace DC Removal
Bandpass Filter
Automatic Gain Control
Spiking/Predictive Decon
Create CGM+ Plotfile
Plot CGM+ Plotfile ZGS

1.3 GEOMETRY

Non-standard geometry is difficult in ProMAX. Rather than do the geometry inside ProMAX the necessary parameters were calculated outside ProMAX and then imported to ProMAX. It was necessary, however, to initialise the geometry first which was achieved as follows.

Geometry Installation*

The * indicates it is a standalone tool which does not need Disk Data Input.

1.4 PROCESSING AND PLOTTING AS A FUNCTION OF RANGE

This flow was used once the shot-receiver ranges had been imported into the ProMAX database. On each occasion the flow is run the range information must be read from the database - it is not stored permanently as a header value.

Disk Data Input
Trace DC Removal
Bandpass Filter
Database/Header Transfer
Trace Header Math
Trace Header Math
Linear Moveout Correction

Automatic Gain Control
Spiking/Predictive Deconvolution
Trace Mixing
Trace Header Math
Create CGM+ Plotfile
Plot CGM+ Plotfile ZGS

The two Trace Header Math tools after the Database/Header Transfer load the range and the absolute range into OFFSET and AOFFSET respectively. This transfer allows the velocity tool to be used on the screen display. To plot trace spacing as a function of range you need to assign the range as CDP. To do this the integer value of the range is loaded into the CDP header prior to plotting. The plot is then created in the CDP spatial domain. The conversion to an integer means it is necessary to calculate the range in meters otherwise all shots within 1 km would be collapsed together.

2.0 ProMAX 5.1 TOOL PARAMETERS

Below are lists of the critical input parameters for the tools used, note that this is not a complete list.

2.1 SEG-Y INPUT

Type of storage	Tape
Input multiple files from tape(s)	Yes
Multiple file selection	Select
Specify input files list	1/
IBM standard label?	No
Input data's sample rate	10.0
Maximum time to input	60000.0
Get channel number from trace headers	Yes
Input trace format	Get from header
Is this stacked data?	No
Maximum traces per ensemble	25000
Primary sort header word	SHOT
Input primary selection choice	Input ALL
Input secondary selection choice	None
Enter primary tape drive device path name	/dev/rmt/1

Notes: When selecting which file to load it is only possible to indicate one file at a time. To view more than one channel, first execute the flow, and then change the 1/ to a 2/ and execute again. When ProMAX gets to the end of the file it states 'Run out of data'. This phrase simply means 'at the end of the file' so select 'stop'.

2.2 DISK DATA OUTPUT

Record length to output	0.0
Compress the data	Yes
Pre-geometry database initialization	No

Note: The 0.0 outputs all the data.

2.3 DISK DATA INPUT

Trace read option	Sort
Select primary trace header entry	Recording channel number
Select secondary trace header entry	Field file ID number
Select tertiary trace header entry	None
Sort order for dataset	1:705550-711400(1)/

Notes: In some flows it is necessary to indicate all traces for a process in which case it is useful to have the primary trace header entry something that is the same for all traces. In the case of the Chukchi data, channel number is such a field. The secondary trace header entry is actually the one that picks out the required traces.

2.4 BANDPASS FILTER

Type of filter	Single filter
Type of filter specification	Ormsby bandpass
Phase of filter	Zero
Domain of filter	Frequency
Frequency values	4-6,13-18

Note: The phase of the filter can either be zero or minimum.

2.5 AUTOMATIC GAIN CONTROL

Application mode	Apply
Type of AGC scalar	Mean
AGC operator length	60000
Basis for scalar application	Centred

Note: AGC was applied before spiking deconvolution.

2.6 SPIKING/PREDICTIVE DECONVOLUTION

Type of deconvolution	Minimum phase spiking
Decon operator length	1500
Operator 'white noise' level	0.1
Get decon gates from database?	No
Select primary decon gate header word	Recording channel number
Select secondary decon gate header word	None
Specify decon gate parameters	1:0-40000/
Output traces or filters	Normal decon output
Apply bandpass filter after decon	Yes
Bandpass filter freq values	4-6,13-18

Notes: There are two types of spiking deconvolution, 'Minimum phase spiking' and 'Zero phase', the effect of these is the same as with the bandpass filter. The deconvolution operator length is the maximum length of wavelet that ProMAX looks for and collapses to a spike. Parameters five to seven specify where to look for the repeating wavelet. In this case it looks in all traces (they all have a channel number of 1), between 0 and 40 sec. This wide time window was necessary before the data had been linearly reduced.

2.7 DATABASE/HEADER TRANSFER

Direction of transfer	Load to trace header from database
Number of parameters	1

First database parameter	SIN GEOMETRY RANGE
First header entry	range

Notes: This tool loads the RANGE values previously loaded into the database and stores them in the attribute range (the two names do not have to be the same). The attribute range can then be used latter in the flow.

