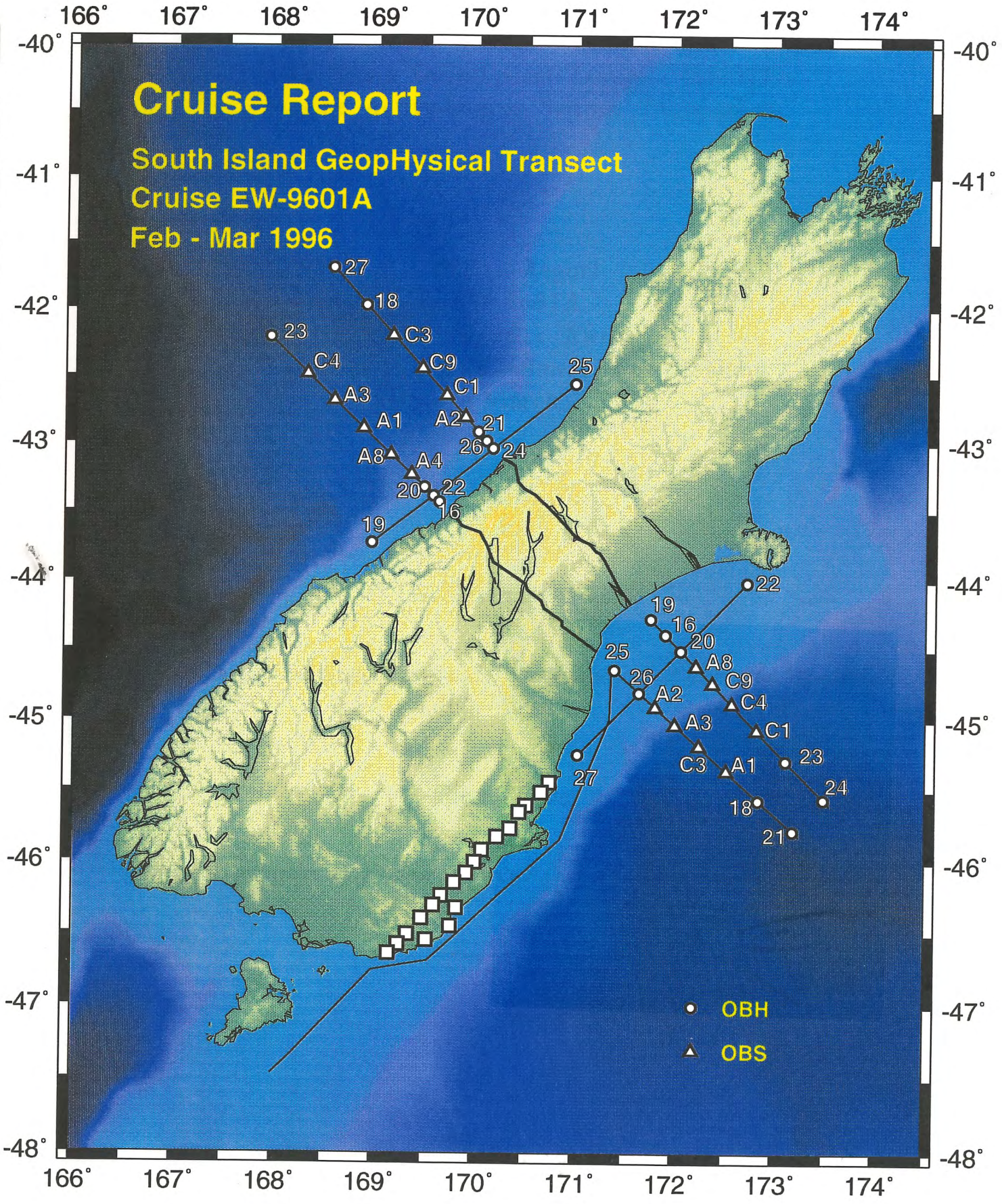
Cruise Report
South Island GeopHysical Transect
Cruise EW-9601A
Feb - Mar 1996
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OBH
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South Island GeopHysical Transect (SIGHT): Marine Active-Source Seismic Component

Cruise Report
EW-9601A
R/V *Maurice Ewing*
Lyttleton to Port Chalmers, New Zealand
Feb. 8 – March 7, 1996

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Summary

This report documents R/V *Maurice Ewing* cruise EW-9601, which formed a major part of a multidisciplinary, joint US- New Zealand investigation of continental deformation at convergent plate boundaries (SIGHT — the South Island GeopHysical Transect). The Alpine Fault zone of the South Island of New Zealand marks the Pacific/Australian plate boundary, where oblique convergence of two thin continental crustal blocks has built the Southern Alps. The active-source component of SIGHT was designed to exploit the narrowness of the South Island by using onshore/offshore seismic techniques to provide a detailed image of the boundary from both sides.

The *Ewing* fired over 41,000 shots from its 20-gun tuned airgun source into a wide array of seismic receivers: the *Ewing's* 4-km-long multichannel streamer, eleven Woods Hole Oceanographic Institution ocean-bottom hydrophones (OBH) and nine U.S. Geological Survey ocean-bottom seismometers (OBS), and 200 Reftek portable seismometers deployed on three major transects and several cross-lines. All operational goals of the experiment were attained. Forty-four deployments and recoveries of OBH/S were accomplished; the multichannel streamer was deployed and recovered twice; and sixteen sonobuoys were launched. Preliminary velocity models were produced shipboard for one of the onshore explosion transects and one of the offshore OBH lines. Brute stacks of all MCS lines were produced shipboard, showing reflections from the entire crust and Moho. The resulting data sets will provide fundamental new information on the deep structure of the Pacific/Australian plate boundary and, when combined with the passive seismic, petrophysical, magnetotelluric, and geological data being acquired under the auspices of this project, enable new insights into the deformation of continental lithosphere under oblique compression.

Scientific Objectives

This cruise forms a major part of a joint US- New Zealand investigation aimed at improving our understanding of continental deformation at convergent plate boundaries. Mountain belts are the highly visible products of continental collisions and contain unique clues about the rheological properties of continental lithosphere and the processes by which it deforms. Within mountain belts, compression, overthrusting, and erosion often combine to expose large sections of high-grade metamorphic rocks and associated faults. Collisional mountain belts are are usually paired with, and mechanically linked to, large asymmetric foreland basins that contain much of the world's hydrocarbons.

On the South Island of New Zealand, along the Pacific/Australian plate boundary, youthful oblique convergence of two thin continental crustal blocks — the submerged Lord Howe Rise to the west and the Chatham Rise/Campbell Plateau to the east — has resulted in a relatively narrow (~80 km wide) zone of active mountain building, the Southern Alps. The plate boundary has recently been forced into a condition of transpression through plate boundary reorganization processes. The South Island thus offers a natural laboratory for the study of partitioning between convergence and translation. In the central Southern Alps of New Zealand, there is also the apparent paradox that the greatest present uplift and deformation is associated with relatively low seismicity. Finally, the narrowness of the South Island provides a unique opportunity to use marine onshore/offshore seismic techniques to provide a detailed image of the boundary from both sides.

The active-source seismic survey was designed to provide fundamental knowledge on deformation in a transpressional continental orogen by identifying potential strain markers in the lithosphere on both sides of the plate boundary. By tracing these strain markers — such as the Moho, lower-crustal laminations, and crustal shear zones — we hope to constrain whether, and at what levels of the lithosphere, strain is accomodated by brittle faulting or plastic flow. The specific goals of the survey were to obtain wide-angle onshore/offshore, marine multichannel seismic, and OBH/S wide-angle data along three profiles, two across the orogen and one across undeformed rocks that form the orogen. The data acquired will constrain models of continental collision by providing information on :

- crustal thickness across the orogen
- seismic velocity structure through the crust and upper mantle
- structure and inferred deformation under the upthrust Southern Alps
- change in structure across the plate boundary
- seismic structure of the relatively undeformed crust on either side of the orogen

Operational Objectives

The cruise formed the marine component of an offshore/onshore seismic experiment, comprising seismic measurements along two profiles across the central South Island and extending about 200 km offshore from either coast, and one profile across the eastern coast and southeastern part of South Island. Data were recorded by 200 Reftek portable seismographs deployed along the three profiles, by 20 OBH/S on the offshore extensions of the profiles (deployed sequentially on either side), and by a 3- to 4-km-long towed hydrophone streamer. Shots were fired using a 130-liter (8495 cu. in.) airgun array. strike lines were also recorded on either side of the South Island. The survey followed immediately after an onshore seismic refraction/wide angle reflection experiment along the profiles across the South Island.

The primary operational goals were to:

- Deploy and recover 20 OBH/S on two 200 km profiles (9 OBH/s per profile) and a tie line (2 OBH/S) on each side of the South Island.
- Fire the 20 - gun array intto the OBH/S, MCS streamer, and the onshore array to give two 600 km long composite profiles across the collisional orogen.
- Obtain MCS data along these profiles.
- Record sonobuoy and MCS data on the Dunedin and Stewart Island profiles.
- Record a cross-pattern of profiles where the Haast schist projects offshore to measure P-wave anisotropy at seismic wavelengths.
- Maintain good communications with the onshore base in Timaru.
- Produce SEGY archive files for the OBS/H data and sonobuoy data.
- Copy all MCS prestack data to DAT tapes.
- Produce a preliminary stack of the MCS data along the main profiles.

All operational goals were achieved.

SIGHT Project PIs
Active-Source Seismic Component

United States		New Zealand	
Thomas Henyey	USC	Fred Davey	IGNS
David Okaya	USC	Tim Stern	VUW
Steve Holbrook	WHOI		

Science complement

W. Steven Holbrook	Co-Chief Scientist	WHOI
Fred J. Davey	Co-Chief Scientist	IGNS
F. Beecher Wooding	Research Specialist	WHOI
James Dolan	Research Associate	WHOI
David DuBois	Research Assistant	WHOI
Dan Lizarralde	Graduate Student	WHOI/MIT
Jun Korenaga	Graduate Student	WHOI/MIT
Greg Miller	Physical Scientist	USGS
Robert Busby	Consultant	Channel Z Seismometry
David Wilson	Graduate Student	Univ. of Otago
Cris Henstock	Graduate Student	Univ. of Otago
Joseph N. Stennett	Science Officer	LDEO
William J. Robinson	System Manager	LDEO
Charles W. Donaldson	Electronic Technician	LDEO
John G. DiBernardo	Airgun Technician	LDEO
Ropate Maiwiriwiri	Airgun Technician	LDEO
Paul O. Olsgaard	Airgun Technician	LDEO
Matthew J. Cheslik	Airgun Technician	LDEO

R/V Maurice Ewing Crew

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

Narrative

3 Feb 1996, Saturday

The EWING arrived in port at Lyttleton around 0930 LT. Holbrook and Lizarralde visited the ship at 1030, spoke briefly with disembarking scientists Steve Cande, Joann Stock, and Dietmar Müller, then met with Science Officer Joe Stennett. Wooding, Korenaga, and Busby arrived in ChCh at 1200. Holbrook and Busby went to Timaru to visit the onshore field headquarters.

4 Feb 1996, Sunday

Began unloading 40' container ~0900; container empty by early afternoon. We noticed that the container had been damaged on the left side near the door -- there is a large dent and small gash in the side of the container. Our anchor pallets were smashed, but there appears to be no permanent damage to our gear. OBH frames are stowed on fantail. OBH and OBS electronics are being set up in the dry staging area; OBH pressure cases and OBS spheres will be set up in the wet staging area. Sun workstations indigo and jade have been set up in the Analytical Lab; hekla, ballyhoo and alpamayo will be set up in the main lab.

Fred Davey came by the ship just before lunch; Joe Stennett gave us a quick tour of the ship and we discussed several points of our operation with him. Fred left around 1400 for Timaru and will return on Tuesday.

In discussions w/ Capt. Jim O'Loughlin and Joe Stennett, it is clear that we will only have ~ 3 km of working streamer when we sail, due to damage/loss of streamer incurred during Taiwan and Woodlark Basin surveys. Sections under repair at Syntron in Houston will not be shipped to NZ in time for our sailing date. However, if missing streamer sections (~9 sections) can be sent to Wellington in time for our return through the Cook Strait, we will bring them aboard. This will probably require docking in Wellington due to the size and weight of 9 streamer sections.

5-6 Feb 1996, Monday-Tuesday

The science party continued setting up computers and gear in the main lab, wet and dry staging areas, and analytical lab. During these two days the science party stayed in the Windsor Hotel in Christchurch and commuted to Lyttleton in a rental van.

7 Feb 1996, Wednesday

The science party checked out of the Windsor Hotel in Christchurch and moved aboard the ship at 0900. At 1000 onshore PIs Tom Henyey, David Okaya, Tim Stern, and John McRaney came aboard for last-minute consultation and planning. A team of TV journalists interviewed Fred Davey in the early afternoon, and at 1500 Steve Holbrook led a tour of the ship for about 15 people from the onshore deployment teams who had come up from Timaru. Weather cold and rainy.

8 Feb 1996, Thursday

We set sail at 0920 under cloudy skies. At 1520 we had our first fire and boat drill. At 1605 we hove to for our first wireline release test — a particularly important test since we were using borrowed acoustic releases and only using one release per OBH. The rosette with the first eight releases was deployed through the stern A-frame on the trawl wire and reached 1030 m depth at 1645. The test was successfully completed at 1710, and by 1735 the rosette was back on deck. We hove to again at 1815 for the second release test; the remaining four releases successfully released at 1900 and were back on board by 1940. We got underway for the Cook Strait and the west coast.

9 Feb 1996, Friday

Underway to the West Coast. We passed through Cook Strait in the night hours and rounded Cape Farewell on glassy seas under sunny skies. The underway watch is proceeding in main lab, the four graduate students each taking a six hour shift. We decided on a slight change in cruise plan: we will begin shooting Line 1W first rather than 2W. This produces a shooting pattern that finishes on the north end of Line 3, which is where we would like to begin recovery so as to minimize bottom times on the instruments. We apprised the onshore team in Timaru of this change via e-mail; no impact on the onshore logistics should result from this change.

At 2130 we received e-mail from the onshore team informing us of a change in Reftek programming: the 230 Mb instruments will only record 1 component rather than the two we had decided upon. This decision was based on a review of the recording times of those instruments, which at 6.35 days (for two channels) was deemed inadequate to provide the desired contingency. We also learned that the helicopter crews on the divide planned to fly in today, weather permitting.

10 Feb 1996, Saturday

We approached our first deployment site (OBH 25) at about 0345 LT. At 0405 Beecher discovered that the release on the frame of OBH 25 failed its air acoustic test: although it successfully released, it would not ping a confirmation. Beecher suspects a dead transponder battery and will check it later today. Meanwhile we decided to swap out that release. The resulting delay of about 15 minutes caused the captain to overshoot the mark at 0435 LT before we were ready to deploy. We backed down on the site and at 0500 OBH 25 was deployed in 64 m of water. Beecher deployed the transducer over the starboard side, ranged to the instrument, disabled it, received confirm disable, and verified disable by interrogating with no response. (This procedure was followed on subsequent deployments.)

We continued deployments throughout the day in worsening weather, deploying OBH 24 at 0923, OBH 26 at 1018, OBH 21 at 1145, OBS A2 at 1256, OBS C1 at 1428, OBS C9 at 1627, OBS C3 at 1840, OBH 18 at 2104, and OBH 27 just after midnight. This completed our Line 1W deployments, and we turned W-SW and had a nice smooth downwind ride to our next station at the W end of Line 2W.

At the 2130 email we heard from Mike Rawson that Syntron have completed repairs on 3 Canto sections, with another 5 scheduled for repair by early next week. Rawson will advise us whether those eight streamer sections (800 m total) will be delivered to Port Chalmers in time for our anticipated port call on Feb. 22 or 23. The tone of his message was hopeful.

11 Feb 1996, Sunday

We reached the first deployment site at the west end of Line 2W, OBH 23, at 0400 LT and deployed the OBH at 0433. We continued deployments through the day in marginal weather. We deployed OBS C4 at 0710 LT. The position of OBS A3 was moved about 7.4 km along the line to avoid a steep canyon, delaying deployment until 0947 LT. We deployed OBS A1 at 1137 and OBS A8 at 1335. Another submarine canyon necessitated the repositioning of OBS A4, causing another one hour delay as we searched for a good deployment site. After choosing a site and beginning the deployment operation, pitching of the ship in the worsening seas caused OBS A4 to slam against the counter during deployment, breaking the anchor free and forcing us to abort the operation and attach a new anchor to the apparently undamaged sphere. We discussed the possibility of suspending deck operations due to the growing sea state but decided to proceed as long as was safe. We finally deployed OBS A4 at 1707 LT.

By the time we slowed for approach to the site for OBH 22 at 1940 LT, we were facing sustained winds of 40 knots, with gusts to 54 knots. The only saving grace was that the wind direction was out of the northeast, so the South Island was keeping the fetch to a minimum and thus providing some shelter. At 1950 we observed a small fishing boat

heading toward the coast about 300 m off our port beam; this boat was laboring dramatically over the 8-10' swells. We soldiered on and deployed OBH 22 at 2019. At 2024 the WHOI transducer was chopped off in the screws; we deployed the spare transducer off the port side and continued operations. We deployed the last instrument on line 2W, OBH 16, at 2152.

At 2200 we got underway on the 3-hour steam to the last deployment site, the OBH at the southern end of line 3W off Jackson Head.

12 Feb 96, Monday

By the time we approached the site at 0045, the sea state had worsened further, with three foot waves breaking over the stern every minute or two. Winds were sustained at 45 knots, with maximum gusts of up to 67 knots. At 0100 we deemed the conditions unsafe and decided to delay deployment of the last OBH. The captain decided to work our way a little farther offshore in hopes of finding a less extreme sea state, while still remaining in the area so that we could attempt deployment when the storm blew over.

At 0150 we noticed on the fantail video monitor a glass ball on the deck near the A-frame. Closer investigation revealed that the leg on the forward port side had broken off the OBH frame; it was still tied to the A-frame via an aircraft strap but was rolling around significantly. We called the bridge and woke Beecher. By 0210 Beecher and the captain were on the fantail in the storm, lashing the remainder of the OBH frame to the A-frame. The captain declined the suggestion of moving the OBH frame to a more sheltered position, as this operation was deemed too dangerous under the circumstances. By 0220 Beecher had brought the broken frame leg into the wet staging area and the deck was secure. Fortunately the electronics package had not yet been brought out to the frame; there was, however, a borrowed release and recovery aids attached to the frame. However, due to the conditions on deck, all we could do was wait out the storm and hope that the OBH frame did not further disintegrate through the night.

At 0510 several OBH anchors were reported moving around on the fantail. These were secured. By 0700 the weather had moderated sufficiently to warrant detailed investigation of the OBH frame, which had survived the night on the fantail. No irreparable damage was sustained, so it was decided to attempt repairs. Beecher and Dan worked with Chief Engineer Steve Pica, who generously devoted parts and labor to replace the damaged gussets with diamond-plate aluminum. By 1030 repairs were complete and we steamed back toward the OBH deployment site, which was by now several hours distant. We arrived on site at 1400 as the sun began to emerge from the clouds. Seas were much calmer and the wind was down -- a remarkable improvement over just twelve hours earlier. At 1422 we deployed OBH 19 in 130 m of water, completing our OBH/S deployment operations on the west side.

Before we got underway to our designated MCS streamer position, Chief Mate Lou Mello climbed the stern post atop the A-frame to repair a running light. After this, one more light was repaired on the foredeck, and we were underway by 1450. By late afternoon the weather had improved markedly, with sunshine and light winds, though a healthy swell remained as a reminder of the previous night's tempest.

At 2130 we were on station to begin streamer deployment. The tail buoy was deployed through the stern A-frame at 2133. Fifteen minutes later Joe Stennett tested the functionality of the streamer birds by holding a bird up against a contact on the tail section and verifying communication on the main lab computer. The fact that we could communicate with the birds came as a pleasant surprise, given the known short in one of the streamer sections.

At 2300 we called the lab in Timaru and updated them on our progress. They hadn't received our 2130 e-mail due to traffic on the Timaru Internet server. They reported that all but 27 onshore stations were deployed, with at least 18 to be deployed the next day. The river deployments by Tim S. would be difficult due to the high river conditions, but we decided to proceed as planned with a 2000 Tuesday start on Line 1W. We also briefly

discussed the idea of an add-on anisotropy shoot off Moeraki Point, should we finish the east coast shooting ahead of schedule, and we agreed to send a diagram of the proposed experiment.

13 Feb 1996, Tuesday

Streamer deployment continued through the night. Deployment of the MCS streamer is a 3-4 person job. Joe Stennett runs the show, operating the winch and the oil gun. Chuck Donaldson assist with both these tasks, checking out the streamer sections as they come off the streamer and calling out which ones need oil. The principal task is to check for air inside the streamer, which must be bled off, and to inject oil to the balance right (a fine art). One watchstander assists on deck with the streamer handling and attachment of birds; one person in the lab is needed to to check that the birds are communicating (using the computer monitor) and to bring out the next bird.

Deployment proceed well for several hours, with bird #10 (out of 18) attached by 0210. The process was slowed during assembly and checkout of the transformer connecting the Can I and Can II (Canto) sections.

At 0915 Joe announced that there may have been a major problem in setting up the streamer: he feared that 110 V current was put down the streamer before the transformer between the Can I and Can II sections was active, thus potentially damaging all the cans outboard of the transformer -- up to about 20 cans. We decided to bring in the streamer and test cans one at a time, replacing bad cans with spares. Because we only had nine spare cans, there was a possibility that, if all the Can I cans had been blown, we would end up with only about a 1.9-km-long streamer.

At 1500 we received the good news that replacing can #12 (cans are numbered from the tail of the streamer) brought 28 sections alive. We now had only two sections at the tail end of the streamer not working. We decided to leave these sections out and inoperative, rather than pull in the entire streamer to replace them, as we were already pushing up against our desired 2100 start time -- and a significant delay would cause us to delay the start of the main transect work until 2100 Wednesday night (the start time of 2100 dictated by our desire to shoot the inboard portions of Lines 1W and 2W during the quiet night hours). We still needed to do some work on a couple of the inner sections: #28 was leaking, and #27 had to be re-banded at the connecter.

The captain pointed out to us that, because of the shallow water, we wouldn't be able to steam far enough landward to have the streamer straight at BOL, but we would be able to steam through BOL with the guns firing. The streamer would be straight by ~2.8 km (one streamer length) down the line.

By 2000 LT we had the last 4 guns deployed, and the first shot was fired at 2007. At 2132 LT we began shooting Line 1W, heading northwest. At 2230 we called Timaru on cell phone an informed them that shooting had begun and that initial looks at the MCS data showed good signal. They requested special 0930 e-mails of shot times on Wednesday and Friday so that they could make segy files from the "QC" boxes specially deployed to check signal levels onshore during shooting.

14 Feb 1996, Wednesday

Shooting continued on Line 1W. At 0415 we asked the bridge to speed up to 5 kts over the ground, as the tail of the streamer was towing at 30 m depth. Bringing the speed up to 5.4 kts through the water raised the streamer tail to 15-20 m depth.

We finished shooting Line 1W at 1956 LT and began a 270° turn onto Line 12W, which we started shooting at 2130. The weather and forecast were both good.

At 2130 we received the encouraging news from Timaru that our shots were being picked up on the QC boxes out to offsets of at least 200 km.

15 Feb 1996, Thursday

Dan has worked out the bugs that had been plaguing our pseudo-real-time MCS stacking procedure; there was a problem in the specification of the velocity function to be used in the stack. We decided to re-start the stacking process at the beginning of Line 1W. This meant that the stacking procedure would no longer be "real-time", but this was deemed acceptable, since no scientific or operational decisions were dependent on seeing the MCS data in real time.

We began turning onto Line 2W at 0810, and started shooting on 2W at 0925.

During the night it became clear that due to moderate currents the bridge was having difficulty maintaining 5.0 kts over the ground without exceeding the 100 RPM limit imposed by the captain. We discussed this with Joe Stennett and Captain O'Loughlin in the morning and resolved that the captain would be called to authorize higher RPM if necessary.

16 Feb 1996, Friday

At 0547 LT we shot past OBH 16, the easternmost instrument on the line, and we called Joe in preparation for the end of Line 2W. We reached the EOL at 0602 and began turning to starboard as the day brightened to reveal patchy, low clouds. At 0640, when the streamer was straight, we began recording Line 23W, the transit line between Line 2W and Line 3. At 1432 we completed Line 23W and began a 180° turn, coming on to Line 3W at 1432 LT. The weather today is excellent for shooting — sunny, with a light breeze (8–10 knots) and calm seas.

During the day Dan set up on the ship's Sun workstation "hess" a procedure for copying MCS data from 3480 cartidges to DAT tape, using the ship's spare 3480 drive. The goal is to provide Fred Davey with a copy of all MCS data in a medium that can be read using existing IGNS equipment.

At 2130 we tried to phone Timaru on the cell phone but were out of range.

17 Feb 1996, Saturday

In the morning we discussed the suggestion of the Timaru team, received via e-mail, that we consider extending the Dunedin onshore-offshore shooting southward to Stewart Island. Emboldened by the excellent signal propagation observed on the Refteks, the onshore team will deploy Refteks as far south as the latitude of Invercargill for the East Coast shooting. Their suggested southward extension would provide bottoming points beneath the Southland syncline and complete a full "Transect III" through the "undeformed" Haast schist where it is exposed in the Southland.

At 1349 we came to the end of Line 3W, thus completing the west side shooting in just over 3.5 days. The guns were recovered and the booms in one hour later; streamer recovery took a further three hours, with the tail buoy coming on board at 1735. By 1830 we were on station for recovery of OBH 25; the instrument was on deck at 1845 and by 1858 we were underway for the next site. OBH 24 was recovered at 2344 LT.

18 Feb. 1996, Sunday

OBH/S recovery operations continued through the day, with OBH 26 recovered at 0134, OBH 21 at 0254, OBS A2 at 0500, OBS C1 at 0700, OBS C9 at 0926, OBS C3 at 1209, OBH 18 at 1436, and OBH 27 at 1850. By nightfall a heavy fog had settled in, which limited our speed to about 7 kts and delayed our schedule slightly.

19 Feb. 1996, Monday

We began recovering instruments on Line 2W with OBH 23 at 0200. Still only making 7 kts due to thick fog, we steamed for OBS C4 and brought it on board at 0705. OBS A3 was recovered at 0959, OBS A1 at 1200, OBS A8 at 1424, and OBS A4 at 1633. We continued southeastward on Line 2W, recovering OBH 20 at 1752, OBH 22 at 1912, and OBH 16, the landward instrument of the line, at 2015. We then turned southwest and made for the final instrument on the west side, OBH 19.

During the transit we made an INMARSAT call to Timaru, since their 2130 e-mail made it clear that they had not yet received our response to their suggested extension of the Dunedin Line southward to Stewart Island. (We were out of cell phone coverage at this point.) We agreed with their suggested addition of inland Refteks for the Dunedin profile, but expressed our misgivings about choosing the Steward Island shooting over the "Southern Cross" anisotropy shoot, which the Timaru group had expressed reservations about. We agreed to fax them a hard copy of our email so that we could continue the dialogue. The fax was sent at 2234 after a brief course change, which was necessary to move the satellite antenna clear of the stack.

We released OBH 19 just before midnight and had it on deck at 0005. We then got underway for Port Chalmers, where we were to pick up nine sections of MCS streamer that had been shipped from Texas.

20 Feb. 1996, Tuesday

On Tuesday morning the ship's Invercargill agent suggested that we go in to Bluff (near Invercargill) rather than Port Chalmers, so that we could make the streamer transfer during working hours. (Our ETA in Port Chalmers would have been midnight Wednesday.) We decided on this change and so informed the agent.

During the afternoon we were afforded some very nice views of the Fiordland coast, although we were taking some strong winds and swells on the nose, slowing our progress to about 8 kts.

21 Feb. 1996, Wednesday

We tied up dockside in Bluff at 1130 LT and immediately began the crane transfer of the streamer sections. Eleven boxes were brought aboard, nine with active sections, and two with stretch sections. We pushed off at 1220 and got underway to the first OBH site. During the afternoon Joe and the gunners began the painstaking process of filling the new sections with oil.

22 Feb. 1996, Thursday

We approached the first east-coast deployment site in the wee hours of the morning and deployed OBH 27, at the southern end of Line 4E, at 0421. Dawn showed a sunny, cool morning, with calm seas, a light breeze, and clear views of the Hunters Hills and Southern Alps in the distance. Throughout the day Joe and the gunners continued filling the new streamer sections with oil. We steamed north to the landward end of Line 2E and deployed OBH 25 at 0833, then continued deploying on Line 2E throughout the day: OBH 26 at 1022, OBS A2 at 1140, OBS A3 at 1305, OBS C3 at 1453, OBS A1 at 1736, OBH 18 at 1920, and OBH 21 at 2158 LT. By this point the weather had turned cold and windy. We turned northeast and headed for the seaward end of Line 1E.

23 Feb. 1996, Friday

We deployed OBH 24 at 0021 after a minor hiccup: on the first deployment attempt, the anchor slip line had twisted and pinned the anchor up against the stern, keeping the anchor from going free. Beecher rectified the problem for a second approach. We continued through Friday with deployments on Line 1E, sending off OBH 23 at 0257, OBS C1 at 0519, OBS C4 at 0722, OBS C9 at 0852, OBS A8 at 1029, OBH 20 at 1202, OBH 16 at 1326, and OBH 19 at 1507. The streamer filling operation continued through the day, each section being suspended from A deck onto the fantail and filled with oil.

We turned north toward our last deployment site, OBH 22. The instrument was deployed at 1947, with pleasant views of the imposing Banks Peninsula as a backdrop. We then got underway for the streamer deployment site near the south end of Line 4E; as we wanted to begin streamer deployment in the daylight hours, we took the overnight steam at a leisurely 8 kts.

modeling of the Stewart Island onshore-offshore data could be gained by deploying sonobuoys instead of OBHs, with no impact on our cruise schedule and no need to abandon the Southern Cross add-on. We responded at 1900 with a fax informing the Timaru team that we would continue shooting as originally planned.

At 1912 we finished Line 1E and began a 270° turn onto Line 12E, which we came onto at 2017.

28 Feb. 1996, Wednesday

We finished Line 12E at 0020 and made a simple 90° turn to starboard onto Line 2E (a miscommunication with the bridge resulted in Line 12E not being shot through the easternmost OBHs, so there was no need for a 270° turn here). We began shooting Line 2E at its eastern end at 0036.

In the afternoon we called Alan Johansson of Anglo Pacific International to arrange for delivery of a 40' container to Port Chalmers for shipment of the Woods Hole gear back to the States.

At 1815 we were forced to deviate off the line to avoid an unresponsive squid boat. The Woods Hole crew decided to boycott squid products henceforward.

During the turn at the end of Line 2E, Joe repaired a gun firing circuit that had been acting up; recording was stopped for about 15 minutes.

29 Feb. 1996, Thursday

In the morning we received word from Timaru that they agreed with our assessment of the end-of-cruise scenarios and endorsed our plan to proceed with MCS shooting.

At 1334 we increased the shot interval to 22 seconds to accommodate the speed overground of 4.2 kts. At 1550 we started Line 5 off the Otago Peninsula.

At 2030 we decided to circle around; Joe had to take the MCS off line for a total of about 30 minutes while diagnosing transmission problems with the sonobuoy system, resulting in an unacceptably large data gap. This circle cost us about two hours. We were back on line at 2212.

We had decided to deploy two sonobuoys on the Dunedin profile to provide shallow-crustal velocity control on that line where it is most distant from the onshore Refteks. At 2324 we launched sonobuoy #1; returns from this buoy were noisy and ceased altogether after about an hour, so we decided to launch another bouy.

1 March 1996, Friday

We launched sonobuoy #2 at 0102; it transmitted well. Sonobuoy data was plotted out in real time on the PC monitor and the EPC chart recorder in the lab, allowing good quality control. Up to two sonobuoys (AN/SSQ-41B buoys) can be recorded at one time; maximum useful range of the buoys appears to be about 25 km. The sonobuoy data are recorded on 3480 tapes on channels 157–160.

Sonobuoy #3 was launched at 0313. At 0950 we reached the end of Line 5 (the "Dunedin line") and began Line 6.

From 1505 until the end of the line we launched another thirteen sonobuoys, of which four did not provide good data. Joe altered the launch procedure from the "mortar" gun to dropping them off the starboard gun boom, thinking that perhaps the impact following gun launch was damaging the buoys. We continued shooting on Line 6 for the rest of Friday.

2 March 1996, Saturday

We reached the end of Line 6E at 0306, ceased firing, and began recovery operations. The guns were aboard at 0400, and the streamer was completely recovered at 0605 — three hours after the end of shooting. At 0610 we got underway for the long steam back up the coast to begin recovering instruments.

At 0900 we spoke to David Okaya and informed him that we had finished shooting, so retrieval of the Transect III Refteks could proceed. We also updated him on our projected

arrival in Port Chalmers and requested the installation of two Refteks for the Southern Cross shoot.

We approached the first recovery position, OBH 27, at 2230. As if on cue, the weather had deteriorated significantly just in time for recovery operations: 35 kt gusts, rainy, and cold. Sea state was still manageable, though. A storm was hitting the South Island's west coast, and we hoped it would weaken before hitting us fully on the east coast. We recovered OBH 27 at 2247 and got underway for the next site.

3 March 1996, Sunday

We proceeded with recoveries on Line 2E all day Sunday, picking up OBH 25 at 0253, OBH 26 at 0525, OBS A2 at 0710, OBS A3 at 0920, OBS C3 at 1230, OBS A1 at 1510, OBH 18 at 1807, and OBH 21 at 2159.

4 March 1996, Monday

At 0035 we recovered OBH 24, the first instrument on Line 1E. We finished up recoveries without event on the east side through the day, picking up OBH 23 at 0257, OBS C1 at 0514, OBS C4 at 0735, OBS C9 at 1015, OBS A8 at 1133, OBH 20 at 1259, OBH 16 at 1432, OBH 19 at 1553, and OBH 22 at 2032. Recovery of the 19 instruments deployed on the east side took a total of 46 hours. At 2047 we got underway for the Southern Cross deployments.

5 March 1996, Tuesday

In the early hours of the morning we rendezvoused off Oamaru with a small charter boat to transfer a Department of Conservation observer, Linden Perriman, on board. Flat calm weather made the transfer safe and simple; the view of the setting moon over the lights of Oamaru was spectacular. After the transfer we got underway for the Southern Cross deployments, which would consist of three OBH and two OBS.

We began the Southern Cross deployments on a beautiful morning: flat calm seas, sunny, with a light breeze. OBH 27 was deployed at 0811, OBH 26 at 1041, OBH 25 at 1310, OBS A8 at 1507, and OBS A2 at 1616. During the day we were treated to views of dense schools of fish churning the water white and playful dolphins swimming near the ship. After dinner we deployed the guns and single channel streamer in about an hour. Because of the sensitivity to marine life in the area, we brought up the gun array gradually, adding two guns at a time. The firing parameters for the Southern Cross were 30 sec rep rate (randomized ±1 s) and a speed of 4.5 kts over ground, in order to avoid previous shot noise on our 40-km-long profiles.

At 1820 we fired our first shots and began recording Line SC1 at 1827 (first shot #40154).

6 March 1996, Wednesday

Our last full day at sea. We finished line SC1 at 0005 and turned 270° at 10°/minute (twice the usual rate due to the short streamer). We continued the Southern Cross shoot, completing line SC2 at 0317, SC3 at 0941, and finally SC4 at 1702. By 1800 the guns and SCS streamer were aboard, and ten minutes later we began OBH/S recovery. OBH 26 came aboard at 1843, OBH 27 at 2109, and OBS A8 at 2258.

7 March 1996, Thursday

We picked up our last two instruments in the early morning hours — OBS A2 at 0010 (we congratulated Greg Miller on his last OBS recovery), and OBH 25 at 0203. This successfully ended deck operations for the cruise, and we got underway at a leisurely 2-3 kts for Port Chalmers. We met the harbor pilot at 0700 and were alongside at the dock at 0715 (Steve won $25 in the anchor pool). Our 40' container showed up at 0900 and we began offloading operations. Data archiving and computer shutdown continued on Thursday, due to the extremely short transit following our last instrument recoveries.

Shipboard Operations

The Ewing proved to be an entirely suitable platform for our operations, particularly in the following regards:

- The crew is industrious and helpful.
- Technical support is excellent. Joe Stennett is a gold mine of knowledge, and Chuck Donaldson was always ready to lend a hand. The gunners kept guns in good working order throughout shooting, and Chief Engineer Steve Pica put his time and resources at our disposal to repair our damaged OBH on short notice.
- The bridge crew was enthusiastic and capable — they put us over waypoints and accurately on station every time.
- The *Ewing* is well outfitted for OBH/S work — the RDF, navigation, and deck space were all suitable for our needs.
- Computer support and resources are excellent — hardware, software, and grayware. Bill Robinson is knowledgable and helpful.

On several points, however, there is room for improvement in *Ewing* operations:

- The MCS system had insufficient streamer and spares (cans and streamer sections). Not having the requested 4-km-long streamer on the west side shooting was a major disappointment and significantly impacted our ability to suppress multiples in processing that data.
- We had problems with balancing the streamer on the west side -- the sections near the tail were towing at 20–30 m depth throughout most of the west side shooting, even when steaming 5.5 knots through the water. This situation was rectified on the east side by adding oil and birds to that part of the streamer.
- In our opinion Joe Stennett is overworked. He is the only person on board who can oversee the deployment of the streamer and the initiation of the seismic acquisition system. Since this process can take longer than 24 hours and be fraught with glitches, this puts an unreasonable load on Joe — though he is the very model of patience, industriousness, and equanimity throughout — and makes the entire process dependent on one person. It would be advisable to provide an additional person trained in the specifics of the seismic system so that the MCS deployment tasks can be shared.

Communication and coordination

The survey was a highly integrated project between onland and offshore operations. All the airgun shots were required to be recorded by the land based Reftek arrays. The ship operations - deployment of OBS/Hs, deployment of MCS streamer and airguns, shooting of profiles, recovery of OBS/Hs, transit of the ship from the west coast to the east coast of the South Island - had to be closely coordinated with the land operations - installation of 200 Reftek recorders, recovery of Reftek recorders, downloading of data at Timaru, charging of batteries, checking of Reftek recorders - throughout the survey. Both operations had phases which were weather dependent (eg installation of Reftek instruments on the Main Divide by helo) and both land and marine instruments had time limitations (eg OBS/H bottom times). Excellent coordination was essential between the land and marine operations.

Three levels of communication were available: cell phone, email, and Inmarsat fax and phone. All were used, the former two extensively, the latter less so due to cost. The operational constraints on these systems were:

cell phone - limited to a range of about 70 km from the coast and a major population centre. The ship was out of cell phone coverage for about 70% of the west coast work, for about 60% of the east coast work and for 90% of the transit tracks. Several times the Timaru base was unmanned when a call was tried (partially a problem of a 24 hr working base on the ship cf about 10 hr for the shore base) but, fortunately, at most critical discussion/information junctures we were in range.

email - most coordination was carried out by email because of the lack of cell phone coverage and the cost of Inmarsat. It had the advantage of providing hardcopy. Email had two major constraints - it was transferred only twice a day (0930 and 2130 local time approx), and the Timaru node was flaky for the early part of the survey. Despite these constraints, email was the prime means of coordination.

Inmarsat - cost was the constraint here.

Coordination started well, with all Project PIs involved in the onshore explosion survey immediately prior to the offshore-onshore work. This enabled PIs to discuss the offshore-onshore work before the cruise commenced and get experience of some of the problems which would be experienced with the land operations. All PIs met on the EWING prior to sailing to discuss the plans. In addition, activity calenders were produced and exchanged for the marine and land operations. These were updated and exchanged on a regular basis by email. Where the cell phone was in range, regular calls were made into the Timaru base to up-date both groups on the current status of the work. The emphasis on, and limitations of, email meant that a quick interchange of concerns or plans was not posssible unless it was considered urgent and Inmarsat used. This did happen on several occasions. However, towards the end of the cruise, misunderstandings did arise in the development of the contingency plans for extension to the survey work (the Stewart Island line and the Southern Cross experiment) because of time delays arising from the use of email and the lack of a facility to have a "round table" discussion between marine PIs and land PIs to review all options and the constraints for the two groups.

An additional problem arose when a shore PI was not available for discussion of consultation because they were in the field. This situation was exacerbated if the ship was just going out of cell phone range.

We were fortunate that there were no major delays with either land or marine operations that would have necessitated a significant change in plan at short notice. The major change in the original operational plan was the decision to shoot line 4 (the coastal profile on the east coast) before the second recording window on the programmed Reftek recorders had switched on. This change in plan was accommodated by early communication on the options by email and the use of the cell phone when on the east

coast. The second major interaction was over the development of the contingency plans for additional studies, when it appeared likely that the planned work programme would be completed early. Two options were developed for further work, one by the shipboard team and one by the land based group. Email was used to exchange ideas and outline constraints from both groups, but the time delays in getting a response via email (12 hrs minimum) meant that a long time elapsed before the full constraints on a range of options were known to all. This led to frustration. In the event, the good weather conditions and reliable equipment resulted in both additional surveys being carried out.

Department of Conservation Observer

The additional survey off Oamaru (the "Southern Cross Survey) was notified to both Maritime Safety Authority and Department of Conservation. The Department of Conservation requested that they place an observer on board the ship to observe the behavior of marine mammals and seabirds during the airgun work. The survey area is close to the habitat of the Hooker's Dolphin, a rare native New Zealand dolphin. The observer, Lyndon Perriman, a Conservation Officer with the Department of Conservation's Dunedin office, was picked up at sea off Oamaru, and stayed on the ship until the completion of the survey 2 days later. His expenses were covered by the project. He investigated the seismic surveying method and operations of airguns but spent most of the daylight hours during the airgun operations watching for marine mammals and seabirds. The weather was very good and seas calm, so observing conditions were optimum. His report will be copied to the PIs.

Shipboard Computing and Networking

WHOI computer resources employed on EW9601 included three SUN workstations, two HP workstations, three PCs, one MacIntosh SE, one PowerBook 145, one PowerBook 5000 and two HP laserprinters. The workstations and PCs were set up on the ship's ehternet and shared disk and printer resources. The PCs were able to access the workstations' large disk partitions using PC-NFS, and performed data downloading tasks via the ethernet connection and PC-NFS to the SUN workstations. The following table lists the computer resources and their functions for EW9601. A common user account, "kiwi", was established on all workstations assuring consistent file ownership, and access for all cruise related data handling, while also establishing a common user working environment.

Computer/Type	Function	Resources
indigo / SUN	transcription, archiving and SEGY conversion	~3 Gbytes disk space Exabyte tape drive
jade / SUN	transcription, archiving and SEGY conversion	~2 Gbytes disk space Exabyte tape drive
alpamayo / SUN	data processing and SEGY conversion	~2 Gbytes disk space Exabyte tape drive
ballyhoo / HP	MCS data processing OBH/S data processing	Optical disk drive
hekla / HP	MCS data processing OBH/S data processing	IBM 3490 cartridge tape reader ~4 Gbytes disk space
OBH1 / PC	raw data download program instruments pre- and post- deployment checkout	PC-NFS download hardware and software SAIL communications
OBH1 / PC	raw data download program instruments pre- and post- deployment checkout	PC-NFS download hardware and software SAIL communications
k2 / HP	network printer	
PowerBook 145	document processing	
PowerBook 5300	document processing	
MAC SE	document processing	

The ship's network experienced intermittent delays, and network traffic collisions were significantly elevated above what would normally be expected. The cause of these problems was not determined definitively but could have been the result of a faulty ethernet cable or perhaps a bad transceiver. No data were lost as a result of the network hiccups, but performance was degraded. WHOI computer resources will be tested separate of the ships network to determine whether their network devices are sound.

O.B.H. DECK OPERATIONS

Both deployments and recoveries of the OBHs for this experiment were carried out without the use of the deck cranes, other than for movement of anchors into the deployment location.

DEPLOYMENTS

Instruments were deployed over the stern, utilizing the A Frame and Trawl Winch. As in the past, anchors were suspended over the transom, hanging on a slip line. The instrument frame was positioned under the A Frame before mounting the OBH electronics package, in order to avoid undue vibration during movement on deck. The frames were oriented with the OAS hydrophones facing aft, in order to avoid possible damage during tag line removal. The instruments were deployed with their single EG&G Model 8242 releases enabled.

Once in position, the frames were fitted with the OBH electronics packages; the recovery aids were switched on, and their proper operaton confirmed; the mooring pennant, previously shackled to the anchor, was attached to the release drop hook; lines were rove through the two inner tag line brackets; and the trawl wire was attached to the lifting bail via a quick release hook. In order to reach from the suspended anchor to the OBH frame, the mooring pennants needed to be fed over the MCS roller under the A Frame. This necessitated lengthening the pennants from their usual 3 Meters, to approx. 4.5 Meters.

On information from laboratory that the ship was close to the deployment sight (~100 Meters), the OBH was lifted off the deck with the trawl winch, moved outboard with the A Frame, the anchor slipped onto the release hook, and the instrument lowered to a position approximately 1 Meter above the water. It was stabilized in this position by two tag lines and by the anchor which at this point was about three meters below the surface of the water. When the deployment sight was reached, the frame was lowered into the water, tag lines removed, and the instrument released with the quick release hook.

As soon as possible after launching the instrument and receiving clearance from the bridge, a transducer was lowered approximately 10 meters over the starboard side, and the instrument's transponder interrogated. When ranges collected by the EG&G 8011A Deck Unit indicated that the instrument was sinking (or on bottom at shallow deployment sights), the transponder was disabled, the transducer recovered, and the ship gotten underway for the next way point.

RECOVERIES

Instrument recoveries were effected from the starboard side, at forward end of the waist deck. Location of the EG&G transducer was the same as for deployments. Once the ship arrived over the instrument, its 8242 transponder was enabled, interrogated to confirm location, and then released. Experience showed that rise rates were slightly over 60 Meters a minute for the frames equipped with a single release. Again, as with the deployments, no crane was used. Once released and on the surface, OBHs were brought along side and a recovery line attached. They were then lifted to deck level with a bull rope rove through the starboard A Frame, to a snatch block on deck, and then aft to the starboard capstan. Once at deck level, tag lines were run through the two inboard eyes. Once good control was assured by the tag lines, the frames were lifted by the bull rope, swung inboard with the A Frame, and then lowered onto the deck.

OBH operations conducted in the manner described above went smoothly and easily once the routine was established. Control, especially during deployments, was probably superior to what could have been obtained with the ship's cranes. Operations required marginally more personnel. than would have been needed for crane operations, but the ships crew assisted cheerfully and skillfully.

*.raw files were put on each tar tape and often each tape contained more than one tarfile.

c) A third backup of the data was accomplished by using the 'dump' command to backup those filesystems containing original data (on indigo:/data, /data1, /indigo1 and on jade:/NZ1 and /NZ2). A script containing several 'dump' commands was used for each 8mm tape.

3. Convert the data to SEG-Y format. The program "obh_to_segy" converts raw OBH data to SEG-Y format data. On this cruise it was modified somewhat to accommodate a user supplied reduction velocity, and a user supplied static time shift. The way the program handles input parameters was also modified. It was recommended that the program be made to utilize the OBH clock drift information and correct for clock drift "on the fly" during conversion from raw to SEG-Y formats but at this time that change has not been implemented.

