Cruise Report

EW-96-01a

Crustal Structure of the Puysegur-Fiordland Oblique Convergent Margin

Port Chalmers, N.Z. - Lyttleton, N.Z.
8 March 1996 (JD 68) - 14 March 1996 (JD 74)

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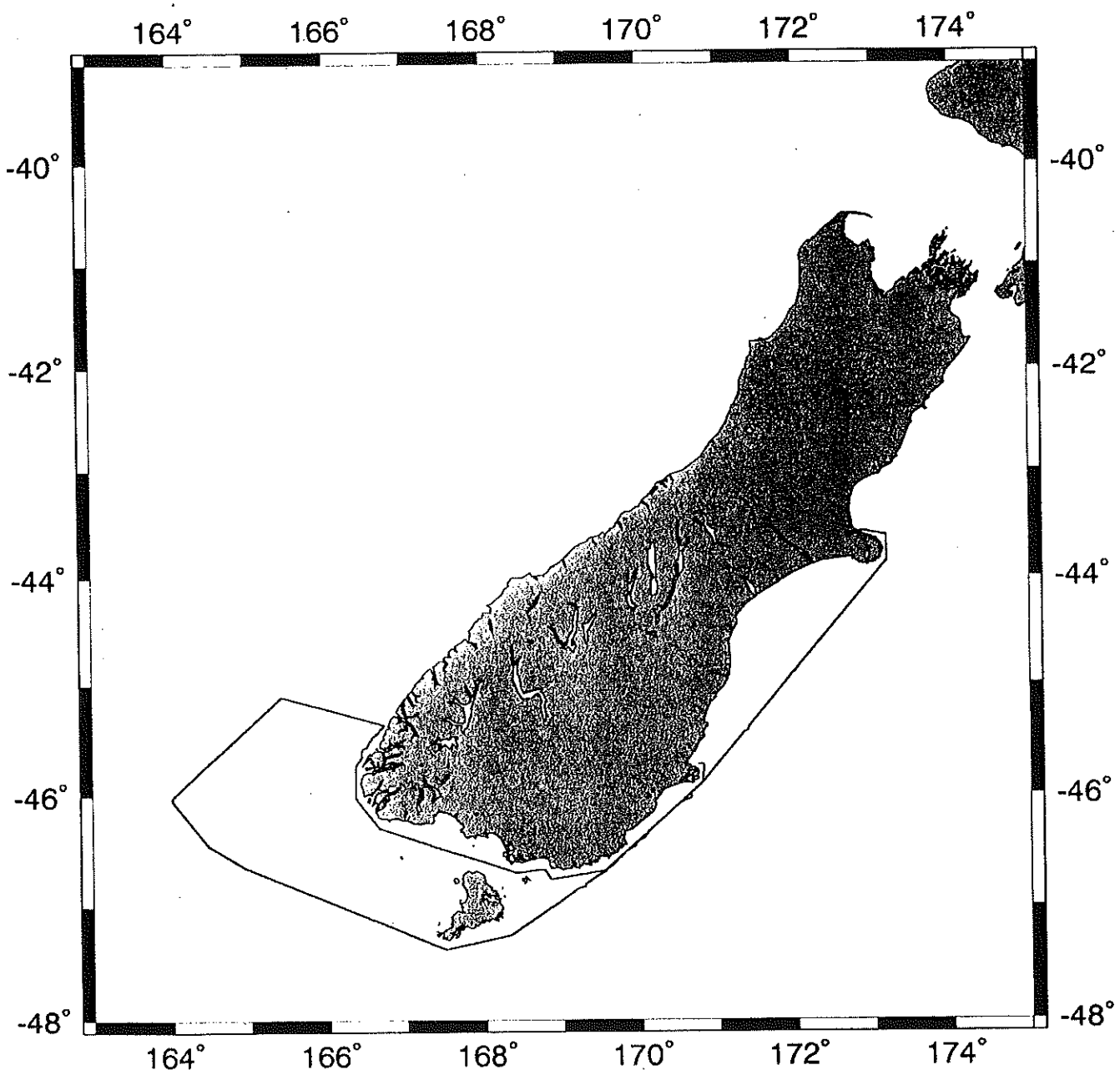
R/V Ewing Ship Tracks



GMT Mar 13 20:24 Crustal Structure of the Puysegur-Fiordland Oblique Convergent Margin Cruise (EW9601a)

Science Personnel

Project	
Davey, Frederick J.	Ch./Scient.
Armstrong, Mark J.	Scientist (student)
Henrys, Stuart	Scientist
Henstock, Crispin O.	Scientist (student)
Houghton, Daniel	Scientist (student)
Lamarche, Geoffroy N.	Scientist
Wilson, David	Scientist (student)

Ship	
Carter, William D.	Sperry rep
Cheslik, Matthew J.	Sci/Gunner
DiBernardo, John G.	Sci/Ch.Gunner
Donaldson, Charles W.	Technician
Maiwiriwiri, Ropate	Sci/Gunner
Olsgaard, Paul O.	Technician
Robinson, William J.	Sys. Adm.
Stennett, Joseph N.	Sci. Officer

R/V Ewing Crew

O'Loughlin, James E	Master
Mello, Louis J	Chief Mate
Smith, William G.	2nd Mate
Thomas, Richard N.	3rd Mate
Santini, John J.	Boatswain
Graham, David G.	A/B
Shank, John B.	A/B
Hanna, Darrell A.	A/B
Dehmlow, Mark A.	O/S
Wyatt, Rickey, R	O/S
Pica, Stephen M.	Chief Engr.
Tucke, Matthew S.	First Engr.
Reid, Richard D.	2nd Engr.
Nichols, John K.	3rd Engr.
Uribe, Guillermo F.	Oiler
Flores, Miguel A.	Oiler
Spruill, Michael L.	Oiler
Matos, Francisco N.	Electrician
Blythe, Andrew B.	Steward
Smith, John S.	Cook
Moqo, Luke	Utility
Powell, Robert V.	Radio OP.

Science objectives

The project aims at understanding the onset and evolution of subduction at a highly oblique convergent margin, the Fiordland - Puysegur convergent margin, which lies along the Australian - Pacific plate boundary. Research in the Puysegur study to date has involved the recent acquisition of a suite of geophysical and geological data including swath bathymetry. However, no crustal seismic reflection data are available in the region. In the Fiordland region, at the north end of the study area, seismological data demonstrates the existence of a steeply dipping subducted plate, dipping at about 80 degrees to the east, from about 40 km to 130 km depth. Incipient thrust faulting has been delineated along the very steep, narrow, continental slope of Fiordland. South of the South Island seismicity is more diffuse and, although plate reconstructions indicate that the Australian plate is being subducted under this region, there is no definition of a subducted plate from seismicity data. Recent work has also defined a complex series of inferred crustal transcurrent faults following the crest of the Puysegur Ridge and western margin of the Puysegur Bank, which are inferred to follow the coast of Fiordland to link up with the transcurrent Alpine Fault in the north. An early stage of subduction has been inferred for this region. Subduction appears to be propagating both to the north and to the south from a more mature stage associated with the Puysegur trench. The Pacific plate to the west of the margin is formed by oceanic crust of two ages, the Tasman Sea crust of late Cretaceous age in the north and the Southern Ocean crust of mid-Tertiary age in the south. The suture between these two, the Resolution ridge, impacts the plate boundary between the Fiordland and Puysegur sectors.

The proposed experiment is to acquire three crustal MCS profiles, across i) the Pacific-Australian plate boundary at the Puysegur ridge-trench system, from Resolution Ridge to Stewart Island, ii) across the Fiordland margin, and iii) across the Resolution ridge (Tasman Sea suture). In addition, wide angle seismic data across the Fiordland margin would be acquired by recording the MCS airgun shots at two broadband seismic recorders on land to the east. These measurements will image the crust and possibly the upper part of the subducted plate, and provide crustal structure and seismic velocity information to determine:

the geometry of the subducting plate and how subduction is occurring,
the style and evolution of deformation at the margin,
the change in style of deformation (Puysegur to Fiordland) with age of crust being subducted,
the effect of the presumed continental Resolution Ridge on the evolution of subduction and deformation of the margin,
the relationship of the Solander Trough to the subduction at the Puysegur Trench

Operational Objectives

The cruise formed part of a larger study of the convergent tectonics of the plate boundary through New Zealand. The work comprised crustal seismic measurements - MCS and sonobuoy data - along two profiles across the young, developing subduction tectonics of the Puysegur Trench and the Fiordland margin, and along one profile across the suture between the Tasman sea oceanic crust in the north and the Southern Ocean oceanic crust in the south. The southern profile comprised a 320 km crustal MCS profile, with sonobuoy wide angle data along the profile, across the convergent margin.The northern profile comprised a 120 km marine MCS profile with wide angle sonobuoy. In addition the airgun shots of the northern profile were to be recorded by two broadband seismicity recorders at about 50 and 135 km inland from the coast to give crustal/upper-mantle wide angle data across the plate boundary zone in this region. The data were to be recorded by a 160 channel, 4 km MCS streamer, a series of sonobuoys and by a minmum of two broadband land stations. Shots were fired using a 130 litre airgun array.

The primary operational goals were:

to obtain sonobuoy and crustal MCS data along three profiles (Puysegur, Fiordland and Tasman Sea) across the plate boundary,

to record swath multibeam data along these profiles,

to record gravity and magnetic data along the crustal profiles,

to maintain good communications with the SAPSE project recording the onland broadband data,

to produce SEGY archive files and preliminary plots for sonobuoy data,

to copy all MCS prestack data to DAT tapes,

to produce a final plot and data archive file for the swath data.

Narrative

Friday 8 March (all times are local: GMT + 13 hrs)

The WHOI/USGS party from the previous South Island Project survey departed from the ship at 1100, after a efficient rapid dismantling and packing of their equipment and instruments (28 hrs). New science party joining the ship included Mark Armstrong (grad student, University of Canterbury, Dan Houghton (grad student, University of Otago), Stuart Henrys (IGNS) and Geoffroy Lamarche (ORSTOM)
2 new CANTO and one DSS sections were received onboard at Port Chalmers
The EWING sailed at 1205 in good weather. Transit watches commenced on leaving the Heads at 1230, running 3.5kHz, hydrosweep, gravity and a dodgy magnetometer. Two out of four EPC recorders were down with failed power supply units.
Liaison with local fishing industry about completion of the South Island Project survey and about the forthcoming survey.
Finished the 3480 to DAT tape copying for the South Island Project at 1440 (598 tapes)

Saturday 9 March

0000 Streamer party, 0030 tail buoy over, extra oil in end 3 sections as these sections sank below the required streamer depth during the previous survey. An extra bird was put on between previous birds 2 and 3 to help control the tail, added extra oil through to bird 7.
0330 put in new DSS section and can. System would not power up, identified as an internal problem as it was still there when cable isolated, so continued running out the streamer while Joe chased the problem which was apparently caused by a loose ribbon edge connector in electronics.
0430 connected in the new CANTO sections. Can 5 would not transmit, could only build streamer to #35, decided to let out and put in the last new section, then pull in to can 5 and check. When last new section in, cable would only build to the previous new section so pulled in cable and removed the adjacent section, testing again, still the same problem so replaced the one just taken out and removed the next. Streamer then built to can 7. Joe thought the new can we installed with the new DSS section could be the problem so recovered to that section and replaced the can. Now building to end and sometimes to can 7. Bit shaky but after much discussion decided to go with the present set-up and hope it holds in.
0815 streamer deployed, guns going out

0914 first shot, slow start for environmental reasons
Split the watchkeepers into two groups and set up jobs for MCS archiving and processing and for Hydrosweep processing.
A problem was encountered reading 3480 tapes when doing the reformating and storing as SEGY on DAT , an error was encountered at end of all 3480s. Caused by changing the recording parameters for the single channel recording during the previous survey. This caused the 3480 to truncate the last shot record, as no space on tape, resulting in the last shot file being lost. Parameters reset and started new line 1Pa with correct format. The former 3480 tapes with errors were reformated and concatenated to DAT using the segycopy utility.
Email to shore party about position and status of land broadband instruments.
Discussion with Captain on scheduled time for end of cruise, will consult LDEO for resolution.
1830 first sonobuoy (17) deployed, initial part not recorded as problems with setting up the system, rest looks good.
Weather deteriorating.
1 EPC recorder fixed by using external power supply unit
Sonobuoy 17 (continuing previous survey numbering) OK, Sonobuoy 18 launched at 2115, sounded good on radio but not good on monitor, swapping it onto the radio for sonobuoy 17 still gave poor results, must be a substandard buoy. Wind 30 kts

Sunday 10 March

Wind force 7 (30 kts) swell 8 - 10 ft.
Shot sonobuoys (19,20,21) at 0006, 0304 and 0639, now recording on EPC recorder as well as PC monitor. Data looks OK.
Science watchkeepers hit by seasickness.
Rawson response to Captain regarding scheduled arrival time - several issues here but in view of rapid turn around at Port Chalmers agreed to arrival at 1000 14th.
Sonobuoys (22,23,24,25a,25) deployed at 926, 1320 (poor), 1327, 1741 (v noisy) and 1813 (OK). weather still rough. The streamer is rising very close to surface in places - often as a wave which propagates along the streamer. Some channels are noisy and will need editing
The 1" bolt holding the inboard end of pipe brace for the stbd gunboom sheared off (boom had been dipping under the water as we rolled), pipe brace removed and a second wire strop installed. Altered course slightly to try and reduce the rolling.
2300 a/c to end of line.
Joe and Chuck working on magnetometer which hasn't worked properly since the start of cruise.