2.8 TRACE HEADER MATHS

Select mode	Fixed equation mode
Define trace header equation	aoffset=abs(range)

Notes: This tool simply sets the aoffset attribute to the absolute value of the range for each trace. It is useful to put the calculated range in offset and aoffset as this allows the velocity tool to be used on screen.

2.9 LINEAR MOVEOUT CORRECTION

Type of LMO application	Forward
Header entry used to specify distance	aoffset
Select primary header entry	None
Specify velocity parameters	8000:

Notes: The distance used must be positive otherwise the timeshift applied will be in the wrong direction for the negative ranges.

2.10 TRACE MIXING

Trace mixing algorithm	Weighted mix
Trace weights for mixing	0.6,1.0,1.0,1.0,0.6
Number of traces to mix over	5

Notes: This tool replaces the center trace by the sum of this trace with adjacent traces weighted as specified by the user. It does not stack the traces hence the total number of traces is not reduced.

2.11 SCREEN DISPLAY

2.11.1 CONSTANT TRACE SPACING

Number of traces per screen	500
Maximum number of ensembles per screen	500
Do you wish to use variable trace spacing?	No
Select trace display mode	WT/VA
Primary trace labelling header entry	FFID
Mode of primary trace annotation	Incremental
Increment for primary trace annotation	50
Secondary trace labelling header entry	None
Trace scaling mode	Conventional

Notes: An ensemble is the group of traces indicated by a single value of the 'primary trace header entry' specified in 'Disk Data Input'. If FFID is specified as the primary entry then the maximum number of ensembles will have to be the same as the number of traces as there is only one trace per ensemble. The best solution is to specify a big number.

2.11.2 VARIABLE TRACE SPACING

Number of traces per screen	0
Maximum number of ensembles per screen	1
Do you wish to use variable trace spacing	Yes
Header entry for trace spacing	range
Secondary trace labelling header entry	range
Mode of annotation	Incremental
Increment	50

Notes: It is only possible to display the data on the screen with variable trace spacing if all the data is displayed on one screen. The user must then zoom in and out to have a closer look if necessary. The 'traces per screen option' must be either 0, for automatic mode, or a number greater than twice the total number of traces. Ideally the 'primary trace header entry, specified in the 'Input from Disk' should be something that specifies all traces (channel number for the Chukchi data), in which case we can enter one here. Otherwise the 'maximum numberof ensembles' must be greater than twice the number of traces. If the maximum number of ensembles specified is not 1 the automatic mode for number of traces does not work in which case both numbers must be greater than twice the total number of traces. Twice the number of traces must be specified because ProMAX will only display half the number given. A problem occurs if the number of traces is greater than 499 as the largest number that can be entered in either of these options is 9999.

2.12 CREATE CGM+ PLOTFILE

2.12.1 CONSTANT TRACE SPACING

Plot file name	cgmplot
Plotting units	cm
Spatial domain of plot	Input trace order
CDP increment	1

Submenu to view Traces/Plots/Posts/Graphs

Components list Post>Header>FFID

Posting method	Value
Select header values to post	706600-706800(50)
Include label	Yes
Label text	FFID

Components list >primary trace data<

Trace space (traces/plot unit)	80
Time scale (plot units/sec)	2
Start time	0
End time	40
Timing lines	2000 5000
Timing annotation increment	5000
Timing annotation format	Decimal seconds
Trace plot mode	Variable area
Section gain	0.5
Clip limit	2

Submenu to view Title box text

Minimum height of side label -1

Submenu to view Processing sequence text Processing sequence options Fully Automatic

Notes: Problems were encountered when the file name was changed from the default. The user must specify the actual numbers to be posted in the 'select header values to post'. The maximum number of traces it is possible to plot was about 80 per cm, to do so it must be a variable area only plot. Specifying '-1' in the 'minimum height of side label' results in no label, specifying the default of 0 generates the label automatically. If a label is generated then specifying a 'fully automatic processing sequence' prevents the user entering a generating tool which causes unnecessary complications.

2.12.2 VARIABLE TRACE SPACING

Before the create plot tool the user must insert a Trace Header Math tool specifying the following:

Select mode Fixed equation mode Define trace header equation cdp=int(range)

The critical parameters in Create CGM+ Plotfile are:

Spatial domain of plot	CDP Leftmost CDP	250 000
	Rightmost CDP	250 000
CDP increment	1	

Submenu to view Traces/Plots/Posts/Graphs Components list >PRIMARY TRACE DATA<

Trace space (traces/plot units) 10 000

Notes: The plot will cover the range specified here however there will only be data if the input traces specified in 'Input From Disk' are in this CDP/range interval. The 'Trace space' is now CDPs per plot unit.

3.0 LOADING RANGES INTO THE ProMAX 5.1 DATABASE

Firstly the database must be initialized loading all the header values into the database. This is achieved by running the Geometry Installation tool in geometry initialize mode.