The command used to generate SEG-Y format files is:

```
obh_to_segy if=RAW.file of=SEGY.file tf=TIMES.file rf=RECVR.file
            sr=start_record er=end_record vr=vel_reduction ts=static_time_shift
```

where:

if = raw OBH data input file name (char)
of = SEGY output file name (char)
tf = shot instant times file name (char)
rf = receiver file name (char)
sr = starting input record (int)
er = ending input record (int)
vr = reduction velocity (float, km/s)
ts = static time shift (float, s)

On this cruise, scripts were set up to run a whole line's worth of raw input files. The end record was chosen to encompass all the line's shots. The static time shift (to 0.1ms) applied was:

-1(UTC/GPS clock offset (ie. -11.0s) + OBH predeployment clock correction)

An example of the command used to convert the data collected by OBH 16 on line 1W is:

```
obh_to_segy if=obh16w1.raw of=obh16_1w.segy tf=line_1w.shots
            rf=obh16.receiver sr=1 er=200 vr=8.0 ts=10.9912
```

4. Process the SEG-Y data. All subsequent processing was performed on the SEG-Y formatted data, using SIOSEIS and pltsegy, two applications resident on the H-P workstations. Processing included decimation, filtering (bandpass and coherency), and deconvolution. Data were displayed on the screen and acceptable Postscript files of record sections and selected trace data were sent to the plotter or laser printer.

Proposed Changes to the Shipboard *obh_to_segy* Procedure

The current shipboard implementation of the obh_to_segy code suffers two principal shortcomings that significantly reduce the usefullness of this shipboard task. 1) The current version of the code permits a single time shift correction (shot time with respect to OBH time) but does not provide for the correction of deployment-to-recovery clock drift. 2) The OBH position currently used as input to the code is the deployment position – no shipboard effort is currently made to relocate the intruments using information from the nearest-ship-approach shots. While the OBH SEG-Y files made on board serve a variety

of useful purposes at sea, they are at an intermediate stage of reduction which only marginally justifies the efforts made to archive them.

The enumerated shortcomings of the shipboard obh_to_segy procedures can be overcome with reasonably little effort. Item (1) requires only a straightforward addition to the code (built around the framework of the time-shift and reduction-velocity corrections to the start-of-trace time) to incorporate a timing correction that linearly varies from the pre-deployment to the post-recovery OBH-to-GPS clock offsets. These offsets are currently logged in the receiver books. Item (2) can be addressed with a procedure such as the following:

a) Plot the ship tracks in the vicinity of each instrument along with deployment and recovery position.
b) Determine on which "side" of the track line the instrument came to rest on the seafloor and the times of shots approximately 5 km on either side (along track) of the instrument.
c) Run obh_to_segy using only those tracks in the neighborhood of the time at which the ship passed the instrument location (5 km on either side should suffice) using the times from step (b).
d) Use the arrival time of the earliest arriving shot to determine a line perpendicular to the ship track along which the instrument must be located.
e) Use deploy/recovery depths and traveltime information to determine an on-bottom position for the instrument.

It is highly desirable that a spreadsheet application run on a Macintosh be used for the tabulation of the various data elements required for the calculation of the on-bottom instrument postion as well as for the calculation itself. This spreadsheet could be naturally incorporated into the data management/tracking tasks currently performed on a Macintosh.

With these changes to the shipboard obh_to_segy procedure, the resulting SEG-Y files of OBH data will be reduced into an archivable format. They will serve as the primary copy of the data to be accessed for further processing and analyses back on the beach.

MCS Operations

Airgun array and streamer configurations

The full 20-gun array was used as sound source for all seismic measurments. Details of the towing pattern, gun size and offset are given in the attached table and figure. Nominal towing depth of both guns and streamer was 8 m. Air pressure was 2000 psi.

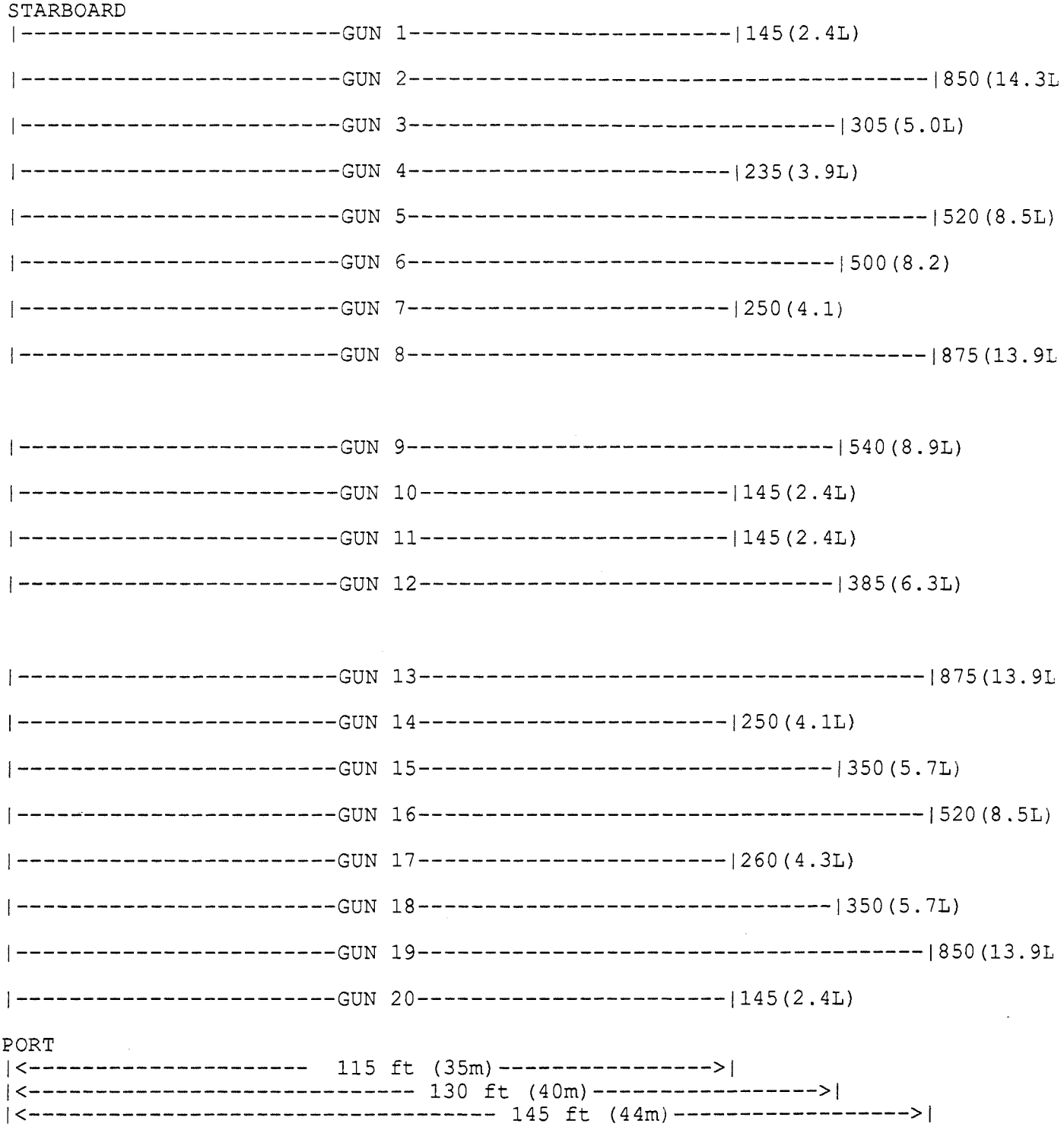
Two MCS streamer configurations were used during the cruise, both using all streamer sections available at the time. For the west coast part of the survey, from Lyttleton to Bluff, the streamer comprised 26 active sections giving a total active length of 2600m. After receiving an additional 9 active sections at Bluff and making repairs to sections not working during the first part of the survey, the streamer for the east coast survey comprised 38 active sections and a total active length of 3800 m. Details of the streamers and the positions of the depth control birds are given in the attached tables.

The shorter high-speed "single channel" streamer was used for the "Southern Cross" survey. This comprised a 50m tow cable, a 25 m stretch section, and then 4 active sections in order from the tow end 12.5 m, 25m, 50m and 50m long. All four channels were recorded.

During the cruise we ran the Sioseis-based, pseudo real-time processing system set up by Graham Kent. This system enables stacks of data to be produced with a delay of one 3480 tape (~20 min.) from acquisition. Early problems in our use of the vtrkwb parameter (?) in the water-depth-tracking velocity function calculation caused us to fall behind in processing the tapes as they came out of the acquisition system. We therefore abandoned our goal of keeping up with the MCS acquisition, at least during the West Coast shooting. Our scientific and operational decisions were in no way dependent on completing the real-time stacking; the real-time display provided on the chart recorder by the LDEO SCSI splitter was sufficient to monitor the seismic structure. We still occasionally viewed gathers from recent 3480s to verify that data were being properly recorded. A description of the "stackit" procedures is attached to this appendix.

Also included in this appendix are guidelines to the MCS acquisition watchstander's duties.

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.

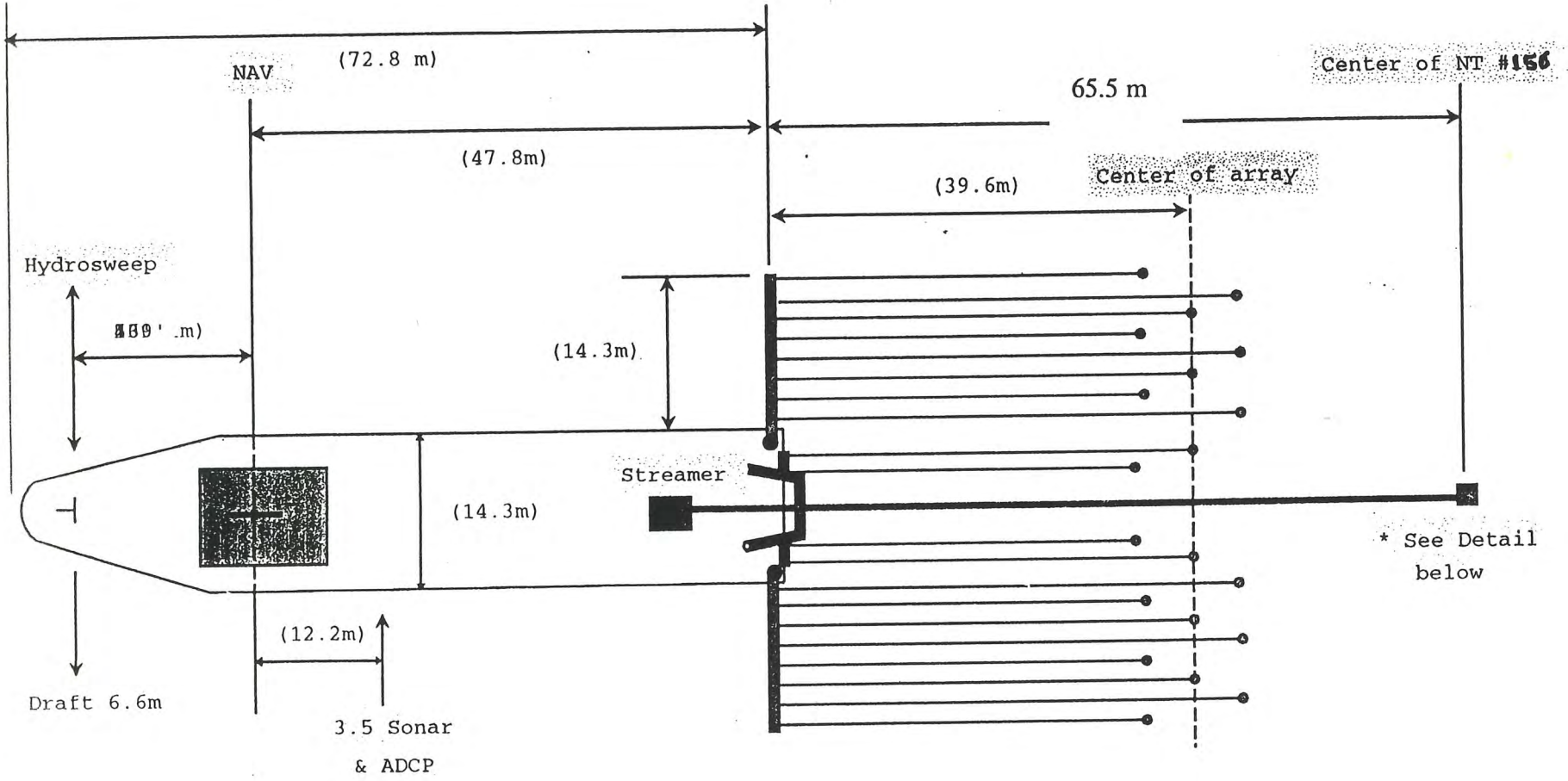
EW9601-Streamer used on western deployment. Sections marked "xx" were physically in the streamer, but were not recorded due to telemtry problems.

Section Number	Section Type	Sect. s/n	Can s/n	Remarks
--	50-m Tailrope	????		
xx	100m DSS240 Active	1531	798	Bird 1
xx	100m DSS240 Active	1486	1029	
xx	" " "	1593	3237	Bird 2
xx	" " "	1348	3302	
01	" " "	1455	3255	Bird 3
02	" " "	1523	1457	
03	" " "	1341	1141	Bird 4
04	" " "	1246	3278	
05	" " "	1176	1254	Bird 5
06	" " "	1244	803	
07	" " "	1460	3114	Bird 6
08	" " "	9466	3109	
09	" " "	9450	1248	Bird 7
10	" " "	9409	1449	
11	" " "	9456	3061	Bird 8
12	" " "	9442	1239	
13	" " "	9453	3046	Bird 9
14	" " "	9140	1046	
15	" " "	9316	3047	Bird 10
16	" " "	9451	3079	
17	" " "	9376	1345	Bird 11
18	" " "	9407	L441	
19	" " "	9335	3150	Bird 12
20	" " "	9109	3139	
	Power Adapter(3 meters)	PWR1		Bird 13
21	100m CANTO Active	2021		Bird 14
22	" " "	2046		Bird 15
23	" " "	2024		Bird 16
24	" " "	2029		
25	" " "	2026		Bird 17
26	" " "	2027		
	Tow leader			
27	Impendance Converter			
28	OBAD			

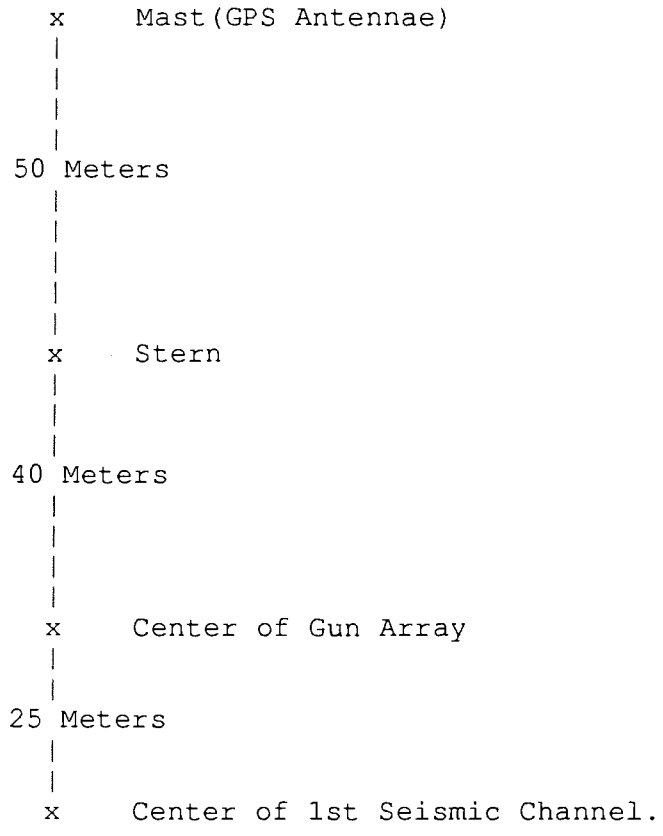
EW9601b----Streamer as used on the eastern deployment.

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	
06	" " "	1341	1141	Bird 3
07	" " "	1246	3278	
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	" " "	9335	3150	Bird 09
24	" " "	9109	3139	
	Power Adapter(3 m)	PWR1		
25	100m CANTO Active	2021		Bird 10
26	" " "	2046		
27	" " "	2024		Bird 11
28	" " "	2029		Bird 17
29	" " "	2012		Bird 12
30	" " "	2028		
31	" " "	2022		Bird 13
32	" " "	2041		
33	" " "	2009		Bird 14
34	" " "	2008		
35	" " "	2005		Bird 15
36	" " "	2019		Bird 18
37	" " "	2026		Bird 16
38	" " "	2027		
	Tow leader			
39	Impedance Converter			
40	OBAD			

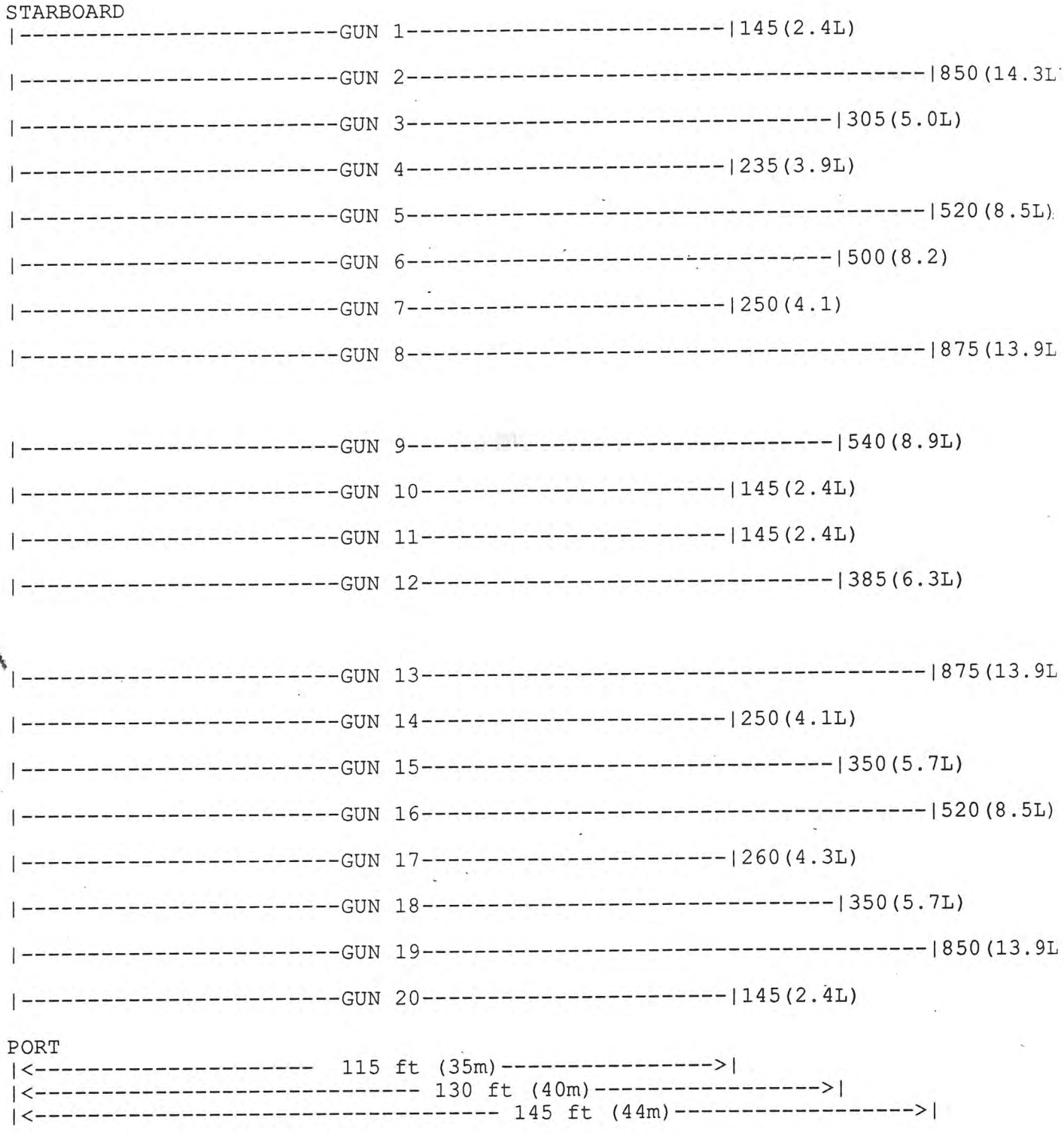
MAURICE EWING SETBACK AND OFFSET DIAGRAM



Offsets for Gun Array and Streamer as used on EW9601.



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



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The towing lines are separated by 5 ft.
The numbers to the right of the tow-line representation are gun volumes in cubic inches.

EW9601-Streamer used on western deployment. Sections marked "xx" were physically in the streamer, but were not recorded due to telemtry problems.

Section Number	Section Type	Sect. s/n	Can s/n	Remarks
--	50-m Tailrope	????		
xx	100m DSS240 Active	1531	798	Bird 1
xx	100m DSS240 Active	1486	1029	
xx	" " "	1593	3237	Bird 2
xx	" " "	1348	3302	
01	" " "	1455	3255	Bird 3
02	" " "	1523	1457	
03	" " "	1341	1141	Bird 4
04	" " "	1246	3278	
05	" " "	1176	1254	Bird 5
06	" " "	1244	803	
07	" " "	1460	3114	Bird 6
08	" " "	9466	3109	
09	" " "	9450	1248	Bird 7
10	" " "	9409	1449	
11	" " "	9456	3061	Bird 8
12	" " "	9442	1239	
13	" " "	9453	3046	Bird 9
14	" " "	9140	1046	
15	" " "	9316	3047	Bird 10
16	" " "	9451	3079	
17	" " "	9376	1345	Bird 11
18	" " "	9407	L441	
19	" " "	9335	3150	Bird 12
20	" " "	9109	3139	
	Power Adapter	PWR1		Bird 13
21	100m CANTO Active	2021		Bird 14
22	" " "	2046		Bird 15
23	" " "	2024		Bird 16

25	" " "	2026	Bird 17
26	" " "	2027	
	Tow leader		
27	Impendance Converter		
28	OBAD		

EW9601b----Streamer as used on the eastern deployment.

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	
06	" " "	1341	1141	Bird 3
07	" " "	1246	3278	
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	" " "	9335	3150	Bird 09
24	" " "	9109	3139	
	Power Adapter	PWR1		
25	100m CANTO Active	2021		Bird 10
26	" " "	2046		
27	" " "	2024		Bird 11
28	" " "	2029		Bird 17

30	"	"	"	2028	
31	"	"	"	2022	Bird 13
32	"	"	"	2041	
33	"	"	"	2009	Bird 14
34	"	"	"	2008	
35	"	"	"	2005	Bird 15
36	"	"	"	2019	Bird 18
37	"	"	"	2026	Bird 16
38	"	"	"	2027	
	Tow leader				
39	Impedance Converter				
40	OBAD				

MCS Acquisition Watch: pseudo real-time data stacking

Overview:

- We are processing the MCS seismic data through stack while acquisition is ongoing. This is primarily a quality control effort, but it will also provide us with a reasonable stack to serve until such time as a proper stack is produced.

- The tasks associated with MCS processing are to be performed only after all tasks associated with data acquisition have been attended to.

- Real time processing will be done on the HP workstation *hekla* running the sioseis program out of the script *stackit*. Sioseis will read SEG-D formatted data from the 3480 cartridge drive, sort the data into CDP gathers, perform NMO and stack, and write out the stacked traces to a SEG-Y file. It will take ~20 min to read and process the data from a single cartridge. When sioseis is ready for another cartridge, it will prompt the operator to load a new cartridge and issue a continuation command.

- Operator control of the processing flow consists of loading tapes into the 3480 cartridge drive, issuing a continuation command to sioseis, and archiving the cartridge which has just been read. Additional quality control elements may be included in this flow.

Cookbook:

Starting sioseis:

1) hekla> cd /mcs/West/3480 (or /mcs/East/3480)
2) hekla> stackit

Changing cartridges:

1) Press reset button on 3480
2) Press unload button on 3480
3) Remove old cartridge and insert new cartridge. If the CHECK 58 message appears, you have inserted (or removed) the cartridge too quickly. Press reset and do over.
4) Issue the continuation to sioseis by placing the file *in* into the directory in which *stackit* is running. The file *in* should consist of either a 0 (for continuation) or a -1 (to end processing). From a window other than the one in which *stackit* is running:
   a) Wait until the display on the 3480 drive says Ready.
   b) hekla> cd /mcs/West (or /mcs/East)
   c) hekla> cp in 3480

- If a mistake was made (forgetting 4a is common) and *stackit* has stopped, you can restart it following the procedures in Stopping and restarting *stackit* .

Quality control measures:

The two principal QC measures will be the display of "data stacked so far" and the display of the first shot gather of a new cartridge. These tasks can be performed during the pause while sioseis is waiting for a continuation. During this pause:

- the data stacked so far can be viewed by copying the *stackit* output SEG-Y file to a separate file name and plotting.
- shot gathers from the next cartridge tape can be read and displayed from a separate sioseis process to verify that all channels are performing properly.

If, after viewing a stack or shot gather, it is determined that the parameters of *stackit* need to be changed, then the procedures for stopping and restarting *stackit* should be followed.

Display of "data stacked so far":
While sioseis is waiting for a continuation:
1) hekla> cp /mcs/West/3480/*name*.segy othername.segy
   where *name* is the file name of the output SEG-Y file of the *stackit* script
2) when the copy is complete, issue continuation to sioseis *stackit* script.
3) The file *othername.segy* may then be manipulated at will.

Viewing the first shotgather of a new tape:
1) Determine the first file on the new tape by inspecting the label.
2) While sioseis is waiting for a continuation, after you have loaded the new tape, from a window other than the one *stackit* is running in:
   a) hekla> cd /mcs/West/3480
   b) hekla> gather ####
      (where #### is the file number of the first file of the new tape)
3) The first shot gather of the new tape will then be read and displayed on the screen, with traces labeled according to range.
4) If there are channels which have large noise signals, note the range of the channel, and proceed with steps for stopping and restarting *stackit* and changing mute parameters of *stackit.*
5) If all looks ok, issue the 0 continuation to *stackit.*

Stopping and restarting *stackit* :
Stop the *stackit* script by issuing a -1 continuation, i.e.:
1) edit the file *in* so that the file includes only the characters *-1*, (see How To Edit).
2) hekla> cp in /mcs/West/3480
3) Sioseis will then close out it's sort file by stacking at the available fold all data currently in the sort file, write these stacked traces to the output SEG-Y file, and close the output SEG-Y file.
4) To complete the "stopping" procedures, rename the stacked SEG-Y file according to the naming convention described in SEG-Y file naming conventions.
5) Make the appropriate changes to the *stackit* script and restart.

IMPORTANT: Whenever stackit is stopped and restarted, we want to restart using the last cartridge to be completely run through *stackit*. So, after performing the stopping procedures, do not unload the cartridge and start with the next one. Restart the *stackit* script using the cartridge which was in the tape drive when *stackit* was stopped.

To restart stackit:
1) hekla> cd /mcs/West/3480 (or cd /mcs/East/3480)
2) Edit the *stackit* script and change the file name in the line: set STKFILE=*name*.segy, so that *name* corresponds to the naming convention described in SEG-Y file naming conventions (see How To Edit).
3)
3) hekla> stackit

Changing mute parameters of *stackit.*
1) Perform stopping procedure for *stackit.*
2) hekla> cd /mcs/West/3480
3) edit the file stackit, and modify the parameters for the process smute to include an offset-time pair corresponding to the bad channel you observed. Example:

```
smute
  xsets 2250  0 16
        3025  0 16  end
end
```

mutes channels at offsets of 2250 m and 3025 m between 0 and 16 s. If you discover that the channel at offset 263 is now also bad, edit the file to read:

```
smute
  xsets  263  0 16
        2250  0 16
        3025  0 16  end
end
```

Other information:

How to Edit

Editing on the HP can be done using vi, emacs or nedit. If you are not familiar with vi or emacs, then you should use nedit or vuepad. nedit and vuepad are a cursor based text editors invoked by:

hekla> nedit filename
hekla> vuepad filename

SEG-Y file naming conventions

The general file name for the stacked data of a given line will be: *linename*.segy, where *linename* is the name assigned for the lines by convention of all the PIs. The line names and corresponding SEG-Y file names for the West side shooting are:

Line Name	SEG-Y Files
line 1W	line1w.segy
line 21W	line21w.segy
line 2W	line2w.segy
line 3	line3.segy
line 13.	line13.segy

These SEG-Y files may be closed out before an entire line is shot and stacked. This would occur if *stackit* was interrupted to adjust any of the scripts parameters. In cases when the stacked data from an entire line are not stored entirely within one SEG-Y but are stored in several cdp-consecutive files, the naming of these files will follow the convention: linename.a.segy, linename.b.segy, linename.c.segy, etc.

If *stackit* is stopped in the middle of shooting line 1W, for example, then the following should happen.

1) hekla> mv line1w.segy line1w.a.segy
2) edit *stackit* to make appropriate changes **AND** change STKFILE to line1w.b.segy
3) restart *stackit*

```
#!/bin/csh
#
set STKFILE=line6E.a.segy
#
#
/users/kiwi/Sioseis/bin/sioseis << !

procs segdin geom header mute smute despike filter gather nmo stack diskob end

segdin
  ffilen 1     lfilen 99999
  ftr 1     ltr 152
  stime 0.0  secs 16.0  decimf 2  iunit 0 end
end

geom
 type 2 fs 1 ls 99999
 gxp 1 -3938 152 -163 ggx -25 dfls 50 dbrps 12.5 smear 12.5 end
end

header
 fno 1 lno 99999 ftr 1 ltr 9999 ltype multiply lhdr 10 -1 end
end

gather
  maxrps 152 nwrds 4060 maxtrs 40 end
end

mute
  fno 1 lno 99999
  xtp  163 .11 3938 3.6 end
end

smute
  fno 1 lno 99999
  xsets  163 0 16
         188 0 16
         213 0 16
         238 0 16
         263 0 16
         288 0 16
         313 0 16
         338 0 16
        1663 0 16
        3013 0 16
        3188 0 16
        3713 0 16 end
end

despike
 thres -500 500 end
end

filter
 ftype 2 pass 5 end # high pass
end

nmo
 vtrkwb 5000.
 fno   40 lno   40 vtp 1500.0  0.053
                       2000.0  1.000
                       2700.0  2.000
                       4300.0  5.300
                       6700.0  9.000
                       9000.0 16.000 end
end

stack
 header normal end
end

diskob
 opath $STKFILE end
```



```
end

end

!
```

MCS Watchstanding Duties and Procedures

Last Revision: 2 March 1996

The nominal duties of the MCS watchstander are summarized here. Check with the previous watchstander and the chief scientist for anomalies or additional duties. The main duties are described, followed by the main procedures to accomplish the duties. The third section describes Additional Procedures which arise from time to time, such as changing lines or rebuilding the streamer. The last section describes the layout of the watchstanders area and should perhaps be read first by new watchstanders.

I. Duties

1) Observe acquisition system monitors for error reports and acquisition interuptions. In the event of acquisition failures lasting more than a few minutes, the Ewing Science Officer should be notified.
2) Complete the seismic log information sheets from data displayed on monitors and change data tapes as necessary.
3) Complete the watchstanders log at half hour intervals, sounded by a buzzer, recording the basic underway information.
4) Note messages from the bridge or others on behalf of the chief scientist.

II. Main Procedures

A description of the location of displays, buttons and alarms is given in Section IV. It doesn't take too long to figure out where everthing is. While the observation section 1) is lengthy, in practice not much happens and more time is actually spent on duties 2) and 3) above, and at times 4).

1) Observing Acquisition system.
Special attention to some monitors is required to detect acquisition system faults. Listed below are the routine checks but be on the lookout for anything that appears to have changed.

1.a) Acquisition system alerts are posted in yellow or red on the "CSRU" screen (#4) [**C**able **S**upervisor and **R**ecording **U**nit]. The system recovers from some errors automatically, but other sequences require operator intervention and occasionally urgent action. Yellow alerts fix themselves generally.

Three common acquisition system alerts are;

> "Shot not recorded due to acquisition error" should be noted on log sheet but no further action is required.
>
> A three line, Red "SQTP --error 84 " may go away after a few iterations. If it persists see the SQTP procedure below to switch recording to the other drive. Occasionally the same error arises on BOTH tape drives and recording is halted. This case is also covered in the procedure.

A load of messages indicating the streamer is being rebuilt, usually accompanied by a continuous alarm buzzer (alarm reset location described in "orientation section") should be noted and repeated rebuilds, say after the fourth in 10 minutes, is cause to alert the science officer and possibly the chief scientist. Note the streamer wiggly line display (#5) after any rebuild to be sure all sections are recording. Note also at the top of the "CSRU" terminal that the correct number of cans has been built. Contact the Science Officer if the rebuild does not appear to be correct-he may ask you reset to the CSRU, see procedure below.

1.b) On rare occasions the "CEO" terminal [Control Executive Overseer], "CEO information" window may fail to update the shot number and file recorded to tape. This occasionally accompanies the SQTP error. If a few shots pass with no update, see the procedure for "CEO Update".

1.c) Glance at the streamer depth profile from time to time. The sea temperature, speed through the water, salinity, buoyancy of each section and various malfunctions can cause the optimum depth, shown in green, to not be maintained by the birds attached to the streamer. About the only thing that can be adjusted easily is the speed through the water. Balancing the streamer depth vs the speed over the ground and corresponding shot interval is the chief scientist's decision. In shallow water (<60 m), special attention to the streamer depth and tension is warranted.

1.d) Glance at the streamer tension and airgun pressure meters to be sure they are within limits. The streamer should not exceed 3600 pounds, it's working limit is 5000. High speed through the water may cause relatively high values. Sudden increase or decrease in tension may indicate the imminent (or recent) loss of the streamer. Notify the Science officer and the bridge immediately. Air gun pressure should rise to about 2000 psi, low values may indicate a leak but are usually caught early on by the gunners. Persistently low numbers may require the shot interval to be increased or an additional compressor to come online.

1.e) Alerts from real time data systems other than MCS are indicated by the "Moray" console beeping. The red window "Watch_Log" will highlight a line indicating which system has issued the alert. Note this in the watch log and disable the alert by typing d and the number of the source. You should contact the Science Officer if the system is critical.

2) Completing the "Seismic Recording Log" information sheets. Each page is labelled with the Cruise number, vessel, region, line number, and a sequential page number. At the start and end of each data tape, the shot number, file number, and time is noted. These values all come from the "CEO" terminal, "CEO Information" window. Each new reel is posted to this window, the reel number should correspond to that on the tape label. You want to note the shot, file and time for the entries before and after each new reel notice. The location of the first shot on each tape is noted in the comment field of the log sheet. This location can be obtained from "Moray" terminal in the purple "Seismic Handler" window. As this window scrolls several lines with each shot, use the scroll bar to find the desired shot number and then select the location information by swiping these characters while holding down the left mouse button. Once selected (they shouldbe highlighted) press the COPY button among the function keys on the left side of keyboard. You can then PASTE the location into another window (any command tool window after typing; cat > /dev/null) and then leisurely jot the numbers onto the log sheet. The "Seismic Log" information is also entered into a MacIntosh Excel spreadsheet. The degree symbol (°) is created with the keystroke combination of "shift-option 8" on a Mac.

3) Completing The Science Watchstanders Log. At regular half hour intervals, indicated by a short buzzer, the routine underway information should be noted on the log sheet. All of this information is obtained from the underway information screen (#11) except for the depth, which is obtained from Hydrosweep Center Beam shown on the "Moray" terminal as " ###.# meters" in a small green window (available when hydrosweep in running). Each page begins with the cruise number and a sequential page number. The pit log, speed, heading and time are obtained from the left-most column of the underway information monitor. Note this is the speed through the water and NOT the "speed made good" in the right column, also known as the "speed over the ground". Other useful information can be jotted into the comments, such as wind speed, direction, barometric pressure and sea temperature. Significant events such as instrument launches, course changes, etc may also be noted on this log.

4) The phone should always be answered, if not by the watchstander, chief scientist or science officer at least by someone. "Main Lab" appears to be the usual greeting.

III. Additional Procedures on the MCS Watch

An index to the accompanying procedures is shown below;

A1) "CEO Information Hung"
A2) Rebooting the streamer
A3) "SQTP --error 84"
A4) Emergency Streamer Dive
A5) Installing new roll of tape labels
A6) Changing Lines
A7) Change of Shot Interval

A1) "CEO Information Hung". The list of files and shots shown in the CEO Information window on the "CEO" terminal occasionally becomes hung and is not updated. The may accompany the "SQTP --error 84" discussed in A3.
REMEDY: On the "CEO" terminal, make the CEO window active by clicking the top of it. Select CSRU and then Command. Enter IEP<cr>, and then select SHIP.
The CEO information screen should now be updated.

A2) Rebooting the streamer. The streamer has either failed to rebuild or has rebuilt an improper configuration, i.e. the wrong number of cans or dead sections exist.
REMEDY:

A2.1 Pull out the keyboard drawer on the left and press any key to access CSRU computer.
A2.2 Press the "CSRU Reset" button on the shelf holding the upper level monitors. It is the rightmost button on a small box with two buttons and three lights below the buttons.
A2.3 Type "ld" to load
A2.4 Type "term" to go into terminal mode, you'll see Crosstalk load.
A2.5 Press function key "F1" to reset the streamer. Look for "Aux. buf..." message.
A2.6 Press "esc" to escape back to command mode in crosstalk, the cursor should be in the highlighted stripe at the bottom of screen.
A2.7 Type "quit" and the screen should revert back to the usual display.

A3) "SQTP -- error 84" This error appears as three red alert lines in the "CSRU" terminal (#4). There does not seem to be any operator or system action causing the error, it just happens from time to time. If it happens repeatedly on one drive, you can force the sytem to switch drives and carry on. This may be the result of a media error.
REMEDY:

A3.1 On the CEO terminal, select control button in the CEO Window and then select "Switch Drives". The offending drive should eject tape and recording automatically switch to the other drive.

Occasionally, both drives may encounter the same error consecutively, resulting in both tapes being ejected and recording halted. In this case,
REMEDY:

A3.2 Label any tape with significant amount of data on it.
A3.3 Insert new tapes or shove the current, relatively unused tapes back into the drives. There will be a few shots missed and some reel numbers for which no actual tapes were produced.
A3.4 Carry on numbering reels as the system does, do not correct the reel numbers.

A4) Emergency Streamer Dive. The bridge will call to alert watchstander of a boat on a course to cross the streamer and an emergency dive should be instigated.
REMEDY: Call Science Officer immediately, (124).

A5) The roll of tape labels has expired.
REMEDY: Call Science Officer, (124).

A6) Line Change Procedure:

Bridge will notify Main lab when the end of line and/or the start of line position has been reached. There may be a delay between the end of one line and the start of the next line as the ship gets into position, hold the procedure at "Starting a New Line".

Ending the Current Line;

A6.1 On the CEO Terminal, activate the "Auto-Start-End" window. Under Controls, select "Force EOL". Wait for CSRU Status in the CEO Window to change to "End Line ...".
A6.2 In the "Auto-Start-End" window under controls select "Go OFFLINE"
A6.3 Note the shot #, File # for the EOL and get the position of the last shot from "Moray" Seismic Handler window.
A6.4 The data tapes should have been ejected along with their labels. Eject the NAV tape by pressing "Reset" and then "Unload" on DRIVE 1. Reload fresh tapes in all drives.

Preparing for a New Line;

A6.5 On the CEO Terminal, under "Auto-Start-End" window change the tape number to the next available number, a number one higher than the last tape of the previous line. Change the NAV tape number and change the Line Name.

A6.6 On "Moray" click on the icon that looks like a record section. This should open the "DMS-Window 2000". Press STOP, change the line name, and then press START. Ideally, this should be done in between gun fires.

A6.7 Restart the streamer according to the procedure in A2

A6.8 On the CEO terminal, under the Auto-Start-End window, select controls and then "Prepare for Acquisition". Wait for the CEO window to say "Prepare ..."

Starting the New Line;

A6.9 In the Auto-Start-End window, select controls and then "Force SOL"

A6.10 Note the Shot and file number for the start of line and get the position of the first shot from Moray Seismic Handler window.

A6.11 Note the line change on the flat-bed recorders

A6.12 Complete the Multichannel Line Log information in the book provided.

A7) Change of Shot Interval

A7.1 Call engineer (131) to advise him you are changing shot interval.

A7.2 On the CEO terminal in the CEO Window bring up "Set up Window"

A7.3 After the guns fire, press "STOP" button in the top center

A7.4 Check the time interval and adjust as needed

A7.5 Press "START" and the guns will fire about two seconds later.

IV. Physical Orientation of Watchstander Area

There are 17 monitor screens arrayed for the benefit of the watchstander, some with multiple windows. Six computer monitors on the lower level, from left to right are identified first and then the 11 monitors on the upper level, again from left to right. Some terminals have identification tags above the screen, windows are identified by the name given in the stripe at the top of the window.

Lower Level Displays

1) "Olive" a navigation terminal, does not require observation.
2) "Moray" Real-time Acquisition Console,
3) "CEO" MCS Acquisition Control
4) "CSRU" MCS Aquisition Status Display
5) Streamer wiggly line display, rebuild terminal
6) "TAGS Console"

Upper Level Displays

7) Waist Deck video monitor
8) Meteorological data display
9) Gun depth display
10) GPS Navigation display
11) Underway data display
12-14) Video monitor of starboard gun davit, fantail, and port gun davit
15) "RDL3" , does not require observation

16) "RGT" Streamer depth display
17) "SLIC/ELIC/TAGS..." Shot interval display

Keyboard for the Streamer terminal (#5) is located in the pullout shelf on the left. Other keyboards are located directly in front of the corresponding monitor.

Mounted on the shelf holding the upper level monitors and directly above "moray" are two LED displays showing red 4 digit numbers. These are the Streamer tension on the left and air gun pressure on the right. Further to the right on the shelf is mounted a box with two push buttons and three lights below. The right button on this box resets the streamer. It is labelled "CSRU Reset". Sea temperature is shown on two blue 4 digit displays mounted on the wall above the main hydrosweep console, look over the top of the "CEO" terminal.

The data tape drives are located in the main electronics rack, "Seismics 2", to the right of the watchstanders position. They are labelled as DATA, DRIVE 2 and DRIVE 3. The navigation tape drive is above these two, on the right and labelled as DRIVE 1.

A push button to turn off the acquisition failure alarm is located two racks to the right of the tape drives (in "Seismics 4") on a box with two vertical columns of lights. The button is furthest to the right, between two handles and is labelled "Alarm reset".