Monday 11 March

Magnetometer cable replaced as partial short (1k) found in the cable.
Hydrosweep froze up at 0020, fixed (hit buttons standby to sound).
Sonobuoy 26 deployed at 0046, data poor
0522 end of line 1Pa - gradual turn onto line 2P- aim to process through
0617 sonobuoy 27 deployed, magnetometer now working for first time for the cruise
The change in course resulted in a following sea - swells passing the ship, lift the stern and tug the streamer and tension goes high, peaking at over 4000 lbs occasionally (once in 5 mins) slowed to 81 revs, closest bird very close to surface - note no lead in stretch or passive sections. Wind 15 - 20 kts. At 0940 tension still occasionally 4100 lbs+, lowered speed to 78 revs (4100 once, 3600+ three times in 15 minutes). At 1100 after discussion with Joe, increased engine revs by 2 revs. Repeated at 1330. At 1445 slowed, pulled in front of the streamer and installed 1 stretch section to reduce tension (Note increase in

streamer offset by 50 m). Some problems in trying to build cable past can 7, eventually did it and in business again. revs up to 85. At 1915 tension > 4000lbs so reduced to 83
Email to shore party confirming shooting times and broadband stations to be used.
Gravity system started giving bad date at about 0414 caused by gyro system malfunction, noted when checking data for plotting. Problem fixed at abt 1400
2330 end of line 2P, start line 3P.

Tuesday 12 March

0010 Streamer aligned on line 3P, deployed sonobuoy 28, after two buoys failed.
0045 put in 3 sec delay on near trace and stack monitors.
Sonobuoys (29,30a,30,31) at 0234, 0503 (noisy), 0558, dud, 0824 (noisy) .
Line 3P will be run as close into the coast as the Captain approves.
1015, water depth getting shallow (< 2000m), delay on monitor removed (parameter file editing problems due to lack of space on disk).
1030 sonobuoy 32 deployed,noisy .
Wind strengthening but seas short.
1140 end of line 3P and MCS operations completed.
1220 guns aboard, streamer being pulled in, stretch section removed first as it can be damaged if wound onto reel, checked that cable can still build, problem with talking to it initially, then would only build to can 7, then built to end. Continued to bring in and check that the cable remains "built"
1440 streamer inboard (3 hrs for streamer and guns)
Underway for Lyttleton - course set to pick up planned transit Hydrosweep track along Fiordland margin but large amount missed as ship travelled south and west during recovery of streamer. Running underway geophysics - magnetics, gravity, 3.5 kHz, Hydrosweep.
1830 weather good
Copying tapes to DAT, sorting and plotting sonobuoys, editing Hydrosweep data, collating and documenting data.

Wednesday 13 March

Continue recording transit geophysics and working on data

Thursday 14 March

Continue recording transit geophysics and working on data
0700 embark pilot
0800 alongside #3 East Pier, Lyttleton

Cruise Summary

During Ewing cruise 96-01a we collected 610km of MCS data and deployed 16 sucessful sonobuoys over the Pacific-Australian plate boundary off southwest New Zealand. 75 hours were spent on MCS recording, with 12 hours on the deployment and recovery of the streamer and airguns. About 60 hours were spent on underway geophysics during transit lines. Gravity and Hydrosweep data were recorded along all these lines with the exception of a gap of 10 hours in the gravity data from 1514 day 70, and a gap of about 1 hour in the Hydrosweep data from 1020 day 70. No magnetic data were recorded until 1717 on day 70, when the fault in the magnetometer was isolated and the tow cable replaced. The magnetometer then worked successfully until the end of the cruise. Power supply failures

in two of the EPC recorders meant that no 3.5 kHz data were recorded until the MCS acquisition was completed. One of the failed EPC recorders was made functional by using an external power supply. It was then used on monitoring the sonobuoy data.

The success of the cruise was helped by the expedience of the Marine Department at Lamont Doherty Earth Observatory in getting MCS streamer sections repaired and shipping them to New Zealand. This ensured we managed to deploy a full 4 km streamer. The streamer appears to be a fragile link in the MCS chain. Installation of new or replacement sections often seem to generate apparent faults elsewhere and there was always a moment of doubt when the streamer was powered up as to whether the cable would build to its full length or a fault would be detected somewhere. Fortunately, when the cable was built and recording started, the cable remained operational throughout. One bird (nearest the ship) was lost during the cruise after a period of large following seas, probably as a result of large vertical motion, generated by the stern of the ship rising and falling and the short lead-in section (50m). For a significant part of line 1P, part of the streamer was at or near the sea surface, as a result of the sea conditions and ship motion, and resulted in noisy data. Careful processing will be needed to mute out these noisy traces. Monitor records indicate that good upper crustal data has been obtained and, in places, lower crustal - Moho data, but more detailed processing and analysis is needed. The subduction decollement surface and overlying thrust structures have been imaged clearly on both plate boundary profiles.

The sonobuoy measurements were only moderately sucessful. 6 out of 22 buoys deployed failed or were excessively noisy. The other buoys gave arrivals out to ranges of about 20 km. Monitoring the quality of the data was only adequate on the EPC recorders. The detail on the PC monitor was insufficient. The response of this PC system to changes in parameters was slow and a display of the present setting of the parameters would be useful.

Apart from one 2 hour "freeze-up" the Hydrosweep system worked well. It would be useful for relative newcomers to swath processing, to have on board some distillation of the collective wisdom on the art of swath editing and processing, including examples.

Weather conditions were variable during the cruise (Appendix F). Light winds (14 kts, 030°) at the start of the cruise, increased steadily to a maximum of 37 kts (200°) at 2330 day 69, corresponding to the central part of line 1P. The winds then decreased steadily through day 70 to 15 kts (190°) and remained steady until 1130 day 71 when they increased to 23 kts at 1630 day 71, correspondng to the start of line 3P. The wind then decrease to about 10 kts (245°) by 0300 day 72, the end of MCS recording. The strong winds and rough seas made the conditions marginal for good MCS and sonobuoy data, particularly along the middle part of line 1P and the start of line 3P. The option of reshooting line 1P would not have given significantly better weather conditions for the reshoot.

We were particularly appreciative of the support of the onboard science support group, Joe, Bill, Chuck, John and the gun crew. This was new to us as usually we have had to do this work ourselves. It may be possible to lighten the load on the shipboard group if some tasks could be done by the project science group - eg sonobuoy launching. The science support group were very hardworking and accessible and deserve the credit for the success of the cruise. Joe Stennett is a particularly key person, and LDEO should be aware of the essential knowledge of the science operations which resides with Joe. At times he had to put in particularly long hours, which he did very willingly.

We found the ship to be a confortable ship to work from and well equipped. Considerable thought has obviously gone into the organising of operations on the ship, both for data acquisition and analysis. The weaker aspect has been the condition of the streamer and this may result from the hard life it has had over the past six months or so.

Acknowledgements

We would like to acknowledge the expertise, support and willing help of the Captain and crew of R/V Ewing, who made the cruise a success. The efficient and rapid pack up and disembarkation of the WHOI/USGS OBH/OBS groups of the previous cruise allowed the maximum time at sea for survey work, and is greatly appreciated. The support of LDEO for the project, in particular the Marine Department in expediting the repair and shipping of streamer sections to New Zealand so we could put a 4000m (just) streamer in the water, is gratefully acknowledged. The research was funded by the NZ Foundation of Research, Science and Technology

Appendices

Appendix A
List of Data

Data list

2 Dos floppies - 1 copy each of MCS lines 1P, 3P and 2P. Four files each line:
*.RUL)recording log), *.RUE (Recording error log), *.TAL (gun log), and *.TAE (gun error log)

237 MCS 3480 SEGD data and 3 NAV cartridges:

LINE	TAPE#s	TAPE COUNT	NAV TAPE#	COUNT
1P	603-628			
	634-746	139	16	1
2P	748-805	58	17	1
3P	806-845	40	18	1

27 DAT SEGY tapes of reformatted 3480 cartridges

LINE	TAPE#s	3480 #s
1P	1-26 (file2)	
2P	26(file 3)-27	748-757
3P	to be done	

Sonobuoy Data
1 DAT tape,
tar file 1) sono1-10.segy; 2) sonoa*.segy, sonob*.segy (* = 9-19)

Miscellaneous Cruise Data

2 MacIntosh floppy copies of Main LAb Mac EW9601a folder, MSC log, Waypoints, etc.

1 DAT tape of tape formatting scripts and sonobuoy data processing
tar file 3) ~ewing20/mcs; 4) ~ewing24

Mainlab Log (2 copies)

Seismic Recording Log (original + copy)

1 Roll MCS Near trace Monitor Records

1 Roll MCS SCSI Splitter Stacked Records

1 Roll of Sonobuoy Records

Underway Geophysics Tapes (Mag, Bathy-Hydrosweep,CB, NAv, Grav)
2x8 mm tapes
1 Roll of swath data

Appendix B
MCS Operations and Log

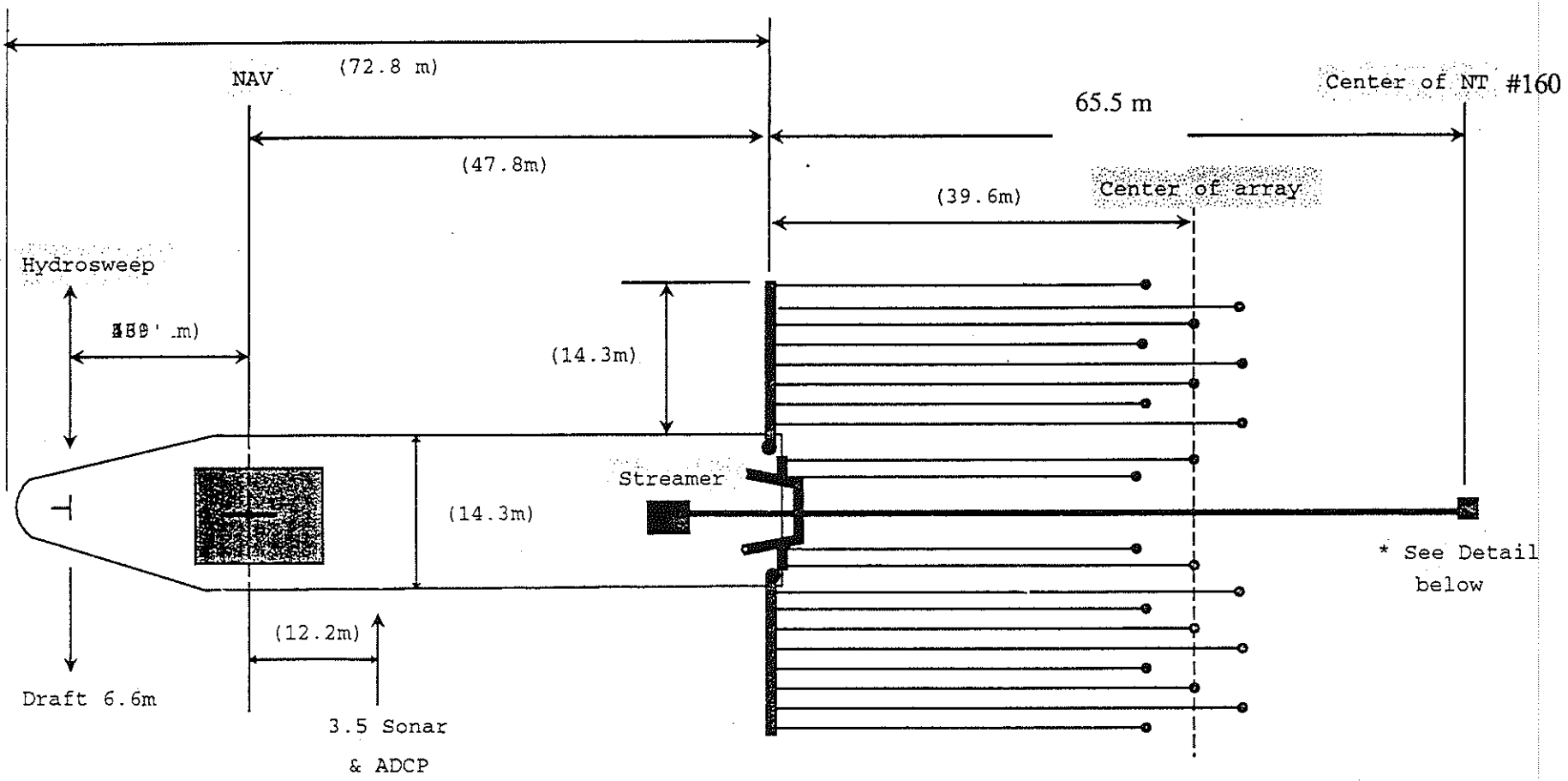
Airgun array and streamer configurations

The full 20 gun array (130 litre) was used as sound source for all the seismic measurments. Details of the towing pattern, gun size and offset are given in the attached table. Nominal towing depth was 8 m. Air pressure was 2000 psi. Shot interval was 20 ± 1seconds, randomised.