New 'header values' for each trace can then be loaded into the database from columns in an ASCII file. One column must contain a number which tallies with a header value that ProMAX 5.1 can key on, for example TRACENO or SIN. Clearly the chosen header entry must contain a unique value for each trace. The other column contains the new header entry to be imported. It does not matter if the ASCII file contains other columns as well.

It is essential that the ASCII file has a value for the new header entry for every trace in the database and they are in the same order. To ensure this is the case it may be useful to export the current header entries in an ASCII file, the additional column of the new header entry values can then be added ensuring that the above condition is met.

3.1 EXPORTING CURRENT HEADER ENTRY VALUES FROM THE ProMAX DATABASE

Select required line and click on 'Database'.

Click on 'Database' and 'Get'.

Select the order required ('SIN' for the Alaskan data), and the attribute ('GEOMETRY FFID' in this case). A plot of the order against the attribute will then appear.

'Cancel' the window to uncover the graph.

Click on 'Ascii' from the top line and 'Save'.

Click on 'User-defined file', enter path and file name and click on 'OK'. This box will then appear highlighted in the ProMAX ASCII format file box. Note: Problems were encountered when the specified path was not the users home directory.

Click on the required attributes in the attributes box ('SIN GEOMETRY FFID' in this case).

Edit the description if required and click on 'OK'. A window will now appear to confirm saving the file. 'Exit' the database.

3.2 IMPORTING NEW HEADER ENTRY VALUES TO THE ProMAX DATABASE

Prepare ASCII file based on the exported one with the new header entry values in an additional column.

Select the required line and click on 'Database'.

Click on 'ASCII' and then 'Client'.

Click on 'File' and enter the path and name of the ascii file to import, then click 'OK'.

Click on 'Order' and select the header entry you wish to key too. This must be a header entry that has a unique value for each trace and is listed in a column in the imported file.

Click on 'Info Type' and select 'Geometry'.

Move mouse to box adjacent to 'Attribute' and type the name of the new header entry.

Click on 'Rows' and type in the rows containing the header values. This can also be achieved by selecting them in the lower window using MB1.

Select the columns which the key header value is in using MB2 in the lower window.

Select the columns the new header entry values are in using MB3 in the lower window.

Click on 'Display', type in a description of the new header entry, and 'OK'.

A plot of the new header entry against the key header enter will now appear (the window can be removed by clicking on 'Cancel').

Save the new header entry by clicking on 'Database' and then 'Save'. Then click on the 'key against new' line in 'New' window. Another window will then appear to confirm the values have been saved.
'Exit'.

APPENDIX 4. PASSCAL SEGY TRACE HEADER FORMAT

Byte #	Description
1 - 4	Trace sequence number within data stream
5 - 8	Trace sequence number within reel (same as above)
9 - 12	Event number
13 - 16	Channel number
29 - 30	Trace identification code = 1 for seismic data
69 - 70	Elevation constant = 1
115 - 116	Number of samples in this trace (note if equal 32767 see bytes 229 - 232)
117 - 118	Sample interval in microsecs for this trace (note if equal 1 see bytes 201 - 204)
119 - 120	Fixed gain flag = 1
121 - 122	Gain of amplifier
157 - 158	Year data recorded
159 - 160	Day of year
161 - 162	Hour of day (24 hour clock)
163 - 164	Minute of hour
165 - 166	Second of minute
167 - 168	Time basis code: 1=local 2=GMT 3=other
174 - 174	Stake number index
181 - 186*	Station Name code (5 chars + 1 for termination)
187 - 194*	Sensor Serial code (7 chars + 1 for termination)
195 - 198*	Channel Name code(3 chars +1 for termination)
199 - 200*	Extra bytes (2 chars)
201 - 204*	Sample interval in microsecs as a 32 bit integer
205 - 206*	Data format flag: 0=16 bit integer 1=32 bit integer
207 - 208*	Miliseconds of second for first sample
209 - 210*	Trigger time year
211 - 212*	Trigger time julian day
213 - 214*	Trigger time hour
215 - 216*	Trigger time minutes
217 - 218*	Trigger time seconds
219 - 220*	Trigger time milliseconds
221 - 224*	Scale factor (IEEE 32 bit float) (true amplitude = (data value)*(scale factor)/gain
225 - 226*	Instrument Serial Number
229 - 232*	Number of Samples as a 32 bit integer
233 - 236*	Max value in counts.
237 - 240*	Min value in counts.