==========
R.W. Busby
March 2, 1996
EW-9601, New Zealand

Tables and Appendices

TABLE 1
OBH/S DEPLOYMENTS

Deployment #1 - West Coast (Lines 1W, 12W, 2W, 23W, 3W)

				DEPLOYMENT					RECOVERY		
SITE	OBH/S	EID #	H S/N	DATE/TIME	LAT.	LON.	DEPTH(m)	START TIME	DATE/TIME	LAT.	LON.
1	25	25	G10	2/09/96 16:00	42° 33.682' S	170° 58.843' E	69	2/13/0700	2/17/96 05:43	42° 33.677' S	170° 58.900' E
2	24	24	GF-11	2/09/96 20:23	43° 02.492' S	170° 10.131' E	89	2/13/0700	2/17/96 10:40	43° 02.650' S	170° 10.065' E
3	26	26	GF-9	2/09/96 21:18	42° 59.134' S	170° 06.001' E	142	2/13/0700	2/17/96 12:25	N/A	N/A
4	21	21	GF-14	2/09/96 22:45	42° 55.111' S	170° 01.042' E	228	2/13/0700	2/17/96 13:54	42° 55.148' S	170° 01.088' E
5	A2			2/09/96 23:56	42° 48.702' S	169° 53.162' E	520	2/13/0700	2/17/96 16:00	N/A	N/A
6	C1			2/10/96 01:28	42° 39.077' S	169° 41.360' E	859	2/12/0700	2/17/96 17:58	42° 39.106' S	169° 40.975' E
7	C9			2/10/96 03:27	42° 26.972' S	169° 26.759' E	1080	2/13/0700	2/17/96 20:26	42° 26.952' S	169° 26.607' E
8	C3			2/10/96 05:40	42° 12.418' S	169° 09.356' E	1221	2/13/0700	2/17/96 23:09	42° 12.563' S	169° 09.008' E
9	18	17	1385	2/10/96 08:04	41° 59.018' S	168° 53.560' E	1227	2/13/0700	2/18/96 01:33	41° 59.213' S	168° 53.292' E
10	27	27	GF-2	2/10/96 11:05	41° 42.237' S	168° 33.475' E	1109	2/13/0700	2/18/96 05:50	41° 42.478' S	168° 33.788' E
11	23	23	GF-3	2/10/96 15:33	42° 13.277' S	167° 56.109' E	1667	2/13/0700	2/18/96 13:00	42° 13.239' S	167° 55.816' E
12	C4			2/10/96 18:10	42° 29.570' S	168° 18.422' E	1572	2/13/0700	2/18/96 18:03	42° 29.245' S	168° 18.131' E
13	A3			2/10/96 20:47	42° 44.142' S	168° 38.618' E	1272	2/13/0700	2/18/96 20:59	42° 44.189' S	168° 38.666' E
14	A1			2/10/96 22:37	42° 53.741' S	168° 52.026' E	1037	2/12/0700	2/18/96 23:00	42° 53.646' S	168° 52.110' E
15	A8			2/11/96 00:35	43° 05.335' S	169° 08.476' E	860	2/13/0700	2/19/96 01:24	43° 05.241' S	169° 08.609' E
16	A4			2/11/96 04:07	43° 14.810' S	169° 21.900' E	716	2/13/0700	2/19/96 03:28	N/A	N/A
17	20	20	151	2/11/96 05:54	43° 19.536' S	169° 28.737' E	322	2/12/0700	2/19/96 04:51	N/A	N/A
18	22	22	GF-6	2/11/96 07:19	43° 23.288' S	169° 34.102' E	128	2/12/0700	2/19/96 06:11	43° 22.992' S	169° 34.092' E
19	16	16	GF-15	2/11/96 08:52	43° 25.895' S	169° 37.910' E	46	2/13/0700	2/19/96 07:11	43° 25.769' S	169° 37.905' E
20	19	19	1387	2/12/96 01:22	43° 40.175' S	169° 04.148' E	130	2/13/0700	2/19/96 11:05	N/A	N/A

SITE	OBH/S	EID #	START TIME	END TIME	DISK SIZE	#TRACKS	#CHANS	SAMP RATE	BYTES/SAMP
1	25	25	2/13/0700	2/19/0942:17	209	208	1	200	2
2	24	24	2/13/0700	2/19/0942:17	209	208	1	200	2
3	26	26	2/13/0700	2/19/0942:17	209	208	1	200	2
4	21	21	2/13/0700	2/19/0528:22	203	202	1	200	2
5	A2		2/13/0700	2/19/1025:48	200	209	2	100	2
6	C1		2/13/0700	2/19/1025:48	200	209	2	100	2
7	C9		2/12/0700	2/18/1025:48	200	209	2	100	2
8	C3		2/13/0700	2/19/1025:48	200	209	2	100	2
9	18	17	2/13/0700	2/19/0942:17	209	208	1	200	2
10	27	27	2/13/0700	2/19/0942:17	209	208	1	200	2
11	23	23	2/13/0700	2/19/0942:17	209	208	1	200	2
12	C4		2/13/0700	2/19/1025:48	200	209	2	100	2
13	A3		2/13/0700	2/19/1025:48	200	209	2	100	2
14	A1		2/12/0700	2/18/1025:48	200	209	2	100	2
15	A8		2/13/0700	2/20/1521:00	500	500	4	100	2
16	A4		2/13/0700	2/20/1521:00	500	500	4	100	2
17	20	20	2/12/0700	2/21/1848:56	324	323	1	200	2
18	22	22	2/12/0700	2/21/1848:56	324	323	1	200	2
19	16	16	2/13/0700	2/19/0942:17	209	208	1	200	2
20	19	19	2/13/0700	2/19/0942:17	209	208	1	200	2

(1) 2/18/1025:48 C9,A1
(2) 2/19/0528:22 21
(3) 2/19/0942:17 25,24,26,18,27,23,16,19
(4) 2/19/1025:48 A2,C1,C3,C4,A3
(5) 2/20/1521:00 A8,A4
(6) 2/21/1848:56 20,22

TABLE 1
OBH/S DEPLOYMENTS

Deployment #2 - East Coast (Lines 4E, 41E, 1E, 12E, 2E, 25E, 5E, 6E)

				DEPLOYMENT					RECOVERY	
SITE	OBH/S	EID #	H S/N	DATE/TIME	LAT.	LON.	DEPTH(m)	START TIME	DATE/TIME	LAT.	LON.
21	27	27	GF-2	2/21/96 15:21	45° 14.707' S	171° 02.050' E	31	2/24/0200	3/02/96 09:47	45° 14.473' S	171° 02.06' E
22	25	25	G10	2/21/96 19:33	44° 38.602' S	171° 23.704' E	39	2/24/0200	3/02/96 13:53	44° 38.09' S	171° 23.42' E
23	26	26	GF-9	2/21/96 21:22	44° 48.385' S	171° 38.751' E	84	2/24/0200	3/02/96 16:21	44° 48.272' S	171° 38.710' E
24	A2			2/21/96 22:40	44° 54.600' S	171° 48.388' E	120	2/24/0200	3/02/96 18:10	44° 54.239' S	171° 48.495' E
25	A3			2/22/96 00:05	45° 02.221' S	172° 00.293' E	1082	2/24/0200	3/02/96 20:20	45° 02.043' S	172° 00.294' E
26	C3			2/22/96 01:53	45° 11.268' S	172° 14.402' E	1395	2/24/0200	3/02/96 23:30	45° 11.177' S	172° 14.496' E
27	A1			2/22/96 04:36	45° 21.753' S	172° 30.927' E	1452	2/24/0200	3/03/96 02:10	45° 21.744' S	172° 31.000' E
28	18	17	1385	2/22/96 06:43	45° 33.914' S	172° 50.541' E	1528	2/24/0200	3/03/96 05:07	45° 33.745' S	172° 50.577' E
29	21	21	GF-14	2/22/96 08:58	45° 46.772' S	173° 11.343' E	1597	2/24/0200	3/03/96 08:59	45° 46.57' S	173° 11.16' E
30	24	24	GF-11	2/22/96 11:21	45° 33.428' S	173° 29.407' E	1430	2/24/0200	3/03/96 11:35	45° 33.23' S	173° 29.40' E
31	23	23	GF-3	2/22/96 13:57	45° 17.206' S	173° 06.916' E	1462	2/24/0200	3/03/96 14:31	45° 17.12' S	173° 07.00' E
32	C1			2/22/96 16:19	45° 04.399' S	172° 49.309' E	1398	2/24/0200	3/03/96 17:14	45° 04.380' S	172° 49.316' E
33	C4			2/22/96 18:22	44° 53.109' S	172° 34.006' E	1194	2/24/0200	3/03/96 18:35	44° 52.966' S	172° 34.036' E
34	C9			2/22/96 19:52	44° 44.499' S	172° 22.418' E	324	2/24/0200	3/03/96 21:15	44° 44.389' S	172° 22.465' E
35	A8			2/22/96 21:29	44° 37.085' S	172° 12.524' E	117	2/24/0200	3/03/96 22:35	44° 37.071' S	172° 12.461' E
36	20	20	151	2/22/96 23:02	44° 30.323' S	172° 03.487' E	80	2/24/0200	3/03/96 23:59	44° 30.22' S	172° 02.38' E
37	16	16	GF-15	2/23/96 00:26	44° 23.360' S	171° 54.297' E	58	2/24/0200	3/04/96 01:32	44° 23.22' S	171° 54.27' E
38	19	19	1387	2/23/96 02:07	44° 16.677' S	171° 45.543' E	40	2/24/0200	3/04/96 02:53	44° 16.64' S	171° 45.50' E
39	22	22	GF-6	2/23/96 06:47	44° 02.338' S	172° 40.916' E	61	2/24/0200	3/04/96 07:32	44° 02.24' S	172° 40.96' E

SITE	OBH/S	EID #	START TIME	END TIME	DISK SIZE	#TRACKS	#CHANS	SAMP RATE	BYTES/SAMP
21	27	27	2/24/0200	3/04/1348:56	324	323	1	200	2
22	25	25	2/24/0200	3/01/0442:17	209	208	1	200	2
23	26	26	2/24/0200	3/04/1348:56	324	323	1	200	2
24	A2		2/24/0200	3/02/1021:00	500	500	4	100	2
25	A3		2/24/0200	3/01/0525:48	200	209	2	100	2
26	C3		2/24/0200	3/01/0525:48	200	209	2	100	2
27	A1		2/24/0200	3/01/0525:48	200	209	2	100	2
28	18	17	2/24/0200	3/01/0442:17	209	208	1	200	2
29	21	21	2/24/0200	3/01/0028:22	203	202	1	200	2
30	24	24	2/24/0200	3/01/0442:17	209	208	1	200	2
31	23	23	2/24/0200	3/01/0442:17	209	208	1	200	2
32	C1		2/24/0200	3/01/0525:48	200	209	2	100	2
33	C4		2/24/0200	3/01/0525:48	200	209	2	100	2
34	C9		2/24/0200	3/01/0525:48	200	209	2	100	2
35	A8		2/24/0200	3/02/1021:00	500	500	4	100	2
36	20		2/24/0200	3/04/1348:56	324	323	1	200	2
37	16	16	2/24/0200	3/01/0442:17	209	208	1	200	2
38	19	19	2/24/0200	3/01/0442:17	209	208	1	200	2
39	22	22	2/24/0200	3/04/1348:56	324	323	1	200	2

(1) 3/01/0028:22 21
(2) 3/01/0442:17 25,18,24,23,16,19
(3) 3/01/0525:48 A3,C3,A1,C1,C4,C9
(4) 3/02/1021:00 A2,A8
(5) 3/04/1348:56 27,26,20,22

TABLE 1
OBH/S DEPLOYMENTS

Deployment #3 - Southern Cross (Lines SC1, SC2, SC3, SC4)

				DEPLOYMENT					RECOVERY		
SITE	OBH/S	EID #	H S/N	DATE/TIME	LAT.	LON.	DEPTH(m)	START TIME	DATE/TIME	LAT.	LON.
40	27	27	GF-2	3/04/96 19:11	45° 11.60' S	171° 21.70' E	91	3/05/0400	3/06/96 08:09	45° 11.68' S	171° 21.76' E
41	26	26	GF-9	3/04/96 21:41	45° 31.00' S	171° 26.00' E	848	3/05/0400	3/06/96 05:43	45° 30.80' S	171° 26.28' E
42	25	25	G10	3/05/96 00:10	45° 31.49' S	170° 58.49' E	46	3/05/0400	3/06/96 13:03	45° 31.63' S	170° 58.39' E
43	A8			3/05/96 02:07	45° 21.40' S	171° 10.00' E	56	3/05/0400	3/06/96 09:58	45° 21.60' S	171° 10.15' E
44	A2			3/05/96 03:16	45° 16.00' S	171° 00.99' E	32	3/05/0400	3/06/96 11:10	N/A	N/A

SITE	OBH/S	EID #	START TIME	END TIME	DISK SIZE	#TRACKS	#CHANS	SAMP RATE	BYTES/SAMP
40	27	27	3/05/0400	N/A	324	323	1	200	2
41	26	26	3/05/0400	N/A	324	323	1	200	2
42	25	25	3/05/0400	N/A	209	208	1	200	2
43	A8		3/05/0400	N/A	500	500	4	100	2
44	A2		3/05/0400	N/A	500	500	4	100	2

TABLE 2
OBH/S DATA QUALITY

Experiment #1

SITE	LAST TRACK START	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (ms) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
1-25	2/17/09:45:36	141-1	141	2/09/03:36:55	6.455	2/17/11:10:13	-8.422	OK
2-24	2/17/14:41:04	147-1	141	2/09/07:24:06	4.471	2/17/14:45:43	89.774	OK
3-26	2/17/22:27:12	158-1	147,31	2/09/16:49:14	-1.265	2/17/22:29:35	-59.187	Track 116 bad. Swap out disk.
4-21	2/18/00:34:08	161-1	141	2/09/21:47:03	5.645	2/18/00:37:33	-18.047	OK
5-A2		44	44	2/09/20:51	6.92	2/17/16:40	N/A	Disk crashed. Data logger reset. 2 Channels good - V., Hyd.
6-C1		151	151	2/09/19:23	5.64	2/17/18:16:35	-71.2	2 Channels good - V., Hyd.
7-C9		188	188	2/09/20:03	9.2	2/17/20:46	-76.4	2 Channels good - V., Hyd.
8-C3		155	155	2/09/17:38	3.84	2/17/23:38	-89.6	2 Channels good - V., Hyd.
9-18	2/18/15:22:40	182-1	182	2/10/06:09:17	10.902	2/18/15:28:13	15.097	Slice in main battery pack. Otherwise OK.
10-27	2/18/22:26:08	192-1	182	2/10/07:45:23	9.712	2/18/22:29:40	-34.847	Tracks 137, 139, 160, 163 bad. Swap out disk. Data unusable after track 136?
11-23	2/19/06:53:52	204-1	180	2/10/12:21:27	7.670	2/19/07:55:53	-29.586	OK
12-C4	2/18/18:11	187	187	2/10/08:43	4.68	2/18/18:37	-84.0	2 Channels good - V., Hyd.
13-A3	2/18/18:53	188	188	2/10/09:32	0.45	2/18/21:25	-78.0	2 Channels good - V., Hyd.
14-A1	2/18/09:42	209	209	2/10/08:10	0.41	2/18/23:43:20	-96.0	2 Channels good - V., Hyd.
15-A8	2/19/01:36	394	394	2/10/07:32	9.60	2/19/01:46	-40.8	Vertical attenuated. Hor. 1, Hor. 2, Hyd. good.
16-A4	2/19/01:36	394	394	2/10/21:37	5.72	2/19/03:52	N/A	Data logger reset on recovery. Release damaged. Cannot redeploy. 4 Channels good - V., Hor. 1, Hor. 2, Hyd.
17-20	2/20/00:29:52	263-1	240	2/11/01:02:03	9.316	2/20/00:39:33	-4.927	OK
18-22	2/20/02:36:48	266-1	240	2/11/02:43:23	10.308	2/20/02:41:13	-22.144	OK
19-16	2/19/09:00:48	208	208	2/11/07:54:03	8.745	2/20/05:07:23	100.319	After 2/10 pre-deployment battery check with meter voltages on screen showed up with zero values and max. positive values. Fuse blown on power interface board. Fuse replaced. Prior to WHOOPS test, low negative voltages were observed on both the 5V and Analog sections. Tattletale and piggyback boards were replaced prior to deployment. Data looks OK.
20-19	2/19/09:00:48	208	208	2/11/11:19:37	5.965	2/20/07:58:07	-11.875	OK

Experiment #2

SITE	LAST TRACK START	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (ms) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
21-27	3/02/14:34:40	256-1	255	2/21/06:43:23	8.068	3/02/14:40:08	-48.562	OK. Dropped hard on deck.
22-25	3/01/04:00:00	208-0	208	2/21/08:19:18	2.162	3/03/02:52:03	-15.559	OK
23-26	3/03/05:23:12	277-1	222	2/21/07:37:53	-14.527	3/03/05:37:10	-100.873	OK
24-A2	3/02/09:58	500	500	2/21/18:22	9.76	3/02/18:56	-90.4	4 Channels good - V., Hor. 1, Hor. 2, Hyd.
25-A3	3/01/04:23	209	209	2/21/19:16	3.52	3/02/20:48	-92.0	2 Channels good - V., Hyd.
26-C3	3/01/04:41	209	209	2/21/23:25	7.16	3/02/23:54	-106.0	2 Channels good - V., Hyd.
27-A1	3/01/04:41	209	209	2/21/19:53	5.56	3/03/02:44	-107.0	2 Channels good - V., Hyd.
28-18	3/01/04:00:00	208	208	2/21/20:29:03	2.109	3/03/07:22:04	6.960	OK. No post-recovery log written to disk.
29-21	2/29/23:46:08	202-0	202	2/21/18:22:04	-7.562	3/03/12:08:43	-40.872	OK
30-24	3/01/04:00:00	208-1	151,57	2/22/06:05:03	138.788	3/04/00:20:22	244.520	Disk error 16, bad track 151. Little or no data lost. Swapped out disk post-recovery.
31-23	3/01/04:00:00	208-0	208	2/22/07:47:18	6.598	3/04/03:49:24	-35.891	Hydrophone leads pinched between ship and frame. Should not be used again. Possible "disk spin-up/down spikes at beginning ~16s. of each track except first track.
32-C1	3/01/04:41	209	255	2/22/07:26	3.88	3/03/17:34	-103.0	2 Channels good - V., Hyd.
33-C4	3/01/04:41	209	255	2/22/08:42	9.52	3/03/19:58	-101.0	2 Channels good - V., Hyd.
34-C9	3/01/04:41	209	255	2/22/06:43	6.56	3/03/21:34	-108.0	2 Channels good - V., Hyd.
35-A8	3/02/09:47	500	255	2/22/05:13	1.96	3/03/23:20	-63.28	4 Channels good - V., Hor. 1, Hor. 2, Hyd.
36-20	3/03/20:53:20 (track 300)	323-0	225	2/22/11:43:06	5.743	3/04/19:53:41	-16.915	OK
37-16	3/01/04:00:00	208-0	208	2/22/22:15:43	131.752	3/05/08:37:25	235.025	No data. Very low noise levels, large DC shift. Noise centered about 4.297 volts. DC shift to flat line for post-recovery WHOOPs. Negative 5V and Analog batteries are low positive values. Negative side analog power supply fuse was blown. Replaced so WHOOPS and voltages are good.
38-19	3/01/04:00:00	208-0	208	2/22/23:44:06	-10.615	3/05/05:43:33	-33.618	OK
39-22	3/03/20:53:20 (track 300)	323-0	225	2/23/03:44:08	-27.294	3/04/22:19:50	-66.966	Dropped very hard on deck. No obvious damage to electronics. Post-recovery WHOOPS first cycle abruptly goes to zero, then looks OK. Later WHOOPS test data looks OK. Otherwise, data OK.

Experiment #3

SITE	LAST TRACK START	TRACKS RECORDED	TRACKS ARCHIVED	INSTRUMENT CORRECTION (ms) DATE/TIME	PREDEPL	DATE/TIME	POSTRECOV	COMMENTS
40-27	3/06/11:02:24	45-0	45	3/04/06:20:03	3.575	3/06/11:40:03	-8.789	OK
41-26	3/06/09:38:08	43-0	43	3/04/08:42:29	-111.193	3/06/10:00:38	-127.549	OK
42-25	3/06/19:30:08	57-0	57	3/04/07:54:45	6.017	3/06/20:08:38	1.746	OK
43-A8	3/06/09:38	84	84	3/04/11:15	6.8	3/06/10:20	2.72	4 Channels good - V., Hor. 1, Hor. 2, Hyd.
44-A2	3/06/10:28	86	86	3/04/09:50	4.04	3/06/11:34	-17.2	4 Channels good - V., Hor. 1, Hor. 2, Hyd.

TABLE 3
OBH ELECTRONICS CONFIGURATION

EID	PRE-AMP	Filter 1	LG GRA	HG GRA	Power Supply Interface	Tattletale	Piggyback	Vectron Oscillator	WET
16	16	5	8	2	5	?	7	317Y1322 1218029	176
17	17	8	4	16	17	138	9	317Y1322 1218025	178
19	19	4	9	13	6	144	4	318Y0467 1167158	174
20	20	15	5	26	4	166	3	317Y1322 1218026	173
21	21	6	1	20	3	467	8	318Y0467 1167157	206
22	22	16	10	25	7	149	2	317Y1322 1218024	229
23	23	2	14	24	12	139	10	318Y0467 1167160	177
24	24	9	19	17	11	167	6	318Y0467 1167159	204
25	25	17	11	12	8	165	12	318Y0467 1167161	203
26	26	13	15	22	9	143	13	317Y1322 1218030	172
27	27	14	28	21	10	146	5	317Y1322 1218028	175

Pre-amp gain is +20dB.
Filter 1 freq./type is 80Hz LP with a gain of 0dB.
Low Gain GRA 1 (Channel 1) gain is 9.4dB, attenuation is 7dB.
High Gain GRA 0 (Channel 2) gain is 35.5dB, attenuation is 7dB.
Power Supply Interface Type is May 1991 with jumper positions W1 and W2 both set to 'A'.
Piggyback Board Type is May 1991.
Program Version is 26 (24 July 1994).
Threshold value is 16300 A/D # (0-32000), 0.122 volts, or 49% of 0.25 volts
Sample rate A/D is 200. Recorded rate is 200.

OBH 27 has a tight fitting end cap. Required wedge after recovery.

POST-RECOVERY #1 CHANGES:

OBH 26: Toshiba model MK2326-FC disk installed, S/N 24042773A
OBH 27: Toshiba model MK2326-FC disk installed, S/N 24042757A

POST-RECOVERY #2 CHANGES:

OBH 24: Toshiba model MK2326-FC disk installed, S/N 24043482A

TABLE 4
OBH FRAME CONFIGURATION

OBH	EID	11 kHz Release	Reply Freq.	Flasher #1	Flasher #2	Radio	Freq.	Hydrophone	Leads
16	16	14754	12.0	B1964	OAR5112	9684	156.575	GF-15	EID 16BB
18	17	904328	10.0	OAR1550	F03012	B1958	159.480	1385	36BM
19	19	16046	12.0	OAR1732	F03010	9694 thick	156.875	1387	20BB
20	20	904428	10.0	OAR5962	B1960	9688(89?)	156.625	151	30BM
21	21	806978	12.0	B1959	F03014	B1956	159.480	GF-14	32BM
22	22	809011	12.0	F03009	F03007	9694 thin	156.525	GF-6	34BM
23	23	904228	10.0	F03011	OAR no S/N	9676	156.375	GF-3	38BM
24	24	806778	12.0	OAR1735	F03008	B1957	159.480	GF-11	35MB
25	25	802937	12.0	F03013	B1963	B1953	154.585	G10	17BB
26	26	803541	12.0	OAR52	F03015	B1955	154.585	GF-9	37BM
27	27	14750	12.0	B1961	B1962	B1954	154.585	GF-2	31BM

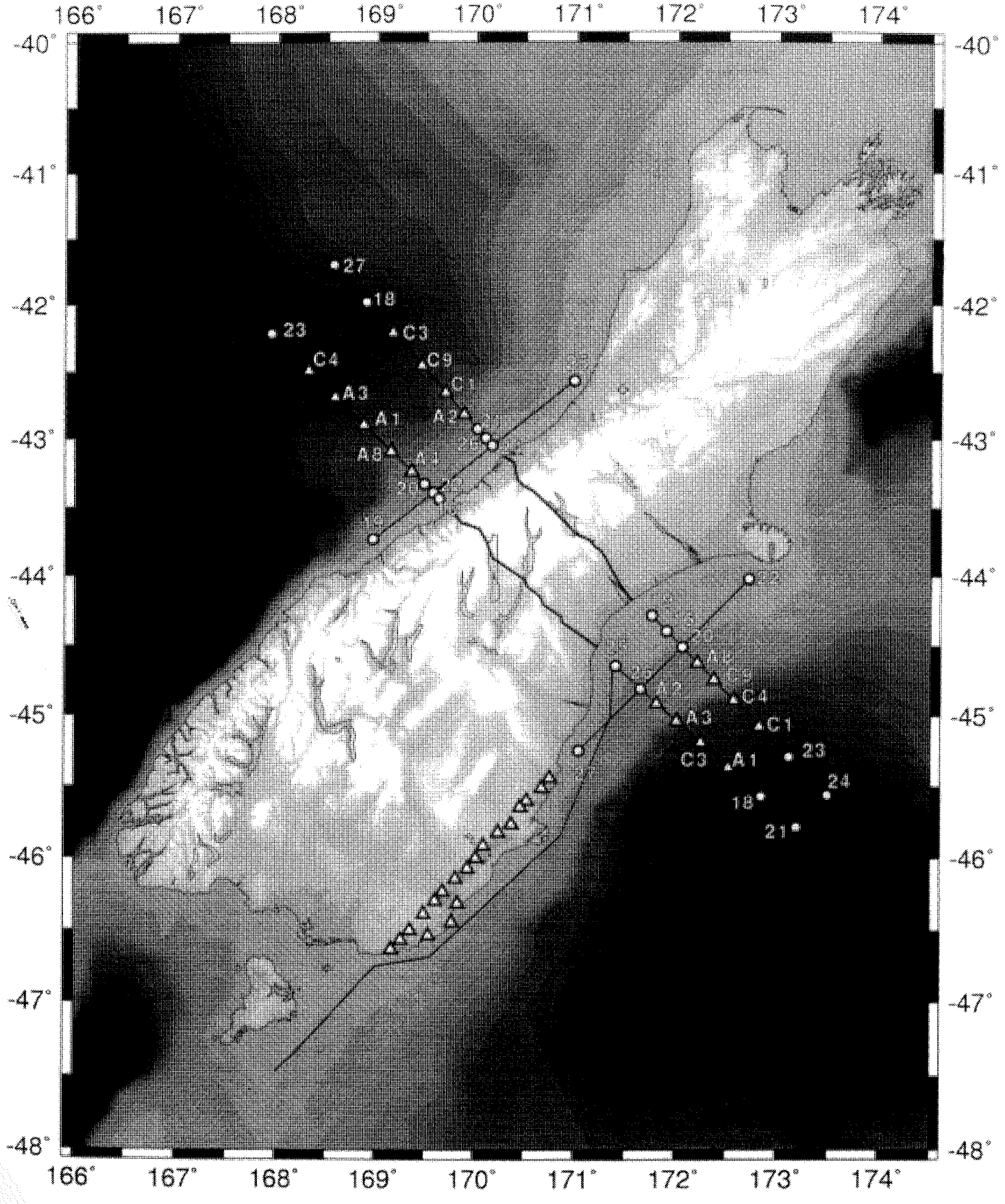
For hydrophone leads BB is Burton to OBH, Burton to hydrophone;
BM is Burton to OBH, Mecca to hydrophone;
MB is Mecca to OBH, Burton to hydrophone.

OBH 16 lost a leg prior to deployment #1 due to heavy seas. Diamond plate gussets were added to strengthen the frame.
OBH 20 was found to have little clearance between the release hook and the electronics pressure case upon recovery from deployment #1. The release was rotated and tape was applied to the pressure case to protect it from damage by the falling hook. A mangled tag line eye was also swapped out prior to deployment #2.
OBH 27 had a radio that would not turn off after deployment #1 despite the switch being off. No water in the radio pressure case. Maybe a battery failed. Surfaces were cleaned and O-rings replaced. Switch checks out OK. Reused for deployment #2.

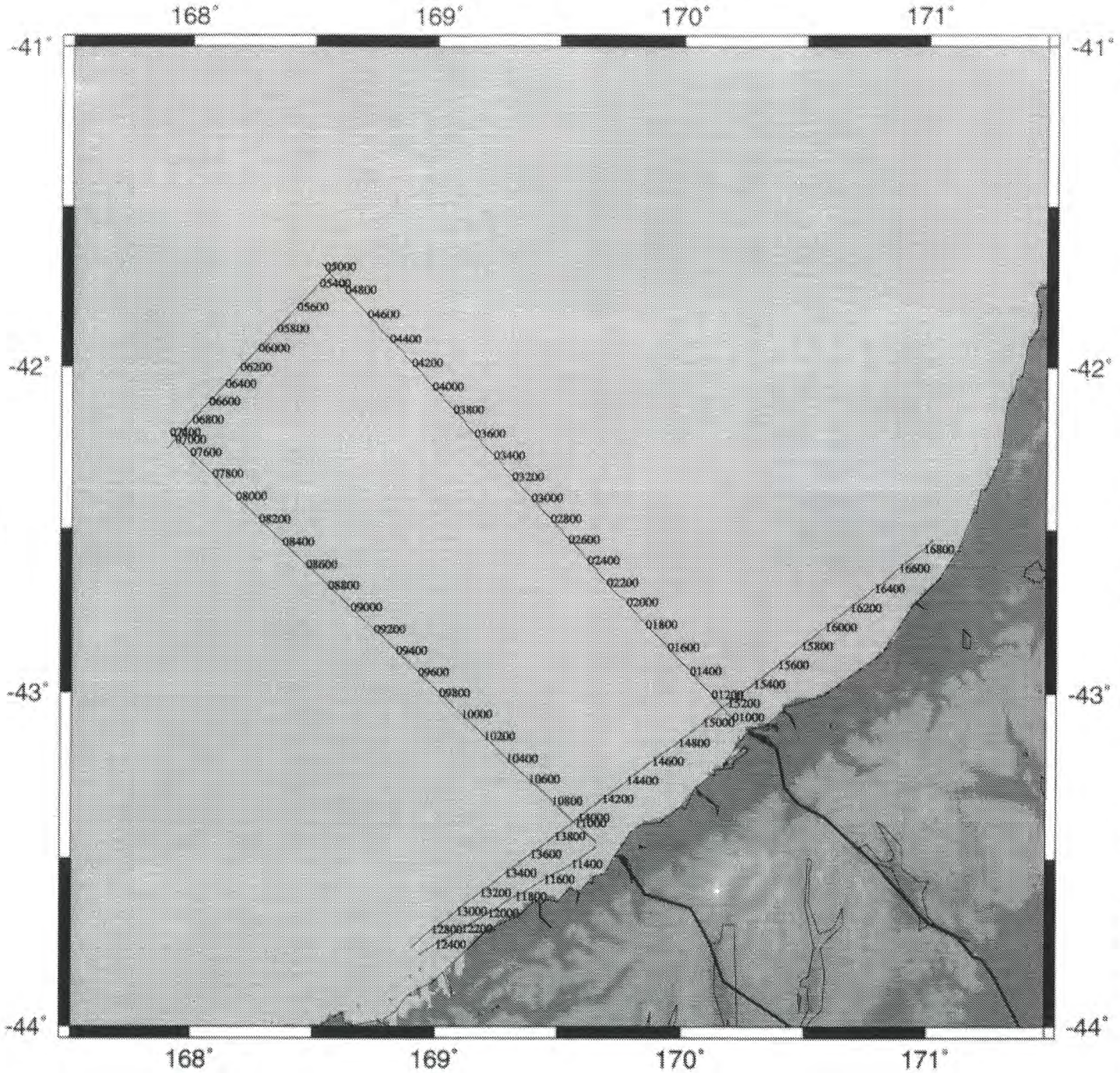
Appendix 1
MCS Tracklines with OBH/S Locations and Shot Points Annotations

On the west side of the South Island, we deployed eleven WHOI OBHs and nine USGS OBSs. On the east side, eleven OBHs and eight OBSs were deployed. These locations are shown in the first figure with MCS tracklines. Circles denote OBHs and Triangles denote OBSs. Solid lines across the island show PASSCAL RefTek configuration, and a hundred RefTeks were placed on each line. Trianges on land show the RefTek locations during the southern coast shooting.

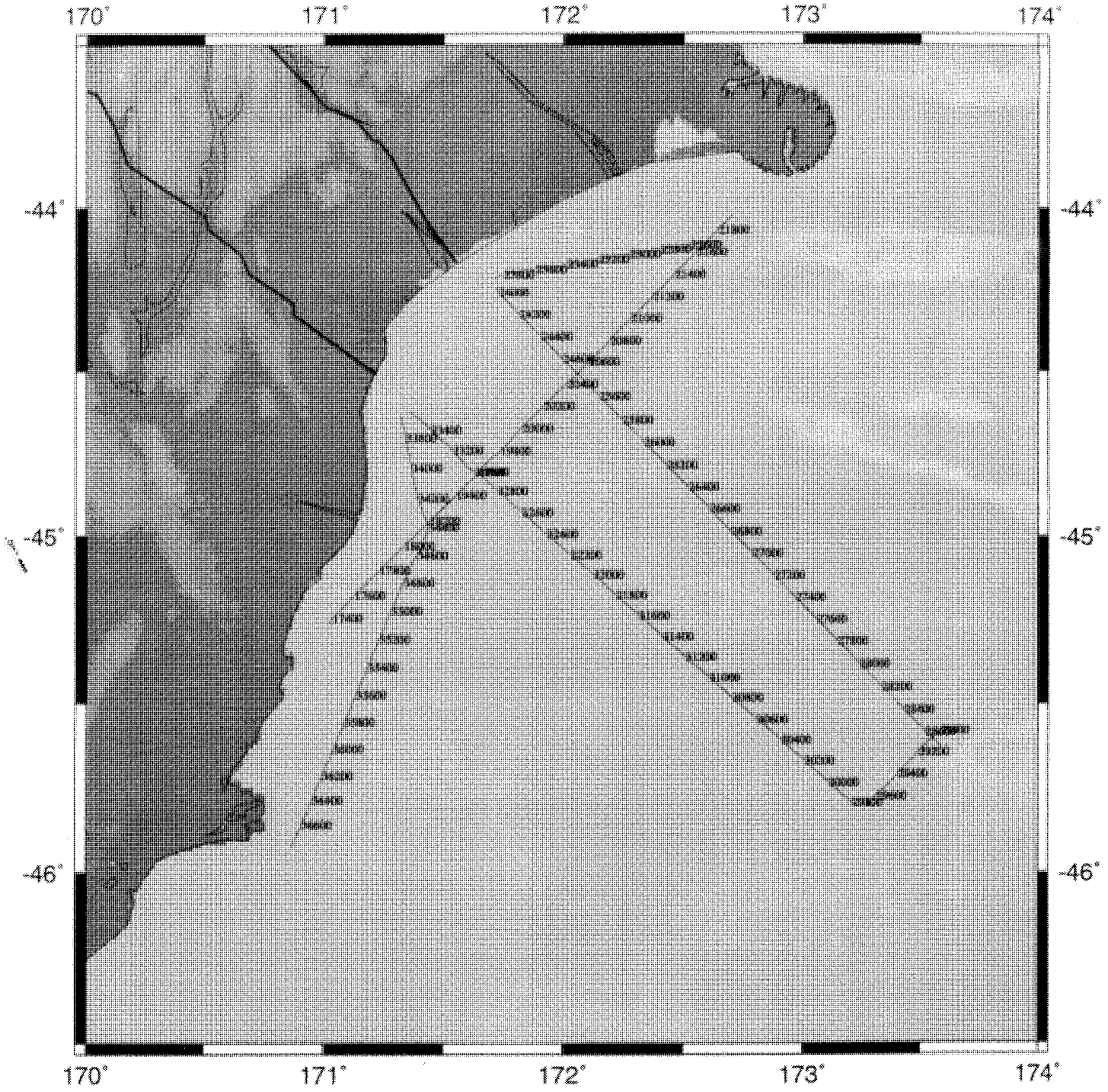
The subsequent figures show MCS tracklines with shot point annotations for west coast shooting, east coast shooting, and southern coast shooting, respectively. A shell script to generate these figures is also appended.


166°
167°
168°
169°
170°
171°
172°
173°
174°
-40°
-41°
-42°
-43°
-44°
-45°
-46°
-47°
-48°
27
18
23
C3
C4
C9
C1
A3
A1
A2
A4
C4
A3
C1
C3
A1
23
24
18
21

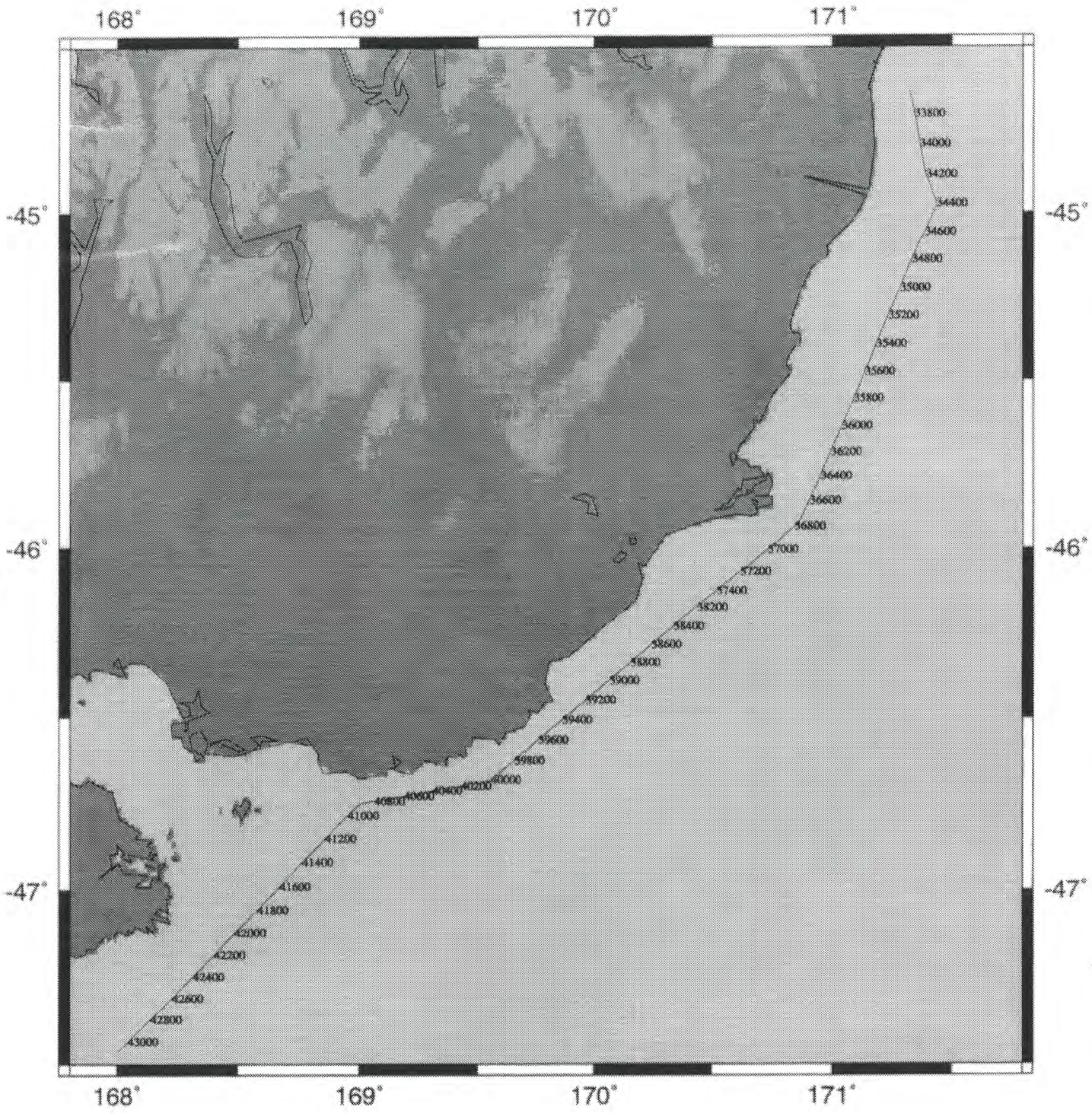
West Coast Shotpoint Data



East Coast Shotpoint Data



Southern Coast Shotpoint Data



```
#
awk '$2/200-int($2/200) == 0 {print $0}' < /users/steveh/nz/shots/shots_edited/line_
1w.shots >eastshots
awk '$2/200-int($2/200) == 0 {print $0}' < /users/steveh/nz/shots/shots_edited/line_
12w.shots >>eastshots
awk '$2/200-int($2/200) == 0 {print $0}' < /users/steveh/nz/shots/shots_edited/line_
2w.shots >>eastshots
awk '$2/200-int($2/200) == 0 {print $0}' < /users/steveh/nz/shots/shots_edited/line_
23w.shots >>eastshots
awk '$2/200-int($2/200) == 0 {print $0}' < /users/steveh/nz/shots/shots_edited/line_
3w.shots >>eastshots
#awk '$2/200-int($2/200) == 0 {print $0}' < /users/steveh/nz/shots/shots_edited/line
_6e.shots >>eastshots
#
awk '{print  $7+($8/60),-($4+($5/60)),$2}' eastshots >eastshots.xyz
#
#grd2cpt -M ../Map/south_island_bathy.grd -V > tmp.cpt
grdimage ../Map/south_island_bathy.grd  -R167.5/171.5/-44/-41 -JM6.5 -P -Ctemp.cpt
-X1. -Y2. -K > shot.ps
psbasemap -R167.5/171.5/-44/-41  -JM -B1f0.5:."West Coast Shotpoint Data": -V -P -O
-K >> shot.ps
pscoast   -R167.5/171.5/-44/-41  -JM -Di -W -I1 -V -P -O  -K  >> shot.ps
psxy ../Map/onshorelines.dat     -JM -R -M -W5 -O -K >> shot.ps
#psxy ../Map/obhloc.dat          -JM -R -M -W5 -Sc0.06 -G0 -O -K >> shot.ps
#psxy ../Map/obsloc.dat          -JM -R -M -W5 -St0.08 -G0 -O -K >> shot.ps
#
awk '{print $7+($8/60),-($4+($5/60))}' /users/steveh/nz/shots/shots_edited/line_1w.s
hots >eastshots.xy
cat eol >>eastshots.xy
awk '{print $7+($8/60),-($4+($5/60))}' /users/steveh/nz/shots/shots_edited/line_12w.
shots >>eastshots.xy
cat eol >>eastshots.xy
awk '{print $7+($8/60),-($4+($5/60))}' /users/steveh/nz/shots/shots_edited/line_2w.s
hots >>eastshots.xy
cat eol >>eastshots.xy
awk '{print $7+($8/60),-($4+($5/60))}' /users/steveh/nz/shots/shots_edited/line_23w.
shots >>eastshots.xy
cat eol >>eastshots.xy
awk '{print $7+($8/60),-($4+($5/60))}' /users/steveh/nz/shots/shots_edited/line_3w.s
hots >>eastshots.xy
cat eol >>eastshots.xy
#awk '{print $7+($8/60),-($4+($5/60))}' /users/steveh/nz/shots/shots_edited/line_6e.
shots >>eastshots.xy
#cat eol >>eastshots.xy
#
psxy eastshots.xy        -JM -R -M -W1 -O -K >> shot.ps
awk '{print $1,$2,'6','0','4','5',$3}' < eastshots.xyz > eastshots.pstext
pstext -JM -R -G255/255/255 -S1 -O < eastshots.pstext >> shot.ps
```

APPENDIX 2: Data List

Onshore Data

1 8mm tape tar format - NZ onshore Profile 1

Deployment #1 (NZ West Coast) Data

11 OBH Receiver Books

12 8mm tapes, dd format archive - OBHs 16,17,19-25,26pt.1,26pt.2,27; 2/17-2/21/96

2 8mm tapes, tar format - copy #1, copy #2 each with 12 OBH *.raw files; 2/22/96

1 8mm tape, dump format, jade:/NZ1 and /NZ2; 2/26/96

1 8mm tape, dump format, indigo:/indigo1, /data1, /data; 2/27/96

3 8mm tapes, tar format, filesystems backed up prior to recoveries; 2/16/96
1) jade:/NZ1
2) indigo:/indigo1
3) indigo:/data1

4 DOS floppies - 2 copies each of MCS West files, lines 1W, 3W, 12W, 02W_A, and 023W. Four files each line:
*.RUL (recording log), *.RUE (recording error log), *.TAL (gun log), and *.TAE (gun error log).

5 8mm tapes, tar format, OBH SEGY files
2/24/96 NZ West Line 1W, 12 files
2/24/96 NZ West Line 2W, 12 files
2/24/96 NZ West Line 3W, 13 files
2/25/96 NZ West Line 12W and 23W, 16 files
2/29/96 NZ West Lines 1W, 12W, 2W, 23W, 3W, OBHs 19,24,26 fixed SEGY, 20 files

5 8mm tapes, tar format or dd format, MCS data files
2/18/96 NZ West MCS Stack 1, Lines 1W, 12W, 2W, 23W, 3W, 5 files (tar)
2/19/96 NZ West MCS Line 1W Brute CDP Gathers 3897-7100 (dd)
2/22/96 NZ West MCS Line 1W CDP Gathers, 4 files (tar); b) 6669-9324, c) 9325-12073
2/24/96 NZ West MCS Line 1W Brute CDP Gathers, 2 files (tar); d) 11981-14736, e) 14637-17392
3/01/96 NZ West MCS Line 1W Brute CDP Gathers 17923-20136, Stack 2, 7 files (tar)

5 8mm tapes, tar format, OBS data
2/21/96 NZ West Line 3W, 20 files SEGY
2/22/96 NZ West Line 2W, 20 files SEGY
2/23/96 NZ West Line 1W, 21 files SEGY
2/23/96 NZ West Line 12W and Line 1W OBS A8 (Hor. 2), 23 files SEGY
2/23/96 NZ West Line 23W, 20 files SEGY; High Density

1 Notebook, NZLW01 OBH Datafile Headers (obh_rec_hdrs output)

194 MCS 3480 data and NAV cartridges:

LINE	TAPE #s	Tape Count	NAV TAPE #	Count
Test	1-2	2	1	1
1W	1-50	50	1	1
12W	51-66	24	2	1
	67 (2 shots only)			
	68-74			
02W	75-119	45	3	1
23W	120-134	15	4	1
3W	135-186	52	5	1
		188		6

34 DAT tapes of copied 3480 cartridges:

LINE	TAPE #s
1W	1-10
12W	10-14
2W	14-22,34
23W	22-24
3W	25-33

Deployment #2 (NZ East Coast) Data

11 OBH Receiver Books

12 8mm tapes, dd format archive - OBHs 16,17,19-23,24a,24b,25-27; 3/03-3/05/96

4 8mm tapes, tar format archive
copy #1, #2 - 5 *.raw files, OBHs 23,20,22,19,16; 3/06/96
copy #1, #2 - 7 *.raw files, OBHs 27,25,26,17,21,24a,24b; 3/06/96

1 8mm tape, dump format, jade:/NZ1 and /NZ2; 3/06/96

8 8mm tapes, High Density tar format, OBS SEGY data
3/06/96 Line 4E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 1,735,171,200 bytes
3/06/96 Line 41E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 712,243,200 bytes
3/06/96 Line 1E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 2,002,296,000 bytes
3/07/96 Line 12E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 366,580,800 bytes
3/07/96 Line 2E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 1,842,312,000 bytes
3/06/96 Line 25E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 1,507,315,200 bytes
3/06/96 Line 5E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 1,413,723,200 bytes
3/05/96 Line 6E, OBSs A1,A2,A3,A8,C1,C3,C4,C9 20 files; 1,363,308,160 bytes

6 DOS floppies - 2 copies each of MCS East files, lines 4E,4E_A,41E,1E,1E_A,12E,2E,25E,5E,5E_A,. and 6E. Four files each line: *.RUL (recording log), *.RUE (recording error log), *.TAL (gun log), and *.TAE (gun error log).

426 MCS 3480 data and NAV cartridges:

LINE	TAPE #s	Tape Count	NAV TAPE #	Count
Test 2	187-191	5	6	1
4E	192-209	18	7	1
Test 3	192-200	9	7(new tape)	1
4Ea	210-255	46	7a	1
41E	256-279	24	8	1
1E	280-281	81	9	1
1Ea	282-292			
1Eb	293-302		1Eb:1	1

	307-364		1Eb:2	1
12E	365-377	13	10	1
2E	378-404	64	11	1
	409-445			
25E	446-497	52	12	1
5E	498-508	11	13	1
5Ea	509-545	37	13(same tape)	
6E	546-598	53	14	1
		413		13

72 DAT tapes of copied 3480 cartridges, (No tape #68):

LINE	TAPE #s
4E	35-38
4Ea	40-47
41E	47-51
1E,1Ea	51-55
1Eb	55-65
12E	66-69
2E	70-72,89-96
25E	96-104
5E,5Ea	67,73-79,105-107
6E	79-88
Test 2	35
Test3	38-39

Sonobuoy Data:
1 DAT tape
1 Optical disk

2 copies of Sonobuoy Logsheets

1 Notebook, NZLE01 OBH Datafile Headers (obh_rec_hdrs output)

Deployment #3 (Southern Cross) Data

3 OBH Receiver Books

3 8mm tapes, dd format archive - OBHs 25-27; 3/07/96

2 8mm tapes, tar format archive
copy #1, #2 - 3 *.raw files, OBHs 25,26,27; 3/07/96

1 8mm tape, High Density tar format, OBS SEGY data
Line SC, OBSs A2,A8, 8 files; 524,388,480 bytes

5 Single Channel Seismic 3480 cartridges: 4 data and 1 NAV

1 Notebook, NZLE02 Southern Cross OBH Datafile Headers (obh_rec_hdrs output)

Miscellaneous Cruise Data

1 8mm tape, dump format - NZLE01 and NZLE02, indigo:/indigo1, /data1, /data ; 3/07/96

1 8mm tape, tar format NZ MCS East Stack 1, West Stack 2, 1W, 21 files; 3/07/96

2 MacIntosh floppy copies of Main Lab Mac EW9601 folder; MCS Log, Waypoints, etc.

Mainlab Log (2 copies)

Seismic Recording Log (2 copies)

Rolls 3.5kHz Records; Z-folded into data envelopes:

1) start - 2030z 07 Feb. 96 JD 38
   end - 2000z 09 Feb. 96 JD 40
2) start - 2100z 09 Feb. 96 JD 40
   end - 0530z 22 Feb. 96 JD 53
3) start - 0600z 22 Feb. 96 JD 53
   end - 0700z 26 Feb. 96 JD 57
4) start - 0700z 26 Feb. 96 JD 57
   end - 2000z 02 Mar. 96 JD 62; includes sonobuoy records for SB 1-16.
5) still on recorder at Port Chalmers port stop

1 Roll MCS Near Trace Monitor Records:
JD 44 0809z - JD 48 ~0045z West Coast
JD 55 1256z - JD 61 1400z East Coast

1 Roll MCS SCSI Splitter Stacked Records:
JD 44 0911z - JD 48 ~0045z West Coast
JD 55 1256z - JD 61 1400z East Coast

1 Roll Single Channel Records (20-60Hz, 8s sweep):
JD 65 3/05/96 0600z - JD 66 3/06/96 0400z Southern Cross

Underway Geophysics Tapes (Mag, Bathy-Hydrosweep CB, Nav, Grav):
2 8mm tapes Lyttleton-Dunedin; preliminary Grav, everything else final. Looseleaf "R/V Ewing Cruise Report"
2 8mm tapes Lyttleton-Dunedin (to be mailed); includes final Grav tie in Lyttleton to apply drift in final Grav. data. Bound copies of "R/V Ewing Cruise Report"
2 DAT tapes Lyttleton-Lyttleton; preliminary Grav, everything else final. Looseleaf "R/V Ewing Cruise Report"
2 DAT tapes Lyttleton-Lyttleton (to be mailed); includes final Grav tie in Lyttleton to apply drift in final Grav. data. Bound copies of "R/V Ewing Cruise Report"

Appendix 3
OBH and Shot Instant Timing

Instrument timing was accomplished with the usual OBH timing rack setup: Track Systems GPS clock, SAIL clock and rubidium oscillator. First, the Track Systems GPS clock was set up with its antenna situated on the after railing on "A" Deck and allowed sufficient time to acquire lock. The SAIL clock was then slaved to the rubidium oscillator and set to match the GPS time indicated by the Trak Systems GPS clock. Daily measurements of the SAIL clock drift were taken, except during shooting operations, when the timing rack was in use by the shot logger.