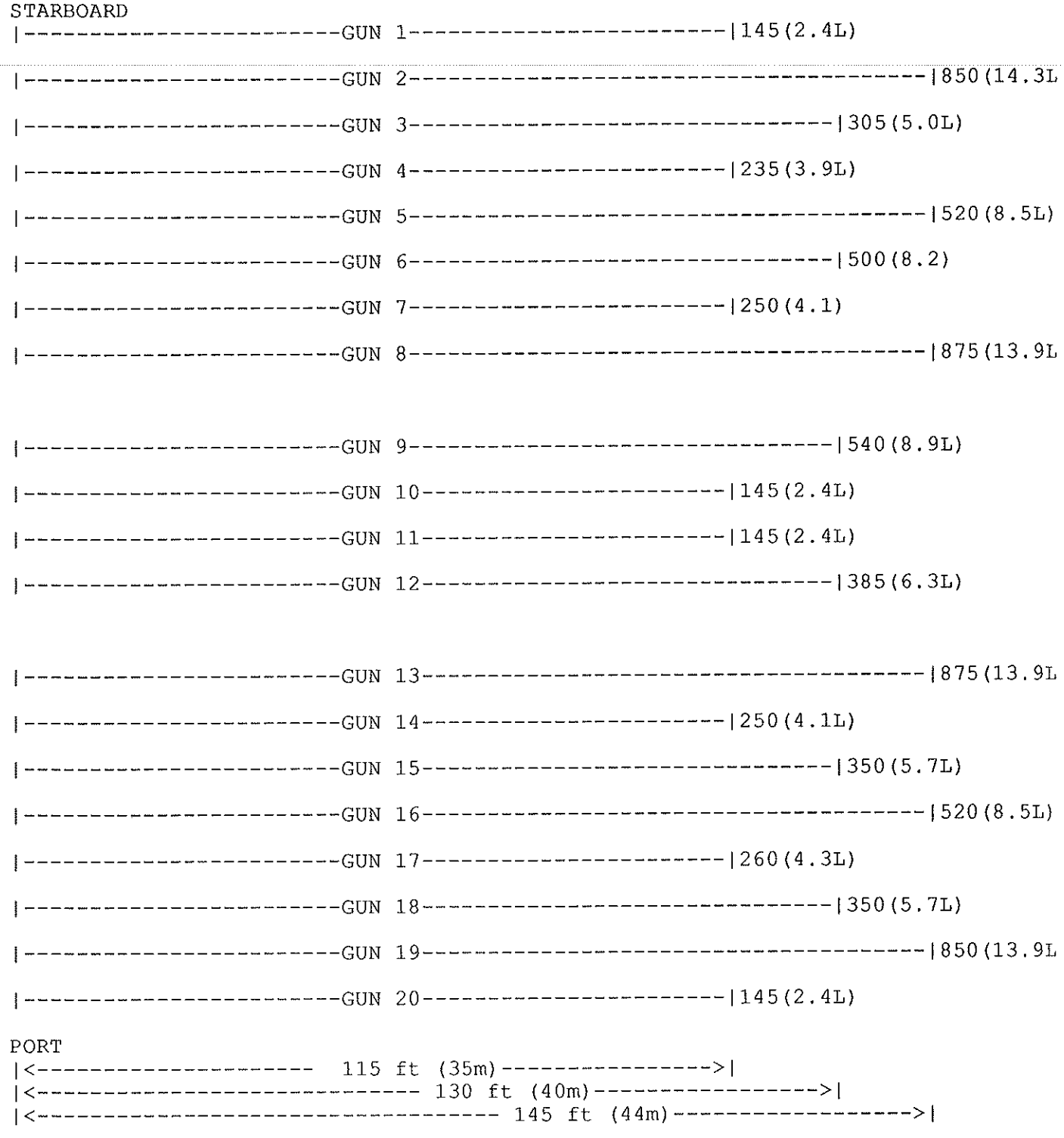
Two MCS streamer configurations were used during the cruise, both using all available streamer sections to give a 160 channel, 4000 m active section. For most of the survey, the leading sections were close to the surface (closest bird at about 2 m). Midway through the survey, on transit line P2, a 50m stretch section was added to the leading end of the streamer to reduce the large fluctuations in streamer tension causedby a following sea. Details of the streamers and the positions of the depth control birds are given in the attached tables.

Nominal fold was 80.

MAURICE EWING SETBACK AND OFFSET DIAGRAM



Typical 20-gun array as used for EW9601. Total array is 8495 cu in.(139 liters

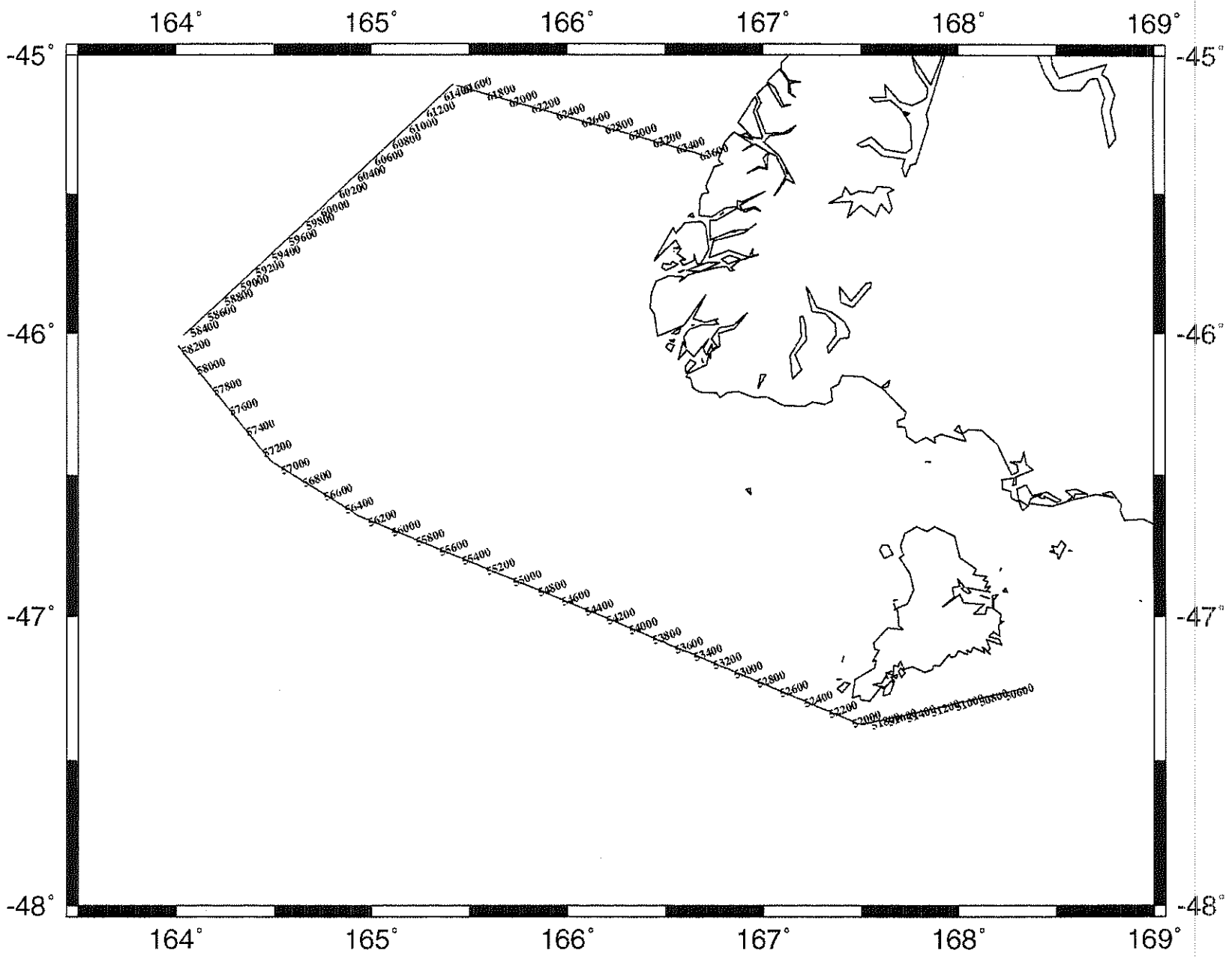


Guns 1-8 are towed from the starboard boom
Guns 9-12 are towed from the stern A-frame
Guns 13-20 are towed from the port boom
The towing lines are separated by 5 ft.
The numbers to the right of the tow-line representation are gun volumes in cubic inches.

EW9601c----Streamer as used for Davey's add-on to 9601.
The stretch section was added in the middle of line 2P

Section Number	Section Type	Sect. s/n	Can s/n	Remarks
--	50-m Tailrope	????		
01	100m DSS240 Active	1531	798	Bird 1
02	100m DSS240 Active	1486	1029	
03	" " "	1593	3237	Bird 2
04	" " "	1348	3255	
05	" " "	1523	1457	Bird 18
06	" " "	1341	1141	
07	" " "	1246	3278	Bird 3
08	" " "	1176	1254	
09	" " "	1244	803	Bird 4
10	" " "	1460	3114	
11	" " "	9466	3109	
12	" " "	9450	1248	Bird 5
13	" " "	9409	1449	
14	" " "	9456	3061	
15	" " "	9442	1239	Bird 6
16	" " "	9453	3046	
17	" " "	9140	1046	
18	" " "	9316	3047	Bird 7
19	" " "	9451	3079	
20	" " "	9376	1345	
21	" " "	9529	61	Bird 08
22	" " "	9407	L441	
23	" " "	9564	3302	
24	" " "	9335	3150	Bird 09
25	" " "	9109	3139	
	Power Adapter(3 m)	PWR1		
26	100m CANTO Active	2021	8233	Bird 10
27	" " "	2046	8250	
28	" " "	2053	8223	Bird 11
29	" " "	2029	8232	
30	" " "	2055	8217	
31	" " "	2012	8240	Bird 12
32	" " "	2028	8220	
33	" " "	2022	8212	Bird 13
34	" " "	2041	8216	
35	" " "	2009	8404	Bird 14
36	" " "	2008	8202	
37	" " "	2005	8209	Bird 15
38	" " "	2019	8204	
39	" " "	2026	8450	Bird 16
40	" " "	2027	8411	
41	50-m Canto Elastic Tow leader(50m past stern)	6001	????	
42	Impedance Converter	8318		
43	OBAD	8370		