* Header values not specified in the standard SEGY format

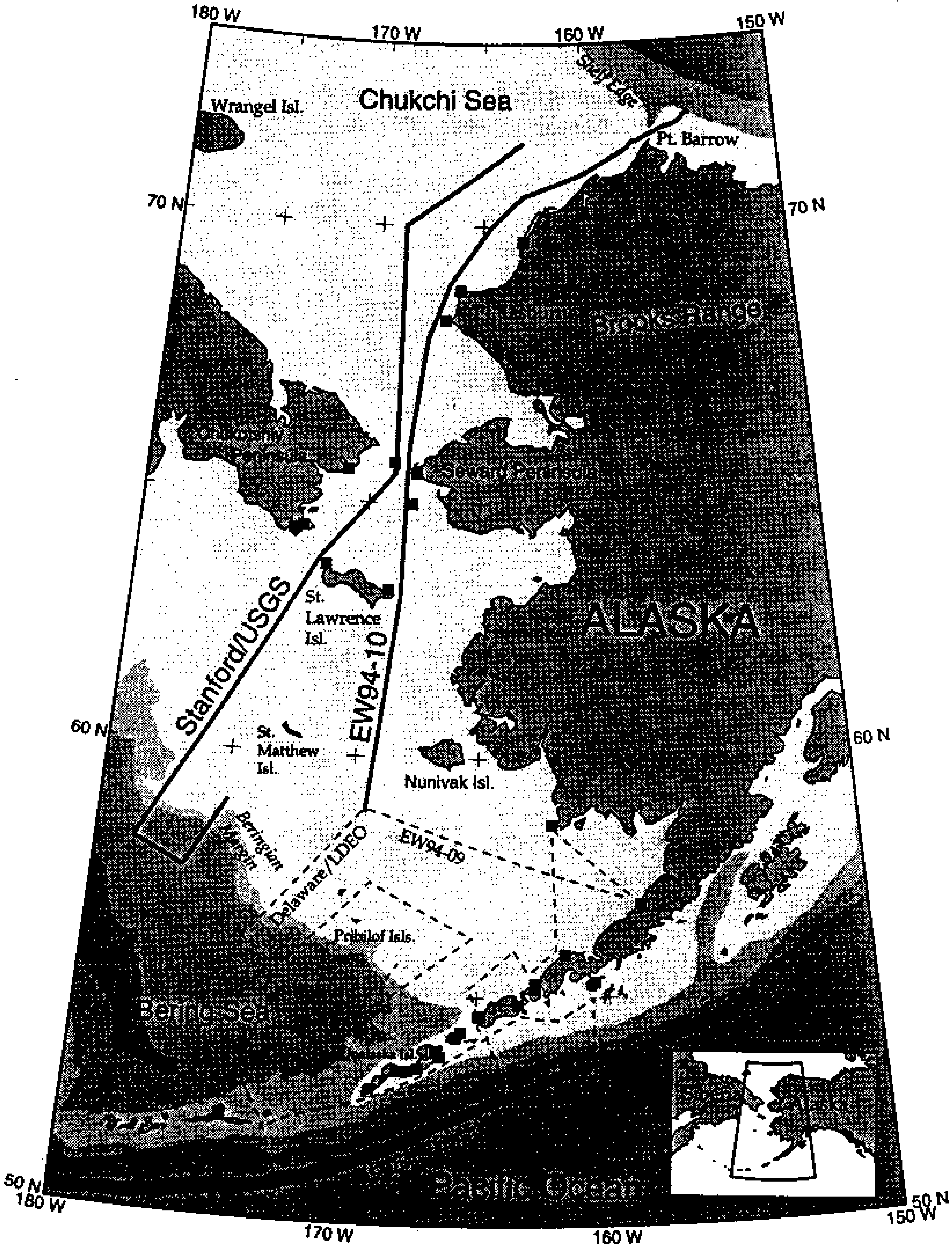

Figure 1. Map showing location of EW94-09 and EW94-10 seismic-reflection surveys in Bering and Chukchi Seas. Filled boxes show locations of Reftek recorders deployed in Alaska and seismic recorders deployed in Russia to record these reflection surveys.