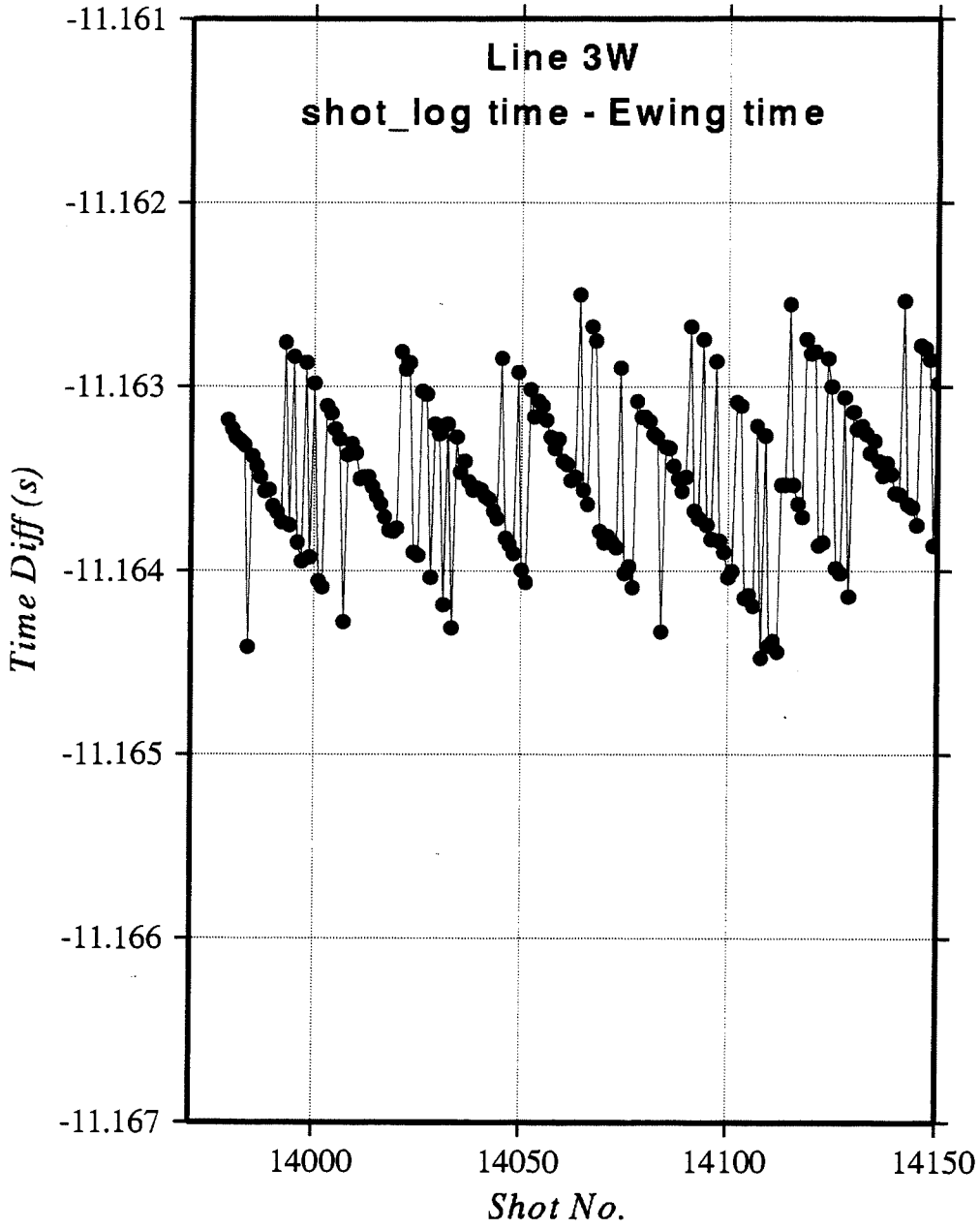
Data collected by the OBHs are time tagged by an internal clock which uses a temperature controlled crystal oscillator as a reference. Prior to deployment and after recovery, the instrument's internal clock is checked, and its offset against the GPS reference standard is recorded. A linear drift rate is calculated for the duration of the deployment and can be used to correct the time tag on the data.

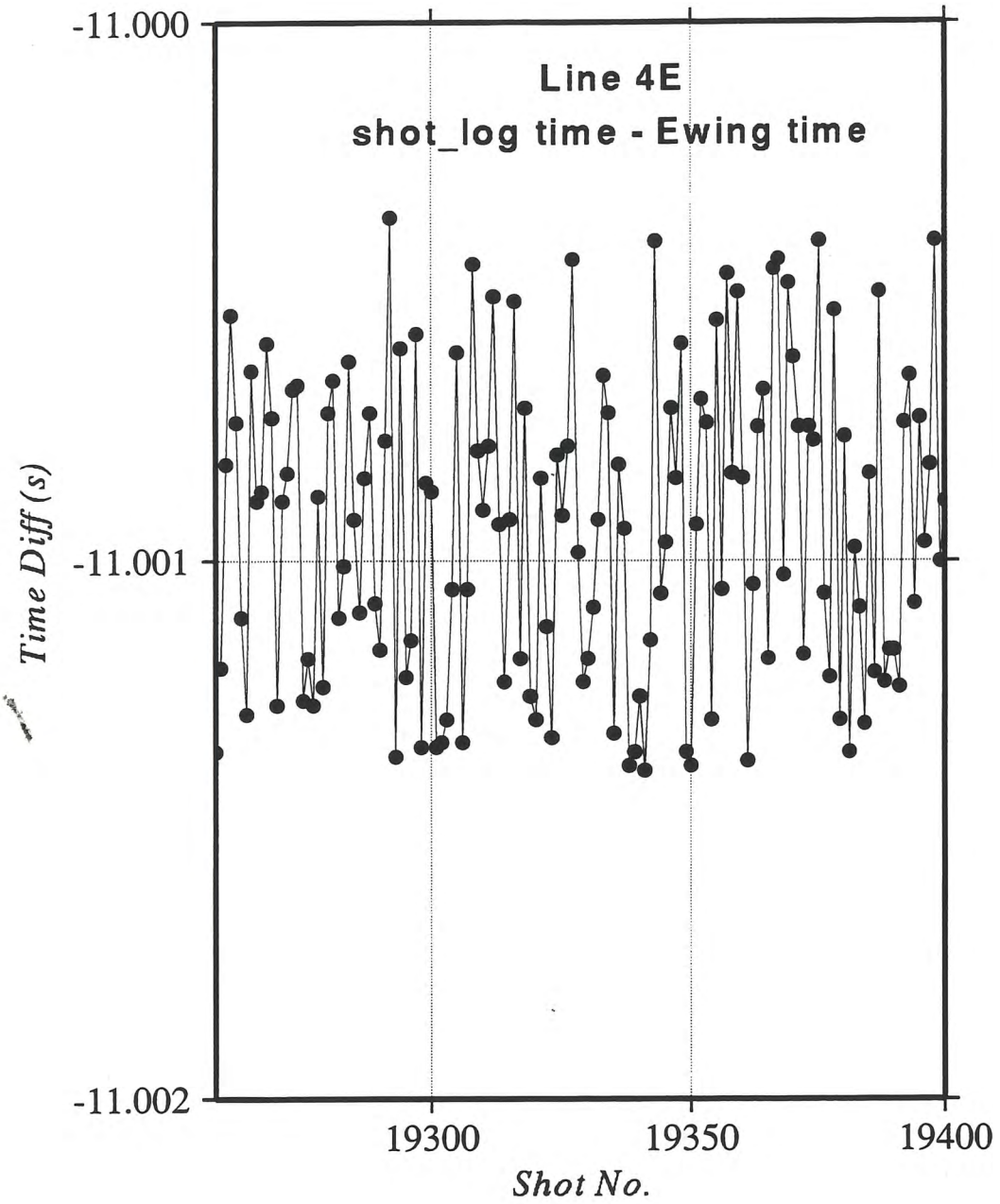
There was some confusion initially as to just what time reference was being displayed by the Trak Systems GPS clock. It is capable of displaying both UTC time and/or GPS time on its display panel. In its original powerup mode the Trak displays GPS time and this is what was used throughout the cruise as the time standard for the OBH clocks. However, it was determined that the other timing systems involved in the experiment, namely USGS OBS timing, as well as the *Ewing's* time reference were based on UTC time. At the time of this cruise, UTC time is 11 (leap) seconds advanced of GPS time. The Trak systems clock can be set to accomodate leap seconds and in future cruises should be set to UTC and that standard used for OBH timing.

Shot instant and navigation data recorded by the *Ewing* were used to convert the raw data to SEG-Y data. In addition, a PC-based shot logger was run to serve as a backup system and to provide a means of checking the Ewing based timing against that used for the OBHs. The PC-based system used a timing pulse provided by the *Ewing* as the trigger source for shot timing and retrieved times latched to the trigger pulse from the SAIL clock. First iterations of comparisons of shot times between the two systems revealed that the systems were not offset by exactly 11 seconds, as would be expected by the UTC-GPS differential, but were actually offset by roughly 11.163 seconds (see Fig. for Line 3W time differences). It was subsequently determined that the two shot logging systems were triggering on opposite edges of the timing pulse, and the pulse width, 163ms, accounted for the timing difference (see Fig. for Line 4E time differences). The sloping or shingled pattern to the time differences seen on Line 3W is not present in the Line 4E time differences, indicating that this pattern is due to some characteristic of the trigger pulse width.

In summary, triggering the shot_log program on the trailing edge of the timing pulse produces a 163 ms time lag between the shot instant and the time logged. This can be corrected by triggering on the leading edge of the timing pulse. On future cruises, we recommend that shot_log be run to compare EWING times and OBH/OBS times to verify that timing is consistent between the two systems, before data is converted using obh2segy.

The PC-based shot logging system occasionally would hang during shooting operations, which necessitated restarting the system, while losing shot instant data. It was thought that the trigger pulse from the *Ewing* may have been causing more than one "@" on the SAIL loop for a single shot trigger pulse, and this may have caused the SAIL clock to go unaddressed. Subsequent requests from the program to retrieve SAIL clock latched times would go unanswered by the clock. The shot logging program would increment its shot counter, but would indicate an error when trying to retrieve latched times. A fix for this bug was implemented, namely to address the SAIL clock before each time retrieval request. This fix has not yet been tested under actual shooting conditions.


Line 3W
shot_log time - Ewing time
-11.161
-11.162
-11.163
-11.164
-11.165
-11.166
-11.167
Time Diff (s)
14000
14050
14100
14150
Shot No.


Line 4E
shot_log time - Ewing time
-11.000
-11.001
-11.002
Time Diff (s)
19300
19350
19400
Shot No.

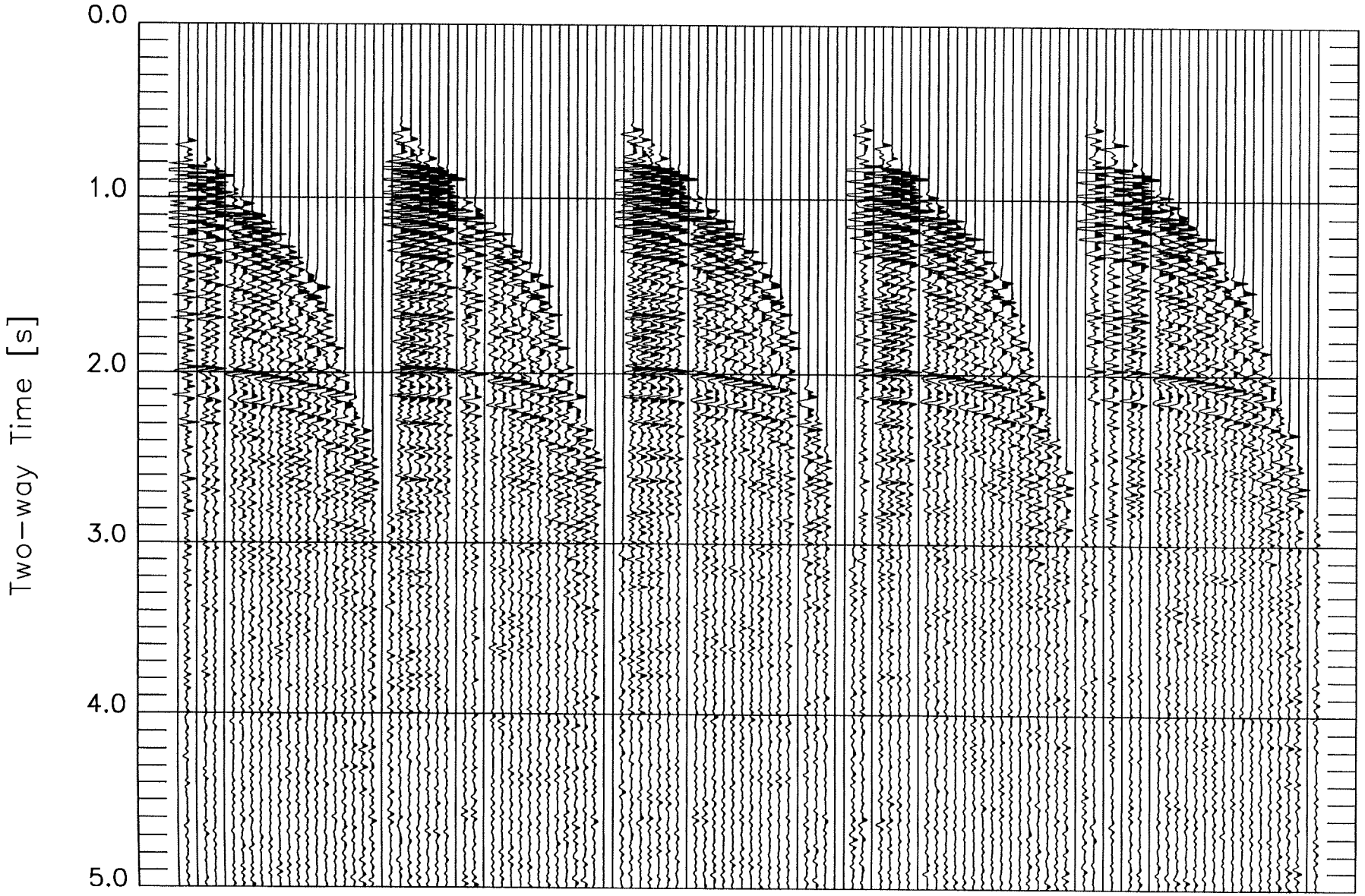
Appendix 4
MCS Data Examples

Examples of the processing steps for the MCS data are shown in the first three figures. Preliminary stacked sections for lines 3W (whole line and detailed section), 5E and 25E are shown in the next four figures.

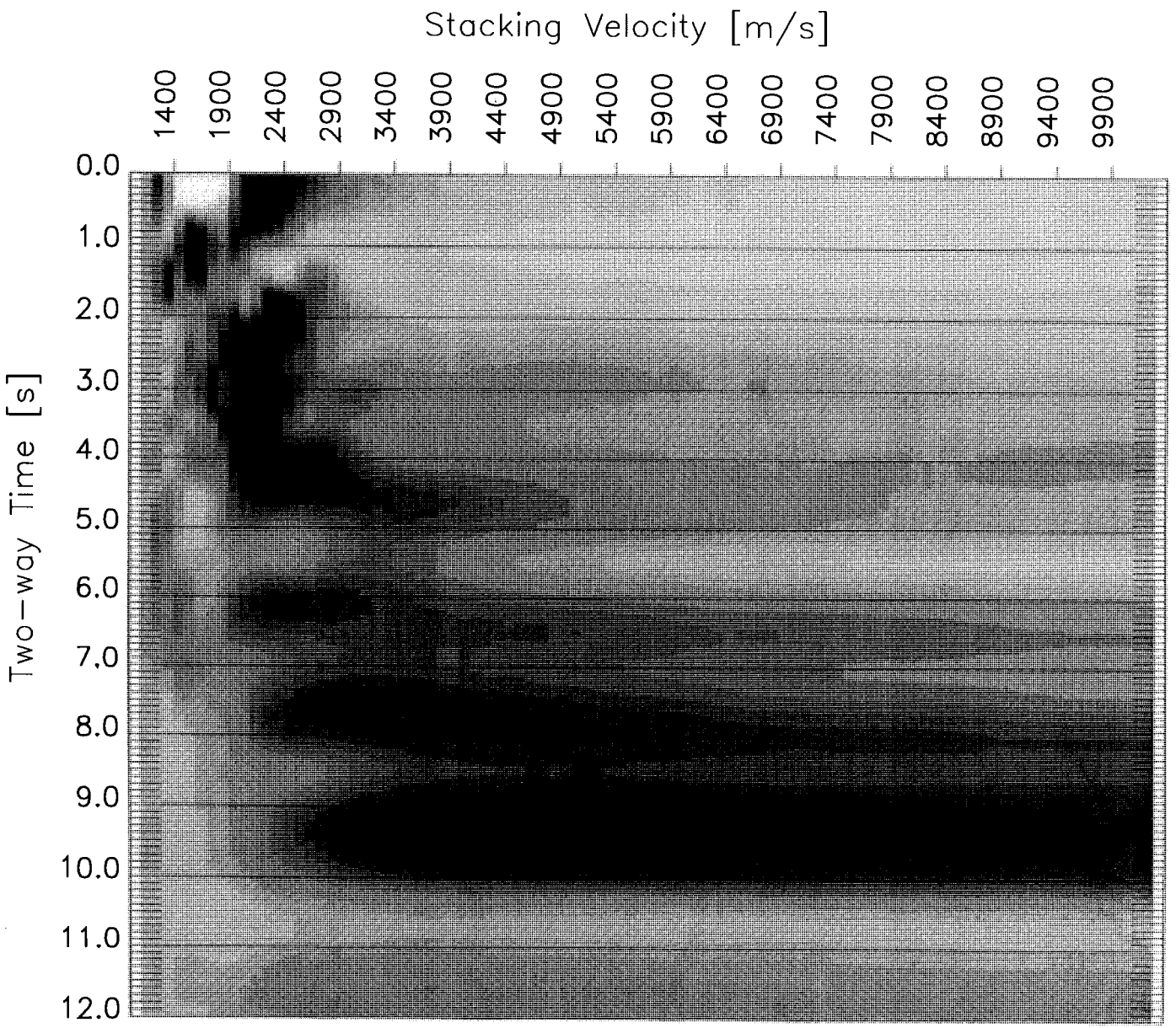
For the west coast MCS recording, shots were at about 50 m spacing and the streamer had 108 channels, giving CMP gathers with about 25 traces in 12.5 m bins. Sample CMP gathers with muting are shown in the first figure. For the shallow water depths, muting was designed to remove the direct and refracted wave phases as much as possible, while retaining major reflections. CMP 4700-4704 are from the nearshore part of line 1W. The semblance spectrum for CMP 4700-4704 is shown in the second figure. High semblance can be clearly seen at 2.0s TWT (basement) and at 9.5s TWT (Moho). Semblance spectra were calculated using 5 adjacent CMP gathers at selected locations for velocity analysis. Normal move out corrected CMP gathers, based on the velocity analysis, are shown in the third figure. The basement and sedimentary reflectors are clear.

Strong lower crustal - Moho reflectors were recorded on the west coast line 3W. In the fourth figure the details of these deeper reflectors (7 - 13s TWT) are clear, and the section shows clear zonation into a stratified sedimentary section down to about 2.5s TWT, a "transparent" upper crust and a highly reflective lower crust with a distinct low reflectivity zone in its deeper part. The top of the lower band of reflectivity is inferred to be Moho. The deeper reflectors dip at about 8° to the north. The fifth figure shows the whole of line 3W. The strong but variable lower crustal reflectivity is clear and a complex origin is indicated by the variable dip of the deeper reflective units, particularly at the northern part of the line. Mid crustal reflectivity is weak and the upper part of the profile clearly defines about 2s TWT of sediments, deepening to about 3s TWT under the southern part of the line. The diffractions from the submarine canyons on the shelf are very strong.

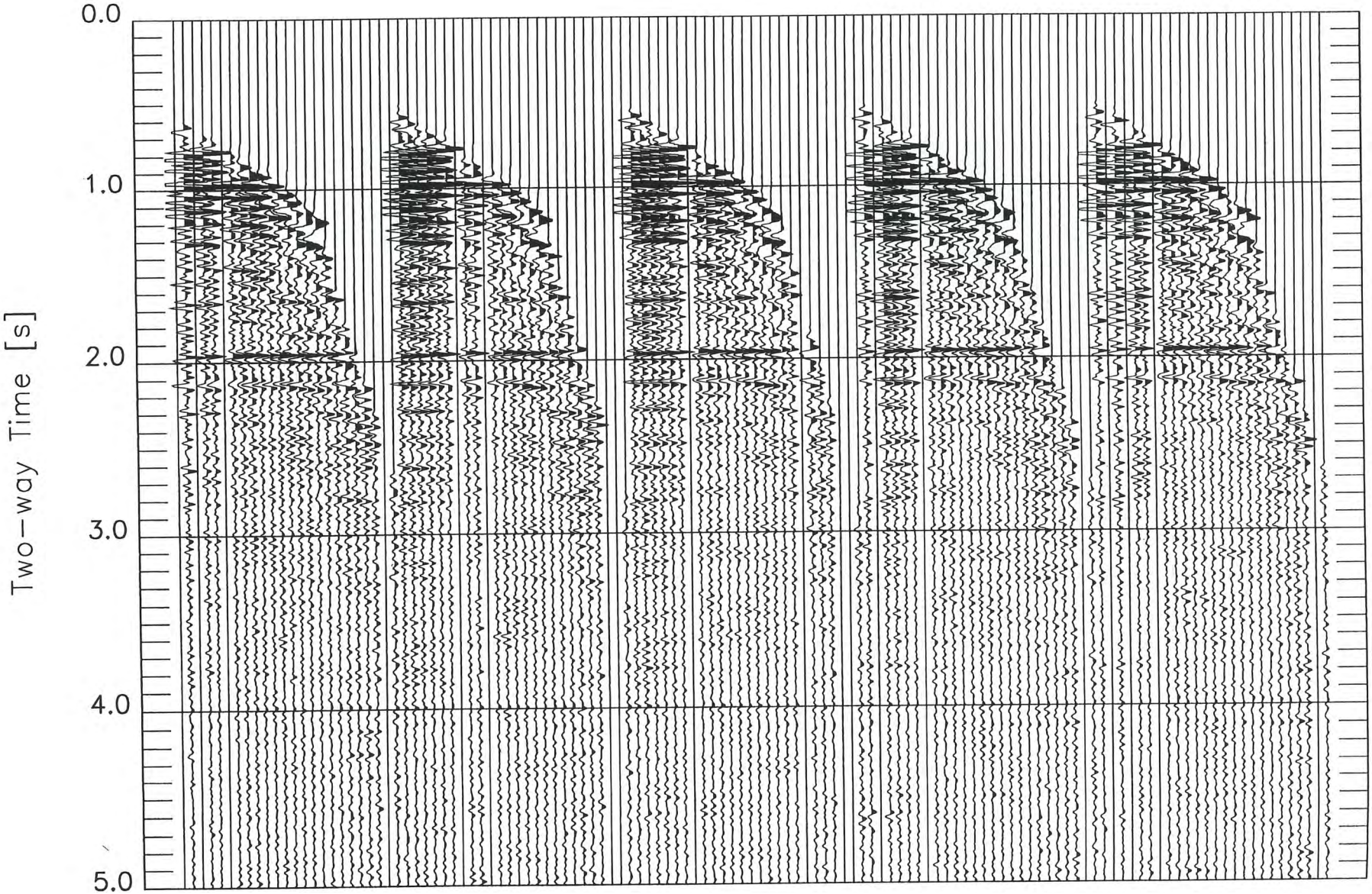
Lower crustal reflectivity is also very strong on the eastern MCS lines, particularly at the northern ends of lines 5E and 25E (sixth and seventh figures) at about 8s - 9s TWT. The base of this zone is inferred to be Moho. Line 5E shows an interesting strongly dipping reflector package, dipping to the south and apparently crossing over the 8s - 9s TWT band. Lower crustal reflectivity appears to be stronger to the north and the dipping package may be related to a crustal suture or detachment. The middle/upper crust has low reflectivity and the upper part of the seismic sections delineates a sedimentary section about 1.5s - 2.5s TWT deep. Submarine canyons again give strong diffractions across the section.



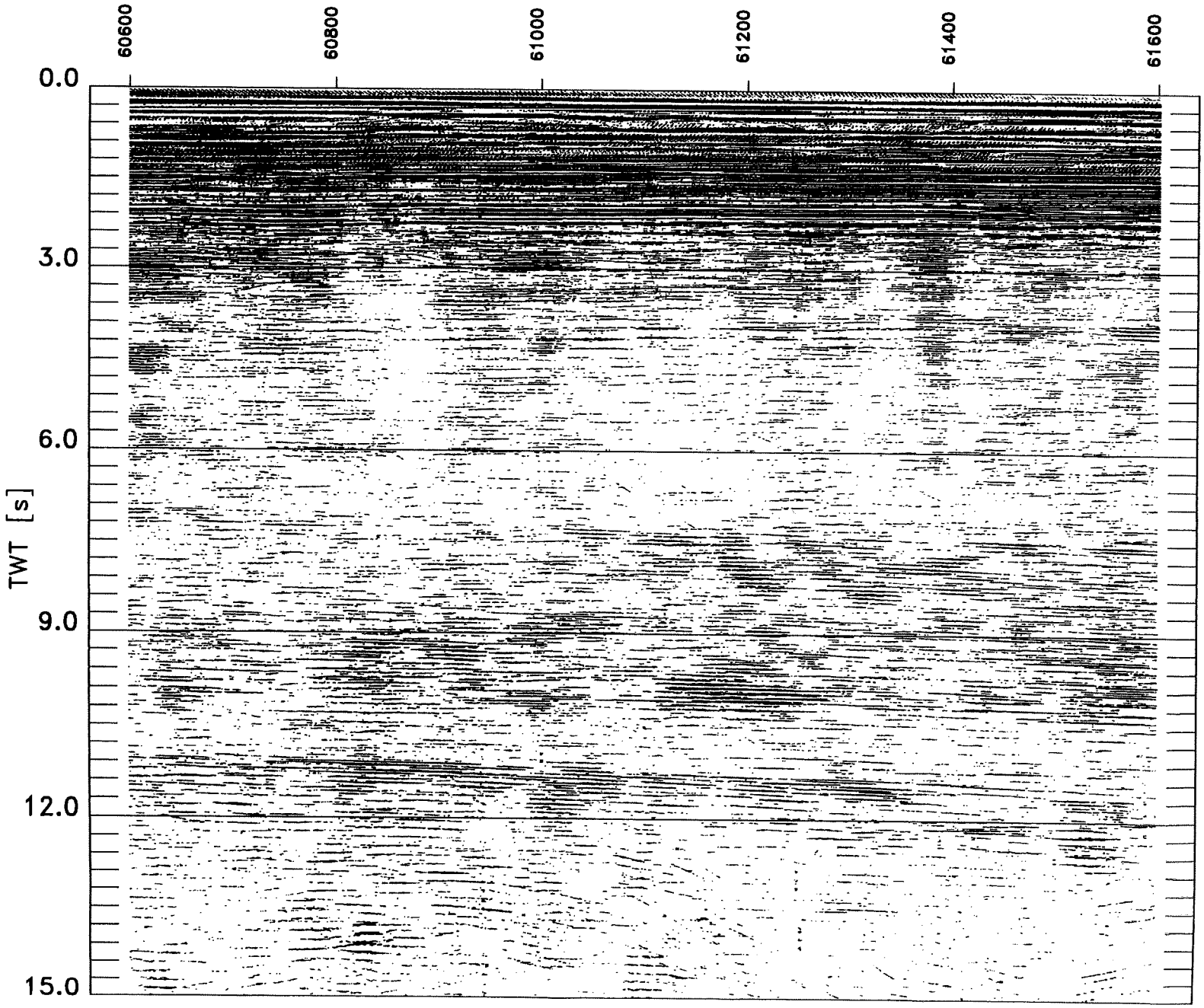
Mute example: CMP 4700-4704



Semblance: CMP 4700-4704



NMO example: CMP 4700-4704

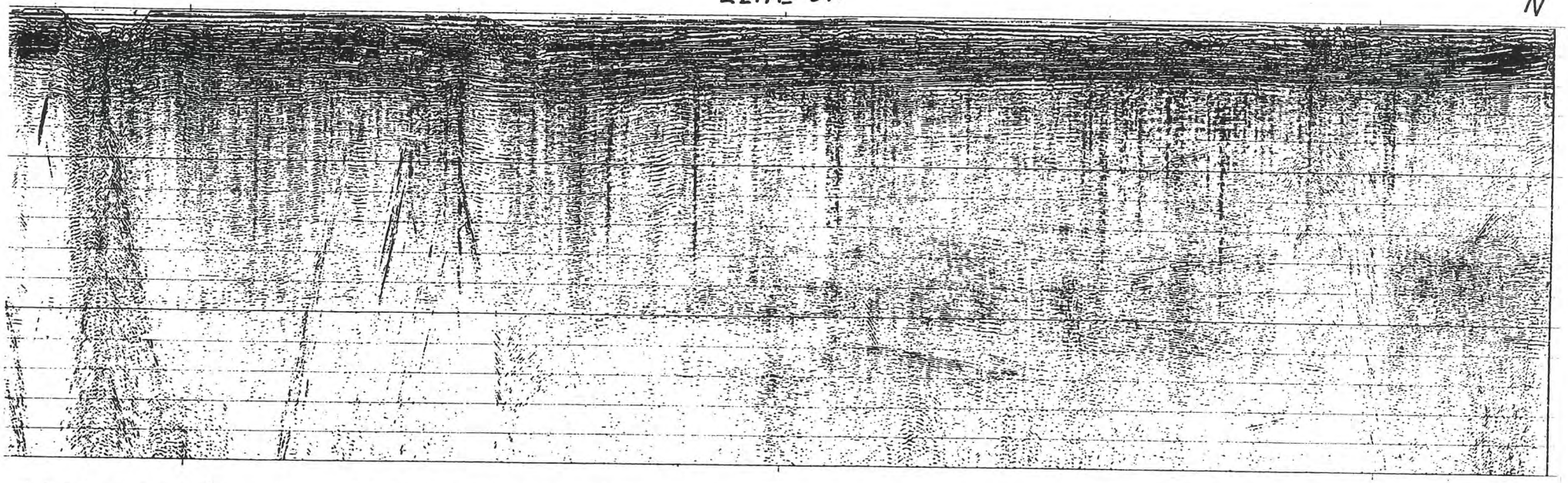


Line3W, 125–137 km from S (bp 5–40, T~.9, coh)

S

LINE 3W

N

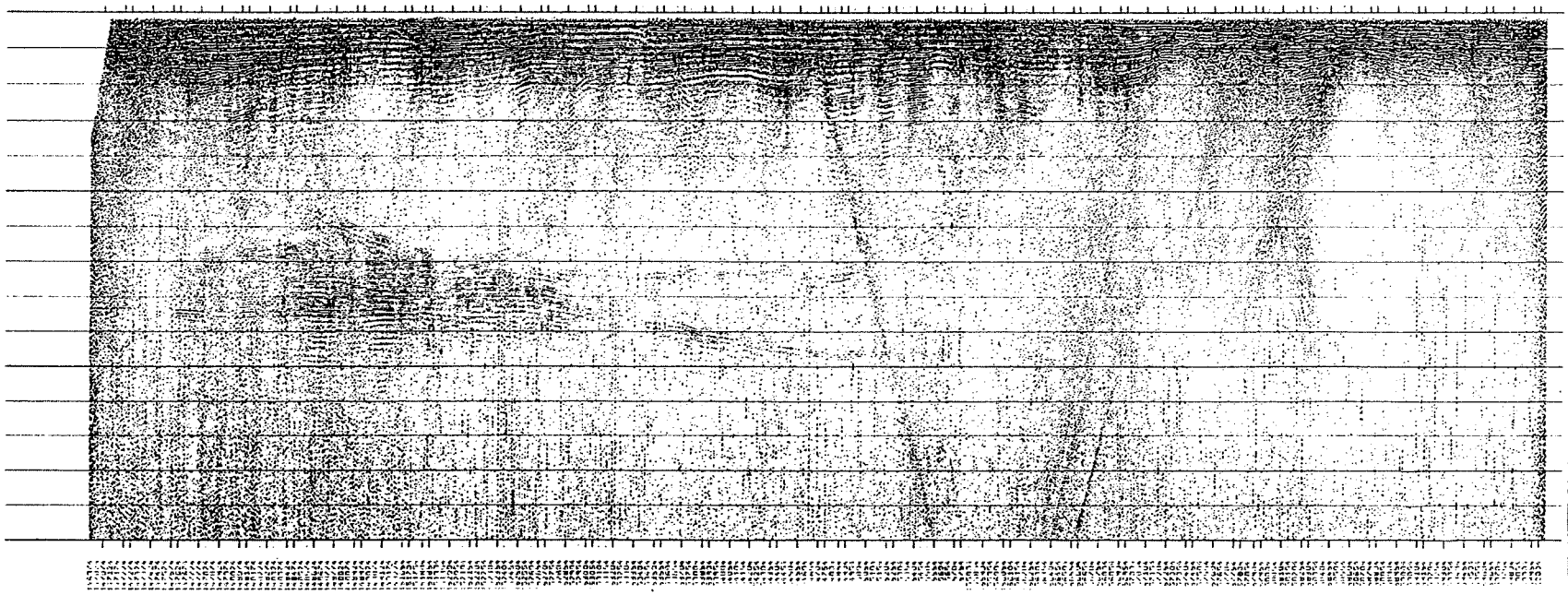


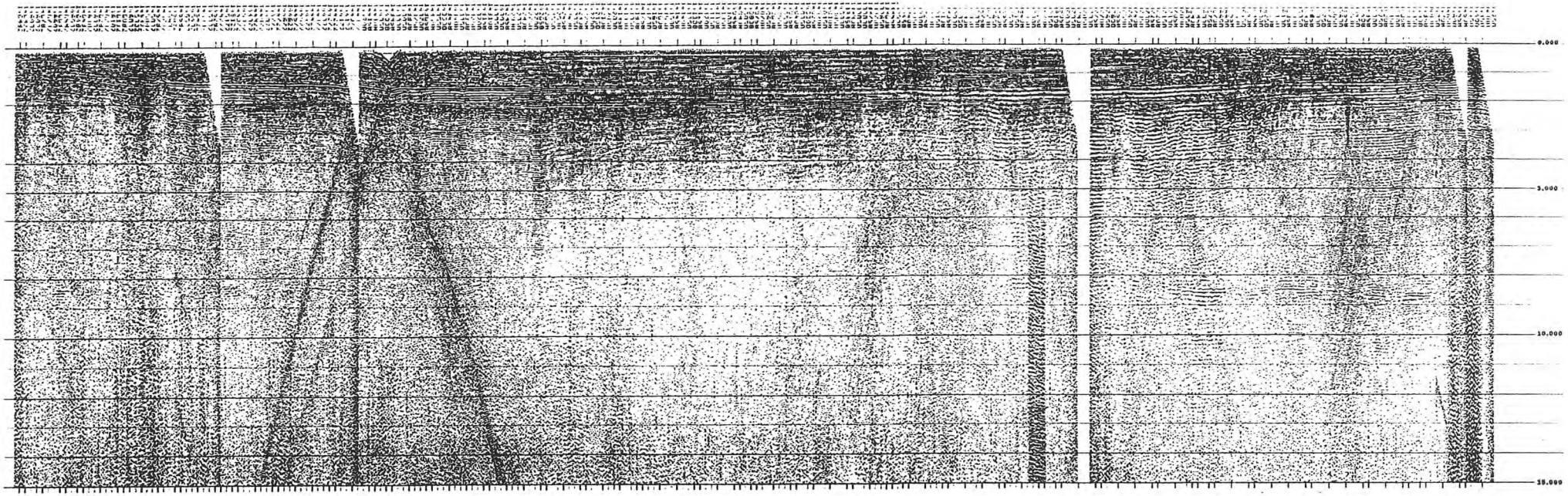
N

LINE 5E

Line 5E

S





S

LINE 25E

N

Appendix 5
Sonobuoy Data

Sixteen radio sonobuoys were deployed from the R/V Ewing, during the shooting of lines 5 (Dunedin) and 6 (Stewart Island), to provide upper crustal seismic velocity control for these line. Line 6 forms the southern part of Transect 3. 4 sonobuoys (5,6,9,14) did not transmit any data, one sonobuoy gave poor data (4). 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 157 and 158, and the second radio channel on traces 159 and 160. The 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 record section "Sonobuoy 15" shows four distinct phases: the direct water wave arrival, a strong basement refraction (about 6 km/s), an intermediate velocity sediment refraction (about 2 km/s), and a band of deep reflections at about 7 seconds two-way-time.

Sonobuoy log

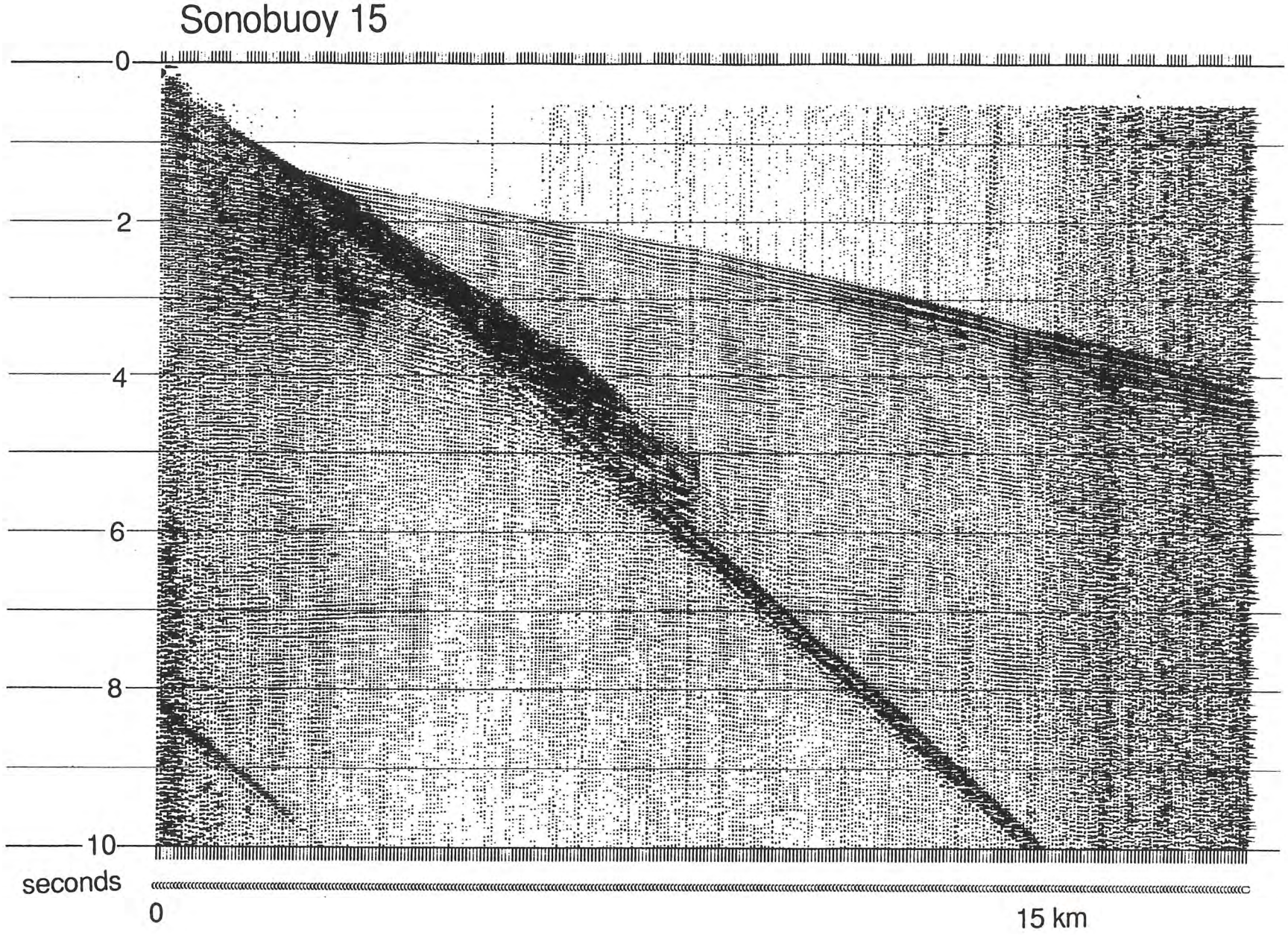
Sonobuoy No	SBtype,#	record trc	start t	3480#	shot numbers	file name	size
			GMT, 60				
1	41B, 19	157	1028	512	38116-38380	sonob.1.segy	8750720
2	41B, 30	157	1202	517	38411-39000	sonob.2.segy	19412304
3	41B, 9	159	1412	524	38800-39357	sonob.3.segy	18422064
			GMT, 61				
4		159	219	562	40929-41010	sonob.4.segy	2710256
5		dud					
6		dud					
7	41B, 29	157	230	562	41017-41700	sonob.7.segy	22548064
8	41B, 10	159	405	567	41297-41550	sonob.8.segy	8618688
9		dud					
10	41B, 20	159	525	571	41558-42009	sonob.10.segy	14725168
11	41B, 17	157	642	575	41781-42250	sonob.11.segy	15352320
12	41B,10	159	802	579	42009-42602	sonob.12.segy	19544336
13	41B, 30	157	939	584	42298-42870	sonob.13.segy	18818160
14		dud					
15	41B, 15	159	1134	590	42646-43125	sonob.15.segy	14824192
16	41B, 10	157	1253	594	42877-43125	sonob.16.segy	7265360
Hydrophone depth 60 ft (18 m)							

```
#!/bin/csh
#
/science/user/ewing20/Sioseis/sioseis.sun << !

procs diskin filter avenor plot  end

  diskin
     ipath sonob.15.segy
        fno 42646    lno 42950

  end
   end


   filter
    pass 5 20 ftype 0 dbdrop 48 end
   end

   avenor
        fno 42646 lno 42746
        sets 0 3 3 10
        levs 10.0 2000.0 end
        fno 42747 lno 99999
        sets 0 0.2 0.2 1
        levs 10.0 100.0 end
   end

   plot
      dir ltr
      stime 0 nsecs 10 tlines 1 5
      trpin 30 vscale .64 decimf 2
      scalar 0 wiggle 0
      def 0.1 clip 0.1
      taginc 1 ann header lhdr 10
      srpath raster
       end
   end

end
!
```



```
/science/user/ewing20/Sioseis/sioseis.sun << !

procs diskin prout diskoa end


segdin
 iunit 4 end
end


header
 fno 1 lno 99999 ftr 1 ltr 9999 ltype multiply lhdr 10 -1 end
end

prout
  fno 1 lno 99999  end
end

diskoa
  fno 1 lno 99999 ftr 157 ltr 157 opath sonob.a1.segy  end
end

diskoc
  fno 1 lno 99999 ftr 159 ltr 159 opath sonob.b1.segy  end
end

end

!
```

```
/science/user/ewing20/Sioseis/sioseis.sun << !

procs diskin prout diskoa end


diskin
        fno 38116 lno 38380 ftr 157  ltr 157  ipath sonob.a1.segy end
        fno 38430 lno 38777 ftr 157  ltr 157  ipath sonob.a2.segy end
end


prout
  fno 1 lno 99999  end
end

diskoa
  fno 1 lno 99999 ftr 157 ltr 157 opath sonob.1.segy  end
end


end

!
```

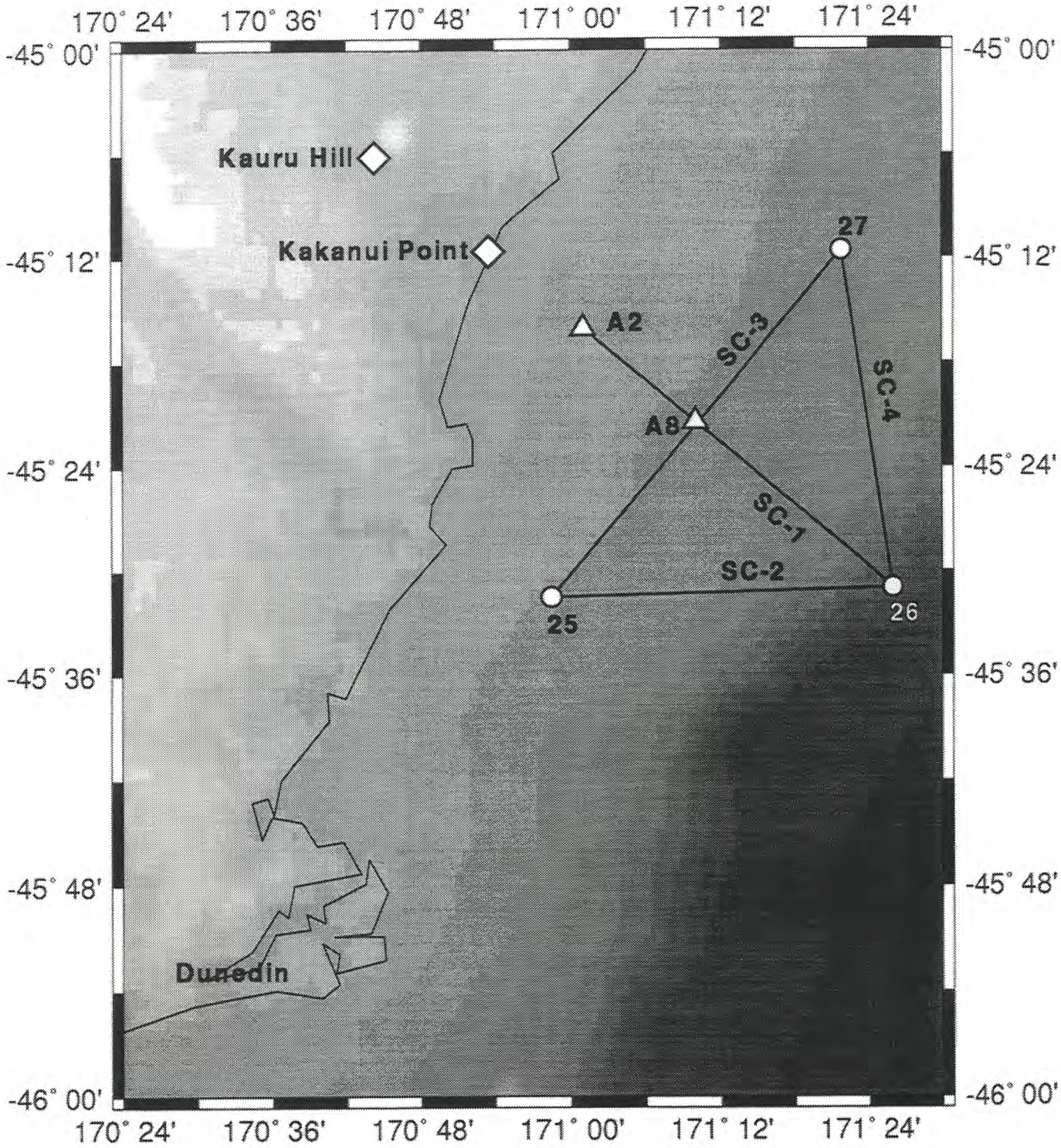

Sonobuoy 15
0
2
4
6
8
10
seconds
0
15 km

Appendix 6
The "Southern Cross" Anisotropy Survey

Laboratory measurements of P-wave velocity in samples of the Haast schist show strong anisotropy, with velocities much faster along the foliation (than across it. If this hand-specimen-scale observation holds at surface seismic wavelengths, there will be important implications for the interpretation of the Transect data through the schist terrane.

An offshore seismic survey was conducted at the end of EW-9601A to test whether the Haast schist shows azimuthal P-wave anisotropy at the scale of our seismic study. The study was sited off Kakanui Point just south of Timaru, where Unit III of the Haast schist projects offshore with near-vertical dips. The shooting pattern, dubbed the "Southern Cross," consisted of two crossing lines between five ocean bottom instruments (3 OBH and 2 OBS) and two lines on the outside of the cross. The NW-SE line (Line SC1) was also recorded by two onshore Refteks deployed by the Timaru team. Single-channel seismic data were recorded during shooting to provide information on sediment thickness along the profiles.

This pattern provides reversed Pg arrivals at perpendicular azimuths beneath the center of the cross (Lines SC1 and SC3), as well as reversed measurements of Pg at two additional azimuths on the edges of the pattern (Lines SC2 and SC4). If the Haast schist forms the basement offshore, as it almost certainly does, and if the foliation projects offshore at a similar azimuth to its onshore pattern, then the Southern Cross array should detect substantially different Pg velocities at different azimuths.