Puysegur MSC Shotpoints



GMT Mar 12 12:16

Line #	J.D.	Date	start/	Time	Latitude	Longitude	Tape	Shot	File	Airguns	S.I.	Type	No.	S.I.	Rec Len			
			end	(Z)	(Start/End)	(Start/End)	#	#	#	(cu. in.)	(s)		Traces	msec	(s)	Notes		
1P	68	9-Mar-96	start	20.59	46°14.76	168°20.49	603	50425	100	8420	20	MCS	160	2	16			
			end	21.18	47:15.41	168°17.27	603	50485	160									
			start	21.18	47°15.41	168°17.27	604	50486	161									
			end	20:30	47°15.66	168°15.51	604	50544	219									
			start	20:30	47:15.66	168°15.51	605	50545	220									
			end	21:58	47°15.94	168°13.60	605	50605	280									
			start	21:58	47°15.94	168°13.60	606	50606	281									
			end	22:19	47°16.30	168°11.14	606	50665	340									
			start	22:19	47°16.30	168°11.14	607	50666	341							Console indicates shot 50667 twice, and no shot 50666		
			end	22:41	47°16.73	168°08.51	607	50726	401									
			start	22:41	47°16.73	168°08.51	608	50727	402									
			end	22:59	47°17.0476	168°06.5047	608	50787	462									
			start	22:59			609	50846	463									
			end	23:18	47°17.3863	168°04.2023	609	50846	522									
			start	23:19			610	50848	522									
			end	23:39	47°17.7399	168°01.8820	610	50907	582									
			start	23:39			611	50908	583									
			end	23:59	47°18.0910	167°59.7023	611	50968	643									
1P	68	9-Mar-96	start	23:59			612	50969	644									
1P	69	10-Mar-96	end	0:19	47°18.4042	167°57.5603	612	51029	704									
			start	0:19			613	51030	705									
			end	0:39	47°18.7266	167°55.3228	613	51089	764									
			start	0:39			614	51090	765									
			end	0:59	47°19.0160	167°53.1443	614	51149	824									
			start	0:59			615	51150	825									
			end	1:19	47°19.3542	167°50.8707	615	51209	884									
			start	1:20			616	51210	885									
			end	1:40	47°19.7516	167°48.5588	616	51269	944									
			start	1:40			617	51270	945									
			end	1:55	47°19.9697	167°46.9460	617	51313	988									
			start	1:57			617a	51322	989									
			end	2:01	47°20.0614	167°46.2233	617a	51333	1000									
			start	2:01			618	51334	1001									
			end	2:20	47°20.3753	167°44.2091	618	51389	1056									
			start	2:20			619	51390	1057									
			end	2:38	47°20.6082	167°42.2769	619	51445	1112									
			start	2:38			620	51446	1113									
			end	2:57	47°20.9122	167°40.6416	620	51501	1168									
			start	2:57			621	51502	1169									
			end	3:15	47°21.1060	167°39.1739	621	51557	1224									
			start	3:15			622	51558	1225									
			end	3:34	47°21.3557	167°37.7853	622	51613	1280									
			start	3:34			623	51614	1281									
			end	3:53	47°21.6022	167°36.3626	623	51669	1336									
			start	3:53			624	51670	1337									
			end	4:12	47°21.8039	167°34.8355	624	51725	1392									
			start	4:12			625	51726	1393									
			end	4:30			625	51781	1448									
			start	4:30			626	51782	1489									
			end	4:49	47°22.2257	167°31.8827	626	51837	1504									
			start	4:49			627	51838	1505									
			end	5:07	47°22.4666	167°30.3054	627	51893	1560									
			start	5:07			628	51894	1561									
			end	5:26	47°22.1032	167°28.5749	628	51949	1616									
			start	5:27			634	51956	1626									
			end	5:46	47°21.5433	167°6794	634	52010	1677									
			start	5:46			635	52011	1678									

			end	6:05	47°21.0135	167°24.7904	635	52066	1733											
			start	6:05			636	52067	1734											
			end	6:24	47°20.4514	167°22.7734	636	52122	1789											
			start	6:24			637	52123	1790											
			end	6:42	47°19.8361	167°20.6627	637	52178	1845											
			start	6:42			638	52179	1846											
			end	7:01	47°19.2728	167°18.5373	638	52234	1901											
			start	7:01			639	52235	1902											
			end	7:20	47°18.6249	167°16.3501	639	52290	1957											
			start	7:20			640	52291	1958											
			end	7:39	47°18.0923	167°14.2934	640	52346	2013											
			start	7:39			641	52347	2014											
			end	7:57	47°17.4212	167°12.2163	641	52402	2069											
			start	7:57			642	52403	2070											
			end	8:16	47°16.8956	167°10.0072	642	52458	2125											
			start	8:16			643	52459	2126											
			end	8:34	47°16.1917	167°07.7133	643	52514	2181											
			start	8:34			644	52515	2182											
			end	8:53	47°15.6625	167°05.7397	644	52570	2237											
			start	8:53			645	52571	2238											
			end	9:12	47°15.0991	167°03.8936	645	52626	2293											
			start	9:12			646	52627	2294											
			end	9:30	47°14.5106	167°01.7525	646	52682	2349											
			start	9:30			647	52683	2350											
			end	9:49	47°13.9354	166°59.7992	647	52738	2405											
			start	9:49			648	52739	2406											
			end	10:08	47°13.4540	166°57.8938	648	52794	2461											
			start	10:08			649	52795	2462											
			end	10:26	47°12.8449	166°56.0557	649	52850	2517											
			start	10:26			650	52851	2518											
			end	10:45	47°12.3595	166°54.1017	650	52906	2573											
			start	10:45			651	52907	2574											
			end	11:04			651	52962	2629											
			start	11:04	47°11.7452	166°52.0822	652	52963	2630											
			end	11:23			652	53018	2685											
			start	11:24	47°11.2139	166°50.1582	653	53019	2686											
			end	11:41			653	53074	2741											
			start	11:42	47°10.7075	166°48.2760	654	53075	2742											
			end	12:00			654	53130	2797											
			start	12:00	47°10.1760	166°46.4721	655	53131	2798											
			end	12:19			655	53186	2853											
			start	12:19	47°09.6763	166°44.6691	656	53187	2854											
			end	12:37			656	53242	2909											
			start	12:37	47°09.1366	166°42.8791	657	53243	2910											
			end	12:56			657	53298	2965											
			start	12:57	47°08.6559	166°41.2408	658	53299	2966											
			end	13:15			658	53354	3021											
			start	13:15	47°08.1067	166°39.6666	659	53355	3022											
			end	13:34			659	53410	3077											
			start	13:34	47°07.6824	166°38.1033	660	53411	3078											
			end	13:52			660	53466	3133											
			start	13:53	46°07.3414	166°36.3876	661	53467	3134											
			end	14:11			661	53522	3189											
			start	14:11	46°06.8779	166°34.7807	662	53523	3190											
			end	14:30			662	53578	3245											
			start	14:30	46°06.4616	166°33.1342	663	53579	3246											
			end	14:48			663	53634	3301											
			start	14:49	47°05.9645	166°31.3362	664	53635	3302											
			end	15:07			664	53691	3357											

			start	15:08	47°05.3060	166°29.4826	665	53692	3358										
			end	15:26			665	53747	3413										
			start	15:26	47°04.8186	166°27.4737	666	53748	3414										
			end	15:43			666	53803	3469										
			start	15:45	47°04.2601	166°25.5055	667	53804	3470										
			end	16:03			667	53859	3525										
			start	16:04	47°03.6635	166°23.5009	668	53860	3526										
			end	16:22			668	53915	3581										
			start	16:22	47°03.1535	166°21.5930	669	53916	3582										
			end	16:41			669	53971	3637										
			start	16:41	47°02.5121	166°19.5338	670	53972	3638										
			end	17:00			670	54027	3693										
			start	17:00	47°01.9890	166°17.6008	671	54028	3694										
			end	17:18			671	54083	3749										
			start	17:19	47°01.4635	166°5.6764	672	54084	3750										
			end	17:37			672	54139	3805										
			start	17:37	47°00.8824	166°15.6308	673	54140	3896										
			end	17:58			673	54195	3861										
			start	17:59	47°00.3413	166°11.7407	674	54196	3862										
			end	18:14			674	54251	3917										
			start	18:15	46°58.7935	166°09.7974	675	54252	3918										
			end	18:33			675	54307	3973										
			start	18:34	46°59.2307	166°07.9612	676	54309	3975										
			end	18:52			676	54363	4029										
			start	18:52	46°58.6924	166°06.1983	677	54364	4030										
			end	19:13			677	54419	4085										
			start	19:13	46°58.09	166°03.93	678	54420	4086										
			end	19:30			678	54475	4141										
			start	19:30	46°57.678	166°02.16	679	54476	4142										
			end	19:52			679	54531	4197										
			start	19:52	46°56.958	166°59.793	680	54532	4198										
			end	20:08			680	54588	4253										
			start	20:08	46°56.425	165°58.038	681	54588	4254										
			end	20:26			681	54644	4309										
			start	20:26	46°55.873	165°56.064	682	54645	4310										
			end	20:39			682	54686	4351										
			start	20:39	46°55.366	165°54.207	683	54687	4352										
			end	20:58			683	54742	4407										
	69		start	20:58	46°54.763	165°52.284	684	54743	4408										
			end	21:17			684	54798	4463										
			start	21.17	46°54.275	165°50.378	685	54799	4464										
			end	21:35			685	54854	4519										
			start	21:35	46°53.687	165°48.327	686	54855	4520										
			end	21:54			686	54910	4575										
			start	21:54	46°53.037	165°46.205	687	54911	4576										
			end	22:13			687	54966	4631										
			start	22:13	46°52.484	165°44.072	688	54967	4632										
			end	22:32			688	55022	4687										
			start	22:32	46°51.836	165°47.874	689	55023	4688										
			end	22:50			689	55078	4743							shot 55060/475 seem to be missing (not listed)				
			start	22:50	46°51.258	165°39.746	690	55079	4744										
			end	23:09			690	55134	4799										
			start	23:09	46°50.5741	165°37.5251	691	55135	4800										
			end	23:27			691	55190	4855										
			start	23:27	46°49.9106	165°35.1734	692	55191	4856										
			end	23:46			692	55246	4911										
1P	69	10-Mar-96	start	23:46	46°49.2632	165°32.9192	693	55247	4912										
1P	70	11-Mar-96	end	0:05			693	55302	4967										
			start	0:05	46°48.6977	165°30.8321	694	55303	4968										

			end	0:23			694	55358	5023											
			start	0:24	46°48.1106	165°28.7234	695	55359	5024											
			end	0:42			695	55414	5079											
			start	0:42	46°47.4979	165°26.8118	696	55415	5080											
			end	1:01			696	55470	5135											
			start	1:01	46°47.0330	165°24.9891	697	55471	5136											
			end	1:19			697	55526	5191											
			start	1:20	46°46.4304	165°22.9531	698	55527	5192											
			end	1:38			698	55582	5247											
			start	1:39	46°45.8480	165°20.8710	699	55585	5249											
			end	1:57			699	55638	5302											
			start	1:57	46°45.3015	165°19.0126	700	55639	5303											
			end	2:15			700	55694	5359											
			start	2:16	46°44.7478	165°17.0231	701	55695	5360											
			end	2:34			701	55750	5415											
			start	2:34	46°44.1449	165°14.9230	702	55751	5416											
			end	2:53			702	55806	5447											
			start	2:53	46°43.5421	165°12.8475	703	55807	5472											
			end	3:12			703	55862	5527											
			start	3:12	46°42.9899	165°10.8350	704	55863	5528											
			end	3:30			704	55918	5583											
			start	3:30	46°42.3844	165°08.7976	705	55919	5584											
			end	3:49			705	55974	5639											
			start	3:49	46°41.7876	165°06.7616	706	55975	5640											
			end	4:07			706	56030	5695											
			start	4:07	46°41.2253	165°04.6921	707	56031	5696											
			end	4:26			707	56086	5751											
			start	4:26	46°40.5981	165°02.7085	708	56087	5752											
			end	4:45			708	56141	5806											
			start	4:45	46°40.0196	165°00.5130	709	56142	5807											
			end	5:03			709	56198	5863											
			start	5:03	46°39.4760	164°58.6215	710	56199	5864											
			end	5:22			710	56254	5919											
			start	5:22	46°39.4760	164°56.6281	711	56255	5920											
			end	5:41			711	56310	5975											
			start	5:41	46°38.8853	164°54.7170	712	56311	5976											
			end	5:59			712	56366	6031											
			start	5:59	46°37.1875	164°52.8159	713	56367	6032											
			end	6:18			713	56422	6087											
			start	6:18	46°36.3866	164°50.7995	714	56423	6088											
			end	6:37			714	56478	6143											
			start	6:37	46°35.5496	164°48.8983	715	56479	6144											
			end	6:56			715	56535	6199											
			start	6:56	46°34.8158	164°47.0703	716	56536	6200											
			end	7:15			716	56591	6255											
			start	7:15	46°34.0760	164°45.3427	717	56592	6256											
			end	7:33			717	56647	6311											
			start	7:33	46°33.2236	164°43.4320	718	56648	6312											
			end	7:52			718	56703	6367											
			start	7:52	46°32.4314	164°41.6389	719	56704	6368											
			end	8:11			719	56759	6422											
			start	8:11	46°31.6483	164°39.8292	720	56760	6423											
			end	8:29			720	56815	6479											
			start	8:30	46°30.8583	164°37.9952	721	56816	6480											
			end	8:48			721	56871	6535											
			start	8:49	46°30.0788	164°36.1202	722	56872	6536											
			end	9:07			722	56927	6591											
			start	9:07	46°29.3137	164°34.3057	723	56928	6592											
			end	9:24			723	56983	6647											