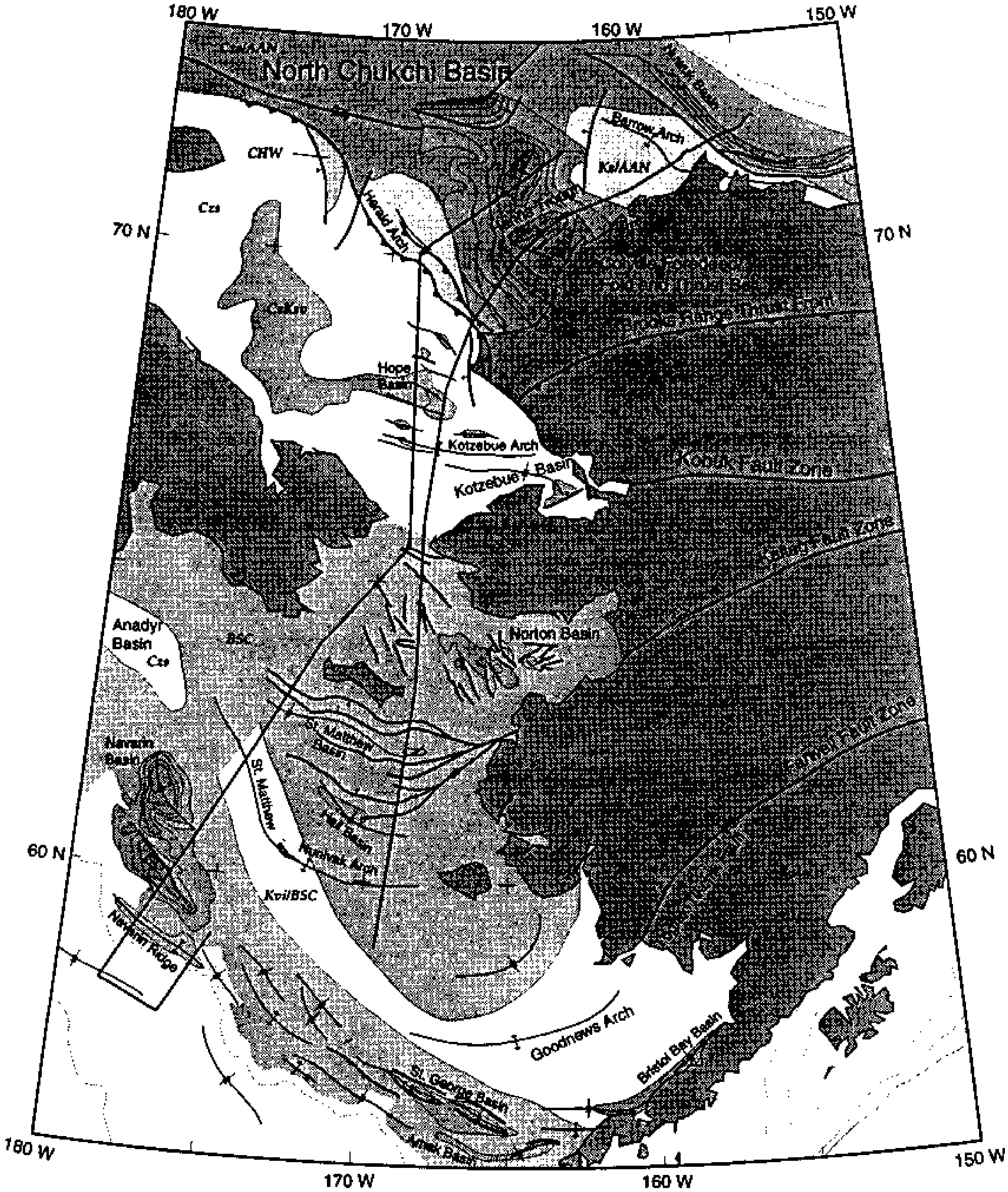

Figure 2a. Geologic map showing main structural trends and elements transversed by seismic-reflection lines.

Legend

BSC	Bering Sea Collage
Kvi/BSC	Bering Sea Collage overlain in parts by Cretaceous volcanic rocks
Czs	Cenozoic sedimentary cover overlying North Slope Block
CzKsv	Cretaceous sedimentary cover overlying North Slope Block
Czs/AAN	Cenozoic sedimentary cover overlying North Slope terrane
Ks/AAN	Cretaceous sedimentary cover overlying North Slope terrane
CHW	Wrangel subterrane

Basin sedimentary thickness are in 2 km intervals. (Lightest color - 3 km.)

Sources: Kirschner, C. E., 1988; Nokleberg, W. J., and others, 1994.

Figure 2b. Legend for Figure 2a.