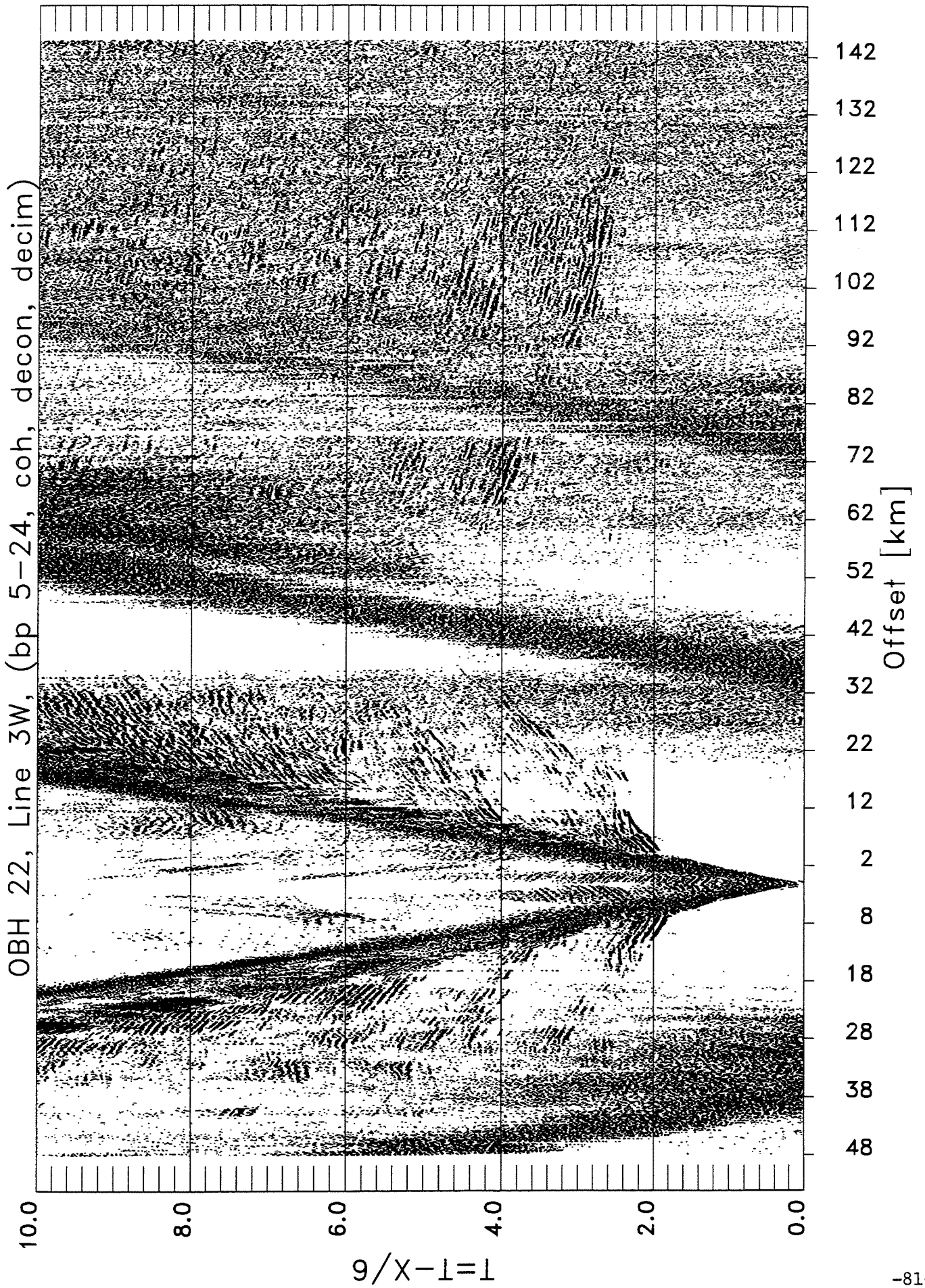

170° 24'
170° 36'
170° 48'
171° 00'
171° 12'
171° 24'
-45° 00'
-45° 12'
-45° 24'
-45° 36'
-45° 48'
-46° 00'
Kauru Hill
Kakanui Point
Dunedin
A2
A8
27
25
26
SC-1
SC-2
SC-3
SC-4

Appendix 7
Record Sections and Preliminary Model, Line 3W

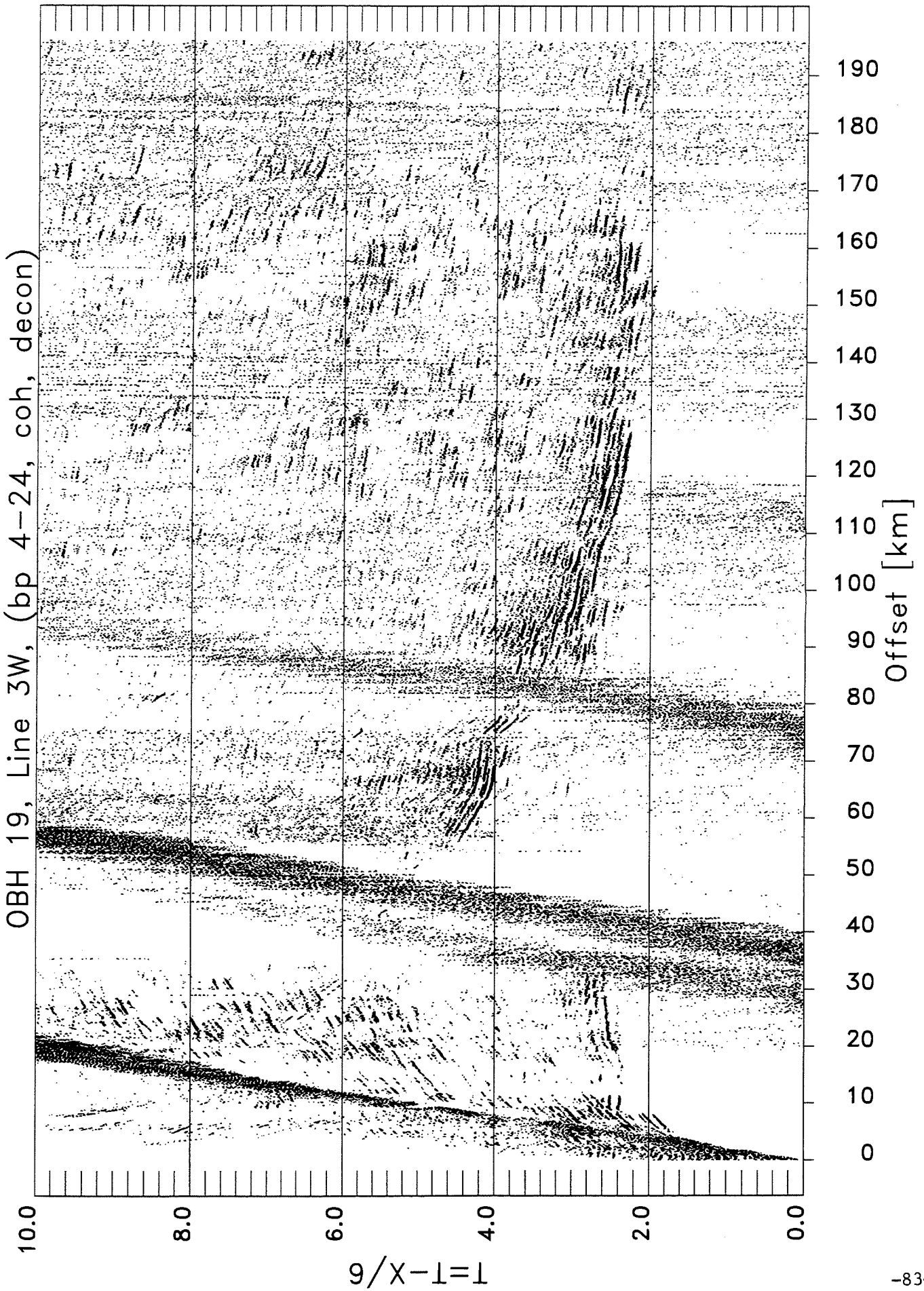
Record sections for the four OBHs stationed on Line 3W are shown. These data have been filter 5-24 Hz, coherency filtered, and deconvolved. Previous shot noise (PSN) is visible in bands every 35-40 km; the PSN is phase-incoherent due to the shot time randomization and becomes very weak beyond 80 km due to the shallow water along the transect.

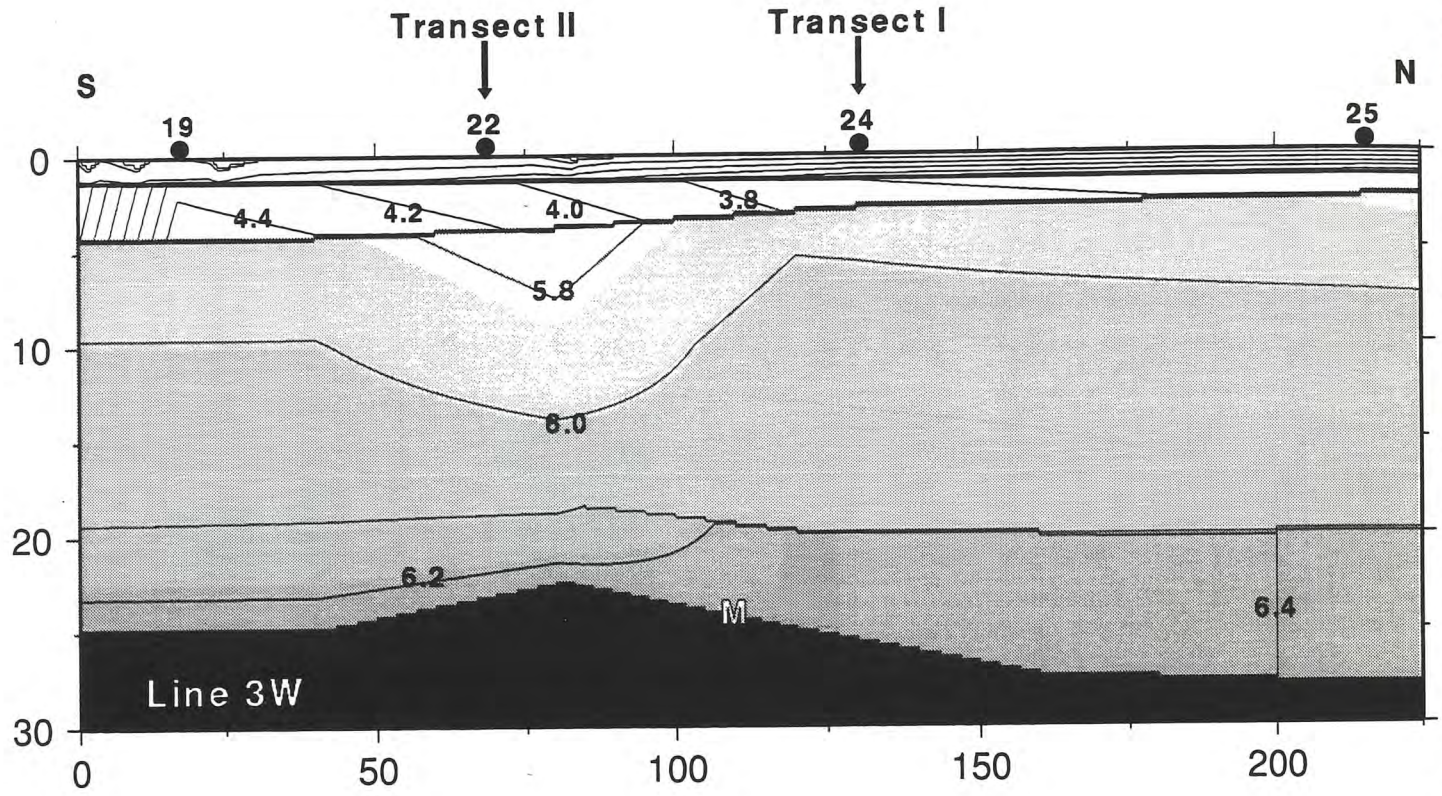
A preliminary model of crustal structure along this line was produced shipboard; the figures show the P-velocity model and ray diagrams for each instrument. The model shows a crustal thickness of 23–28 km, with velocities near 6.0 km/s in the mid-crust and 6.2–6.5 km/s in the lower crust. The wide-angle data show evidence for a substantial change in seismic character between the northern and southern portions of the profile: to the north a strong reflection from the top of the lower crust is observed and Pg velocities are slightly higher; to the south, no distinct lower crust is observed and Pg velocities are slightly lower. These differences are supported by a preliminary stack of the MCS data along this line (not shown), which show a strongly reflective lower crust to the north and a relatively transparent crust above the Moho to the south. Onshore-offshore Transects I and II therefore apparently cross crust of differing character on the Australian plate.

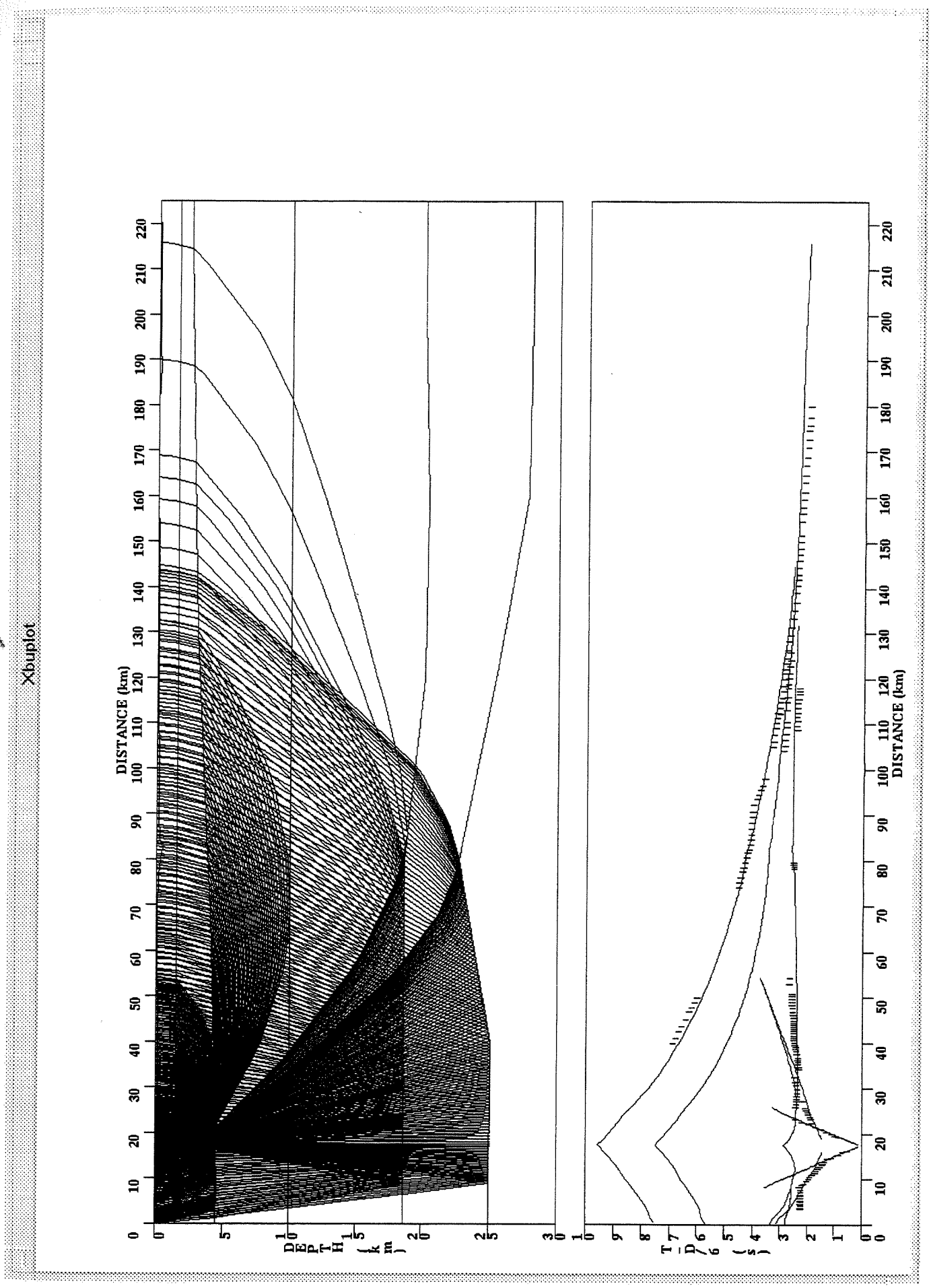
OBH 25, Line 3W, (bp 4–25, coh, decon, decim)
Offset [km]
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
T=T−X/6
10.0
8.0
6.0
4.0
2.0
0.0

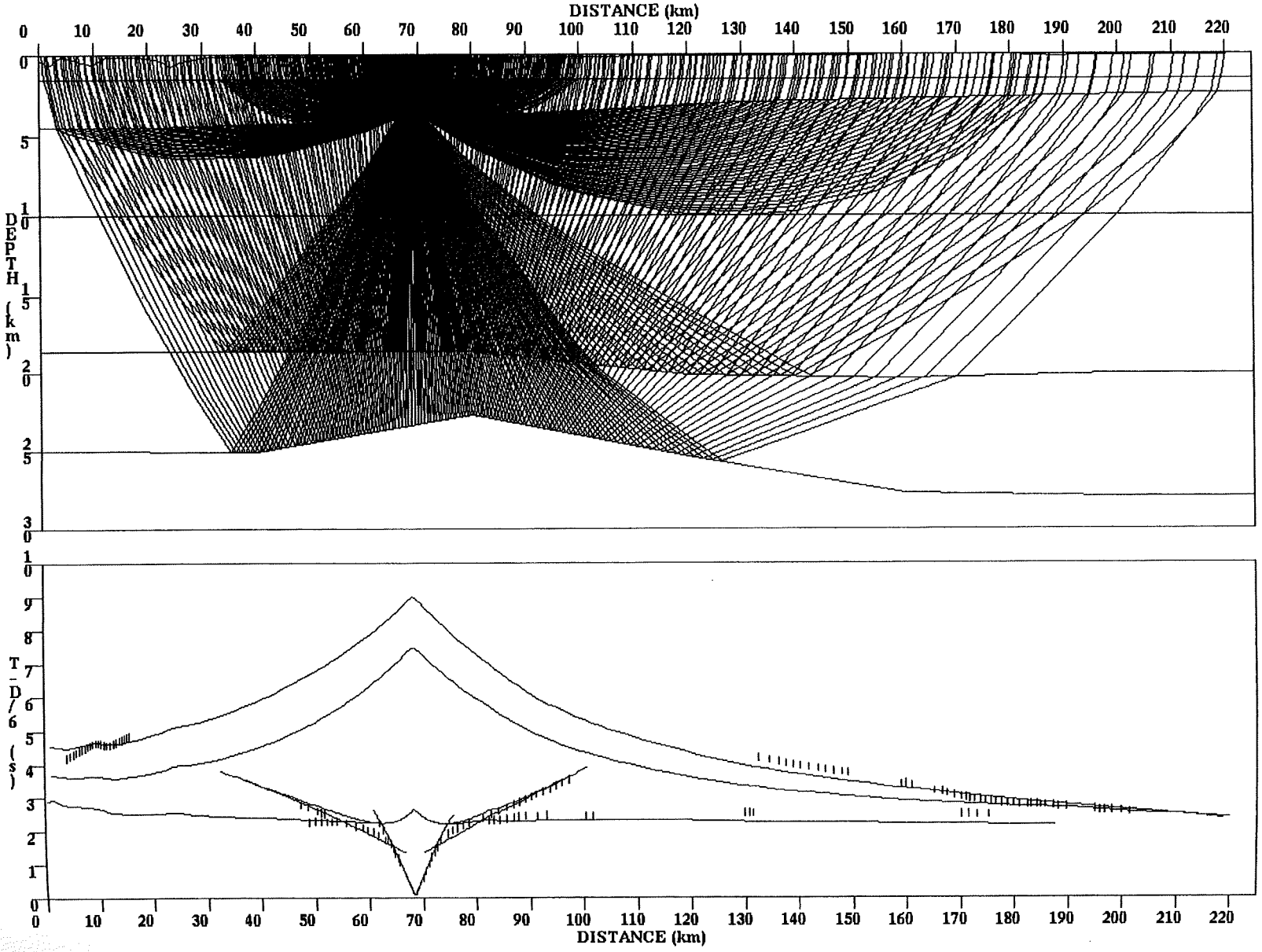

OBH 22, Line 3W, (bp 5-24, coh, decon, decim)
142
132
122
112
102
92
82
72
62
52
42
32
22
12
2
8
18
28
38
48
Offset [km]
10.0
8.0
6.0
4.0
2.0
0.0
T=T-X/6

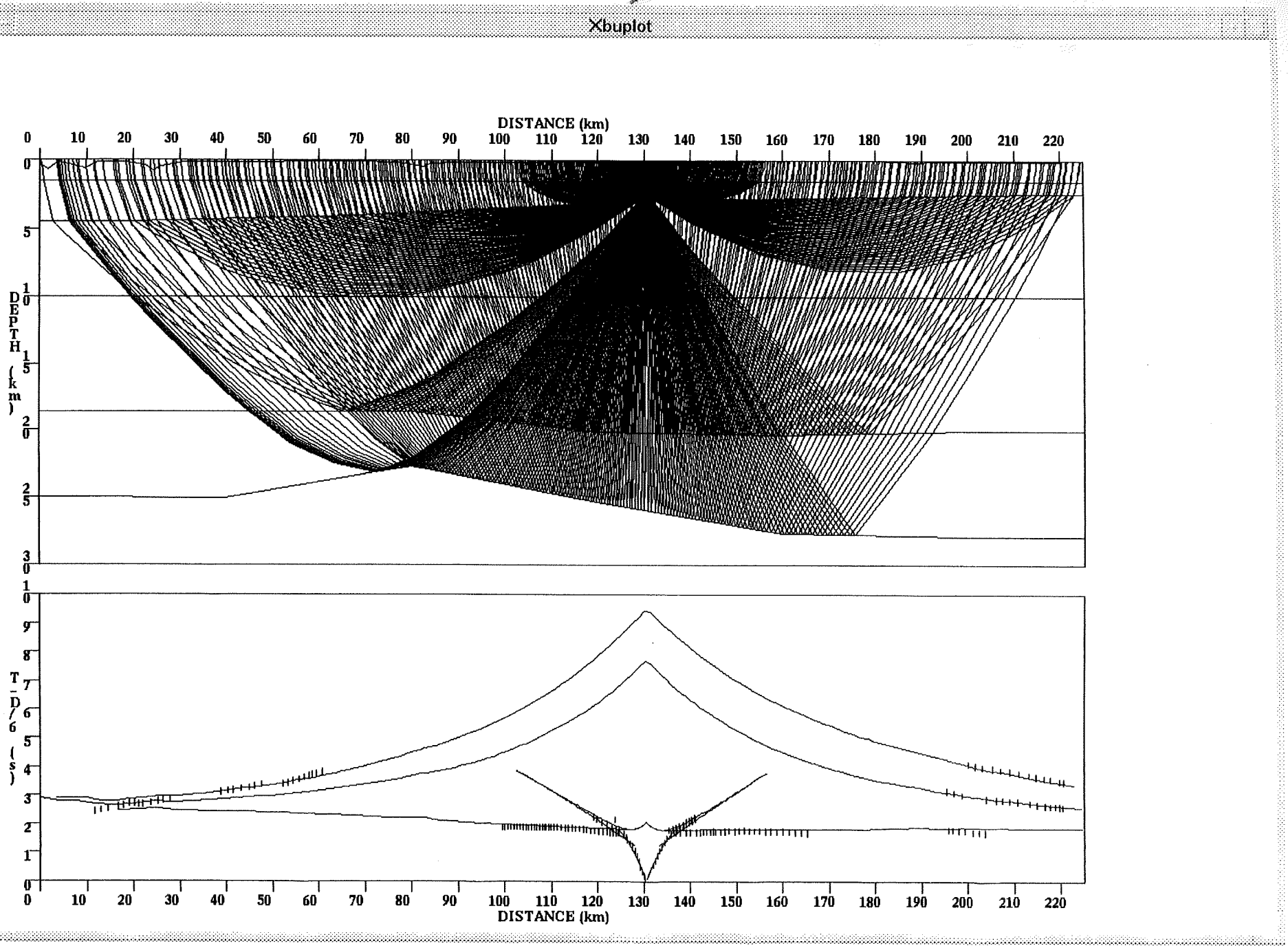
OBH 24, Line 3W, (bp 5–24, coh, decon)
T=T−X/6
10.0
8.0
6.0
4.0
2.0
0.0
Offset [km]
82
72
62
52
42
32
22
12
2
8
18
28
38
48
58
68
78
88
98
108

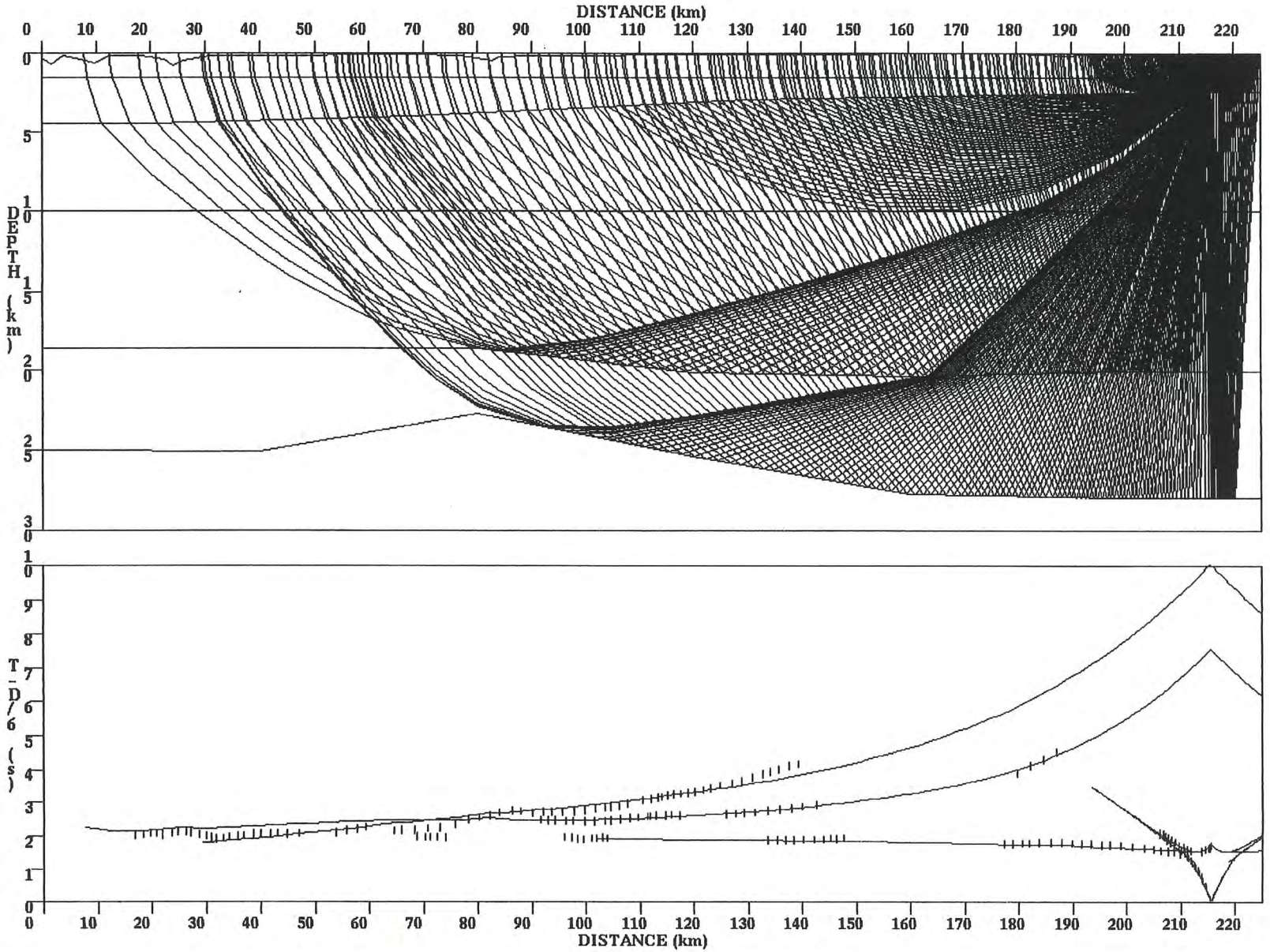

OBH 19, Line 3W, (bp 4-24, coh, decon)
Offset [km]
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
10.0
8.0
6.0
4.0
2.0
0.0
T=T-X/6


Transect II
Transect I
S
N
19
22
24
25
0
10
20
30
4.4
4.2
4.0
3.8
5.8
6.0
6.2
M
6.4
Line 3W
0
50
100
150
200


Xbuplot
DISTANCE (km)
DEPTH (km)
T-D/6 (s)
DISTANCE (km)


DISTANCE (km)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
DEPTH (km)
0 5 10 15 20 25 30
T-D/6 (s)
0 1 2 3 4 5 6 7 8 9 10
DISTANCE (km)

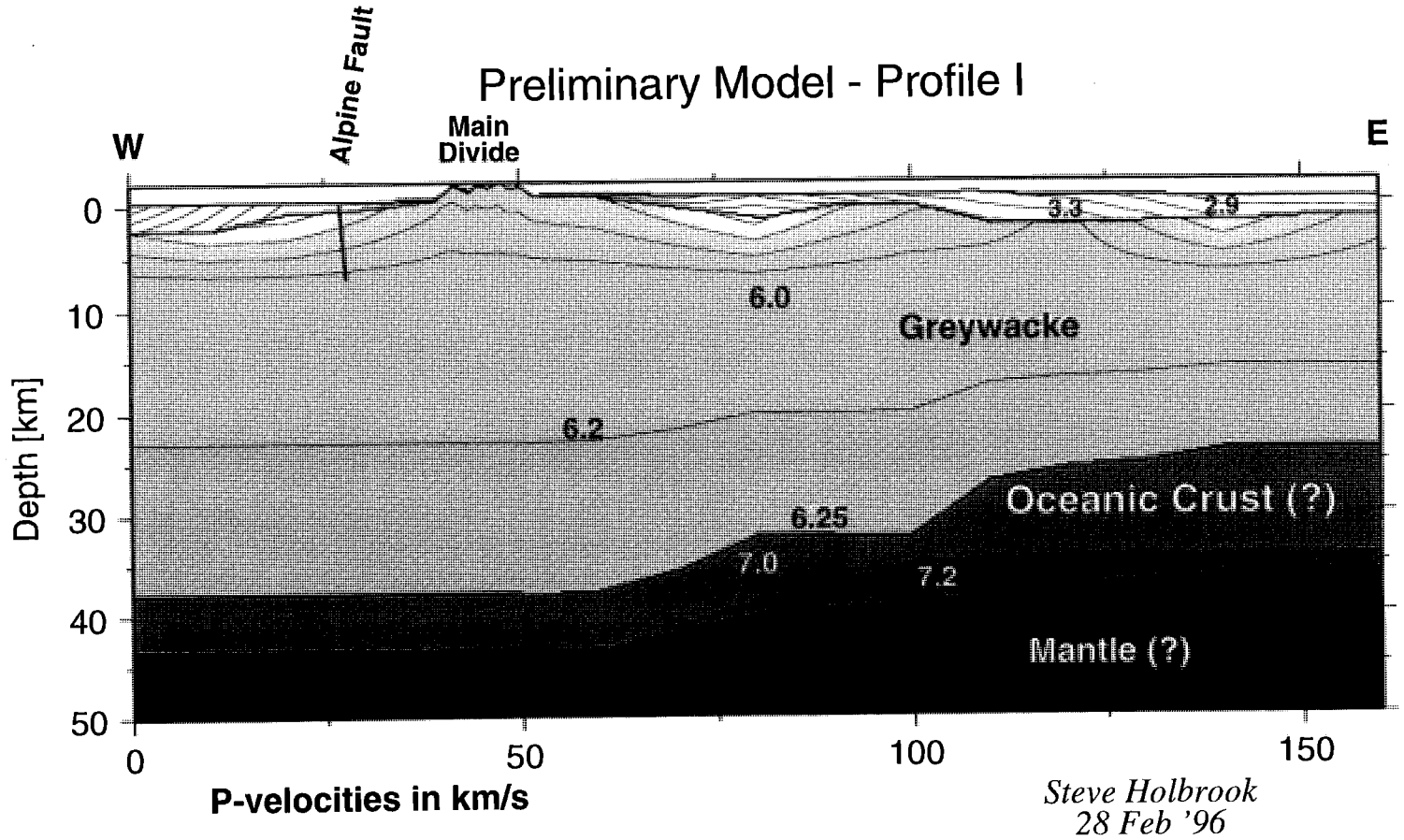

Xbuplot
DISTANCE (km)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
DEPTH (km)
0 5 10 15 20 25 30
T-D/6 (s)
0 1 2 3 4 5 6 7 8 9 10
DISTANCE (km)


DISTANCE (km)
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220
DEPTH (km)
0 5 10 15 20 25 30
T-D/6 (s)
0 1 2 3 4 5 6 7 8 9 10
DISTANCE (km)

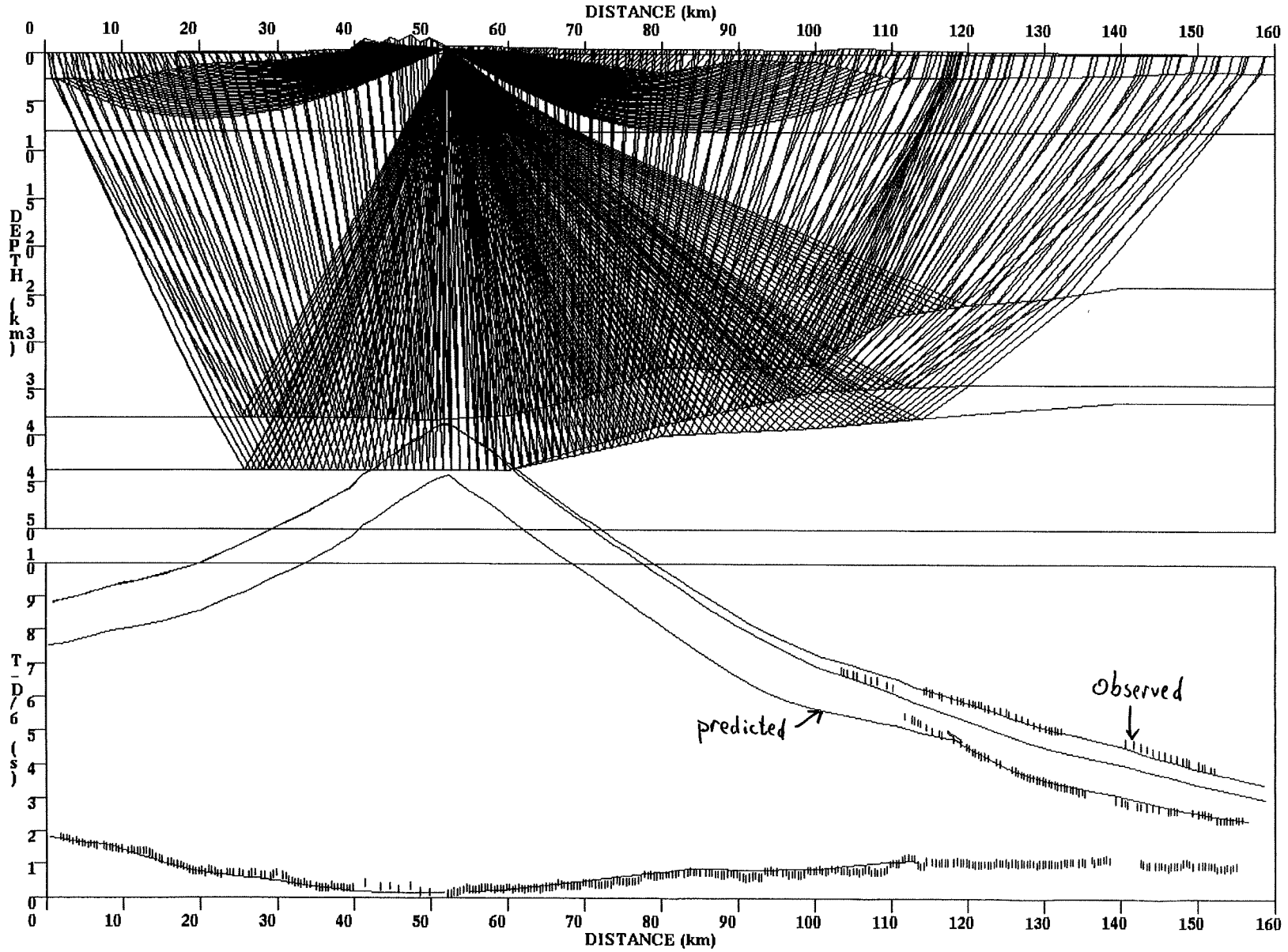
Appendix 8
Preliminary Model, Explosion Line 1

During the cruise we completed a preliminary model of onshore explosion data from Transect I, collected in January 1996 during the first phase of the active-source seismic experiment. The model will provide a starting point for analysis of the onshore-offshore data recorded during shooting of Lines 1W and 1E during EW-9601. Data from sixteen chemical explosions were recorded on 400 portable seismometers deployed across the island.

The attached figures show the preliminary velocity model based on inversion of traveltimes from all sixteen shots, and a sample ray diagram from SP 11, a shot at Mistake Flat in the Havelock River valley. The principal feature of the model is a strong reflector, visible on nearly every shotpoing, that deepens from 23 km depth beneath the east coast to 37 km depth under the Main Divide. This reflector presumably marks the top of the Pacific oceanic believed to underlie the eastern South Island. Several deeper reflectors map out a crust that is at least 43 km thick beneath the central South Island. Mantle refractions were not observed on the explosion data due to the narrowness of the island, so confirmation of crustal thickness and lower-crustal velocities must await incorporation of the onshore-offshore data into the model.


Preliminary Model - Profile I
W
Alpine Fault
Main Divide
E
Depth [km]
0
10
20
30
40
50
3.3
2.9
6.0
Greywacke
6.2
6.25
Oceanic Crust (?)
7.0
7.2
Mantle (?)
0
50
100
150
P-velocities in km/s
Steve Holbrook
28 Feb '96

SP 11



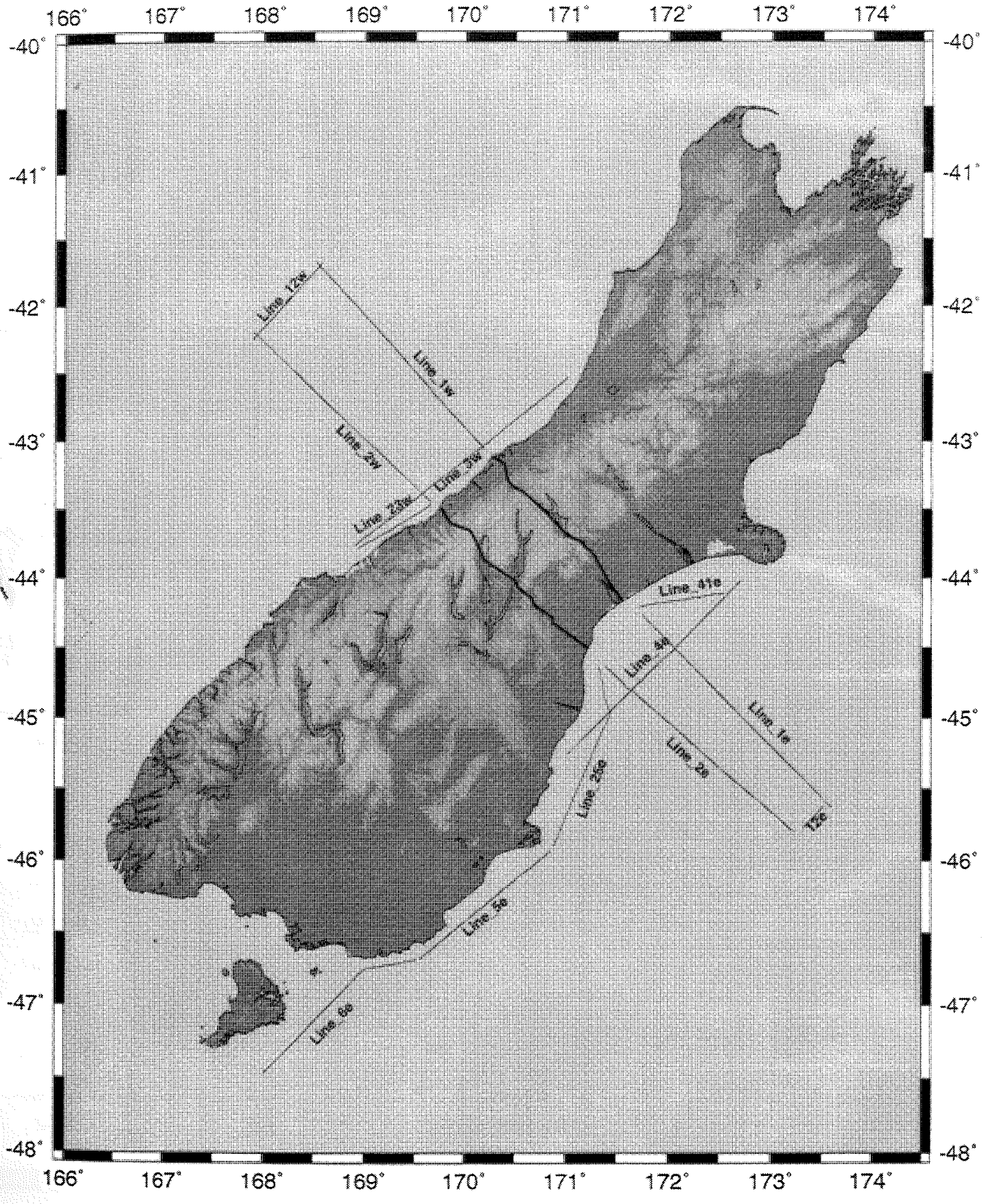
Example of travel time fit

Appendix 9
Underway Geophysical Data

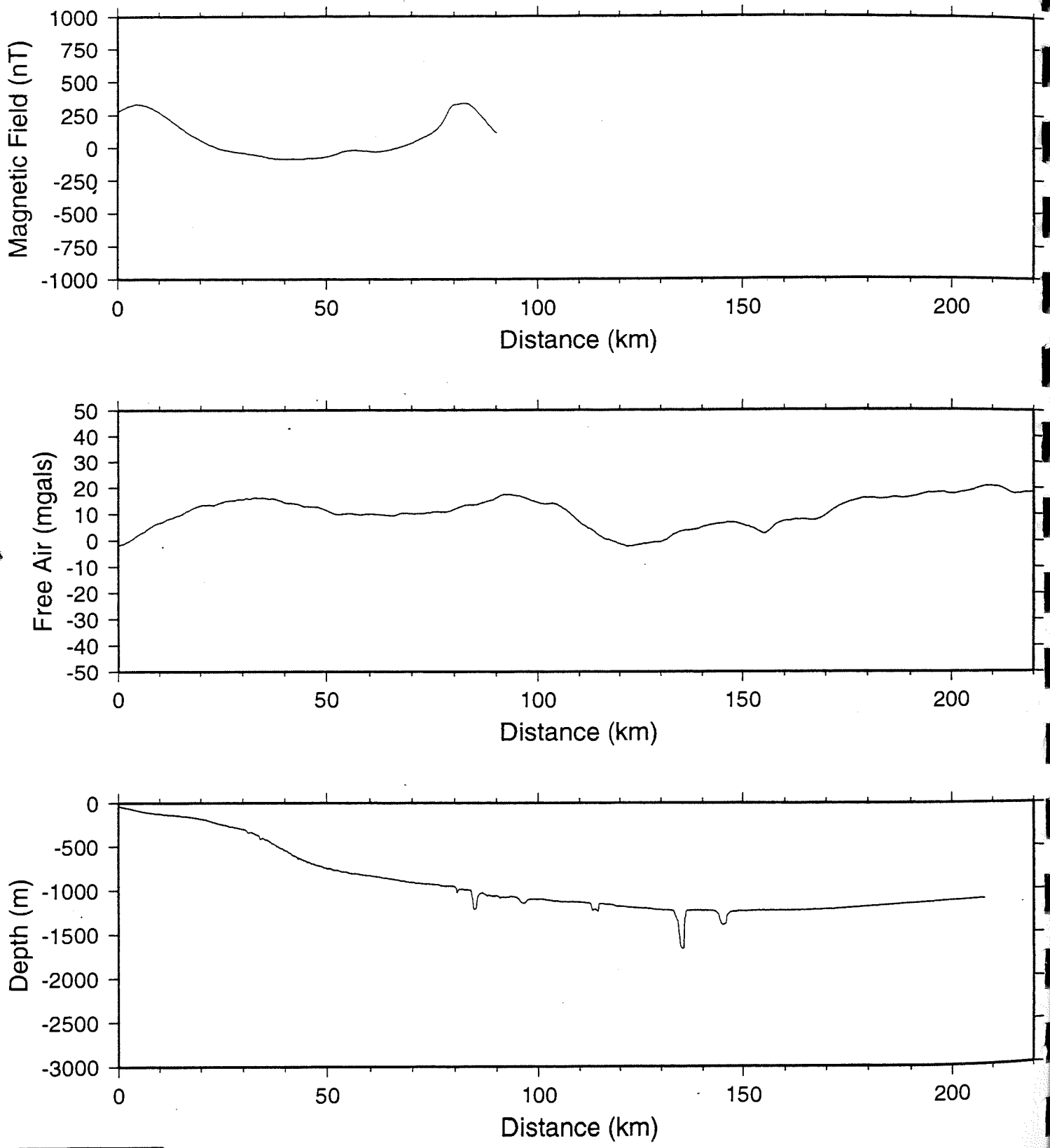
In addition to MCS data, we also collected gravity, magnetic and Hydrosweep bathymetry data. The following figures show magnetic anomaly, free air gravity anomaly, and Hydrosweep centerbeam bathymetry for each line segment.

Eotvos correction with GPS navigation correction was applied to measured gravity values prior to FAA calculation. I GRF 1990 was used as a reference for magnetic anomaly calculation. Shell scripts to produce these figures are appended at the end.