			start	9:24	46°28.4674	164°32.5488	724	56984	6648										
			end	9:44			724	57039	6703										
			start	9:44	46°27.7446	164°30.7982	725	57040	6704										
			end	10:03			725	57095	6759										
			start	10:03	46°26.987	164°28.9989	726	57096	6760										
			end	10:21			726	57151	6815										
			start	10:21	46°25.7227	164°27.5961	727	57152	6816										
			end	10:40			727	57207	6871										
			start	10:40	46°24.5925	164°26.2208	728	57208	6872										
			end	10:58			728	57263	6927										
			start	10:58	46°23.3845	164°24.8194	729	57264	6928										
			end	11:17			729	57319	6983										
			start	11:17	46°22.1751	164°23.3811	730	57320	6984										
			end	11:36			730	57375	7039										
			start	11:36	46°20.9364	164°21.9078	731	57376	7040										
			end	11:54			731	57431	7095										
			start	11:55	46°19.6278	164°20.4026	732	57432	7096										
			end	12:13			732	57487	7151										
			start	12:13	46°18.3707	164°18.9692	733	57488	7152										
			end	12:32			733	57543	7207										
			start	12:32	46°17.1274	164°17.5176	734	57544	7208										
			end	12:50			734	57599	7263										
			start	12:51	46°15.9210	164°16.1094	735	57600	7264										
			end	13:09			735	57655	7319										
			start	13:10	46°15.9210	164°14.7369	736	57656	7320										
			end	13:28			736	57711	7375										
			start	13:28	46°13.5259	164°13.3480	737	57712	7376										
			end	13:47			737	57767	7431										
			start	13:47	46°12.2864	164°11.9281	738	57768	7432										
			end	14:04			738	57823	7487										
			START	14:05	46°11.0932	164°10.5511	739	57824	7488										
			end	14:24			739	57879	7543										
			start	14:24	46°09.8972	164°09.1118	740	57880	7544										
			end	14:43			740	57935	7599										
			start	14:43	46°08.6408	164°07.6812	741	57936	7600										
			end	15:01			741	57991	7655										
			start	15:02	46°07.4475	164°06.3083	742	57992	7656										
			end	15:20			742	58047	7711										
			start	15:20	46°06.3243	164°05.0182	743	58048	7712										
			end	15:39			743	58103	7767										
			start	15:39	46°05.1404	164°03.6382	744	58104	7768										
			end	15:57			744	58159	7823										
			start	15:58	46°04.0138	164°02.3697	745	58160	7824										
			end	16:16			745	58215	7879										
			start	16:16	46°02.8888	164°01.0138	746	58216	7880										
		11-Mar-96	end	16:22			746	58233	7897										
1P	70	END OF LINE	1P													END OF LINE 1P			
2P	70	START OF LIN	2P																
2P		11-Mar-96	start	16:37	46°01.5410	164°00.8713	748	58277	100							START OF LINE 2P			
			end	16:55			748	58332	155										
			start	16:56	46°00.4238	164°02.4312	749	58333	156										
			end	17:14			749	58388	211										
			start	17:14	45°59.4765	164°03.8909	750	58389	212										
			end	17:33			750	58444	267										
			start	17:33	45°58.5325	164°05.3998	751	58445	268										
			end	17:51			751	58500	323										
			start	17:52	45°57.5502	164°06.9180	752	58501	324										
			end	18:10			752	58556	379										

			start	18:10	45°56.5431	164°08.3736	753	58557	380										
			end	18:29			753	58612	435										
			start	18:29	45°55.6348	164°09.8417	754	58613	436										
			end	18:47			754	58668	491										
			start	18:48	45°54.7355	164°11.2693	755	58669	492										
			end	19:06			755	58724	547										
			start	19:06	75°53.711	?	756	58725	548										
			end	19:25			756	58780	603										
			start	19:25	45°52.793	164°14.233	757	58781	604										
			end	19:44			757	58836	659										
			start	19:44	45°51.907	164°15.619	758	58837	660										
			end	20:02			758	58892	715										
			start	20:02	45°51.022	164°16.922	759	58893	716										
			end	20:20			759	58948	771										
			start	20:20	45°50.171	164°18.292	760	58949	772										
			end	20:39			760	59004	827										
			start	20:40	45°49.282	164°19.576	761	59005	828										
			end	20:58			761	59060	883										
			start	20.58	45°48.466	164°20.877	762	59061	884										
			end	21:17			762	59116	939										
			start	21:17	45°47.554	164°22.277	763	59117	940										
			end	21:36			763	59172	995										
			start	21:36	45°46.690	164°23.599	764	59173	996										
			end	21:54			764	59228	1051										
			start	21:55	45°45.831	164°24.927	765	59229	1052										
			end	22:12			765	59284	1107										
			start	22:12	45°44.810	164°26.946	766	59285	1108										
			end	22:32			766	59340	1163										
			start	22:32	45°43.860	164°27.978	767	59341	1164										
			end	22:50			767	59396	1219										
2P	70	11-Mar-96	start	22:50	45°43.037	164°29.194	768	59397	1220										
			end	23:09			768	59452	1275										
			start	23:09	45°42.1961	164°30.4913	769	59453	1276										
			end	23:27			769	59508	1331										
			start	23:28	45°41.2402	164°31.9854	770	59509	1332										
			end	23:46			770	59564	1387										
	70	11-Mar-96	start	23:46	45°40.2737	164°33.4737	771	59565	1388										
2P	71	12-Mar-96	end	0:05			771	59620	1443										
			start	0:05	45°39.3251	164°34.9250	772	59621	1444										
			end	0:23			772	59676	1499										
			start	0:24	45°38.3692	164°36.3855	773	59677	1500										
			end	0:42			773	59732	1555										
			start	0:43	45°37.3628	164°37.8674	774	59733	1556										
			end	1:01			774	59788	1611										
			start	1:01	45°36.4002	164°39.3788	775	59789	1612										
			end	1:19			775	59844	1667										
			start	1:20	45°35.4191	164°40.9152	776	59845	1668										
			end	1:38			776	59900	1723										
			start	1:38	45°34.4211	164°42.4486	777	59901	1724										
			end	1:41	45°34.2652	164°42.6334	777	59909	1732										
			start	2:24	45°32.6425	164°42.1632	778	60038	100										
			end	2:42			778	60091	153										
			start	2:42	45°31.6630	164°46.6708	779	60092	154										
			end	3:00			779	60145	207										
			start	3:00	45°30.6530	164°48.1910	780	60146	208										
			end	3:18			780	60199	261										
			start	3:18	45°29.6256	164°49.7643	781	60200	262										
			end	3:36			781	60251	313										
			start	3:36	45°28.6315	164°51.2841	782	60252	314										

			end	3:54			782	60307	369										
			start	3:54	45°27.6058	164°52.8313	783	60308	370										
			end	4:12			783	60361	423										
			start	4:12	45°26.5895	164°54.2895	784	60362	424										
			end	4:30			784	60415	477										
			start	4:30	45°25.6556	164°55.8032	785	60416	478										
			end	4:48			785	60469	531										
			start	4:48	45°24.7069	164°57.2774	786	60470	532										
			end	5:06			786	60523	585										
			start	5:06	45°23.7324	164°58.7579	787	60524	586										
			end	5:24			787	60577	639										
			start	5:24	45°22.7534	165°00.1899	788	60578	640										
			end	5:42			788	60631	693										
			start	5:42	45°21.8344	165°01.6911	789	60632	694										
			end	6:00			789	60685	747										
			start	6:00	45°20.8742	165°03.1140	790	60686	748										
			end	6:18			790	60739	801										
			start	6:18	45°19.9117	165°04.5915	791	60740	802										
			end				791	60794	855										
			start		45°18.9852	165°05.9591	792	60795	856										
			end	6:54	45°18.0980	165°07.3644	792	60848	909										
			start	6:54			793	60849	910										
			end	7:12			793	60902	963										
			start	7:12	45°17.2042	165°08.7393	794	60903	964										
			end	7:30			794	60956	1017										
			start	7:30	45°16.2834	165°10.0899	795	60957	1018										
			end	7:45			795	61010	1071										
			start	7:48	45°15.3983	165°11.4724	796	61011	1072										
			end	8:06			796	61064	1125										
			start	8:06	45°14.4967	165°12.8658	797	61065	1126										
			end	8:24			797	61118	1179										
			start	8:25	45°13.5341	165°14.2812	798	61119	1180										
			end	8:42			798	61172	1233										
			start	8:42	45°12.5607	165°15.7188	799	61173	1234										
			end	9:01			799	61226	1287										
			start	9:01	45°11.6247	165°17.2269	800	61227	1288										
			end	9:19			800	61280	1341										
			start	9:19	45°10.6817	165°18.6688	801	61281	1342										
			end	9:37			801	61335	1395										
			start	9:37	45°09.7068	165°20.1533	802	61336	1396										
			end	9:55			802	61389	1449										
			start	9:55	45°08.7012	165°21.6383	803	61390	1450										
			end	10:13			803	61443	1503										
			start	10:13	45°07.7122	165°23.1409	804	61444	1504										
			end	10:31			804	61497	1557										
		12-Mar-96	start	10:31	45°06.6853	165°24.6327	805	61498	1558										
2P	71	eol 2P	end	1:37	45°06.4920	165°25.1625	805	61515	1575							END oF LINE 2P			
3P	71	sol 3P	start	10:49			806	61548	100							START OF LINE 3P			
		12-Mar-96	end	11:06			806	61601	153										
			start	11:06	45°06.9550	165°27.8808	807	61602	154										
			end	11:24			807	61655	207										
			start	11:24	45°07.4601	165°29.8226	808	61656	208										
			end	11:42			808	61709	261										
			start	11:42	45°07.8802	165°31.8566	809	61710	262										
			end	12:00			809	61763	315										
			start	12:00	45°08.2305	165°33.7893	810	61764	316										
			end	12:18			810	61817	396										
			start	12:18	45°08.6242	165°35.7072	811	61818	397										
			end	12:36			811	61871	423										