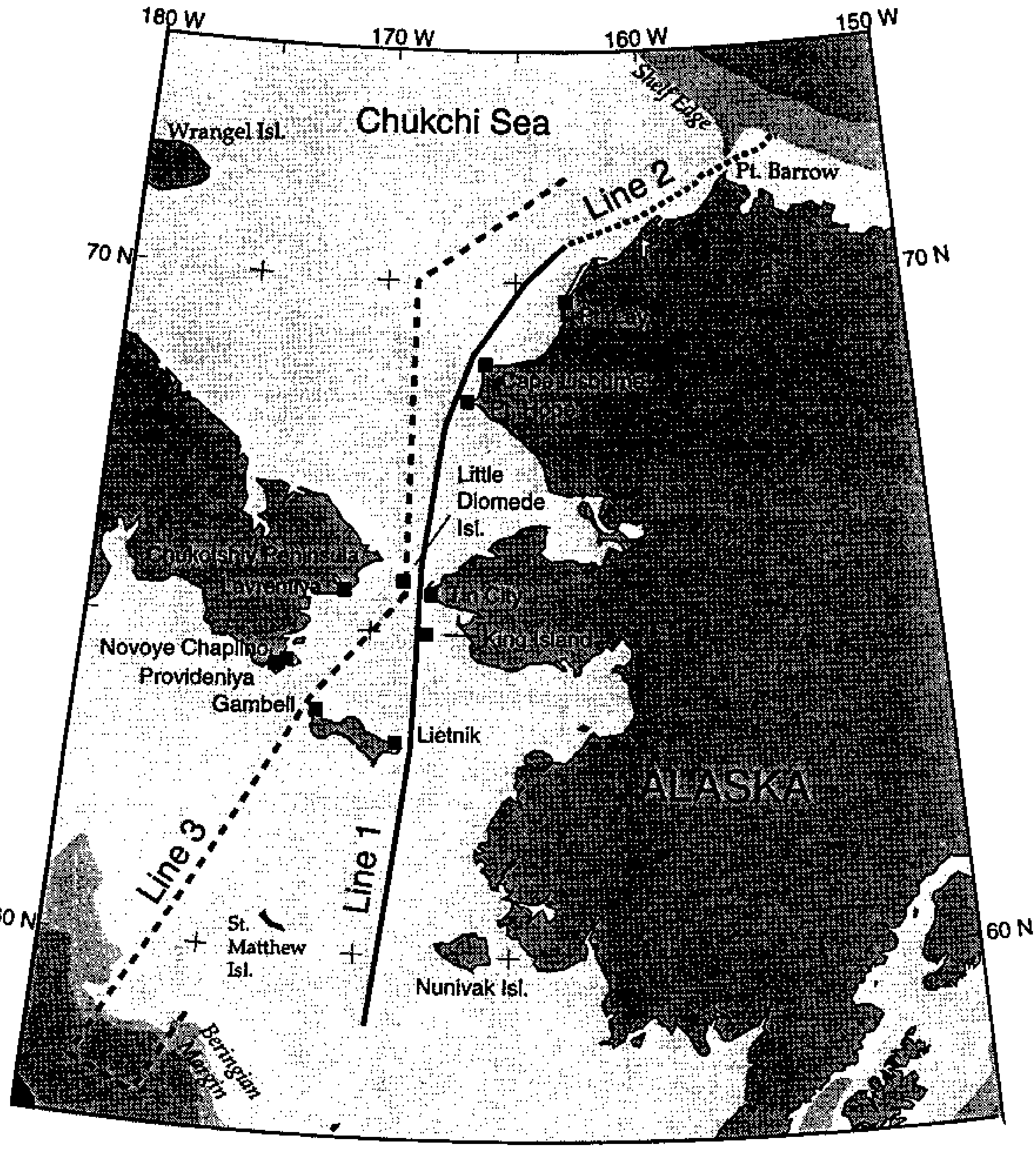

Figure 3. Detail of location map showing Reftek station locations and recorders in Russia.