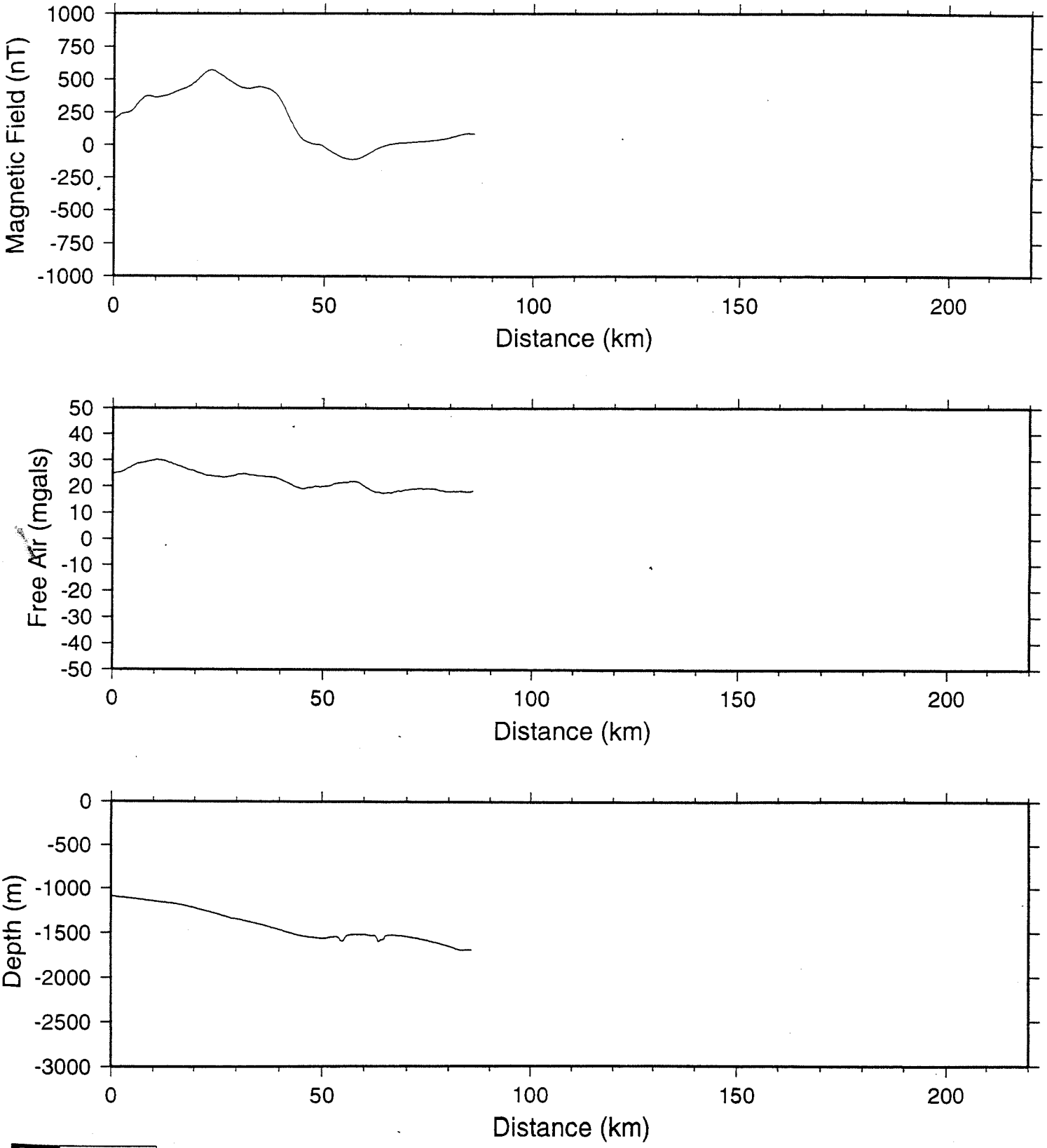
MCS Trackline Data



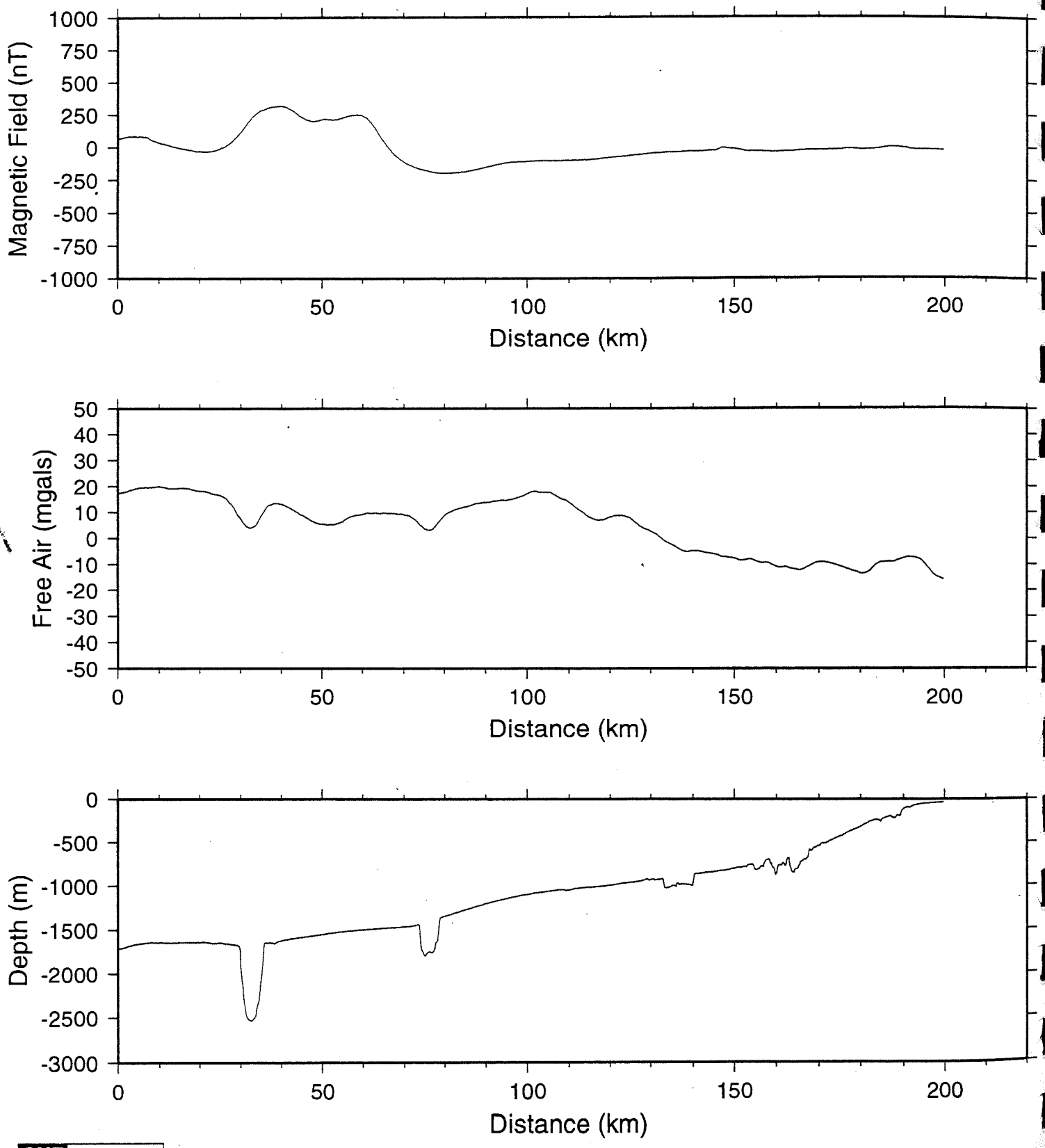
MCS Line_1W


Magnetic Field (nT)
1000
750
500
250
0
-250
-500
-750
-1000
0
50
100
150
200
Distance (km)
Free Air (mgals)
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
50
100
150
200
Distance (km)
Depth (m)
0
-500
-1000
-1500
-2000
-2500
-3000
0
50
100
150
200
Distance (km)
GMT Feb 25 22:03
MCS line_1w

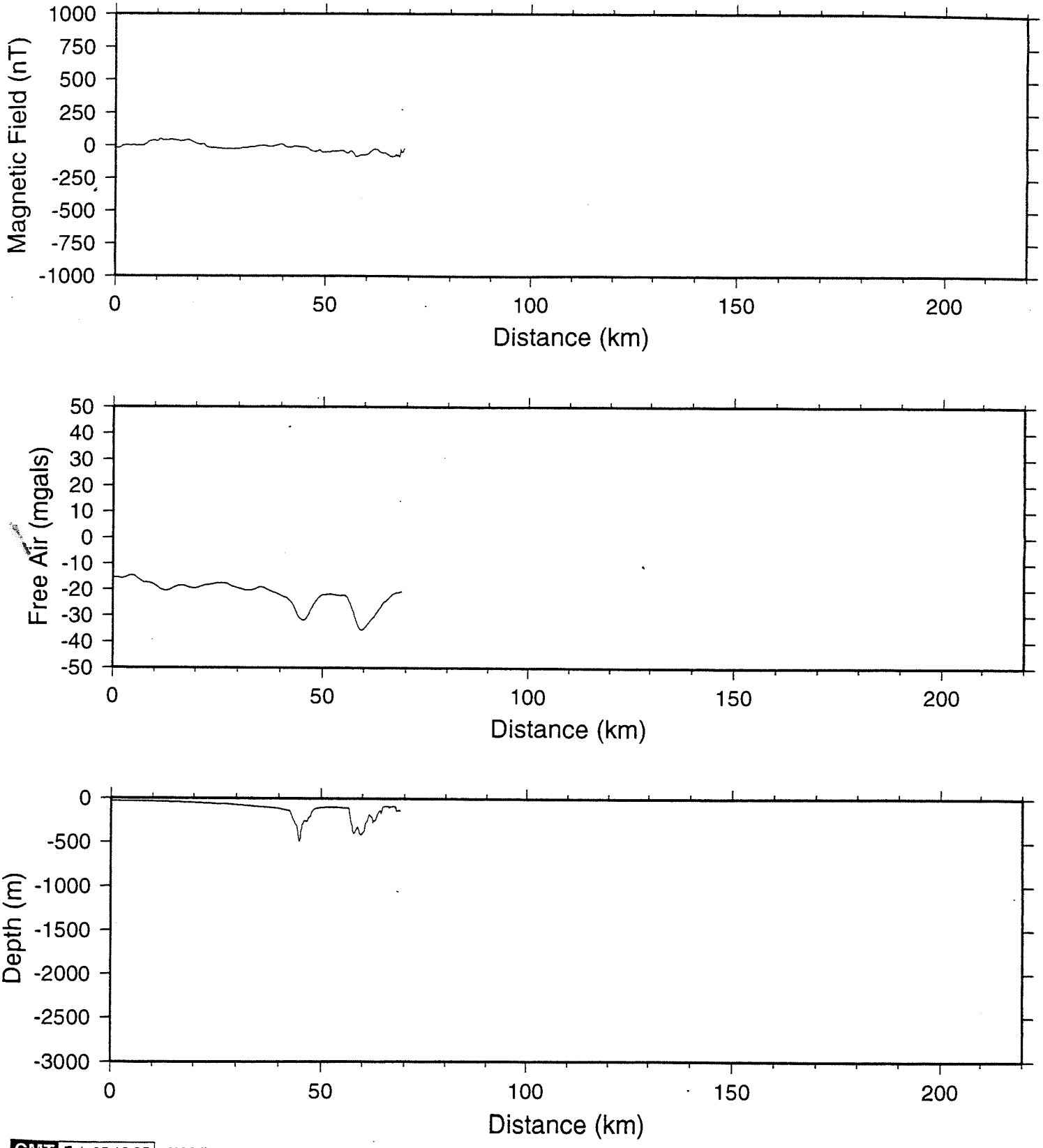
MCS Line_12W


Magnetic Field (nT)
1000
750
500
250
0
-250
-500
-750
-1000
0
50
100
150
200
Distance (km)
Free Air (mgals)
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
50
100
150
200
Distance (km)
Depth (m)
0
-500
-1000
-1500
-2000
-2500
-3000
0
50
100
150
200
Distance (km)
GMT Feb 25 16:26
MCS line_12w

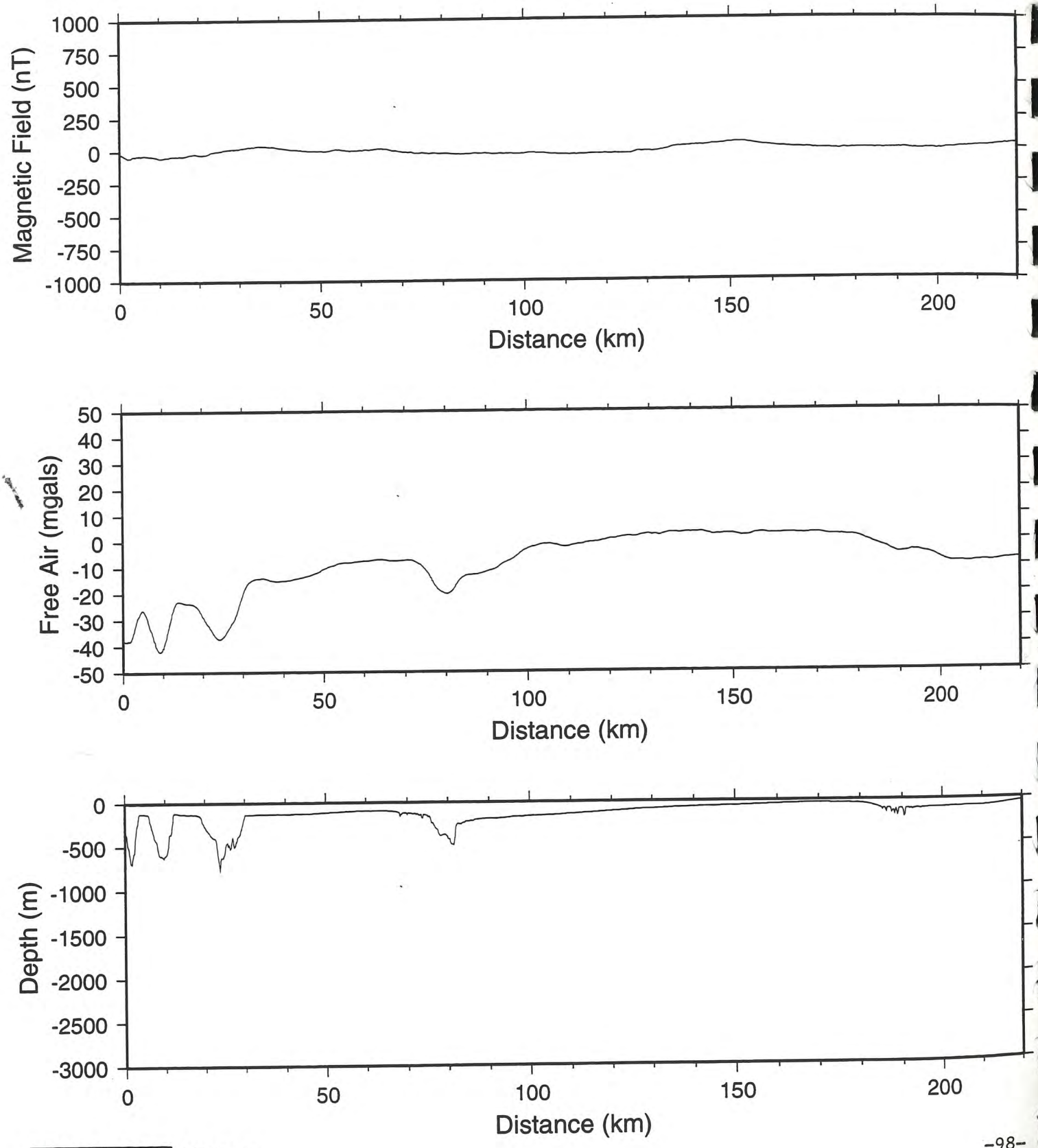
MCS Line_2W


Magnetic Field (nT)
1000
750
500
250
0
-250
-500
-750
-1000
0
50
100
150
200
Distance (km)
Free Air (mgals)
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
50
100
150
200
Distance (km)
Depth (m)
0
-500
-1000
-1500
-2000
-2500
-3000
0
50
100
150
200
Distance (km)
GMT Feb 25 16:25
MCS line_2w

MCS Line_23W

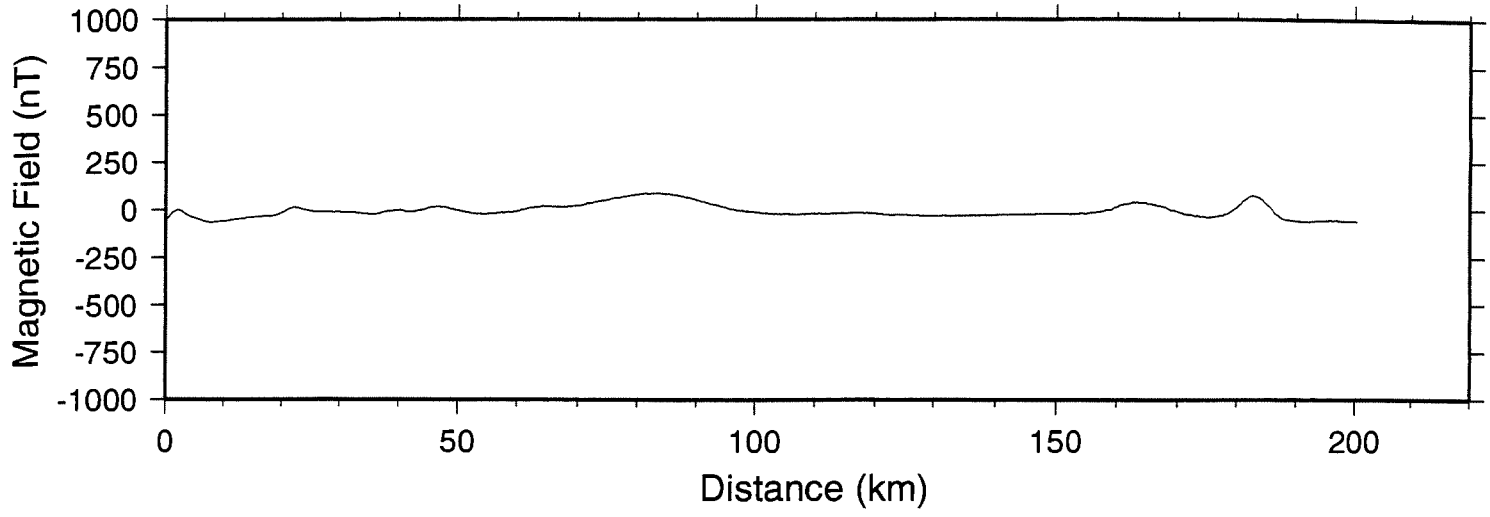

Magnetic Field (nT)
1000
750
500
250
0
-250
-500
-750
-1000
0
50
100
150
200
Distance (km)
Free Air (mgals)
50
40
30
20
10
0
-10
-20
-30
-40
-50
0
50
100
150
200
Distance (km)
Depth (m)
0
-500
-1000
-1500
-2000
-2500
-3000
0
50
100
150
200
Distance (km)
GMT Feb 25 16:25
MCS line_23w