			start	12:36	45°08.9547	165°37.5268	812	61872	424																
			end	12:54			812	61925	477																
			start	12:54	45°09.3458	165°39.3128	813	61926	478																
			end	13:12			813	61979	531																
			start	13:12	45°09.7049	165°41.1221	814	61980	532																
			end	13:30			814	62033	585																
			start	13:30	45°10.0509	165°42.9278	815	62034	586																
			end	13:48			815	62087	639																
			start	13:48	45°104041	165°44.7811	816	62088	640																
			end	14:06			816	62141	693																
			start	14:06	45°10.7954	165°46.6037	817	62142	694																
			end	14:24			817	62195	747																
			start	14:24	45°11.1628	165°48.5662	818	62196	748																
			end	14:42			818	62249	801																
			start`	14:42	45°11.5615	165°50.6509	819	62250	802																
			end	15:00			819	62303	855																
			start	15:00	45°11.9810	165°52.7121	820	62304	856																
			end	15:18			820	62358	909																
			start	15:18	45°12.4002	165°54.8359	821	62358	910																
			end	15:36			821	62411	963																
			start	15:36	45°12.8265	165°56.9573	822	62412	964																
			end	15:54			822	62465	1017																
			start	15:55	45°13.2438	165°59.1315	823	62466	1018																
			end	16:12			823	62519	1071																
			start	16:12	45°13.6594	166°01.1899	824	62520	1072																
			end	16:30			824	62573	1125																
			start	16:30	45°14.0496	166°03.2320	825	62574	1126																
			end	16:48			825	62627	1179																
			start	16:48	45°14.4480	166°05.1972	826	62628	1180																
			end	17:06			826	62681	1233																
			start	17:06	45°14.8154	166°07.1235	827	62682	1234																
			end	17:24			827	62735	1287																
			start	17:24	45°15.2061	166°09.0383	828	62736	1288																
			end	17:42			828	62789	1341																
			start	17:42	45°15.5915	166°10.9646	829	62790	1342																
			end	18:00			829	62843	1395																
			start	18:00	45°15.9534	166°12.9387	830	62844	1396																
			end	18:18			830	62897	1449																
			start	18:18	45°16.3941	166°14.9730	831	62898	1450																
			end	18:36			831	62951	1503																
			start	18:36	45°16.7673	166°16.9187	832	62952	1504																
			end	18:54			832	63005	1557																
			start	18:54	45°17.155	166°19.10	833	63006	1558																
			end	19:12			833	63059	1611																
			start	19:12	45°17.570	166°20.927	834	63060	1612																
			end	19:30			834	63113	1665																
			start	19:30	45°17.944	166°22.975	835	63114	1666																
			end	19:48			835	63167	1719																
			start	19:48	45°18.317	166°24.866	836	63168	1720																
			end	20:06			836	63221	1773																
			start	20:06	45°18.723	166°27.071	837	63222	1774																
			end	20:24			837	63275	1827																
			start	20:24	45°19.105	166°28.844	838	63276	1828																
			end	20:42			838	63329	1881																
			start	20:42	45°19.531	166°31.071	839	63330	1882																
			end	21:00			839	63383	1935																
			start	21:00	45°19.867	166°32.742	840	63384	1936																
			end	21:18			840	63437	1989																
			start	21:18	45°20.271	166°34.788	841	63438	1990																

			end	21:36			841	63491	2043										
			start	21:36	45°20.641	166°36.584	842	63492	2044										
			end	21:54			842	63545	2097										
			start	21:55	45°21.041	166°38.572	843	63546	2098										
			end	22:12			843	63599	2151										
			start	22:13	45°21.505	166°40.846	844	63600	2152										
	71	11-Mar-96	end	22:30			844	63653	2205										
3P	END OF LINE 3P		start	22:30	45°21.821	166°42.418	845	63654	2026										
	END OF SEISMIC		end	22:43	45°22.286	166°43.856	845	63693	2245							END OF LINE 3P			
																END OF SEISMIC			

Appendix C
Sonobuoy Data

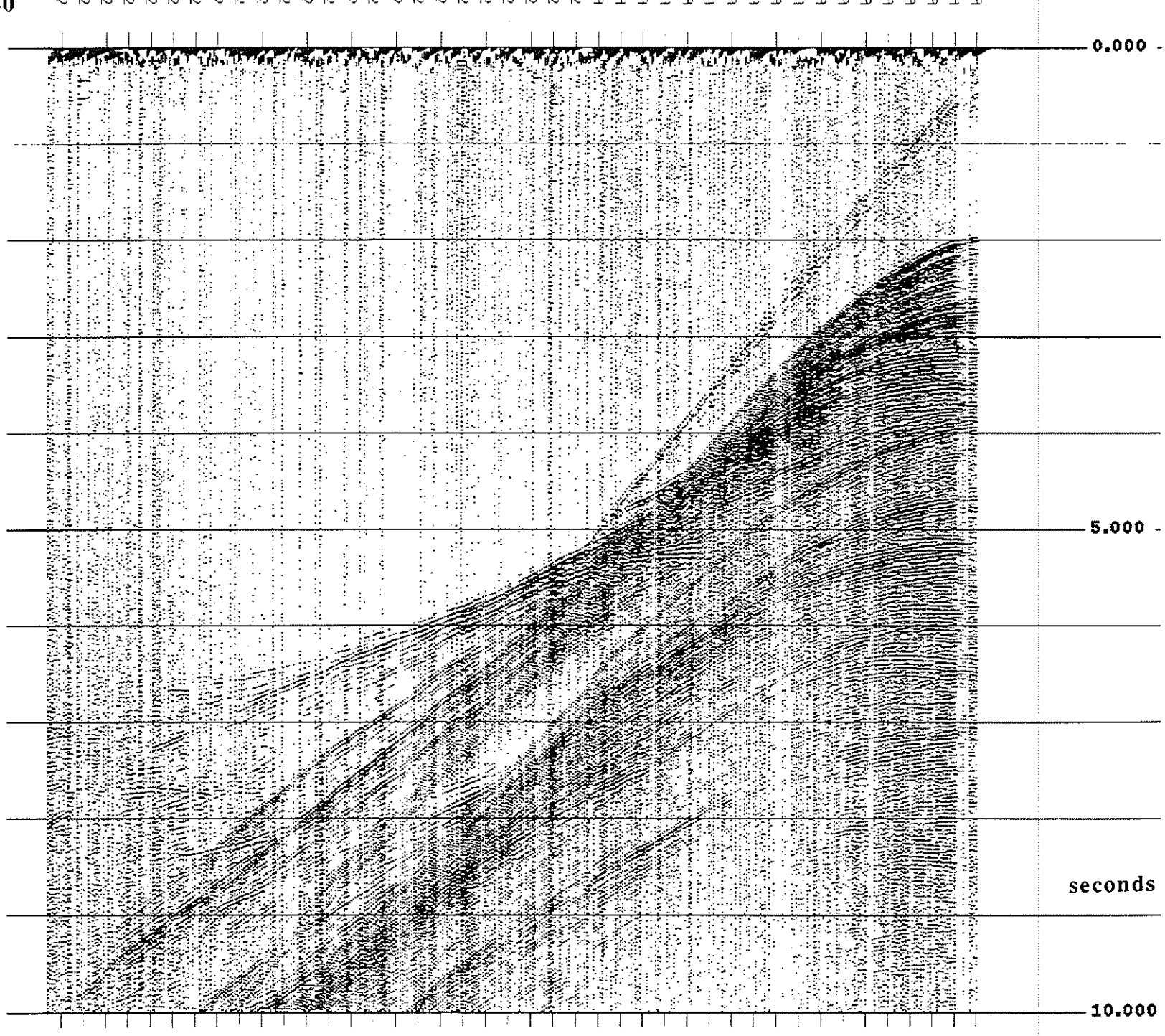
22 radio sonobuoys were deployed from the R/V Ewing along lines P1 and P3 to provide upper crustal seismic velocity control for these line. 6 sonobuoys did not transmit any data or gave poor data. On the other sonobuoys, good data were recorded out to ranges of about 25 km. Two radio channels were available for the sonobuoys enabling two sonobuoys to be recorded at one time. Data from each sonobuoy were recorded, in SEGD format, on two auxilliary channels of the MCS recording, one radio channel being recorded on MCS traces 165 and 166, and the second radio channel on traces 167 and 168. Three Sioseis scripts were used to extract the sonobuoy data from the MCS 3480 tapes, to sort the data into files for each sonobuoy, and to display the data (screen or plotter)

The example record section "Sonobuoy 20" shows several distinct phases: the direct water wave arrival, an intermediate velocity sediment refraction (about 2 km/s), and a series of strong refractions from a complex basement structure.

Puysegur Sonobuoys

Sonobuoy No	SBtype,#	record trc	start t (GMT)	3480#	shot numbers	file name	size	lat	long
			Day 69						
17	41B, 10	166	532	634	51968-52463	sonob.1.segy		47 21.9	167 25.8
18	41B, 18	166	815	643	52483-52961	sonob.2.segy		47 16	167 10
19	41B, 10	165,6,7,8	1106	652	52963-53499	sonob.3.segy		47 11.6	166 51.5
20	41B, 17	165,6,7,8	1404	661	53635-53971	sonob.4.segy		47 07.7	166 35.1
21	41B, 10	165,6,7,8	1739	670	54142-54641	sonob.5.segy		47 0.7	166 13.1
22	41B, 12	165,6,7,8	2026	682	54645-55128	sonob.6.segy		46 55.9	165 55.9
23	41B, 17	165,6,7,8	2320	690	55158-55363	sonob.7.segy		46 50.5	165 36.0
24	41B, 10	165,6,7,8	Day 70 0027	695	55363-55802	sonob.8.segy		46 47.9	165 28.0
dud 25a	41B, 10	166,8	441	708	56127-56233	sonob.9.segy		46 40.1	165 01.0
25	41B, 28	165,6	513	710	56238-56519	sonob.10.segy		46 39.0	164 57.2
26	41B, 10?	165,6,7,8	1146	731	to be done	sonob.11.segy		46 20.0	164 21.0
dud									
27	41B, 28	165,6,7,8	1717	750	tbd	sonob.12.segy		45 59.0	164 04.0
2 x dud			Day 71						
28	41B, 10	165,6,7,8	1129	808	tbd	sonob.13.segy		45 07.6	165 30.6
29	41B, 17	165,7	1334	815	tbd	sonob.14.segy		45 10.0	165 44.0
dud 30a	41B, 10		1603	823	tbd	sonob.15.segy			
30	41B, 16	165,7	1658	826	tbd	sonob.16.segy		45 15.0	166 06.0
dud									
31	41B, 13	166,8	1924	834	tbd	sonob.17.segy		45 18.0	166 22.0
32	41B, 17	165,7	2133	841	tbd	sonob.18.segy		45 20.5	166 36.0
Hydrophone depth 60 ft (18 m)			Float time 8 hrs						