R/V MAURICE EWING SETBACK AND OFFSET DIAGRAM

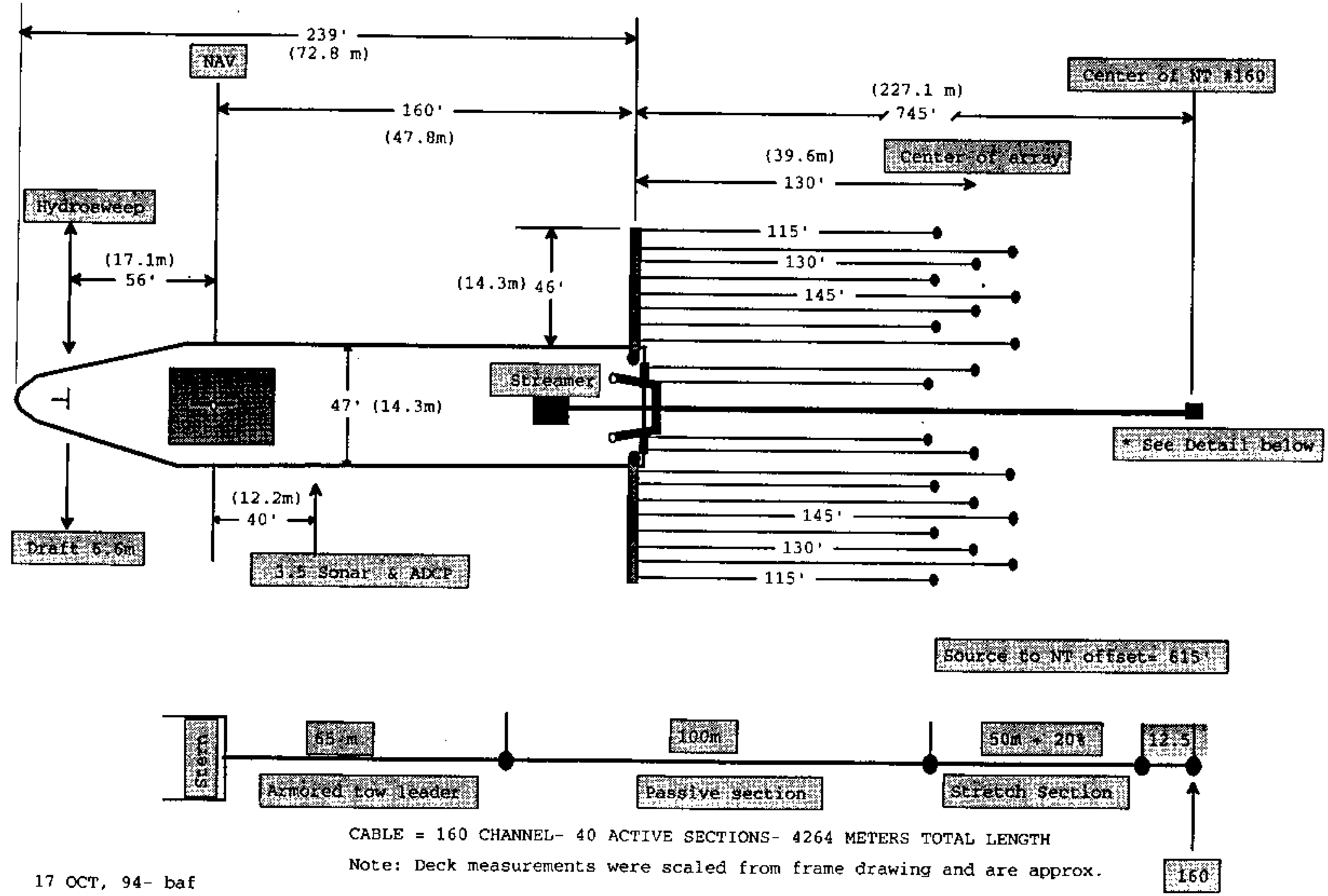

Fig. 4. Schematic diagram of **R/V Maurice Ewing** showing air gun and streamer deployment geometry.