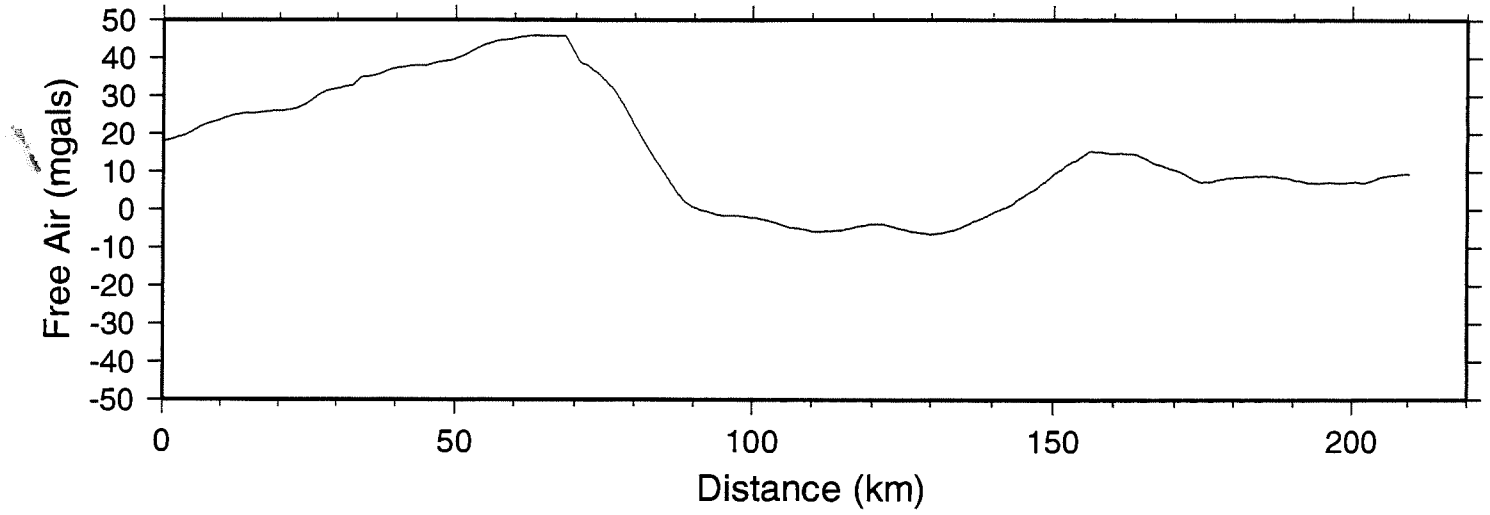
MCS Line_3W

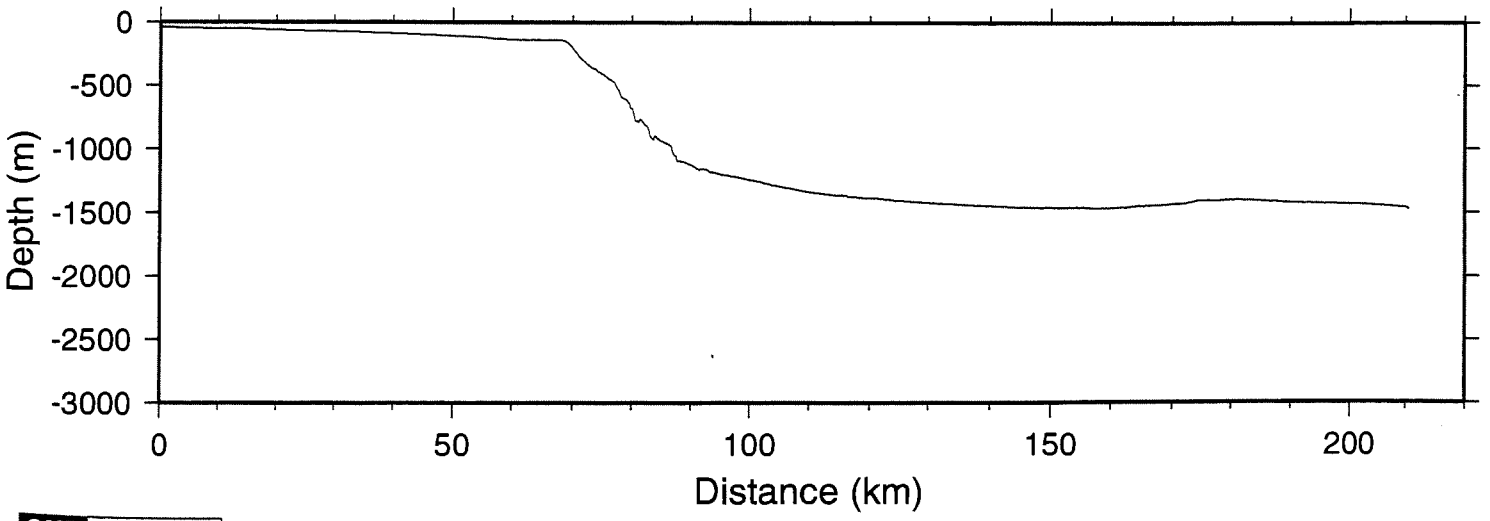


GMT Feb 25 16:23 MCS line_3w

MCS Line_1e

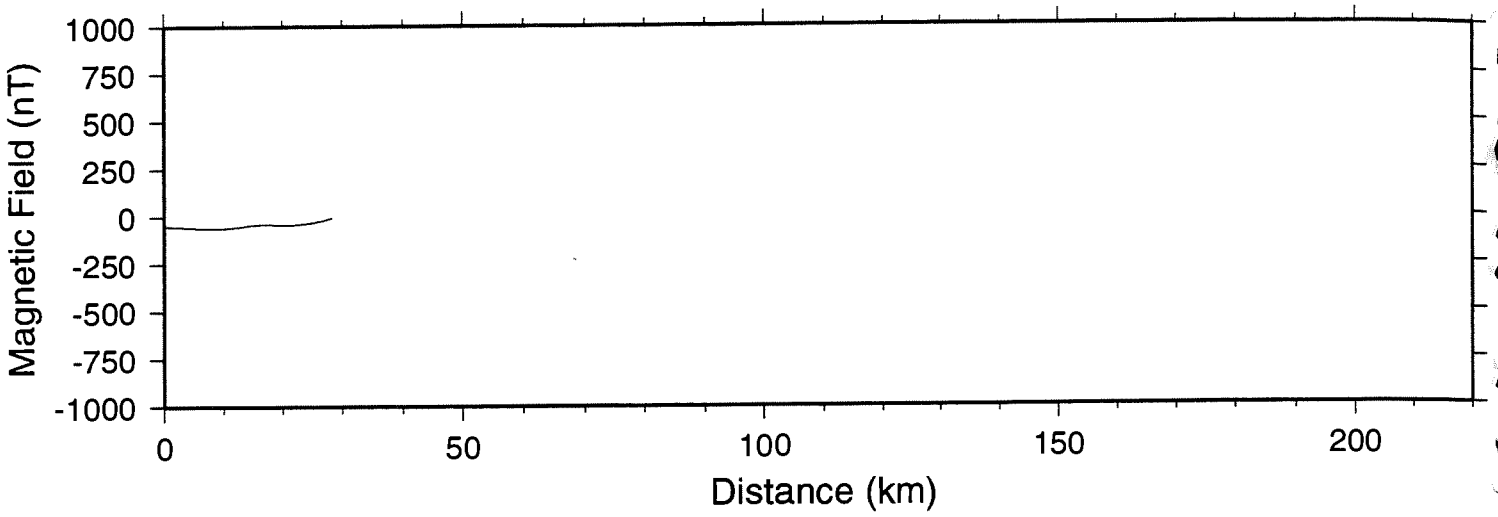


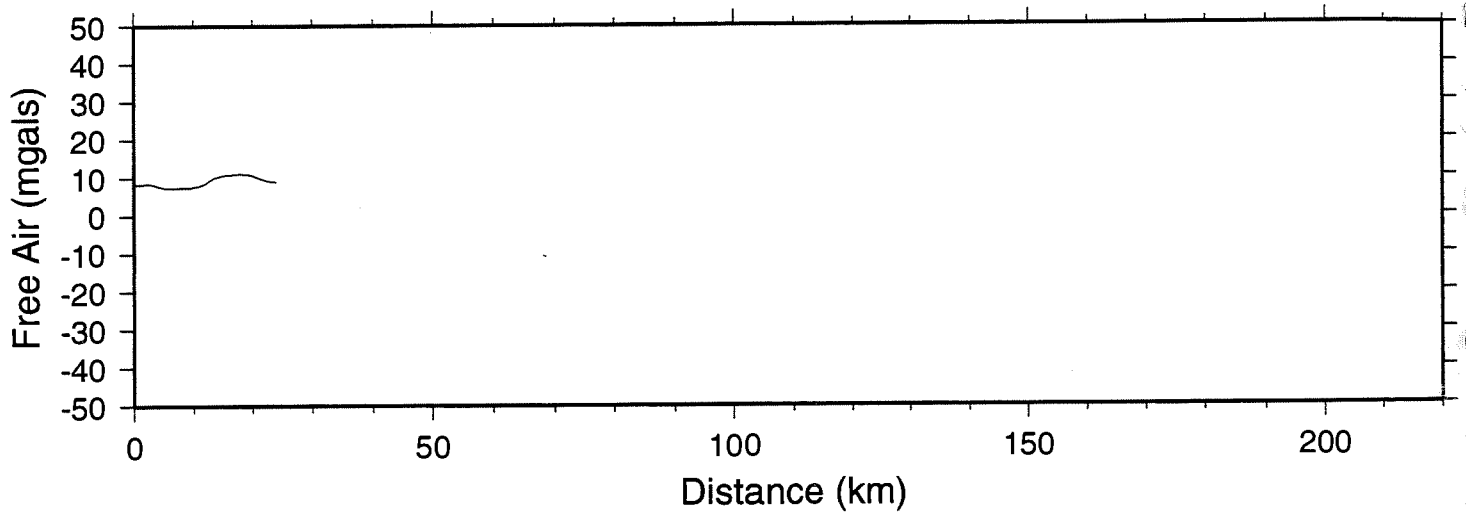


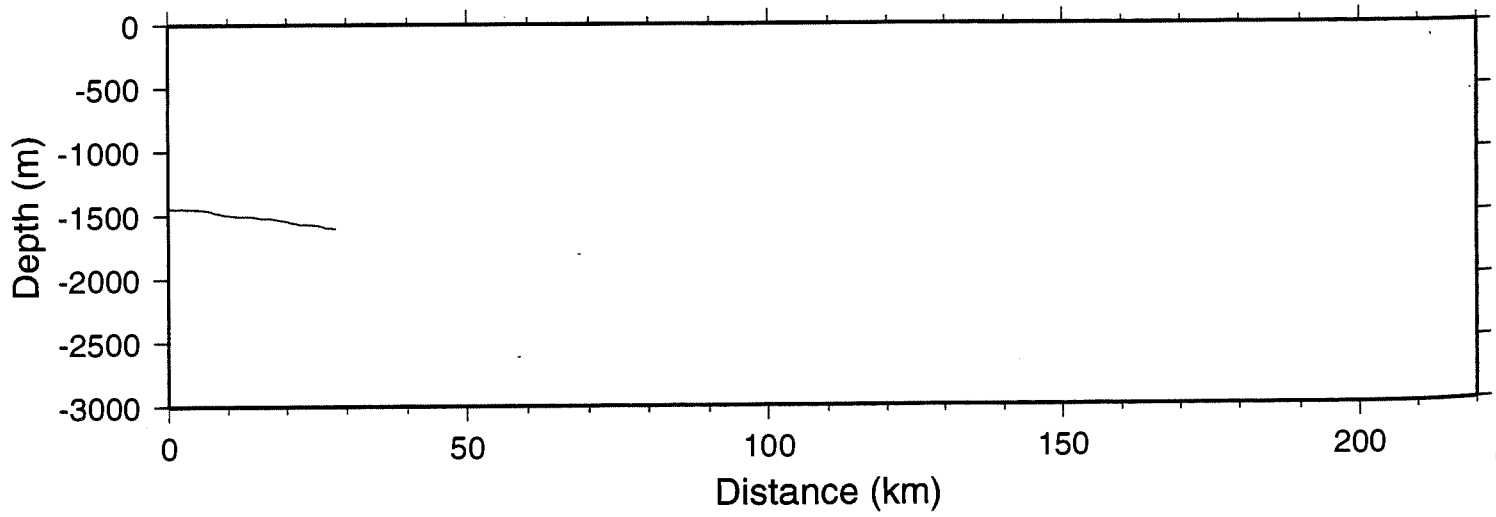


GMT Mar 2 01:42 MCS line_1e

MCS Line_12e

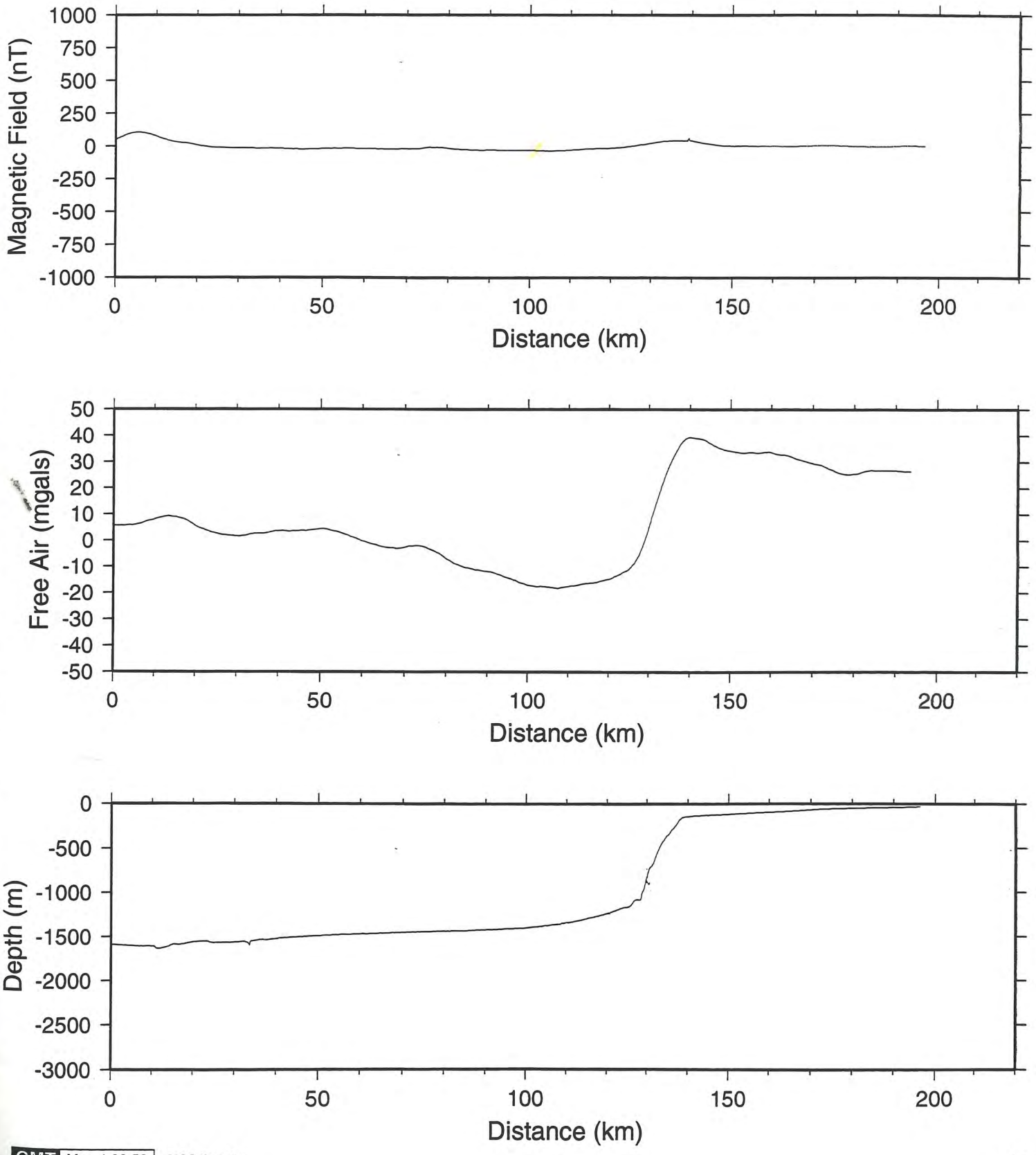






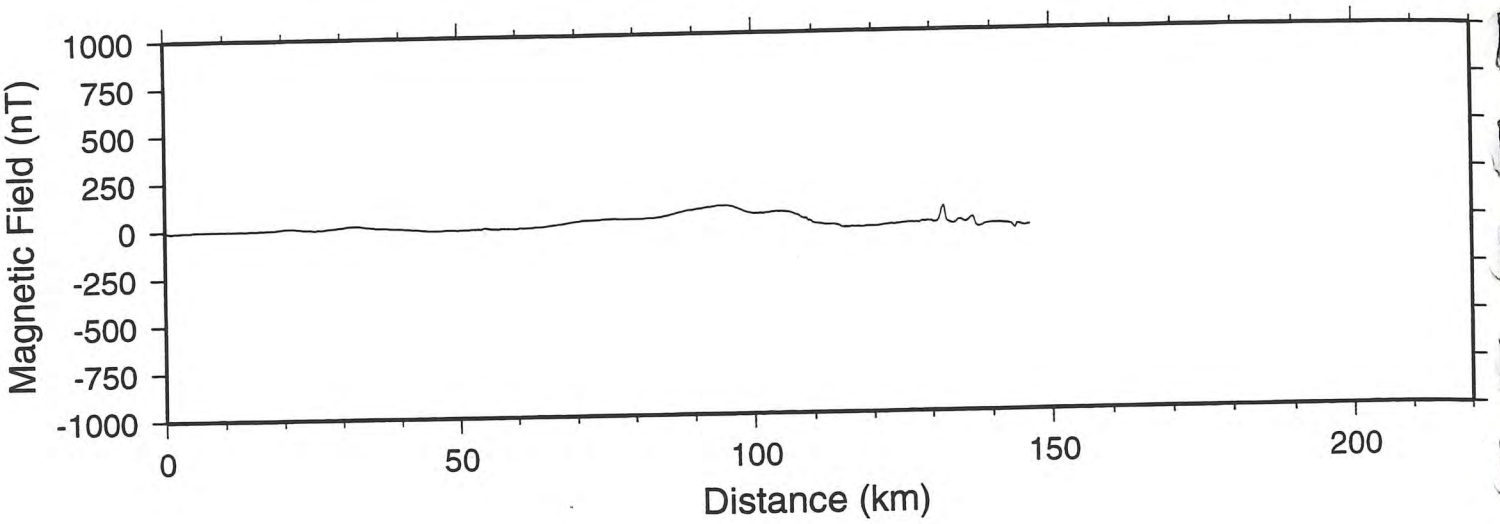
GMT Mar 2 01:40 MCS line_12e

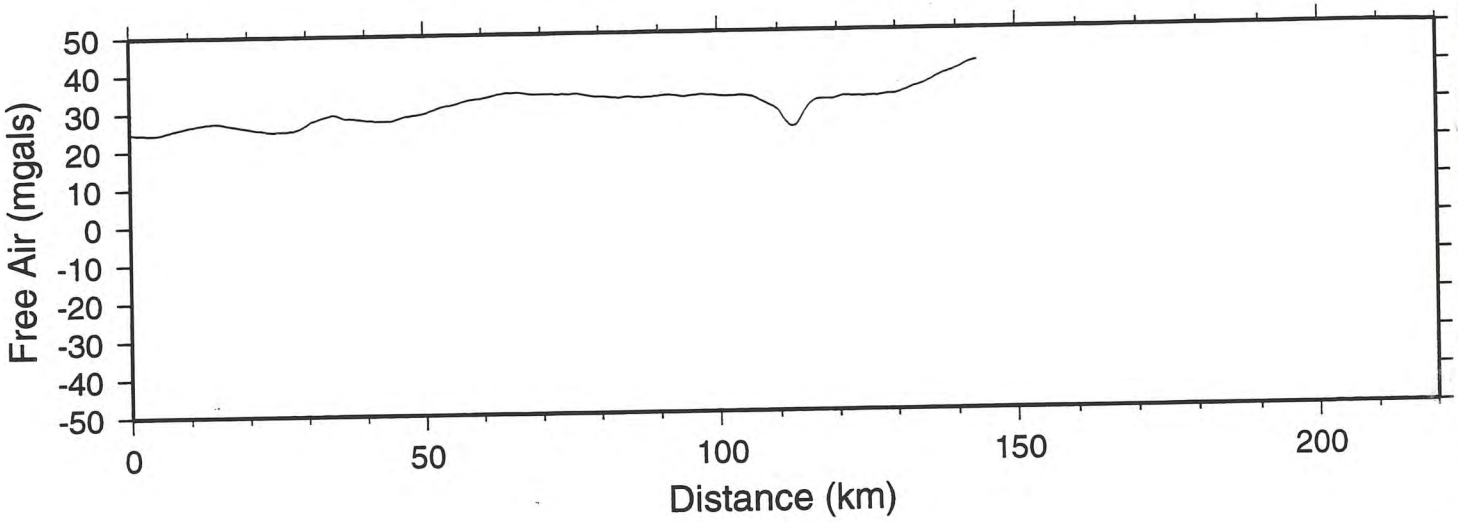
MCS Line_2E

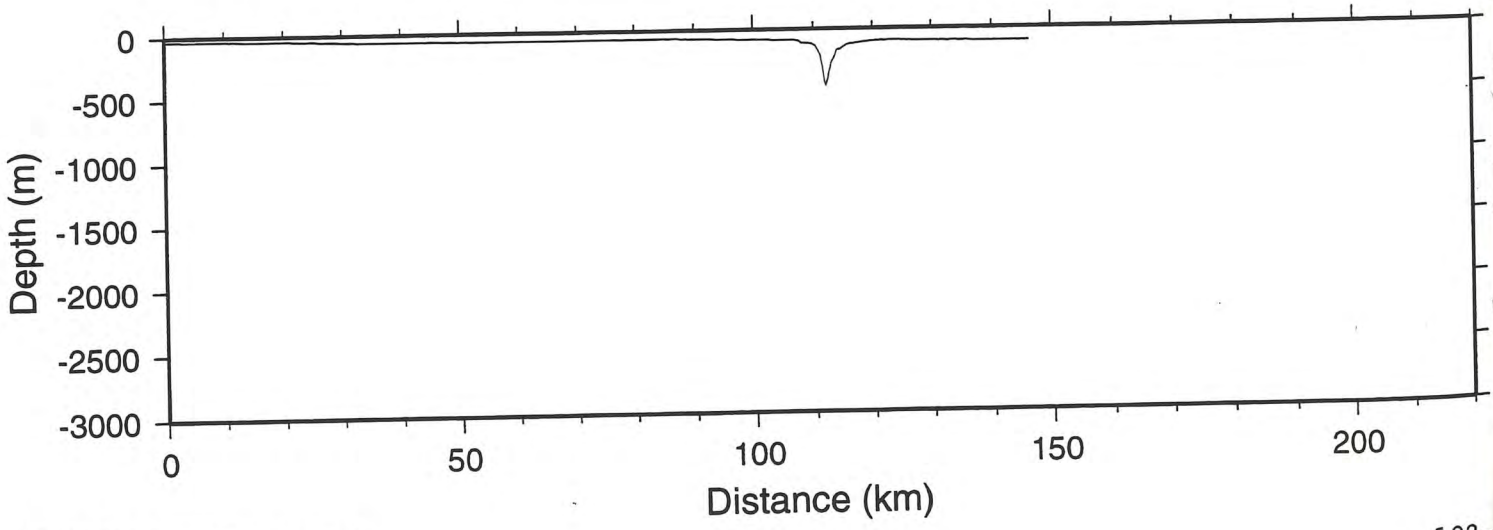


GMT Mar 1 22:59 MCS line_2e

MCS Line_25e

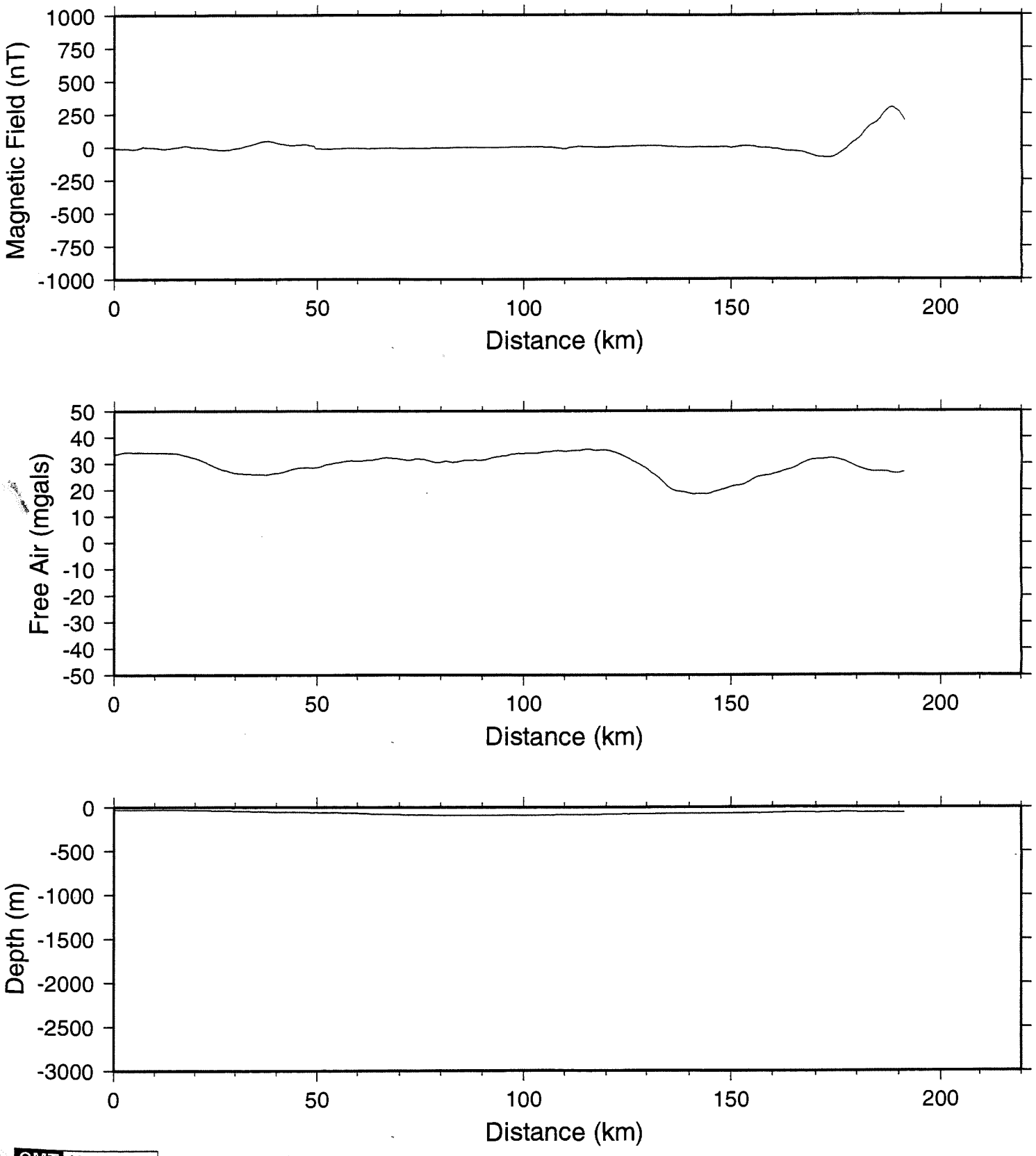






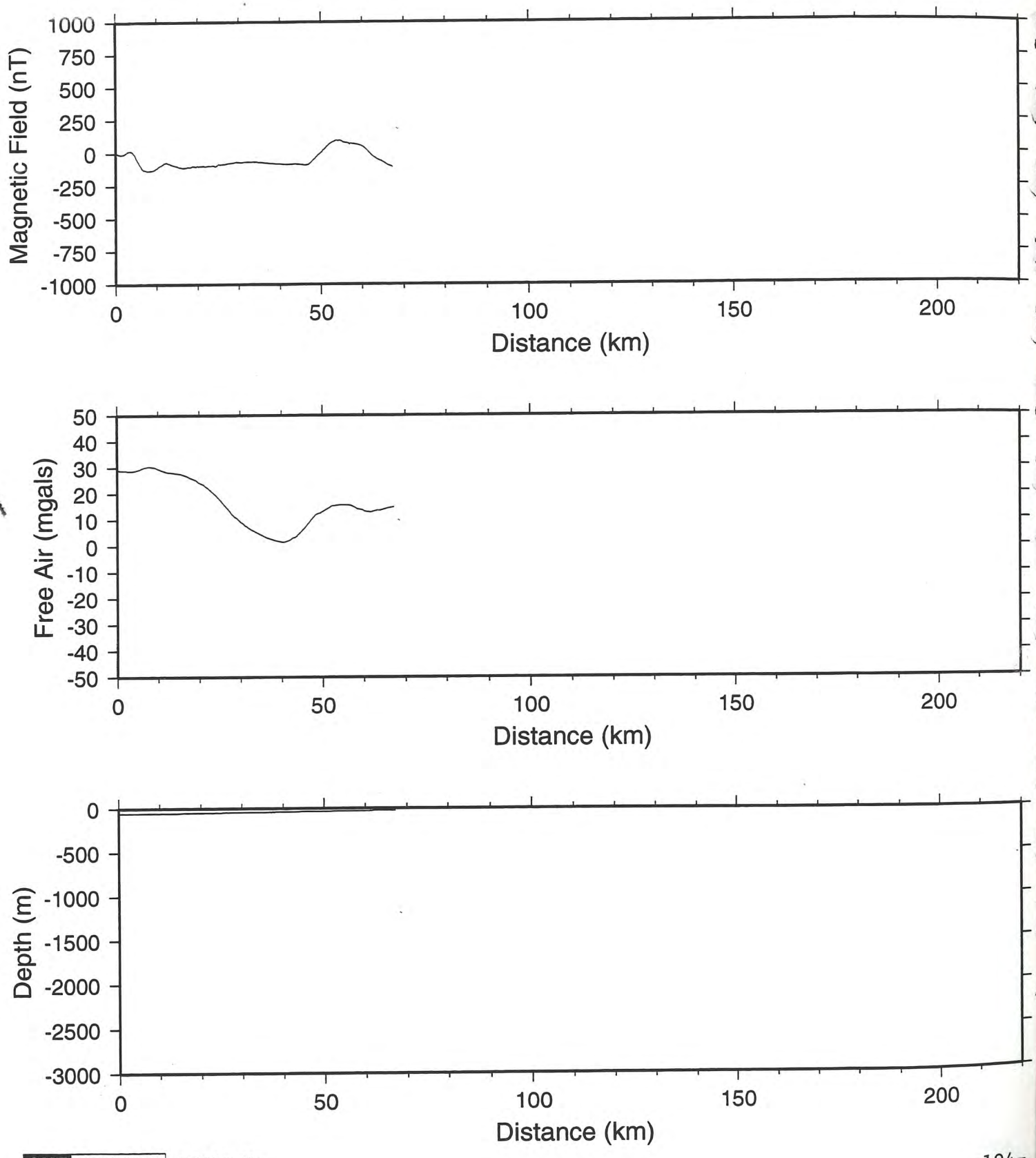
GMT Mar 2 03:10 MCS line_25e

MCS Line_4e_combined



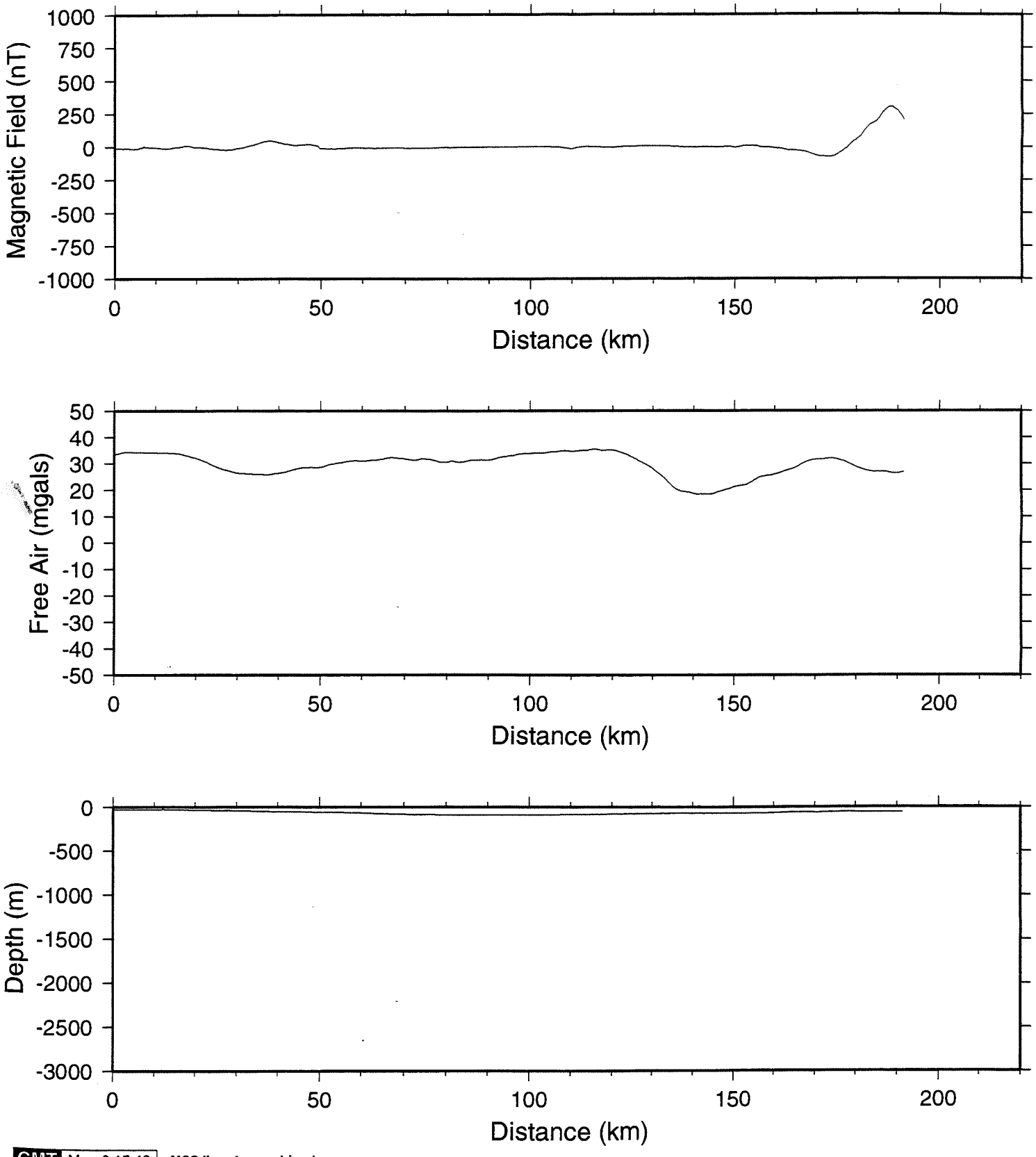
GMT Mar 2 02:29 MCS line_4e_combined

MCS Line_41e



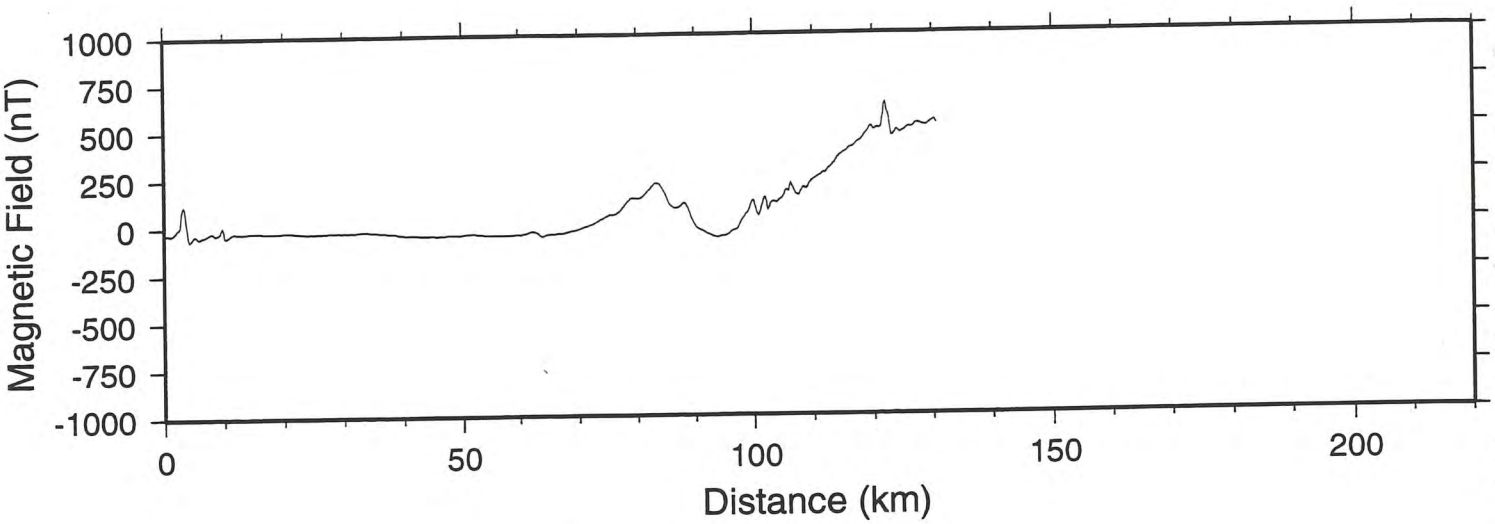
GMT Mar 2 02:36 MCS line_41e

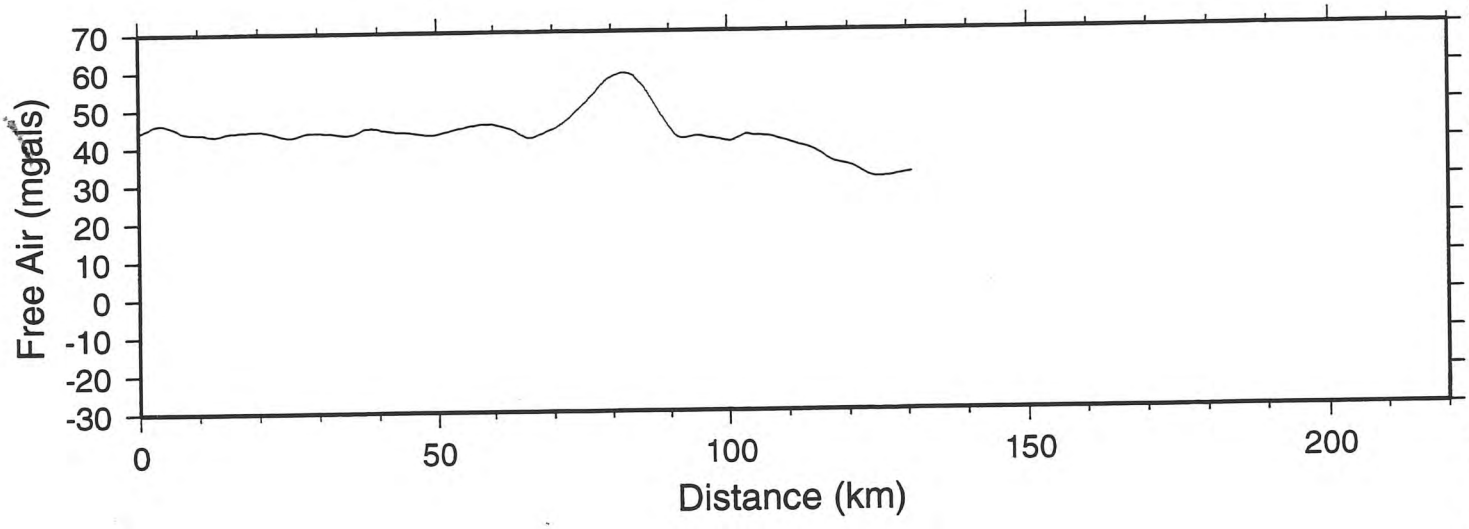
MCS Line_4e_combined

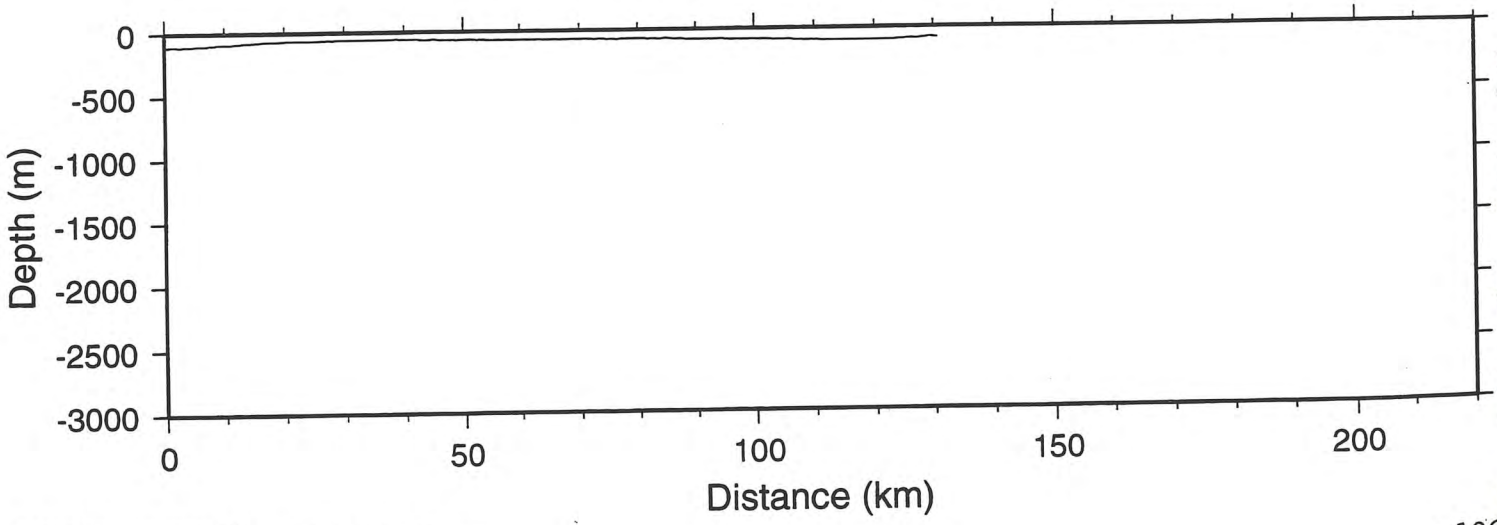


GMT Mar 2 15:48 MCS line_4e_combined

MCS Line_5e_combined

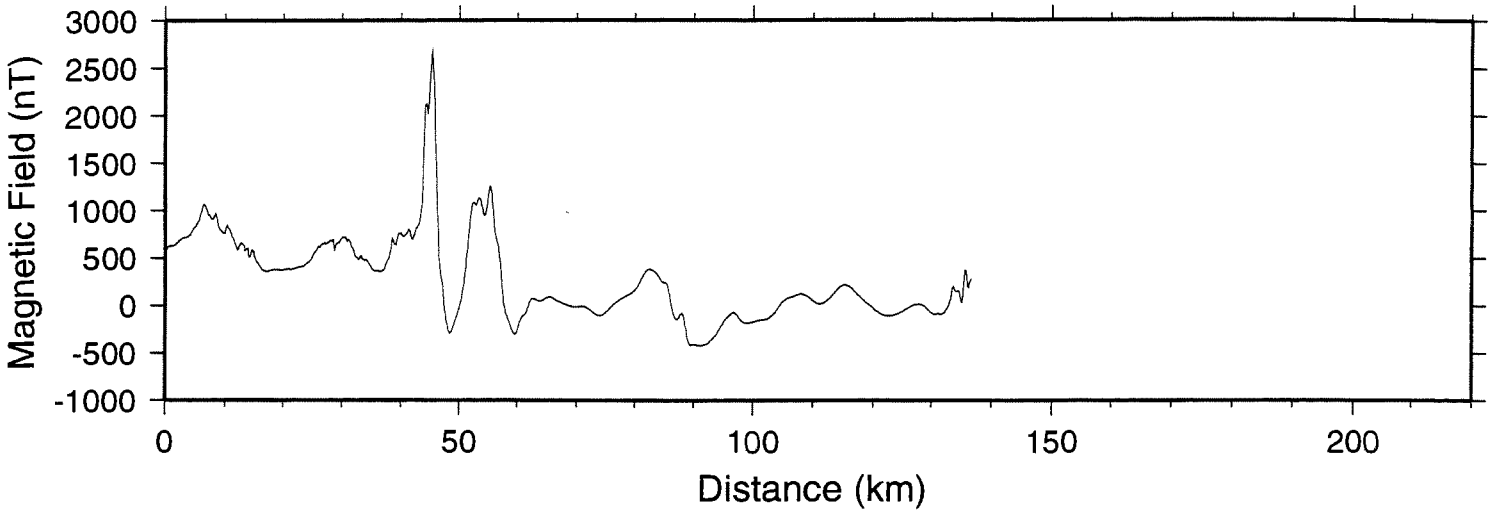


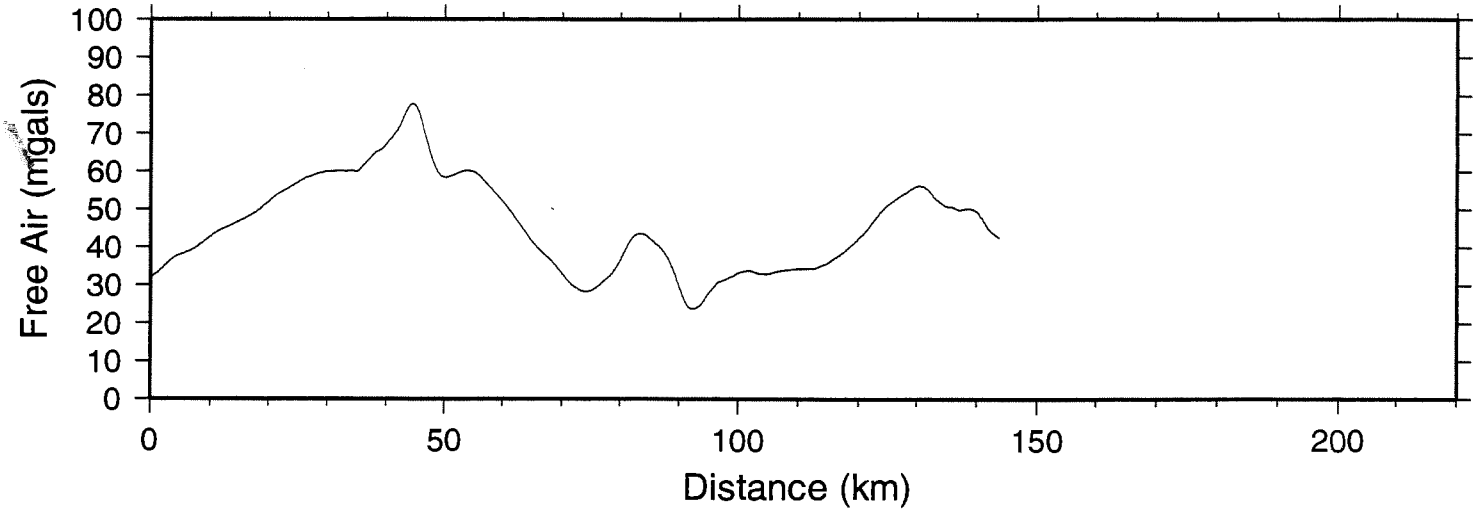


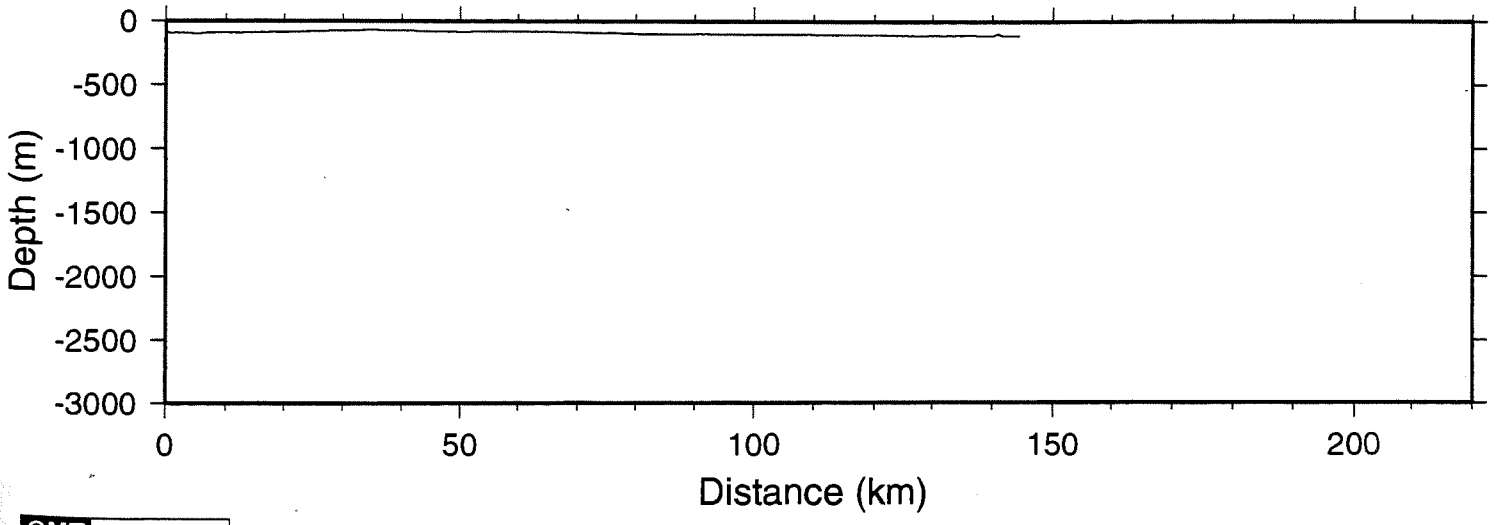


GMT Mar 2 03:05 MCS line_5e_combined

MCS Line_6e







GMT Mar 2 15:55 MCS line_6e

```
#   ************************************************************************
#       this GMT script generates a gridded image of NZ onland topography
#       and overlays labelled MCS tracklines. (DWilson March 1996)
#   ************************************************************************

#grd2cpt -M ../Map/south_island_bathy.grd -V > tmp.cpt
grdimage ../Map/south_island_bathy.grd  -R166/174.5/-48/-40 -JM6.5 -P -Ctemp.cpt  -X
1. -Y1. -K >  nzmap.ps
psbasemap                          -R166/174.5/-48/-40 -JM -B1f0.5:."MCS Trackline Dat
a": -V -P       -O -K >> nzmap.ps
#
awk '{print $2+($3/60),-($4+($5/60)),$6)' /users/kiwi/davew/gravity/grav_1w \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $2+($3/60),-($4+($5/60)),$6)' /users/kiwi/davew/gravity/grav_12w \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $2+($3/60),-($4+($5/60)),$6)' /users/kiwi/davew/gravity/grav_2w \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $2+($3/60),-($4+($5/60)),$6)' /users/kiwi/davew/gravity/grav_23w \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $2+($3/60),-($4+($5/60)),$6)' /users/kiwi/davew/gravity/grav_3w \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_1e \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_12e \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_2e \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_25e \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_4e_combined
 \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_41e \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_5e_combined
 \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
awk '{print $4+($5/60),-($2+($3/60)),$6)' /users/kiwi/davew/gravity/grav_6e \
| psxy -R -JM -O -V -P -K>>nzmap.ps
#
#
pscoast                            -R166/174.5/-48/-40 -JM -Di -W -I1 -V -P          -O
  -K  >> nzmap.ps
psxy ../Map/onshorelines.dat       -JM -R -M -W5                  -O -K >> nzmap.ps
#psxy ../Map/obhloc.dat                     -JM -R -M -W5 -Sc0.06 -G0 -O -K >> nzmap.ps
#psxy ../Map/obsloc.dat                     -JM -R -M -W5 -St0.08 -G0 -O -K >> nzmap.ps
pstext -JM -R -G0 -O << END >> nzmap.ps
169.5   -42.35  8       312     1       5       Line_1w
167.96  -42.1   8       47      1       5       Line_12w
168.74  -42.9   8       315     1       5       Line_2w
169.7   -43.35  8       39      1       5       Line_3w
168.9   -43.65  8       31      1       5       Line_23w
168.5   -47.25  8       46      1       5       Line_6e
170     -46.5   8       40      1       5       Line_5e
171.15  -45.7   8       70      1       5       Line_25e
172     -45.15  8       318     1       5       Line_2e
173.36  -45.79  8       45      1       5       12e
172.8   -44.9   8       315     1       5       Line_1e
171.6   -44.7   8       45      1       5       Line_4e
171.90  -44.1   8       10      1       5       Line_41e
END
```

```
#       ***********************************************************************
#       This GMT script generates plot for trackline Free Air Gravity,
#       Magnetic, and Bathymetry data. The Gravity data has been filtered
#       to remove very high frequency noise
#       ***********************************************************************
#
#!/bin/csh -f
#
awk '{print $6+($7/60),-($3+($4/60)),-$8}' bathymetry/bathy_3w >bathymetry/bathy.dec
imal
set bfirst = `head -1 bathymetry/bathy.decimal | awk '{print $1 "/" $2}' `
set blast = `tail -1 bathymetry/bathy.decimal | awk '{print $1 "/" $2}' `
echo $bfirst
echo $blast
#exit
#
project /users/kiwi/davew/bathymetry/bathy.decimal -Fpz -C$bfirst -M -E$blast -V >ba
thymetry/bathy.pz
#
set bmax_dist = `tail -1 /users/kiwi/davew/bathymetry/bathy.pz | awk '{print $1}' `
echo $bmax_dist
#
psxy /users/kiwi/davew/bathymetry/bathy.pz -JX6.8/2 -R0/220/-200/0 \
 -Bf10a50:"Distance (km)":/a50:"Depth (m)":WeSn -P -K -U"MCS line_3w " -Xl.2  >plot_
3w.ps
#
#_____________________________________________________________________________
awk '{print $2+($3/60),-($4+($5/60)),$6}' gravity/grav_3w  >gravity/grav.decimal
set gfirst = `head -1 gravity/grav.decimal | awk '{print $1 "/" $2}' `
set glast = `tail -1 gravity/grav.decimal | awk '{print $1 "/" $2}' `
echo $gfirst
echo $glast
#exit
#
project /users/kiwi/davew/gravity/grav.decimal -Fpz -C$gfirst -M -E$glast -V >gravit
y/grav.pz
#
set gmax_dist = `tail -1 /users/kiwi/davew/gravity/grav.pz | awk '{print $1}' `
echo $gmax_dist
#
filter1d /users/kiwi/davew/gravity/grav.pz -Fb3 -D1 -Egmaxdist -N -V >gravity/grav.f
ilt
#
psxy /users/kiwi/davew/gravity/grav.filt -JX6.8/2 -R0/220/0/50 \
 -Bf10a50:"Distance (km)":/10:"Free Air (mgals)":WeSn -O -Y3 -K >>plot_3w.ps
#
#_____________________________________________________________________________
#
#
awk '{print $6+($7/60),-($3+($4/60)),$9}' magnetics/mag_3w  >magnetics/mag.decimal
set mfirst = `head -1 magnetics/mag.decimal | awk '{print $1 "/" $2}' `
set mlast = `tail -1 magnetics/mag.decimal | awk '{print $1 "/" $2}' `
echo $mfirst
echo $mlast
#exit
#
project /users/kiwi/davew/magnetics/mag.decimal -Fpz -C$mfirst -M -E$mlast -V >magne
tics/mag.pz
#
set mmax_dist = `tail -1 /users/kiwi/davew/magnetics/mag.pz | awk '{print $1}' `
echo $mmax_dist
#
psxy /users/kiwi/davew/magnetics/mag.pz -JX6.8/2 -R0/220/-100/500 \
 -Bf10a50:"Distance (km)":/100:"Magnetic Field (nT)"::."MCS Line_3w ":WeSn -Y3 -O >>
plot_3w.ps
#
#_____________________________________________________________________________
```

```
#       ***************************************************************
#       This is an RGB colour file for shading the NZ Bathy-Topo plot
#       ***************************************************************
#
-4501   0       0       0       -1000   3       121     255
-1000   3       121     255     -500    83      157     255
-500    83      157     255     0       38      207     255
0       38      207     255     1       85      216     142
1       85      216     142     500     197     236     155
500     197     236     155     1000    223     255     187
1000    223     255     187     2500    255     226     93
2500    255     226     93      3212.92 255     255     255
#
#       ***************************************************************
#       This is an RGB greyscale file for shading the MCS trackine plot
#       ***************************************************************
#
-4501   230     230     230     0       230     230     230
0       230     230     230     1       137     137     137
1       137     137     137     500     157     157     157
500     157     157     157     1000    187     187     187
1000    187     187     187     2500    217     217     217
2500    217     217     217     3212.92 255     255     255
```

```
#       ***************************************************************
#       This GMT script plot Onshore and Offshore Bouguer
#       gravity anomalies for Crustal transect 1 (DWilson March 96)
#       ***************************************************************
#
#!/bin/csh -f
set last1 = `tail -1 boug_1w | awk '{print $1}' `
set last2 = `tail -1 boug_1e | awk '{print $1}' `
echo $last1
echo $last2
#
filter1d boug_1w -FG10 -T0/$last1/2 -V >grav_1w.filt
filter1d boug_1e -FG10 -T0/$last1/2 -V >grav_1e.filt
#
awk '{print (206.577-$1),$2/10}' grav_1w.filt >temp_w
awk '{print $1+6+206.577,$2/10}' boug_land >temp
awk '{print $1+33+160+206.577,$2/10}' grav_1e.filt >temp_e
#
psxy temp_w -JX9/6 -R0/600/-100/120 \
 -Bf10a50g50WeSn:"Distance (km)":/a20g20:"Gravity (mGals)"::."Crustal Transect 1": -
W2 -X1.5 -K  >plot.ps
#
psxy temp -JX9/6 -R -W2 -K -O >>plot.ps
#
psxy temp_e -JX9/6 -R -W2 -O >>plot.ps
```

Appendix 10
MCS Log

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
Test	44	13-Feb-96	start	7:07			1	1001	1	8420	21	MCS	104	2	16	
			end	8:00			1	1083	83							
	44	13-Feb-96	start	8:00			2	1084	84							
			end	8:23			2	1149	149							
1W	44	13-Feb-96	start	8:31			1	1001	1		20	MCS	10	2	16	
			end	8:59			1	1083	83							
		13-Feb-96	start	8:59			2	1084	84							
			end	9:32			2	1185	166							
			start	9:33			3	1186	167							
			end	10:00			3	1268	249							
			start	10:00			4	1269	250							
			end	10:28	42° 56.943	170° 03.3207	4	1351	332							
			start	10:28	42° 56.9268	170° 03.2944	5	1352	333							
			end	10:55	42° 55.1945	170° 01.1299	5	1434	415							
			start	10:56	42° 55.1768	170° 01.1012	6	1435	416							
			end	11:23			6	1517	498							
			start	11:23			7	1518	499							Reel 7 bad - apparently no
			end	11:26			7	1527	508							EOT mark
			start	11:26			8	1528	509							
			end	11:54	42°51.3321	169°56.3470	8	1609	590							
			start	11:54			9	1610	591							
			end	12:22			9	1693	673							
			start	12:22	42°49.4656	169°54.0255	10	1694	674							
			end	12:49			10	1776	756							
			start	12:50			11	1777	757							
			end	13:18	42°46.1538	169°49.8366	11	1859	839							
			start	13:18	42°46.1343	169°49.5946	12	1860	840							
			end	13:45	42°44.5261	169°47.7996	12	1942	922							
			start	13:46	42°44.5050	169°47.7814	13	1943	923							
			end	14:12	42°42.8542	169°46.0171	13	2025	1005							
			start	14:13	42°42.8336	169°46.9934	14	2026	1006							
			end	14:40	42°41.4130	169°43.9434	14	2108	1088							
			start	14:41	42°41.3902	169°43.9208	15	2109	1089							
			end	15:08	42°39.9426	169°41.9409	15	2191	1171							
			start	15:08	42°39.9426	169°41.9409	16	2192	1172							
			end	15:35	42°38.1889	169°40.1166	16	2274	1254							
			start	15:36	42°38.1696	169°40.0961	17	2275	1255							
			end	16:03	42°36.5589	169°38.3633	17	2357	1337							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	16:04	42°36.5425	169°38.3398	18	2358	1338							
			end	16:31	42°34.8993	169°36.4306	18	2440	1420							
			start	16:32	42°34.8915	169°36.4047	19	2441	1421							
			end	16:58	42°33.2263	169°34.4793	19	2523	1503							
			start	16:59	42°33.2076	169°34.4511	20	2524	1504							
			end	17:26	42°31.7202	169°32.3581	20	2606	1586							
			start	17:27	42°31.7036	169°32.3367	21	2607	1587							
			end	17:54	42°30.0619	169°30.5834	21	2689	1669							
			start	17:54	42°30.0403	169°30.5591	22	2690	1670							
			end	18:21	42°28.5140	169°28.6820	22	2772	1752							
			start	18:22	42°28.4933	169°28.6652	23	2773	1753							
			end	18:49	42°26.9805	169°26.7531	23	2855	1835							
			start	18:50	42°26.9611	169°26.7308	24	2856	1836							
			end	19:17	42°25.3770	169°24.9051	24	2938	1918							
			start	19:17	42°25.3701	169°24.8912	25	2939	1919							
			end	19:45	42°23.7575	169°22.9395	25	3021	2001							
			start	19:45	42°23.7370	169°22.9151	26	3022	2002							
			end	20:12	42°22.1451	169°20.9786	26	3104	2084							
			start	20:13	42°22.1297	169°20.9591	27	3105	2085							
1W	44	96:02:13	end	20:40	42°20.5301	169°19.0651	27	3187	2167							
			start	20:40	42°20.5106	169°19.0434	28	3188	2168							
			end	21:07	42°18.8853	169°17.1248	28	3270	2250							
			start	21:08	42°18.8689	169°17.0965	29	3271	2251							
			end	21:35	42°17.3076	169°15.2259	29	3353	2333							
			start	21:35	42°17.2850	169°15.1993	30	3354	2334							
			end	22:03	42°15.6973	169°13.2882	30	3436	2416							
			start	22:03	42°15.6790	169°13.2658	31	3437	2417							
			end	22:30	42°14.0376	169°11.2994	31	3519	2499							
			start	22:31	42°14.0147	169°11.2788	32	3520	2500							
			end	22:58	42°12.3173	169°09.2361	32	3602	2582							
			start	22:59	42°12.2986	169°09.2122	33	3603	2583							
			end	23:26	42°10.5081	169°07.182	33	3685	2665							
			start	23:26	42°10.4791	169°07.1062	34	3686	2666							
			end	23:54	42°08.6390	169°04.984	34	3768	2748							
			start	23:54	42°08.629	169°04.9565	35	3769	2749							
	45		end	0:21	42°06.8075	169°02.8073	35	3851	2831							
			start	0:22	42°06.7860	169°02.7840	36	3852	2832							
			end	0:49	42°05.0332	169°00.7193	36	3934	2914							
			start	0:49	42°05.0084	169°00.6927	37	3935	2915							

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
	45		end	1:17	42°03.2336	168°58.4933	37	4017	2997							
			start	1:17	42°03.2097	168°58.4683	38	4018	2998							
			end	1:45	42°01.3912	168°56.3980	38	4100	3080							
			start	1:45	42°01.3696	168°56.3683	39	4101	3081							
			end	2:12	41°59.5452	168°54.1615	39	4183	3163							
			start	2:13	41°59.5258	168°54.1331	40	4184	3164							
			end	2:40	41°57.6801	168°51.9149	40	4266	3246							
			start	2:40	41°57.6656	168°51.8900	41	4267	3247							
			end	3:08			41	4349	3329							
			start	3:08	41°55.789	168°49.563	42	4350	3330							
			end	3:35			42	4432	3412							
			start	3:36	41°59.5452	168°54.1615	43	4433	3413							
			end	4:03			43	4515	3495							
			start	4:03	42°01.3912	168°56.3980	44	4516	3496							
			end	4:31			44	4598	3578							
			start	4:31	41°57.6656	168°51.8900	45	4599	3579							
			end	4:58			45	4681	3661							
			start	4:59	41°48.2029	168°40.553	46	4682	3662							
			end	5:26			46	4764	3744							
			start	4:27	41°46.3100	168°38.2550	47	4765	3745							
			end	5:54			47	4847	3827							
			start	5:55	41°44.4411	168°36.0906	48	4848	3828							
			end	6:22			48	4931	3910							
			start	6:23	41°42.5763	168°33.6958	49	4932	3911							
			end	6:50			49	5014	3993							
			start	6:50	41°40.7477	168°31.8661	50	5015	3994							
			end	6:56			50	5035	4014							End of Line1W
Line12W	45	Feb 14, '96	start	8:42	41° 43.1694	168° 32.3440	51	5352	16							
			end	9:10			51	5434	97							
			start	9:11	41° 45.1073	168° 30.0764	52	5436	99							
			end	9:37			52	5517	180							
			start	9:38	41° 46.9999	168° 27.8727	53	5518	181							
			end	10:05			53	5600	263							
			start	10:06	41° 48.7559	168° 25.6580	54	5601	264							
			end	10:34			54	5686	346							
			start	10:34	41° 50.5936	168° 23.5127	55	5687	347							
			end	11:11			55	5799	61							
			start	11:12			56	5800	62							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			end	11:39			56	5882	144							
			start	11:40	41°51.4196	168°18.8861	57	5883	145							
			end	12:07			57	5965	227							
			start	12:08	41°55.8333	168°17.1258	58	5966	228							
			end	12:35			58	6048	310							
			start	12:35	41°57.4029	168°15.1432	59	6049	311							
			end	13:03			59	6132	393							
			start	13:03	41°58.9728	168°13.3571	60	6133	394							
			end	13:30			60	6215	476							
			start	13:31	42°00.3335	168°11.6310	61	6216	477							
			end	13:58			61	6299	560							
			start	13:58	42°01.6263	168°10.0906	62	6299	561							
			end	14:25			62	6381	642							
			start	14:26	42°02.9300	168°08.4903	63	6382	632							
			end	14:53			63	6464	725							
			start	14:53	42°04.2944	168°06.9332	64	6465	726							
			end	15:21			64	6547	808							
			start	15:22	42°05.7037	168°05.3084	65	6548	809							
			end	15:48			65	6630	891							
			start	15:49	42°06.9855	168°03.6135	66	6631	892							
			end	16:16			66	6713	974							
			start	16:16			67	6715	975							
			end	16:16			67	6715	975							
			start	16:17	42°08.4024	168°01.8858	68	6716	977							
			end	16:44			68	6797	1058							
			start	16:45	42°09.7796	168°00.2321	69	6798	1059							
			end	17:12			69	6880	1141							
			start	17:12	42°11.2861	167°58.3693	70	6881	1142							
			end	17:40			70	6964	1224							
			start	17:40	42°12.8852	167°56.5640	71	6965	1225							
			end	18:07			71	7047	1307							
			start	18:08	42°14.4749	167°54.7267	72	7048	1308							
			end	18:35			72	7130	1390							
			start	18:36	42°14.6364	167°52.1310	73	7131	1391							
			end	19:03			73	7213	1473							
			start	19:04			74	7214	1474							
12W			end	19:07			74	7226	1486							
02W			start	20:25	42°13.2107	167°56.1629	75	7459	1							
			end	20:53	42°14.7886	167°58.2172	75	7541	83							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	20:53	42°14.8077	167°58.2434	76	7542	84							
			end	21:20	42°16.3616	168°00.3327	76	7624	166							
			start	21:20	42°16.3824	168°00.3615	77	7625	167							
			end	21:48	42°17.9738	168°02.5600	77	7707	249							
			start	21:48	42°17.9883	168°02.5926	78	7708	250							
			end	22:15	42°19.6340	168°04.8102	78	7790	332							
			start	22:16	42°19.6459	168°04.8402	79	7791	333							
			end	22:43	42°21.3438	168°07.1138	79	7873	415							
			start	22:44	42°21.3629	168°07.1379	80	7874	416							
			end	23:11	42°23.1248	168°09.4554	80	7956	498							
			start	23:11	42°23.1455	168°09.4831	81	7957	499							
			end	23:38	42°24.8423	168°11.9566	81	8039	581							
			start	23:39	42°24.8652	168°11.9864	82	8040	582							
	46		end	0:06	42°26.6227	168°14.3727	82	8122	664							
			st art	0:06	42°26.6438	168°14.4029	83	8123	665							
			end	0:34	42°28.2852	168°16.7435	83	8205	747							
			start	0:35	42°28.3043	168°16.7675	84	8206	748							
			end	1:01	42°30.0043	168°19.0905	84	8288	830							
			start	1:02	42°30.0278	168°19.1241	85	8289	831							
			end	1:29	42°31.7372	168°21.5383	85	8371	913							
			start	1:30	42°31.7572	168°21.5714	86	8372	914							
			end	1:57	42°33.5013	168°23.9000	86	8454	996							
			start	1:57	42°33.5173	168°23.9283	87	8455	997							
			end	2:25	42°35.2935	168°26.2776	87	8537	1079							
			start	2:25	42°35.3185	168°26.3106	88	8538	1080							
			end	2:52	42°36.9725	168°28.6552	88	8620	1162							
			start	2:52	42°36.9903	168°28.6851	89	8621	1163							
			end	3:20			89	8703	1245							
			start	3:20	42°38.6653	168°31.0170	90	8704	1246							
			end	3:48			90	8786	1328							
			start	3:48	42°40.2442	168°32.2517	91	8787	1329							
			end	4:16			91	8873	1411							
			start	4:17	42°42.0114	168°35.7039	92	8874	1412							
			end	4:44			92	8956	1494							
			start	4:44	42°43.6144	168°37.8853	93	8957	1495							
			end	5:13			93	9040	1577							
			start	5:13	42°45.4131	168°40.4142	94	9041	1578							
			end	5:42			94	9123	1660							
			start	5:42	42°47.0123	168°42.7369	95	9124	1661							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			end	6:07			95	9206	1743							
			start	6:08	42°48.6058	168°44.9758	96	9207	1744							
			end	6:35			96	9289	1826							
			start	6:36	42°50.1532	168°47.2817	97	9290	1827							
			end	7:03			97	9373	1909							
			start	7:04	42° 51.7843	168° 49.4247	98	9374	1910							
			end	7:31			98	9456	1992							
			start	7:31	42° 53.4783	168° 51.6479	99	9457	1993							
			end	7:59			99	9540	2075							
			start	7:59	42° 55.1075	168° 53.9694	100	9541	2076							
			end	8:26			100	9623	2158							
			start	8:27	42° 56.6635	168° 56.1226	101	9624	2159							
			end	8:54			101	9706	2241							
			start	8:54	42° 58.1808	168° 58.2819	102	9707	2242							
			end	9:22			102	9790	2324							
			start	9:22	42° 59.7821	169° 00.5570	103	9791	2325							
			end	9:50			103	9874	2407							
			start	9:50	43° 01.3913	169° 02.8906	104	9875	2408							
			end	10:18			104	9957	2490							
			start	10:18	43° 03.0445	169° 05.1667	105	9958	2491							
			end	10:46			105	10040	2573							
			start	10:46	43° 04.6632	169° 07.4678	106	10041	2574							
			end	11:13			106	10123	2656							
			start	11:14	43°06.2592	169°09.8883	107	10124	2657							
			end	11:41			107	10206	2739							
			start	11:42	43°07.9235	169°12.2461	108	10207	2740							
			end	12:09			108	10289	2822							
			start	12:10	43°09.6523	169°14.5442	109	10290	2823							
			end	12:37			109	10372	2905							
			start	12:37	43°11.3005	169°16.7679	110	10373	2906							
			end	13:04			110	10455	2988							
			start	13:05	43°12.9428	169°19.0843	111	10456	2989							
			end	13:32			111	10538	3071							
			start	13:32	43°14.4614	169°21.3755	112	10539	3072							
			end	14:00			112	10621	3154							
			start	14:00	43°15.9946	169°23.6729	113	10622	3155							
			end	14:27			113	10704	3237							
			start	14:28	43°17.6197	169°26.0257	114	10705	3238							
			end	14:55			114	10787	3320							

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
			start	14:56	43°19.2439	169°28.3295	115	10788	3321							
			end	15:23			115	10870	3403							
			start	15:23	43°20.9620	169°30.6814	116	10871	3404							
			end	15:51			116	10953	3486							
			start	15:51	43°22.6463	169°30.0340	117	10954	3487							
			end	16:18			117	11036	3569							
			start	16:19	43°24.2652	169°35.4753	118	11037	3670							
			end	16:46			118	11119	3652							
			start	16:47	43°25.8739	169°37.9645	119	11120	3653							
02W			end	17:02			119	11168	3701							
23W	46		start	17:41	43°29.2240	169°37.5578	120	11283	1							
			end	18:09			120	11368	83							
			start	18:10	43°30.5140	169°34.6421	121	11369	84							
			end	18:37			121	11451	166							
			start	18:37	43°31.8513	169°31.9177	122	11452	167							
			end	19:05	43°32.8413	169°29.0326	122	11534	249							
			start	19:05	43°32.8536	169°29.0009	123	11535	250							
			end	19:33	43°34.0845	169°26.1444	123	11620	332							
			start	19:34	43°34.0958	169°26.1058	124	11621	333							
			end	20:01	43°35.4005	169°23.3509	124	11703	415							
			start	20:01	43°35.4176	169°23.3618	125	11704	416							
			end	20:30	43°36.6899	169°20.2287	125	11790	498							
			start	20:30	43°36.7061	169°20.1932	126	11791	499							
			end	20:58	43°37.8457	169°17.4449	126	11873	581							
			start	20:58	43°37.8595	169°17.4201	127	11874	582							
			end	21:25	43°39.2567	169°14.8633	127	11956	664							
			start	21:26	43°39.2723	169°14.8239	128	11957	665							
			end	21:55	43°40.5372	169°11.7805	128	12045	747							
			start	21:56	43°40.5521	169°11.7486	129	12046	748							
			end	22:23	43°41.7451	169°09.0410	129	12128	830							
			start	22:23	43°41.7583	169°09.0108	130	12129	831							
			end	22:55	43°42.8711	169°05.9990	130	12225	913							
			start	22:56	43°42.8847	169°05.9728	131	12226	914							
			end	23:23	43°44.1610	169°03.3874	131	12308	996							
			start	23:23	43°44.1755	169°03.3551	132	12309	997							
			end	23:54	43°45.5073	169°00.0958	132	12402	1079							
			start	23:55	43°45.5249	169°00.0618	133	12403	1080							
	47		end	0:22	43°46.6905	168°57.4527	133	12485	1162							
			start	0:22	43°46.7063	168°57.4201	134	12486	1163							

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
eol			end	0:42	43°47.4830	168°55.4579	134	12546	1223							
sol			start	1:32	43°44.7077	168°56.1586	135	12694	1							
3W			end	1:59	43°43.2528	168°58.5923	135	12776	83							
			start	1:59	43°43.2374	168°58.6164	136	12777	84							
			end	2:26	43°41.8562	169°01.0414	136	12859	166							
			start	2:27	43°41.8388	169°01.0700	137	12860	167							
			end	2:54	43°40.5273	169°03.7195	137	12942	249							
			start	2:55	43°40.5077	169°03.7503	138	12943	250							
			end	3:22			138	13025	332							
			start	3:22	43°38.9011	169°04.2459	139	13026	333							
			end	3:49			139	13108	415							
			start	3:50	43°37.5652	169°08.7442	140	13109	416							
			end	4:17			140	13191	498							
			start	4:17	43°36.2145	169°11.2307	141	13192	499							
			end	4:45			141	13274	581							
			start	4:45	43° 34.9244	169° 13.5929	142	13275	582							
			end	5:12			142	13357	664							
			start	5:12	43°33.1899	169°5.798	143	13358	665							
			end	5:40			143	13441	747							
			start	5:40	43°31.5196	169°18.1970	144	13442	748							
			end	6:08			144	13524	830							
			start	6:09	43°30.3941	169°21.5024	145	13525	831							
			end	6:36			145	13607	913							
			start	6:37	43°29.0608	169°23.8362	146	13608	914							
			end	6:44			146	13630	936							RecProbs,changed drive
			start	6:44			147	13631	937							
			end	7:11			147	13713	1019							
			start	7:12	43° 27.3472	169° 26.9294	148	13714	1020							
			end	7:39			148	13796	1102							
			start	7:39	43° 26.0094	169° 29.3013	149	13797	1103							
			end	8:06			149	13879	1185							
			start	8:07	43° 24.6889	169° 31.7013	150	13880	1186							
			end	8:35			150	13963	1268							
			start	8:35	43° 23.2030	169° 34.1317	151	13964	1269							
			end	9:02			151	14046	1351							
			start	9:03	43° 21.8081	169° 36.6108	152	14047	1352							
			end	9:30			152	14129	1434							
			start	9:30	43° 20.3980	169° 39.0057	153	14130	1435							