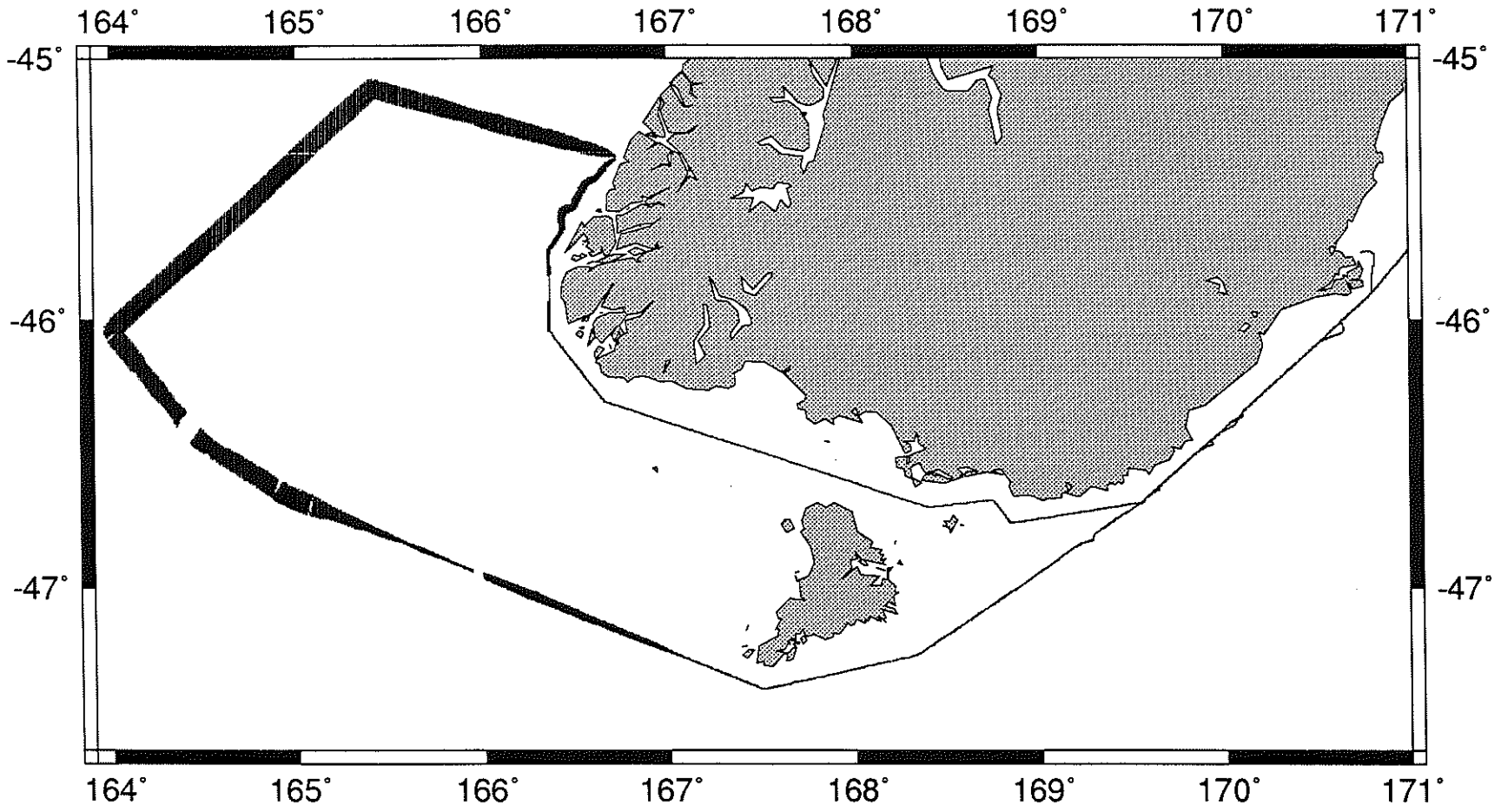
Sonobuoy 20



Appendix D
Hydrosweep Data

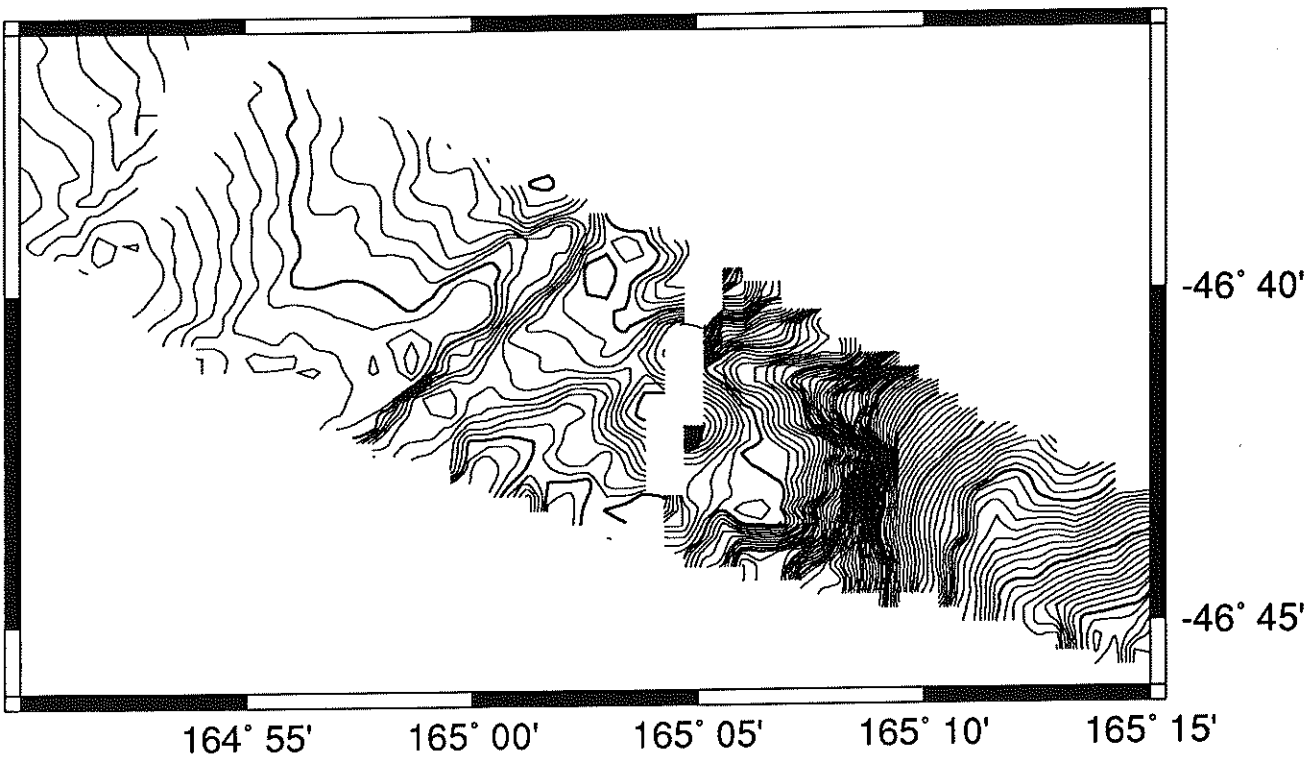
Hydrosweep data were recorded for the whole survey, apart from some small gaps. The data were edited onboard using the MB software. The following figures give some examples of the output.

R/V Maurice Ewing 9-13 March 1996



GMT Mar 13 21:51 Geoffroy Lamarche

Puysegur Trench Hydrosweep Coverage

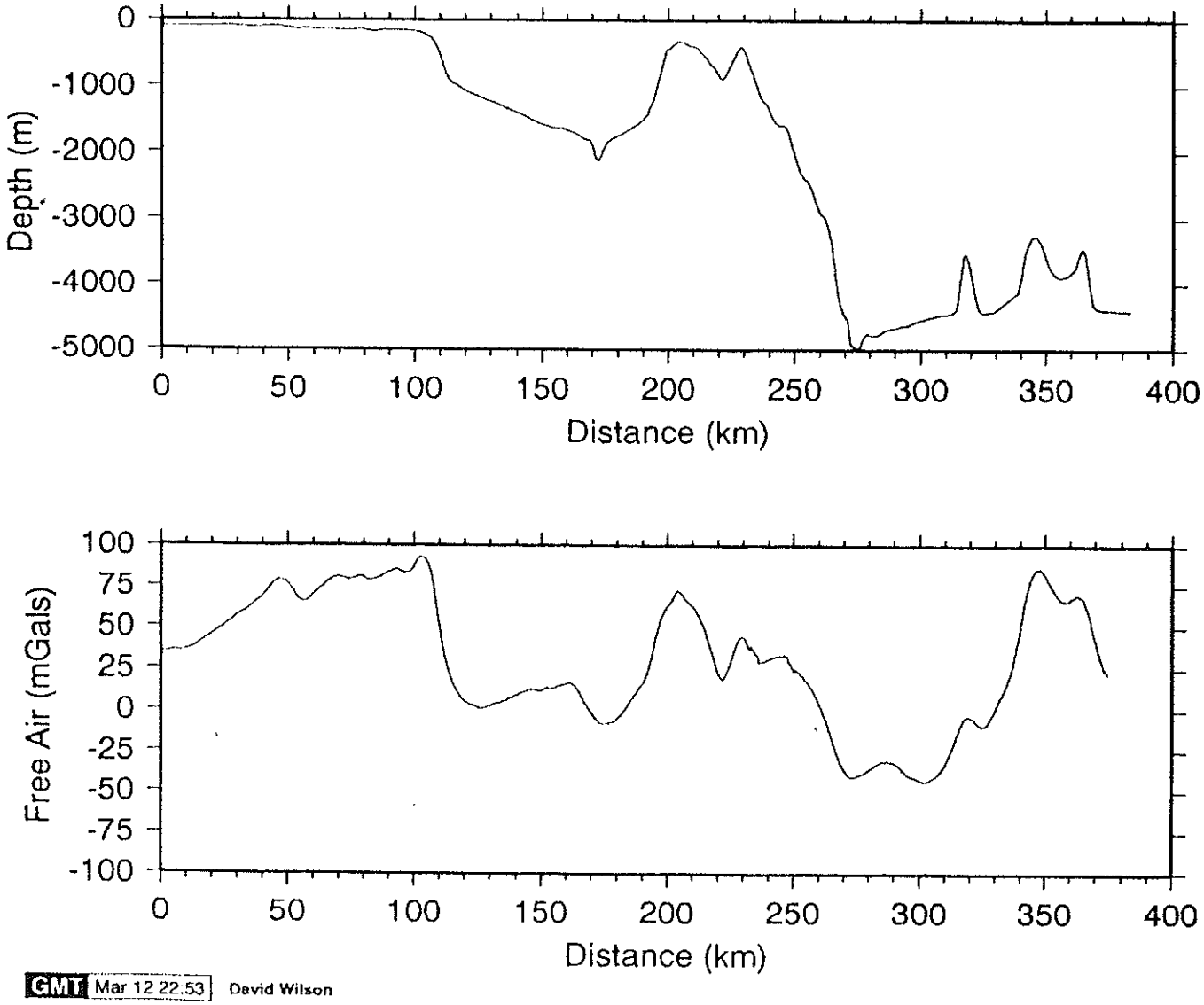


GMT Mar 13 20:21 Geoffroy Lamarche

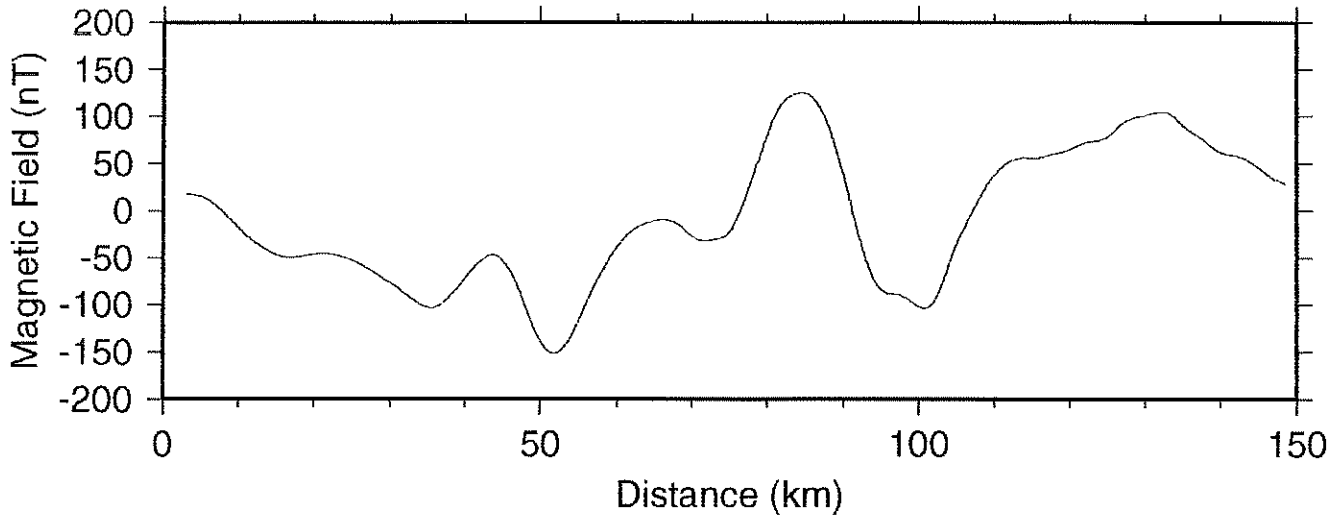
Appendix E
Magnetic, Gravity and Bathymetry Data Plots

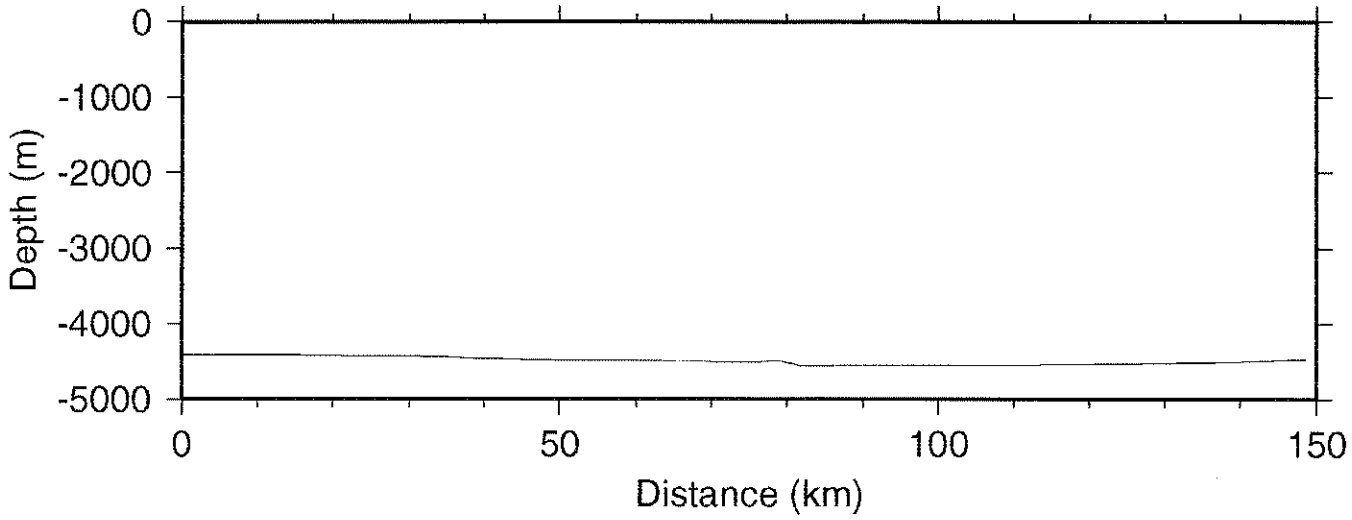
The underway gravity, magnbetic and centre-beam bathymetry data are plotted on the following figures for lines 1P, 2P and 3P. The gravity data were recorded with a BGM K3 marine gravimeter No 314. Magnetic data were recorded using a Varian V-75 proton magnetometer. Bathymetry data are from the centre beam of the Hydrosweep system. Bathymetric and shallow seismic data were also recorded using a 3.5 kHz system.