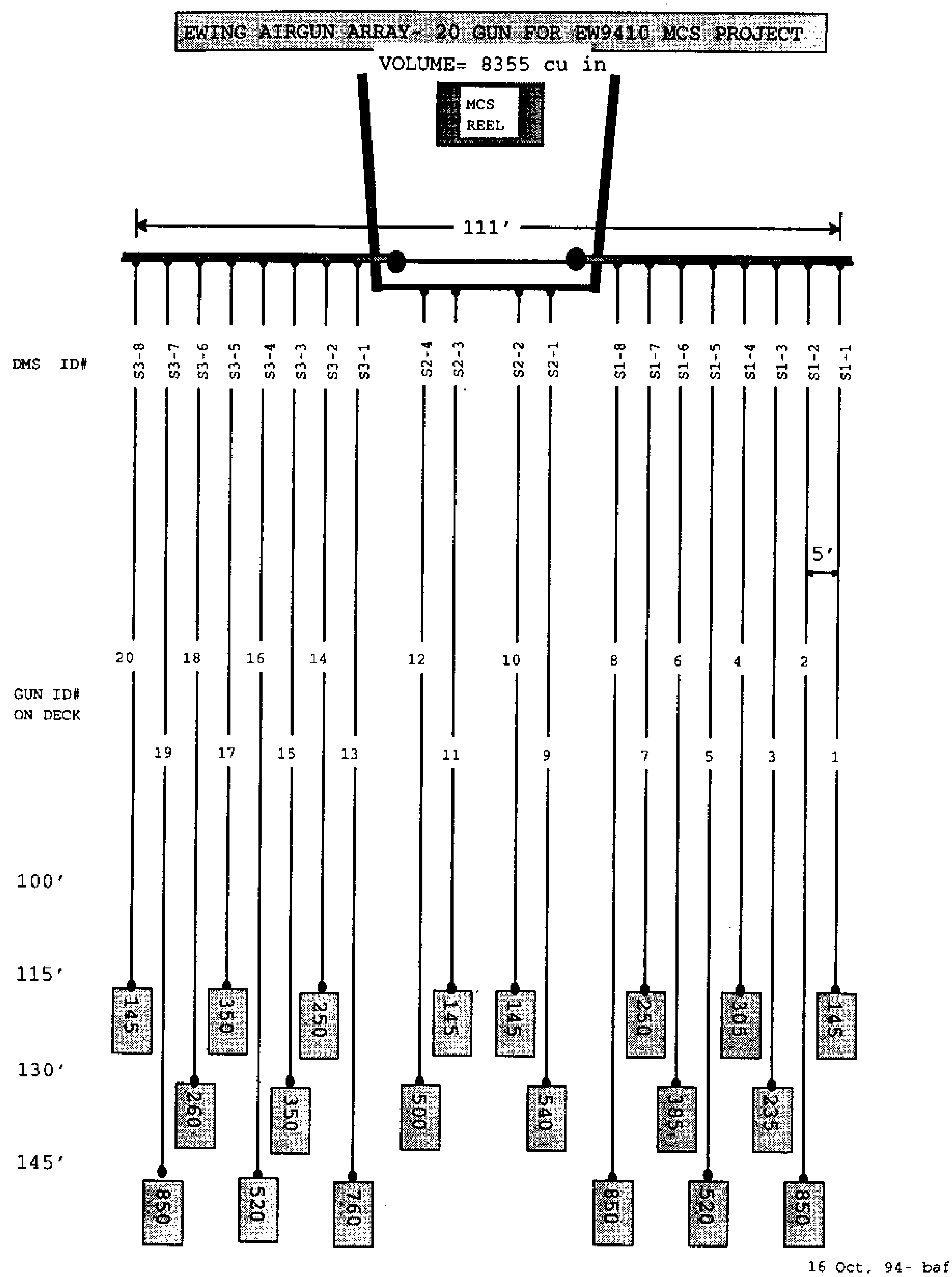

Fig. 5. Detailed schematic diagram of **R/V Maurice Ewing** air gun array.

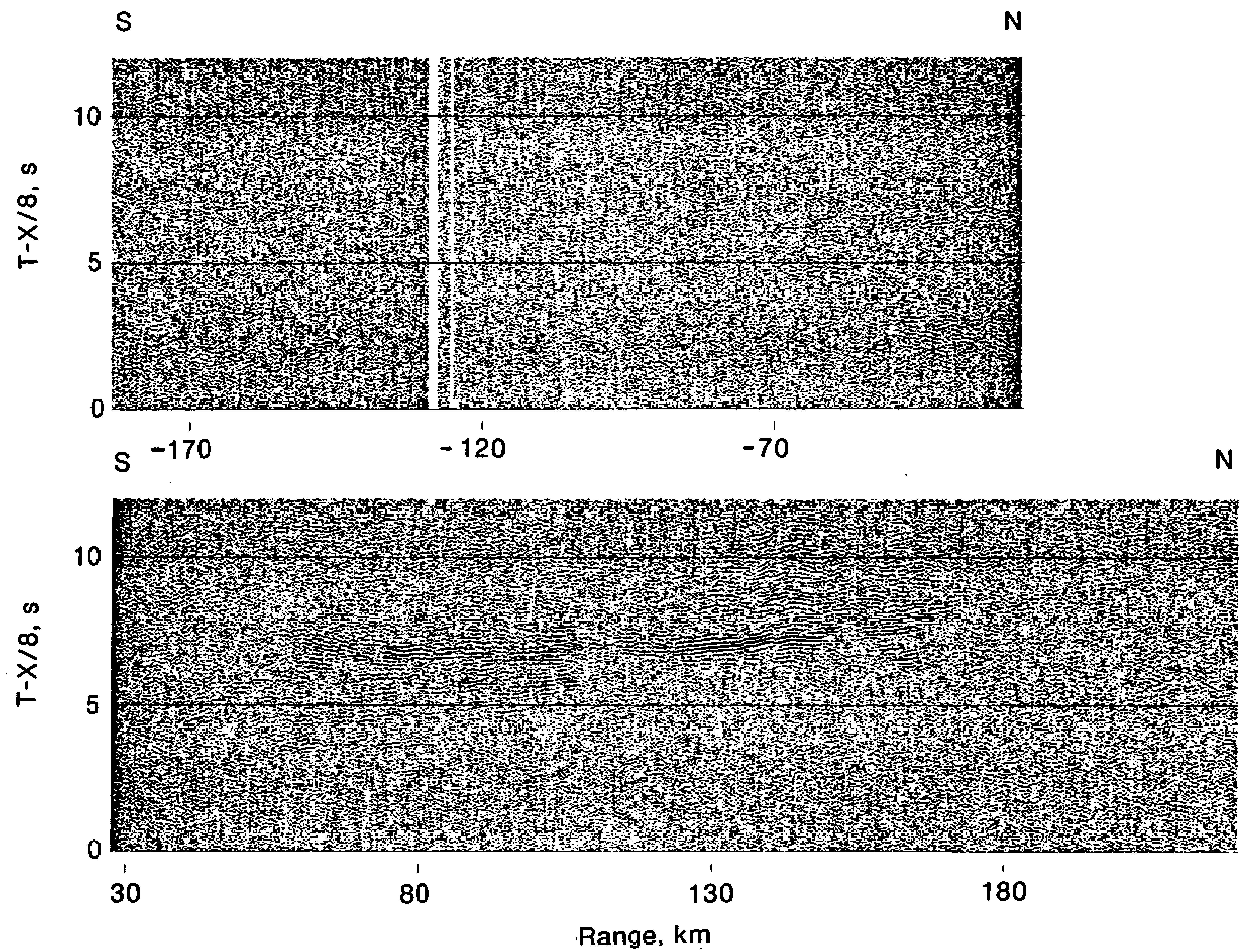

Figure 6. Receiver gather for station Lietnik from Line 1. The record section has been linearly reduced using a velocity of 8 km/s, bandpass filtered (6 to 13 Hz), deconvolved with a spiking operator, and mixed over five traces.