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
			end	9:58			153	14212	1517							
			start	9:58	43° 18.9758	169° 41.3425	154	14213	1518							
			end	10:25			154	14295	1600							
			start	10:26	43° 17.6513	169° 43.8760	155	14296	1601							
			end	10:53			155	14378	1683							
			start	10:54	43°16.2405	169°46.3825	156	14379	1684							
			end	11:21			156	14461	1766							
			start	11:21	43°14.6821	169°48.7623	157	14462	1767							
			end	11:48			157	14544	1849							
			start	11:49	43°13.2683	169°51.3214	158	14545	1850							
			end	12:16			158	14627	1932							
			start	12:16	43°11.8811	169°53.8267	159	14628	1933							
			end	12:44			159	14711	2015							
			start	12:45	43°10.3816	169°56.4382	160	14712	2016							
			end	13:12			160	14794	2098							
			start	13:12	43°09.0315	169°59.1456	161	14795	2099							
			end	13:39			161	14877	2182							
			start	13:40	43°07.4549	169°01.5829	162	14878	2183							
			end	14:07			162	14960	2264							
			start	14:07	43°06.0460	169°04.1366	163	14961	2265							
			end	14:34			163	15043	2347							
			start	14:35	43°04.5228	169°06.4915	164	15044	2348							
			end	15:02			164	15126	2430							
			start	15:03	43°03.0820	169°09.0649	165	15127	2431							
			end	15:30			165	15209	2513							
			start	15:31	43°01.6566	170°11.5515	166	15210	2514							
			end	15:58			166	15252	2596							
			start	15:58	43°00.2640	170°14.1538	167	15253	2597							
			end	16:25			167	15375	2679							
			start	16:26	42°58.7523	170°16.6250	168	15376	2680							
			end	16:53			168	15458	2762							
			start	16:54	42°57.2421	170°19.1419	169	15459	2763							
			end	17:21			169	15541	2845							
			start	17:22	42°55.7410	170°21.5136	170	15542	2846							
			end	17:49			170	15624	2928							
			start	17:49	42°54.2823	170°24.0292	171	15625	2929							
			end	18:16			171	15707	3011							
			start	18:17	42°52.8681	170°26.4842	172	15702	3012							
			end	18:44			172	15790	3094							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	18:45	42°51.4211	170°28.8818	173	15791	3095							
			end	19:12	42°50.0352	170°31.2988	173	15874	3177							
			start	19:13	42°50.0159	170°31.3198	174	15875	3178							
			end	19:40	42°48.6344	170°33.6118	174	15957	3260							
3W	47	2/16/96	start	19:41	42°48.6145	170°33.6417	175	15958	3261							
			end	20:08	42°47.1912	170°36.1311	175	16040	3343							
			start	20:08	42°47.1716	170°36.1604	176	16041	3344							
			end	20:36	42°45.6534	170°38.6054	176	16124	3426							
			start	20:36	42°45.6387	170°38.6344	177	16125	3427							
			end	21:03	42°44.1575	170°41.1702	177	16207	3509							
			start	21:04	42°44.1380	170°41.1977	178	16208	3510							
			end	21:31	42°42.6762	170°43.6064	178	16290	3592							
			start	21:31	42°42.6560	170°43.6357	179	16291	3593							
			end	21:59	42°41.2673	170°46.0501	179	16373	3675							
			start	21:59	42°41.2485	170°46.0779	180	16374	3676							
			end	22:26	42°39.8623	170°48.6409	180	16456	3758							
			start	22:27	42°39.8492	170°48.6709	181	16457	3759							
			end	22:54	42°38.2072	170°51.1122	181	16539	3841							
			start	22:55	42°38.1810	170°51.1414	182	16540	3842							
			end	23:22	42°36.6038	170°53.7079	182	16622	3924							
			start	23:22	42°36.5887	170°53.7359	183	16623	3925							
			end	23:49	42°35.1206	170°56.2261	183	16705	4007							
	47		start	23:50	42°35.1048	170°56.2460	184	16706	4008							
	48		end	0:17	42°33.7064	170°58.7421	184	16788	4090							
			start	0:17	42°33.6875	170°58.7749	185	16789	4091							
			end	0:45	42°32.1130	171°01.1622	185	16871	4173							
			start	0:45	42°32.0852	171°01.1919	186	16872	4174							
			end	0:49	42°31.8520	171°01.4636	186	16882	4184							eol3w
END OF WEST SIDE SHOOTING																
START EAST SIDE SHOOTING																
test2	55	24-Feb-96	start	12:48			187	17036	100							
			end	13:07			187	17095	159							
			start	13:08			188	17096	160							
			end	13:27	45°18.1991	171°05.8575	188	17155	219							
			start	13:28	45°18.2021	171°05.8155	189	17156	220							
			end	13:47	45°18.1758	171°03.3458	189	17215	279							

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
			start	13:48	45°18.1749	171°03.3078	190	17216	280							
			end	14:07	45°17.9431	171°00.8880	190	17275	339							
			start	14:08	45°17.9332	171°00.8478	191	17276	340							
			end	14:13	45°17.5890	171°00.3701	191	17292	356							
line 4E			start	14:36	45°15.7072	171°00.9870	192	17360	100							
			end	14:55	45°14.2769	171°02.5409	192	17419	159							
			start	14:56	45°14.2584	171°02.5716	193	17420	160							
			end	15:16			193	17482	219							
			start	15:17	45°13.0213	171°04.4812	194	17483	220							
			end	15:36			194	17542	279							
			start	15:37	45°11.7314	171°06.1561	195	17543	280							
			end	15:56			195	17602	339							
			start	15:57	45°10.4900	171°07.9762	196	17603	340							
			end	16:17			196	17662	399							
			start	16:17	45°09.1875	171°09.7785	197	17663	400							
			end	16:36			197	17722	459							
			start	16:37	45°07.8208	171°11.7075	198	17723	460							
			end	16:56			198	17782	519							
			start	16:57	45°06.4544	171°13.5905	199	17783	520							
			end	17:16			199	17842	579							
			start	17:17	45°05.1166	171°15.4244	200	17843	580							
			end	17:36			200	17902	639							
			start	17:37	45°03.7374	171°17.3806	201	17903	640							
			end	18:00			201	17972	699							
			start	18:00	45°02.2220	171°19.5019	202	17973	700							
			end	18:20			202	18032	759							
			start	18:20	45°008208	171°21.4145	203	18033	760							
			end	18:40			203	18092	819							
			start	18:40	44°59.4464	171°23.3224	204	18093	820							
			end	19:02			204	18157	879							
			start	19:02	44°57.9286	171°25.3809	205	18158	880							
			end	19:23			205	18221	939							
			start	19:23	44°56.6210	171°27.2880	206	18222	940							
			end	19:43			206	18281	999							
			start	19:43	44°55.4809	171°29.5333	207	18282	1000							
			end	20:16			207	18381	1059							
			start	20:17	44°53.4674	171°33.2404	208	18382	1060							
			end	20:53			208	18491	1119	a end @18463						

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	20:54	44°50.8680	171°36.4956	209	18492	1120							
			aborted	21:08			209		1157							
		line 4e_a	start	0:52	44°56.4730	171°27.5033	210	19207	100							
			end	1:12			210	19266	159							
			start	1:12	44°55.2384	171°29.1850	211	19267	160							
			end	1:32			211	19326	219							
			start	1:32	44°53.9827	171°30.9214	212	19327	220							
			end	1:52			212	19386	279							
			start	1:52	44°52.7262	171°21.7298	213	19387	280							
			end	2:12			213	19446	339							
			start	2:12	44°51.4217	171°34.5046	214	19447	340							
			end	2:32			214	19506	399							
			start	2:32	44°50.1091	171°36.2077	215	19507	400							
			end	2:52			215	19566	459							
			start	2:52	44°48.8477	171°38.0474	216	19567	460							
			end	3:11			216	19626	519							
			start	3:12	44°47.6151	171°39.6369	217	19627	520							
			end	3:32			217	19686	579							
			start	3:32	44°46.3509	171°41.1537	218	19687	580							
			end	3:52			218	19746	639							
			start	3:52	44°45.2452	171°42.8834	219	19747	640							
			end	4:12			219	19806	699							
			start	4:12	44°44.2226	171°44.7304	220	19807	700							
			end	4:32			220	19866	759							
			start	4:32	44°43.0125	171°46.2813	221	19867	760							
			end	4:52			221	19926	819							
			start	4:52	44°41.6718	171°47.9346	222	19927	820							
			end	5:12			222	19986	879							
			start	5:12	44°40.4815	171°49.5655	223	19987	880							
			end	5:32			223	20046	939							
			start	5:32	44°39.3064	171°51.1929	224	20047	940							
			end	5:52			224	20106	999							
			start	5:52	44°38.1480	171°52.7978	225	20107	1000							
			end	6:12			225	20166	1059							
			start	6:12	44°36.9133	171°54.3940	226	20167	1060							
			end	6:32			226	20226	1119							
			start	6:32	44°35.6774	171°56.0072	227	20227	1120							
			end	6:52			227	20286	1179							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	6:52	44°34.4354	171°57.6082	228	20287	1180							
			end	7:12			228	20346	1239							
			start	7:12	44°33.2738	171°59.3569	229	20347	1240							
			end	7:32			229	20406	1299							
			start	7:32	44°32.1025	172°01.1896	230	20407	1300							
			end	7:52			230	20466	1359							
			start	7:52	44°30.9036	172°02.8991	231	20467	1360							
			end	8:12			231	20526	1419							
			start	8:12	44°29.6909	172°04.4624	232	20527	1420							
			end	8:32			232	20586	1479							
			start	8:32	44°28.4390	172°06.0242	233	20587	1480							
			end	8:52			233	20646	1539							
			start	8:52	44°27.2246	172°07.5932	234	20647	1540							
			end	9:12			234	20706	1599							
			start	9:12	44°26.0623	172°09.1735	235	20707	1600							
			end	9:32			235	20766	1659							
			start	9:32	44°24.9942	172°10.8036	236	20767	1660							
			end	9:52			236	20826	1719							
			start	9:52	44°23.7370	172°12.3359	237	20827	1720							
			end	10:12			237	20886	1779							
			start	10:12	44°22.5415	172°13.8834	238	20887	1780							
			end	10:32			238	20946	1839							
			start	10:32	44°21.3553	172°15.5172	239	20947	1840							
			end	10:52			239	21007	1899							
			start	10:52	44°20.0895	172°17.1190	240	21008	1900							
			end	11:12			240	21067	1959							
			start	11:12	44°18.9590	172°18.8173	241	21068	1960							
			end	11:32			241	21127	2019							
			start	11:32	44°17.7436	172°20.3193	242	21128	2020							
			end	11:52			242	21187	2079							
			start	11:53	44°16.5084	172°22.0117	243	21188	2080							
			end	12:12			243	21247	2139							
			start	12:13	44°15.3175	172°23.5856	244	21248	2140							
			end	12:32			244	21307	2199							
			start	12:33	44°14.1498	172°25.1753	245	21308	2200							
			end	12:52			245	21367	2259							
			start	12:53	44°12.8670	172°26.8879	246	21368	2260							
			end	13:12			246	21427	2319							
			start	13:12	44°11.5995	172°28.5401	247	21428	2320							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			end	13:32			247	21487	2379							
			start	13:32	44°10.3491	172°30.1941	248	21488	2380							
			end	13:52			248	21547	2439							
			start	13:53	44°09.1408	172°31.8481	249	21548	2440							
			end	14:12			249	21607	2499							
			start	14:12	44°07.9695	172°33.4412	250	21608	2500							
			end	14:32			250	21667	2559							
			start	14:32	44°06.7312	172°35.0494	251	21668	2560							
			end	14:52			251	21727	2619							
			start	14:52	44°05.5009	172°36.6822	252	21728	2620							
			end	15:12			252	21787	2679							
			start	15:13	44°04.2666	172°38.3062	253	21788	2680							
			end	15:32			253	21847	2739							
			start	15:33	44°03.1123	172°39.9236	254	21848	2740							
			end	15:52			254	21907	2799							
			start	15:53	44°01.8608	172°41.4844	255	21908	2800							
			end	16:06	44°01.1439	172°42.2154	255	21947	2839							End of Line 4E
41E	56	96/2/25	start	19:35			256	22569	100							
			end	19:53			256	22628	159							
			start	19:54	44°06.9443	172°30.6986	257	22629	160							
			end	20:13			257	22688	219							
			start	20:14	44°07.1378	172°28.4044	258	22689	220							
			end	20:33			258	22748	279							
			start	20:34	44°07.4022	172°26.1170	259	22749	280							
			end	20:53			259	22808	339							
			start	20:54	44°07.6612	172°23.7875	260	22809	340							
			end	21:13			260	22868	399							
			start	21:14	44°07.8322	172°21.4522	261	22869	400							
			end	21:33			261	22928	459							
			start	21:34	44°08.1530	172°19.1431	262	22929	460							
			end	21:53			262	22988	519							
			start	21:54	44°08.4680	172°16.8641	263	22989	520							
			end	22:13			263	23048	579							
			start	22:14	44°08.7317	172°14.5381	264	23049	580							
			end	22:34			264	23108	639							
			start	22:34	44°08.9835	172°12.2243	265	23109	640							
			end	22:53			265	23168	699							
			start	22:54	44°09.3076	172°09.9073	266	23169	700							

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
			end	23:14			266	23228	759							
			start	23:14	44°09.5387	172°07.6156	267	23229	760							
			end	23:34			267	23288	819							
			start	23:34	44°09.7790	172°05.2656	268	23289	820							
			end	23:54			268	23348	879							
			start	23:54	44°10.0999	172°02.9363	269	23349	880							
			end	0:14			269	23408	939							
			start	0:14	44°10.3389	172°00.5500	270	23409	940							
			end	0:34			270	23468	999							
			start	0:34	44°10.5906	171°58.2004	271	23469	1000							
			end	0:54			271	23528	1059							
			start	0:54	44°10.8676	171°5.8849	272	23529	1060							
			end	1:13			272	23587	1119							
			start	1:14	44°11.1684	171°53.6185	273	23588	1120							
			end	1:34			273	23648	1179							
			start	1:34	44°11.4181	171°51.2616	274	23659	1180							
			end	1:53			274	23708	1239							
			start	1:54	44°11.6735	171°48.9715	275	23709	1240							
			end	2:13			275	23768	1299							
			start	2:14	44°11.9569	171°46.6261	276	23769	1300							
			end	2:34			276	23828	1359							
			start	2:34	44°12.2119	171°43.9669	277	23829	1360							
			end	2:54			277	23888	1419							
			start	2:54	44°12.8874	171°41.6035	278	23889	1420							
			end	3:14			278	23948	1479							
			start	3:14	44°14.4103	171°42.2682	279	23949	1480							
			end	3:34			279	24008	1539							
1E	56		start	3:34	44°15.5639	171°44.0150	280	24009	1540							
			end	4:02			280	24093	1599							
			start	4:02	44°17.3272	171°46.2730	281	24094	1600							
			end	4:05			281	24101	1606							
			start	4:14			282	24129	100							
			end	4:20			282	24149	120							
			start	4:20	44°18.4520	171°47.8456	283	24150	121							
			end	4:40			283	24208	179							
			start	4:40	44°19.6883	171°49.4622	284	24209	180							
			end	5:00			284	24268	239							
			start	5:01	44°20.9227	171°51.0964	285	24269	240							
			end	5:20			285	24328	299							

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
			start	5:21	44°22.1804	171°52.6954	286	24329	300							
			end	5:40			286	24388	359							
			start	5:41	44°23.3303	171°54.2683	287	24389	360							
			end	6:01			287	24448	419							
			start	6:01	44°24.5299	171°55.8462	288	24449	420							
			end	6:21			288	24508	479							
			start	6:21	44°25.7809	171°57.4427	289	24509	480							
			end	6:40			289	24568	539							
			start	6:41	44°26.9614	171°59.0793	290	24569	540							
			end	7:00			290	24628	599							
			start	7:01	44°28.1186	172°00.6465	291	24629	600							
			end	7:20			291	24688	659							
			start	7:21	44°29.3353	172°02.1707	292	24689	660							
			end	7:40			292	24748	719							
			start	7:41	44°30.4574	172°03.6408	293	24749	720							
			end	8:14			293	24848	779							
			start	8:14	44°32.3530	172°06.1950	294	24849	780							
			end	8:34			294	24909	839							
			start	8:35	44°33.6533	172°07.7110	295	24910	840							
			end	8:54			295	24969	899							
			start	8:55	44°34.9957	172°06.6309	296	24970	900							
			end	9:14			296	25029	959							
			start	9:15	44°34.2573	172°04.6171	297	25030	960							
			end	9:34			297	25089	1019							
			start	9:35	44°33.0443	172°02.9187	298	25090	1020							
			end	9:54			298	25149	1079							
			start	9:55	44°31.7496	172°01.3601	299	25150	1080							
			end	10:14			299	25209	1139							
			start	10:15	44°30.4434	171°59.6500	300	25210	1140							
			end	10:34			300	25269	1199							
			start	10:35	44°28.8703	171°59.3409	301	25270	1200							
			end	10:54			301	25329	1259							
			start	10:55	44°29.0308	172°01.4698	302	25330	1260							
			end	11:14			302	25389	1319							
			start	11:15			307	25394	1323							
			end	11:35			307	25452	1382							
			start	11:36	44°31.3166	172°04.8251	308	25453	1383							
			end	11:55			308	25512	1442							
			start	11:56	44°32.5766	172°06.4742	309	25513	1443							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			end	12:15			309	25572	1502							
			start	12:16	44°33.8982	172°08.2853	310	25574	1504							
			end	12:35			310	25632	1562							
			start	12:36	44°35.2231	172°10.0609	311	25633	1563							
			end	12:55			311	25692	1622							
			start	12:56	44°36.5484	172°11.8265	312	25693	1623							
			end	13:15			312	25752	1682							
			start	13:16	44°37.8254	172°13.5544	313	25753	1683							
			end	13:35			313	25812	1742							
			start	13:36	44°39.0770	172°15.1794	314	25813	1743							
			end	13:55			314	25872	1802							
			start	13:56	44°40.2960	172°16.8189	315	25873	1803							
			end	14:15			315	25932	1862							
			start	14:16	44°41.5241	172°18.3741	316	25933	1863							
			end	14:35			316	25992	1922							
			start	14:36	44°42.7252	172°20.0209	317	25993	1923							
			end	14:55			317	26052	1982							
			start	14:56	44°43.9579	172°21.6958	318	26053	1983							
			end	15:15			318	26112	2042							
			start	15:16	44°45.2580	172°23.4460	319	26113	2043							
			end	15:35			319	26172	2102							
			start	15:36	44°46.5542	172°25.2196	320	26173	2103							
			end	15:56			320	26233	2162							
			start	15:56	44°47.7135	172°26.8075	321	26234	2163							
			end	16:16			321	26293	2222							
			start	16:16	44°48.9080	172°28.4399	322	26294	2223							
			end	16:36			322	26353	2282							
			start	16:36	44°50.1473	172°30.0217	323	26354	2283							
			end	16:56			323	26413	2342							
			start	16:56	44°51.3449	172°31.6859	324	26414	2343							
			end	17:16			324	26473	2402							
			start	17:16	44°52.4204	172°33.1348	325	26474	2403							
			end	17:35			325	26533	2462							
			start	17:35	44°53.5712	172°34.7392	326	26534	2463							
			end	17:56			326	26593	2522							
			start	17:56	44°54.8035	172°36.4243	327	26594	2523							
			end	18:15			327	26653	2582							
			start	18:15	44°55.9953	172°38.0037	328	26654	2583							
			end	18:35			328	26713	2642							

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
			start	18:35	44°57.2260	172°39.6043	329	26714	2643							
			end	18:56			329	26773	2702							
			start	18:56	44°58.5170	172°41.2595	330	26774	2703							
1E	58		end	19:15			330	26833	2762							
			start	19:16	44°59.6592	172°42.8983	331	26834	2763							
			end	19:36			331	26893	2822							
			start	19:36	45°00.8389	172°44.5038	332	26894	2823							
			end	19:56			332	26953	2882							
			start	19:56	45°02.0114	172°46.1074	333	26954	2883							
			end	20:16			333	27013	2942							
			start	20:16	45°03.1868	172°47.6362	334	27014	2943							
			end	20:36			334	27073	3002							
			start	20:36	45°04.3969	172°49.2888	335	27074	3003							
			end	20:56			335	27133	3062							
			start	20:56	45°05.6179	172°50.9395	336	27134	3063							
			end	21:16			336	27193	3122							
			start	21:16	45°06.8012	172°52.6292	337	27194	3123							
			end	21:36			337	27253	3182							
			start	21:37	45°07.9814	172°54.2173	338	27254	3183							
			end	21:56			338	27313	3242							
			start	21:57	45°09.1740	172°55.8489	339	27314	3243							
			end	22:16			339	27373	3302							
			start	22:16	45°10.3810	172°57.4571	340	27374	3303							
			end	22:36			340	27433	3362							
			start	22:37	45°11.5559	172°59.1188	341	27434	3363							
			end	22:56			341	27493	3422							
			start	22:56	45°12.7411	173°00.7871	342	27494	3423							
			end	23:16			342	27553	3482							
			start	23:17	45°13.9468	173°02.3912	343	27554	3483							
			end	23:36			343	27613	3462							
			start	23:37	45°15.1012	173°04.0006	344	27614	3463							
			end	23:57			344	27674	3602							
			start	23:57	45°16.3291	173°05.6090	345	27675	3603							
			end	0:17			345	27734	3662							
			start	0:17	45°17.4206	173°07.1735	346	27735	3663							
			end	0:37			346	22794	3722							
			start	0:37	45°18.5959	173°08.7926	347	22795	3723							
			end	0:56			347	27854	3782							
			start	0:57	45°19.8211	173°10.4086	348	27855	3783							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			end	1:17			348	27914	3842							
			start	1:17	45°20.9220	173°12.0749	349	27915	3843							
			end	1:37			349	27974	3902							
			start	1:37	45°22.2393	173°13.7825	350	27975	3903							
			end	1:57			350	28034	3962							
			start	1:57	45°23.5087	173°15.5104	351	28035	3963							
			end	2:17			351	28094	4022							
			start	2:17	45°24.7210	173°17.2291	352	28095	4023							
			end	2:37			352	28154	4082							
			start	2:37	45°25.9198	173°18.8957	353	28155	4083							
			end	2:57			353	28214	4142							
			start	2:57	45°27.1270	173°20.6139	354	28215	4143							
			end	3:17			354	28274	4202							
			start	3:17	45°28.3699	173°22.2956	355	28275	4203							
			end	3:37			355	28334	4262							
			start	3:37	45°29.5707	173°24.0197	356	28335	4263							
			end	3:57			356	28394	4322							
			start	3:57	45°30.7873	173°25.7171	357	28395	4323							
			end	4:04			357	28418	4346							
			start	4:05	45°31.2973	173°26.3770	358	28419	4347							
			end	4:24			358	28477	4405							
			start	4:24	45°32.4803	173°28.0304	359	28478	4406							
			end	4:44			359	28537	4465							
			start	4:45	45°33.6369	173°29.6667	360	28538	4466							
			end	5:04			360	28597	4525							
			start	5:05	45°34.8611	173°31.3550	361	28598	4526							
			end	5:24			361	28657	4585							
			start	5:25	45°36.0350	173°32.9677	362	28658	4586							
			end	5:44			362	28717	4645							
			start	5:45	45°37.2243	173°34.6534	363	28718	4646							
			end	6:04			363	28777	4705							
			start	6:05	45°37.7356	173°36.7336	364	28778	4706							
			end	6:12			364	28799	4727							
12E	58	96/2/27	start	7:17	45°34.5945	173°35.2157	365	28997	100							
			end	7:38			365	29057	160							
			start	7:38	45°35.6679	173°33.4876	366	29058	161							
			end	7:58			366	29118	221							
			start	7:58	45°36.8872	173°31.8234	367	29119	222							
			end	8:18			367	29179	282							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	8:18	45°38.0853	173°30.1619	368	29180	283							
			end	8:39			368	29240	343							
			start	8:39	45°39.3133	173°28.4721	369	29241	344							
			end	8:59			369	29301	404							
			start	8:59	45°40.4728	173°26.8685	370	29302	405							
			end	9:19			370	29362	465							
			start	9:19	45°41.6350	173°25.2170	371	29363	466							
			end	9:40			371	29423	526							
			start	9:40	45°42.8313	173°23.5787	372	29424	527							
			end	10:00			372	29484	587							
			start	10:00	45°44.0484	173°21.9120	373	29485	588							
			end	10:20			373	29545	648							
			start	10:20	45°45.2548	173°20.1827	374	29546	649							
			end	10:41			374	29606	709							
			start	10:41	45°46.4161	173°18.5099	375	29607	710							
			end	11:01			375	29667	770							
			start	11:01	45°47.6351	173°16.8482	376	29668	771							
			end	11:21			376	29728	831							
			start	11:21	45°48.5256	173°15.0061	377	29729	832							
			end	11:21			377	29728	831							
2E	58		start	11:36	45°47.9460	173°13.4892	378	29771	100							
			end	11:56			378	29831	160							
			start	11:56	45°46.9519	173°11.6564	379	29832	161							
			end	12:16			379	29892	221							
			start	12:17	45°45.9201	173°09.9278	380	29893	222							
			end	12:37			380	29953	282							
			start	12:37	45°44.8048	173°08.1771	381	29954	283							
			end	12:57			381	30014	343							
			start	12:58	45°43.6491	173°06.2793	382	30015	344							
			end	13:17			382	30075	404							
			start	13:18	45°42.4513	173°04.4018	383	30076	405							
			end	13:38			383	30136	465							
			start	13:38	45°41.2966	173°02.4668	384	30317	466							
			end	13:58			384	30197	526							
			start	13:59	45°40.1245	173°00.5861	385	30198	527							
			end	14:18			385	30258	587							
			start	14:19	45°38.9527	172°58.7217	386	30259	588							
			end				386	30320	648							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start		45°37.7764	172°56.8196	387	30321	649							
			end	15:00			387	30381	709							
			start	15:00	45°36.6130	172°54.8954	388	30382	710							
			end	15:20			388	30442	770							
			start	15:20	45°35.5714	172°53.1671	389	30443	771							
			end	15:40			389	30503	831							
			start	15:41	45°34.4736	172°51.4374	390	30504	832							
			end	16:01			390	30564	892							
			start	16:01	45°33.364	172°39.6417	391	30565	893							
			end	16:21			391	30625	953							
			start	16:21	45°32.1879	172°47.7426	392	30626	954							
			end	16:41			392	30686	1014							
			start	16:41	45°31.0338	172°45.9230	393	30687	1015							
			end	17:02			393	30747	1075							
			start	17:02	45°29.8700	172°43.9904	394	30748	1076							
			end	17:22			394	30808	1136							
			start	17:22	45°28.5717	172°41.9211	395	30809	1137							
			end	17:42			395	30869	1197							
			start	17:43	45°27.5723	172°40.2790	396	30870	1198							
			end	18:03			396	30930	1258							
			start	18:03	45°26.4862	172°38.5416	397	30931	1259							
			end	18:23			397	30991	1319							
			start	18:23	45°25.3983	172°36.8516	398	30992	1320							
			end	18:43			398	31052	1380							
			start	18:44	45°25.2828	172°34.9501	399	31053	1381							
			end	19:04			399	31113	1441							
			start	19:04	45°23.1871	172°33.2398	400	31114	1442							
			end	19:24			400	31174	1502							
			start	19:24	45°22.0387	172°31.3632	401	31175	1503							
			end	19:44			401	31235	1563							
			start	19:45	45°20.8940	172°29.6475	402	31236	1564							
			end	20:04			402	31296	1624							
			start	20:05	45°19.7786	172°27.8711	403	31297	1625							
			end	20:26			403	31357	1685							
			start	20:26	45°18.6937	172°26.0669	404	31358	1686							
			end	20:26			404	31361	1689							
			start	20:27	45°18.5508	172°25.8503	409	31366	1693							
			end	20:48			409	31425	1753							
			start	20:48	45°17.3920	172°24.0632	410	31426	1754							

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
			end	21:08			410	31486	1814							
			start	21:08	45°16.2793	172°22.3036	411	31487	1815							
			end	21:28			411	31547	1875							
			start	21:29	45°15.1368	172°20.4790	412	31548	1876							
			end	21:49			412	31608	1936							
2E	58		start	21:49	45°14.0082	172°18.6462	413	31609	1937							
			end	22:09			413	31669	1997							
			start	22:09	45°12.8596	172°16.9300	414	31670	1998							
			end	22:29			414	31730	2058							
			start	22:30	45°11.7971	172°15.2202	415	31731	2059							
			end	22:48			415	31785	2091	shots, error@end						
			start	22:49	45°10.7631	172°13.6081	416	31789	2092							
			end	23:10			416	31851	2152							
			start	23:10	45°09.6304	172°11.724	417	31852	2153							
			end	23:30			417	31912	2213							
			start	23:30	45°08.5191	172°10.1343	418	31913	2214							
			end	23:50			418	31973	2274							
			start	23:51	45°07.3420	172°08.4058	419	31974	2275							
			end	0:11			419	32034	2335							
			start	0:01	45°06.2398	172°06.6894	420	32035	2336							
			end	0:31			420	32095	2396							
			start	0:31	45°05.1393	172°04.9497	421	32096	2397							
			end	0:51			421	32156	2457							
			start	0:52	45°05.1393	172°03.2045	422	32157	2458							
			end	1:11			422	32217	2518							
			start	1:12	45°02.9542	172°01.4559	423	32218	2519							
			end	1:32			423	32278	2579							
			start	1:32	45°01.8300	171°59.7187	424	32279	2580							
			end	1:52			424	32339	2640							
			start	1:53	45°00.6675	171°57.8650	425	32340	2641							
			end	2:13			425	32400	2701							
			start	2:13	44°59.5055	171°56.1022	426	32401	2702							
			end	2:33			426	32461	2762							
			start	2:33	44°58.3402	171°54.2305	427	32462	2763							
			end	2:54			427	32522	2823							
			start	2:54	44°57.1370	171°52.3687	428	32523	2824							
			end	3:14			428	32583	2884							
			start	3:14	44°55.9475	171°50.4852	429	32584	2885							
			end	3:34			429	32644	2945							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			start	3:35	44°54.6374	171°48.4247	430	32645	2946							
			end	3:54			430	32705	3006							
			start	3:55	44°53.4259	171°46.5902	431	32706	3007							
			end	4:15			431	32766	3067							
			start	4:15	44°52.2790	171°44.8003	432	32767	3068							
			end	4:36			432	32827	3128							
			start	4:36	44°51.1200	171°42.9914	433	32828	3129							
			end	4:56			433	32888	3189							
			start	4:56	44°49.9953	171°41.2368	434	32889	3190							
			end	5:16			434	32949	3250							
			start	5:16	44°48.8492	171°39.5312	435	32950	3251							
			end	5:37			435	33010	3311							
			start	5:37	44°48.0246	171°37.6258	436	33011	3312							
			end	5:57			436	33071	3372							
			start	5:57	44°47.1214	171°35.6614	437	33072	3373							
			end	6:17			437	33132	3433							
			start	6:18	44°45.7617	171°34.1770	438	33133	3434							
			end	6:37			438	33193	3494							
			start	6:38	44°44.4249	171°32.5819	439	33194	3495							
			end	6:58			439	33254	3555							
			start	6:58	44°43.2674	171°30.8532	440	33255	3556							
			end	7:18			440	33315	3616							
			start	7:19	44°42.1118	171°29.1206	441	33316	3617							
			end	7:39			441	33376	3677							
			start	7:39	44°41.0112	171°27.4575	442	33377	3678							
			end	7:59			442	33437	3738							
			start	7:59	44°39.8721	171°25.6556	443	33438	3739							
			end	8:19			443	33498	3799							
			start	8:20	44°38.6570	171°23.8306	444	33499	3800							
			end	8:40			444	33559	3860							
			start	8:40	44°37.4695	171°22.0247	445	33560	3861							
EOL 2E			end	8:45	44°37.1978	171°21.6233	445	33574	3875							
25E	59	96/2/28	start	8:54	44°36.9713	171°20.5717	446	33602	100							
			end	9:15			446	33663	160							
			start	9:15	44°38.3470	171°19.5856	447	33664	161							
			end	9:35			447	33724	221							
			start	9:35	44°40.0291	171°20.0637	448	33725	222							
			end	9:55			448	33785	282							
			start	9:56	44°41.6761	171°20.5214	449	33786	283							

Line #	J.D.	Date	start/ end	Time (Z)	Latitude (Start/End)	Longitude (Start/End)	Tape #	Shot #	File #	Airguns (cu. in.)	S.I. (s)	Type	No. Traces	S.I. (msec)	Rec Len (s)	Notes
			end	10:16			449	33846	343							
			start	10:16	44°43.3918	171°20.9719	450	33847	344							
			end	10:36			450	33907	404							
			start	10:36	44°45.0240	171°21.4515	451	33908	405							
			end	10:56			451	33968	465							
			start	10:57	44°46.6814	171°21.8952	452	33969	466							
			end	11:17			452	34029	526							
			start	11:17	44°48.3620	171°22.2438	453	34030	527							
			end	11:37			453	34090	587							
			start	11:37	44°50.0499	171°22.6749	454	34091	588							
			end	11:57			454	34151	648							
			start	11:58	44°51.7312	171°23.0832	455	34152	649							
			end	12:18			455	34212	709							
			start	12:18	44°53.4077	171°23.7808	456	34213	710							
			end	12:38			456	34273	770							
			start	12:38	44°55.0182	171°24.5799	457	34274	771							
			end	12:58			457	34334	831							
			start	12:59	44°56.6305	171°25.4017	458	34335	832							
			end	13:19			458	34395	892							
			start	13:19	44°58.1791	171°26.1914	459	34396	893							
			end	13:39			459	34456	953							
			start	13:40	44°59.7664	171°25.6089	460	34457	954							
			end	14:00			460	34517	1014							
			start	14:00	45°01.3349	171°24.6645	461	34518	1015							
			end	14:20			461	34578	1075							
			start	14:20	45°02.8796	171°23.7902	462	34579	1076							
			end	14:40			462	34639	1136							
			start	14:41	45°04.3501	171°22.5779	463	34640	1137							
			end	15:00			463	34700	1197							
			start	15:01	45°05.8196	171°21.4582	464	34701	1198							
			end	15:20			464	34761	1258							
			start	15:20	45°07.3887	171°20.6378	465	34762	1259							
			end	15:41			465	34822	1319							
			start	15:41	45°08.9720	171°19.7855	466	34823	1320							
			end	16:01			466	34883	1380							
			start	16:02	45°10.4509	171°18.8284	467	34884	1381							
			end	16:22			467	34944	1441							
			start	16:23	45°11.9952	171°17.9077	468	34945	1442							
			end	16:42			468	35005	1502							

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
			start	16:42	45°13.5976	171°16.9793	469	35006	1503							
			end	17:03			469	35066	1563							
			start	17:03	45°15.1091	171°16.0588	470	35067	1564							
			end	17:23			470	35127	1624							
			start	17:23	45°16.6582	171°15.1687	471	35128	1625							
			end	17:43			471	35188	1685							
			start	17:43	45°16.6582	171°15.1687	472	35189	1686							
			end	18:03			472	35249	1746							
			start	18:04	45°19.7138	171°13.3118	473	35250	1747							
			end	18:24			473	35310	1807							
			start	18:24	45°21.2487	171°12.4045	474	35311	1808							
			end	18:44			474	35371	1868							
			start	18:45	45°22.8026	171°11.5465	475	35372	1869							
			end	19:04			475	35432	1929							
			start	19:05	45°24.3471	171°10.6220	476	35433	1930							
			end	19:25			476	35494	1990							
			start	19:25	45°25.8564	171°09.6691	477	35495	1991							
			end	19:46			477	35555	2051							
			start	19:46	45°27.3807	171°08.8319	478	35556	2052							
			end	20:06			478	35616	2112							
			start	20:06	45°28.8298	171°07.8915	479	35617	2113							
			end	20:26			479	35677	2173							
			start	20:27	45°30.2888	171°07.0758	480	35678	2174							
			end	20:47			480	35738	2234							
			start	20:47	45°31.7532	171°06.1865	481	35739	2235							
			end	21:07			481	35799	2295							
			start	21:07	45°33.2082	171°05.3243	482	35800	2296							
			end	21:27			482	35860	2356							
			start	21:27	45°34.7050	171°04.4112	483	35861	2357							
			end	21:48			483	35922	2417							
			start	21:48	45°36.2331	171°03.4831	484	35923	2418							
			end	22:08			484	35983	2478							
			start	22:08	45°37.7412	171°02.6336	485	35884	2479							
			end	22:28			485	36044	2539							
			start	22:29	45°39.2085	171°01.7352	486	36045	2540							
			end	22:49			486	36105	2600							
			start	22:49	45°40.6980	171°00.8923	487	36106	2601							
			end	23:09			487	36166	2661							
			start	23:09	45°42.0745	171°00.0305	488	36167	2662							

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
			end	23:29			488	36227	2722							
			start	23:30	45°43.4824	170°59.1523	489	36228	2723							
			end	23:50			489	36288	2783							
			start	23:50	45°44.8329	170°58.4203	490	36289	2784							
			end	0:10			490	36349	2844							
			start	0:11	45°46.0624	170°57.7154	491	36350	2845							
			end	0:31			491	36410	2905							
			start	0:31	45°47.3322	170°56.9784	492	36411	2906							
			end	0:52			492	36471	2966							
			start	0:53`	45°48.6465	170°56.2651	493	36472	2967							
			end	1:15			493	36532	3027							
			start	1:15	45°49.9546	170°55.3418	494	36533	3028							
			end	1:37			494	36593	3088							
			start	1:38	45°51.3421	170°54.5095	495	36594	3089							
			end	2:00			495	36654	3150							
			start	2:00	45°52.7794	170°53.5915	496	36655	3151							
			end	2:22			496	36715	3211							
			start	2:22	45°54.2234	170°52.5313	497	36716	3212							
		EOL 25e	end	2:39	45°55.3026	170°51.0234	497	36761	3253							
		SOL 5e	start	2:47	45°55.7688	170°51.4362	498	36782	100							
			end	3:09			498	36843	160							
			start	3:10	45°56.9215	170°49.4081	499	36844	161							
			end	3:31			499	36904	221							
			start	3:32	45°58.1982	170°47.3201	500	36905	222							
			end	3:54			500	36965	282							
			start	3:54	45°59.4699	170°45.1923	501	36966	283							
			end	4:16			501	37026	343							
			start	4:17	46°00.7030	170°43.0270	502	37027	344							
			end	4:38			502	37087	404							
			start	4:39	46°01.9985	170°40.9474	503	37088	405							
			end	5:01			503	37148	465							
			start	5:01	46°03.2353	170°38.8471	504	37149	466							
			end	5:23			504	37209	526							
			start	5:23	46°04.2903	170°36.8041	505	37210	527							
			end	5:43			505	37270	587							
			start	5:43	46°05.2920	170°34.8917	506	37271	588							
			end	6:03			506	37331	648							
			start	6:03	46°06.3826	170°33.0078	507	37332	649							

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
			end	6:23			507	37392	709							
			start	6:04	46°07.4351	170°31.2179	508	37393	710							
EOL 5E	60	96/2/29	end	7:00	46°09.3467	170°28.3021	508	37500	750							
SOL 5EA	60	96/2/29	start	9:16	46°05.8420	170°34.2123	509	37908	100							
			end	9:34			509	37965	157							
			start	9:35	46°06.8019	170°32.5836	510	37966	158							
			end	9:54			510	38023	215							
			start	9:54	46°07.6539	170°31.0116	511	38024	216							
			end	10:13			511	38081	273							
			start	10:13	46°08.5049	170°29.4497	512	38082	274							
			end	10:32			512	38139	331							
			start	10:33	46°09.4037	170°27.8787	513	38140	332							
			end	10:52			513	38197	389							
			start	10:52	46°10.3834	170°26.3117	514	38198	390							
			end	11:11			514	38255	447							
			start	11:12	46°11.3093	170°24.6066	515	38256	448							
			end	11:30			515	38313	505							
			start	11:31	46°12.2578	170°22.8369	516	38314	506							
			end	11:50			516	38371	563							
			start	11:50	46°13.2763	170°21.1672	517	38372	564							
			end	12:09			517	38429	621							
			start	12:09	46°14.2995	170°19.5931	518	38430	622							
			end	12:28			518	38487	679							
			start	12:29	46°15.2231	170°17.8177	519	38488	680							
			end	12:48			519	38545	737							
			start	12:48	46°16.2370	170°16.2468	520	38546	738							
			end	13:07			520	38603	795							
			start	13:08	46°17.1001	170°14.5450	521	38604	796							
			end	13:27			521	38661	853							
			start	13:27	46°18.0737	170°12.9789	522	38662	854							
			end	13:46			522	38719	911							
			start	13:46	46°18.9170	170°11.4498	523	38720	912							
			end	14:05			523	38777	969							
			start	14:06	46°19.8108	170°09.9337	524	38778	970							
			end	14:25			524	38835	1027							
			start	14:25	46°20.6901	170°08.3777	525	38836	1028							
			end	14:44			525	38893	1085							
			start	14:44	46°21.5785	170°06.8250	526	38894	1086							

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
			end	15:03			526	38951	1143							
			start	15:04	46°22.5173	170°05.2613	527	38952	1144							
			end	15:23			527	39009	1201							
			start	15:23	46°23.5725	170°03.3630	528	39010	1202							
			end	15:42			528	39067	1259							
			start	15:42	46°24.5376	170°01.7382	529	39068	1260							
			end	16:01			529	39125	1317							
			start	16:02	46°25.5339	170°00.00622	530	39126	1318							
			end	16:21			530	39183	1375							
			start	16:21	46°26.4727	169°58.3371	531	39184	1376							
			end	16:40			531	39241	1433							
			start	16:40	46°27.5155	169°56.5782	532	39242	1434							
			end	16:59			532	39299	1491							
			start	17:00	46°28.4676	169°54.8460	533	39300	1492							
			end	17:19			533	39357	1549							
			start	17:19	46°29.5299	170°53.0002	534	39358	1550							
			end	17:38			534	39415	1607							
			start	17:38	46°30.6103	169°51.1260	535	39416	1608							
			end	17:58			535	39473	1665							
			start	17:58	46°31.5729	169°49.4751	536	39474	1666							
			end	18:17			536	39531	1723							
			start	18:17	46°32.5780	169°47.7036	537	39532	1724							
			end	18:36			537	39589	1781							
			start	18:36	46°33.6317	169°45.8946	538	39590	1782							
			end	18:55			538	39647	1839							
			start	18:56	46°34.6427	169°44.1515	539	39648	1840							
			end	19:15			539	39705	1897							
			start	19:15	46°35.6541	169°42.3693	540	39706	1898							
			end	19:34			540	39763	1955							
			start	19:34	46°36.6891	169°40.6015	541	39764	1956							
			end	19:53			541	39821	2013							
			start	19:54	46°37.7129	169°38.8368	542	39822	2014							
			end	20:13			542	39879	2071							
			start	20:13	46°38.6741	169°37.1164	543	39880	2072							
			end	20:32			543	39937	2129							
			start	20:32	46°39.7041	169°35.3513	544	39938	2130							
			end	20:51			544	39995	2187							
			start	20:52	46°40.7114	169°33.5638	545	39996	2188							
5E	60		end	20:58			545	40014	2206							End of Line 5E

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
6E	60		start	21:10	46°41.1433	169°31.5411	546	40049	100							Start of Line 6E
			end	21:28			546	40106	157							
			start	21:29	46°41.4495	169°29.3852	547	40107	158							
			end	21:48			547	40164	215							
			start	21:48	46°41.7247	169°27.1426	548	40165	216							
			end	22:07			548	40222	273							
			start	22:07	46°41.9847	169°24.9047	549	40223	274							
			end	22:26			549	40280	331							
			start	22:27	46°42.2644	169°22.7269	550	40281	332							
			end	22:46			550	40338	389							
			start	22:46	46°42.5330	169°20.5906	551	40339	390							
			end	23:05			551	40396	447							
			start	23:06	46°42.7227	169°18.5373	552	40397	448							
			end	23:24			552	40454	504							
			start	23:25	46°43.0208	169°16.5150	553	40455	505							
			end	23:44			553	40512	563							
			start	23:44	46°43.2710	169°14.4478	554	40513	564							
			end	0:03			554	40570	621							
			start	0:03	46°43.5065	169°12.2589	555	40571	622							
			end	0:22			555	40628	679							
			start	0:22	46°43.7838	169°10.0687	556	40629	680							
			end	0:42			556	40686	737							
			start	0:42	46°44.0651	169°07.8708	557	40687	738							
			end	1:01			557	40744	795							
			start	1:02	46°44.2970	169°05.0692	558	40745	796							
			end	1:21			558	40802	853							
			start	1:22	46°44.5681	169°03.5969	559	40803	854							
			end	1:40			559	40860	911							
			start	1:40	46°44.8315	169°01.4322	560	40861	912							
			end	2:00			560	40919	969							
			start	2:00	46°45.5075	168°59.4318	561	40920	970							
			end	2:19			561	40977	1027							
			start	2:19	46°46.6811	168°57.8061	562	40978	1028							
			end	2:38			562	41035	1085							
			start	2:39	46°47.7341	168°56.2099	563	41036	1086							
			end	2:58			563	41093	1143							
			start	2:58	46°48.8853	168°54.7010	564	41094	1144							
			end	3:17			564	41151	1201							

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
			start	3:17	46°50.0589	168°53.1284	565	41152	1202							
			end	3:36			565	41209	1259							
			start	3:37	46°51.2623	168°51.4218	566	41210	1260							
			end	3:56			566	41267	1317							
			start	3:56	46°52.4950	168°49.7636	567	41268	1318							
			end	4:15			567	41325	1375							
			start	4:15	46°53.6663	168°48.1266	568	41326	1376							
			end	4:34			568	41383	1433							
			start	4:35	46°54.9000	168°46.4857	569	41384	1434							
			end	4:54			569	41441	1491							
			start	4:54	46°56.1016	168°44.8194	570	41442	1492							
			end	5:13			570	41449	1549							
			start	5:13	46°57.3248	168°43.1538	571	41500	1550							
			end	5:32			571	41557	1607							
			start	5:32	46°58.5272	168°41.4773	572	41558	1608							
			end	5:52			572	41615	1665							
			start	5:52	46°59.7582	168°39.8714	573	41616	1666							
			end	6:11			573	41673	1723							
			start	6:11	47°00.9073	168°38.2532	574	41674	1724							
			end	6:30			574	41731	1781							
			start	6:31	47°02.0599	168°36.6751	575	41732	1782							
			end	6:50			575	41789	1839							
			start	6:50	47°03.2778	168°35.0664	576	41790	1840							
			end	7:09			576	41847	1897							
			start	7:09	47°04.4005	168°33.3812	577	41848	1898							
			end	7:28			577	41905	1955							
			start	7:29	47°05.5770	168°31.8243	578	41906	1956							
			end	7:44			578	41952	2002	early EOT						
			start	7:52	47°06.9206	168°29.9605	579	41976	2022							
			end	8:07			579	42022	2068							
			start	8:08	47°07.7944	168°28.6966	580	42023	2069							
			end	8:27			580	42080	2126							
			start	8:27	47°08.9301	168°27.2371	581	42081	2127							
			end	8:46			581	42138	2184							
			start	8:46	47°10.0663	168°25.8119	582	42139	2185							
			end	9:05			582	42196	2242							
			start	9:06	47°11.1101	168°24.3001	583	42197	2243							
			end	9:25			583	42254	2300							
			start	9:25	47°12.1924	168°22.7248	584	42255	2301							

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
			end	9:44			584	42312	2358							
			start	9:44	47°13.3613	168°21.2903	585	42313	2359							
			end	10:03			585	42370	2416							
			start	10:04	47°14.4077	168°19.7119	586	42371	2417							
			end	10:23			586	42428	2474							
			start	10:23	47°15.4659	168°18.2060	587	42429	2475							
			end	10:42			587	42486	2532							
			start	10:42	47°16.5785	168°16.7018	588	42487	2533							
			end	11:01			588	42544	2590							
			start	11:01	47°17.6523	168°15.2596	589	42545	2591							
			end	11:20			589	42599	2645							
			start	11:20	47°18.6732	168°13.8098	590	42600	2646							
			end	11:40			590	42660	2706							
			start	11:40	47°19.8024	168°2640	591	42661	2707							
			end	11:59			591	42718	2764							
			start	12:00	47°20.8438	168°10.7372	592	42718	2765							
			end	12:19			592	42776	2822							
			start	12:19	47°21.8919	168°09.1951	593	42777	2823							
			end	12:38			593	42834	2880							
			start	12:39	47°23.042	168°07.421	594	42835	2881							
			end	12:58			594	42892	2938							
			start	12:58	47°24,1165	168°05.8836	595	42893	2939							
			end	13:17			595	42950	2996							
			start	13:19	47°25.1738	168°04.2297	596	42951	2997							
			end	13:36			596	43008	3054							
			start	13:37	47°26.3302	168°02.5310	597	43009	3055							
			end	13:56			597	43066	3112							
			start	13:56	47°27.4222	168°00.855	598	43067	3113							
			end	14:00	47°27.8273	167°59.8961	598	43096	3142							