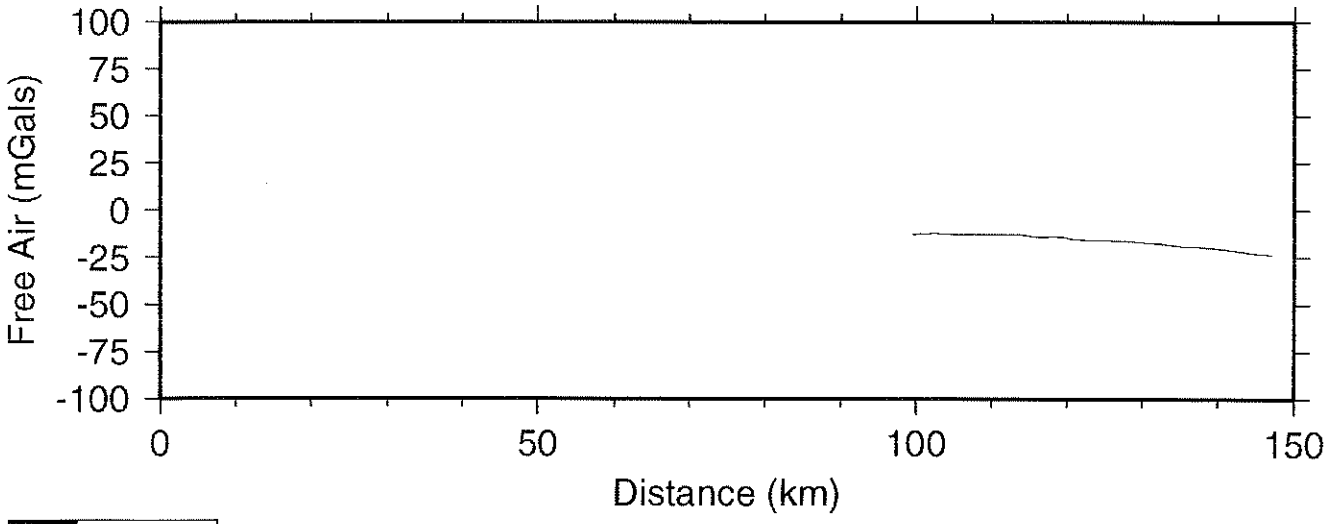
MSC Line_1p


0
-1000
-2000
-3000
-4000
-5000
Depth (m)
0
50
100
150
200
250
300
350
400
Distance (km)
100
75
50
25
0
-25
-50
-75
-100
Free Air (mGals)
0
50
100
150
200
250
300
350
400
Distance (km)
GMT Mar 12 22:53
David Wilson

MSC Line_2p

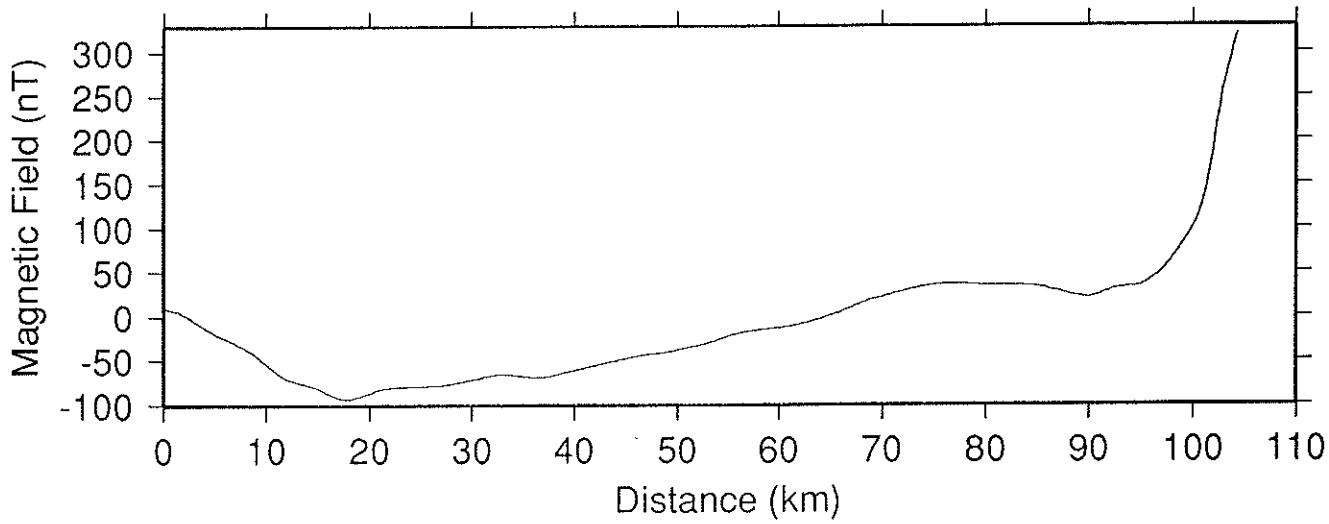


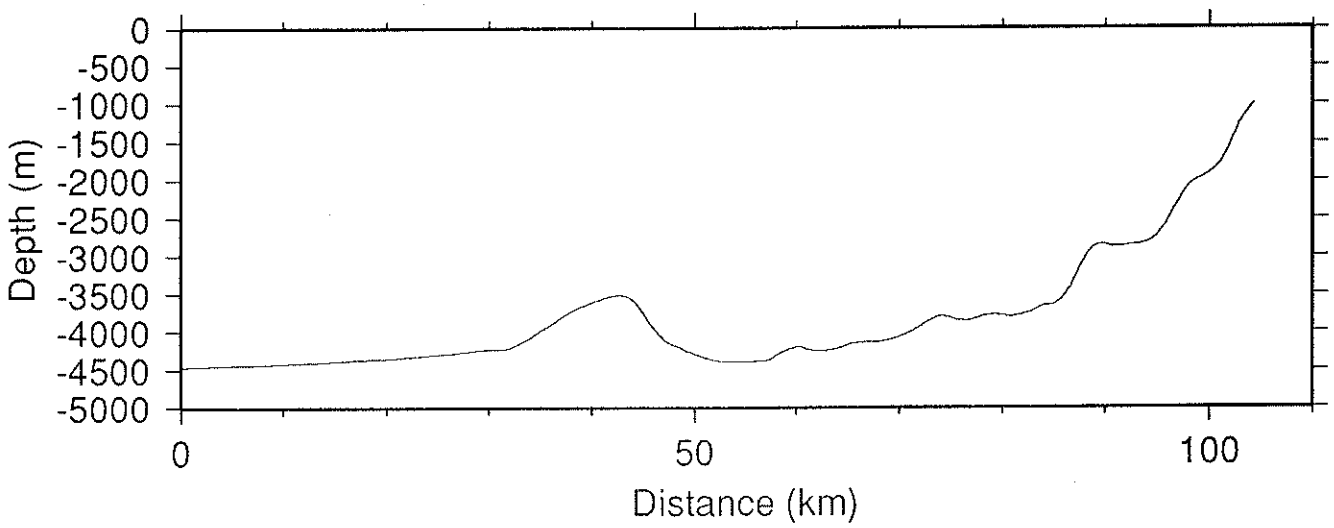


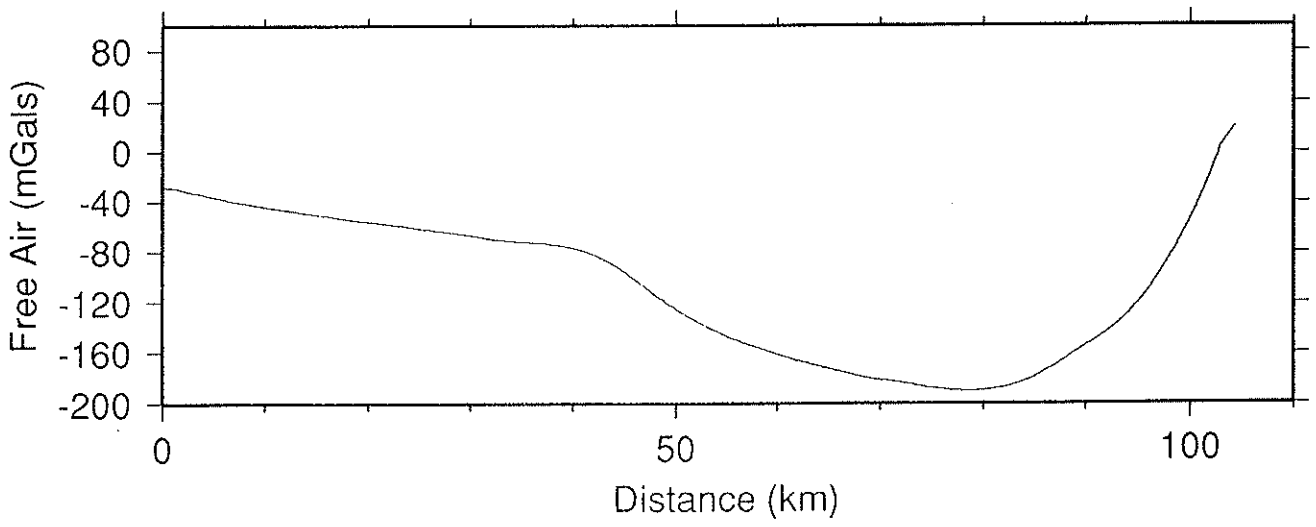


GMT Mar 12 23:40 David Wilson

MSC Line_3p







GMT Mar 12 16:59 David Wilson

Appendix F
Weather and Sea Data from Ship's Log

DATE	HOUR	WIND force	WIND dir	SWELL ht (feet)	SWELL dir
FRI 8 MARCH	4	lite	-	-	-
	8	lite	-	-	-
	12	2	ENE	-	-
	16	4	NE	3	NExN
	20	3	SE x S	3	ENE
	24	4	SE		SSW
SAT 9 MARCH	4	4	SE x E	2	NE
	8	3 -- 4	SE xS	2 -- 3	ENE
	12	2	S 1/y	2 -- 3	NExN
	16	4	SW xW	2 -- 4	WSW
	20	5	WSW	3	W1y
	24	5 -- 6	SW	4 -- 5	W
SUN 10 MARCH	4	6	SWxW	5 -- 7	SWxW
	8	7	SW 1y	8 -- 10	WSW
	12	6	SW	8 -- 10	WSW
	16	7	SSW	8 -- 10	SWxS
	20	6	Sx1/2W	8 -- 10	SxW
	24	4	SxW	8 -- 10	SxW
MON 11 MARCH	4	6	SxW	6 -- 8	SxW
	8	4	SxW	6 -- 8	SxW
	12	3	SxS1/2E	6	SWxS
	16	4	SxW	6	SxW
	20	5	SxW	4 -- 6	SE SxW
	24	5	SxW	5	SE 1 y
TUS 12 MARCH	4	6	SxW	6	SxW
	8	6	SSW	6	SSW
	12	4	SWxSW 1/2S	6	SWxS
	16	5	SxW	3 -- 5	SSW
	20	4	WNW	4	SWxS
	24	6	Wy W 1/2S	4	SW '1y
WED 13 MARCH	4	4	WxN	4	SW
	8	3	WNW	3 -- 4	SWxS
	12	4	NW 1y	3	SyE
	16	4	WNW	3	SW
	20	3 -- 4	NNE	3	SxW
	24	4	ENE	3	NxE
THU 14 MARCH	4	4	ENE	2	NxE
	8	lite	-	-	-